4245 Park Approach
Thorpe Park, Leeds
LS15 8GB

t: 0113 264 9960
f: 0113 264 9962
e: info@thesiriusgroup.com

Mr T Hanrey
Lidl GB Ltd
Iport Unit 4
Ontario Drive
Doncaster
DN11 0BF

Date: 6th May 2022

Our Ref: C8781/MB/9853

Dear Tom

Re: Hazardous Ground Gas Risk Assessment for Land at Centre 27, off Bankwood Way, Birstall, Batley (Planning Application Ref: 2021/62/92528/E)

1.0 Introduction

Sirius Geotechnical Ltd (Sirius) was commissioned by Lidl GB Ltd (Lidl) to undertake a supplementary ground gas risk assessment for land at Centre 27, off Bankwood Way, Birstall, Batley ("the site"). This investigation is intended to supplement previous Phase 1 and 2 Ground Investigation reports for the site, undertaken by third parties, in order to better characterise and assess risks associated with hazardous ground gas.

The site is currently undergoing planning for a proposed retail development, with associated parking, servicing areas and soft landscaping (in accordance with planning application ref. 2021/62/92528/E), as detailed within SMR Architect's Proposed Site Plan (drawing ref. 7404-SMR-00-ZZ-DR-A-2003-S3-P2, last dated April 2021). A copy of the proposed development plan is included within Appendix A.

Previous ground investigation and geotechnical assessment reports undertaken for the site, and provided to Sirius for review, are detailed below. It is understood that the following information has been assigned to Lidl and can be relied upon:

- Geo-environmental Assessment, Centre 27, Birstall, completed by Delta Simons Environmental Consultants Ltd (Delta Simons) on behalf of AEW UK, report ref. 14-0672.03, dated July 2018.
- Combined Phase 1 & Phase 2 Ground Investigation Report, Bankwood Way, Birstall, completed by Curtins on behalf of Lidl GB Ltd, report ref. 076893-CUR-00-XX-RP-GE-002-V01, dated October 2020.

- Geotechnical Assessment of Proposed Ground Improvement Works, Proposed Lidl Store, Bankwood Way, Birstall, West Yorkshire, completed by GB Card and Partners Ltd (GB Card), on behalf of Beam Consulting, ref. GB/661, dated December 2020.

- Detailed Coal Mining Risk Assessment for Land at Centre 27, off Bankwood Way, Birstall, Batley completed by Sirius Geotechnical Ltd. Ref C8781/GH/9715/Rev B dated 28th October 2021.

- Supplementary Coal Mining Investigation for Land at Centre 27, off Bankwood Way, Birstall, Batley completed by Sirius Geotechnical Ltd. Ref C8781/AW/9824 dated 28th March 2022.

Whilst this letter report discusses pertinent findings of the previous investigations, it must be read in conjunction with the aforementioned reports, which present in detail the site setting and ground conditions.

There may be conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for conditions not revealed by the investigation.

This report has been prepared for the sole use of Lidl GB Ltd. No other third party may rely upon or reproduce the contents of this report without the written approval of Sirius Geotechnical Ltd. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk and the authors do not owe them any Duty of Care or Skill.

2.0 Overview of Previous Geoenvironmental Information and Conceptual Site Model (Gas) Development

Site Location & Description

The site is located off Bankwood Way, Birstall, Batley, approximately 9km southwest of Leeds City Centre. A site location plan, Drawing No. C8781/01 is included within Appendix A.

The site covers an area of approximately 1.5 hectares and currently comprises open disused land with stockpiles of demolition rubble. Until recently the site comprised seven office units. It is understood that the office units and external hardstand suffered damage/distortion associated with the settlement of the underlying made ground, more specifically within the southern site area (assumed to be associated with landfill waste underlying this part of the site, as discussed below).

The site is located within an existing commercial and retail park, with undeveloped land to the east.

Site History

Review of historical Ordnance Survey (OS) mapping indicates that from at least 1852 (the earliest available mapping) the site was generally undeveloped. From 1893 / 1894, an area of earthworks is shown crossing the site assumed to be associated with the opencast mining of the Flockton Thin coal seam (as discussed below); this is no longer evident by the 1907 OS map. Further earthworks are shown from 1956 within the north and northeast of the site, indicating sloped ground. In addition, significant areas of earthworks and refuse heaps are also shown to the east and south of the site.

Environmental records indicate landfilling operations (Nab Lane Refuse Disposal Tip) commenced in 1970 at the site, accepting inert, industrial, commercial, liquid and household waste. A further record lists the site as a registered landfill from 1982. Neither record indicates when operations ceased.

From 1992 the site is shown to have been developed with commercial / office units, which appear from online aerial images to have been subsequently demolished/cleared some time prior to 2018.

Published Geological Information

British Geological Survey (BGS) maps show the site to be underlain by made ground. No superficial deposits are shown to be present on-site.

The site is recorded to be underlain by strata of the Pennine Lower Coal Measures Formation (PLCMF), comprising undifferentiated mudstone, siltstone, sandstone, coal seams, ironstone beds, seatearth beds and marine bands. The western and northern site areas are shown to be underlain by Emley Rock of the PLCMF, described by the BGS as a fine-grained flaggy sandstone with mudstone partings.

The Flockton Thin (or Black Bed Coal) is conjectured to outcrop within the site, trending approximately south to north from the southern corner of the site, before turning abruptly in an approximately easterly direction, crossing the site boundary in the area of the eastern corner. The thickness of the Flockton Thin coal seam is recorded to range between 0.3m and 0.8m.

Recorded Mine Workings

A previously obtained Coal Authority (CA) Mining Report (Reference 51002302567002, dated 30th September 2020, included within the Curtins Ground Investigation Report), states that the site is located within a "*High Risk Development Area".* The shallowest recorded worked coal seams underlying the site are the Flockton Thin and the Top Fenton (or First Brown Metal) Coal Seams, recorded to have been mined at a depth of 10m and 30m beneath the site, respectively.

In addition, an adit is recorded to be located within the northeast of the site (CA ref. 423427-054), with a recorded bearing of 24°. The CA hold no details of any past treatment of the adit.

Landfills/Waste Disposal

Review of the Envirocheck Report obtained as part of the 2020 Curtins ground investigation report indicates that a historical landfill, namely Nab Lane Refuse Disposal Tip, extended across the southern, north eastern and eastern portions of the site. The landfill was authorised to accept inert, industrial, commercial and household waste, and liquid sludge, with operations commencing in November 1970. The last input date is not indicated.

A further entry lists the site as a registered landfill which was operational from March 1982.

A further two historical landfill sites are recorded within 250m of the site. Howden Clough Landfill Site is indicated 53m to the east of the site. The site was authorised to accept household, commercial and industrial waste from May 1989 until an unknown date. The site is also listed as a registered landfill which details the site as '*dormant*' in March 1996. A refuse tip situated 82m to the southeast is shown on historical mapping dated 1972. No details pertaining to this site are recorded.

Radon Gas

The BGS and Public Health England Radon Mapping indicate that the site is situated in an area where <1% of homes are above the radon action level and in accordance with current guidance radon protection measures are not considered necessary in the construction of new retail premises.

Proven Ground Conditions

Three phases of previous investigation have been undertaken at the site, by Delta Simons in 2018, Curtins in 2020, and Sirius in 2022 with exploratory hole positions shown in Drawing No. C8781/02 included in Appendix A.

Made ground soils, of variable thickness, were encountered in the majority of exploratory holes ranging between 0.3m and 14m thick, and was generally noted to become thicker towards the east. The made ground generally comprised mixed cohesive fill (firm and stiff gravelly clay) and occasionally mixed granular fill (sandy gravel). Within the south eastern part of the site landfill waste (including plastic bags, metal, brick, cloth, tyres etc) was encountered up to a maximum depth of 12.5m bgl.

The variation in made ground is considered to be associated with earthworks identified on the historical mapping. Cross sections reproduced from the Delta Simons report (drawing Refs 14-60723.03 – 7c & 7f contained within Appendix B of this report), illustrate the general profile of the infilled excavation, along with the inferred former location of the Flockton Thin Coal seam, having since been removed by either opencast or underground mining. Similarly, the sections show

the steeply-sloping highwall in the northeast of the site, and the thicker landfill waste deposits in the southwest.

Natural strata comprising weathered and competent PLCM mudstone and sandstone was recorded underlying the made ground soils. Coal seams and / or evidence of associated mine workings were identified within a number of rotary boreholes and selected trial pits.

The previous ground investigation works identified a 0.2m to 0.6m thick, intact coal seam in the western, northern and north-eastern parts of the site at depths of between 2.8m and 8.4m bgl. This coal seam is considered to be representative of the Flockton Thin coal seam. Evidence of shallow mine workings (i.e. zones of soft ground/fill) was identified at corresponding depths in the south western and north eastern parts of the site.

The Flockton Thin coal seam was found to be absent within the southern, eastern and central parts of the site and is assumed to have been removed as part of historic excavations at the site.

The Delta-Simons investigation in 2018 encountered coal considered to be associated with the First (and Second) Brown Metal coal seams at depths ranging from 37.3m and 38.7m bgl.

As part of the 2022 Sirius mining investigation forty rotary probeholes were drilled along three 20m perpendicular transects within the north eastern part of the site, in order to investigate the presence of the recorded adit. No evidence of the adit was identified, to a maximum depth of 25m bgl, along the transects (allowing for an up to 8m departure from its recorded location), and it was concluded that the adit may have been removed as part of historical earthworks within the north eastern site area.

Soil Organic Matter Content

The granular and cohesive made ground on the site has been recorded to typically contain organic matter concentrations of between 0.5% and 4.6%. Although, a sample of cohesive made ground obtained from the eastern part of the site (from TT204A at 2.0 – 2.5m) was recorded to have a recorded organic matter content of 20%.

Laboratory testing undertaken on samples of the landfill material as part of the previous investigations recorded organic matter concentrations of between 4.4% and 9.9%.

Chemical Contamination that could Influence Ground Gas Composition

Chemical testing has not identified any contaminants of concern above the assessment criteria for a commercial end-use, with the exception of elevated PAH in one sample of landfill waste.

No groundwater analysis has been undertaken as part of the previous investigations.

Previous Ground Gas Monitoring Data

As part of the 2018 Delta Simons ground investigation 10 No. gas and groundwater monitoring wells were installed within window sample boreholes (DS102 and DS104 – DS112) to depths of between 2.0m – 5.0m bgl. The majority of the monitoring wells were sealed into either the mixed

cohesive/granular made ground or natural strata, with the exception of the monitoring well installed within DS104 which was partly sealed into the landfill waste material.

Gas monitoring undertaken as part of the 2018 investigation comprised the deployment of continuous monitoring instruments for a period of approximately two weeks in each monitoring well. Gas monitoring identified locally elevated concentrations of carbon dioxide (max 6.3% v/v) and methane (max 2.0% v/v), with low/non detectable flows. Although, it is acknowledged that the 2018 investigation did not specifically target the landfill material.

As part of the 2020 Curtins investigation monitoring wells were installed within 4 No. boreholes (BH201 – BH203 and RH211) to depths of between 7.5m and 14.0m bgl so as to specifically target the landfill material. These monitoring wells were monitored on three occasions over a four week period. Significantly higher concentrations of ground gas was identified, with maximum reported methane and carbon dioxide concentrations of 78.8% and 21.4% v/v, respectively, and maximum peak and steady flow rates of 5.2l/h. Also to note is that during the drilling of the boreholes as part of the Curtins investigation bubbling/effervescing was recorded in the perched groundwater identified within BH202.

3.0 Sirius Ground Gas Risk Assessment

As only a limited number of gas monitoring wells and monitoring visits were undertaken as part of the Curtins investigation, it was recommended that further ground gas monitoring be required to better determine the ground gas regime at the site and to satisfy the planning requirements set by Kirklees Council.

Sirius Fieldwork

Fieldworks were undertaken between 14th and 18th February 2022 and comprised the:

- Drilling of 2 No. cable percussive boreholes (CP301 and CP302) to depths of 9.0m and 10.0m bgl, respectively, within the southern part of the site in order to target the area of known landfill material. Gas and groundwater monitoring wells were installed within both boreholes, with the response zones sealed within the landfill material.

- Drilling of 5 No. rotary probeholes (RO301 – RO305) to a maximum depth of 5.0m bgl in order to target the footprints of the proposed retail units within the south eastern and south western parts of the site and allow the installation of gas/groundwater monitoring wells. The response zones were sealed within the landfill material within rotary probeholes RO301, RO302 and RO304.

- Ambisense Gasflux real-time data monitors were installed within three selected gas wells. These included CP301 and CP302 in order to target the landfill material, and RO305 in order to assess ground gas concentrations outwith the zone of deep made ground/landfill material. Equipment was installed within robust metal well covers. These were installed and maintained by Ambisense throughout the works.

  Continuous ground gas monitoring was commenced on the 11th March and completed on 4th April 2022.

- Spot (periodic) gas monitoring of the remaining wells has been carried out on five occasions between 24th February and 14th April 2022 in order to achieve a more comprehensive spatial coverage of the site and allow comparison with the continuous data.

Installation of real time data loggers provides higher quality and more reliable data. Such data loggers also allow a direct correlation between atmospheric pressure changes and gas concentrations and flows. The only downside to the dataloggers is that groundwater levels cannot be obtained in 'real time'. Instruments were installed following an initial monitoring visit to identify wells exhibiting relatively higher concentrations of ground gas and groundwater levels such that a functioning section of well screen was present. Copies of the calibration certificates for the gas data loggers, are contained within Appendix F.

The Sirius exploratory hole positions are shown on Drawing No. C8781/03, contained within Appendix A.

Copies of engineers logs, drilled as part of this and the previous ground investigation works, for the monitoring wells which form part of this investigation are contained within Appendix C.

Ground Conditions

The ground conditions encountered during the Sirius investigation were consistent with those

expected based on earlier phases of investigation and generally comprised a surface covering of granular made ground to depths of between 1.5m and 2.0m bgl, which in turn was underlain by landfill material within the southern and south eastern parts of the site (CP301, CP302, RO301, RO302 and RO304) to a maximum proven depth of 10.0m bgl.

The exception being RO303, located within the north eastern part of the site in which mixed cohesive made ground was encountered underlying the surface granular material to a proven depth of 5.0m bgl. In addition, RO305 located within the south western part of the site encountered PLCMF, comprising mudstone and a 0.8m thick intact coal seam, to a maximum proven depth of 5.0m bgl underlying the surface made ground.

Results of Continuous Monitoring

The results of the continuous gas monitoring are summarised in Table 1 below. The results are also presented graphically on Figures 1 to 9 presented in Appendix D. Figures 1 to 6 show the relationship between methane, carbon dioxide, oxygen, flow, carbon monoxide, hydrogen sulphide and changing atmospheric pressure. In addition, the concentrations of volatile organic compounds (VOCs) recorded over the continuous gas monitoring period are shown on Figure 7 within Appendix D.

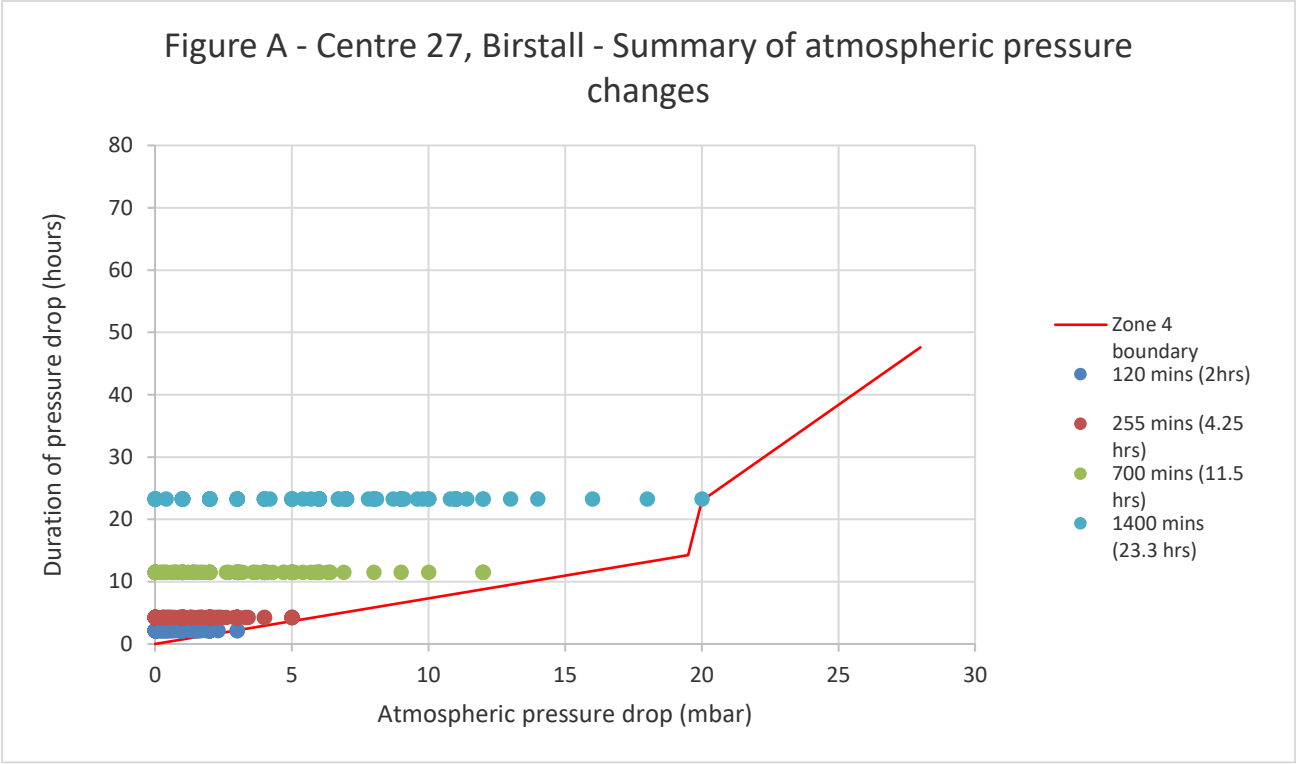
Figures 8 and 9 show the continuous Qhg (Quantity of hazardous gas) values for carbon dioxide and methane compared to numerical boundaries for CS4 conditions from BS8485:2019.

Table 1 – Summary Results of Continuous Monitoring

Well	Response Zone (m bgl)	Response Zone Stratum	Concentration ranges (%v/v)			Steady Flow (Litres/hour)	Peak Flow (Litres/hour)	Barometric Pressure mB
			Methane	Carbon Dioxide	Oxygen			
CP301	2.0 – 8.7	Landfill Material	ND to 81.38	0.15 to 27.86	ND to 20.38	-0.92 to 12.29	12.59	988 to 1045
CP302	2.0 – 10.0	Landfill Material	ND to 82.79	0.03 to 22.67	ND to 19.82	-3.57 to 13.2	13.54	
RO305	2.0 – 5.0	PLCM	ND to 0.1	0.02 to 0.3	18.22 to 20.41	-0.09 to 0.09	1.45	

Atmospheric pressure during the period of monitoring ranged from 988mb to 1045mb, and showed a number of marked rises and falls. Based on guidance contained within CL:AIRE TB18 and TB17, care needs to be taken to ensure that monitoring encompasses suitable periods of 'worst case' atmospheric conditions where this could potentially be a significant driver of ground gas migration. Where continuous monitoring is carried out TB18 suggests that at least two such periods are included in order that characteristic patterns can be reliably identified. TB17 provides a basis for identifying where 'worst case' conditions are likely to have been monitored.

Figure A below provides a summary of atmospheric pressure data collected from the continuous monitoring instruments during the monitoring period assessed over time periods ranging from c. 2 hours to c. 24 hours in duration plotted against the 'worst case' zone or 'zone 4' as described in CL:AIRE TB17.



It can be seen that a period of falling pressure over several timescales falls within the 'worst case' zone, with several other periods very near to the zone. On this basis it is concluded that the variation in conditions is sufficiently comprehensive to give a high level of confidence that likely worst case conditions have been considered as required by the guidance.

From review of the continuous ground gas data the following can be ascertained:

CP301 & CP302 – Sealed into the Landfill Material

- Methane concentrations were recorded to range between non-detectable to 82.79% v/v, although typically appeared to remain at a constantly high concentration, ranging between 69.5% and 82.79% v/v. Two distinct drops in methane concentrations are evident on 13th and 17th March, and appear to broadly correlate with two distinct increases in barometric pressure as shown on Figure 1 – "time series decomposition – atmospheric pressure & methane concentrations", contained within Appendix D.

- Carbon dioxide concentrations were recorded to range between 0.03% and 27.86% v/v, although they typically appeared to remain constant and generally ranged between 19.35% and 27.86% v/v as shown on Figure 2 – "time series decomposition – atmospheric pressure & carbon dioxide concentrations", contained within Appendix D. Similarly, carbon dioxide concentrations were shown to decrease significantly on the same two occasions noted above.

- Oxygen levels were generally noted to be <1% v/v within these monitoring wells, with the exception of two significant increases in concentrations to a maximum of 20.38% v/v, during similar time periods as noted above.

- Constant and peak flow rates were generally recorded to range between -3.57 - 13.2l/h and -3.27 – 13.54l/h, respectively. Flow rates were generally noted to be greater within CP302. There appears to be a relationship between gas flow rates and atmospheric pressure (Figure 4) with higher flows recorded during periods of falling pressure which is typical of that expected for a relatively unconfined ground gas source.

- Carbon monoxide concentrations were generally noted to be <10ppm. However, as with the above two distinct increases in concentration were identified on 13th and 17th March with maximum recorded concentrations of 58.9ppm and 62.2ppm within CP301 and CP302, respectively.

- Hydrogen sulphide and VOC concentrations within CP301 and CP302 were noted to be <3ppm and non-detectable, respectively.

RO305 – Sealed into the Lower Coal Measures Strata

- Low/non detectable concentrations of carbon dioxide and methane (<1%) were detected within the monitoring well, coupled with low gas flow rates (ranging between - 0.09 to 0.09l/h).

- Oxygen levels were recorded to be relatively consistent ranging between 18.22 and 20.41% v/v.

- Carbon monoxide and hydrogen sulphide concentrations recorded within RO305 were noted to be <3ppm and <1ppm, respectively, during the monitoring period.

- VOC concentrations detected within RO305 were noted to <3ppm during the monitoring period.

Results of periodic monitoring to date

The results of the periodic monitoring completed (5 visits) are included within Appendix E and summarised in Table 2 below. Results are grouped by zone as determined by the conceptual site model.

Table 2 – Summary of periodic monitoring results.

Well	Response Zone (m bgl)	Response Zone Stratum	Concentration ranges (%v/v unless otherwise stated))					Peak Flow (Litres/hour)	Steady Flow (Litres/hour)
			Methane	Carbon Dioxide	Oxygen	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)		
Landfill Material									
RO301	1.0 - 5.0	Landfill Material	75.4 - 82.3	9.5 - 24.5	ND	1 - 6	ND - 2	ND - 0.5	ND - 0.5
RO302	2.0 - 5.0	Landfill Material	ND	3.5 - 8.2	11.4 - 15.9	ND - 12	ND - 1	ND	ND
RO304	1.5 - 5.0	Landfill Material	13.0 - 26.9	1.6 - 4.8	ND - 8.8	ND - 12	ND - 1	ND	ND
CP301	2.0 - 8.7	Landfill Material	71.5 - 82.9	7.2 - 15.2	ND - 0.4	ND - 12	ND - 1	ND - 23.4	ND – 21.0
CP302	2.0 - 10.0	Landfill Material	84.1 - 85.7	4.0 - 9.1	ND - 0.2	1 - 10	ND - 1	3.7 - 11.5	3.7 – 11.5
BH202	1.0 - 9.5	Landfill Material	13.3 - 80.5	4.3 - 33.2	ND - 15.2	1 - 6	ND - 1	ND	ND
BH203	2.0 - 7.5	Landfill Material	71.0	14.6	ND	5	2	ND	ND
RH211	1.0 - 12.5	Cohesive Made Ground & Landfill Material	80.5 - 83.9	10.5 - 18.9	ND	1 - 6	ND - 3	0.5 - 4.5	0.5 – 4.5
Cohesive Made Ground									
RO303	1.0 - 5.0	Cohesive Made Ground	ND	0.5 - 2.1	17.4 - 19.6	ND - 6	ND	ND	ND
Coal Measures Strata									
RO305	2.0 - 5.0	PLCM	ND	0.1 - 2.7	15.2 - 15.6	ND - 10	ND - 2	ND	ND

Atmospheric pressure during the spot monitoring visits ranged from 982mb to 1022mb, and included periods of falling, steady and rising pressure.

The periodic gas monitoring identified the monitoring wells installed within the landfill material to exhibit significantly elevated concentrations of methane (max concentration of 85.7% v/v), and elevated concentrations of carbon dioxide (max concentration of 33.2% v/v), with depleted oxygen levels ranging from non-detectable to 15.9% v/v. Maximum initial and constant gas flow rates of 23.4l/h and 21.0l/h, respectively, were recorded within the monitoring wells installed within the landfill material.

In comparison, the monitoring wells installed within RO303 and RO305, located outside the area underlain by landfill material and sealed into the mixed cohesive made ground and PLCM, respectively, typically identified non-detectable concentrations of methane, low concentrations of carbon dioxide (<5% v/v) and non-detectable initial and constant gas flows.

In addition to the above, non-detectable/low concentrations of carbon monoxide (<12ppm), hydrogen sulphide (<3ppm) and VOCs (<2.3ppm) were detected within all the monitoring wells during the spot monitoring visits.

Data obtained from periodic monitoring appear to be generally consistent with that from the continuous monitoring locations.

4.0 Ground Gas Risk Assessment

Current Guidance

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

- BS8485:2019 "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings";
- BS8576:2013 "Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds (VOCs)";
- CIRIA "Assessing Risks Posed by Hazardous Ground Gases to Buildings", report C665, 2007;
- CIRIA "The VOCs Handbook. Investigating, Assessing and Managing Risks from Inhalation of VOCs at Land Affected by Contamination", report C682, 2009;
- CL:AIRE "A Pragmatic Approach to Ground Gas Risk Assessment", report ref. RB17, November 2012;
- NHBC "Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present", report version 04, March 2007.
- CL:AIRE TB17 "Ground gas monitoring and 'worst case' conditions". 2018
- CL:AIRE TB18 "Continuous Ground Gas Monitoring and the Lines of Evidence Approach to Gas Risk Assessment", January 2019.

Conceptual Site Model for Hazardous Ground Gases

Ground Gas Sources

The identified potential sources of hazardous ground gas that may affect the site include areas of deep made ground located within the southern, central and eastern parts of the site, most specifically within the southern area where the deep made ground comprises landfill material. Gas monitoring undertaken has demonstrated that this material is generating significant volumes of methane and carbon dioxide associated with decomposition of degradable material.

Other sources of ground gas, although to a lesser extent to the landfill material, include mines gas associated with shallow mine workings identified below the western and northern parts of the site.

Potential Transport Pathways

Ground gases may migrate vertically or laterally from sources beneath the site through permeable strata (e.g., granular made ground and natural soils or jointed rock), and / or via preferential pathways (e.g., mine entries, fissures etc). However, from review of the ground gas monitoring data obtained as part of the previous and this current investigation it would appear that ground gas generated by the landfill material is generally confined to the southern and south eastern parts due to the presence of low gas permeable Coal Measures strata and cohesive made ground limiting vertical and lateral migration of ground gas originating within the landfill material.

It is understood that the commercial units are to be constructed on Controlled Modulus Columns, which comprise 320mm nominal diameter concrete columns which are intended to improve the bearing properties of the soil mass as a whole. Although, deep foundations can act as preferential pathways for vertical migration where they penetrate though horizons of low gas permeability, it is considered that CMCs should not substantially alter the potential for gas accumulation or migration and can be afforded a high degree of gas protection within its design if necessary.

Should ground gases have migrated to shallower depths via the potential vertical pathways described above, they could migrate laterally throughout the development via preferential pathways (e.g., underground service ducts and trenches filled with granular materials, granular fill materials / piling mats, etc.), to accumulate within confined spaces within buildings and structures. The potential pathways, via which ground gases may migrate to below proposed buildings and may then enter buildings, are illustrated in Figure 2 of BS8485.

Receptors

The most sensitive receptors will be proposed future buildings and their occupants.

Construction/maintenance workers operating within enclosed spaces below ground level during the development phase are also potentially at risk, resulting from the presence of elevated concentrations of methane, carbon dioxide, and depleted oxygen concentrations.

In relation to the risk posed to off-site users, it would appear that ground gas generated by the landfill material is generally confined to the southern and south eastern parts, as stated above. On that basis, and given that the properties to the north, north east and west of the site appear to be of recent construction (c. 2000) and built post landfilling operations commenced at Nab Lane Refuse Disposal Tip (which occupies the southern part of the site and land to the south), it is therefore anticipated that these properties will incorporate gas protection measures within their construction. On that basis, it is considered that the risk associated with the migration of hazardous ground gas, generated from on-site sources, to the off-site properties and their respective end-users is low.

The land to the south of the site is currently undeveloped and is understood to be occupied by the Nab Lane Refuse Disposal Tip which extends onto the southern part of the subject site. On that basis, a similar ground profile and ground gas generation hazard is anticipated beneath land to the south of the site. Therefore, it is considered that the risk associated with the migration of hazardous ground gas, generated from on-site sources, to neighbouring users to the south of the proposed commercial development is low.

It is acknowledged that following completion of the development, the effectiveness of the vertical dispersion and venting is likely to be altered, with sealing of the surface to some degree resulting from the construction of car parking, roads, earthworks activities etc. This may lead to the potential increase in lateral gas migration away from the landfill material, within the southern part of the site, to off-site sources. However, given that that ground gas generated by the landfill material appears to be confined to the southern and south eastern parts due to the presence of low gas permeable Coal Measures strata and cohesive made ground, it is considered likely that preferentially ground gas would migrate through the landfill material which extends off-site to the south, given its more permeable nature, and therefore not adversely impact the nearby existing commercial properties.

Ground Gas Risk Assessment

As detailed previously the ground gas monitoring has highlighted several potential sources of ground gas on-site, although the landfill material identified within the southern part is considered to

have the highest gas generation potential.

The results of the continuous ground gas monitoring of boreholes CP301 and CP302 identified concentrations of methane and carbon dioxide to be relatively constant throughout the monitoring period with maximum recorded concentrations of 82.79% and 22.67% v/v, respectively. Peak and constant gas flow rates, although variable, were noted to typically range between -3.27 – 13.54l/h and -3.57 – 13.2 l/h, respectively, and were generally noted to be greater within CP302.

Qhg values for methane and carbon dioxide were calculated in accordance with BS8485:2019 on the basis of measured gas flows obtained from continuous monitoring installations, specifically the monitoring wells installed within boreholes CP301 and CP302 where the response zones were sealed into the landfill material.

In accordance with the requirements of BS8485:2019, the worst-possible case condition has been calculated for methane and carbon dioxide, as a 'worst-case' check in the first instance. In accordance with the guidance, adopting the worst-possible Qhg as the Gas Screening Value (GSV) should be undertaken only when considered prudent and reasonable to do so.

Based on the monitoring results obtained, the following 'worst possible' Qhg values were derived:

- Methane: 11.20 litres/hour (based on a concentration of 82.79% v/v and a maximum peak flow rate of 13.54 l/h).

- Carbon dioxide: 3.68 litres/hour (based on a concentration of 27.86% v/v and a maximum constant flow rate of 13.2 l/h).

These 'worst possible' Qhg values are indicative of a moderate to high hazard potential for methane and carbon dioxide, and would result in the site being classified as Characteristic Situation 4 (CS 4), as defined in Table 2 of BS8485: 2019.

The results of the 'worst credible' Qhg values for carbon dioxide and methane recorded within CP301 and CP302 are summarised in Figure 8, included within Appendix D. These plots demonstrate that the worst credible Qhg values for methane consistently exceeds the CS4 GSV of 3.5 l/h, within CP302 and on several occasions within CP301. However, at no point during the monitoring period do conditions approach the upper boundary of CS4. Conditions are consistent with ongoing degradation of degradable elements within the historic landfill resulting in high gas concentrations. Consistent gas flows are recorded indicating some volume of gas production, although this is not sufficiently high to exceed the CS4 situation and worst case flows are in response to atmospheric pressure changes which have been appropriately assessed.

It is acknowledged that the results of the gas monitoring indicate that comparably lower concentrations of both carbon dioxide and methane, as well as lower initial and constant gas flow rates, were recorded within the wells installed outwith the zone of landfill material. However, based on the current proposed development layout it appears that the footprints of both proposed commercial units will partly be underlain by the landfill material and therefore CS4 conditions should be assumed.

Low oxygen concentrations have been detected on several occasions within the areas of deep made ground. Whilst such low oxygen concentrations within the ground are considered unlikely to present a significant risk to end users (providing there are no basement areas), low oxygen could potentially pose an unacceptable risk to construction and maintenance workers operating in excavations and below ground confined spaces (e.g. drainage chambers) and as such appropriate

risk assessments and mitigation measures will be required during construction of below ground structures.

No significant concentrations of hydrogen sulphide were detected and the potential risk from such gas is considered negligible. In the absence of any other more appropriate guidance on carbon monoxide concentrations, reference has been made to the HSE document EH40/2005:2011 “Workplace exposure limits” to ascertain an appropriate guidance value. That document indicates a long-term exposure limit (8-hr TWA reference period) of 30ppm for carbon monoxide. It is acknowledged that on two isolated occasions carbon monoxide wase noted to increase from typical concentrations of <10ppm to a maximum recorded value of 62.2ppm. On both occasions the adopted workplace exposure limit of 30ppm were exceeded for periods of < 8 hours.

Given that the marked increases in carbon monoxide concentrations, in exceedance of the adopted work exposure limit, do not appear to be for long sustained periods of time and appear to be isolated occurrences, it is considered that gas protection measures designed to meet the requirements for CS4 conditions will be sufficient to mitigate the risks associated with the migration of carbon monoxide at the recorded concentrations. Consequently, the detected concentrations of carbon monoxide are not considered to present a potential unacceptable risk to human health.

5.0 Conclusions and Recommendations

CL:AIRE TB18 advises that monitoring should continue until sufficient confidence is gained that further monitoring will not change the outcome of the assessment. Based on the range of atmospheric conditions included in the monitoring period, the established repetition in patterns of gas concentration and the continuous dataset now available it is considered that this point has been reached and that no further monitoring is necessary.

On the basis of the data obtained and the risk assessment given the site is concluded to fall within Characteristic Situation (CS) 4 as defined in BS8485:2019. A CS4 classification indicates a moderate to high potential risk from hazardous ground gas.

Based on Table 4 within BS8485:2019, and assuming Type C buildings, a gas protection score of 4.5 would be required for the proposed commercial development. This could be achieved, for example, by a passive sub-floor dispersive layer of suitable design (assuming a very good performance) and installation of a suitable gas resistant membrane, installed and verified in accordance with the requirements of BS8485:2019. Gas protection measures should be validated in accordance with Appendix 3 of the YALPAG Verification Requirements for Gas Protection Systems. Given the higher level of risk identified on this site it is essential that the gas protection system is properly designed by a suitably qualified specialist.

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

Prior to undertaking any construction on the site, the proposed design of gas protection measures and strategy for verification must be agreed with the local authority.

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

gas concentrations are detected, then all personnel should immediately evacuate the area and the advice of an appropriate specialist be obtained before work continues.

All existing monitoring wells should be fully decommissioned prior to development commencing.

We trust that you find the comments above suitable for your current requirements, and that you will forward this letter to the Local Authority for their review and approval. If you do have any queries or require any other information, please contact the undersigned directly.

Yours sincerely,

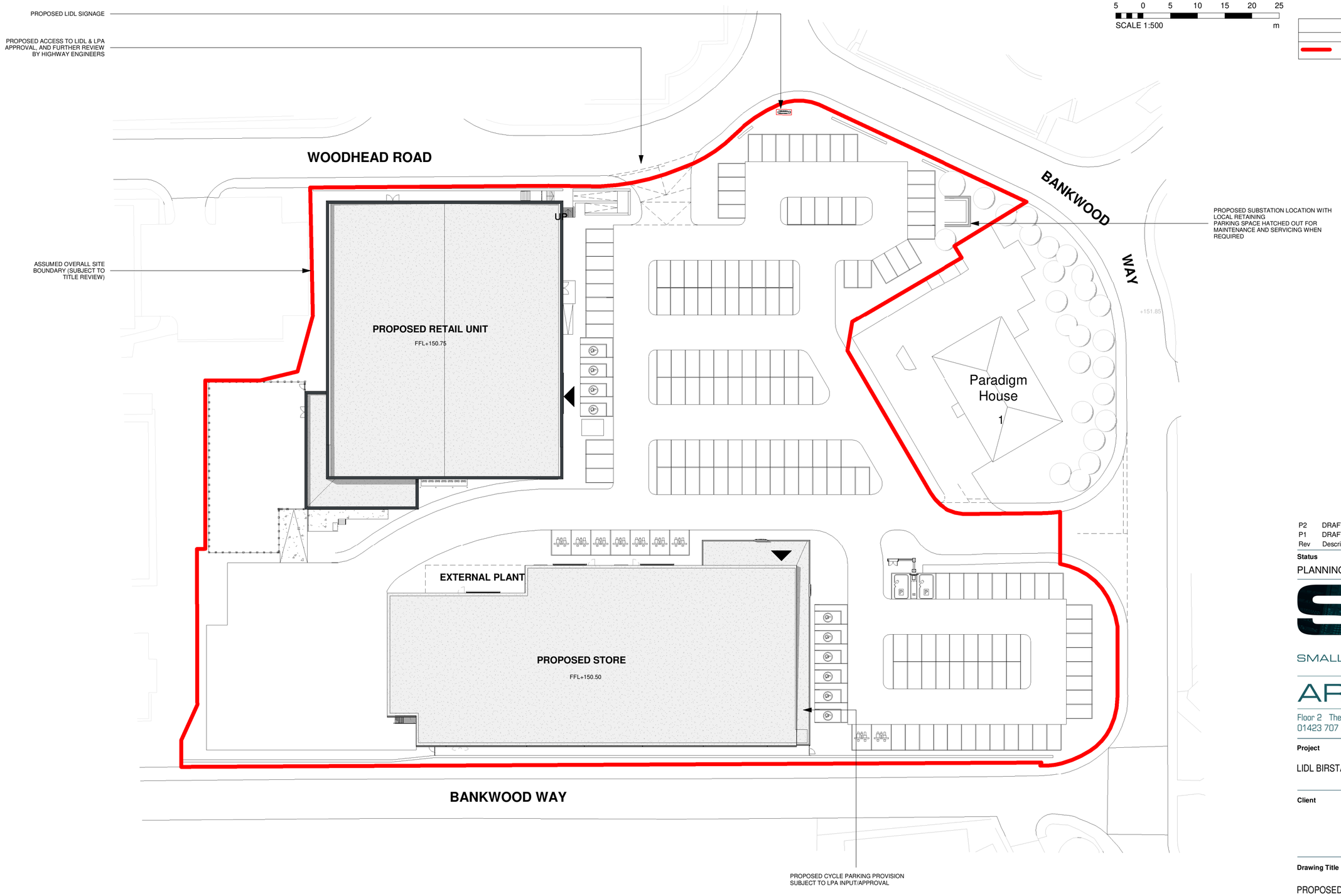
Redacted

Mark Brennan
Regional Director
For and on behalf of Sirius Geotechnical Ltd

Encs: Appendix A - Drawings
Appendix B - Delta Simons Cross Sections
Appendix C - Exploratory Hole Records
Appendix D - Continuous Ground Gas Monitoring Data
Appendix E - Ground Gas and Groundwater Monitoring Results
Appendix F - Calibration Certificates

APPENDIX A

DRAWINGS



N

5 0 5 10 15 20 25

SCALE 1:500 m

Do not scale this drawing.
Architects are to be notified of any discrepancies.
Contractors must check all dimensions on site.
This drawing is subject to copyright laws and is for use on this project only.
This drawing is to be used solely for the information as titled only.
For other information refer to the latest revision of any cross referenced drawings.
To be read in conjunction with relevant design standards/protocols

This is a colour drawing. In order to ensure any subsequent reproduction is viewed correctly it should be printed in full colour.

SITE AREA EXTG			
		ACRES	HECTARES
	OVERALL SITE BOUNDARY (ASSUMED)	3.78	1.53

Rev	Description	Date	Drn	Ckd
P2	DRAFT PLANNING ISSUE	16.04.21	MN	JM
P1	DRAFT PLANNING ISSUE	18.12.20	GL	JM

Status

PLANNING

SMR
SMALLEY MARSEY RISPIN
ARCHITECTS
Floor 2 The Exchange Station Parade Harrogate HG1 1TS
01423 707 757 admin@smrarchitects.co.uk

Project

LIDL BIRSTALL, BANKWOOD WAY

Client

Drawing Title

PROPOSED SITE PLAN

Proj Ref	Origin	Zone	Level	Type	Role	Num	Status	Rev
- - - 7404	- SMR	- 00	- ZZ	- DR	- A	- 2003	- S3	- P2

SMR Job Ref	Sheet	Scale	Drawn
7404-00-2003	A2	1 : 500	MN

NOTES

Site Location

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

SIRIUS GEOTECHNICAL LTD
4245 Park Approach, Thorpe Park, Leeds LS15 8GB
www.thesiriusgroup.com
TEL: 0113 264 9960
FAX: 0113 264 9962

CLIENT: Lidl GB Ltd	DRAWING NO.: C8781/01	REVISION NO.: 0	
SITE: Centre 27, Bankwood Way, Birstall	DRAWN BY: MF	APPROVED BY: AW	
DRAWING TITLE: Site Location Plan	DATE: March 2022	SCALE: 1:25,000	A4

N

RH207
TP114
DS112(s)
RH208
DS111(s)
RH209
RT109
RH206
TT205
TP113
DS102(s)
TP112
DS108(s)
DS110(s)
RH210
TP103
RH205
RH208
RT108
TP111
TP104
DS109(s)
BH201
RH212
TP116
TT204C
TP110
RH211
RT104
RO302
DS103
TP109
DS107(s)
RT105
TP106
TT204B
RO305
CP301
BH203
RT107
TT204A
TP105
DS104(s)
RH204
DS106(s)
RO304
RO301
TP108
BH202
DS105(s)
TT203
TT202
CP302
RT106
RO303
TP102
RH201
TT201
RH202
TT201A
RH203
RT101
RT103
RT102

NTS

NOTES

Site Boundary

Delta-Simons Site Investigation, 2018

- DS100 — Dynamic Sampler Borehole
- RT100 — Rotary Borehole
- TP100 — Trial Pit

Curtins Site Investigation, 2020

- RH200 — Rotary Probe Borehole
- BH200 — Cable Percussive Borehole
- RH210 — Rotary Probe Borehole with Cored Follow On
- TT200 — Trial Trench

Sirius Borehole Locations , 2022

- Cable Percussive Borehole with Gas / Groundwater Monitoring Well
- Rotary Borehole with Gas / Groundwater Monitoring Well
- Rotary probehole whereby solid coal was encountered
- Rotary probehole whereby soft ground / no coal was encountered
- Indicative Trial / Trench Location

REVISION		BY	DATE
0	For Information	MF	20/10/21
A	>>	>>	>>
B	>>	>>	>>
C	>>	>>	>>
D	>>	>>	>>

SIRIUS
GEOTECHNICAL LTD
4245 Park Approach,
Thorpe Park,
Leeds
LS15 8GB
www.thesiriusgroup.com
TEL: 0113 264 9960
FAX: 0113 264 9962

CLIENT

Lidl GB Limited

SITE

Centre 27
Birstall

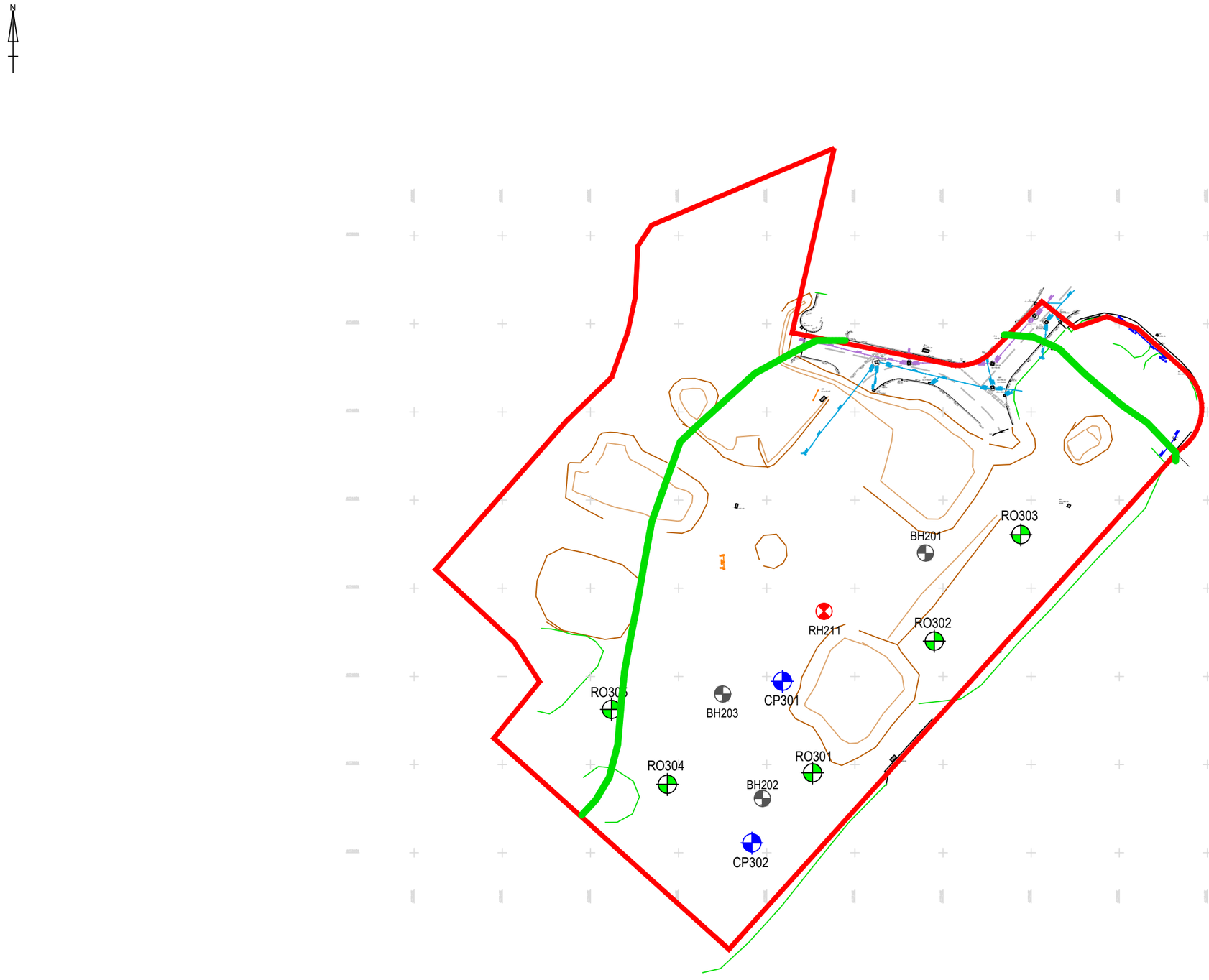
DRAWING TITLE

Previous Exploratory Hole Location Plan

DRAWING NO.	REVISION NO.
C8781/02	0

DRAWN BY	APPROVED BY
MF	GH

DATE	SCALE	PAPER SIZE
March 2022	1:500	A2



NOTES

Site Boundary

Sirius Borehole Locations , 2022

Cable Percussive Borehole with Gas / Groundwater Monitoring Well (Sirius)

Rotary Borehole with Gas / Groundwater Monitoring Well

Curtins Borehole Locations , 2020

Cable Percussive Borehole with Gas / Groundwater Monitoring Well (Curtins)

Rotary Borehole with Gas / Groundwater Monitoring Well

Approximate line of conjectured high wall of former opencast and landfill operations.

REVISION		BY	DATE
0	>>	>>	>>
A	>>	>>	>>
B	>>	>>	>>
C	>>	>>	>>
D	>>	>>	>>

SIRIUS
GEOTECHNICAL LTD
4245 Park Approach,
Thorpe Park,
Leeds
LS15 8GB
www.thesiriusgroup.com
TEL: 0113 264 9960
FAX: 0113 264 9962

CLIENT

Lidl GB Limited

SITE

**Centre 27,
Birstall**

DRAWING TITLE

Ground Gas Monitoring Well Locations

DRAWING NO.	REVISION NO.
C8781/03	0
DRAWN BY: AW	APPROVED BY: MB
DATE: April 2022	SCALE: 1:1,000
PAPER SIZE: A3	

APPENDIX B

DELTA SIMONS CROSS SECTIONS

LEGEND

Indicative Strata Boundary

C

C'

GROUND LEVEL

MADE GROUND

PENNINE LOWER COAL MEASURES

TP114: 0.10, 0.80, 1.90, 3.60, 3.70

DS112: 0.08, 0.60, 2.60, 3.80, 4.10, 5.70, 5.80, 6.17

DS102: 0.30, 1.10, 1.20, 6.45

TP103: 0.30, 0.70, 2.70, 2.90

RT103: 0.10, 0.15, 1.00, 9.00, 11.80, 15.20, 19.50, 20.00

RT102: 0.10, 1.00, 9.00, 20.00

Legend Key

- MADE GROUND
- TOPSOIL
- Clayey sandy GRAVEL
- SANDSTONE
- Clayey SAND
- Silty CLAY
- COAL
- MUDSTONE

122.00

Chainage (m)	0.00	9.61	22.84	67.79	85.66	104.14	110.53	119.09	
Offset (m)	5.93	1.08	3.89	7.91	4.99	8.03			
Elevation (mAOD)	151.91	151.62	150.51	150.03	148.50	148.50			

deltasimons
Environment - Health & Safety - Sustainability

TITLE:
Indicative Geological Cross-Section C - C'

Centre 27

Birstall

DRAWN BY: EN	ENGINEER: TS	VERTICAL SCALE: 1:150	PROJECT NO: 14-0672.03
CHECKED BY: RJS	REVISION: 0	HORIZONTAL SCALE: 1:450	FIGURE NO: 7c
DATE: 20 July 2018	CLIENT: AEW UK		

LEGEND

Indicative Strata Boundary

Anticipated former Flockton Thin Coal Seam

F'

F

RT107

RT108

RT105

RT104

RT103

RT102

RT101

GROUND LEVEL

ANTICIPATED FORMER FLOCKTON THIN COAL SEAM

MADE GROUND

PENNINE LOWER COAL MEASURES

'Possible workings encountered in RT107. RT108 and RT101'

Legend Key

- MADE GROUND
- SANDSTONE
- TOPSOIL
- Void
- MUDSTONE
- SILTSTONE
- COAL

100.00

Chainage (m)	0.00	18.16	30.10	32.14	35.59	48.10	61.89	69.95	75.27	83.31	90.14	96.45	107.68	125.05	133.14	154.78	161.16	170.57	174.50	185.06		
Offset (m)		24.59	7.01	14.88	11.48	13.19	13.58	21.44	21.64	3.30	13.27	25.77	26.82	21.53	5.10	1.19	4.25	18.11	2.51			
Elevation (mAOD)		150.62	151.11	150.76	150.75	150.70	150.31	149.47	150.87	150.16	150.14	151.00	149.90	150.51	150.03	148.50	148.50	149.37	148.92			

TITLE:

Indicative Geological Cross-Section F - F'

Centre 27

Birstall

deltasimons

Environment - Health & Safety - Sustainability

DRAWN BY: EN	ENGINEER: TS	VERTICAL SCALE: 1:250	PROJECT NO: 14-0672.03
CHECKED BY: RJS	REVISION: 0	HORIZONTAL SCALE: 1:650	FIGURE NO: 7f
DATE: 20 July 2018	CLIENT: AEW UK		

APPENDIX C

EXPLORATORY HOLE RECORDS

BOREHOLE RECORD

BH No. **CP301** Sheet 1 of 1

Site: Centre 27, Birstall

Contract No: C8781

Client: Lidl GB Ltd

Date(s): 14/02/2022

Method: Cable percussive drilling rig utilising 150mm diameter casing

Scale: 1:50

Logged By: AW Checked By: AW

Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD			
Type	Depth From - To(m)	SPT (N), {ppm}, (Cu Peak), Vane Result (kN/m2)	Ground -water	Description	Depth (m)	Level (m AOD)	Legend / Well
B	0.00 - 1.00			MADE GROUND - Grey sandy GRAVEL with low cobble content of concrete. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of concrete and brick.			
				MADE GROUND - Black WASTE comprising 65% plastic, 20% decomposed material, 5% wood, 5% metal and 5% glass. Strong putrescent odour.	2.00		
B	3.00 - 4.00						
B	5.00 - 6.00						
B	7.00 - 8.00						
B	8.80			Extremely weak grey MUDSTONE. Recovered sandy gravel of mudstone.	8.80		
				End of Borehole at 9.00m	9.00		

1 2 3 4 5 6 7 8 9 10

Remarks and Groundwater Observations:

1. Borehole completed at 9.0m bgl within competent strata
2. No groundwater encountered.
3 50mm gas/groundwater monitoring well installed as detailed above.

GL (mAOD)

Easting: 423703.40

Northing: 427398.84

Fig No. CP301

BOREHOLE RECORD

BH No. **CP302** Sheet 1 of 1

Site: Centre 27, Birstall

Contract No: C8781

Client: Lidl GB Ltd

Date(s): 15/02/2022

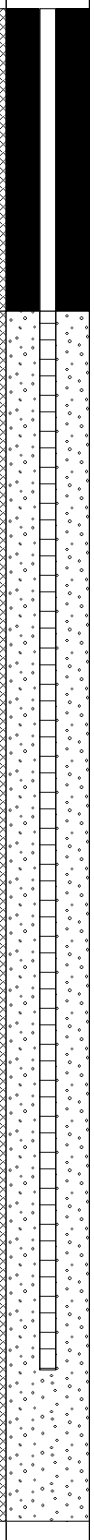
Method: Cable percussive drilling rig utilising 150mm diameter casing

Scale: 1:50

Logged By: AW | Checked By: AW

Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD			
Type	Depth From - To(m)	SPT (N), {ppm}, (Cu Peak), Vane Result (kN/m2)	Ground -water	Description	Depth (m)	Level (m AOD)	Legend / Well
B	0.00 - 1.00			MADE GROUND - Grey sandy GRAVEL with low cobble content of concrete. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of concrete and brick.			
				MADE GROUND - Black WASTE comprising 65% plastic, 20% decomposed material, 5% wood, 5% metal and 5% glass. Strong putrescent odour.	2.00		
B	3.00 - 4.00						
B	5.00 - 6.00						
B	7.00 - 8.00						
B	9.00 - 10.00			*From 9.0.m bgl - Carpet encountered limiting advancement of the borehole.*			
				End of Borehole at 10.00m	10.00		



Remarks and Groundwater Observations:

1. Borehole terminated at 10.0m bgl within backfilled carpet limiting the advancement of the borehole.
2. No groundwater encountered.
3 50mm gas/groundwater monitoring well installed as detailed above.

GL (mAOD)

Easting: 423696.73

Northing: 427362.19

Fig No. CP302

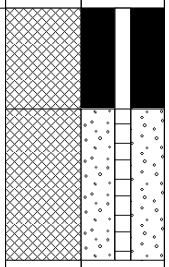
BOREHOLE RECORD

BH No. **RO301**
Sheet 1 of 1

Site: Centre 27, Birstall
Contract No: C8781
Client: Lidl GB Ltd
Date(s): 18/02/2022
Method: Casagrande C6-2 utilising air flush
Scale: 1:150
Logged By: Driller
Checked By: AW
Driller: Sirius Drilling Ltd

SAMPLE DETAILS | STRATA RECORD

Depth From - To(m)	TCR	SCR	RQD	FI	Ground -water	Description	Depth (m)	Level (m AOD)	Legend	Well
						MADE GROUND - Grey sandy GRAVEL (Drillers description)				
						MADE GROUND - Black WASTE (Drillers description)	2.00			
						End of Borehole at 5.00m	5.00			



Remarks and Groundwater Observations:

1. Borehole completed at 5.0m bgl.
2. 50mm gas/groundwater monitoring well installed as detailed above.
3. No groundwater encountered.

GL (m AOD)
Eastings:
Northings:

Fig No.
RO301

BOREHOLE RECORD

BH No. **RO302**
Sheet 1 of 1

Site: Centre 27, Birstall
Contract No: C8781
Client: Lidl GB Ltd
Date(s): 18/02/2022
Method: Casagrande C6-2 utilising air flush
Scale: 1:150
Logged By: Driller
Checked By: AW
Driller: Sirius Drilling Ltd

SAMPLE DETAILS | STRATA RECORD

Depth From - To(m)	TCR	SCR	RQD	FI	Ground -water	Description	Depth (m)	Level (m AOD)	Legend	Well
						MADE GROUND - Grey sandy GRAVEL (Drillers description)				
						MADE GROUND - Black WASTE (Drillers description)	2.00	146.20		
						End of Borehole at 5.00m	5.00	143.20		

Remarks and Groundwater Observations:

1. Borehole completed at 5.0m bgl.
2. 50mm gas/groundwater monitoring well installed as detailed above.
3. No groundwater encountered.

GL (m AOD) 148.20
Eastings: 423737.16
Northings: 427406.06

Fig No. RO302

BOREHOLE RECORD

BH No. **RO303**
Sheet 1 of 1

Site: Centre 27, Birstall
Contract No: C8781
Client: Lidl GB Ltd
Date(s): 18/02/2022
Method: Casagrande C6-2 utilising air flush
Scale: 1:150
Logged By: Driller
Checked By: AW
Driller: Sirius Drilling Ltd

SAMPLE DETAILS | STRATA RECORD

Depth From - To(m)	TCR	SCR	RQD	FI	Ground -water	Description	Depth (m)	Level (m AOD)	Legend	Well
						MADE GROUND - Grey sandy GRAVEL (Drillers description)				
						MADE GROUND - Dark grey sandy gravelly CLAY (Drillers Description).	1.50	147.04		
						End of Borehole at 5.00m	5.00	143.54		

Remarks and Groundwater Observations:

1. Borehole completed at 5.0m bgl.
2. 50mm gas/groundwater monitoring well installed as detailed above.
3. No groundwater encountered.

GL (m AOD) 148.54
Eastings: 423757.89
Northings: 427428.04

Fig No. RO303

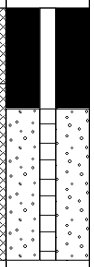
BOREHOLE RECORD

BH No. **RO304**
Sheet 1 of 1

Site: Centre 27, Birstall
Contract No: C8781
Client: Lidl GB Ltd
Date(s): 18/02/2022
Method: Casagrande C6-2 utilising air flush
Scale: 1:150
Logged By: Driller
Checked By: AW
Driller: Sirius Drilling Ltd

SAMPLE DETAILS | STRATA RECORD

Depth From - To(m)	TCR	SCR	RQD	FI	Ground -water	Description	Depth (m)	Level (m AOD)	Legend	Well
						MADE GROUND - Grey sandy GRAVEL (Drillers description)				
						MADE GROUND - Black WASTE (Drillers description)	1.50	147.83		
						End of Borehole at 5.00m	5.00	144.33		



Remarks and Groundwater Observations:

1. Borehole completed at 5.0m bgl.
2. 50mm gas/groundwater monitoring well installed as detailed above.
3. No groundwater encountered.

GL (m AOD) 149.33
Eastings: 423677.33
Northings: 427375.15

Fig No. RO304

BOREHOLE RECORD

BH No. **RO305**
Sheet 1 of 1

Site: Centre 27, Birstall
Contract No: C8781
Client: Lidl GB Ltd
Date(s): 18/02/2022
Method: Casagrande C6-2 utilising air flush
Scale: 1:150
Logged By: Driller
Checked By: AW
Driller: Sirius Drilling Ltd

SAMPLE DETAILS | STRATA RECORD

Depth From - To(m)	TCR	SCR	RQD	FI	Ground -water	Description	Depth (m)	Level (m AOD)	Legend	Well
						OVERBURDEN (Drillers description)				
						MUDSTONE (Drillers description)	1.50	148.65		
						COAL (Drillers description)	2.20	147.95		
						MUDSTONE (Drillers description)	3.00	147.15		
						End of Borehole at 5.00m	5.00	145.15		

Remarks and Groundwater Observations:

1. Borehole completed at 5.0m bgl.
2. 50mm gas/groundwater monitoring well installed as detailed above.
3. No groundwater encountered.

GL (m AOD) 150.15
Eastings: 423664.79
Northings: 427392.27

Fig No. RO305

Borehole Log

Borehole No. **BH202**

Sheet 1 of 2

Project Name: Bankwood Way. Birstall	Project No. 076893	Co-ords: 423699.00 - 427373.00	Hole Type CP
Location: Bankwood Way, Birstall		Level: 148.57	Scale 1:50
Client: Lidl GB Limited		Dates: 04/09/2020 - 07/09/2020	Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10	148.47		Grey and brown slightly clayey slightly sandy angular to subangular fine to coarse GRAVEL of concrete, brick and sandstone. (DEMOLITION FILL).
		0.50 - 0.80	B D					
					0.80	147.77		Creamish brown slightly sandy very gravelly CLAY. Gravel is angular to subangular fine to coarse of limestone. (SUBBASE).
		1.00 - 1.10	ES					
		1.00 - 1.50	B D					Soft brown and greenish grey slightly sandy gravelly CLAY. Sand is fine to coarse of green quartz. Gravel is angular to subrounded fine to coarse of sandstone, quartz, brick and coal with rare concrete and timber. (MADE GROUND).
		1.20		N=16 (4,5/16 for 225mm)				
		2.00		N=14 (6,5/14 for 225mm)	2.00	146.57		LANDFILL WASTE within a black clayey matrix. Waste comprises plastic bags, carpet, rubber and tyres, timber, metal, metal wire, and brick, concrete and sandstone cobbles. Recovered wet from 3.0mbgl. Frequent fragments of bone at 9.0mbgl. Strong putrid/organic odour. (MADE GROUND).
		2.50 - 2.60	ES					
		2.50 - 3.00	B D					
		3.00		50 (25 for 145mm/50 for 70mm)				
		4.00		N=11 (2,3/11 for 225mm)				
		4.00 - 4.10	ES					
		4.00 - 4.50	B D					
		5.00		N=17 (3,3/17 for 225mm)				
		6.00		N=18 (4,4/18 for 225mm)				
		6.50 - 7.00	B D					
		7.00		50 (25 for 50mm/50 for 73mm)				
		8.00		N=18 (3,5/18 for 225mm)				
		8.00 - 8.50	B D					
		9.00		N=15 (2,3/15 for 225mm)				
					9.70	138.87		Reworked natural recovered as dark greyish
					10.00	138.57		

Continued on next sheet

Remarks

AGS

Borehole Log

Borehole No. **BH202**

Sheet 2 of 2

Project Name: Bankwood Way. Birstall	Project No. 076893	Co-ords: 423699.00 - 427373.00	Hole Type CP
Location: Bankwood Way, Birstall		Level: 148.57	Scale 1:50
Client: Lidl GB Limited		Dates: 04/09/2020 - 07/09/2020	Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.00 10.00 - 10.45	D	50 (25 for 145mm/50 for 150mm)	10.45	138.12		brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of coal, brick, mudstone and sandstone. Occasional fragments of plastic throughout. (MADE GROUND). Medium strong brown mottled orange and grey thinly laminated MUDSTONE. Frequent orange oxidation on bedding planes. (PENNINE LOWER COAL MEASURES). End of borehole at 10.45 m

11 12 13 14 15 16 17 18 19 20

Remarks

Borehole Log

Borehole No. **BH203**

Sheet 1 of 1

Project Name: Bankwood Way. Birstall	Project No. 076893	Co-ords: 423690.00 - 427396.00	Hole Type CP
Location: Bankwood Way, Birstall		Level: 149.11	Scale 1:50
Client: Lidl GB Limited		Dates: 07/09/2020 - 07/09/2020	Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30 - 0.80	ES D					Creamish brown clayey slightly sandy angular to subangular fine to coarse GRAVEL of limestone. (SUBBASE).
					1.00	148.11		
		1.20		N=7 (1,2/7 for 225mm)				Reworked natural recovered as brown slightly sandy gravelly CLAY with low cobble content. Cobbles and gravel are whole and subangular brick. (MADE GROUND).
		1.50 - 2.00	B D					
		2.00		N=34 (2,3/34 for 225mm)	2.00	147.11		LANDFILL WASTE within a black clayey matrix. Waste comprises plastic bags, carpet, rubber and tyres, timber, metal, metal wire, and brick, concrete and sandstone cobbles. Recovered wet from 3.5mbgl. (MADE GROUND).
		3.00		50 (25 for 50mm/50 for 55mm)				
		3.00 - 3.50	ES D					
		4.00		N=11 (2,2/11 for 225mm)				
		5.00		N=16 (1,2/16 for 225mm)				
		6.00		N=15 (2,3/15 for 225mm)				
		6.50 - 7.00	ES D					
		7.00		N=12 (2,2/12 for 225mm)				
		7.50 - 8.00	B D		7.50	141.61		Firm orangish brown mottled grey CLAY. (PENNINE LOWER COAL MEASURES).
		8.00		N=23 (2,2/23 for 225mm)	8.00	141.11		Extremely weathered MUDSTONE recovered as hard to stiff brown mottled orange and grey slightly gravelly clay. Gravel is angular to subangular fine to coarse of mudstone. (PENNINE LOWER COAL MEASURES).
		8.00 - 8.50	D		8.50	140.61		End of borehole at 8.50 m

Remarks

AGS

Rotary Core Log

Borehole No.
RH211
Sheet 1 of 3

Project Name:	Bankwood Way. Birstall	Project No. 076893	Co-ords:	423713.00 - 427415.00	Hole Type RC
Location:	Bankwood Way, Birstall		Level:	150.22	Scale 1:40
Client:	Lidl GB Limited		Dates:	10/09/2020 - 11/09/2020	Logged By

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							0.30	149.92		Creamish brown clayey slightly sandy angular to subangular fine to coarse GRAVEL of limestone and sandstone. (SUBBASE).
										Reworked natural recovered as dark greyish brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, sandstone and coal with rare brick and timber. (MADE GROUND).
							7.20	143.02		LANDFILL WASTE within a black clayey matrix. Waste comprises plastic bags, carpet, rubber and tyres, timber, metal, metal wire, and brick, concrete and sandstone cobbles. Recovered wet from 3.5mbgl. (MADE GROUND).
										Continued on next sheet

1 2 3 4 5 6 7 8

Remarks

AGS

Rotary Core Log

Borehole No. **RH211**

Sheet 2 of 3

Project Name: Bankwood Way. Birstall	Project No. 076893	Co-ords: 423713.00 - 427415.00	Hole Type RC
Location: Bankwood Way, Birstall		Level: 150.22	Scale 1:40
Client: Lidl GB Limited		Dates: 10/09/2020 - 11/09/2020	Logged By

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		12.50 - 13.00	B				12.50	137.72		Extremely weak to weak thickly laminated dark greyish brown MUDSTONE. Discontinuities: widely spaced, sub-horizontal (10 degrees), planar, open, locally clay filled. Orangish brown staining confined to fracture and bedding planes. Recovered non-intact from 12.6mbgl to 13.1mbgl and 13.5mbgl to 13.75mbgl.
		12.00 - 13.50	2	63	20	0				
		13.15 - 13.25	U							
		13.35 - 13.50	U							
		13.75 - 13.85	U				13.75	136.47		
							13.85	136.37		Medium strong to strong light grey thinly cross bedded fine grained SANDSTONE.
		14.20 - 14.30	U							Extremely weak to weak thickly laminated dark greyish brown silty MUDSTONE. Discontinuities: widely spaced, sub-horizontal (10 degrees), planar and closed. Orangish brown oxidation staining confined to fracture and bedding planes.
		13.50 - 15.00	10	100	66	40				
		14.60 - 14.70	U				14.50	135.72		Weak thinly laminated dark grey clayey SILTSTONE. Discontinuities: widely spaced, sub-horizontal (10 degrees), planar, closed. Orangish brown oxidation staining confined to fracture and bedding planes. Locally non-intact.
							14.90	135.32		
							15.00	135.22		Medium strong light grey silty fine grained SANDSTONE.
		15.00 - 16.50	8	53	10	0				No recovery.
							15.60	134.62		
		15.70 - 16.10	B				15.70	134.52		Medium strong to strong light brown fine to medium grained SANDSTONE.
										Extremely weak to weak thickly laminated grey

Continued on next sheet

Remarks

AGS

Rotary Core Log

Borehole No. **RH211** Sheet 3 of 3

Project Name: Bankwood Way. Birstall	Project No. 076893	Co-ords: 423713.00 - 427415.00	Hole Type RC
Location: Bankwood Way, Birstall		Level: 150.22	Scale 1:40
Client: Lidl GB Limited		Dates: 10/09/2020 - 11/09/2020	Logged By

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		16.20 - 16.40	U				16.10	134.12		locally orangish brown oxidation stained silty MUDSTONE recovered non-intact.
										Weak to strong grey clayey SILTSTONE. Locally non-intact.
							16.50	133.72		No recovery.
		16.50 - 18.00	0	33	10	0				
							17.40	132.82		Weak to strong grey clayey SILTSTONE. Locally non-intact.
		17.80 - 18.00	U							
							18.00	132.22		No recovery.
		18.00 - 19.50	6	50	25	10	18.75	131.47		Extremely weak to medium strong thinly laminated grey silty MUDSTONE. Recovered locally non-intact.
		18.80 - 18.90	U							
		19.00 - 19.10	U							
		19.30 - 19.40	U				19.20	131.02		Exremely weak to medium strong grey clayey SILTSTONE. Recovered locally non-intact.
							19.50	130.72		No recovery.
		19.50 - 21.00	3	33	0	0				
		20.50 - 20.90	B				20.50	129.72		Extremely weak to medium strong grey clayey SILTSTONE. Recovered locally non-intact.
		20.90 - 21.00	U							
		21.10 - 21.30	U							
		21.30 - 21.50	U				21.30	128.92		Medium strong to strong grey thinly laminated slightly silty MUDSTONE. Discontinuities: widely spaced, sub-horizontal (20 degrees), planar, closed, locally clay filled.
		21.00 - 22.50	10	85	40	30				
		22.10 - 22.30	U							
							22.50	127.72		End of borehole at 22.50 m

Remarks

APPENDIX D

CONTINUOUS GROUND GAS MONITORING DATA

FIGURE 1 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & METHANE CONCENTRATIONS

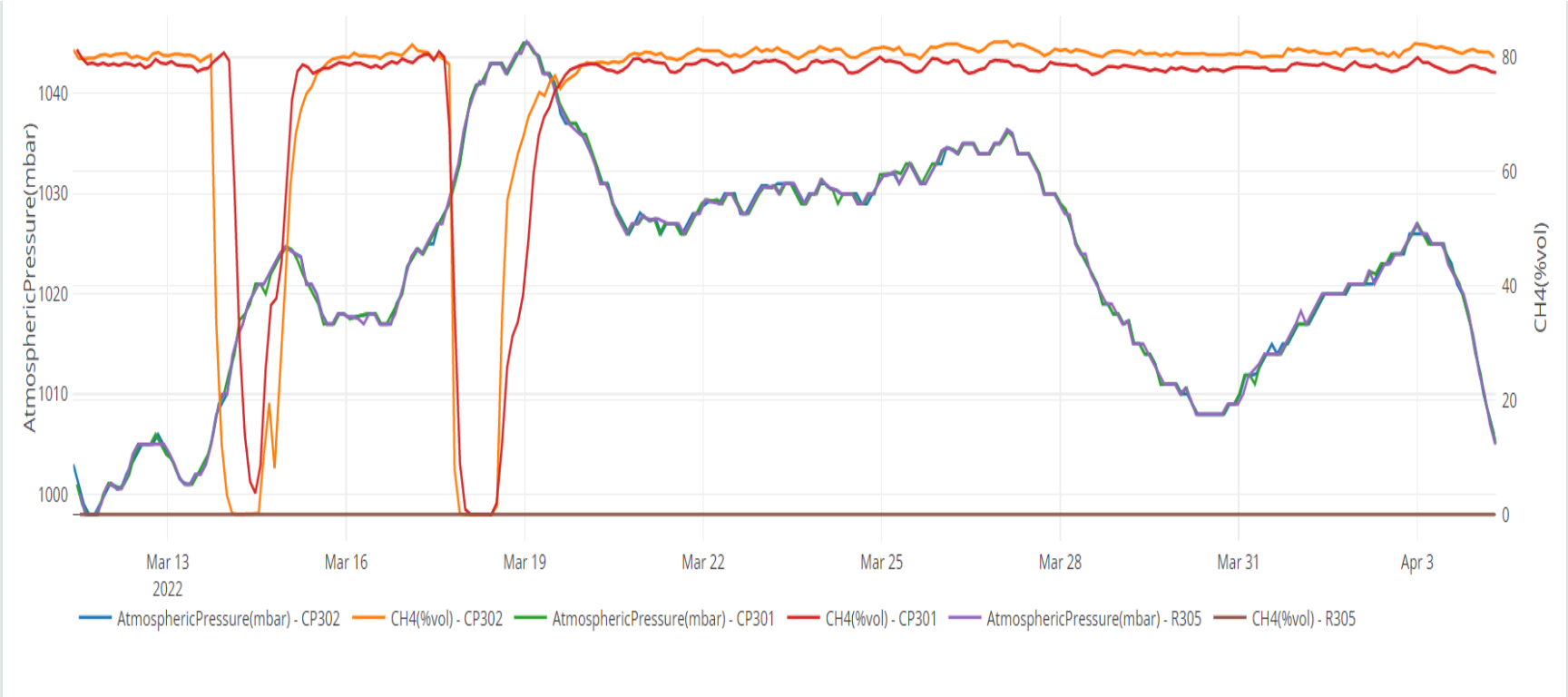


FIGURE 2 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & CARBON DIOXIDE CONCENTRATIONS

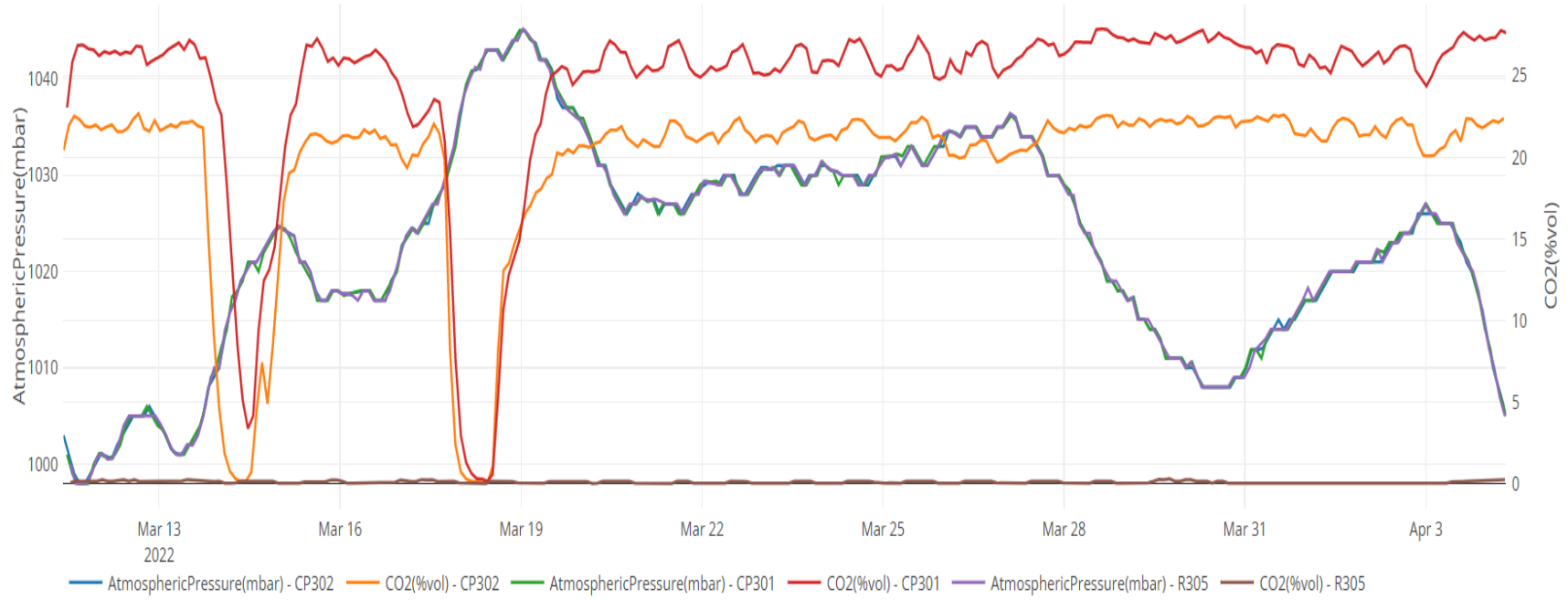


FIGURE 3 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & OXYGEN CONCENTRATION

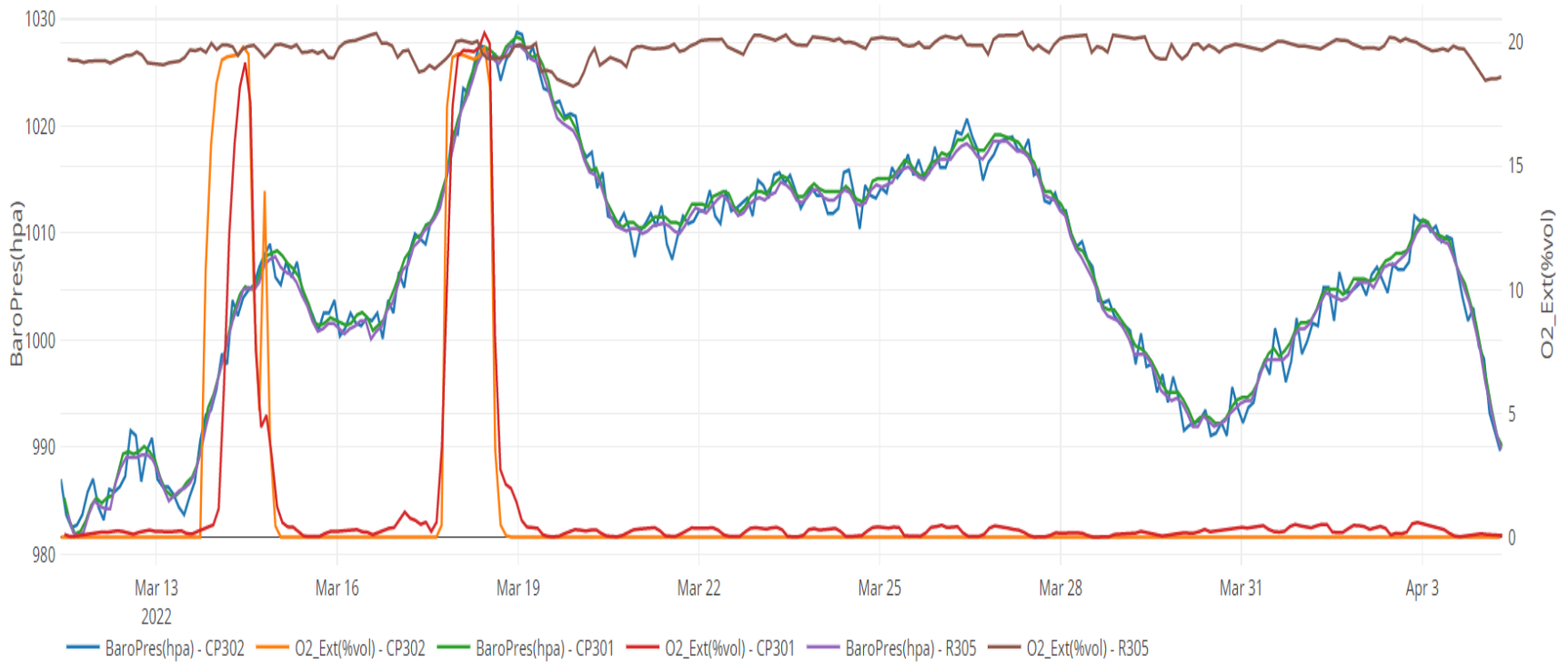


FIGURE 4 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & GAS FLOW RATES

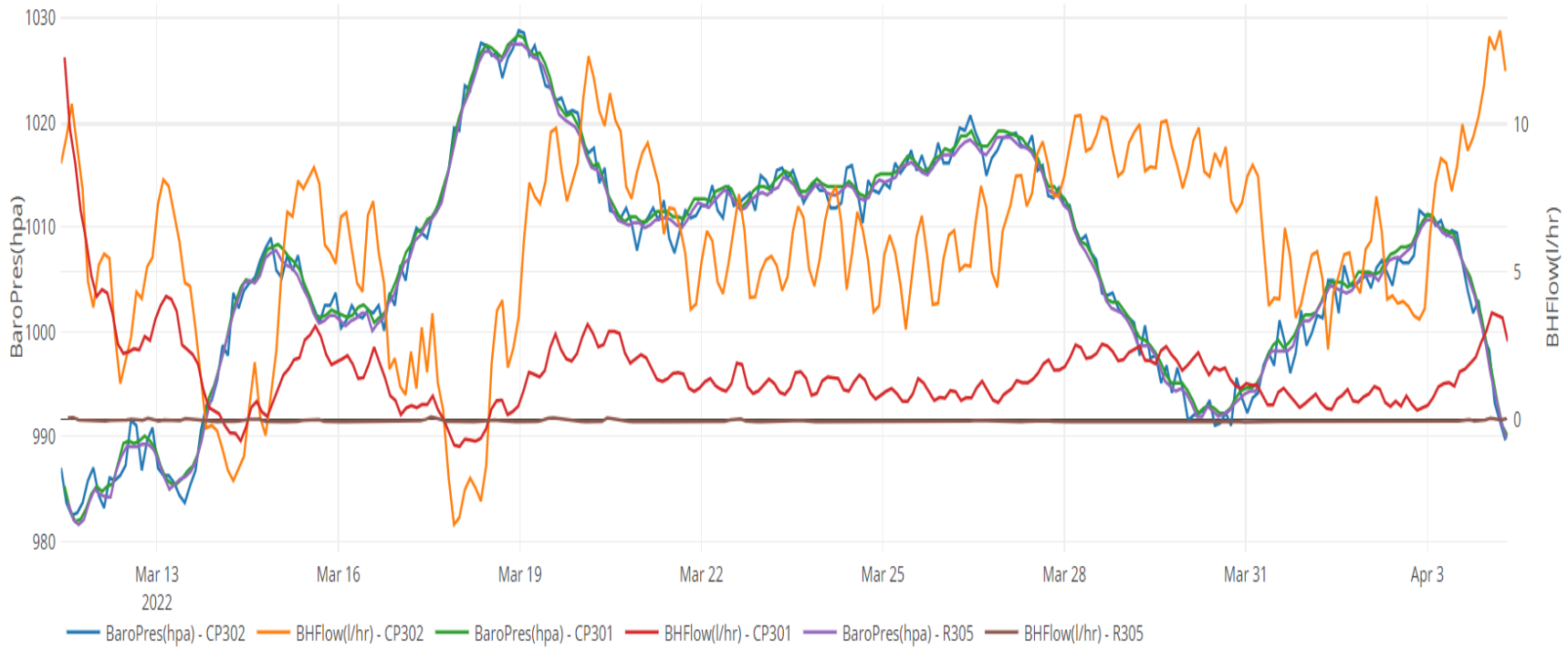


FIGURE 5 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & CARBON MONOXIDE CONCENTRATIONS

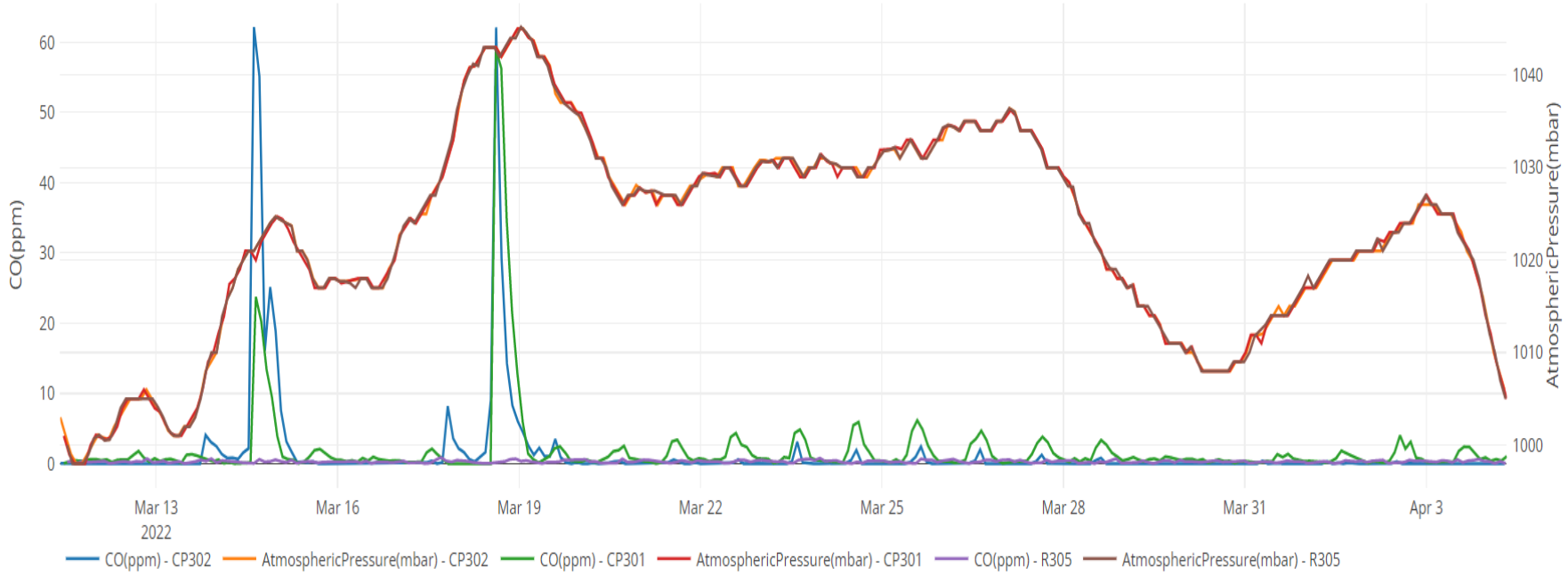


FIGURE 6 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & HYDROGEN SULPHIDE CONCENTRATIONS

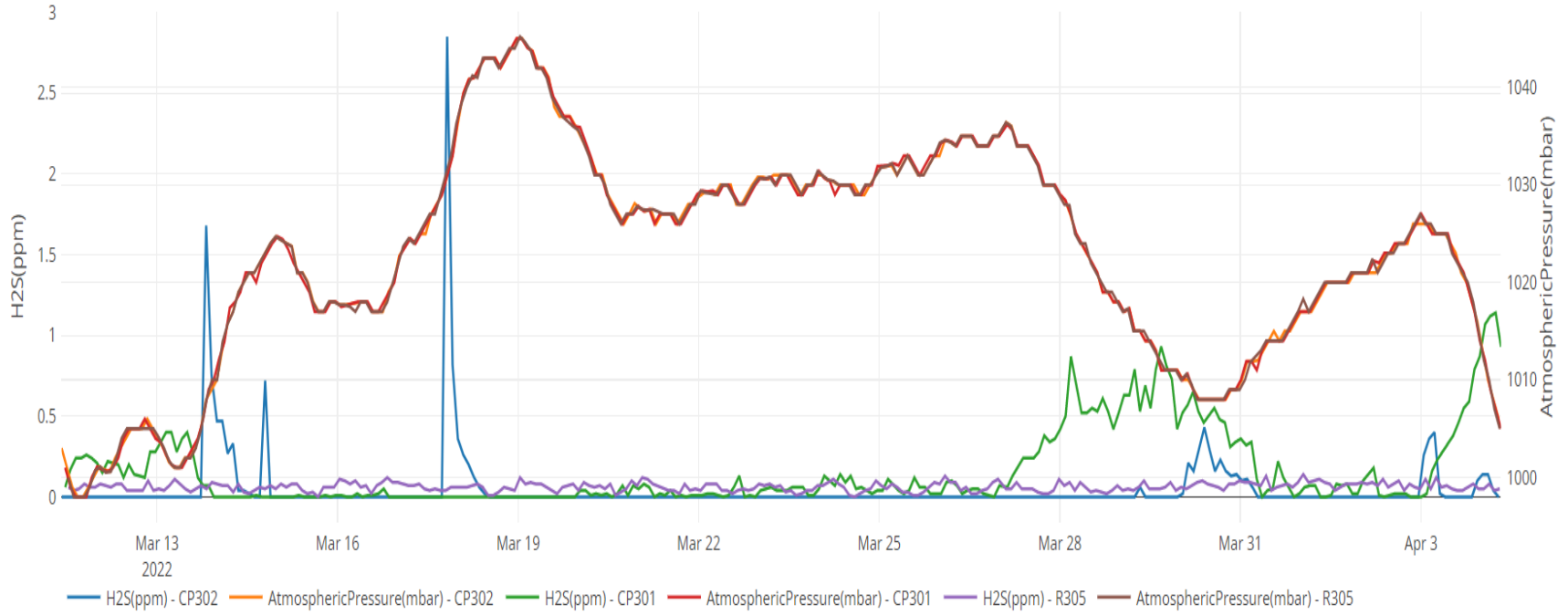


FIGURE 7 – TIME SERIES DECOMPOSITION – VOC CONCENTRATIONS

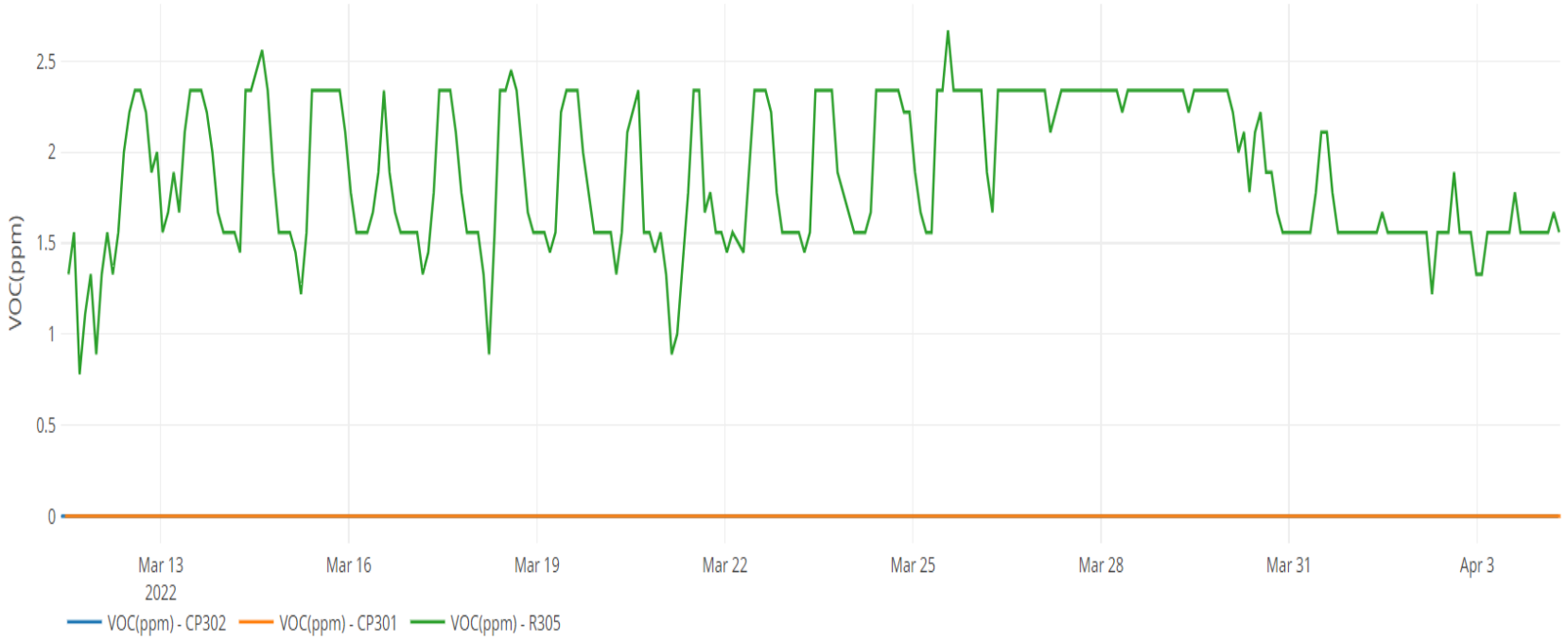


FIGURE 8 – TIME SERIES DECOMPOSITION – GSV for METHANE

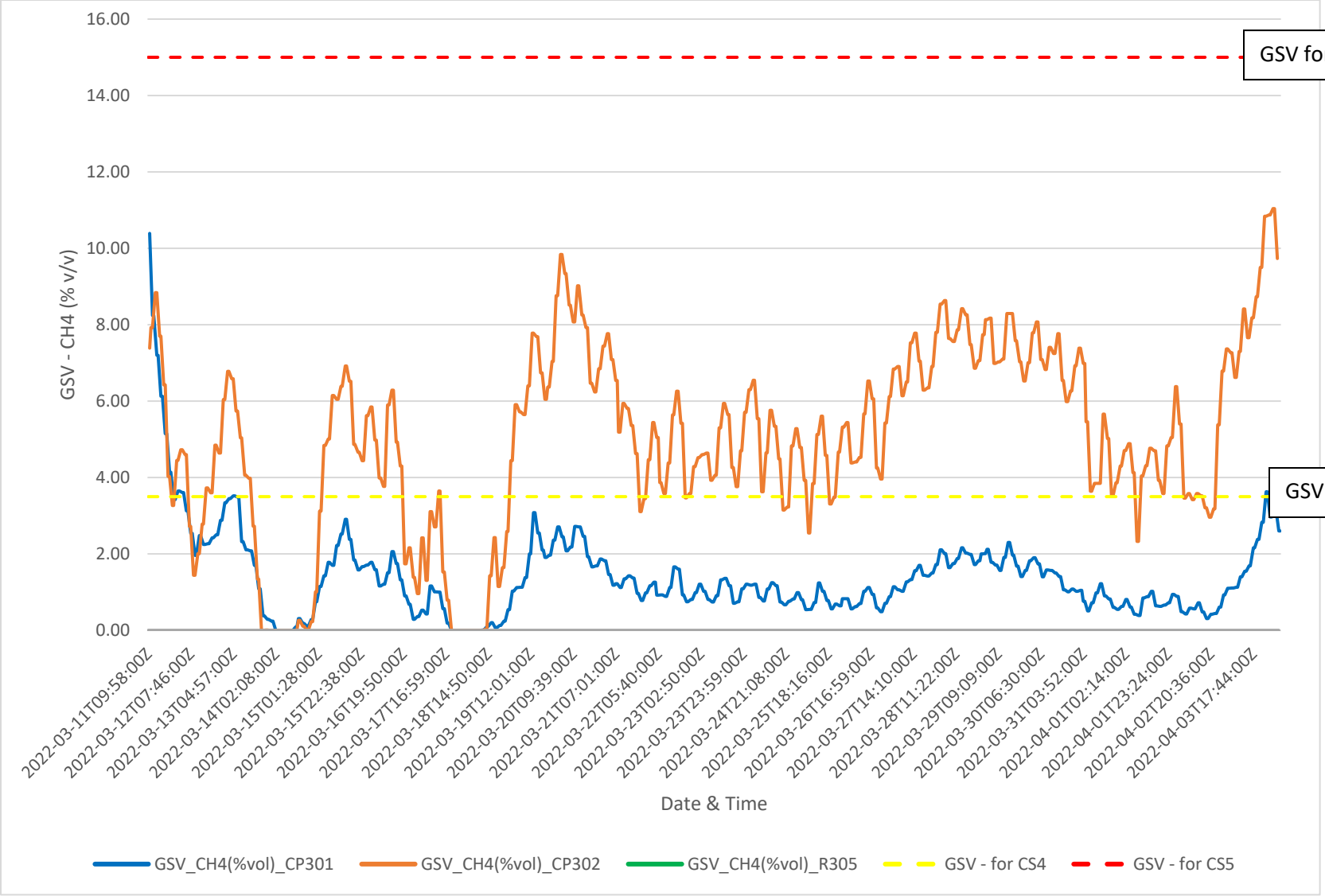
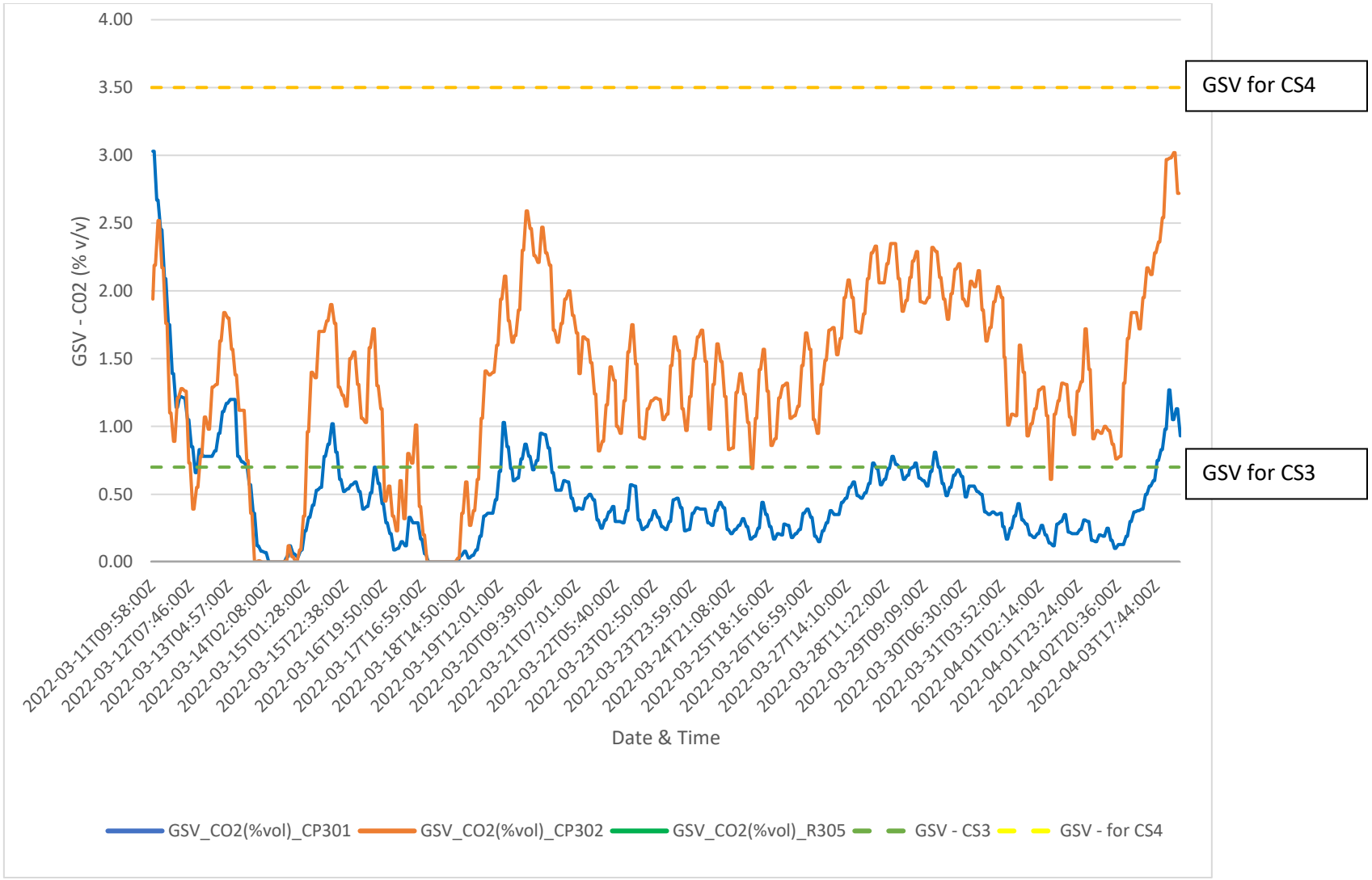


FIGURE 9 – TIME SERIES DECOMPOSITION – GSV FOR CARBON DIOXIDE



APPENDIX E

GROUND GAS AND GROUNDWATER MONITORING DATA SHEETS

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Lidl GB Ltd
Site: Centre 27, Birstall
Date: 24/02/2022
Job No: C8781
Visit No: 1 **of** 5
Operator: AW
Project Manager: AW

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA			Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady								
RO301	**78.6**	78.6	>>>	>>>	9.6	**9.5**	6	3	ND	ND	ND	ND	NR	NR	ND	ND	ND	ND	0.0786	0.0095	4.32	4.83	1 - 5m - Landfill Material	
RO302	**ND**	ND	ND	ND	3.5	**3.5**	12	10	ND	ND	12.4	12.4	NR	NR	ND	ND	ND	ND	0.0001	0.0035	DRY	4.70	2.0 - 5.0m - Landfill Material	
RO303	**ND**	ND	ND	ND	0.5	**0.5**	6	5	1	ND	18.4	18.4	NR	NR	ND	ND	ND	ND	0.0001	0.0005	1.70	4.87	1.0 - 5.0m - Cohesive Made Ground	
RO304	**16.8**	16.8	>>>	>>>	1.6	**1.6**	12	10	1	ND	8.8	8.8	NR	NR	ND	ND	ND	ND	0.0168	0.0016	2.30	4.82	1.5 - 5.0m Landfill Material	
RO305	**ND**	ND	ND	ND	0.1	**0.1**	10	6	2	ND	15.2	15.2	NR	NR	ND	ND	ND	ND	0.0001	0.0001	2.50	4.84	1.5 - 5.0m - Coal Measures	
CP301	**71.5**	71.5	>>>	>>>	15.2	**15.2**	12	10	ND	ND	0.4	0.4	NR	NR	ND	ND	ND	ND	0.0715	0.0152	3.97	8.67	2.0 - 8.7m - Landfill Material	
CP302	**84.1**	84.1	>>>	>>>	4.0	**4.0**	10	5	ND	ND	0.2	0.2	NR	NR	3.7	3.7	20.0	ND	3.1117	0.1480	4.67	8.88	2.0 - 10.0m - Landfill Material	
Max	**84.1**	**84.1**	**>>>**	**>>>**	**15.2**	**15.2**	**12**	**10**	**2**	**ND**	**18.4**	**18.4**	**NR**	**NR**	**3.7**	**3.7**	**20.0**	**ND**	**3.1117**	**0.1480**	**4.67**			
Min	**ND**	**ND**	**ND**	**ND**	**0.1**	**0.1**	**6**	**3**	**ND**	**ND**	**ND**	**ND**	**NR**	**NR**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0001**	**DRY**			

ND - Not detected

NR - Not recorded

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

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:	X	Dry		Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:		None	X	Slight		Cloudy		Overcast		
Precipitation:	X	None		Slight		Moderate		Heavy		
Time monitoring performed:			13:00	Start			14:30	End		
Barometric pressure (mbar):			982	Start			982	End		
Pressure trend (Daily):				Falling	X	Steady		Rising		
Source:	https://www.timeanddate.com/weather/uk/leeds/historic									
Air Temperature (Deg. C):			2	Before			4	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM430 (BM36)
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last external calibration: 20/04/2021
Date of next external calibration: 20/04/2022
Date of last in-house calibration: 06/12/2021

Ambient air check: **CH_4** ND **CO_2** ND **O_2** 20.7

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Lidl GB Ltd **Job No:** C8781
Site: Centre 27, Birstall **Visit No:** 2 **of** 5
Date: 03/03/2022 **Operator:** WW **Project Manager:** AW

Monitoring Point	GAS CONCENTRATIONS: Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		VOLATILES: PID Peak (ppm)	Product thickness (mm)	FLOW DATA: Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Qhg per borehole: Methane (l/hr)	CO2 (l/hr)	WELL AND WATER DATA: Water level (mbgl)	Depth of well (m)	Response Zone	Comments
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady								
RO301	**82.3**	82.3	>>>	>>>	11.6	**11.6**	5	1	1	ND	ND	ND	NR	ND	ND	ND	ND	ND	0.0823	0.0116	4.34	4.83	1 - 5m - Landfill Material	
RO302	**ND**	ND	ND	ND	4.7	**4.7**	5	3	ND	ND	11.4	11.4	NR	ND	ND	ND	ND	ND	0.0001	0.0047	4.51	4.70	2.0 - 5.0m - Landfill Material	
RO303	**ND**	ND	ND	ND	0.9	**0.9**	5	1	1	ND	17.4	17.4	NR	ND	ND	ND	ND	ND	0.0001	0.0009	3.86	4.87	1.0 - 5.0m - Cohesive Made Ground	
RO304	**13.0**	13.0	>>>	>>>	3.2	**3.2**	3	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	ND	0.0130	0.0032	2.51	4.82	1.5 - 5.0m Landfill Material	
RO305	**ND**	ND	ND	ND	1.8	**1.8**	3	ND	1	ND	15.6	15.6	NR	ND	ND	ND	ND	ND	0.0001	0.0018	2.44	4.84	1.5 - 5.0m - Coal Measures	
CP301	**82.0**	82.0	>>>	>>>	7.2	**7.2**	3	ND	1	ND	ND	ND	NR	ND	23.4	21.0	242.0	120.0	19.1880	1.5120	3.48	8.67	2.0 - 8.7m - Landfill Material	
CP302	**85.7**	85.7	>>>	>>>	5.7	**5.7**	5	1	ND	ND	ND	ND	NR	ND	3.9	3.9	24.0	ND	3.3423	0.2223	5.02	8.88	2.0 - 10.0m - Landfill Material	
Max	**85.7**	**85.7**	**>>>**	**>>>**	**11.6**	**11.6**	**5**	**3**	**1**	**ND**	**17.4**	**17.4**	**NR**	**ND**	**23.4**	**21.0**	**242.0**	**120**	**19.1880**	**1.5120**	**5.02**			
Min	**ND**	**ND**	**ND**	**ND**	**0.9**	**0.9**	**3**	**ND**	**ND**	**ND**	**ND**	**ND**	**NR**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0009**	**2.44**			

ND - Not detected

NR - Not recorded

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

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:		Dry	X	Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:		None		Slight		Cloudy	X	Overcast		
Precipitation:	X	None		Slight		Moderate		Heavy		
Time monitoring performed:			14:20	Start			15:40	End		
Barometric pressure (mbar):			995	Start			993	End		
Pressure trend (Daily):			X	Falling		Steady		Rising		
Source:	https://www.timeanddate.com/weather/uk/leeds/historic									
Air Temperature (Deg. C):			7	Before			7	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM430 (BM36)
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last external calibration: 20/04/2021 **Date of last in-house calibration:** 06/12/2021
Date of next external calibration: 20/04/2022

Ambient air check: **CH_4** ND **CO_2** ND **O_2** 20.7

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Lidl GB Ltd
Site: Centre 27, Birstall
Date: 24/03/2022
Job No: C8781
Visit No: 3 **of** 5
Operator: WW
Project Manager: AW

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA			Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady								
RO301	**81.5**	81.5	>>>	>>>	11.8	**11.8**	6	3	2	ND	ND	ND	1	ND	ND	ND	ND	ND	0.0815	0.0118	4.54	4.83	1 - 5m - Landfill Material	
RO302	**ND**	ND	ND	ND	8.2	**8.2**	3	1	1	ND	12.6	12.6	ND	ND	ND	ND	ND	ND	0.0001	0.0082	4.68	4.70	2.0 - 5.0m - Landfill Material	
RO303	**ND**	ND	ND	ND	2.1	**2.1**	3	1	2	ND	17.9	17.9	ND	ND	ND	ND	ND	ND	0.0001	0.0021	4.74	4.87	1.0 - 5.0m - Cohesive Made Ground	
RO304	**24.4**	24.4	>>>	>>>	4.8	**4.8**	5	1	1	ND	ND	ND	2	ND	ND	ND	ND	ND	0.0244	0.0048	2.96	4.82	1.5 - 5.0m Landfill Material	
RO305	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	4.84	1.5 - 5.0m - Coal Measures	Continuous monitoring data
CP301	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	8.67	2.0 - 8.7m - Landfill Material	Continuous monitoring data
CP302	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	8.88	2.0 - 10.0m - Landfill Material	Continuous monitoring data
BH202	**67.8**	67.8	>>>	>>>	33.2	**33.2**	5	3	1	ND	ND	ND	1.4	ND	ND	ND	ND	ND	0.0678	0.0332	5.20	9.50	1.0 - 9.5m - Landfill Material	
BH203	**71.0**	71.0	>>>	>>>	14.6	**14.6**	5	3	2	ND	ND	ND	2.3	ND	ND	ND	ND	ND	0.0710	0.0146	3.20	6.60	2.0 - 7.5m - Landfill Material	
RH211	**83.9**	83.9	>>>	>>>	16.2	**16.2**	5	3	2	ND	ND	ND	ND	ND	4.5	4.5	28.0	ND	3.7755	0.7290	7.80	11.73	1.5 - 12.0m - Cohesive Made Ground & Landfill Material	
Max	**83.9**	**83.9**	**>>>**	**>>>**	**33.2**	**33.2**	**6**	**3**	**2**	**ND**	**17.9**	**17.9**	**2.3**	**ND**	**4.5**	**4.5**	**28.0**	**ND**	**3.7755**	**0.7290**	**7.80**			
Min	**ND**	**ND**	**ND**	**ND**	**2.1**	**2.1**	**3**	**1**	**1**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0021**	**2.96**			

ND - Not detected

NR - Not recorded

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

METEOROLOGICAL AND SITE INFORMATION:

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

State of ground:	X	Dry		Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:	X	None		Slight		Cloudy		Overcast		
Precipitation:	X	None		Slight		Moderate		Heavy		
Time monitoring performed:			12:30	Start			14:00	End		
Barometric pressure (mbar):			1010	Start			1007	End		
Pressure trend (Daily):				Falling		Steady	x	Rising		
Source:	https://www.timeanddate.com/weather/uk/leeds/historic									
Air Temperature (Deg. C):			15	Before			17	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM430 (BM36)
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last external calibration: 20/04/2021 **Date of last in-house calibration:** 06/12/2021
Date of next external calibration: 20/04/2022

Ambient air check: **CH_4** ND **CO_2** ND **O_2** 20.7

PID:
Calibrated range: 5
Calibration gas: Benzene C6H6
Response time: 2 seconds
Accuracy: (+/-) 3% displayed reading
Date of last external calibration: 03/07/2021 **Date of last in-house calibration:** 06/12/2021
Date of next external calibration: 02/07/2022

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Lidl GB Ltd
Site: Centre 27, Birstall
Date: 01/04/2022
Job No: C8781
Visit No: 4 **of** 5
Operator: JC
Project Manager: AW

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA			Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady								
RO301	**81.2**	81.2	>>>	>>>	11.2	**11.2**	6	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0812	0.0112	4.47	4.83	1 - 5m - Landfill Material	
RO302	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	4.70	2.0 - 5.0m - Landfill Material	
RO303	**ND**	ND	ND	ND	0.7	**0.7**	3	1	1	ND	17.7	17.7	ND	ND	ND	ND	ND	ND	0.0001	0.0007	4.79	4.87	1.0 - 5.0m - Cohesive Made Ground	
RO304	**24.8**	24.8	>>>	>>>	2.2	**2.2**	6	1	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	0.0248	0.0022	2.98	4.82	1.5 - 5.0m Landfill Material	
RO305	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	4.84	1.5 - 5.0m - Coal Measures	Continuous monitoring data
CP301	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	8.67	2.0 - 8.7m - Landfill Material	Continuous monitoring data
CP302	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	8.88	2.0 - 10.0m - Landfill Material	Continuous monitoring data
BH202	**80.5**	80.5	>>>	>>>	11.0	**11.0**	6	3	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	0.0805	0.0110	5.12	9.50	1.0 - 9.5 - Landfill Material	
BH203	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	6.60	2.0 - 7.5m - Landfill Material	Well destroyed.
RH211	**83.8**	83.8	>>>	>>>	10.5	**10.5**	6	2	ND	ND	ND	ND	ND	ND	2.5	2.5	24.0	60	2.0950	0.2625	7.40	11.73	1.5 - 12.0m - Cohesive Made Ground & Landfill Material	
Max	**83.8**	**83.8**	**>>>**	**>>>**	**11.2**	**11.2**	**6**	**3**	**1**	**ND**	**17.7**	**17.7**	**1.2**	**ND**	**2.5**	**2.5**	**24.0**	**60**	**2.0950**	**0.2625**	**7.40**			
Min	**ND**	**ND**	**ND**	**ND**	**0.7**	**0.7**	**3**	**1**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0007**	**2.98**			

ND - Not detected

NR - Not recorded

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

METEOROLOGICAL AND SITE INFORMATION:

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

State of ground:		Dry	X	Moist		Wet		Snow		Frozen
Wind:		Calm	X	Light		Moderate		Strong	
Cloud cover:		None	X	Slight		Cloudy		Overcast	
Precipitation:		None	X	Slight		Moderate		Heavy	
Time monitoring performed:			13:00	Start			14:20	End	
Barometric pressure (mbar):			999	Start			997	End	
Pressure trend (Daily):				Falling		Steady	X	Rising	
Source:	https://www.timeanddate.com/weather/@2655593/historic								
Air Temperature (Deg. C):			12	Before			11	After	

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM430 (BM36)
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last external calibration: 20/04/2021
Date of next external calibration: 20/04/2022
Date of last in-house calibration: 30/03/2022

Ambient air check: **CH_4** ND **CO_2** ND **O_2** 20.1

PID:
Calibrated range: 5
Calibration gas: Benzene C6H6
Response time: 2 seconds
Accuracy: (+/-) 3% displayed reading
Date of last external calibration: 20/04/2021
Date of next external calibration: 20/04/2022
Date of last in-house calibration: 30/03/2022

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Lidl GB Ltd
Site: Centre 27, Birstall
Date: 14/04/2022
Job No: C8781
Visit No: 5 **of** 5
Operator: CP
Project Manager: AW

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA			Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady								
RO301	**75.4**	75.4	>>>	>>>	24.5	**24.5**	4	4	2	2	ND	ND	ND	ND	0.5	0.5	2.0	60	0.3770	0.1225	4.61	4.83	1 - 5m - Landfill Material	
RO302	**ND**	ND	ND	ND	5.2	**5.2**	ND	ND	ND	ND	15.9	15.9	ND	ND	ND	ND	ND	ND	0.0001	0.0052	4.66	4.70	2.0 - 5.0m - Landfill Material	
RO303	**ND**	ND	ND	ND	1.2	**1.2**	ND	ND	ND	ND	19.6	19.6	ND	ND	ND	ND	ND	ND	0.0001	0.0012	4.74	4.87	1.0 - 5.0m - Cohesive Made Ground	
RO304	**26.9**	26.9	>>>	>>>	4.3	**4.3**	2	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0269	0.0043	2.97	4.82	1.5 - 5.0m Landfill Material	
RO305	**ND**	ND	ND	ND	2.7	**2.7**	ND	ND	ND	ND	15.3	15.3	ND	ND	ND	ND	ND	ND	0.0001	0.0027	2.83	4.84	1.5 - 5.0m - Coal Measures	
CP301	**82.9**	82.9	>>>	>>>	9.4	**9.4**	2	2	ND	ND	ND	ND	0.5	ND	19.5	19.5	147.0	60	16.1655	1.8330	3.87	8.67	2.0 - 8.7m - Landfill Material	
CP302	**85.2**	85.2	>>>	>>>	9.1	**9.1**	4	4	1	1	ND	ND	0.7	1	11.5	11.5	82.0	90	9.7980	1.0465	5.37	8.88	2.0 - 10.0m - Landfill Material	
BH202	**13.3**	13.3	>>>	>>>	4.3	**4.3**	1	1	ND	ND	15.2	15.2	ND	ND	ND	ND	ND	ND	0.0133	0.0043	5.18	9.50	1.0 - 9.5 - Landfill Material	
BH203	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	6.60	2.0 - 7.5m - Landfill Material	
RH211	**80.5**	80.5	>>>	>>>	18.9	**18.9**	1	1	3	3	ND	ND	0.2	ND	0.5	0.5	ND	ND	0.4025	0.0945	7.93	11.73	1.5 - 12.0m - Cohesive Made Ground & Landfill Material	
Max	**85.2**	**85.2**	**>>>**	**>>>**	**24.5**	**24.5**	**4**	**4**	**3**	**3**	**19.6**	**19.6**	**0.7**	**0.7**	**19.5**	**19.5**	**147.0**	**90**	**16.1655**	**1.8330**	**7.93**			
Min	**ND**	**ND**	**ND**	**ND**	**1.2**	**1.2**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0012**	**2.83**			

ND - Not detected

NR - Not recorded

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

METEOROLOGICAL AND SITE INFORMATION:

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

State of ground:	X	Dry		Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:		None	X	Slight		Cloudy		Overcast		
Precipitation:	X	None		Slight		Moderate		Heavy		
Time monitoring performed:			13:00	Start			14:30	End		
Barometric pressure (mbar):			1022	Start			1022	End		
Pressure trend (Daily):				Falling	X	Steady		Rising		
Source:	https://www.timeanddate.com/weather/@2655593/historic									
Air Temperature (Deg. C):			16	Before			17	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM430 (BM36)
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last external calibration: 20/04/2021 **Date of last in-house calibration:** 30/03/2022
Date of next external calibration: 20/04/2022

Ambient air check: **CH_4** ND **CO_2** ND **O_2** 20.2

PID:
Calibrated range: 5
Calibration gas: Benzene C6H6
Response time: 2 seconds
Accuracy: (+/-) 3% displayed reading
Date of last external calibration: 20/04/2021 **Date of last in-house calibration:** 30/03/2022
Date of next external calibration: 20/04/2022

APPENDIX F

CALIBRATION CERTIFICATES

Calibration Certificate

Validation Unit 6091
DATE TIME : 16/02/2022 16:41
GUI VERSION : 0.3.28
Firmware VERSION : 1.3.28

Calibration Value

CO2_nc	17.374	396.6	984.7		
CH4_nc	20.086	399.8	984.7		
O2(exbrd)		91.492	43.2		
GaugPr		3.983	536.4		
BaroPr		2.095	-216.781		
VOC		1.138	55		
%RH		26.776	1.001		
CO		2.257	1027.4		
H2S		4.264	1025.8		
Generic2P		-75.2	670.044		
BH-flow	3212.706	109.344	822.4	22.788	2714.533

ModCalDate: 16/02/2022 16:38

CO2_nc

DATE TIME : 16/02/2022 13:50

	Ref	ADC	Value(information)	Error	Error %
Low	0	396.8	0.01	0.01	---
High	40	1086.4	39.7	-0.3	-0.75

CO2_nc sensor pass

CH4_nc

DATE TIME : 16/02/2022 13:50

	Ref	ADC	Value(information)	Error	Error %
Low	0	400.6	0.04	0.04	---
High	60	1678	59.5	-0.5	-0.83

CH4_nc sensor pass

O2(exbrd)

DATE TIME : 16/02/2022 13:50

	Ref	ADC	Value(information)	Error	Error %
Low	0	40	-0.04	-0.04	---
High	20.9	1980.4	21.2	0.3	1.44

O2(exbrd) sensor pass

GaugPr

DATE TIME : 16/02/2022 12:43

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	543.2	1.71	1.71	--
ref 1	-86	195.2	-85.66	0.34	-0.4

GaugPr sensor sensor pass

BaroPr

DATE TIME : 16/02/2022 12:43

	Ref	ADC	Value(information)	Error	Error %
Low	985.1	1846.6	984.9	-0.2	-0.02
High	779.4	1416	779.4	0	0

BaroPr sensor pass

VOC

DATE TIME : 23/12/2021 12:27

	Ref	ADC	Value(information)	Error	Error %
Low	0	67	-0.88	-0.88	---
High	100	183	102.3	2.3	2.3

VOC sensor pass

%RH

DATE TIME : 16/02/2022 13:13

	Ref	ADC	Value(information)	Error	Error %
Low	51.5	1466.6	50.2	-1.3	-2.52
High	15.8	908	16.86	1.06	6.71

%RH sensor pass

CO

DATE TIME : 16/02/2022 16:10

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	1028.8	0.62	0.62	--
ref 1	100	1249.6	98.46	-1.54	-1.54

CO sensor sensor pass

H2S

DATE TIME : 16/02/2022 16:10

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	1031	1.22	1.22	--
ref 1	25	1137.8	26.26	1.26	5.04

H2S sensor sensor pass

BH-flow

	Ref	ADC	Value(information)	Error	Error %
Low1	0	821	-0.01	-0.01	---
Low2	18	2794	18.03	0.03	0.17
High3	30	3401.2	30.12	0.12	0.4
High4	48	3810.4	48.1	0.1	0.21

BH-flow sensor pass

Signed By: **R. Hill**

16/02/2022

Calibration Certificate

Validation Unit 6125
DATE TIME : 15/12/2021 13:36
GUI VERSION : 0.3.28
Firmware VERSION : 1.3.40

Calibration Value

CO2_nc	17.745	396.8	1027.3		
CH4_nc	21.301	400.6	1027.3		
O2(exbrd)		94.153	115.6		
GaugPr		4.077	531.8		
BaroPr		2.081	-199.195		
VOC		1.24	53		
%RH		29.127	0.992		
CO		4.495	1020		
H2S		10.319	1021.6		
Generic2P		-75.52	1086.16		
BH-flow	3206.462	112.366	833.4	23.233	2715.8

ModCalDate: 14/12/2021 17:50

CO2_nc

DATE TIME : 14/12/2021 17:41

	Ref	ADC	Value(information)	Error	Error %
Low	0	396.8	0	0	---
High	40	1102.4	39.88	-0.12	-0.3

CO2_nc sensor pass

CH4_nc

DATE TIME : 14/12/2021 17:41

	Ref	ADC	Value(information)	Error	Error %
Low	0	400.4	-0.01	-0.01	---
High	60	1765.6	60.18	0.18	0.3

CH4_nc sensor pass

O2(exbrd)

DATE TIME : 14/12/2021 17:41

	Ref	ADC	Value(information)	Error	Error %
Low	0	95.2	-0.22	-0.22	---
High	20.9	2093.4	21	0.1	0.48

O2(exbrd) sensor pass

GaugPr

DATE TIME : 14/12/2021 17:15

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	532.2	0.1	0.1	--
ref 1	-96.2	139	-96.34	-0.14	0.15

GaugPr sensor sensor pass

BaroPr

DATE TIME : 14/12/2021 17:15

	Ref	ADC	Value(information)	Error	Error %
Low	1026.9	1938	1027	0.1	0.01
High	770	1404.2	770.5	0.5	0.06

BaroPr sensor pass

VOC

DATE TIME : 14/12/2021 17:51

	Ref	ADC	Value(information)	Error	Error %
Low	0	53	0	0	---
High	100	177	101.2	1.2	1.2

VOC sensor pass

%RH

DATE TIME : 14/12/2021 17:30

	Ref	ADC	Value(information)	Error	Error %
Low	31.1	1179.2	30.7	-0.4	-1.29
High	0.1	642.8	1.24	1.14	1140

%RH sensor pass

CO

DATE TIME : 14/12/2021 17:48

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	1020.2	0.05	0.05	--
ref 1	100	1478.6	102.04	2.04	2.04

CO sensor sensor pass

H2S

DATE TIME : 14/12/2021 17:48

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	1021	-0.06	-0.06	--
ref 1	25	1281.6	25.16	0.16	0.64

H2S sensor sensor pass

BH-flow

	Ref	ADC	Value(information)	Error	Error %
Low1	0	825.6	-0.07	-0.07	---
Low2	18	2852.6	17.97	-0.03	-0.17
High3	30	3424.4	30.5	0.5	1.67
High4	48	3871.6	49.76	1.76	3.67

BH-flow sensor pass

Signed By: **R. Hill**

15/12/2021

Calibration Certificate

Validation Unit 6134
DATE TIME : 01/11/2021 16:45
GUI VERSION : 0.3.28
Firmware VERSION : 1.3.40

Calibration Value

CO2_nc	17.567	398.2	1021.6		
CH4_nc	20.875	396.8	1021.6		
O2(exbrd)		94.382	3		
GaugPr		4.092	530.8		
BaroPr		2.077	-190.851		
VOC		1.03	54		
%RH		38.434	0.54		
CO		3.594	1021		
H2S		7.632	1021.6		
Generic2P		-74.96	1076.94		
BH-flow	3293.325	115.211	807.199	23.711	2781.666

ModCalDate: 01/11/2021 16:38

CO2_nc

DATE TIME : 01/11/2021 16:21

	Ref	ADC	Value(information)	Error	Error %
Low	0	398.4	0.01	0.01	---
High	40	1078.4	40.46	0.46	1.15

CO2_nc sensor pass

CH4_nc

DATE TIME : 01/11/2021 16:21

	Ref	ADC	Value(information)	Error	Error %
Low	0	397.6	0.04	0.04	---
High	60	1690.2	60.44	0.44	0.73

CH4_nc sensor pass

O2(exbrd)

DATE TIME : 01/11/2021 16:21

	Ref	ADC	Value(information)	Error	Error %
Low	0	7.4	0.04	0.04	---
High	20.9	1974	20.9	0	0

O2(exbrd) sensor pass

GaugPr

DATE TIME : 01/11/2021 15:54

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	528	-0.68	-0.68	--
ref 1	-98.8	125.6	-99.02	-0.22	0.22

GaugPr sensor sensor pass

BaroPr

DATE TIME : 01/11/2021 15:54

	Ref	ADC	Value(information)	Error	Error %
Low	995.3	1876.6	995.4	0.1	0.01
High	774	1416.2	773.7	-0.3	-0.04

BaroPr sensor pass

VOC

DATE TIME : 01/11/2021 16:39

	Ref	ADC	Value(information)	Error	Error %
Low	0	54	0	0	---
High	100	157	100.9	0.9	0.9

VOC sensor pass

%RH

DATE TIME : 01/11/2021 16:18

	Ref	ADC	Value(information)	Error	Error %
Low	38.6	1238.8	37.5	-1.1	-2.85
High	24.8	933.2	24.8	0	0

%RH sensor pass

CO

DATE TIME : 01/11/2021 16:29

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	1024.4	0.94	0.94	--
ref 1	100	1383.2	100.78	0.78	0.78

CO sensor sensor pass

H2S

DATE TIME : 01/11/2021 16:29

	Ref	ADC	Value(information)	Error	Error %
ref 0	0	1023	0.18	0.18	--
ref 1	25	1216.6	25.54	0.54	2.16

H2S sensor sensor pass

BH-flow

	Ref	ADC	Value(information)	Error	Error %
Low1	0	801.8	-0.05	-0.05	---
Low2	18	2881.8	18.01	0.01	0.04
High3	30	3480.2	29.46	-0.54	-1.8
High4	48	3905.2	47.36	-0.64	-1.33

BH-flow sensor pass

Signed By: **R. Hill**

01/11/2021