GroundSolve Ltd
Consulting Geotechnical Engineers

LLANGOLLEN ROAD, ACREFAIR - GROUND GAS PROTECTION VERIFICATION REPORT - PLOTS 10, 11, 12, 12A(13) AND 14

GSL3116R06

VERSION 1

15 SEPTEMBER 2025

FINAL

Prepared for:

Gower Homes Ltd

Prepared by: Eve Rowland

GroundSolve Ltd

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This report has been prepared by GroundSolve Ltd with all reasonable care and diligence, within the best practice and guidance current at the time of issue within the proposed redline boundary and proposed Site end use as presented by the Client.

This report is confidential to the Client and GroundSolve Ltd accepts no responsibility whatsoever to third parties to whom this report is presented.

Version No.	Description of Issue / Revision	Date of Issue	Author	Reviewed & Approved By
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CONTENTS

1 INTRODUCTION 1
1.1 Report Objectives 1
1.2 Introduction 1
2 SITE DETAILS AND DESCRIPTION 2
3 GROUND GAS REGIME 3
3.1 Introduction 3
3.2 Protection Measures Detail 3
4 GROUND GAS VERIFICATION VISITS 5
5 SITE CERTIFICATION 6
6 REFERENCES 7
7 DEFINITIONS 8

LIST OF FIGURES

Figure 1 – Site Location Plan 2

LIST OF TABLES

Table 2.1 Current Site Overview. 2

APPENDICES

Appendix A – Drawings

Appendix B – Ground Gas Verification Visit Sheets

Appendix C– Current Guidance for Ground Gas Risk Assessment

Appendix D– Specification Sheets

1 INTRODUCTION

1.1 Report Objectives

GroundSolve Ltd was commissioned by Gower Homes Ltd to carry out a verification report for the installed ground gas protection measures for plots 10, 11, 12, 12A (Plot 13) and 14 at the former Air Products Site located at Llangollen Road, Acrefair, Wrexham, LL14 3HW. The purpose and objectives of this report is given below:

- To confirm that the measures have been implemented in accordance with the design protective of the site's gas situation.
- To verify that the protection measures implemented on site have been installed correctly without fault.

1.2 Introduction

GroundSolve Ltd were commissioned by Gower Homes Ltd to undertake 5 No. membrane verification visits to validate the gas protection measures which have been implemented on site for plots 10, 11, 12, 12A (Plot 13) and 14. Site verification visits were conducted between 17th and 24th of March 2025 by a suitably qualified GSL Engineer.

Verification works were conducted in accordance with all relevant guidance including:

- BS 8485:2015+A1:2019.
- CIRIA C735 (2014)
- CL:AIRE RB17 (2012)

All information given in this report is based on the ground conditions encountered during the site work and on the results of laboratory and field tests performed during the investigation. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations and water conditions between or below exploratory holes. It should be noted that groundwater levels, gas concentrations and gas flows usually vary due to seasonal, atmospheric and/or other effects and may at times differ to those measured during the investigation.

2 SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview.

Site name	Llangollen Road, Acrefair.
Site address	Llangollen Road, Acrefair, Wrexham, LL14 3HW.
National Grid Reference (NGR)	328158 , 343235.
Approximate Site area	 **Figure 1 – Site Location Plan**
Current land use on the Site	The site is currently in development to build new residential plots.
Surrounding land uses	The surrounding land use to the site is primarily residential and open space.
General topography and ground levels	The site is approx. 145m AOD in the northeast of the site falling to 137m AOD in the south of the site.
Published Geology	BGS map 121 1:50,000 of Wrexham and BGs GeoIndex details the site is not in an area of artificial Made Ground. The site is underlain by superficial deposits of Till, and bedrock of the Pennine Middle Coal Measures Formation. Previous third-party investigations were reviewed by GroundSolve as part of the Remediation Strategy produced for the site (report reference: GSL3059R01 dated 26th February 2024) detailed Made Ground on site although not detailed on published mapping.

3 GROUND GAS REGIME

3.1 Introduction

GroundSolve Ltd did not conduct any ground gas monitoring on site, however monitoring data has been provided, conducted by Earth Environmental & Geotechnical and WSP which have been reviewed in detail to ensure that the proposed ground gas regime recommended is in agreement with the opinions of GSL based on the data.

Site work has previously been conducted on site by third parties. Earth Environmental & Geotechnical (EEG) classified the site as CS1 based on their calculated Gas Screening Value (GSV) of 0.0074 which is within the CS1 threshold, however Table 8.5 in CIRIA C665 guidance states *consideration should be given to increasing the site's protection to CS2 if carbon dioxide concentrations are above 5% v/v or methane above 1% v/v.* GroundSolve reviewed the full monitoring data for the site conducted by EEG which detailed consistent carbon dioxide above 5% v/v .

WSP conducted 3 No. monitoring visits, however they did not conduct a ground gas risk assessment. The GSV calculated from their results also detailed the site as a CS1 scenario.

Following this review of the results from WSP and EEG it was determined by GroundSolve that the site should be classified as Characteristic Situation 2 – Low Risk Scenario for which ground gas protections measures are required in accordance with BS:8485:2015+A1:2019 and CIRIA C665 based on the consistently elevated carbon dioxide.

Based on the CS2 classification of the ground gas regime for the site; a ground gas protection scheme with a points score of 3.5 has been recommended in accordance with British Standard B8485:2015+A1:2019 which is protective of the Characteristic Situation applied to the site.

Basic radon protection measures are also required on the site.

3.2 Protection Measures Detail

The finalised protection measures to be implemented on site comprise:

- Floor Slab – 1.5 point:
    - 150mm cast in situ reinforced suspended floor slab.
- Pressure relief pathway – 0.5 points:
    - Very good performance – 100mm gravel layer with gas drains to the external of the building.
- Gas membrane – 2 points:

- Visqueen low permeability gas membrane suitable for CS2 and basic radon protection.
- Visqueen ultimate double-sided joining tape.
- Visqueen ultimate top hat units.
- Visqueen foil lap tape.

The gas protection measures installed on site equal 4.0 points, which exceeds the protective for the CS2 classification for the site. Drawings provided by the client outlining the design have been included within Appendix A.

4 GROUND GAS VERIFICATION VISITS

In total 5 No. verification visits have been conducted by GroundSolve Ltd to verify the installation of the protection measures at plots 10, 11, 12, 12A (Plot 13) and 14.

The ground gas protection measures were installed by Gower Homes Ltd site staff.

The membrane was inspected to ensure it was installation has been carried out in accordance with the agreed design scheme. The membrane was lapped by 100mm and sealed with Solco Double Sided Butyl Tape and Solco Gas Resistant Foil Backed Joint Tape. Lapped edges, seams and service entries were subject to integrity testing via mechanical picking to ensure a full, non-broken seal was in place.

Any defects or deviations from the design identified by the GSL engineer were recorded and highlighted to the site team/installers and remediated in the presence of the GSL engineer.

Site visit verification sheets detailing the works conducted are included within Appendix B**.**

5 SITE CERTIFICATION

Based on the site visits conducted on site by GroundSolve, it is considered that the implemented ground gas protection measures are acceptable and conform with the specification.

6 REFERENCES

AGS: 2010: Electronic transfer of geotechnical and geoenvironmental data (Edition 4 including addendum 3, 2011). Association of Geotechnical and Geoenvironmental Specialists.

BRE Special Digest 1: 2005 Concrete in aggressive ground.

BS 1377 : 1990 : Methods of test for soils for civil engineering purposes. Published in nine parts. British Standards Institution.

BS 5930 : 2015 + A1:2020 : Code of practice for site investigation. British Standards Institution.

BS 8485:2015+A1:2019 : Code of practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings.

BS 10175 : 2011 + A2:2017: Investigation of potentially contaminated sites – Code of Practice. British Standards Institution

BS EN 1997-1: 2004 : Eurocode 7 – Geotechnical Design – Part 1: General rules. Including UK National Appendix of November 2007. British Standards Institution.

BS EN ISO 14688-1 : 2002 : Geotechnical investigation and testing – Identification and classification of soil – Part 1: Identification and description. British Standards Institution.

BS EN ISO 14688-2 : 2018 : Geotechnical investigation and testing – Identification and classification of soil – Part 2: Principles for a classification. British Standards Institution.

BS EN ISO 14689 : 2018 : Geotechnical investigation and testing – Identification and classification of rock – Part 1: Identification and description. British Standards Institution.

BS EN ISO 22475-1 : 2006 : Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1: Technical principals for execution (July 2011 reprint). British Standards Institution.

BS EN ISO 22476-3 : 2005 : Geotechnical investigation and testing – Field Testing – Part 3: Standard penetration test

Britain From Above - https://britainfromabove.org.uk/en/image/WPW060399

http://www.warstateandsociety.com/Bombing-Britain

https://www.epa.gov/pfas/basic-information-pfas

UK Maps of Radon, http://www.ukradon.org/information/ukmaps

Health and Safety Executive (2015) Construction (Design and Management) Regulations.

Coal Authority Interactive Map Viewer, http://mapapps2.bgs.ac.uk/coalauthority/home.html

BGS Geology of Britain Viewer http://mapapps.bgs.ac.uk/geologyofbritain/home.html

CIRIA C665 Assessing risks posed by hazardous ground gases to buildings (2007)

NHBC Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (2007)

7 DEFINITIONS

AOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GQRA	Generic Quantitative Risk Assessment
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
ppm	Parts per million
ppmv	Parts per million by volume
SAC	Special Area of Conservation
SPZ	Source Protection Zone
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest

APPENDIX A – DRAWINGS

SITE PLAN

LLANGOLLEN ROAD

GWR

BOWLING GREEN

LANCASTER TERRACE / MAES DERWYDD

1
9
10

BIN COLLECTION AREA
plots 4 - 8
6M WIDE PRIVATE DRIVE

C FFL 52.55 5
HI FFL 51.95 4
C FFL 51.55 3
R FFL 51.15 2
HI FFL 50.60 1
B 6 FFL 52.80
F 7 FFL 53.00
C 8 FFL 52.50
F 9 FFL 51.90
FFL 50.80
B 10 FFL 51.00
R FFL 50.40 11
FFL 50.30

ESTABLISHED SOFT LANDSCAPE AREA TO BE RETAINED TO GIVE SOFT, NATURAL BORDER WITH MAES DERWYDD

Plots 10 and 11

OPEN SPACE AND SUDS ATTENUATION AREA

BIN COLLECTION AREA
plots 12 - 20

6M WIDE PRIVATE DRIVE

2m wide footpath link

6M WIDE PRIVATE DRIVE

PLOTS 17-21 INCLUSIVE TO FACE OUTWARDS ONTO LLANGOLLEN ROAD

R FFL 49.90 21
E FFL 49.90 20
E 19
E FFL 49.90 18
E 17
C FFL 49.80 15
B FFL 49.80 16
E FFL 49.80 14A
E 14
B FFL 49.85 12A
HI FFL 49.90 12

Plots 12, 12A (Plot 13) and Plot 14

51 53
50 52
43 45
42 44
17
14

0M 10 20 50M
SCALE BAR 1:500

EDGE ARCHITECTS

RIBA Chartered Practice

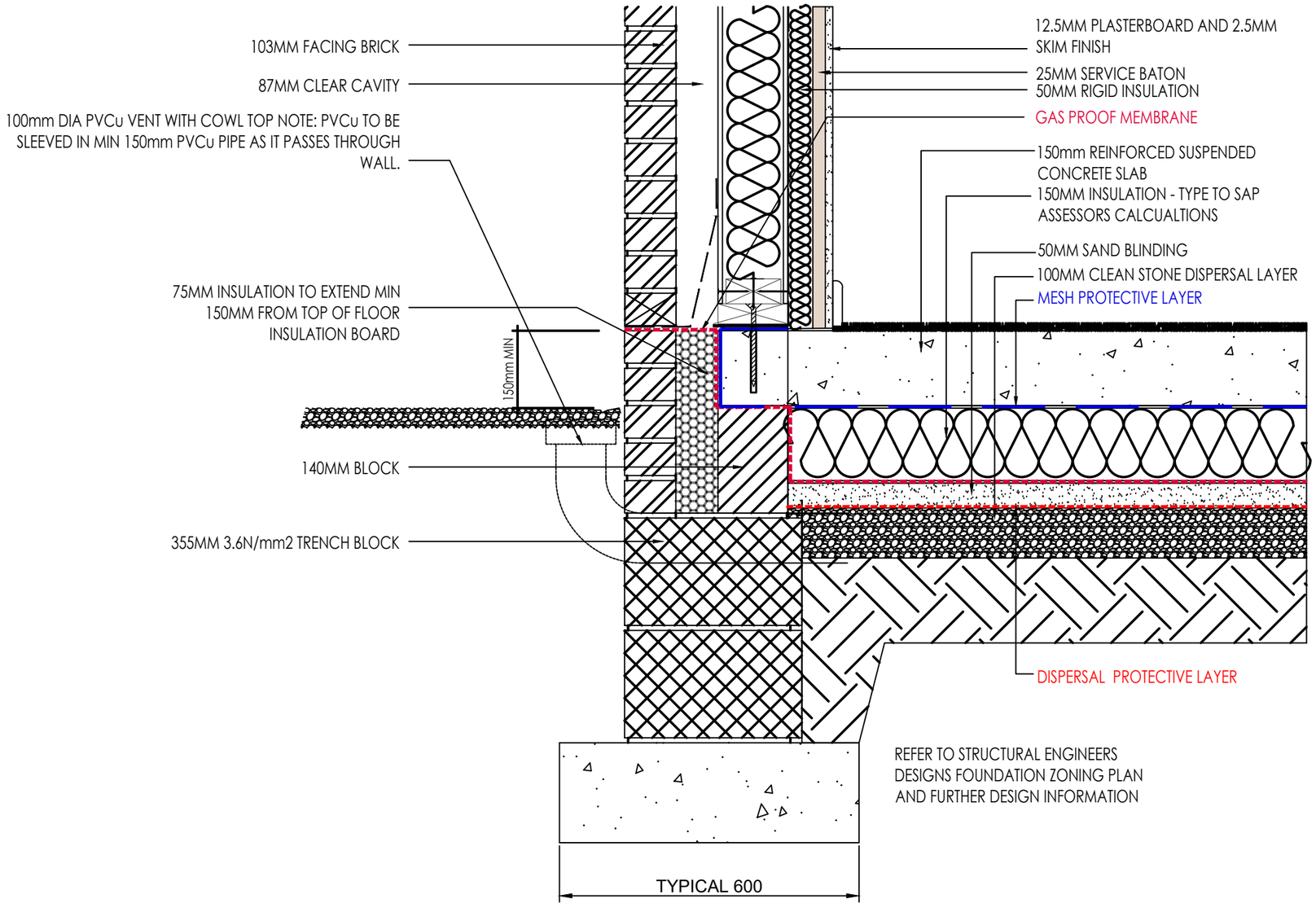
EDGE Architects NW Ltd.
Studio 55:20
North Wales Business Park, Abergele
Conwy, LL22 8LJ

CLIENT:
Gower Homes Ltd

ADDRESS:
Former Air Products site, Llangollen Road, Acrefair LL14 3HW

PROJECT:
Proposed residential development

DRAWING No: 21-DES-001-02 D
DATE: MARCH 2022
SCALE: 1:500 @ A3



VENTED GAS MEMBRANE PROTECTION DETAIL- LLANGOLLEN ROAD, ACREFAIR

EDGE ARCHITECTS

RIBA Chartered Practice
EDGE Architects NW Ltd.
Studio 55:20
North Wales Business Park, Abergele
Conwy, LL22 8LJ

CLIENT:
GOWER HOMES

HOUSETYPE:
BEAUMARIS

TITLE:
VENTED- GAS MEMBRANE PROTECTION DETAIL

DRAWING No:
DETAIL 002 - Rev A

DATE: MAY 2024

SCALE: 1:10 @ A3

APPENDIX B – GROUND GAS VERIFICATION VISIT SHEETS

GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	J Thorburn

GroundSolve Ltd Visual Inspection of Gas Protection Measures

Job Name:	Llangollen Road, Acrefair	**Gas Characteristic Situation:**	CS2 and basic radon protection
Job No.:	GSL3116 - PLOT10	**Development Type:**	Residential
Date:	17/06/2025	**Foundation type**	Piled
Visit By:	James Thorburn	**Passive or Active?**	Passive
Weather:	Partly cloudy	**Other Staff on Site:**	Gareth Evans – Gower Homes

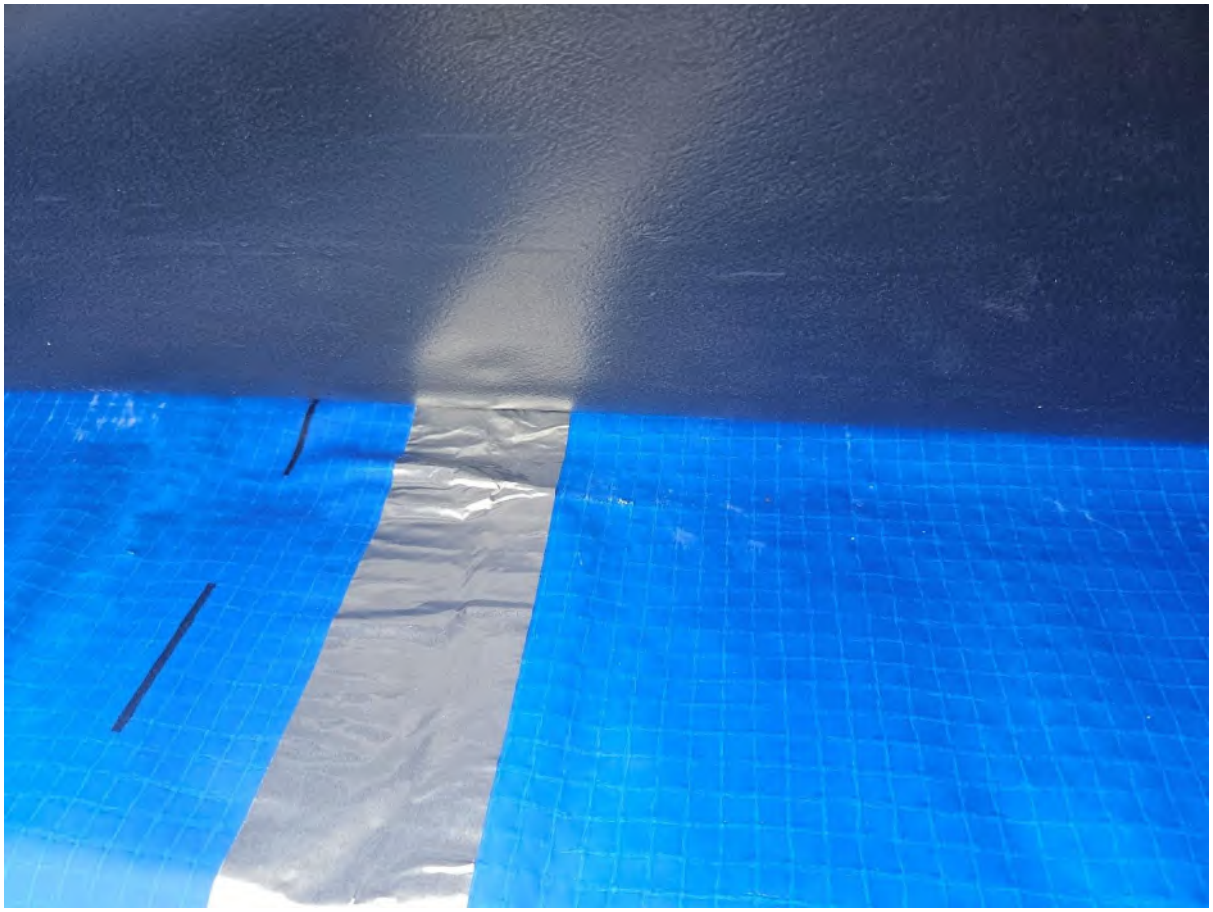
Assessment of Measures on Site

Verification Area		
• The verification visit conducted on the 17th June 2025 ahead of the plot 10 concrete slab pour.		
No.	**Item**	**Comment**
1 Gas Membrane		
1.1	Condition of sub-grade and underside of gas membrane	Subgrade in good condition, comprising; • 100mm of clean stone. • Terram dispersal protection membrane layer. • 50mm of sand blinding. • Gas membrane.
1.2	Gas membrane type	Solshield High-Performance Damp-Proof Membrane – Blue multi-layer low density reinforced polyethylene membrane
1.3	Gas membrane condition	The membrane was in good condition.
1.4	Joining tape product and or sealing technique used	Solco Double Sided Butyl Tape and Solco Gas Resistant Foil Backed Tape
1.5	Lapping design	100mm laps at membrane edges with double taped edges.
1.6	Laps, welds and joint seals	Well-sealed
1.7	Service entry seals	Sealed with Solco Gas Resistant Foil Backed Tape
2 Passive Venting		
2.1	Sub-floor void	A sub floor void has been installed comprising of 100mm of clean stone.
2.2	External wall airbricks	N/A
2.3	Internal sleeper walls	N/A
2.4	External air vents/ducts	The sub-floor void is connected to vents to the exterior of the buildings.
3 Active Venting		
3.1	System details	N/A – passive venting system in place.
Additional Notes		

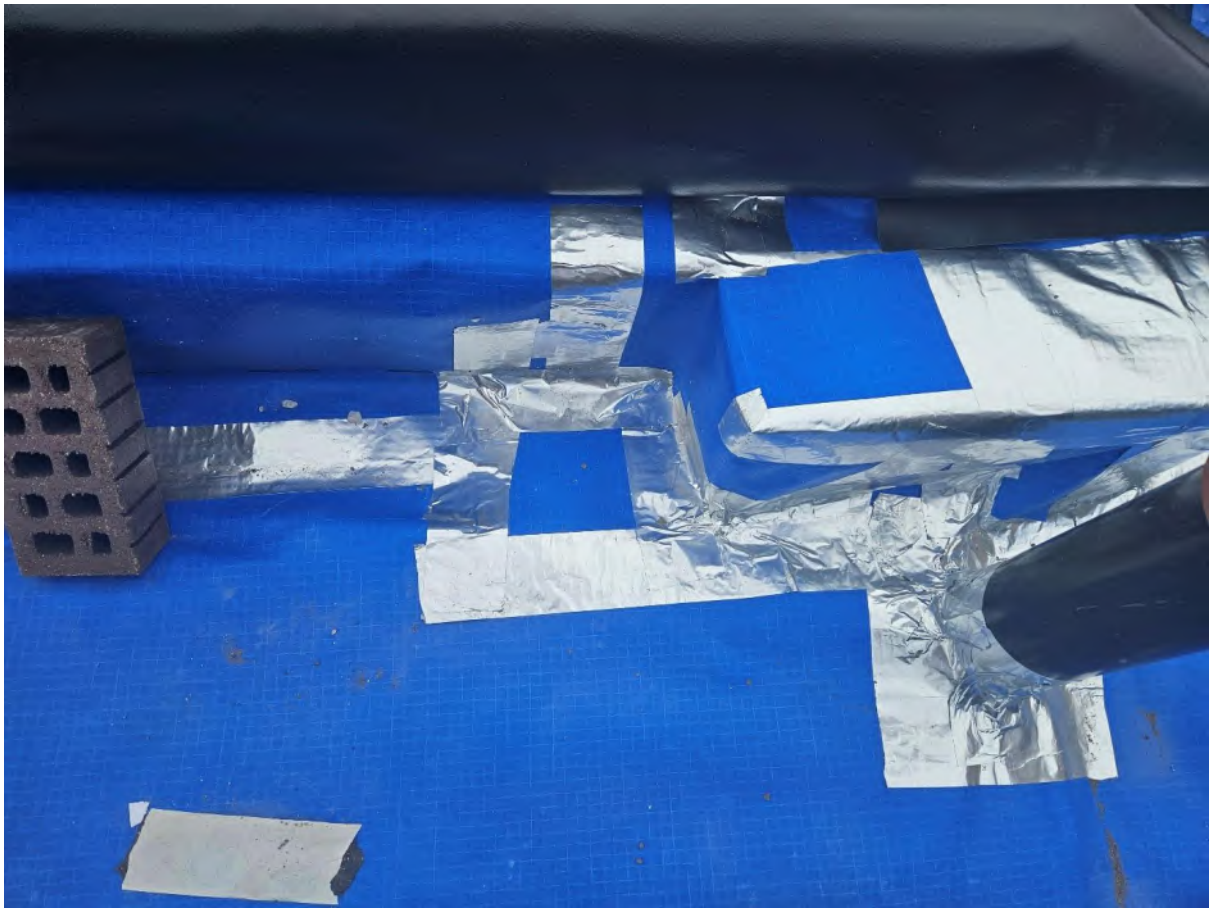
Conclusion
Plot 10 has been verified as acceptable and complies with the specification.



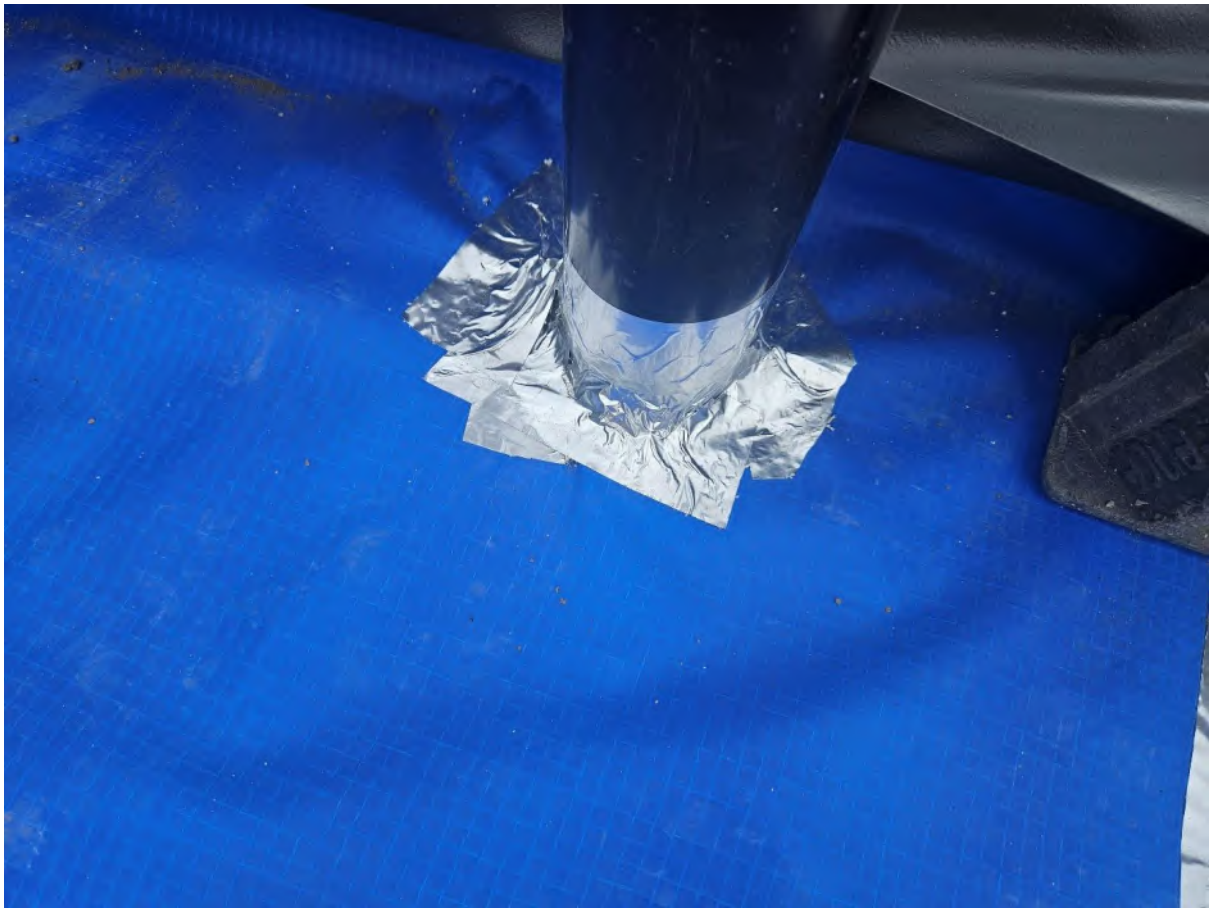
Photograph 1 – Overview of Plot 10



Photograph 2 – Well sealed double taped lapped edges



Photograph 3 – Well-formed corner details



Photograph 4 – Well sealed service entries

GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	J Thorburn

GroundSolve Ltd Visual Inspection of Gas Protection Measures

Job Name:	Llangollen Road, Acrefair	**Gas Characteristic Situation:**	CS2 and basic radon protection
Job No.:	GSL3116 - PLOT11	**Development Type:**	Residential
Date:	12/06/2025	**Foundation type**	Piled
Visit By:	James Thorburn	**Passive or Active?**	Passive
Weather:	Partly cloudy	**Other Staff on Site:**	Gareth Evans – Gower Homes

Assessment of Measures on Site

Verification Area		
• The verification visit conducted on the 12th June 2025 ahead of the plot 11 concrete slab pour.		
No.	**Item**	**Comment**
1 Gas Membrane		
1.1	Condition of sub-grade and underside of gas membrane	Subgrade in good condition, comprising; • 100mm of clean stone. • Terram dispersal protection membrane layer. • 50mm of sand blinding. • Gas membrane.
1.2	Gas membrane type	Solshield High-Performance Damp-Proof Membrane – Blue multi-layer low density reinforced polyethylene membrane
1.3	Gas membrane condition	The membrane was in good condition.
1.4	Joining tape product and or sealing technique used	Solco Double Sided Butyl Tape and Solco Gas Resistant Foil Backed Tape
1.5	Lapping design	100mm laps at membrane edges with double taped edges.
1.6	Laps, welds and joint seals	Well-sealed
1.7	Service entry seals	Sealed with Solco Gas Resistant Foil Backed Tape
2 Passive Venting		
2.1	Sub-floor void	A sub floor void has been installed comprising of 100mm of clean stone.
2.2	External wall airbricks	N/A
2.3	Internal sleeper walls	N/A
2.4	External air vents/ducts	The sub-floor void is connected to vents to the exterior of the buildings.
3 Active Venting		
3.1	System details	N/A – passive venting system in place.
Additional Notes		

Conclusion
Plot 11 has been verified as acceptable and complies with the specification.



Photograph 1 – Overview of Plot 11



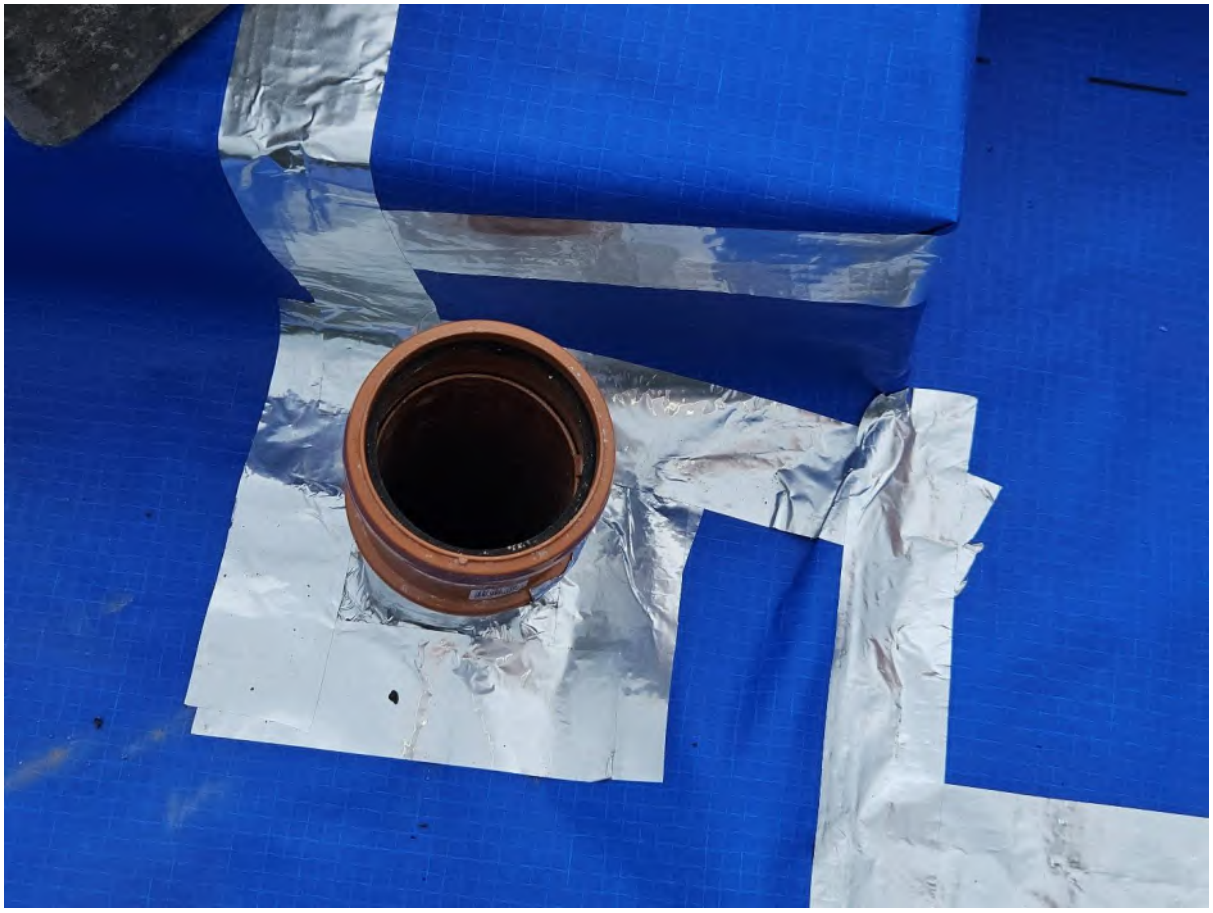
Photograph 2 – Well sealed double taped lapped edges



Photograph 3 – Well formed corner details



Photograph 4 – Well sealed service entries



Photograph 5 – Well sealed service entries and formed corner details.

GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	Eve Rowland

GroundSolve Ltd Visual Inspection of Gas Protection Measures

Job Name:	Llangollen Road, Acrefair	**Gas Characteristic Situation:**	CS2 and basic radon protection
Job No.:	GSL3116 - PLOT12+12A	**Development Type:**	Residential
Date:	11/07/2025	**Foundation type**	Piled
Visit By:	Eve Rowland	**Passive or Active?**	Passive
Weather:	Warm and Sunny	**Other Staff on Site:**	Gareth Evans – Gower Homes

Assessment of Measures on Site

Verification Area		
• The verification visit conducted on the 11th July 2025 ahead of the plot 12 and 12A (Plot 13) concrete slab pour.		
No.	**Item**	**Comment**
1 Gas Membrane		
1.1	Condition of sub-grade and underside of gas membrane	Subgrade in good condition, comprising; • 100mm of clean stone. • Terram dispersal protection membrane layer. • 50mm of sand blinding. • Gas membrane.
1.2	Gas membrane type	Solshield High-Performance Damp-Proof Membrane – Blue multi-layer low density reinforced polyethylene membrane
1.3	Gas membrane condition	The membrane was in good condition.
1.4	Joining tape product and or sealing technique used	Solco Double Sided Butyl Tape and Solco Gas Resistant Foil Backed Tape
1.5	Lapping design	100mm laps at membrane edges with double taped edges.
1.6	Laps, welds and joint seals	Well-sealed
1.7	Service entry seals	Sealed with Solco Gas Resistant Foil Backed Tape
2 Passive Venting		
2.1	Sub-floor void	A sub floor void has been installed comprising of 100mm of clean stone.
2.2	External wall airbricks	N/A
2.3	Internal sleeper walls	N/A
2.4	External air vents/ducts	The sub-floor void is connected to vents to the exterior of the buildings.
3 Active Venting		
3.1	System details	N/A – passive venting system in place.
Additional Notes		

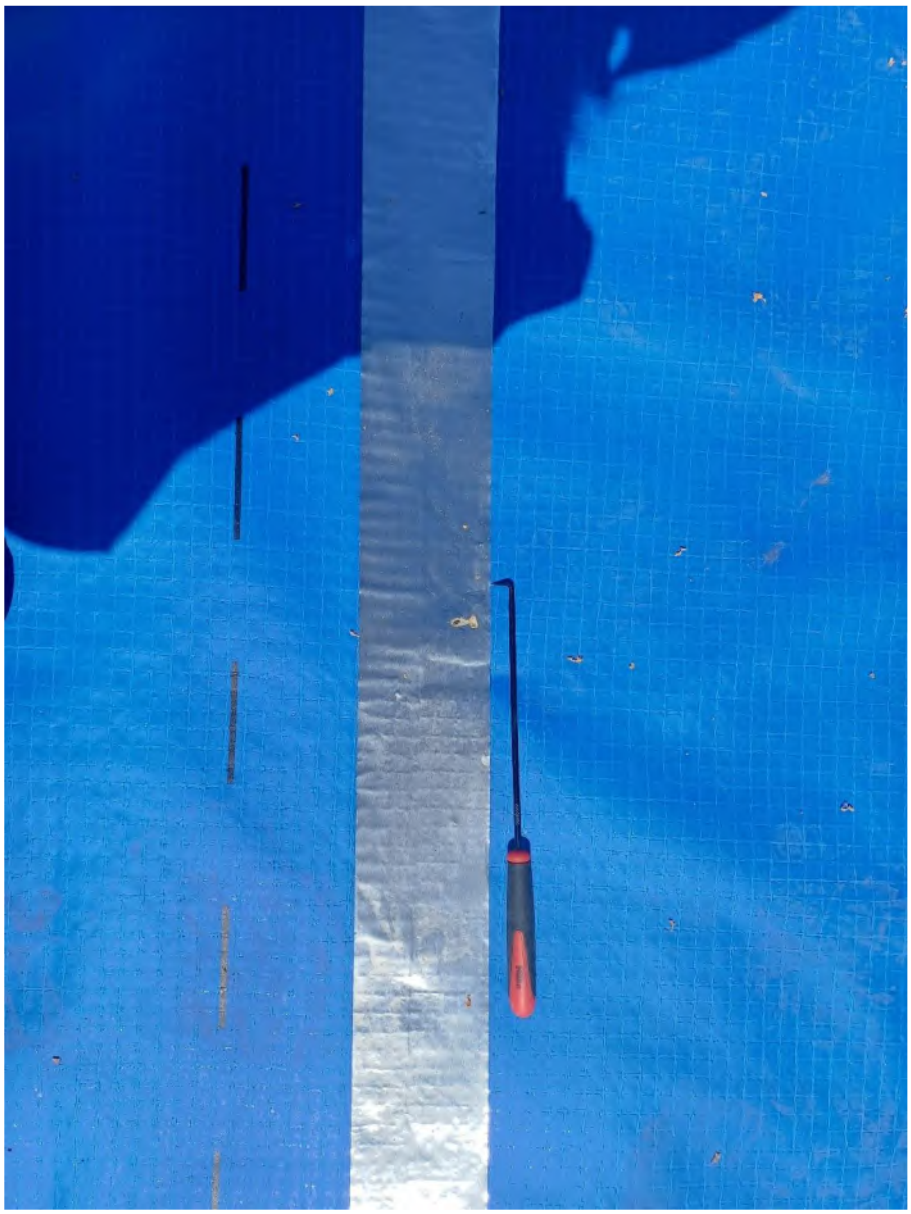
Conclusion
Plot 12 and 12A have been verified as acceptable and complywith the specification.



Photograph 1 – Overview of Plot 12



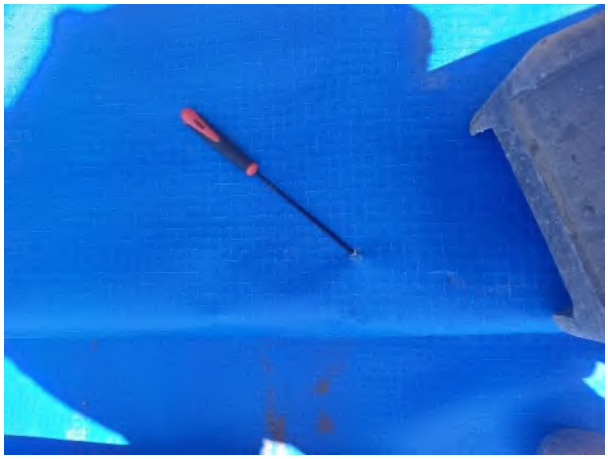
Photograph 2 – Overview of Plot 12A



Photograph 3 – Mechanically picked, well-sealed double taped edges



Photograph 4 – Well formed, sealed corner detailing



Photograph 5.1 – Small puncture hole observed in plot 12A



Photograph 5.2 – Puncture hole sealed with gas resistant foil tape



Photograph 6 – Well sealed service entries

GroundSolve Ltd

Job No.:	GSL3116
Job Title.:	Llangollen Road, Acrefair
Engineer:	Eve Rowland

GroundSolve Ltd Visual Inspection of Gas Protection Measures

Job Name:	Llangollen Road, Acrefair	**Gas Characteristic Situation:**	CS2 and basic radon protection
Job No.:	GSL3116 - PLOT14	**Development Type:**	Residential
Date:	09/09/2025	**Foundation type**	Piled
Visit By:	Eve Rowland	**Passive or Active?**	Passive
Weather:	Cloudy	**Other Staff on Site:**	Gareth Evans – Gower Homes

Assessment of Measures on Site

Verification Area		
• The verification visit conducted on the 9th September 2025 ahead of the plot 14 concrete slab pour.		
No.	**Item**	**Comment**
1 Gas Membrane		
1.1	Condition of sub-grade and underside of gas membrane	Subgrade in good condition, comprising; • 100mm of clean stone. • Terram dispersal protection membrane layer. • 50mm of sand blinding. • Gas membrane.
1.2	Gas membrane type	Solshield High-Performance Damp-Proof Membrane – Blue multi-layer low density reinforced polyethylene membrane
1.3	Gas membrane condition	The membrane was in good condition.
1.4	Joining tape product and or sealing technique used	Solco Double Sided Butyl Tape and Solco Gas Resistant Foil Backed Tape
1.5	Lapping design	100mm laps at membrane edges with double taped edges.
1.6	Laps, welds and joint seals	Well-sealed
1.7	Service entry seals	Sealed with Solco Gas Resistant Foil Backed Tape
2 Passive Venting		
2.1	Sub-floor void	A sub floor void has been installed comprising of 100mm of clean stone.
2.2	External wall airbricks	N/A
2.3	Internal sleeper walls	N/A
2.4	External air vents/ducts	The sub-floor void is connected to vents to the exterior of the buildings.
3 Active Venting		
3.1	System details	N/A – passive venting system in place.
Additional Notes		

Conclusion
Plot 14have been verified as acceptable and complies with the specification.



Photograph 1 – Mechanically picked, well-sealed double taped seams



Photograph 2 – Well sealed service entries



Photograph 3 – Mechanically picked, well-sealed corner details



Photograph 4 – Overview of plot 14



Photograph 5 – well sealed taping

APPENDIX C– CURRENT GUIDANCE FOR GROUND GAS RISK ASSESSMENT

Current Guidance for Ground Gas Risk Assessment

Origin of Ground and Landfill Gases

When carrying out a ground gas risk assessment for permanent ground gases (e.g., methane and carbon dioxide), the origin or source of the gases is important as potential risks will vary depending on the source. This Appendix relates to the risk of the two main ground gases of concern: methane and carbon dioxide and does not apply to other ground gases (e.g., radon or vapours from hydrocarbon spills). Methane and carbon dioxide are major constituents of landfill gas but can also occur from a variety of anthropogenic and natural sources, as summarised in Table G1 below:

Table G1. Potential Sources of Ground Gases

Gas	Source	Comments
Landfill Gas	Anaerobic decomposition of degradable waste within landfill sites. Typically, 60% methane and 40% carbon dioxide during methanogenic phase.	Composition varies over time, particularly in early stages. Contains a range of minor constituents (particularly carbon monoxide and hydrogen sulphide).
Landfill Associated Gases	- Anaerobic degradation of leachate external to the site; - Degassing of dissolved gases in groundwater; - Evolution of gases following interaction between leachate and groundwater	Can result in secondary (external) production of methane or carbon dioxide.
Made Ground	Anaerobic degradation of organic components	Very variable depending on source
Sewer Gas, Cess Pits	Anaerobic degradation of organic components of sewage producing methane and carbon dioxide.	Often characterised by hydrogen sulphide odour.
Mains Gas	Leakage from underground pipework or storage tanks. Mainly methane but often contains higher alkanes.	An odouriser is added to permit detection of leaks. Typically, 90% CH_4, but 1 to 27% C_2-C_4 alkanes, May also contain other trace gases e.g., CO, helium and CO_2 (from degradation of CH_4 in the ground).
Other Anthropogenic Sources	- Degradation of leaked or spilled hydrocarbons or other industrial chemicals; - Anaerobic degradation of organic contaminants in groundwaters (e.g., silage liquor); - Reactions between monitoring well construction components and environment; - Burial grounds/cemeteries.	Hydrocarbon spillages often have an 'oily' odour. Fuel spillages common – Petrol or Diesel and can contain a wide range of VOC's. Can degrade to produce methane / carbon dioxide.
Alluvium / Marsh / Peat Gas	Anaerobic microbial degradation of organic material (usually waterlogged vegetation / peat). Often associated with the presence of alluvial deposits or dredgings.	
Geogenic Gas	Natural seepages of carbon dioxide and hydrocarbon gases derived from geologic sources such as coal seams and deep oil / gas source formations. Can be present in solution in groundwaters.	Methane most common but can contain carbon dioxide and higher alkanes.
Mine Gases	Various types. Most common is "fire damp" with high methane, produced by the desorption of gas trapped in coal. "Black damp" (Stythe gas) with high carbon dioxide and denser than air. "White damp" is high in carbon monoxide.	Methane most common. Can contain higher alkanes, carbon dioxide and carbon monoxide. Often low in oxygen.
Natural Shallow Ground Gas	Various types - high carbon dioxide formed by subsurface aerobic activity leading to depleted oxygen and elevated carbon dioxide; - chemical degradation of rocks (e.g., carbonates) producing carbon dioxide; - carbon dioxide production in root zone of soils by plants.	Gases can be emitted from ground under falling barometric pressure conditions.

This Appendix concentrates on the assessment of risk from methane and carbon dioxide. This Appendix does not provide guidance for the assessment of risk when other gases are present due to 'Other Sources' from the above table (particularly organic compounds such as BTEX and VOC's or for the risk from radon or hydrogen sulphide).

To determine the origin of the gas a range of factors must be considered together, including;

1. Proximity of likely sources;
2. Ground conditions (geology, hydrogeology, anthropogenic pathways etc);
3. Properties of gases present including:
    a. Chemical composition;
    b. Physical properties;
    c. Ratios of components e.g., methane : carbon dioxide.
4. Timeframe of activities such as infilling periods, capping works, installation of gas control systems etc.

Identification of the originating source may be problematic given that there may be more than one source present and trace gas analysis may be required. Identification of the sources of the gases encountered during monitoring is usually carried out through a process of eliminating the most unlikely potential sources (given the site setting) and selecting those which are the more likely candidates.

Hazards Associated with Presence of Ground Gases

Methane gas is combustible and potentially explosive. When the concentration of methane in air is between the limits of 5.0%v/v and 15.0%v/v an explosive mixture is formed. The Lower Explosive Limit (LEL) of methane is 5.0%v/v, which is equivalent to 100% LEL. The 15.0%v/v limit is known as the Upper Explosive Limit (UEL), but concentrations above this level cannot be assumed to represent safe concentrations. Further, the LEL and UEL will vary (up and down) depending upon the proportion of other gases (including oxygen). However, the fact that methane is a colourless, odourless gas means that there is no simple indicator of the presence of the gas until such a time as explosive limits are reached, and an incident occurs. Methane is lighter than air and has a low toxicity. However, at high concentrations it can result in asphyxiation due to oxygen displacement.

Carbon dioxide is a colourless, odourless gas, which, although non-flammable, is both toxic and an asphyxiant. As carbon dioxide is denser than air, it will collect in low points and depressions. The UK Health & Safety Executive (HSE) has published information relating to concentrations of carbon dioxide that humans may be exposed to, which uses concentrations contained in the Control of Substances Hazardous to Health Regulations 2002 (as amended). These are the Long-Term Occupational Exposure Limit (LTOEL, 8-hour period) and the Short-Term Occupational Exposure Limit (STOEL, 15-minute period), which are 0.5% and 1.5% carbon dioxide, respectively.

Parameters Influencing the Rate of Ground Gas Production

Figure G2 is taken from EA guidance document LFTGN 03 illustrates typical ground gas generation curves from biodegradable materials:

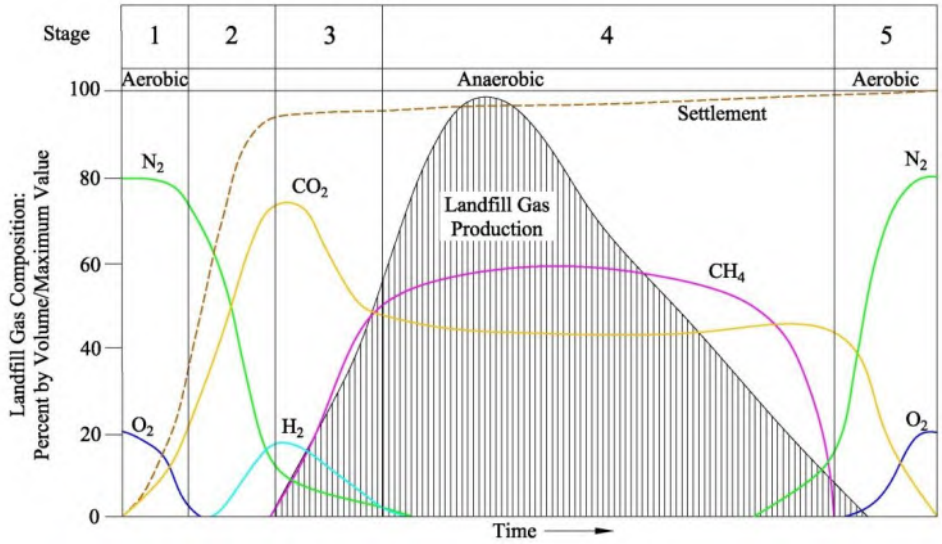


Figure G2. Idealised Representation of Landfill Gas Generation.

The production of methane and carbon dioxide at a landfill site may be expected to be considerable and ongoing. Concentrations of methane will eventually decrease, followed by concentrations of carbon dioxide, but the duration and rate of gas production can vary markedly between sites. Five distinct phases of gas production occur during the process which are, in order of event (as marked on Figure G2), as follows:

1. An aerobic phase involving oxygen depletion and temperature increase through aerobic respiration;
2. The establishment of anaerobic conditions and the evolution of carbon dioxide and hydrogen through acidogenic activity;
3. Commencement of methanogenic activity; the establishment of populations of methanogenic bacteria;
4. A phase of stable methanogenic activity, which may go on for many tens of years;
5. A phase of decreasing methanogenic activity, representing depletion of the organic material and a return to aerobic conditions.

The time scale for the return to the normal ground gas concentrations will be highly variable, depending upon the types and quantities of materials present. In addition, the optimum parameters influencing the rate of decomposition and ground gas production within the ground at a site are as follows:

- High water content with adequate rainfall and water infiltration to provide moisture content between approximately 20 to 26%;

- Conditions that either are or are very close to anaerobic;
- High proportion of biodegradable materials;
- A pH between 6.5 and 8.5, ideally verging slightly on the acidic between pH 6 to 7;
- Temperature between 25°C and 55°C;
- The ratio of the biochemical and chemical oxygen demands (BOD:COD);
- High permeability;
- Small particle size, as finer subsurface materials possess a greater surface area to provide a growing 'face' for the micro-organisms but high fines levels reduces permeability and reduces decomposition rate.

For this reason, it is vital that sources of methane and carbon dioxide are identified prior to the commencement of any work on a construction site, and that the ground gas regime is characterised at the worst temporal conditions a site may experience. From this, a risk assessment is carried out to identify the risk at the site from ground gases so that suitable protection measures can be designed and incorporated into a development to prevent a dangerous build-up of gas occurring.

Factors Influencing the Migration and Behaviour of Ground Gases

There are many factors that influence the migration of ground gases which can affect the risk from a gassing source:

- driving force – pressure differential along a pathway, diffusion and dissolved in solution;
- meteorological conditions – short term and seasonal conditions including atmospheric pressure changes (e.g., rapidly falling pressure causes gas to expand increasing emission rates), rainfall, frozen ground and thawing, temperature;
- geological and groundwater conditions – these can have the over-riding influence on the direction/pathways and quantity of migrating gas;
- anthropogenic influences – man-made pathways include mine shafts, service runs/drains, foundation piles, underground voids/pits/basements, foundation/building design/construction

Guidance Documents

Currently in the UK, there are no statutory threshold limits for hazardous gases in the ground as site specific variables mean that standard threshold values cannot be applied. The published guidance relating to development of sites where methane and carbon dioxide are present has been produced in response to building projects on or close to landfill sites, as both gases are principal constituents of landfill gas. Much of the historic guidance that has been produced on gas risk assessment focused on landfill sites and as a result there has previously been a lack of clarity when relating the process to gas conditions on non-landfill sites.

Statutory guidance regarding methane in the ground has previously taken a limiting concentration of 1.0 % by volume methane (equal to 20% of the lower explosive limit of methane in air) above which necessary actions will be appropriate. For carbon dioxide the limiting recommended trigger was 1.5 % by volume (the Long-Term Exposure Limit for carbon dioxide). Above these concentrations the Building Regulations Approved Document C (1992) stated that consideration should be given to whether actions may be appropriate, whilst more specific solutions would be likely to be necessary at concentrations greater than 5% by volume of carbon dioxide (Building Regulations Approved Document C, 1992). However, the latest fully revised version of Approved Document C (DoE, 2004) no longer endorses this approach and instead requires the use of a risk-based approach in interpreting the findings of a gas monitoring survey. Further, the latest EA documentation on landfill gas (LFTGN 03, 2004) continues to sanction the use of a risk-based approach through a structured approach to the assessment of ground gases and links with the risk assessment process outlined within CLR 11 for soil contaminants.

With the above in mind, recent guidance has been produced in 2006 and 2007 with the aim of providing up to date advice in relation to residential and commercial development. The guidance does not address issues associated with gas derived from landfills, for this refer to *"Guidance on the Management of Landfill Gas"* (Environment Agency 2004) for an overview.

Recent guidance relevant to gas assessments for residential and commercial development includes;

- **Wilson *et al.* (CIRIA C665, December 2007) *"Assessing Risks Posed by Hazardous Ground Gases for Buildings."***

  This document provides up to date advice on all aspects of ground gas risk assessment such as investigation, monitoring programmes, data collection and interpretation. The guidance presents separate methodologies for the characterisation of:

  - **All development types except low rise housing with gardens and for Low Rise Buildings without a 150mm void** (Situation A) (Table 8.5 CIRIA C665)

  and;

  - **Low rise housing with gardens with a 150mm ventilated sub-floor void** (Situation B) (Table 8.7 CIRIA C665)
    (See below for further explanation of the methods of characterisation)

- **Boyle and Witherington (NHBC / RSK Group, Report 10627-R01(04) January 2007) *"Guidance on the Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present."***

  This document presents the "Traffic Lights System" detailed below and is relevant only for low rise properties (e.g., bungalows and town houses) that have a ventilated sub-floor void (i.e., Situation B as described in CIRIA C665).

- **Wilson and Card (CIEH, expected 2011) *"Ground Gas Handbook for Designers and Regulators"***

  This document is expected to provide practical guidance on ground gas assessments and the design and evaluation of protection measures.

- **British Standard (BS 8485+A1, January 2019)** ***"Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings"***

  This document provides an overview of gas characterisation and assessment. The Standard is intended to be used by designers of gas protection measures and regulators involved in the assessment of design solutions. The Standard provides a framework in line with CLR11 allowing designers to judge the adequacy of ground gas and related site investigation data. The document provides an approach to determine appropriate ground gas parameters that can be used to identify a range of possible construction solutions mitigating against the presence of ground gas on a development site.

Each of these documents continues to highlight the importance of, and give further guidance towards, carrying out a tiered risk-based decision-making process in accord with government policy on dealing with contamination from historic or natural sources and highlight the importance of the Conceptual Model in site characterisation. These documents also stress the importance that the assessor should be confident that the ground gas monitoring results are representative of the likely worse case ground gas regime on a site and that the data collected from the site is sufficient. With this in mind, CIRIA C665 sets out ideal monitoring periods as below.

Idealised Frequency and Period of Monitoring (after Table 5.5a and 5.5b, CIRIA C665)

		Generation Potential of Source				
		Very Low	**Low**	**Moderate**	**High**	**Very High**
Sensitivity of Development	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with Gardens)	6/3	9/6	12/6	24/12	24/24

Notes

1. First number is the number of readings and the second is the minimum period in months (e.g., 6/2 – six sets of readings over two months).

2. At least two sets of readings must be at low (preferably under 1,000 mb) and falling pressure.

3. High sensitivity end use on high or very high hazard site will not normally be acceptable unless the source is treated to reduce gassing potential.

Before the latest guidance, good practice for site characterisation had been based upon the method proposed by Wilson and Card (1999). CIRIA C665 (2007) effectively supersedes Wilson and Card (1999) and includes a modified version of the Wilson and Card method (Tables 8.5, 8.6 and Box 8.1). Gas concentrations and flow rates for either methane and/or carbon dioxide measured at a site to 'Characteristic Situations.' Appropriate protection measures are selected from Table 8.6 (if using modified Wilson & Card method) and from Box 8.4 from CIRIA C665 (if using the NHBC traffic lights method). Throughout the risk assessment process, strong regard must be given to the nature of the gassing source, the flow rates and the estimated surface emissions. Note that certain protection measures are stated in CIRIA Report 149 that are now considered wholly inappropriate to certain developments and consequently should not be used without modification. Throughout the process, it is important to remember that these tables are not

intended to be used as a definitive design tool and have been prepared to show the typical scope of measures for gas control.

Both the NHBC (2007) and CIRIA (2007) guidance documents and BS 8485+A1 (2019) propose that both ground gas concentrations and flow rates are used to calculate the limiting gas well gas volume flow rates for methane and carbon dioxide, based on the ground gas conditions monitored for during the worse-case temporal conditions. This limiting gas well volume flow rate is termed the Gas Screening Value (GSV, note that this was termed borehole gas volume flow), and is calculated as follows:

$$\textbf{GSV}\ (\text{l/hr}) = \frac{[\text{gas well gas concentration (\%v/v)}] \times [\text{gas well flow rate (l/hr)}]}{100}$$

These GSVs are then compared to generic 'Traffic Lights' contained within the NHBC guidance, which present typical maximum gas concentrations and limiting GSV's, for 'Situation B Development' (Low rise housing with gardens).

Table 8.7 NHBC Traffic light system for 150 mm void

Traffic Light	Methane [1]		Carbon Dioxide [2]	
	Typical max concentration [3] (% by volume)	Gas Screening Value [2,4] (litres/hour)	Typical max concentration [3] (% by volume)	Gas Screening Value [2,4] (litres/hour)
Green	1	0.13	5	0.78
Amber 1	5	0.63	10	1.6
Amber 2	20	1.60	30	3.10
Red				

Notes:

1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated;
2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;
3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

Box 8.4 of CIRIA C665 Gas protection measures for low-rise housing development based upon allocated NHBC Traffic light (Boyle and Witherington, 2007)	
Traffic Light Classification	**Protection Measures Required**
Green	Negligible gas regime identified, and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Membranes should always be fitted by a specialist Contractor. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

For a 'Situation A Development' (All development except low rise housing with gardens), the GSV value is used to derive the appropriate Characteristic Situation from Table 8.5 of CIRIA C665 (below):

Table 8.5 from CIRIA C665 Modified Wilson and Card Classification					
Characteristic Situation (CIRIA R149)	**Comparable Partners in Technology gas Regime (see Box 8.2)**	**Risk Classification**	**Gas Screening Value (CH_4 or CO_2) (l/hr)[1]**	**Additional Factors**	**Typical Source of Generation**
1	A	Very low risk	<0.07	Typically, methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mine working flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mine working susceptible to flooding, completed landfill (WMP 26B criteria)
5	E	High risk	<70		Mine working unflooded inactive with shallow workings near surface
6	F	Very high risk	>70		Recent landfill site

It was intended in CIRIA C665 that the characteristic situation allocated to the development from the table above would then be used in Table 8.6 of CIRIA C665 in order to determine the level of gas protection the development requires. However, BS8485:2015 superseded this document and a different set of mitigation standards were put forward.

The recommended minimum gas protection score (points) be selected based on the building type (Table 3 which defines four building types) and the ground gas Characteristic Situation as detailed in Table 4 of BS8485:2015+A1:2019 (see below).

The first step in the decision-making process is to obtain the level of gas protection necessary in the range 0 to 7.5 from Table 4. Then a combination of structural barriers (Table 5) ventilation protection measures (Table 6) and/or gas resistant membranes (Table 8)should be chosen to meet that requirement. The level of gas protection necessary should take into account the characteristic gas situation and a number of other factors. The whole decision-making process should be made transparent, where all parties can see the approach being taken, can understand the various steps and decisions made and be confident that a risk-assessed solution has been designed and installed commensurate with the construction and site constraints.

Where the gas Characteristic Situation is 4 or more (and for NHBC Red situations according to CIRIA C665), the site requires a comprehensive risk assessment to confirm the scope of protection measures. These are higher risk sites and reliance on Table 4 alone is not sufficient.

BS8485:2015+A1:2019 Table 3 Building Types				
	Type A	**Type B**	**Type C**	**Type D**
Ownership	Private	Private or commercial/ public, possible multiple	Commercial / public	Commercial / industrial
Control (change of use, structural alterations, ventilation	None	Some but not all	Full	Full
Room sizes	Small	Small / medium	Small to large	Large industrial / retail park style

BS8485:2015+A1:2019 Table 4 Gas Protection Score by CS and Type of Building				
CS	Required Gas Protection			
	High risk	Medium risk	Low risk	
	Type A	Type B	Type C	Type D
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 (A)	5.5(A)	4.5	3.5
5	(B)	6A)	5.5	4.5
6	(B)	(B)	(B)	6
a) Residential building should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g., high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g., in institutional and/or fully serviced contractual situations.				
b) The gas hazard is too high for this empirical method to be used to define the gas protection measures				
NOTE 3 The NHBC has published guidance for use on residential developments, which utilise an alternative classification ("traffic light") system. This guidance typically applies to Type A buildings utilising beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilising this system would therefore need to refer to NHBC to assess compliance for specific recommendations [see 8485:2015 for further on this note]				
NOTE4 The method of selecting the combination of these types of protection is given in section 7.2 of BS8485:2015. Once type of measures has been decided, the detailed design and specification of the measures should be undertaken (section 7.3)				

Section 7.2 defines the order of selecting protective measures. The first choice is provided by structural barriers as defined in Table 5.

BS8485+A1:2019 Table 5 Gas protection scores for structural barriers		
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
Floor and substructure design		
Floor slabs Block and beam floor slab	0	*General – score conditional that breaches of slab are sealed*
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5	
Cast in situ monolithic reinforced ground-bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations (with only nominal mesh reinforcement)	1 or 1.5	*To achieve 1.5, raft or suspended slab to be well reinforced to prevent cracking and minimal penetrations*
Basement floor and walls to BS 8102:2009, Grade 2 waterproofing – See notes in BS8485:2015+A1:2019	2	
Basement floor and walls to BS 8102:2009, Grade 3 waterproofing - See notes in BS8485:2015+A1:2019	2.5	*Conditional that waterproofing is not based on geosynthetic clay liner*

Ventilation methods are detailed in Table 6, and points can only be gained from using one of the five types:

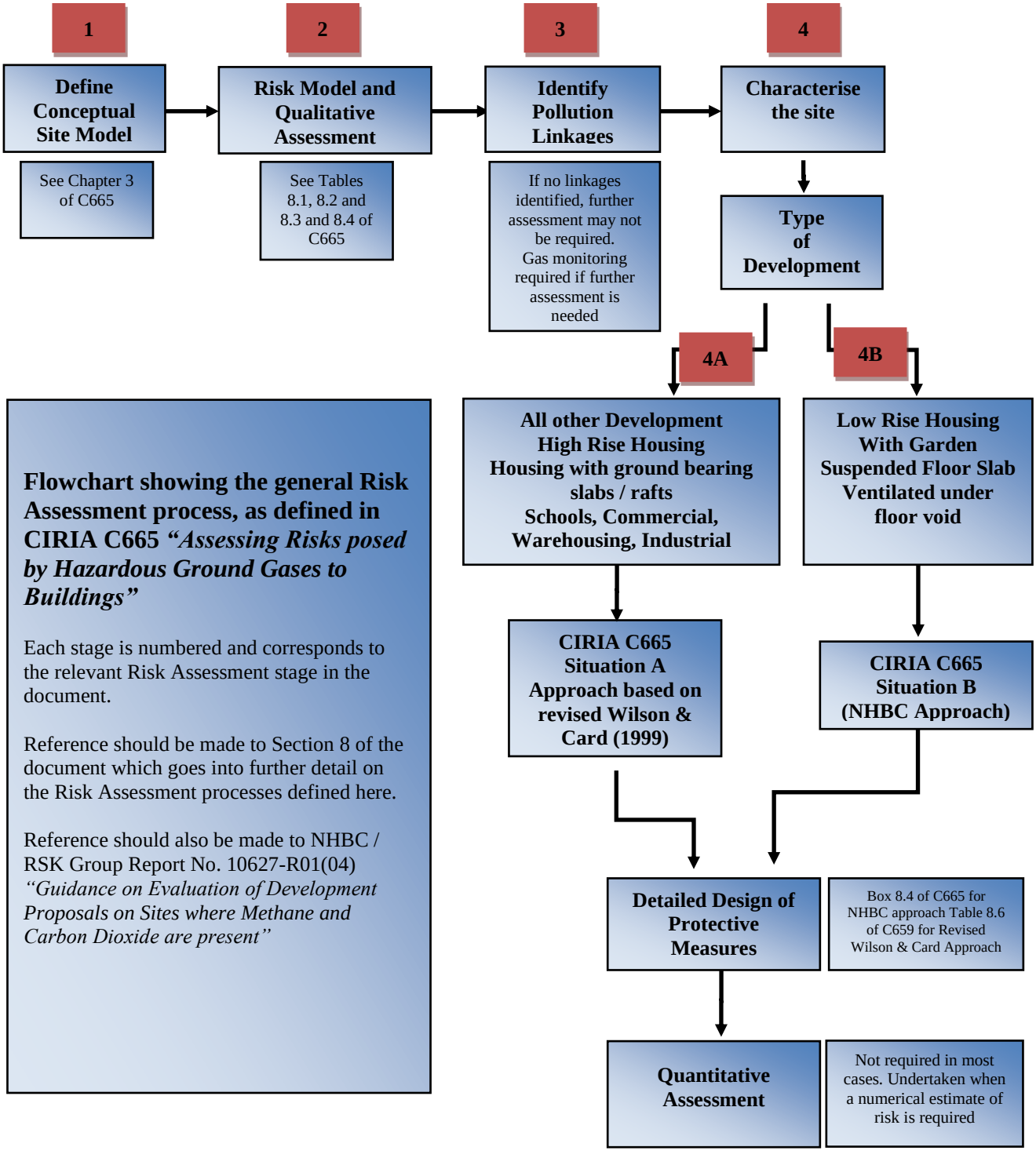
BS8485:2015+A1:2019 Table 6 Gas Protection Scores for Ventilation Protection Measures		
PROTECTION ELEMENT/SYSTEM	**SCORE**	**COMMENTS**
a) Pressure relief pathway (usually formed by low fines gravel or with a thin geocomposite blanket with strips terminating in a gravel trench external to the building	0.5	*Whenever possible, a pressure pathway relief pathway (as a minimum) should be installed in all gas protection measures systems.* *If a layer has a low permeability and/or is not terminating in a venting trench (or similar), then the score is zero.*
b) Passive sub floor dispersal layer Very good performance Good performance Media used to provide the dispersal layer are: • Clear void • Polystyrene void forming blanket • Geocomposite void former blanket • No-fines gravel layer with gas drains • No-fines gravel layer	 2.5 1.5	*Performance criteria shown in Fig B.6 and B.7 of BS 8484:2015.[See Annex B]*
c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	*This system relies on continued serviceability of the pumps; therefore, alarm and response systems should be in place. [See Annex B].*
d) Active positive pressurisation by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	*This system relies on continued operation of the pumps; therefore, alarm and response systems should be in place. [See Annex B].*
e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or under croft)	4	*Assumes car park is vented , designed to Building Regulations 2000, Approved Document F.*

Membrane methods are detailed in Table 7.

BS8485:2015+A1:2019 Table 7 Gas protection score for gas resistant membrane		
PROTECTION ELEMENT/SYSTEM	**SCORE**	**COMMENTS**
Gas resistant membrane meeting all of the following criteria: • Sufficiently impervious to gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method) • Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • Sufficiently strong to withstand in-service stresses (e.g., settlement if placed below a floor slab); • Sufficiently strong to withstand the installation process and following trades until covered (e.g., penetration from steel fibres in fibre reinforced concrete, dropping tools etc); and to withstand in-service stresses (e.g., settlement if placed below a floor slab) • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735	2	*The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints.* *If a membrane is installed that does not meet the criteria, then the score is zero.*
See notes in BS8485:2015+A1:2019 regarding membrane requirements		

For a site which is impacted by migratory gases from an off source, the development may be protected by imposing pathway intervention methods, which if successfully validated, could also remove the need for further analysis. It is essential that the gas regime in these circumstances has been fully characterised and that the only source impacting the site is located off site and that the pathway is clearly defined and its interception equally proven before construction commences. Pathway intervention methods may include vertical membrane installations, venting trenches, rows of stone columns, activated trenches and various proprietary systems. These systems are particularly relevant to domestic housing where there is limited scope for foundation type solutions.

Following the choice of protection measures, detailed design should be entered into [Section 8 of BS 8485:2015+A1:2019].



Flowchart showing the general Risk Assessment process, as defined in CIRIA C665 *"Assessing Risks posed by Hazardous Ground Gases to Buildings"*

Each stage is numbered and corresponds to the relevant Risk Assessment stage in the document.

Reference should be made to Section 8 of the document which goes into further detail on the Risk Assessment processes defined here.

Reference should also be made to NHBC / RSK Group Report No. 10627-R01(04) *"Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are present"*

APPENDIX D– SPECIFICATION SHEETS

SOLCO

Technical Datasheet

Last Issued: March 2021

Solco Double Sided Butyl Tape

Description:

Solco Double Sided Butyl Tapes are preformed high performance polyisobutylene (PIB) based sealing tape with enhanced adhesive characteristics for more demanding applications where there are requirements for a high degree of bonding such as cavity trays and polythene membranes.

Solco Double Sided Butyl Tape has excellent adhesion to a wide range of substrates, with good UV resistance, and remains flexible throughout its service life.



- **Solventless formulation.**
- **Instant seal.**
- **Direct control over the quantity of sealant used in the joint.**
- **Environmentally friendly.**
- **Ease of use.**
- **Good adhesion on both faces to most building materials.**
- **High pumping resistance.**

Typical Uses:

- Bonding membranes to DPCs.
- Bonding and sealing cavity Trays & Top Hats.
- Bonding and sealing waterproof & gas protection membranes at overlaps.

Installation:

- Solco Single Sided Butyl Tape should be applied to surfaces at a temperature range of between +5°C and +40°C.
- For best performance, the surfaces should be clean, dry, and grease free.
- Apply tape to the lap area of the laid sheet starting approx 50mm from the membrane edge. The product should be unwound and lightly pressed into position leaving the release paper in place.
- Overlap adjoining membrane by 150mm.
- On forming the joint, the release paper is removed and the closing surface pushed firmly in place, Pressure is applied along the length of the joint and mechanically fixed if necessary.
- When the weather is cold, store tape in a warm, dry place until required.
- Installation is not recommended below 5°C.

Technical Data:

Property	Value
Life Expectancy	>25 years
UV Resistance	Excellent
Service Temperature	-40°C to +90°C
Joint Movement	Up to 15%
Dynamic Tensile Tension (Separation Rate of 100mm/min at 20°C)	20 N/cm^2
Dynamic Shear (Separation Rate of 200mm/min at 20°C)	22 N/cm^2
Gas / Vapour Permeability	
Methane Permeability [BS ISO EN 15105-1]	1.97 ml/m^2/day/atm
Carbon Dioxide Permeability [BS ISO EN 15105-1]	1.01 ml/m^2/day/atm
Radon Permeability [SP3873]	7.1x10^{-7} m^2/s
Water Vapour Permeability [BS 15106-3]	0.006 g/m^2/day

Storage:

- Keep rolls stored in a cool dry place.
- Shelf life of 24 months in ambient conditions.

Roll Sizes
50mm x 10m
100mm x 10m

Solco, Unit 51, Portmanmoor Road Industrial Estate, Ocean Park, Cardiff, CF24 5HB

Solco Gas Resistant Foil Backed Joint Tape

Description:

Solco Gas resistant Foil Backed Jointing Tape is a very strong laminated single sided tape for securing laps & joints. It can be used for bonding Solco Waterproofing and Gas Protection Membranes at overlaps and for bonding membranes to DPC's.



- **Complies with BS 8485:2015 + A1:2019.**
- **Protects against CO_2 and CH_4.**
- **Good Ageing Resistance.**
- **Simple Application.**
- **Low moisture transmission rate.**
- **Excellent sealing performance.**

Technical Data:

Property	Value
Thickness	0.090 mm
Adhesion to Steel	16 N/mm
Tack Rolling Ball	50 cm
Tensile Strength	100 N/25mm
Elongation	20%
Service Temperature	-30°C to + 120°C
Application Temperature	5°C to +40°C
Methane Transmission Rate*	<0.20

*ISO 15105-1 AT 23°C, and 0% r.F. Ml m²

Applications:

Tape for sealing waterproofing and gas protection membranes at overlaps and for bonding membranes to DPCs at junctions with internal and external walls.

Installation:

- Ensure that surfaces are clean and dry.
- Apply tape equidistant over the bonded membrane lap.
- Apply pressure to the tape to ensure adhesion.
- When the weather is cold, store tape in a warm, dry place until required. Installation is not recommended below 5°C.

Declaration of Conformity:

BS EN8485+A1:2019: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings - ISO 15105.

REACH SVHC Status:

- NO SHVC present according to candidates list of 20th June 2016.

Storage:

- Recommended shelf life of 12 months from date of despatch at the moderate temperature and humidity environment.

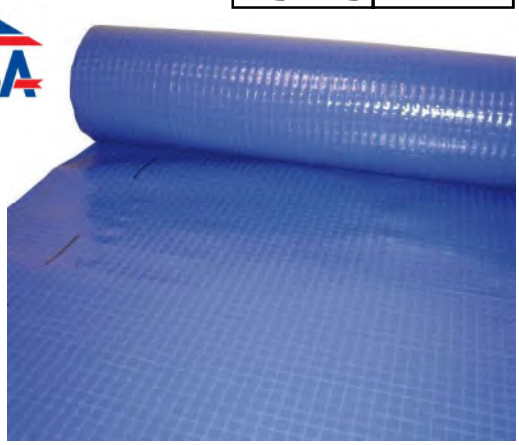
Solco, Unit 51, Portmanmoor Road Industrial Estate, Ocean Park, Cardiff, CF24 5HB

Solshield High Performance Damp Proof Membrane

CE TYPE A EN 13967

Description:

Solshield High Performance DPM is a multi-layer low density reinforced polyethylene membrane, reinforced with a polypropylene reinforcing grid. Solshield HP DPM is designed to be suitable for use as a low permeability gas membrane, in areas where low levels of radon and carbon dioxide are present, and can be used as an air / moisture protection system.



- **BBA Cert 20/5737.**
- **Compliant to NHBC Standards 2019, Chapter 5.1.**
- **CE Marking Standard EN13967:2012.**
- **Complies with relevant codes of practice as published by CIRIA.**
- **Suitable for low levels of Radon & Carbon Dioxide.**
- **High strength and resistance to puncture.**
- **Compliant to NHBC Amber 1, where low levels of CO^2 are present.**
- **Suitable for use with the Solco DPC System Accessories.**

This membrane is particularly suited for applications where heavy duty foundations and steel reinforced slabs are to be installed, and where a durable, robust and high puncture-resistant membrane is better suited.



Solshield High Performance DPM is fully compliant with the standards for damp proof membranes as required by the UK building regulations. Solshield HP DPM provides a barrier for moisture, usually used within building foundations. It can also be used for a range of other damp proofing applications. Solshield HP DPM is suitable for use in concrete floors in domestic and commercial (schools, hospitals leisure, shopping centres, etc.) applications, in accordance with Clause 11 of CP 102:1973, where there may be capillary rise of moisture but not where it may be subject to hydrostatic pressure.

Solshield HP DPM should be jointed using welding for the most demanding installations or jointed using the range of Solco Tapes and ancillary items for all other instances (as shown below).

Solco can also produce DPM in a range of sizes and specifications to meet your specific needs.

General:

Solshield HP DPM should not be installed at temperatures below 5°C, to prevent the risk of surface condensation. The membrane must be installed and fixed in accordance with the relevant clauses in BRE Report BR 211:2015.

The membrane should be installed on a sand blinding layer, Solshield P30 protection fleece, or a smooth concrete float finish. In order to provide a continuous barrier across the cavity, Solshield HP DPM should be taken through the blockwork and incorporated below the damp proof course cavity tray in the outer leaf.

SOLSHIELD HP DPM is suitable for installation with block & beam floor application with 150mm clear void, reinforced raft foundation and in situ suspended slab.

Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane.

enquiries@Solco.co.uk www.solco.co.uk Tel: 02920 495 555

Technical Data:

Property	Test Method	Value
Thickness	EN 1849-2	0.50mm
Thickness - Between Scrim	Micrometer	0.30mm
Width	EN 1849-2	2.0m
Length	EN 1849-2	50m
Weight	EN 1849-2	370g/m^2
Hydraulic Properties		
Water Column Test	EN 20811	Pass
Resistance to Water Penetration	EN 13967, EN 1928	Pass
Durability of Watertightness against Ageing	EN 1296, EN 13967, EN 1928	Pass
Mechanical Properties		
Resistance to Static Load	EN 12730 B	20kg
Tensile Strength (MD)	EN 12311 - 1	500N/mm
Tensile Strength (CMD)	EN 12311 - 1	470N/mm
Tensile Elongation (MD)	EN 12310 - 1	15%
Tensile Elongation (CMD)	EN 12310 - 1	20%
Puncture Resistance (CBR)	EN 12236	1.04kN
Resistance to Tearing (Nail Shank) (MD)	EN 12310 - 1	400N
Resistance to Tearing (Nail Shank) (CMD)	EN 12310 - 1	350N
Durability and Chemical Resistance		
Radon Permeability	K124/02/95	$4.3x10^{-12}$ m^2/s
Carbon Dioxide Permeability	BS EN ISO 15015 - 1	<514 ml/m^2/day/atm
Methane Permeability	BS EN ISO 15015 - 1	<514 ml/m^2/day/atm

Storage and Handling on Site:

Solshield HP DPM is classified as non-hazardous (code of practice CP102 1973).
Rolls should be stored on a flat surface, kept under cover, and protected from sunlight and mechanical damage.
The product is chemically inert and any acids or alkalis present in the subsoil will not affect the membrane.
Do not use when exposed to sunlight and general outdoor weather conditions for long periods of time.
Quality control during the laying of the membrane is extremely important. The membrane should be protected either through the use of temporary protection over its whole area or the immediate laying of the concrete slab.
Care should be taken when handling building materials over the exposed surface.

Solco, Unit 51, Portmanmoor Road Industrial Estate, Ocean Park, Cardiff, CF24 5HB

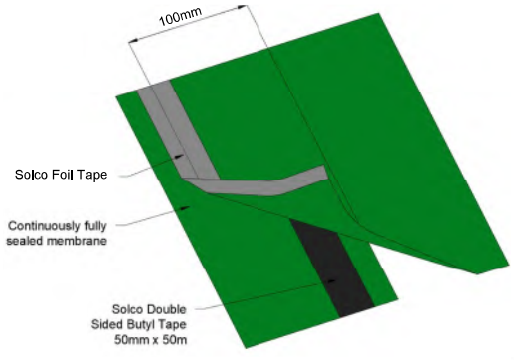
Installation:

1. The membrane must only be applied to surfaces that have a smooth finish - free from voids, projections, and mortar deposits. Surfaces should be dry and free from dust and frost. In order to provide a continuous barrier across the cavity, Solshield HP DPM should be taken through the blockwork and incorporated below the damp proof course cavity tray in the outer leaf.
2. Concrete surfaces should be dense. Vertical surfaces of brickwork and blockwork must be dry and rendered to provide an even surface. Brickwork or blockwork not rendered must be flush pointed to give a smooth surface without sudden changes in level.
3. Solshield HP DPM is rolled out with the coloured side up, ensuring that it is properly aligned. All end and side overlaps should be a minimum of 100mm and prepared.
4. When the membrane is laid below the concrete slab, it should be loose-laid to accommodate any small movements.
5. All surfaces must be dried thoroughly prior to joining. Roll edges can be welded or taped.
6. The continuity of the damp proofing must extend over the footprint of the building, and the membrane must be sealed to a damp-proof course where required.
7. The membrane should be covered by a screed or other protective layer, such as Solco Protection Fleece, as soon as possible after installation. If blockwork protection is used, care must be taken to avoid damage to the membrane during construction. Care should be taken when handling building materials over the exposed surface.

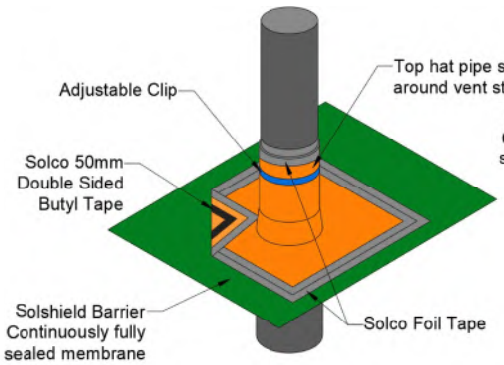
Jointing Detail:

1. Apply Solco Double Sided Butyl Tape around 50mm from the membrane edge, leaving the backing paper on.
2. Lay the next membrane, overlapping the first by a minimum of 100mm.
3. Remove the backing paper from the double sided butyl tape and join the top sheet to the bottom sheet, by applying pressure with a hand roller.
4. Where the membranes overlap, apply Solco Single Sided Foil Tape, equidistant on both membranes (see detail). All service entry points must have airtight seals. Top hats and corner pre-forms must be sealed using double sided butyl tape.

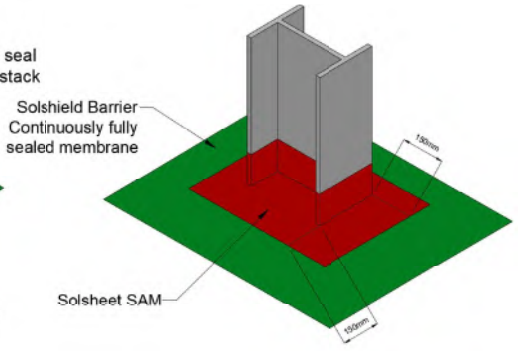
Typical Jointing Details for Solshield HP DPM



Typical Lap Detail



Typical Penetration Detail



Typical Column Detail

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Note:

All service entry points must have airtight seals Top hats and corner pre-forms must be sealed using double sided butyl tape.



JOINTING DETAIL

Ancillary Products

Solco Foil Backed Jointing Tape	Single Sided Tape	75mm x 50mm	Securing laps & joints	Rolls
Solco Double Sided Butyl Tape	Butyl Adhesive Tape	50mm x 10m	Securing joints and laps	Rolls
Solco Top Hats	Polymeric	Various	For sealing around penetrations through gas membrane	Each
Solcourse HP DPC	A flexible bitumen free polymeric damp proof course	300mm - 1000mm	DPC	20m Rolls
Solco Int / Ext Corner Cloaks	Prefabricated corner details			
Solco P30 Protection Fleece	To form a protective layer to prevent damage to the membrane	2m x 50m	Protection Fleece	Rolls
Solco HP Emulsion / Primer	Used to provide adhesion to bitumen enhanced geomembranes	5L & 25L	Primer	Drums
Solseal Flexible Liquid Membrane	A flexible and elastomeric membrane	5L & 25L	Liquid Membrane	Drums