

GeoEnginSeer Ltd Geological Services

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Ground Gas Protection System Verification Plan

Building Warrant Application

Prepared for

Home Group

C/O GeoEnvironmental Engineering, 31 Casshow Way, Cockermouth, Cumbria, CA13 9FY

Site Name: Griffin Close Frizington

Publish Date: 23.10.2024

Version Number: V1 **GESL Job Ref:** 1711

Project: Erection Of 18 No. 2 Bedroom Dwellings and Associated External Works

Planning application reference: 4/24/2252/0F1 – Cumberland Council

Client: GeoEnvironmental Engineering

Main Contact: James Brock **Tel:** 07557446043

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Installer: To be confirmed

Verification Plan Created by: Ben Crowther B.Sc, M.Sc, PGCE, FGS, CIEH, PCA QT, SGPV

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Executive Summary

Site Address:	Land Between Griffin Close & Greenvale Court, Frizington, Cumbria
Relevant Site Investigation Report extract:	The following reports have been undertaken by GeoEnvironmental Engineering for this site: • Desk Top Study, ref: 2022-5436, dated: 17.08.2022 • Ground Investigation Report, ref: 2023-5696, dated: 03.02.2023 • Supplementary Mining Investigation Report, ref: 2024-6310, dated: 06.08.2024 The following extract was taken from the Mining Investigation Report: <i>"The supplementary investigation has confirmed the presence of a column of soft clay extending to a depth of at least c.3.6m bgl within the northern part of the site that has been interpreted as an infilled mine shaft. This feature is c.20m south east of the mine shaft location as recorded by the CA.</i> <i>It is recommended that rotary probing is undertaken across this feature to confirm if it is a mine shaft and if so, what depth it extends to and how it has been filled beyond the depth of the trench. If the feature is confirmed to be a shaft, it is recommended that it is grouted (if possible) and/or stabilized using an appropriately designed geotextile or concrete cap. The remedial works should be completed under permit from The Coal Authority.</i> <i>It is recommended that the site layout is redesigned to accommodate the mine shaft with no houses constructed within the zone of influence, i.e. 45 degrees from the intersection between the shaft and solid strata. Based on borehole RBH-F, solid strata was encountered at a depth of 5m bgl, therefore, no development should take place within 5m of the shaft edge.</i> <i>Remedial works should be undertaken by an appropriate contractor and a report should be issued upon completion identifying where the workings were encountered, their depths and grout take. The works should be covered by appropriate insurances."</i>
Site description and context:	The site, occupying an area of c.0.51ha is located in the northern part of the Frizington, Cumbria as indicated on the site location plan. Access to the site is from Griffin Close to the east. National Grid Reference: 303358, 517388 Post Code: CA26 3SH (approximate only) The site was previously occupied by a care home that has since been demolished. The site is currently undeveloped and covered with grass and occasional block paving. The site is bound by Griffin Close and Greenvale Court to the south east and south west respectively, and by bushes and trees to the north east and north west.



Planning Permission:	4/24/2252/0F1 – Cumberland Council
Geology and Aquifer Designations:	A review of published geological plans and the GSR does not indicate the presence of made ground materials on site. However, as the site has previously been developed some made ground is anticipated. This is likely to comprise disturbed natural materials with anthropogenic debris. Relict structures may be present associated with the former building (foundations and floor slabs). A review of published geological plans and the GSR indicates that the site is underlain by Glacial Till, which typically comprises sandy gravelly clay with sand, gravel, cobbles and boulders. Areas close to the site (to the north) are noted as being devoid of drift geological deposits, so rockhead could potentially be close to surface beneath residual soils. The Solid geological deposits below the site are recorded as the Pennine Middle Coal Measures, which typically comprise mudstone, siltstone and sandstone with some productive coal seams.
Ground Gas and Summary of Gas Risk Assessment	A maximum Carbon Dioxide (CO₂) concentration of 4.5%v/v has been recorded and no Methane (CH₄) was detected. The minimum Oxygen (O₂) concentration was 0.8% and the flow was <0.1l/h throughout. In accordance with CIRIA C665 the maximum recorded CO₂ concentration has been converted to a Gas Screening Value (GSV), summarised as follows. In this instance, the CO₂ GSV is: ■ CO₂ GSV = (Max CO₂ (%) / 100) x Max Flow (l/hr), ■ Therefore; (4.5 / 100) x 0.1 = 0.0045 l/hr GSV Since no Methane have been detected no GSV has or can be formulated. Therefore, in accordance with CIRIA C665 Table 8.5, taking into consideration the GSV for CO₂ and the maximum gas concentrations, the site falls into Characteristic Situation 1 (CS1) or the Green Classification when utilising the NHBC Characterisation System. This indicates that gas precautions are not necessary.
Remediation Strategy	GeoEnvironmental Engineering completed gas monitoring during the initial ground investigation and did not record any elevated levels of ground gas. However, subsequent investigations identified shallow mine workings and a mine shaft on the site. They have recommended to the Client that they install gas protection measures within 50m of the mine shaft and overlying areas that have been stabilised (grouted).
Gas Protection Measures Required	GeoEnvironmental Engineering have recommended gas protection measures as a precaution due to proximity to local mine workings.



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Annex

A - Example of an appropriate verifier

B - Detailed Drawings of the location of gas protection measures in the build

C - Web Links to Example Materials

Purpose of the Verification Plan

A verification plan sets out the known details of a development and risks and details the inspection and testing regime that will ensure a high level of protection against the low level risk of adverse ground gas affecting a development site;

This report has been prepared in general accordance with UK guidance and good practice documents, including (but not limited to):

- BS8485: 2015 + A1: 2019 - Code of Practice for the Design of Protective Measures for Methane & Carbon Dioxide Ground Gases for New Buildings (BSI, 2019);
- CIRIA Report C735 - Good Practice on the Testing and Verification of Protection Systems for Buildings Against Hazardous Ground Gases (CIRIA, 2014);
- Land Contamination: Risk Management (<https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>) (Environment Agency, October 2020); and
- BS EN ISO 21365 - Soil quality – Conceptual Site Models for Potentially Contaminated Sites (BSI, 2020).
- Radon: Guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects) 2023 edition.

A copy of this report should be submitted to relevant Regulators / stakeholders for their review, comment and approval.



Limitations of the Verification Plan

This report is based on the information that has been made available to GeoEnginSeerLtd by the client, contractor and architect regarding the site. The conclusions drawn in the report are considered correct although any subsequent additional information or actions may allow for refinement of the conclusions. It should be noted that: The report has been prepared under the express instruction and is solely for the use of the Client.

The findings of this report represent the professional opinion of experienced Ground Gas System Surveyors. GeoEnginSeer Ltd. does not provide legal advice. The advice of lawyers may also be required.

All work carried out in the preparation of this report has utilised, and is based upon understanding of current relevant UK standards and codes, technology, and legislation. (BS8485:2015+A1:2019 & CIRIA 735).

Changes in the aforementioned legislation and guidance may occur at any time and could render conclusions null.

This report is limited to the boundaries identified by the client on this site and confirmed within this document.

A retrospective fit may be required if additional services are introduced, or if service conduits are not sealed, or if service conduits have services provided through them at a later date and are not sealed to the conduit and or gas protection system. If a site is left open for prolonged periods following verification or works are conducted that may damage the integrity of the installation by follow-on trades, repairs may be needed, the standards observed in a positive verification report may be compromised. Intellectual rights to this document may be rescinded.

The report is limited to the boundaries identified by GeoEnginSeer Ltd on this site and confirmed within this document.

Principals of Griffin Close Verification Plan

GeoEnginSeerLtd, independent specialist, has been appointed by the client to create this Verification Plan, conduct Verification visits and to produce a Verification Report for the installation of gas protection measures at Griffin Close.

Verifier Experience

GeoEnginSeerLtd staff collectively have a 44 year history in the industry dealing with gas barriers and containment. Ben Crowther – Director details appended below.

GeoEnginSeerLtd has been a verification specialist company for 5 years and has experience with gas and water protective systems ranging from multistory apartment blocks, residential housing, commercial developments and industrial heavy machinery floors as well as HS2 tunnels and shafts.

Verification Testing

A non-destructive testing regime is used to verify installed gas protective measures. GeoEnginSeerLtd can and will conduct the following methods for testing the integrity of the installed materials.

Visual examination, pick testing, Air Lance testing and air flow testing to sub floor void.

Examination of start up test welds by destructive testing shall also occur if heated hand welding is conducted.

Some of these tests adhere to ASTM D4437, 2008 Edition, April 1, 2008, others are novel and are described in the CIRIA C735 code of practice documentation and BS 8485+2015+A1:2019.

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Professionally Designed System:

A Structural Engineer designed system has been produced, in conjunction with the Architects plans with close attentive reference to standard installation principals from manufacturers.

These plans are reproduced in this document but refer to latest editions for scaling or build program.

The wording on the plans details the build up of layers and placement of the Pressure relief layer and Gas Resistant membrane and other components of this gas protection plan.

Much of the wording is drawn from manufacturers recommendations, which can be found on their websites, under installation details. Links provided in the Appendix.

Plans will demonstrate the sealing round penetrations, depth of ventilation sub floor void (minimum 150mm sub floor void for very good performance) and duct work connecting the subfloor void or passive ventilation layer to the outside air. These details will follow the Manufacturers detailed specification drawings. Links in Appendix and drawings included below.

Assured Professionalism

Guidance and professional bodies such as member of the British Verification Council (Ben Crowther was a founding member) and quality assurance peer review organisations such as CL:AIRE with their TGVP/SGVP system all suggest several key elements are required for the action of verification which are all included in this plan. There is a small additional fee for a declared site through the CL:AIRE system, which is optional.

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Professional Installers:

As the installation may be conducted by professional staff qualified with the NVQL2 diploma in substructure occupations (installation of Gas Membranes) a professionally qualified person is not necessary in this case, with approval from Powerbase, the materials manufacturer and so experienced ground workers can create an excellent installation as long as manufacturers guidelines are followed.

Frequency of Inspection:

Verification is required for the all installation events, prior to any covering of the gas barrier on the new build properties.

The plan for Griffin Close will be 100% inspection of membrane and evidential reporting on Depth of the void as well as inspection during installation of insulation for protection of the installed membrane. This is especially the case if experienced ground workers conduct the installation. Immediately post installation is the Key time that damage can occur and must be dealt with appropriately. Care in the placement of insulation will be observed after checking 25% of all seams and seals.

Subgrade

Subgrade quality is key to a successful install, subgrade inspection forms shall be submitted by site management or acceptance forms from professional installers to GeoEnginSeerLtd.

With Griffin Close the subfloor build-up of Void space, (with connections to outside air) Beam and Block Flooring, and professionally installed Membrane Gas Barrier, with independent verification, which will then be protected with the rapid installation of insulation or screeding.



Additional Important Considerations:

Follow on trades taking care and avoiding damage to the installed material is crucial all levels of Management must pay heed to this to prevent damage as detailed above.

Tool Box talks detailing the above and the importance of reporting damage so it can be repaired is critical.

Individual or Daily Verification Event Recording

Each verification event will photographically document any repairs. These records may include subgrade sign off forms and each report will evidence all non-destructive testing conducted. A report of the event detailing any issues, concerns and all testing will be produced each time verification is required. This will usually be close to the end of each stage of installation, so that repairs can be affected. Air flow testing will occur to any installed ventilation duct work.

Confirmation of appropriate products used over 100% of the installed system will be conducted on each and every verification event.

Communication

Communication is crucial to a successful project. Appropriately timed verification event coordination will occur just before the completion of each section of gas protection measure installation, especially of the gas resistant barrier membrane.



British Standard 8485:2015+A1:2019 Calculated Points System

This has been outlined in the Geo Environmental Engineering Remedial Strategy document. The Architect and manufacturer of gas protection membrane designed solution for gas protection is a robust system that achieves the points that are required to ensure protection of this property and the occupants.

3.5 points are required for this Type A building, with the precautionary adoption of Characteristic Situation 2, Low Risk is in effect at this site. The installation of an appropriate gas barrier membrane (link in appendices), and subsequent independent verification testing provides 2.0 points. The inclusion of a passive dispersal layer of very good ventilation standard provides 1.5 points.

This gives a total score of 3.5 points in the British Standard referenced above.

Passive Ventilation Connection to the Open Atmosphere

There are accepted standards in the construction industry that address this principal. Industry standards (NHBC, LABC, Premier Guarantee and others) accept minimum 1.8m centers of ventilation points around the development, and this is in line with guidance and manufacturers recommendations.

Conclusive Reporting

A final Gas Protection Verification Report for the Griffin Close project will be supplied to summarise and document all the above testing, materials deployed and as built effectiveness of the passive ventilation system. Any damage, repairs and variations necessary, if any, to this plan will be documented.

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Conclusion - Statement

This system provides the minimum of two elements required by the British Standard guidance for the 3.5 points required for the protection of this privately owned residential Type A building.

The gas protection measures above constitute a satisfactory solution for this system, given the level of risk and allows for structural stability of the development.

Ben Crowther
23.10.2024

SGPV 004



Product Specification

The following pages detail appropriate gas resistant materials for the Griffin Close, such as Powerbase Multigas 500.

The materials have been chosen to protect different areas of the designed build. The design of protective layers has included a three tier system to protect this development by placing a sub floor void under the gas resistance membrane system.

The following specification is specific to this development – to encompass a minimum standard material to meet the BS8485:2015+A1:2019 characteristic situation 2 requirement.

Verification of the installed gas protection scheme is a strict requirement.

Seals between the outer service pipes placed through conduits and the internal face, and possible external face of such conduits also needs careful addressing. In the UK area an accepted suggested material to fit this purpose is Filo seal or StopAq.

It is the recommendation of GeoEnginSeer Ltd that, wherever possible, welded seams should be implemented in place of taped seams. There is a tendency of taped and self-adhesive seems to perform to a lesser standard than that of welded seams when installed in adverse weather conditions. Welded seams have been found to be more withstanding of previously conducted destructive testing.



Product	Description	Installation & Testing
Example Membrane: Powerbase Multigas 500 Gas Resistant Membrane	Powerbase® is a range of geosynthetic barrier membranes for protection against naturally occurring hazardous gases and soils contaminated with hydrocarbons or toxic industrial pollutants. They are also used for groundwater and environmental protection installations.	Installation as per manufacturers guidance. Compliant to BS 8485:2015 + A1:2019. Independently tested to ISO 15105-1. CE Marking
Gas Resistant Self-Adhesive Membrane	Gas Resistant (GR) Self Adhesive Membrane (SAM) is a material designed to prevent the transmission of carbon dioxide, radon and methane gases in tanking applications or where hydrostatic pressure is present. Resistance to gas is achieved by an integral aluminum film. Substrates should be primed with a Tanking Primer prior to application.	Installation as per manufacturers guidance & BBA Cert Annex C - Testing in accordance with CIRIA 735 & BS8485:2015+A12019
Preformed Corners or Top hats	Manufacturers can produce formed shapes to fit round difficult corners or pipe joints. These need to be sized correctly for pipe or service entry fittings used in welded/GR-SAM fitted situations	These elements also need to be in line with manufacturers guidance & BBA Cert Annex C - Testing in accordance with CIRIA 735 & BS8485:2015+A12019
Seal between inner of conduits for serves and outer of conduit	Filo seal, or similar or better performance material: https://www.filoform.co.uk/filoseal-hd-re-enterable-duct-sealing	No BBA exists so an appropriate gas resistant self-adhesive should be used to ensure gas resistance is achieved.
Liquid Membrane and close sealed foam (eg Filoseal)	Sealing the gap between service conduits internal face and external surface of the service	Physical and visual checks of the integrity of the seals

Verification Process

Verification is accordance with the Construction Industry Research and Information Association (CIRIA 735) & British Standards 8485:2015 +A1:2019

The following tests will be conducted during the Verification process.

1. Pick & Probe testing on minimum of 100% of all seams
2. Non Destructive Air Lance testing on a minimum of 100% of all seams to ASTM D4437 (2008)
3. Visual Inspections on minimum of 100% of all seams
4. Destructive Testing on selected seam test welds or field tests where appropriate
5. Verification reporting prior to each major concrete pour, or built wall section, shall be conducted and will include written records, photographic evidence and subgrade sign off records.
6. Visual inspection of Subgrades and subgrade hand over forms where available.
7. Trace gas testing on appropriate locations, can be conducted post construction.
8. Air flow testing on passive ventilation to check flow potential in the subfloor voids.

In addition; where possible a quality control regime conducted by a named installer shall be recorded and added to verification reporting upon each verification reporting event.

Risk – Based Approach to Verification

A risk based system takes account of various factors that will influence the consideration of the scope of verification activities, including integrity testing. The verification specialist will consider the following:

1. Site – specific gas regime.
 2. Number of buildings/plots to be inspected and over the period this will take place.
 3. Complexity of the design and installation.
 4. Qualifications and or experience of the workforce.
 5. Additional gas resistance protection.
-

Elements that have been considered in the generation of this Verification Plan

Gas Regime:

Low Risk	CS2 - Amber 1
Intermediate Risk	CS3/4
High Risk	CS4 and above

Design complexity:

Simple	Few service entries/penetrations, gas membrane and sub floor void
Complex	Variety of gas protection measures, numerous columns/penetrations/service entries, corners and small spaces

Number of plots/buildings:

Small	<5
Medium	5-15
Large	>10

Installation workforce: To be confirmed

Non Specialist	General builder/ground worker
Skilled	Qualified and experienced installer (NVQ 2 qualification in gas protection installation)

:

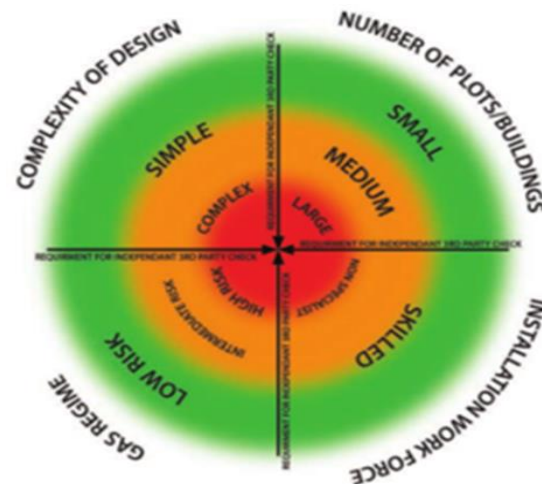


Diagram of risk from Ciria 735

Conclusion: The Gas Regime for this development is a Characteristic Situation 2 = Low Risk

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Annex

A – Ben Crowther: GeoEnginSeerLtd: Verification Specialist: Person Specification.

B – Building Plans, elevations, location plan and setting out of plots

C – Product Specification: Example Gas Membrane and associated jointing and sealing products.

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Geological Services: Verification Specialist: Freelance Geologist

Ben Crowther trading as GeoEnginSeer Ltd; Independent Geological Services.

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Qualifications: B.Sc, M.Sc, PGCE, FGS, CIEH, PCA QT (CSSW) SGVP (CL:AIRE)

NVQL3 Assessor of: Verification of Gas Protection Measures (NVQL4)

Confined Spaces L1, IPAF Harness Training, Cradle Safety.

PCA Qualified Technician in structural waterproofing. October 2020

Experience Summary:

15 years local authority regulation

14 years site investigation, site supervision, construction quality assurance and verification

Previous Secretary of, and founder member of the British Verification Council

Attendee of CIRIA Research Group 'Remedial Measures for Proprietary Gas Protection Measures'

Assessor for: NVQL4 Verification of Gas Protection Systems

CL:AIRE GPVS Assessor, SGVP certificate holder No.004

Climber, Fell Runner, Wild Swimmer, Ex Royal Marine Diver.

Recent CPD Summary:

GG5 2 Day A-Z of Ground Gas August 2017

CIRIA Verification Training Event October 2017

PCA Structural Waterproofing Conference 2018, 2019

CIRIA Technical Meeting for Retrospective Fitting of Gas Resistant Membranes 2019

Brownfield Summit Attendance 2018, 2019, 2020, 2021, 2022

DoWCoP CL:AIRE Training March 2021

PCA CSSW Qualified Technician Training 2021, working towards CSSW qualification.

Appeared on: Gassing On! with Neil Salvidge.

HS2 Align Training for Tunnel Shaft H&S Green Tunnels and Shaft Work: C1 and C2,

2022 Cradle safety and IPAF harness use trained: Operator Licence: OP/2157339

Signature:



GEO2022-5496: Griffin Close, Frizington - Exploratory Hole Location Plan

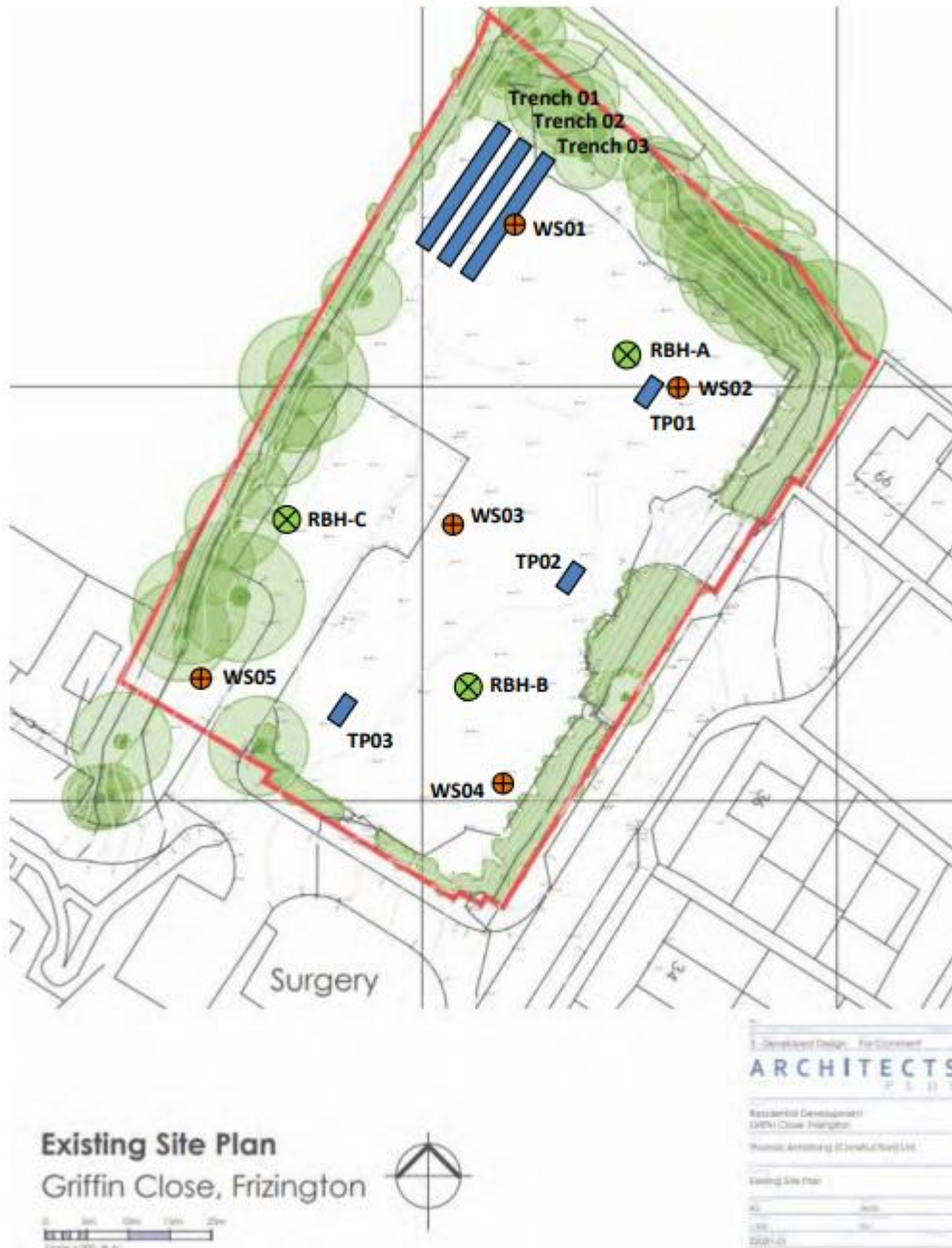


Figure 2: Site Borehole Map

This document has been created in accordance with British Standards 8485:2015+A1:2019 & Construction Industry Research and Information Association
 CIRIA 735 – Good Practice on the testing and verification of ground gas protection systems for buildings against hazardous ground gases



Figure 3: Existing Site Plan

This document has been created in accordance with British Standards 8485:2015+A1:2019 & Construction Industry Research and Information Association
 CIRIA 735 – Good Practice on the testing and verification of ground gas protection systems for buildings against hazardous ground gases



Figure 4: Proposed Site Plan

This document has been created in accordance with British Standards 8485:2015+A1:2019 & Construction Industry Research and Information Association
 CIRIA 735 – Good Practice on the testing and verification of ground gas protection systems for buildings against hazardous ground gases

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Annex C

Example materials website to use to as reference for installation guides.

Links provided to save space: example:

<https://itpltd.com/powerbase-multigas-barriers/>

Others can be found through:

[BGA \(britishgeomembraneassociation.co.uk\)](http://britishgeomembraneassociation.co.uk)

<https://visqueen.com/products/visqueen-gas-barrier/>

Last accessed October 2024.