Geotechnical & Geo-environmental Desk Study Report
Cwm Farm, Dare Road, Aberdare

Prepared For:
Trustees of Cwm Farm Estate, Aberdare

April 2019

Job No: 15266
Executive Summary

<table>
<thead>
<tr>
<th>Site location</th>
<th>The site situates on farmland to the west of the southwest of Aberdare at a National Grid Reference of 299390, 202510. It occupies an approximate plan area of 6.01 hectares.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site history</td>
<td>The site has been occupied by field land with a farmhouse and stables at the southern area of the site since the earliest map researched. Railway lines have surrounded the site until the latter half of the twentieth century. The site is located within an area that has been heavily exploited by the coal mining industry.</td>
</tr>
</tbody>
</table>
| Geology       | The site is underlain by the South Wales Middle Coal Measures Formation. Dip readings indicate that bedrock dips to the south by 8-9°.  
|               | The conjectured Two Feet Nine Group coal seam (2-foot 3 inches thick) is shown outcropping approximately 200m to the north of the site. Based on a dip of 8°, it is expected that the Two Feet Nine will lie at shallow depth beneath the northeast of the site.  
|               | Two unnamed thin coal seams (1 foot each) are located approximately 3.6m and 8.4m beneath the Two Feet Nine Group coal seam, the Driver, Four Feet and No.1 Yard coal seam lie approximately 23m, 29m and 44m below the Two Feet Nine Group. It should however be noted that variation of the depths can be expected.  
|               | The conjectured outcrop of the Gorllwyn coal seam lies approximately 60m to the south of the site, and therefore will not underlie the site. The generalised vertical section does not indicate any coal seams between the Two Feet Nine Group and the Gorllwyn.  
|               | The Gladlys Fault, which trends from north northwest to south southwest lies approximately 330m east of the site and downthrows to the west.  
|               | Till deposits are shown across the entire site. |
| Assessment of Shallow Mining Risk | When assessing the risks from shallow mine workings, as a rule of thumb to prevent the future collapse of mine workings migrating to the surface and forming crown holes there should be a 10:1 rock head to void ratio.  
|               | It is unlikely that this criterion would be achieved over the Two Feet Nine coal seam; particularly at the far north of the site. There may also be insufficient rockhead cover above the coal seams down to No.1 Yard.  
|               | The coal seams that lie within shallow depth of the site are typically recorded as being of workable thickness and are worked in the local area. It is therefore possible that workings in the Two Feet Nine coal seam, and others below will lie at shallow depth; particularly beneath the northern portion of the site.  
|               | Given the amount of mining features shown on both the historical maps and geological maps for the area, and the mining report for the site, it is considered that the risk to surface stability at the site from shallow unrecorded workings is high.  
|               | A site investigation comprising rotary probeholes should therefore be carried out to quantify the risk from past workings in the shallow seams beneath the site. |
| Preliminary Engineering Recommendations | Given the potential risk to the proposed development from shallow mine working a likely foundation solution is unable to be offered at this time.  
|               | If, however the results of the recommended site investigation indicate near surface soils to have suitable consistency and mine workings beneath the site are discounted then a traditional strip and trench fill foundation may be recommended as a likely solution. |
| Recommended | An intrusive site investigation should be undertaken to achieve the following objectives:  
|               | 1. Investigate the risk from historical unrecorded mine workings beneath the site  
|               | 2. Identify the potential environmental liabilities at the site associated with any soil, gas and groundwater contamination from past site uses.  
|               | 3. Provide a summary of the environmental conditions at the site, together with any necessary remediation works to render the site fit for its intended use.  
|               | 4. Provide recommendations with regard to any relevant geotechnical aspects pertaining to the development |
TABLE OF CONTENTS

SECTION 1 Introduction and Proposed Development
  1.1 Limitations and Exceptions of Desk Study

SECTION 2 Review of Existing Data
  2.1 Physical Setting, Current Use and Site Conditions
  2.2 Site History
  2.3 Geological
    2.3.1 Geology
    2.3.2 Mining
    2.3.3 Radon
  2.4 Environmental Setting
    2.4.1 Hydrogeology and Hydrology
    2.4.2 Groundwater
    2.4.3 Flooding
    2.4.4 Waste
    2.4.5 Pollution
    2.4.6 Infilled Land

SECTION 3 Preliminary Qualitative Risk Assessment
  3.1 General
  3.2 Preliminary Site Conceptual Model
  3.3 Potential Sources of Contamination and Gas
  3.4 Potential Receptors
  3.5 Potential Pathways
  3.6 Summary of Site Conceptual Model

SECTION 4 Assessment of the Risk from Past Shallow Coal Mining

SECTION 5 Preliminary Engineering Recommendations
  5.1 Preparation of Site
  5.2 Foundation and Floor Slab Solution
  5.3 Excavations and Formations
  5.4 Access Roads and Car Parking Areas
  5.5 Protection of Buried Concrete
  5.6 Storm Water Drainage

SECTION 6 Recommended Site Investigation
  6.1 General
  6.2 Intrusive Investigation
  6.3 Soil Sampling Strategy
  6.4 Laboratory Chemical Analysis
  6.5 Gas Monitoring

Figures
  Figure 2.1 Site Location
  Figure 2.2 Extract from 1:10,560 Geological Sheet SN 90 SE
**TABLE OF CONTENTS** (Continued)

**Tables**
- Table 2.1  Historical Development from Map Information
- Table 3.1  Qualitative Preliminary Human Health Risk Assessment
- Table 3.2  Qualitative Preliminary Environmental Risk Assessment

**Annexes**
- Annex A  Historical Maps
- Annex B  Envirocheck Datasheets
- Annex C  Coal Authority Mining Report
- Annex D  Risk Assessment Definitions

**Drawings**
- Drawing 01A  Workings in the Upper Yard Seam (Gladlys Colliery)
- Drawing 01B  Workings in the Four Feet Seam (Gladlys Colliery)
SECTION 1  Introduction and Proposed Development

Trustees of Cwm Farm Estate, Aberdare propose a residential development comprising low-rise housing at Cwm Farm, Dare Road, Aberdare.

CB3 Consult Limited is the Consulting Civil and Structural Engineer for the proposed development.

Terra Firma (Wales) Limited has been commissioned to undertake a Phase I geotechnical & geo-environmental desk study of the site.

The main objectives of the desk study were to:

- To provide information on past and current uses of the site and surrounding area
- To provide information on the nature of any hazards and physical constraints, for example buried structures/obstructions
- To provide information on the likely ground conditions beneath the site, including soil types, groundwater and if made ground is likely to be present
- To provide information on the geology, hydro-geology and hydrology of the site
- Identify the likely potential environmental liabilities at the site associated with any soil and groundwater contamination from past site uses
- Identify if methane/radon gas emissions either from the site or surrounding areas is likely to be present
- To produce an initial site conceptual model of the site, to illustrate the nature and extent of potential contamination, its source, potential pathways and likely receptors (pollutant linkage)
- To provide data for a preliminary risk assessment
- To provide data to assist in the design of an intrusive site investigation and give early indications of possible remediation requirements

1.1 Limitations and Exceptions

Trustees of Cwm Farm Estate, Aberdare has requested that a Desk Based Coal Mining Risk Assessment Report be prepared.

The Coal Mining Risk Assessment was conducted and this report has been prepared for the sole internal reliance of Trustees of Cwm Farm Estate, Aberdare and its design and construction team. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Terra Firma (Wales) Limited. If an unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report represents the findings and opinions of experienced geotechnical consultants. Terra Firma (Wales) Limited does not provide legal advice and the advice of lawyers may also be required.

The subsurface geological profiles are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested.
SECTION 2  Review of Existing Data

2.1  Physical Setting and Current Site Use

The site situates on farmland to the west of Aberdare at a National Grid Reference of 299390, 202510. It occupies an approximate plan area of 6.01 hectares.

Figure 2.1: Site Location - OS Vector Map (not to scale)

The site is accessed from a single lane access road to the south of the site. The road leads to Dare Valley Country Park to the west. The site is field land, separated into nine parcels of land, and surrounded by hedgerows and trees. A farmhouse and stables are located at the centre/south of the site

The site falls gently to the north, and towards Afon Dare. A steep embankment falls down to a stream, which runs alongside the site’s southeast and east boundary.
2.2 Site History

The history of the site has been traced using historical Ordnance Survey maps obtained from Landmark Information Group. These are presented in Annex A. A summary of the history of the site is given below. Distances, where quoted are approximate.

<table>
<thead>
<tr>
<th>Map Edition and Scale</th>
<th>Key Features on Site</th>
<th>Key Features off Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1868 1:2,500</td>
<td>The site is separated into three fields with a farmhouse (known as Glyn-brownwydd) at the south of the site. A footpath lead from the site entrance at the south of the site, northwards through the farmhouse and up to the railway embankment, which runs across the site's northern boundary. The embankment extends onto the far north of the site along the west side of the footpath.</td>
<td>Railway embankments abut the site’s north, east and southwest boundaries. A stream flows to the southeast of the site. The site lies 490m west of Aberdare, separated by fields. Graig Colliery lies 40m south of the site and Dare Pit lies 55m to the north; both are surrounded by colliery spoil. Gladlys Old Pit (disused) is located 190m northeast of the site. Air shafts are located around the site; the nearest of which is located 125m southwest of the site. Dare viaduct is located 35m northwest of the site and Dare River flows from east to west within 30m of the site’s northern boundary.</td>
</tr>
<tr>
<td>1900 1:2,500</td>
<td>The site has been divided into four fields and a garden at the rear of farm (now known as Cwm Farm). The route of the footpath has been altered slightly to run alongside the farm rather than through it.</td>
<td>Dare Junction is located to the immediate south of the site. An old coal level is recorded 30m southeast of the site. Gladlys New Pit is located 205m east of the site.</td>
</tr>
<tr>
<td>1920 1:2,500</td>
<td>No significant changes.</td>
<td>The number of lines at Dare Junction has decreased. Graig Colliery has become disused. Gladlys Old &amp; New Pits, and Dare Colliery are no longer recorded and have been replaced by terrace housing.</td>
</tr>
<tr>
<td>1938 1:10,560</td>
<td>No significant changes.</td>
<td>No significant changes.</td>
</tr>
<tr>
<td>1963 1:2,500</td>
<td>Four new farm buildings have been built around Cwm Farm farmhouse.</td>
<td>The railway lines to the southwest and east have been dismantled and removed, leaving only the embankments. A large housing estate has been built 65m east of the site. No signs of coal mining exist around the site.</td>
</tr>
<tr>
<td>1976 1:2,500</td>
<td>No significant changes.</td>
<td>No significant changes.</td>
</tr>
</tbody>
</table>
### 2.2 Site History (Continued)

<table>
<thead>
<tr>
<th>Map Edition and Scale</th>
<th>Key Features on Site</th>
<th>Key Features off Site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1993 1:1,250</strong></td>
<td>No significant changes. The site is part of Dare Valley Country Park</td>
<td>The railway line to the north of the site has been dismantled and removed, leaving only the embankment. A large housing estate and comprehensive school has been built 120m and 80m north of the site respectively.</td>
</tr>
<tr>
<td><strong>2003 1:10,000</strong></td>
<td>No significant changes.</td>
<td>No significant changes.</td>
</tr>
<tr>
<td><strong>2019 1:10,000</strong></td>
<td>No significant changes.</td>
<td>Houses have been built 50m north of the site</td>
</tr>
</tbody>
</table>
2.3 Geological Setting

2.3.1 Geology

The 1:10,560 scale geological map of the area (Sheet SN 90 SE) and the 1:50,000 scale geological map (Sheet 247) of the area was consulted. An extract of the 1:50,000 geological map is presented in Annex B and an extract of the 1:10,560 is presented below.

![Extract from 1:10,560 Geological Sheet SN 90 SE](image)

The site is underlain by the South Wales Middle Coal Measures Formation. These are grey coal-bearing mudstones/siltstones, with seatearths and minor sandstones. Dip readings indicate that bedrock dips to the south by 8-9°.

The conjectured Two Feet Nine Group coal seam (2-foot 3 inches thick) is shown outcropping approximately 200m to the north of the site. Based on a dip of 8°, it is expected that the Two Feet Nine will lie at shallow depth beneath the northeast of the site.

Two unnamed thin coal seams (1 foot each) are located approximately 3.6m and 8.4m beneath the Two Feet Nine Group coal seam. The Driver, Four Feet and No.1 Yard coal seam lie approximately 23m, 29m and 44m below the Two Feet Nine Group. It should however be noted that variation of the published depths can be expected.
2.3 Geology (Continued)

The conjectured outcrop of the Gorllwyn coal seam lies approximately 60m to the south of the site, and will therefore not underlie the site. The generalised vertical section does not indicate any coal seams between the Two Feet Nine Group and the Gorllwyn.

The Gladlys Fault, which trends from north northwest to south southwest lies approximately 330m east of the site and downthrows to the west.

Till deposits are shown across the entire site. These are a group of sediments laid down by the direct action of glacial ice. They have a variable lithology, usually sandy, silty clay with gravel, cobbles and boulders, but can contain gravel-rich, or laminated sand layers; varied colour and consistency.

2.3.2 Mining

A Coal Authority Mining Report was obtained for the site and is presented in Annex C.

The report states that the property is in a surface area that could be affected by underground mining in 15 seams of coal at shallow to 210m depth, and last worked in 1936.

The report states that there are no known coal mine entries within, or within 20 metres of, the boundary of the property.

The Coal Authority has no record of a mine gas emission requiring action.

The geological map shows a shaft at Dare Pit 60m to the north. Any seams worked by the shaft will lie beneath the site.

An adit located approximately 18m to the south of the site is likely to have exploited the Gorllwyn coal seam to the south of the site.

Mine Abandonment Plans procured from the Coal Authority show shallow workings in The Yard coal seam beneath the north of the site and the Six Feet coal seam beneath the majority of the site. Drawings 02A and 02B illustrate the positions of these workings. The Coal Authority do not hold any abandonment plans for seams at shallower depth beneath the site. This does not imply that unrecorded workings in these seams do not exist beneath the site.

Whilst the Coal Authority state that the workings presented in Drawing 02 and 02B are shallow, inaccuracies in their data is commonplace and should not be relied heavily upon. The best way to accurately record the depths to coal seams and shallow workings beneath the site would be to drill a series of boreholes across the site.

2.3.3 Radon

The Envirocheck datasheet and maps state that no radon protection is required for new dwellings at the investigation site.
2.4 Environmental Setting

The following sections have been compiled using the Envirocheck Datasheet and maps which can be found in Annex B.

2.4.1 Hydrogeology and Hydrology

The nearest surface water feature recorded is located 1m to the west of the site and relates to a stream, which flows along the site’s west boundary from the south and into the River Dare, which runs from west to east 32m from the north boundary of the site. Another stream runs from south to north into River Dare within 4m of the site’s west/southwest boundary.

Surface and shallow groundwater beneath the site is likely to flow in northerly and westerly directions towards the nearby streams and rivers.

Deeper groundwater flow within the underlying bedrock will be controlled by the strata dip and any fractures or bedding planes within the rock units.

The bedrock beneath the site has an aquifer designation of ‘Secondary A’. These are “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers”.

Superficial deposits are designated as being Secondary Aquifer - Undifferentiated. This is assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

2.4.2 Groundwater

The Envirocheck Report does not place the site within 1km of a groundwater source protection zone.

2.4.3 Flooding

The site does not lie in an area considered to be at risk from flooding (1 in 100 probability) or extreme flooding (1 in 1000 probability) from rivers or sea.

The BGS data states that most of the site has “limited potential for groundwater flooding to occur”, and “potential for groundwater flooding of property situated below ground level”. “Potential for groundwater flooding to occur at surface" is recorded at the south and southwest of the site.

The far west and south of the site fall within the Surface Water 1 in 30-year flood extent. This flood area surrounds the site and encroaches further onto the west and south of the site for 1 in 100, and 1 in 1000-year flood extents.

The detailed flood maps are presented in Annex B.
2.4.4 Waste

No landfills or areas of infilled land are recorded by the Envirocheck Report to be within 250m of the site.

A scrapyard was located 61m northeast of the site at Lambert Terrace, Gladlys. The facility received between 10,000 and 25,000 (small input rate) until 1990 when the licence was surrendered.

2.4.5 Pollution

A Category 3 minor pollution incident involving crude sewage was recorded at the site’s north boundary in 1996. The incident reference is 29590.

2.4.6 Infilled Land

Two large areas of infilled land are recorded within 10m of the site. These are likely to be colliery spoil tips from the historic mining that has taken place around the site. Two small infilled streams are also identified within 250m of the site; the closest of which is located 39m east of the site.
SECTION 3 Preliminary Human Health and Environmental Risk Assessment

3.1 General

The contaminated land regime is set out in Part IIA of the Environmental Protection Act (EPA) 1990 and was introduced on the 1st April 2000 in England and 1st July 2001 in Wales. A similar regime was introduced in Scotland on 14th July 2000. Part IIA was introduced to achieve two aims:

(1) The identification of contaminated land

(2) The remediation of contaminated land that poses an unacceptable risk to human health and/or the environment

Under Part IIA the statutory definition of ‘contaminated land’ is: any land which appears to the local authority in whose area it is situated, to be in such a condition, by reason of substances in, on, or under the land, that:

(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) Pollution of controlled waters is being, or is likely to be, caused.”

For land to be classified as ‘Contaminated Land’ there must be a ‘pollutant linkage’.

For our definitions of pollution linkage and how we define risk please refer to Annex D which includes our classifications of consequence and probability and risk assessment matrix.

3.2 Preliminary Site Conceptual Model

The preceding sections enable a preliminary conceptual model of the site to be drawn up, to illustrate the likely ground conditions beneath the site together with a preliminary assessment of the nature of any underlying aquifers and groundwater movement. The preliminary site conceptual model is used as a model for the design and implementation of the site investigation, whereby areas of potential contamination can be targeted as well as investigating the site as a whole.

3.3 Potential Sources of Contamination and Gas

The potential contamination beneath the site, whether in the matrix of soil or groundwater is related to the sites past use. The site has been unoccupied field land throughout the years researched apart from an embankment at the far north of the site, a footpath, and a farmhouse and stables that lie at the southern end of the site. The farmhouse and stables are still standing.

Based on the age of the embankment, it is most likely that re-worked natural soils were used to construct it. However, exploratory holes should be excavated into it to confirm its composition and samples from it tested.

The site should therefore be tested for a standard suite of common contaminants such as metals, metalloids, polycyclic aromatic hydrocarbons, and phenol. If any anthropogenic material is encountered on site, the samples should also be screened for asbestos.
3.4 Potential Receptors and Pollution Pathways

There are human and hydrological receptors to any contamination that may be present on site.

Construction workers will be excavating in soils and will be exposed via dermal contact with soils and dust, ingestion of soil dust and inhalation of soil dust.

A residential end use is proposed. Once developed, future site users (residents and visitors) will potentially be at risk from contaminated soils through the same pathways, ingestion of soil from site grown vegetables and potable drinking water.

Neighbouring site users and passers-by may potentially be exposed to soil dust.

If contamination is identified it may be leachable, enabling it to mobilise through perched groundwater within site soils and impact on deeper groundwater or surface water.

A Preliminary Human Health and Environmental Risk Assessment summarises the above and is detailed in the Table 3.1 below and on the following pages.
### Table 3.1 Preliminary Human Health Risk Assessment

<table>
<thead>
<tr>
<th>Potential Source</th>
<th>Potential Pathway</th>
<th>Potential Target</th>
<th>Preliminary Risk Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Soil</td>
<td>Dermal contact with soil, ingestion of soil/dust, inhalation of soil dust</td>
<td>Construction workers</td>
<td>Low Risk: COSHH assessment and good level of PPE/hygiene by site workers/staff; dust suppression measures if required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Passers - by/neighbouring site users</td>
<td>Low Risk: Significant quantities of Made Ground or anthropogenic material is not anticipated on the site.</td>
</tr>
<tr>
<td></td>
<td>Dermal contact with soil, ingestion of soil/dust or site grown vegetables, inhalation of soil dust</td>
<td>Site End Users – Employees and visitors.</td>
<td>Low Risk: Significant quantities of Made Ground or anthropogenic material is not anticipated on the site.</td>
</tr>
<tr>
<td>Radon Gas from underlying bedrock</td>
<td>Migration into indoor air</td>
<td>Site End Users – Employees and visitors.</td>
<td>Medium Risk: BGS Radon Report confirms no radon protection measures required</td>
</tr>
<tr>
<td>Landfill gas</td>
<td>Migration through superficial deposits and bedrock and accumulation indoors</td>
<td>Site End Users – Employees and visitors.</td>
<td>Negligible Risk: No landfill facilities within 250m of the site.</td>
</tr>
<tr>
<td>Ground gas</td>
<td>Direct from any made ground/buried organic matter on site and accumulation indoors</td>
<td>Site End Users – Employees and visitors.</td>
<td>Low Risk: Significant quantities of Made Ground or soils containing significant amounts of organic matter are not anticipated on site. Infilled land related to past mining surrounds the site.</td>
</tr>
<tr>
<td>Vapours</td>
<td>Migration into indoor air</td>
<td>Site End Users – Employees and visitors.</td>
<td>Negligible Risk: Made Ground is not anticipated on site and no contamination sources or contaminative site uses related to vapours have been identified.</td>
</tr>
<tr>
<td>Site Soils</td>
<td>Permeation of drinking water pipes</td>
<td>Site End Users – Employees and visitors.</td>
<td>Low Risk: Significant amounts of Made Ground or anthropogenic material is not anticipated on the site.</td>
</tr>
</tbody>
</table>
### 3.5 Preliminary Human Health and Environmental Risk Assessment

(Continued)

<table>
<thead>
<tr>
<th>Table 3.2 Preliminary Environmental Risk Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aquatic Environment</strong></td>
</tr>
<tr>
<td>Site Soils</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Site Soils</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Site Soils</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Vegetation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Soils</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Building Materials</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Soils</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
SECTION 4  Assessment of the Risk from Past Shallow Coal Mining

Based upon the geological and desk study information the stratigraphical sequence beneath the site is taken to be:

- Till
- Measures
- Two Feet Nine 2-foot 3 inches thick
- Measures
- Unnamed (thin) coal seam 1-foot thick
- Measures
- Unnamed (thin) coal seam 1-foot thick
- Measures
- Driver 2-foot thick
- Measures
- Four Feet 3-foot 3 inches thick
- Measures
- No.1 Yard 3-foot 6 inches thick
- Measures
- Six Feet 6-feet thick
- Measures

When assessing the risks from shallow mine workings, as a rule of thumb to prevent the future collapse of mine workings migrating to the surface and forming crown holes there should be a 10:1 rock head to void ratio.

It is unlikely that this criterion would be achieved over the Two Feet Nine coal seam; particularly at the far north of the site. There may also be insufficient rockhead cover above the coal seams down to No.1 Yard.

The coal seams listed above are typically recorded as being of workable thickness and are worked in the local area. It is therefore possible that workings in the Two-Feet Nine coal seam, and others below will lie at shallow depth; particularly beneath the northern portion of the site.

Given the amount of mining features shown on both the historical maps and geological maps for the area, and the mining report for the site, it is considered that the risk to surface stability at the site from shallow unrecorded workings is high.

A site investigation comprising rotary probeholes should therefore be carried out to quantify the risk from past workings in the shallow seams beneath the site.
SECTION 5 Preliminary Engineering Recommendations

Recommendations given in the following sections are based upon the available desk study information and need to be confirmed by the recommended site investigation outlined in Section 6.

5.1 Preparation of Site

Any trees and surface vegetation beneath the proposed development area, including all roots should be grubbed up and removed from site.

Contingencies should be made for the protection/diversion any underground/overhead services present beneath/above the site brought about as a result of the proposed works.

Any reduced levels should be brought up to the required levels with suitable inert mainly granular materials. Department of Transport (DoT) type 2 sub base or similar should be used and should be compacted in layers to the requirements of the Specification for Highway works.

Allowances should also be made for the excavation of any soft spots/areas and their replacement with well compacted imported granular materials.

In accordance with EC Regulation 1272/2008 and Environment Agency Guidance WM2 soils and other materials destined for off-site disposal should be classified on the basis of their hazard phrases prior to disposal. Soils are classified as a mirror entry waste and should be classified on the basis of their specific chemical properties. Terra Firma offer this service if required.

5.2 Foundation and Floor Slab Solution

Given the potential risk to the proposed development from shallow mine working a likely foundation solution is unable to be offered at this time.

If, however the results of the recommended site investigation indicate near surface soils to have suitable consistency and mine workings beneath the site are discounted then a traditional strip and trench fill foundation may be recommended as a likely solution.

5.3 Excavations and Formations

Most of the shallow excavations should be possible with normal soil excavating machinery. However, allowances should be made for the use of hydraulic breaker attachments if excavating out any shallow bedrock.

Shallow excavations may encounter groundwater flows. Any inflows together with rainwater infiltration should be dealt with by conventional pumping techniques.

The sides of any excavations deeper than 1.2m should be supported by planking and strutting or other proprietary means.

The sub-formations/formations will be highly susceptible to loosening, softening and deterioration by exposure to weather (rain, frost and drying conditions), the action of water (flood water or removal of groundwater) and site traffic. Formations should never be left unprotected and continuously exposed to rain causing degradation, or left exposed/uncovered overnight, unless permitted by a qualified engineer.
5.3 Excavations and Formations (Continued)

Construction plant and other vehicular traffic should not be operated on unprotected formations.

5.4 Access Roads and Car Parking Areas

For car parking and road area formations the CBR value for shallow soils should be determined by in-situ CBR testing.

Allowances should be made for the removal of any ‘soft spots/areas’ and their replacement with well-compacted granular materials as previously described.

5.5 Protection of Buried Concrete

Within BRE Special Digest 1 the chemical agents that aggressively attack concrete are sulphate, sulphides, magnesium ions, ammonium ions, carbon dioxide, chloride ions and phenols.

It is recommended that soils are tested to facilitate a classification.

5.6 Storm Water Drainage

Soakaway drainage is unlikely to be suitable in the shallow glacial Till materials. Soil infiltration should however be confirmed by a ground investigation and in-situ soakaway tests.
SECTION 6  Recommended Site Investigation

6.1 General

An intrusive site investigation should be undertaken to achieve the following objectives:

- Investigate the risk from historical unrecorded mine workings beneath the site.
- Identify the potential environmental liabilities at the site associated with any soil, gas and groundwater contamination from past site uses.
- Provide a summary of the environmental conditions at the site, together with any necessary remediation works to render the site fit for its intended use.
- Provide recommendations with regard to any relevant geotechnical aspects pertaining to the development.

6.2 Intrusive Investigation

A trial pitting investigation is recommended to inspect the ground conditions and to take soil samples for laboratory environmental and geotechnical testing.

Rotary boreholes extended to a minimum depth of 30m are recommended to establish the risk to proposed structures from unrecorded shallow mining.

6.3 Soil Sampling Strategy

The sampling strategy will be dictated by the site investigation and its findings.

The ultimate objectives of the soil sampling are:

- Determine type and concentration of contamination
- Determine lateral and vertical spread of contaminants
- Ensure representativeness of the entire site
- Identify hot spots
- Provide sufficient data in order to undertake a robust quantitative risk assessment and determine if and what remedial measures are necessary
- Prevent cross contamination between samples

6.4 Laboratory Chemical Analysis

Soil samples should be tested for the following suite of substances as a minimum.

<table>
<thead>
<tr>
<th>Metals and Metalloids</th>
<th>In-Organics</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Cyanide</td>
<td>pH (acidity)</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Sulphate</td>
<td>Asbestos</td>
</tr>
<tr>
<td>Chromium III</td>
<td></td>
<td>BRE SD1 Suite</td>
</tr>
<tr>
<td>Chromium VI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Organic Chemicals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyaromatic Hydrocarbons (PAH)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.5 Gas Monitoring

Based on the available desk study information, there is a potential ground gas risk due to the nearby infilled land. Gas monitoring should therefore be undertaken to inform a ground gas risk assessment.

A minimum six gas monitoring visits should be carried out at regular intervals. This will allow for variations of temperature, rainfall and atmospheric pressure. At each visit the levels of methane, carbon dioxide and hydrogen sulphide need to be established as well as the lower and upper explosive limits for methane and the flow rate. All results should be compiled and interpreted in line with CIRIA C665. This document specifies if and which gas protection measures may be required for the proposed new development.
Glamorganshire
Published 1884 - 1885
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1864 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed data. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Order Details
Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT
Glamorganshire
Published 1900 - 1901
Source map scale - 1:10,560
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840’s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,500 maps. The published date given therefore is often some years later than the surveyed data. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940’s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Historical Map - Slice A

Order Details
Order Number: 196925494_1.1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Glamorganshire
Published 1921
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Historical Map - Slice A

Map Name(s) and Date(s)

Order Details
Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT
Historical Aerial Photography

Published 1945

Source map scale - 1:10,560

The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 1950's meant that every photograph was re-checked for potentially unsafe information with security sites replaced by fake fields or clouds. The original editions were withdrawn and only later made available after a period of fifty years although due to the accuracy of the editing, without viewing both revisions it is not easy to spot the edits. Where available Landmark have included both revisions.

© Landmark Information Group and/or Data Suppliers 2010.

Historical Aerial Photography - Slice A

Map Name(s) and Date(s)

Order Details
Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT
Ordnance Survey Plan
Published 1964
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Order Details
Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT

Map Name(s) and Date(s)

Historical Map - Slice A
Order Details
Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT

Ordnance Survey Plan
Published 1969
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1864 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed data. Before 1838, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840's, a Provisonal Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.
Ordnance Survey Plan
Published 1978
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

Historical Map - Slice A

Order Details
Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmbran, Aberdare, CF44 7PT
Ordnance Survey Plan
Published 1982
Source map scale - 1:10,000
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed data. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1840's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

Historical Map - Slice A

Order Details
Order Number: 196325494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details
Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT
Order Details

Order Number: 196925494_1_1
Customer Ref: Cwm Farm, Aberdare
National Grid Reference: 299390, 202510
Slice: A
Site Area (Ha): 6.01
Search Buffer (m): 1000

Site Details

Cwm Farm, Dare Road, Cwmdare, Aberdare, CF44 7PT

Historical Map - Slice A

Ordnance Survey Plan
Published 1990
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1890s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.