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P – Geotechnical & Coal Mining Risk Assessment Reports

Merthyr Tydfil County Borough Council

GOAT MILL ROAD DEVELOPMENT

Desk Study



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Merthyr Tydfil County Borough Council

GOAT MILL ROAD DEVELOPMENT

Desk Study

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Desk Study

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1 INTRODUCTION

The land to the east of Goat Mill Road, Merthyr Tydfil, has been considered as a potential site for industrial or commercial development. The available land is approximately 14.6-hectares.

The proposed development comprises a central spine road with commercial units aligned to the east and west with associated access roads. A drainage system comprising swales alongside the site roads, with attenuation ponds located to the north and south of the site are also proposed. Access to the site will be via junctions on Goat Mill Road located to the north and south of the site.

1.1 OBJECTIVES

Merthyr Tydfil County Borough Council have appointed WSP UK Ltd (WSP) to prepare a Desk Study for the proposed development of land off Goat Mill Road, hereafter referred to as the 'Site'.

This Desk Study report for the proposed development is based on the Preliminary Sources Study Report (PSSR) recommendations, as described in CD 622 Managing Geotechnical Risk [1]. The report aims to establish the geotechnical and environmental risks associated with the site.

It is important to understand that any risks identified during a preliminary assessment, such as the ones presented in this document, are perceived risks based on the information reviewed. A more detailed assessment of the actual risks can only be assessed following further surveys and intrusive investigations. The preliminary assessments presented herein are qualitative, based on professional judgement following the review of available data and within the context of the existing and proposed use at the time of writing.

This Desk Study report has been prepared to inform the preliminary design of the proposed scheme. The report summarises the relevant existing historical, geotechnical and environmental information for the Site and provides a preliminary assessment of the anticipated ground conditions. A Geotechnical Risk Register, which discusses the pertinent geotechnical and geo-environmental risks, and Geohazard plan are provided.

General recommendations for an intrusive geotechnical/geo-environmental Ground Investigation (GI) are also included in this report.

1.2 LIMITS OF STUDY AREA

The plot of land, known as Goat Mill Road, is referred to as the 'Site' in this report. It is located approximately 1.1km east of Merthyr Tydfil; see Figure 1-1 below. The Site is centred around an approximate National Grid Reference (NGR) 306219E, 206929N. A detailed Site boundary location plan can be found in Appendix A. It is based on a client provided planning application boundary produced by Sirius Planning.

The Site is located east of Goat Mill Road and the A4102 and west of the A4060 dual carriageway. The Site is bound to the north by an access road to Phoenix Industrial Estate, and residential properties of Mount View to the south. The Site is known to be subject to former industrial and mining activities, most recently opencast workings..

The Site generally comprises open, sparsely grassed gravel, with a wooded margin along the western and eastern edges and pockets of dense vegetation growth scattered throughout. Two watercourses are located on Site. One is located towards the northern extent of Site and the other is

located towards the southern side of Site. Based on OS Maps Online [2], the Site is typically shown to decrease in elevation from west to east, from approximately 282m to 279m Above Ordnance Datum (AOD), and decrease from north to south, from approximately 288m to 278m AOD.

There is an unnamed watercourse which runs along a significant length of the northern site boundary. At its downstream point it exits the site via a culvert under Goat Mill Road. Its upstream channel is partly fed by an off-site culvert which passes through the base of an embankment which carries the A4046. There is a second unnamed watercourse, of lesser flow, which exits the site platform in the south western part of the site, and this also utilises a culvert passing beneath Goat Mill Road. The route of this culvert beneath the site cannot be verified by a site visit but it is possible that there is linkage to a second culvert located beneath the A4046 embankment, located just beyond the south western site boundary.

Figure 1-1 Site Location.



1.2.1 PREVIOUS GEOTECHNICAL STUDIES

WSP are aware of one previous Geotechnical Studies which is relevant to the Site. This study is noted in Table 1-1.

Table 1-1 - Previous Geotechnical Studies.

Document	Document Reference	Produced by
PRELIMINARY APPRAISAL (DESK STUDY) of land off GOAT MILL ROAD, MERTHYR TYDFIL	REPORT C8341 Rev B	Sirius Geotechnical Ltd 2024

1.3 GEOTECHNICAL CATEGORY

The scheme is expected to be classified as a Geotechnical Category 2 scheme in accordance with BS EN 1997-1:2004 [3]. Geotechnical Category 2 schemes include ‘conventional types of structure and foundation with no exceptional risk or difficult or loading conditions.’

1.4 LIMITATIONS

WSP has prepared this report for the sole use of the Client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of WSP. No other third-party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety. Information provided by others has been taken in good faith as being accurate. WSP cannot accept liability for any deficiencies in third party information.

It should be noted that, prior to commencement of the detailed design of the proposed development, the Site boundaries may be subject to change. Revision of this document and its associated preliminary risk assessment may be necessary in the future.

2 SOURCES OF INFORMATION, DESK STUDY, SITE RECONNAISSANCE, SITE DESCRIPTION AND REVIEW OF FINDINGS

2.1 SOURCES OF INFORMATION

The information sources and documents consulted in the preparation of this Preliminary Sources Study Report are summarised in Table 2-1. The findings are discussed in the succeeding chapters.

Table 2-1 - Details of all Sources Used and Enquiries made to obtain Relevant Information.

Information Type	Title/Source
Geology	▪ British Geological Survey (BGS) GeoIndex [4] ▪ BGS (1979) 1:50,000 scale solid and drift geological map of Merthyr Tydfil (Sheet 231) [5]. ▪ BGS (1972) 1:10,560 scale solid and drift geological map SO00NE [6]. ▪ BGS Online Lexicon [7]. ▪ Geology of the South Wales Coalfield, Part V, the country around Merthyr Tydfil. Memoir for 1:50 000 geological sheet 231 (England and Wales) [8].
Mining Summary	▪ BGS (1972) 1:10,560 scale solid and drift geological map SO00NE [6]. ▪ WSP (2024) Coal Mining Risk Assessment [9].
Historical Borehole Summary	▪ BGS GeoIndex [4].
Topography	▪ Google Earth Pro [10]
Hydrology	▪ Natural Resources Wales (NRW) Check your flood risk [11]
Hydrogeology	▪ British Geological Survey (BGS) GeoIndex [4]. ▪ British Geological Survey (BGS) Sheet 17: Hydrogeological Map of South Wales (1:125,000, 1986) [12] ▪ Natural Resources Wales (NRW) Water Quality Archive [13]
Radon	▪ UK Health Security Agency UK maps of radon [14]
Unexploded Ordinance (UXO)	▪ Zetica UXO Risk Maps [15].
Historical Development	▪ The National Library of Scotland [16]

Information Type	Title/Source
Landfills	▪ Natural Resources Wales (NRW) Historic Landfill Sites [17] ▪ Natural Resources Wales (NRW) Permitted Waste Sites [18]

2.2 GROUNDSURE REPORT

A Groundsure Report, Ref: WSP-PT5-U7G-NVJ-D4M, was also obtained for this project, and this is presented in Appendix E. Pertinent information found in the Groundsure Report has been used throughout this desk study.

3 SITE RECONNAISSANCE

3.1 WALKOVER SURVEY

WSP undertook a walkover survey on 08-July-2024. The weather at the time of the walkover was damp and partially cloudy. Photographs and site notes were recorded at the time of the visit. Vegetation growth obscured areas of the site reducing possible observations of the Site.

Although no evidence of past coal mining features on site. Theoretical locations of mine entries were identified using the CA interactive viewer [19], however, there was no physical evidence of their presence, such as fenced perimeters or local subsidence. It was observed that vegetation growth was dominant in the areas where these features were indicated.

A summary of the observations made during the inspection is provided below and should be read in conjunction with the photographic plates included in Appendix B.

- Topography was mostly flat; the northeastern corner was observed to sharply rise in level towards the extents of the Site boundary.
- The Site surfacing comprises mainly open sparsely grassed gravel, with a wooded areas present along the west and east flanks.
- A drainage channel was observed along the northern side of Site. This is thought to be the previously identified watercourse. No obvious flow was observed at the time of the walkover. The watercourse towards the south of Site was also confirmed, again with no obvious sign of flow.
- A single span concrete footbridge is present, crossing the southern drainage ditch.
- A precast concrete box culvert is present, crossing the northern drainage ditch.
- Wet/marshy ground was observed towards the northwestern corner of Site.
- Potential soft ground was observed towards the extreme southern extent of Site.
- Two historic groundwater or ground gas monitoring wells were observed. WSP requested further information from the client, however, were told no records are available.
- No bulk material storage or waste storage was identified on-site.

4 GROUND CONDITIONS

4.1 PUBLISHED GEOLOGY

A summary of the anticipated ground conditions underlying the Site is shown in Table 4-1, based on the published geology.

Table 4-1 - Published Ground Conditions.

Strata Type	Strata Name	Description
Made Ground	Made Ground	The geological mapping suggests Made Ground consisting of spoil from coal and iron workings covers much of the Site and surrounding area. The BGS Geoindex, indicates that the Made Ground is an Artificial Deposit. There is an area, labelled '*Many Bell Pits'* on the geological mapping where Made Ground is absent. Though not labelled 'Many Bell Pits', a similar outlined area of land on BGS Geoindex also shows Made Ground to be absent. Colliery spoil and backfill is likely to be highly variable in composition, comprising a range of clast sizes with the high potential of comprising anthropogenic material.
Superficial Deposits	Till - Devensian	Glacial Till is shown across the central southern part of the Site according to the 1:10,560 geological map. The BGS Geoindex contradicts the mapping and shows that Glacial Till is present across the whole Site. Typically, this material typically comprises of a firm to very stiff, gravelly, sandy clay. *Given the subsequent opencast mining history of the Site, there is uncertainty as to whether superficial deposits are present.*
Solid Geology	The South Wales Lower Coal Measures (LCM) Formation	The South Wales Lower Coal Measures (LCM) Formation of Carboniferous age is present beneath the Site. The published geology indicates the LCM strata comprise coal-bearing mudstones and siltstones with seatearths and minor sandstone. The 1:10,560 geological map, also indicates presence of Ironstone Veins.

4.1.1 STRUCTURAL GEOLOGY

The published geology shows the regional geology to dip 6° to the southeast.

Inferred on the geological maps is the northwest to southeast trending Dowlais Fault, with the downthrown side towards the southwest. This is the closest mapped fault to Site and is approximately 200m to the north.

Figure 10 from the Geology of the South Wales Coalfield memoir [8], shows the Penydarren Fault and an unlabelled fault in the vicinity of Site. However, a closer review when looking at the 1:10,560 SO00NE geological map [20] suggests these are approximately 750m and 500m to the southeast of Site respectively. The Penydarren Fault is shown to have a downthrow towards the northeast, the unlabelled fault has a downthrow towards the southwest.

4.1.2 LANDSLIPS

No landslips are recorded on the BGS GeoIndex Onshore map [4] nor any recorded on the BGS 1:10,560 map [6].

4.2 MINING SUMMARY

This sub-section should be read in conjunction with the Goat Mill Road Coal Mining Risk Assessment (CMRA) [9] is attached in Appendix C.

4.2.1 COAL SEAMS

Figure 6 from the Geology of the South Wales Coalfield memoir [8], which presents a generalised vertical section of the Lower Coal Measures, suggests the following sequence of coal seams thought to be relevant to Site, in descending order:

- Amman Rider
- Yard Seam
- Seven Feet
- Five Feet
- Gellideg

The conjectured outcropping Amman Rider coal seam is shown to be located in the southeastern part of Site, trending in a north to south direction according to sheet SO00NE [6]. The thickness of this seam according to the coal sequence section, is indicated to be 0.46m, however, it is not clear where this thickness was recorded or if it is an average thickness for the district. It is anticipated to be present beneath Site if it has not been subject to mining. **Figure 4-1** shows an extract of the SO00NE sheet of the area surrounding the Site and the generalized vertical section for the Lower Coal Measures.

There is no evidence on sheet SO00NE showing the Yard Seam and Five Feet between the Amman Rider and Gellideg coal seams. The Seven Feet is shown to crop southwest of the Site. However, it has not been mapped at surface in the area of Site.

The Gellideg seam is shown as a conjectured outcrop along the north and western boundary. Its position appears to coincide with the northwestern area of Site, or it is shown marginally west of the Site. Sheet SO00NE suggests the seam thickness is 1.2m to 1.5m. Approximately 250m towards west of Site, the geological map notes that the Gellideg seam was encountered at 232m AOD in the Garw Pit.

According to the Geology of the South Wales Coalfield memoir [8]: '*In the Taff Valley around Merthyr Tydfil the Gellideg is the lowest of three closely spaced coals (the upper two forming the standard Five-Feet), which make up a composite seam, known formerly as the Lower Four-Feet'*.

The Gellideg seam underlies the Five Feet Seam, which has a recorded thickness of 1.4m according to the generalised section.

Approximately 100m east of Site, the conjectured Bute and Nine-Feet seams are shown. Given the dip and direction of the solid geology, unless some unknown structural feature is these seams will not be present beneath the Site.

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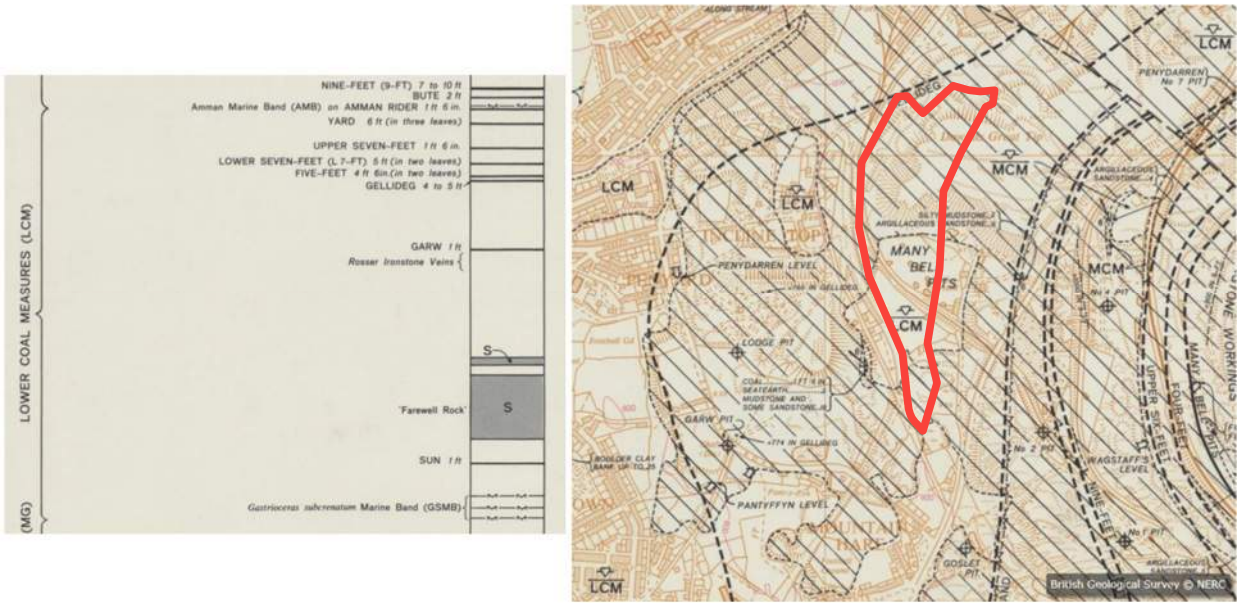


Figure 4-1 - Extracts from 1:10,560 SO00NE geological map showing the approximate Site location (red boundary) and the coal sequence.

With reference to **Figure 4-1**, various earthworks and tips associated with the industrial history of the area on and around the Site are recorded. Railway embankments and cuttings are also shown.

4.2.2 RECORDED MINING

4.2.2.1 Recorded Coal Mining at Shallow Depth (<30m)

The Coal Consultants Mining Report suggests a shallow spine roadway exists within the Site boundary. The location of the spine road is unknown, and no further details are given. Abandonment Plan ref. SWR2510 also suggests that spine roads exist beneath Site. It is unknown whether these and any associated workings exist within 30m or influencing depth of ground level.

Based on open cast abandonment plan series ref.17930, coal mining at shallow depth has taken place towards the centre and eastern extent of Site. According to the abandonment plans this was to the base of the Lower Four Feet Lower Leaf, i.e. the Gellideg seam. However historical unrecorded mining cannot be discounted.

Opencast coal extraction activity has taken place onsite and will have excavated any workings within the extraction zone, although remnants would remain within the side slopes. Recorded mining at

shallow depth is a risk in those areas that were not subject to open cast mining and should be investigated to confirm the presence, or otherwise of workings and roadways, depth, extraction thickness of workings, location of the opencast highwall and opencast backfill properties to inform the risk to redevelopment.

4.2.2.2 Unrecorded Coal Mining at Shallow Depth

The CA interactive map viewer indicates that the Site lies within a surface coal resource area. The CA also suggest on the interactive map viewer and mining report that there are probable unrecorded shallow workings. The whole Site is also subject to unlicensed opencast mining, with the historical review of the Site indicating past mining to the southern, western and northern extents of Site. Shallow workings from the area of bell pits, not subject to opencast mining could be present towards the west of Site.

4.2.2.3 Recorded Coal Mining at Greater Depth (>30m)

The CA have no record to suggest coal mining at greater depth. The Gellideg or Lower Four Feet is generally the lowest seam worked in the Merthyr District. Ironstone veins are known to have been worked below the Gellideg, particularly to the north of the district.

The historical maps identify several ironstone mines and small pit features on and surrounding the Site.

Furthermore, abandonment plan SWR2510 indicates ironstone roadways beneath Site, suggesting workings beneath the Gellideg seam. BGS borehole ref.SO00NE72 shows the lowest ironstone vein i.e. the Rosser Veins to be up to approximately 38m below the Gellideg. The CA do not hold records of recorded mining at greater depth beneath the Site, however, this abandonment plan could potentially suggest workings beyond 30m below ground level.

4.2.2.4 Surface Mining (Opencast Workings)

The CA has record of past opencast coal mining activities within the enquiry boundary and 500m of the Site. This comprises the Great White Tip opencast onsite, with the Incline Top opencast immediately to the west.

4.2.2.5 Mine Entries

The CA has records of twenty mine entries within and close to the Site boundary. Other than location, mineral type and potential treatment, the CA have no further information regarding the mine entries.

Six mine entries are shown onsite, comprising of three shafts (ref. 306206-008, 306206-009 and 306206-067) and three adits (ref. 306206-005, 306206-006 and 306206-083). The CA believe that five of these mine entries excluding entry Ref.306206-005 have been subject to potential treatment in the form of partial or full excavation during past opencast mining. Possible remnants of the recorded shafts may remain below the base of the backfilled opencast mine. It is considered that the disused shaft is of shaft Ref. 306206-009. The abandonment plans only indicate workings of one suspected/possible adit, thought to be workings of adit ref.306206-006. The CA suggest mine entry ref. 306206-083 was for the extraction of Ironstone.

There are seven adits located beyond the western and northern boundary of Site. Along the western boundary five adits (ref. 306206-004, 306206-022, 306206-030, 306207-019 and 306207-078) are shown to head towards Site, indicating the potential for worked seams beneath Site in areas not

subject to opencast working. The remaining two adits north of Site (ref. 306207-018 and 306207-077), are shown to head eastwards. It is possible that these adits lead to workings beneath Site. The CA only have records of workings to the central and eastern extent of Site, suggesting that workings from these adits may pre-date the legal requirement to lodge abandonment plans. Additionally, the CA suggest adit ref. 306206-004 and 306207-018, were for the mining of ironstone, the working of which are likely to be below the Gellideg seam.

The remaining shafts and adits are either located too far from the Site boundary to pose a risk to it or, in the case of the adits, appear to be aligned away from the Site and do not pass beneath it. Of these, based on the mapped locations shown by the '*Summary of Findings'* plan in conjunction with the published geology, the following mine entries are considered to not pose a risk to the Site:

- 306207-032
- 306206-014
- 306206-074
- 306206-010
- 306206-087
- 306206-088
- 306206-007

4.2.2.6 Ground Movements Due to Coal Mining

The CA has no records of any damage due to geological faults, ground subsidence or other lines of weakness that have been caused by coal mining. The CA has not received a damage notice or claim for subsidence within 50 meters of the enquiry boundary since October 1994.

However, abandonment plan ref. SWR2510 indicates that the Penydarran Fault underlies the southern/southwestern part of Site.

As noted above this abandonment plan is difficult to orientate and scale accurately to Site. Therefore, the evaluation of this location is an approximation and should not be taken as exact.

4.2.2.7 Mine Gas Emissions

The CA has no record of past mine gas emissions requiring action and no mine gas has been recorded within 500m of the Site. However, due to the presence of probable shallow workings beneath the Site, there is potential for mine gases to migrate to the surface through fissures within the rock and opencast backfill, which will have a higher permeability and any superficial strata, if present.

It is noted that groundwater or ground gas monitoring boreholes are present on the Site. No records have been made available for these locations.

4.2.2.8 Mine Water Treatment Schemes

There are no recorded mine water treatment locations within 500m of the Site boundary.

4.2.2.9 Recorded Coal Mining Surface Hazard

The Site has been subject to opencast mining. The mining report contains no records of remediated Sites or subsidence. There are no recorded CA managed tips within 500m of the Site boundary.

4.3 BGS EXPLORATORY HOLE RECORDS

4.3.1 HISTORICAL BOREHOLE LOGS

A review of the BGS historical exploratory hole records has identified two available borehole records on or close to Site. Both are appended in Appendix D.

4.3.2 BGS REF. SO00NE72

Located within the site, this record is titled; '*Strata Between the Lower 4ft Coal and Farewell Rock at Dowlais'*. The date and exact location of the borehole is not given, but the following location is indicated within the records NGR 306300E, 207000N.

The scan quality is poor. However, it shows what is understood to be ironstone veins encountered below the Lower 4ft Coal, i.e. the Gellideg coal seam. Table 4-2 summarises the information presented within the log. Approximate depth estimates for the ironstone veins below the Lower 4Fft Coal have been based on the vertical scale in conjunction with the grid lines shown on the log.

Table 4-2 - Summary of anticipated Ironstone Veins and approximate depths below the Lower 4ft Coal.

Description	Approximate depth below the Lower 4ft Coal (m)
Spotted or Black Ball Ironstone	3.0
Yellow Ironstone	9.0
Red Ironstone	12.0
Blue Ironstone	15.0
Lumpy Ironstone	27.5
Rosser Ironstone Veins	30.5 – 38.0

The log also records the presence of the Farewell Rock at an approximate depth of 43m below the Lower 4ft Coal, indicating the base of the economically workable Coal Measures.

4.3.3 BGS REF. SO00NE53

Approximately 150m southeast of Site, this borehole was drilled in early winter 1975, at an elevation of 303.9m AOD, for the National Coal Board at Longtown Tip (Tip No. 724). The record of the log is summarised below:

Table 4-3 - Summary of BGS borehole ref.SO00NE53

Strata	Depth (m bgl)	Elevation (m AOD)	Description
Spoil	0.0 – 16.8	303.9 – 287.1	Typically described a loose gravel or gravelly silty sand. Described as *'Run of Mine'* from 0.0 – 16.5m bgl.
Mantle: Boulder Clay (Glacial Till)	16.8 – 23.8	287.1 – 280.1	Soft to stiff sandy clayey silt to silty clay with varying amounts of gravel and cobbles including limestone and quartzite.
Sandstone	23.8 – 25.1	280.1 – 278.8	Dark grey, fine grained, thinly laminated, poorly jointed, faintly weathered, Sandstone. Moderately strong to strong, numerous carbonaceous/silty partings, coaly at base.
Mudstone	25.1 – 27.5	278.8 – 276.4	Grey, thinly laminated, well jointed, blocky, faintly weathered Mudstone, moderately weak to moderately strong, planty at base.
Little Seam/Seven Feet	27.5 – 27.9	276.4 – 276.0	Soft broken coal with shaley partings.
Seatearth/Fireclay	27.9 - 30.8	276.0 – 273.1	Seatearth/fireclay with suspected old iron stone working between 29.65 – 30.15m bgl.
Siltstone with Sandstone and silty Mudstone	30.8 – 40.7	273.1 – 263.2	Grey to black, thinly to thickly laminated, sparely jointed, faintly weathered, Mudstone moderately strong to strong, occasional ironstones and plants, some carbonaceous partings.
Coal *	40.7 - 41.5	263.2 – 262.4	Black, thinly laminated, high angle parted fresh, very weak, seaty at top.
Seatearth/Fireclay *	41.5 – 42.3	262.4 – 261.6	Grey, thickly laminated, uneven jointed, fresh, moderately weak with numerous listric surfaces and rootlets.
Coal *	42.3 – 44.5	261.6 – 259.4	Black, high angled parted to solid fresh coal, very weak to weak. Three thin bands of Seatearth/Fireclay present between coal between 0.1 and 0.2m thick.
Seatearth/Fireclay	44.5 – 45.3	259.4 – 258.6	Grey to black, thinly laminated, poorly jointed, fresh, very weak to moderately strong, silty horizons, well preserved plants, listric features.

* This log indicates from 40.7 to 44.5m bgl is representative of the '*Lower Four Feet Seam (Five Feet - Gellideg)*'.

4.4 TOPOGRAPHY

Based on information from Google Earth Pro [10], the site elevation is approximately 278m Above Ordnance Datum (AOD), the elevation increases in the northeastern part of the site to approximately 288m.

4.5 GEOMORPHOLOGY

LiDAR data has been assessed using the DataMapWales Interactive Map [21]. No significant geomorphological features have been identified. Several circular features are noted on the LiDAR, these correspond to areas of dense vegetation growth observed on the site walkover.

4.6 HYDROLOGY

4.6.1 SURFACE WATER FEATURES

Drainage ditches are located towards the northern extent and the south side of Site. A single span concrete bridge crosses the drainage ditch on the south side. A precast concrete box culvert crosses the drainage ditch on the northern side. No flow was noted in the drainage ditches during the site walkover, however small body of stagnant water was present within the northern ditch.

Surface water features within 500m of the Site include:

- A drainage ditch along the A4060, 120m east of the Site, which links to three culvert openings which pass beneath the A4060 road embankment and when wet direct surface water westward toward the site. It is postulated that at least one of the most southernly set of culverts (they are positioned within 30m of each other) drain beneath the site in culvert.
- A complex of three ponds, 1 larger and two smaller ponds are found 280m east of the Site.
- A pond is located 450 southeast of the Site.
- A named surface watercourse passing 80m south of the Site.
- A large body of water is present approximately 1.4km east of the Site. This body of water is located within the former Ffos-y-Fran opencast coal mine, that was closed in November 2023.

The River Taff is located approximately 1,400m southwest to the Site.

4.6.2 SURFACE WATER ABSTRACTIONS

There are no surface water abstractions recorded within 1km of the Site.

4.7 HYDROGEOLOGY

4.7.1 AQUIFER STATUS

The aquifer designations of the superficial deposits across Site are as follows, based on the BGS GeoIndex Onshore Map [4], it is likely that these deposits have been severely impacted upon as a result of mining and industrial activities:

- Superficial Deposits – Secondary (Undifferentiated) Aquifer
- Bedrock Geology – Secondary (A) Aquifer

All aquifer types have a high groundwater vulnerability. These classifications are defined by the Environmental Agency as follows:

- Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.
- Secondary Undifferentiated are aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value.

The South Wales Lower Coal Measures Formation is described as a moderately productive aquifer.

4.7.2 PRELIMINARY HYDROGEOLOGICAL MODEL

No groundwater was encountered within the on-site BGS borehole; however, groundwater was encountered within the South Wales Middle Coal Measures Formation at 57.0m bgl in SO00NE51/A (located approximately 425m east of the Site), a copy of the log is located in Appendix D.

Given the presence of the unnamed stream in the north of the site there may be potential for shallow groundwater to be present within the granular deposits of Made Ground or within the Secondary (A) Aquifer of the Till. Analysis of Sheet 17: Hydrogeological Map of South Wales [15] did not provide a discernible depth or direction of groundwater within the underlying South Wales Lower Coal Measures Formation. However, the main groundwater body is considered likely to be present within the underlying South Wales Lower Coal Measures Formation.

It should be noted that the hydrogeological model will have been significantly impacted by historical mining.

4.7.3 GROUNDWATER ABSTRACTIONS

No recorded groundwater abstractions within 500m of the Site.

4.8 FLOODING

Publicly available information regarding risk of flooding is presented below. This does not purport to be a full flood risk assessment and additional assessment by specialists may be required.

4.8.1 HISTORICAL FLOOD EVENTS

No record of historical flooding events was found.

4.8.2 GROUNDWATER AND SURFACE WATER FLOODING

The Site contains several small drainage ditches in the north and south of the site. Natural Resources Wales [11] indicates that the site is at high risk of flooding from surface water and small watercourses, shown as a risk greater than 3.3% chance a year.

As discussed within Section 3.1, the area directly adjacent to the small drainage ditch in the north was saturated with surface water.

The entire Site is at a low risk from groundwater flooding.

4.8.3 FLOOD RISK REVIEW

According to the NRW website [11], the site is at low risk of flooding from rivers and the sea.

4.9 DESIGNATED SITES

No record of designated sites was found.

4.10 LANDFILLS

There is one recent historic landfill found 397m south of the Site. The site is operated by Hurley T (ref: HUR001) and is a type A6 landfill for taking other wastes, its status is 'closure'. There is one on-site historical landfill associated with the Dowlais Great Tips and held by British Steel [17]. The type of waste deposited was inert, industrial, commercial and liquid sludge. The last record of this site was 31/12/1998. An additional historic landfill was found 489m south, disposing of inert, industrial, commercial and household waste. The last record of this site was 31/12/1985. There were also two refuse tips located 89m and 162m south of the Site (within 1973 mapping).

Trecatti Landfill is an active landfill located 1,625m to the northwest of the site. It is currently operated by Biffa Ltd and accepts "difficult and special" waste. Culverts from this landfill follow the A4060 and, as mentioned previously, one is thought to underlie the site.

4.11 WASTE

There are seven. of licensed waste sites within 500m of the Site, these are detailed in Table 4-2.

Table 4-4 – Licensed Waste Sites within 500m of the Site

Locations	Operator	Type of waste	Size (tonnes)	Status
103m – 104m north	Indigo Equity Holdings	Special waste transfer station	25,000	Issued
462m north	Silent Valley Waste	Special waste transfer station	25,000	Issued
485m north	Merthyr Tydfil County Borough Council [18]	Household, commercial and industrial waste	25,000	Effective (transferred to household waste only in 2018)
485m – 486m north	Sundorne Products	Household waste	25,000	Effective
485m – 487m north	Environmental Waste Controls	Household, commercial and industrial waste	25,000	Effective
493m – 496m north	Silent Valley Waste Services Ltd	Household, commercial and industrial waste	25,000	Issued
498m – 499m south	Tony Hurley	Household, commercial, industrial and other waste	25,000	Effective

4.12 RADON

The site is shown on the UK Health Security Agency UK maps of radon [14] and is shown as being within the lowest band of radon potential, less than 1% of homes at or above the Action Level. Therefore, no radon protection measures are likely to be required.

4.13 UNEXPLODED ORDNANCE

A review of the Zetica UXO [15] website was undertaken. The risk map indicates the Site to be in an area with low risk of unexploded ordnance, with the area indicated as having 15 bombs per 1,000 acres or less. Based on this information, no further action is required.

4.14 SENSITIVE LAND USES

Cwm Glo a Glyndyrys, a Site of Special Scientific Interest is found 2km to the southwest of the Site.

The Site is not within a Nitrate Vulnerable Zone (NVZ) or Source Protection Zone (SPZ).

There is an area of ancient semi-natural and restored ancient woodland found 605m to the south of the Site.

The entire Site is classed as Grade 4 (poor) or Grade 5 (very poor) quality agricultural land.

4.15 CLIMATE CHANGE

4.15.1 FUTURE CLIMATE CHANGE UNDER TPC8.5 SCENARIO

Sea Level Rise / Flood Risk

The Site is currently located approximately 35km west of the Celtic Sea. The Site is at an elevation of approximately 280m Above Ordnance Datum (m AOD).

Under TCP8.5 sea level along the Celtic Sea is expected to rise by 1.13m by 2100. Due to the distance from the Site and the Site's elevation, sea level rise is not expected to impact the Site.

Projected Changes to Groundwater Levels

The Site is located within the SE Valleys Carboniferous Coal Measures Groundwater body. The eFLAG project far-future (2050-2079) projections for groundwater recharge within this catchment report within this catchment report a 0.5mm per day decrease for the summer months, 0.3mm per day decrease for the autumn months and 0.6mm per day increase for the winter months for this groundwater body. No change to current recharge is indicated for the spring months. This indicated potential minor decreases in groundwater levels, during the summer and autumn, relative to the current baseline but an increase in groundwater levels for winter.

Projected changes to Rainfall

The expected amount of rainfall for the Site to receive is down 10.8%, from current levels, between 2071-2100. This has the potential to cause less surface water runoff in the near future and beyond.

4.16 HISTORICAL DEVELOPMENT OF THE SITE AREA

Historical maps and aerial photography were obtained from National Library of Scotland [16] and were reviewed to identify former relevant land uses on and off Site, that may pose geotechnical or geo-environmental risks to the Site. Historical findings are summarised in Table 4-5.

Table 4-5 – Historical review summary.

Date (Map Scale)	Within the Site boundary	Surrounding Site
County Layers: 1840s – 1880s (Six Inch)	The northern part of the Site is part of the wider Dowlais Great Tip. A railway track is present within the tip. There is a spur from this line, heading towards the centre of Site, but terminates within the extents of the Dowlais Great Tip. There are two Air Shafts towards the central area of Site. Ton-y-ffald Level (Coal) is labelled towards the western side of Site. Various earthworks/tips are noted onsite: ▪ A cluster of apparent pits/ponds are shown towards the centre of Site. ▪ A pit/pond feature is shown east of Ton-y-ffald level. ▪ The western side of Site is bound by a cutting, in which runs the labelled Dowlais Railway. ▪ A series of earthworks, with areas of pastures are present in the western-northwestern extent of Site, east of the Dowlais Railway. ▪ A Reservoir is shown to encroach the southern tip of the Site. A northeast to southwest trending watercourse appears to run through the southern part of the Site and feed into the north side of this Reservoir. This watercourse is believed to be the one observed during the walkover. The reservoir is mapped at the location where potentially softer ground was observed. Immediately north of the reservoir, unlabelled earthworks/tips appear to be present. An unlabelled tank is also present in this vicinity. ▪ A series of unlabelled roads and buildings are present within the Site boundary.	Dowlais Great Tip extends beyond the northeastern boundary of Site. Pwll-yr-Hwyaid, which translates from Welsh as ‘Duck Pond’, is present outside of the northeastern boundary. The surrounding area is heavily affected by mining, with numerous air shafts and mine entries, railways, tramways, engine houses, reservoirs and a limekiln present. Dowlais Iron Works, Coed Cae pond and a Brick Works is shown approximately 150m of the north or northeast of the Site. Pen-y-daren Iron Works is 200m west of the Site. Many springs are shown to surround Site.
Towns: 1840s – 1890s (1:1,500)	Old levels of coal or coal and ironstone are labelled towards the southern and western extents of Site. Another area of earthwork is shown towards the centre of Site. An area of land labelled ‘railway in construction’ is shown towards the northwest of the Site boundary. A form of road connects Ton-y-ffald level with what appears to be a building labelled Ton-y-ffald on the eastern end of Site. Numerous unidentified, roughly circular features, interpreted as bell pits, are shown in the central southern part of the Site.	This map is incomplete to the east; therefore, information of the surrounding area is limited. A steelwork is labelled immediately north of the Site boundary.
1975 (1:2,500)	A tank (unknown contents) is present on the western boundary, in the south of the Site.	No obvious significant changes.
Outline: 1885 - 1900 (One Inch)	No obvious significant changes.	No obvious significant changes.
1900 (1:2,500)	Tank on the western boundary is no longer present.	No obvious significant changes.
Hills: 1885 - 1903 (One Inch)	No obvious significant changes.	No obvious significant changes.

Date (Map Scale)	Within the Site boundary	Surrounding Site
1888 - 1915 (Six Inch)	A railway, Dowlais Steel Works Branch/GWR & Rhymney Joint Line are shown, follows the western boundary and then crosses the southern half of the Site. The railway previously in construction towards the northwest of Site has been constructed. A Reservoir and filtering beds are also labelled towards the northwestern side of Site. No earthworks/tips are indicated towards the south of Site, north of the reservoir the map shows the ground to comprise of areas of pasture. The two Air Shafts in the central part of the Site are now labelled as Old Air Shafts. Ton-y-ffald Level is no longer shown, though the associated building towards the eastern extent of Site remains. The roads previously shown onsite are no longer present or have been labelled as footpaths. The ground cover within Dowlais Great Tip is shown to be of rough pasture. The railway tracks are no longer shown.	Pen-y-daren Iron Works is no longer shown. The steelwork is no longer labelled, but the footprint of the building remains, and Dowlais Iron Works is still labelled. Numerous air shafts, reservoirs and mine entries are now labelled old or disused. However, the surrounding area is still heavily affected by ongoing mining.
1892 - 1914 (25 Inch)	Railway tracks are mapped, from the centre of Site to the eastern boundary, on the extents of the expanded Dowlais Great Tip. Further earthworks are shown towards the northwestern extent of Site, likely associated with mining but do not appear to form part of the Dowlais Great Tip. The reservoir and filtering beds previously labelled towards the northwestern side of Site are no longer shown. Earthworks are shown north of the reservoir towards the southern tip of Site. This contradicts the 1888 – 1915 map.	Most mining features previously discussed are no longer labelled. The remain features include No.1, No.2, No.4, No.6 and No.7 Pits, all disused, old ironstone levels and ironstone shaft, an old air shaft and railway infrastructure.
1919 – 1930 (One Inch)	No obvious significant changes.	The Brick Works are no longer labelled northeast of Site.
1937 – 1961 (1:25,000)	Dowlais Great Tip is no longer labelled although an earthwork is present in its location. Railway tracks are no longer mapped, from the centre of Site to the eastern boundary, in the extents of the Dowlais Great Tip. Dowlais Railway is no longer present across the southwestern side of the Site boundary, however, the associated earthworks are still present.	Several disused pits, shafts and reservoirs are labelled. Incline Top Level is present west of Site. Dowlais Iron Works is no longer present though there are several industrial premises shown.
1944 – 1973 (1:1,250/1:2,500)	Several ponds and a Sinks are shown onsite. There are ‘Ruin’ buildings labelled in the northwestern part of the Site and towards the eastern extent. One of the two Old Air Shafts is no longer shown.	An unlabelled road, what is now known as Goat Mill Road and the A4102 is present in the location of the old railways west of Site. Industrial premises labelled as Works, Depot, Factory or Bakery are present north of Site in the area formerly occupied by Dowlais Iron Works. Near the Depot are circular tanks. The A4060 road has been built east of Site.
Outline: 1945 – 1965 (1:25,000)	No obvious significant changes.	No obvious significant changes.

Date (Map Scale)	Within the Site boundary	Surrounding Site
Air Photos: 1945 – 1950 (1:10,560)	No obvious significant changes. The Site is occupied by a large spoil tip in the central and northern part of the Site, with the railway present in the southern part.	No obvious significant changes.
1948 – 1973 (1:2,500)	No obvious significant changes.	A slag heap is labelled approximately 100m towards the southeast from Site.
1982 (1:10,000)	A tank (contents unknown) is present in the centre of the Site, near the western boundary.	No obvious significant changes.
1988 (1:2,500)	The Dowlais Great Tip is no longer present [(1)]. Tank near the western boundary is no longer present. Majority of the Site comprises an opencast mine, an unquarried margin to the north of the railway line comprises numerous ponds.	No obvious significant changes.
Google Earth Aerial Imagery (2001)	Site appears to be flat with open sparsely grassed gravel. A wooded margin is present along the western and eastern edges of the Site. Opencast mine has been infilled.	Residential development at Incline Top, immediately west of Goat Mill Road. Gas holder Stations are no longer present north of Site.
2001 (1:10,000)	A pond is shown in the north of the Site. Three reservoirs and an associated building are found in the north of the Site.	No obvious significant changes.
Google Earth Aerial Imagery (2004)	No obvious significant changes.	No obvious significant changes.
Google Earth Aerial Imagery (2006)	No obvious significant changes.	Residential development at Incline Top and between the A4102 and Pantyffyn Road, west of Site. Evidence of potential industrial activity, approximately 200m, southeast of Site, beyond the A4060.
Google Earth Aerial Imagery (2008)	No obvious significant changes.	Further evidence of industrial activity is present beyond the A4060, which appears to be associated with the Ffos-y-fran Opencast Mine which opened in 2008. Further residential development at Incline Top.
Google Earth Aerial Imagery (2009)	No obvious significant changes.	No obvious significant changes.

Date (Map Scale)	Within the Site boundary	Surrounding Site
Google Earth Aerial Imagery (2010)	No obvious significant changes.	Further earthworks and pits present at Ffos-y-fran Opencast Mine.
2010 (1:10,000)	Pond and reservoirs are no longer present. A drain follows the northern boundary of the Site.	No obvious significant changes.
Google Earth Aerial Imagery (2016)	No obvious significant changes.	Workings of Fros-y-fran Opencast mine appear to have moved towards the east direction. The ground cover in the formerly mined area appears to be grass.
Google Earth Aerial Imagery (2018)	No obvious significant changes.	No obvious significant changes.
Google Earth Aerial Imagery (2019)	No obvious significant changes.	No obvious significant changes.
Google Earth Aerial Imagery (2021)	No obvious significant changes.	No obvious significant changes.
Google Earth Aerial Imagery (2023)	No obvious significant changes.	No obvious significant changes. *Note: According to BBC News, the Fros-y-fran Opencast mine closed in November 2023.*

(1) Images of the Dowlais Great Tip, also known as the Great White Tip: The Dowlais Great White Tip (alangeorge.co.uk)

The undated website indicates that the tip, referred to on the website as the '*White Tip'*, was removed during the 1970s.

There is also a scan of a undated newspaper article, titled; '*The Old Grey Man, he aint what he used to be'* written by Gerard Kiley for the Merthyr Express. The quality of the scan is poor; however, the article indicates that: '*Underneath the White Tip as we know it is another layer of white deposits'.*

4.17 MAN-MADE FEATURES

Based on observations during the walkover survey presented in Section 3.1 and the historical review of the area, the following man-made features have been identified on site.

- Two groundwater or ground gas monitoring wells
- One single span concrete footbridge.
- One precast concrete box culvert

The circular features identified on aerial photography and possibly features identified on Lidar are associated with areas of dense vegetation. Further observations were not possible.

4.18 ANTICIPATED GROUND CONDITIONS

Table 4-6 summarises the anticipated strata underlying the Site based on a review of information presented. Figure 4-2 shows the boundaries of the anticipated ground conditions.

Table 4-6 - Anticipated ground conditions.

Strata Type	Anticipated Ground Conditions	Approximate Location Anticipated
Made Ground	Opencast Backfill	Central area of site, denoted by the red outline
Made Ground	Made Ground	Outer perimeter of site – denoted between the red and blue outlines
Superficial Deposits	Till - Devensian	Outer perimeter of site – denoted between the red and blue outlines
Solid Geology	South Wales Middle Coal Measures Formation	Site Wide

Figure 4-2 - Anticipated Ground Conditions



4.19 REGULATORY INFORMATION

4.19.1 PLANNING HISTORY

A review of the Blaenau Gwent planning information available online did not show any pertinent records for the Site. However, this did not have a search by address feature, information was looked at manually therefore planning applications may have been missed.

5 REGULATORY CONSULTATION

5.1 REGULATORY INFORMATION

Information relating to various regulatory controls has been taken from the Groundsure Report, which is presented in Appendix E. The potential for hazardous materials to impact upon the ground conditions, surface or groundwater on-site are summarised below within Table 5-1.

Table 5-1 - Regulatory Information within 500

Environmental Data	Distance from Site (500m)	Details	Potential risk
Sites determined as Contaminated Land	N/A	No sites determined as contaminated land were recorded within 500m of the Site.	No
Licensed Discharges to Controlled Waters	Onsite	Effluent: Trade discharges Receiving water: Culvert to River Taff Effective: 10/11/1992 Revoked: 01/11/1996	No – due to age of final revocation.
	79m north	Effluent: Trade Discharges Receiving water: Nant Morlais Brook Effective: 01/09/1977 Revoked: 26/01/1994	
	119m southeast [18]	Effluent: Trade Discharges Receiving water: Tributary to Nant Morlais Effective: 04/10/2018 Revoked: not supplied	Yes – potential for contamination
	119m southeast [18]	Effluent: Trade Discharges Receiving water: Tributary to Nant Morlais Effective: 08/01/1999 Revoked: not supplied	Yes – potential for contamination
	155m northeast	Effluent: Trade Discharges Receiving water: Nant Morlais Effective: 23/07/1996 Revoked: 02/10/1997	No – due to age of revocation
	246m northeast	Effluent: Trade Discharges	

Environmental Data	Distance from Site (500m)	Details	Potential risk
		Receiving water: Nant Morlais Effective: 03/10/1997 Revoked: 08/01/1999	No – due to age of revocation
	270m northeast [18]	Effluent: Trade Discharges Receiving water: Tributary to Nant Morlais Effective: 09/01/1999 Revoked: 01/07/2013	
	338m northeast [18]	Effluent: Trade Discharges Receiving water: Tributary to Nant Morlais Effective: 09/01/1999 Revoked: 01/07/2013	
	360m northeast	Effluent: Trade Discharges Receiving water: Nant Morlais Effective: 03/10/1997 Revoked: 08/01/1999	
	378m northwest	Effluent: Trade Discharges Receiving water: Nant Morlais Effective: 15/06/1989 Revoked: 14/04/1994	
	390m south	Effluent: Trade Discharges Receiving water: Tributary to Nant Morlais Effective: 23/07/1996 Revoked: 02/10/1997	
	450m south	Effluent: Trade Discharges Receiving water: Nant Cwm Clacs Effective: 23/07/1996 Revoked: 02/10/1997	
	464m west [18]	Effluent: Sewage Receiving water: Morlais Brook Effective: 31/03/2002 Revoked: 07/10/2019	

Environmental Data	Distance from Site (500m)	Details	Potential risk
	470m west [18]	Effluent: Sewage Receiving water: Morlais Brook Effective: 07/10/2019 Revoked: not supplied	No – due to distance from Site
	472m west [18]	Effluent: Unspecified Receiving water: Morlais Brook Effective: 15/04/1964 Revoked: 30/02/2002	No – due to revocation date
	491m north [18]	Effluent: Sewage Receiving water: Morlais Brook Effective: 21/08/2002 Revoked: not supplied	No – due to distance from Site
	493m north [18]	Effluent: Sewage Receiving water: Morlais Brook Effective: 21/08/2020 Revoked: not supplied	No – due to distance from Site
	499m north [18]	Effluent: Unspecified Receiving water: Morlais Brook Effective: 15/04/1964 Revoked: 08/03/2002	No – due to revocation date
Pollution Incidents	228m west	Pollutant: Atmospheric pollutants Air Impact: Category 3 (minor) Date: 20/05/2001	No – due to age of incident
	355m north	Pollutant: Multiple pollutants Air Impact: Category 3 (minor) Date: 18/06/2013	No – due to distance from Site
	386m south	Pollutant: Specific waste materials Land Impact: Category 3 (minor) Air Impact: Category 3 (minor) Date: 11/10/2013	No – due to distance from Site
	424m northwest	Pollutant: Atmospheric pollutants Air Impact: Category 3 (minor) Date: 20/05/2001	No – due to distance from Site

Environmental Data	Distance from Site (500m)	Details	Potential risk
	437m west	Pollutant: Oils and fuel Water Impact: Category 3 (minor) Date: 17/12/2001	No – due to distance from Site
	452m west	Pollutant: Inert material and waste Water Impact: Category 2 (significant) Date: 05/08/2021	No – due to distance from Site
Licensed Pollutant Release	71m northwest	Operator: Triumph Furniture Ltd Process: Timber Manufacture Status; Historical permit	No – due to status
	147m northeast	Operator: Celtic Energy Ltd Process Coal & Coke Status Historical permit	
	250m southwest	Operator: Stephens & George Ltd Process: Printing Status: Current permit	No – due to distance from Site
	269m southwest	Operator: British Coal Opencast Process: Coal & Coke Status: Historical permit	No – due to status and distance from Site
	343m north	Operator: Rontech Watford Ltd Process: Unloading of Petrol Status: Current permit	No – due to distance from Site
	492m west	Operator: Texaco Process: Unloading of Petrol Status: Historical permit	No – due to status and distance from Site
Radioactive Substance Authorisations	N/A	No entries within 500m of the Site.	No
Regulated Explosive Sites	N/A	No entries within 500m of the Site.	No
Recent Industrial Land Uses	On-site	Shaft (disused)	Yes

Environmental Data	Distance from Site (500m)	Details	Potential risk
	1-100m	Electrical infrastructure.	Yes – potential for historical contamination
	100-250m	Packaging, business parks, industrial estates, electronic equipment, container storage, lifting and handling equipment and engines.	Potential - due to distance from site.
Control of major accident hazards sites (COMAH)	N/A	No entries within 500m of the Site.	No
Pollutant Release to Surface waters	N/A	No entries within 500m of the Site.	No
Hazardous Substance Storage / Use	N/A	No entries within 500m of the Site.	No
Pollution Inventory Waste Transfers	N/A	No entries within 500m of the Site.	No
Fuel Station Entries	349m north	Esso. New Road, Dowlais, Methyr Tydfil, CF48 3DA. Status: Open	No

5.2 CORRESPONDENCE

5.2.1 NATURAL REASOURCES WALES (NRW)

The NRW was contacted on 28 August 2024 and a response was received on 02 September 2024. The response provided a number of NRW websites that have been used and referenced throughout this report. A copy of the response is located in Appendix F.

5.2.2 CONTAMINATED LAND OFFICER (CLO)

The CLO at Merthyr Tydfil County Borough Council was contacted on 28 August 2024. No response has yet been received. If pertinent information is found this report will be updated or the information will be sent as an addendum to this report.

6 CONCEPTUAL SITE MODEL (CSM)

6.1 INTRODUCTION

The preliminary CSM is based upon the environmental conditions of the site as described in the previous sections.

The methods used within this assessment follow a risk-based approach with the potential environmental risk assessed qualitatively using the 'source-pathway-receptor' contaminant linkage concept introduced in the guidance documents (principally the EA's LCRM) on the practical implementation of the Environmental Protection Act 1990.

Environmental risk can be defined as the combination of the consequence of a harmful effect and the probability of its occurrence. The existence of a contaminant linkage is primarily dependant on site usage and environmental conditions.

The environmental risk assessment has been carried out by identifying and evaluating the significance of the following:

- Potential Sources of Contamination: these include any actual or potentially contaminating materials and activities, located either on or in the vicinity of the site.
- Potential Pathways for Contamination Migration: these are the routes or mechanisms by which contaminants may migrate from the source to the receptor.
- Potential Receptors of Contamination: these include present or future land users, activities or persons at the site.

The preliminary CSM was developed based on an industrial / commercial end use as this is the most sensitive end use proposed at the site. A summary of the applicable legislative and planning framework for the assessment is presented in Appendix E**.**

The on-site preliminary CSM is presented in Table 6-1, and the off-site CSM in Table 6-2**.**

Table 6-1 – On-site conceptual site model

Potential Contaminant Linkage	Source	Potential Contaminants	Pathway	Receptor	Risk	Comment / Justification
PCL-1	Made Ground associated with open-cast mine fill and previous use as Dowlais Great Tip (with associated tanks, railway sidings and shafts)	A wide range of potential contaminants, depending on the source of material, but may include hydrocarbons, PAHs, VOCs, SVOCs, metals, sulphates, caustic substances, asbestos and hazardous ground gas including carbon dioxide, methane and hydrogen sulphide.	▪ Dermal contact. ▪ Indirect ingestion of contaminants. ▪ Inhalation of dust/fibres. ▪ Ground gas/vapour migration from Made Ground or mine gases	Human Health (Current and future Site Users)	**Moderate Risk** (Medium likelihood)	Made Ground is likely to be present across the site. The presence of Made Ground may cause toxic/flammable ground gases which can migrate into enclosed buildings. Asbestos and ACMs have the potential to be present with the Made Ground. The risk should be mitigated with appropriate health and safety procedures during any breaking of ground or during any redevelopment. The risks will require investigation and mitigation where required via remediation. Following remediation work and mitigation measures the risk to future site users would be deemed to be low.
PCL-2				Human Health (Construction works and future maintenance workers)	**Low to Moderate Risk** (Medium, Low likelihood)	There may be the potential for direct contact of contaminated soils and shallow groundwater during below ground construction and maintenance works. The risk should be mitigated with appropriate health and safety procedures.

PCL-3			▪ Inhalation of dust/fibres.	Human Health (adjacent site users)	**Low to Moderate Risk** (Low likelihood)	Areas surrounding the Site include nearby commercial properties and surrounding general public. Risks to adjacent land users should be managed and mitigated in line with Construction (Design and Management) regulations during demolition / construction phases of the development.
PCL-4			▪ Direct contact with corrosive substances (e.g., sulphates and hydrocarbons) in the soil and shallow groundwater or mine water	Below ground infrastructure and enclosed spaces/structures associated with the proposed development	**Moderate Risk** (Medium, Low likelihood)	Made Ground and impacted soils / groundwater can have chemically aggressive properties and impact on the durability of buried services / utilities. This risk should be investigated further and mitigated where required.
PCL-5			▪ Runoff of contaminated surface water. ▪ Soil erosion and/or overland flow to nearby surface water features; ▪ Lateral migration with groundwater to surface water features (i.e., contribution via baseflow).	Drainage ditches and ponds.	**Low Risk** (Low likelihood)	There is the potential for lenses of groundwater to be present within granular deposits of Made Ground. The groundwater may laterally migrate to the surface water features as a part of a baseflow or leach into granular superficial deposits. Minewater may have potential to also seep laterally into watercourses. The risk is low given large distance to any surface water receptors, though the risk could rise to Moderate Risk for minewater movements .

PCL-6			▪ Leaching of contaminants through the unsaturated zone and subsequent impact on groundwater. ▪ Vertical migration of leachable contaminants to underlying superficial aquifers.	Shallow groundwater within the Till (secondary undifferentiated aquifer). Deeper groundwater within the South Wales Middle Coal Measures Formation (secondary (A) aquifer)	**Moderate Risk** (Medium likelihood)	It is considered likely that contamination will have leached from the Made Ground to shallow groundwater within the Till. Lateral and Vertical migration is considered to be likely between the granular Till and South Wales Middle Coal Measures Formation.

Table 6-2 – Off site conceptual site model

Potential Contaminant Linkage	Source	Potential Contaminants	Pathway	Receptor	Risk	Comment / Justification
PCL-7	Operations/activities from a number of nearby active commercial/industrial trades: ▪ Fros-y-fran Opencast mine ▪ Trecatti Landfill	A wide range of potential contaminants depending on the source material including metals, hydrocarbons,	▪ Ground gas/vapour migration.	Human Health (Future site users)	**Low to Moderate Risk** (Low / Medium likelihood)	Potential for contamination in wider commercial / industrial estate based off current and historical industrial/commercial use. Made Ground (if present) may generate ground gas / vapours which could migrate laterally

	▪ Works (iron, gas, brick etc.) ▪ Factories ▪ Quarries and pits ▪ Railways ▪ Power station ▪ Electrical sub stations Discharge to controlled waters found 119m southeast	sulphates, VOCs, SVOCs, asbestos and PAHs				onto the site and accumulate in confined spaces within buildings Further assessment of ground gas risks within areas of proposed enclosed spaces/strictures is required by the completion of supplementary intrusive investigation and monitoring in order to refine the risk assessment.
PCL-8			▪ Vertical and lateral leaching from impacted soil. ▪ Vertical and lateral migration from groundwater.	Groundwater	**Low** (Low likelihood))	Flow is to the west so any dissolved contamination would be carried away form the site and the aquifer beneath the site may not receive a significant source load of contaminants Lateral and vertical migration is considered to be likely between granular Till and South Wales Middle Coal Measures Formation.
PCL-9			▪ Direct contact with corrosive substances (e.g., sulphates and hydrocarbons) in shallow groundwater.	Below ground infrastructure and enclosed spaces/structures associated with the proposed development	**Low to Moderate Risk (**Low /mediumikelihood)	

7 GEOTECHNICAL RISKS

7.1 GEOTECHNICAL RISK REGISTER

Table 7-2 provides a risk register classification and geotechnical risk register for the Site which has been prepared based on the available information. The scoring system used in this register can be seen in Table 7-1.

Table 7-1 – Likelihood classification and risk evaluation

Probability (P)		Impact/Consequence (I)		Risk (R) (P×I=R)		Impact/Consequence (I)				
						1	2	3	4	5
Very Likely	5	Very High	5	Probability (P)	1	1	2	3	4	5
Probable	4	High	4		2	2	4	6	8	10
Likely	3	Medium	3		3	3	6	9	12	15
Unlikely	2	Low	2		4	4	8	12	16	20
Negligible	1	Very Low	1		5	5	10	15	20	25

Table 7-2 - Geotechnical Risk Register.

Risk ID	Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Risk
1	Possible aggressive ground conditions, due to Made Ground or contaminated ground from areas of previous industrial use or from natural sources.	Increased construction and disposal costs. Damage to concrete foundations/structures. Health & safety risk if structural failure occurs.	3	3	9	Undertake appropriate GI throughout the Site to determine ground conditions. Implement all recommendations of BRE Special Digest 1 for design and composition of buried concrete. If aggressive groundwaters are identified, then sulphate-resistant protection measures shall be implemented.	1	3	3
2	Unrecorded/unknown coal workings, mine entries and treatment. Opencast backfill of unknown and variable composition.	Surface deformation, structural damage, subsidence, health & safety risk. Risk to human health. Programme delays. Increase in costs due to further investigation and treatment works. Elevated risk of damage to plant and injury to construction workers.	4	5	20	Undertake appropriately targeted GI to verify presence or absence of voids beneath Site and determine whether ground gas is being generated. Undertake appropriate GI throughout the Site to determine ground conditions and locate position of opencast extents. Requirements for ground treatment to be design based on recorded conditions. Foundations to be designed in accordance with design standards.	1	5	5
3	Shallow abandoned coal mine workings	Surface deformation, structural damage, subsidence, health & safety risk. Risk to human health. Programme delays. Increase in costs due to further investigation and treatment works. Elevated risk of damage to plant and injury to construction workers.	3	5	15	Undertake appropriately targeted GI to investigate unrecorded shallow mine workings and any other voids associated with underground workings in these areas.	2	5	10
4	Shallow abandoned ironstone workings	Collapse of workings within the Ironstone seams. Surface deformation, structural damage, subsidence, health & safety risk. Risk to human health. Programme delays. Increase in costs due to further investigation and treatment works. Elevated risk of damage to plant and injury to construction workers.	2	5	10	Recommended that at least one borehole should be extended to the Rosser Veins during the GI, which is anticipated to be approximately up to 60m bgl, to help inform decisions with respect to any potential risks to redevelopment posed by workings within the Ironstone Veins.	1	5	5
5	Former Iron works - Slags	Contamination and Health & safety risk Surface deformation, structural damage, risk due to swelling of slag material.	2	4	8	Undertake appropriately targeted GI to investigate potential former iron works area for evidence of slag material. If slag material encountered, testing of material to determine the characteristics and if the slag poses risks to the proposed structures. Requirements for ground treatment to be design based on recorded conditions.	1	4	4

Risk ID	Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Risk
6	Abandoned adits, shafts and roadways	Collapse of workings within the Ironstone seams. Surface deformation, structural damage, subsidence, health & safety risk. Risk to human health. Programme delays. Increase in costs due to further investigation and treatment works. Elevated risk of damage to plant and injury to construction workers.	2	5	10	Geophysical techniques, such as micro-gravity, resistivity or seismic may provide a relative low cost, wide area investigation technique to determine the position of roadways, voids. Any features identified would still require ground proving with boreholes or similar. If encountered, adits, shafts and roadways with insufficient ground cover would likely require remediation as part of Site development enabling works. This may comprise local excavation and backfilling with engineered fill where the voids are very shallow, stabilisation by grout injection or, the use of high strength geogrids as tension membranes to manage the impacts of any ground movement below less sensitive areas such as green spaces.	1	5	5
7	Limited knowledge of depth and consistency of backfilled excavations within the opencast extent	Surface deformation, structural damage, subsidence, health & safety risk. Risk to human health. Programme delays. Increase in costs due to further investigation and treatment works. Elevated risk of damage to plant and injury to construction workers. Increased risk of mine gas migration and potentially lead to settlement of future structures.	3	5	15	Undertake appropriate GI throughout the Site to determine ground conditions and locate position of opencast extents. Future redevelopment must take in account the nature and depth of the backfill, as well as any remaining open voids, and pre-treatment may be required before developing proceeds.	2	4	8
8	Differential settlement and insufficient bearing resistance caused by variable ground conditions in the backfill. Differential settlement due to significant changes in the depth of fill materials across a short distance. Hard spots over the highwall of the former open cast mine.	Deformation and/or failure of structure foundations, potential deformation of structures. Health & safety risk. Increased construction/repair costs. Programme delays.	4	3	12	Undertake appropriate GI throughout the Site to determine ground conditions and locate position of open cast extents. Consider removing soft spots or incorporating ground improvement, if unsuitable founding material is encountered. Requirements for ground treatment to be design based on recorded conditions. Foundations to be designed in accordance with design standards.	2	3	6
9	Soft spots or compressible strata.	Deformation of structure foundations, impact upon structures. Increased construction/repair costs. Health & safety risk.	3	3	9	Undertake appropriate GI throughout the Site to determine ground conditions with supervision of a geotechnical engineer/engineering geologist on-Site. Requirements for ground treatment to be design based on recorded conditions. Foundations to be designed in accordance with design standards. Consider removing soft spots, incorporating ground improvement, if superficial deposits are unsuitable founding material, or surcharging high risk areas.	1	3	3
10	Unknown groundwater regime.	Impact upon design and performance of foundations. Construction issues with ground water inundating excavations and/or resulting in	3	4	12	Undertake appropriate GI throughout the Site to determine geotechnical parameters and groundwater levels. Temporary works designer to assess the need of pumping, if required during construction.	1	4	4

Risk ID	Hazard	Consequence	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Risk
		instability. Delays to programme. Drainage issues having impact on longevity of design.							
11	Ground Contamination	Increased construction costs if capping layers have to be provided to cap contamination or soak-ways are unsuitable due to risk of spreading mobile contamination. Health and safety risk	4	3	12	Undertake appropriate GI throughout the Site to determine ground conditions with suitable levels of risk assessment.	1	3	3
12	Ground gas associated with mining, carbon dioxide and methane.	Gas collecting in excavations, structures, ducts, manholes etc, leading to asphyxiation or fire. Increase in costs due to programme delays.	2	5	10	According to the CMRA [9], the CA have no records of past mine gas emissions affecting the Site. Work to be carried out in accordance with CA Permit and under the close supervision of an on-site engineering geologist or geotechnical engineer. All drilling equipment is to be operated by qualified operatives and as per Site specific method statements. Ground gas monitoring to be undertaken and risk assessment performed. Gas protection measures to be designed accordingly. The presence of hazardous ground gases on the Site may require the implementation of gas protection measures for proposed enclosed and occupied spaces.	1	5	5
13	Drainage issues or proposed soakaway drains	Ground movement as a result of inundation or collapse settlement with colliery spoil. Consolidation as a result of suspectable soils softening. Programme delays.	3	4	12	Undertake detailed ground investigation and site assessment, including soak-away tests. Potential for collapse settlement induced by soakaway drains to be assessed. If used, soakaways may be required to be located away from structures. Detailed design stage to consider drainage.	1	3	3

8 RECOMMENDATIONS FOR GROUND INVESTIGATION

8.1 RECOMMENDATIONS

Full details of the proposed ground investigation will be presented in the Ground Investigation Scoping Report (GISR). The following provides a summary of what will be required to manage the geotechnical and geoenvironmental risks of the site.

The ground investigation (GI) will allow for geotechnical and geo-environmental information to be obtained to help address risks identified in this report and inform the design stages of the project by defining the ground conditions at the Site. The objectives of the proposed GI are as follows:

- Confirm the ground conditions beneath the Site including the specific features noted below:
  - The opencast mine extents, location of its high wall, shallow mine workings, spine roads and mine entries, including bell-pits.
  - The depth and composition of the open cast backfill.
  - The depth of the made ground/superficial materials and the depth to solid geology.
- Obtain soil and rock samples for geotechnical and geoenvironmental laboratory testing.
- Derive geotechnical parameters to inform the design stage.
- Obtain geo-environmental and ground chemistry data of the ground including ground gas and groundwater monitoring, to form a detailed Conceptual Site Model (CSM).
- Confirm the groundwater conditions.
- Allow ongoing development of the Geotechnical Risk Register.

The recommendations for the ground investigation comprises a variety of exploratory holes, including boreholes, trial pits and soakaways, together with a range of insitu and remote testing, including geophysics, standard penetration testing and plate loading testing. In addition, a laboratory investigation will be undertaken on the samples recovered from the exploratory holes.

It is recommended that a phase of geophysics is undertaken initially to determine the location of the opencast mine extents and mine entries beneath the site. It is considered that resistivity and microgravity techniques may be required.

It is recommended that boreholes are formed using dynamic sampling or light cable percussive techniques with rotary core follow on. Probe holes may be progressed by open hole drilling to deeper depths where the sole purpose is to investigate mine workings, although will need to be supplemented by cored boreholes. Should shallow mine workings be encountered during the ground investigation, a revised intrusive probing programme may be required to confirm the mining risk to the scheme.

8.1.1 TESTING

Geotechnical in-situ testing is likely to include, but not limited to, standard penetration tests (SPT), plate loading tests (PLT) and soakaway tests in accordance with BRE 365.

Geotechnical laboratory testing is likely to include, but not limited to, particle size distribution (PSD), moisture content, Atterberg limits, BRE SD1 Suite, unconsolidated/consolidated drained/undrained triaxial tests, shear boxes, one-dimensional consolidation, point load testing and unconfined compressive strength.

Geo-environmental laboratory testing of soils samples is likely to include, but not limited to, asbestos, heavy metals, speciated petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), volatile and semi volatile organic compounds (VOCs and SVOCs) and selected inorganics. The results will be screened against generic assessment criteria to determine potential risks to human health.

A limited number of soil leachate samples should be tested and likely to include, but not limited to, heavy metals, speciated petroleum hydrocarbons, PAHs, VOCs and SVOCs, ammoniacal nitrogen and selected inorganics. The results will be screened against relevant Drinking Water Standards (DWS) and Environmental Quality Standards (EQS) for a Level 1 controlled waters risk assessment.

Where possible groundwater samples and surface water samples shall be collected from groundwater monitoring installations and nearby surface water features on one occasion and likely tested for, but not limited to, heavy metals, speciated petroleum hydrocarbons, PAHs, VOCs and SVOCs, ammoniacal nitrogen and selected inorganics. The results will be screened against relevant DWS and EQS for a Level 2 controlled waters risk assessment.

8.1.2 STANDARDS & CODES OF PRACTICE

At a minimum, all works will be carried out and reported in accordance with the following standards and codes of practice:

- BS EN 1997-1, ‘Eurocode 7 – Geotechnical Design, General Rules’ [3].
- BS EN 1997-2, ‘Eurocode 7 – Geotechnical Design, Ground Investigation and Testing’ [22].
- BS EN 14688-1, ‘Geotechnical Investigation and Testing – Identification and classification of Soil’ [23].
- BS EN 14689-1, ‘Geotechnical Investigation and Testing – Identification, description and classification of Rock’ [24].
- BS EN ISO 22475-2, ‘Geotechnical Investigation and Testing – Sampling methods and groundwater measurements’ [25].`
- BS EN ISO 22476-1:2023, ‘Geotechnical Investigation and Testing- Field Testing. Part 1: Electrical cone and piezocone penetration test’ [26].
- BS EN ISO 22476-3, ‘Geotechnical Investigation and Testing. Field Testing. Standard Penetration Test’ [27].
- BS 1377, ‘Methods of test for Soils for Civil Engineering Purposes’ Parts 1, 2, 3 and 9 [28] [29] [30] [31].
- BS EN ISO 17892, ‘Geotechnical Investigation and Testing. Laboratory testing of soil’ Parts 1 to 12 [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] .
- BS 5930, ‘Code of Practice for Ground Investigations’ [44].
- BS10175, ‘Investigation of Potentially Contaminated Sites- Code of Practice’ [45].
- BRE Digest 365 Soakaway Design 2016 [46].

9 REFERENCES

[1] Highways England, “CD622 "Managing Geotechnical Risk"," 2019.

[2] OS Maps, “Explore OS Maps,” [Online]. Available: https://explore.osmaps.com/?lat=51.776100&lon=-1.894300&zoom=7.0000&style=Standard&type=2d. [Accessed October 2023].

[3] British Standards Institution, “BS EN 1997-1:2004+A1:2013 Eurocode 7: Geotechnical Design - Part 1: General Rules,” BSI Standards Limited, London, 2013.

[4] BGS, “BGS Geoindex - Onshore,” [Online]. Available: https://www.bgs.ac.uk/map-viewers/geoindex-onshore/. [Accessed August 2024].

[5] BGS, “Geological Survey of England and Wales 1:63,360/1:50,000 geological map series, New Series Sheet 231,” [Online]. Available: https://webapps.bgs.ac.uk/data/maps/Maps.cfc?method=listResults&series=E50k&scale=&origID=&getLatest=&pageSize=100&MapName=231. [Accessed August 2024].

[6] BGS, “BGS 1:10,560 scale solid and drift geological map SO00NE,” 1972. [Online]. Available: https://largeimages.bgs.ac.uk/iip/mapsportal.html?id=18677750. [Accessed July 2024].

[7] BGS, “BGS - Lexicon,” [Online]. Available: https://webapps.bgs.ac.uk/lexicon/.. [Accessed February 2024].

[8] BGS, “Geology of the South Wales Coalfield, Part V, the country around Merthyr Tydfil. Memoir for 1:50,000 geological sheet 231 (England and Wales),” BGS, 1990. [Online]. Available: https://webapps.bgs.ac.uk/memoirs/docs/B01823.html. [Accessed August 2024].

[9] WSP UK Ltd, “Goat Mill Road Coal Mining Risk Assessment (UK-70116992-CMRA-0001),” 2024.

[10] Google, “Google Earth Pro version 7.3.6.9750 (64-bit),” 2022.

[11] Natrual Resources Wales, “Check your flood risk,” [Online]. Available: https://check-your-flood-risk.naturalresources.wales/?culture=en-GB. [Accessed July 2024].

[12] BGS, “Scanned Hydrogeological Maps,” [Online]. Available: https://largeimages.bgs.ac.uk/iip/hydromaps.html?id=south-wales.jp2. [Accessed September 2024].

[13] NRW, “Water Quality Archive,” [Online]. Available: https://datamap.gov.wales/layers/geonode:nrw_water_quality_archive_stations. [Accessed September 2024].

[14] UK Health Security Agency, “UK maps of radon,” [Online]. Available: https://www.ukradon.org/radonmaps/. [Accessed July 2024].

[15] “Zetica, Risk Maps,” [Online]. Available: https://zeticauxo.com. [Accessed February 2024].

[16] The National Library of Scotland, “Map Finder with Marker Pin,” [Online]. Available: https://maps.nls.uk/geo/find/marker/. [Accessed 2021 September].

[17] NRW, “Historical Landfill Sites,” [Online]. Available: https://datamap.gov.wales/layers/inspire-nrw:NRW_Historic_Landfill_Sites. [Accessed September 2024].

[18] NRW, “Permitted Waste Sites,” [Online]. Available: https://naturalresources.wales/evidence-and-data/maps/find-details-of-permitted-waste-sites/?lang=en. [Accessed September 2024].

[19] “Coal Authority Map Viewer,” [Online]. Available: https://mapapps2.bgs.ac.uk/coalauthority/home.html.. [Accessed October 2023].

[20] BGS, “Maps & Sections,” [Online]. Available: https://webapps.bgs.ac.uk/data/MapsPortal/?_ga=2.114788738.446276208.1698227831-1716465959.1698227831. [Accessed October 2023].

[21] Welsh Government, “DataMapWales,” February 2024. [Online]. Available: https://datamap.gov.wales/maps/new#/.

[22] British Standards Institution, “BS EN 1997-2:2007 Eurocode 7 - Geotechnical Design - Part 2: Ground Investigation and Testing,” BSI Standards Limited, London, 2010.

[23] British Standards Institution, “BS EN ISO 14688-1:2018 Geotechnical Investigation and Testing - Identification and Classification of Soil. Identification and description,” BSI Standards Limited, London, 2018.

[24] British Standards Institution, “BS EN ISO 14689: 2018 Geotechnical investigation and testing-identification, description and classification of rock,” BSI Standards Limited, London, 2018.

[25] British Standards Institution, “BS 22475-2:2011, Geotechnical investigation and testing-Sampling methods and groundwater measurements- Part 2: Qualification criteria for enterprises and personnel,” BSI Standards Limited, London, 2011.

[26] British Standards Institution, “BS EN ISO 22476-1:2023 Geotechnial investigation and testing- Field testing. Part 1: Electrical cone and piezocone penetration test,” BSI Standards Limited, London, 2023.

[27] British Standards Institution, “BS EN ISO 22476-3:2005 + A1:2011 Geotechnical investigation and testing. Field testing. Standard penetration test,” BSI Standards Limited, London, 2012.

[28] British Standards Institution, “BS 1377-1:2016 Methods of test for soils for civil engineering purposes. General requirements and sample preparation.,” BSI Standards Limited, London, 2016.

[29] British Standards Institution, “BS 1377-2:2022 Methods of test for soils for civil engineering purposes. Classification tests and determination of geotechnical properties.,” BSI Standards Limited, London, 2022.

[30] British Standards Institution, “BS 1377-3:2018 Methods of test for soils for civil engineering purposes. Chemical and electro-chemical testing (+A1:2021).,” BSI Standards Limited, London, 2018.

[31] British Standards Institution, “BS 1377-9:1990 Methods of test for soils for civil engineering purposes. In-situ tests.,” BSI Standards Limited, London, 1990.

[32] British Standards Institution, “BS EN ISO 17892-1:2014 Geotechnical investigation and testing - Laboratory testing of soil. Determination of water content (+A1:2022),” BSI Standards LImited, London, 2014.

[33] British Standards Institution, “BS EN ISO 17892-2:2014 Geotechnical investigation and testing - laboratory testing of soil. Determination of bulk density.,” BSI Standards Limited, London, 2014.

[34] British Standards Institution, “BS EN ISO 17892-3:2015 Geotechnical investigation and testing - laboratory testing of soil. Determination of particle density.,” BSI Standards Limited, London, Geotechnical investigation and testing - laboratory testing of soil. Determination of particle density.

[35] British Standards Institution, “BS EN ISO 17892-4:2016 Geotechnical investigation and testing - laboratory testing of soil. Determination of particle size distribution (ISO 17892-4:2016),” BSI Standards Limited, London, 2016.

[36] British Standards Institution, “BS EN ISO 17892-5:2017 Geotechnical investigation and testing - laboratory testing of soil. Incremental loading oedometer test (ISO 17892-5:2017),” BSI Standards Limited, London, 2017.

[37] British Standards Institution, “BS EN ISO 17892-6:2017 Geotechnical investigation and testing - laboratory testing of soil. Fall cone test (ISO 17892-6:2017),” BSI Standards Limited, London, 2017.

[38] British Standards Institution, “BS EN ISO 17892-7:2018 Geotechnical investigation and testing - laboratory testing of soil. Unconfined compression test (ISO 17892-7:2017),” BSI Standards Limited, London, 2018.

[39] British Standards Institution, “BS EN ISO 17892-8:2018 Geotechnical investigation and testing - laboratory testing of soil. Unconsolidated undrained triaxial test,” BSI Standards Limited, London, 2018.

[40] British Standards Institution, “BS EN ISO 17892-9:2018 Geotechnical investigation and testing - Laboratory testing of soil. Consolidated triaxial compression tests on water saturated soils,” BSI Standards Limited, London, 2018.

[41] British Standards Institution, “BS EN ISO 17892-10:2018 Geotechnical investigation and testing - Laboratory testing of soil. Direct shear tests,” BSI Standards Limited, London, 2018.

[42] British Standards Institution, “BS EN ISO 17892-11:2019 Geotechnical investigation and testing - laboratory testing of soil. Permeability tests,” BSI Standards Limited, London, 2019.

[43] British Standards Institution, “BS EN ISO 17892-12:2018 Geotechnical investigation and testing - laboratory testing of soil. Determination of liquid and plastic limits (+A2:2022),” BSI Standards Limited, London, 2018.

[44] British Standards Institution, “BS 5930:2015+A1:2020 Code of practice for ground investigations,” BSI Standards Limited, London, 2015.

[45] British Standards Institution, “BS 10175:2011 + A2:2017 Investigation of Potentially contaminated sites- code of practice,” BSI Standards Limited, London, 2017.

[46] BRE, “Digest 365 Soakaway design. 2016 revision,” IHS BRE Press, Bracknell, 2016.

[47] ICE, “UK Specification for Ground Investiagtion - Third Edition,” 2022.

[48] Sirius Geotechnical Ltd, “PRELIMINARY APPRAISAL (DESK STUDY) of land off GOAT MILL ROAD, MERTHYR TYDFIL - REPORT C8341 Rev B,” 2022.

Appendix A

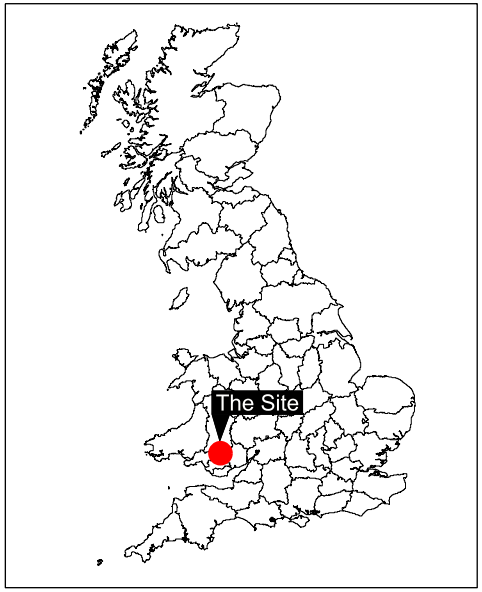
SITE BOUNDARY

Public



SITE LOCATION
SCALE 1:5,000

SITE LOCATION
SCALE 1:50,000



SITE LOCATION
SCALE 1:50,000

LEGEND

SITE BOUNDARY

CLIENT
MERTHYR TYDFIL COUNTY BOROUGH COUNCIL

PROJECT
GOAT MILL ROAD

TITLE
SITE LOCATION PLAN

CONSULTANT
wsp

YYYY-MM-DD	2024-08-28
DESIGNED	CB
PREPARED	ECS
REVIEWED	OEG
APPROVED	

PROJECT NO.	CONTROL	REV.	DRAWING
UK-70116992	1001-ME-0001	A	1

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Appendix B

SITE WALKOVER PHOTOGRAPHS

Public



Plate 1: Northern site entrance from Goat Mill Road



Plate 2: Northeastern and steepened section of the site



Plate 3: Northern drainage ditch, leading toward marshy area south of northern entrance



Plate 4: Vegetated area located near possible adit location, adit reference 306206-083.



Plate 5: Vegetated area located near possible coal shaft location, reference 306206-067.

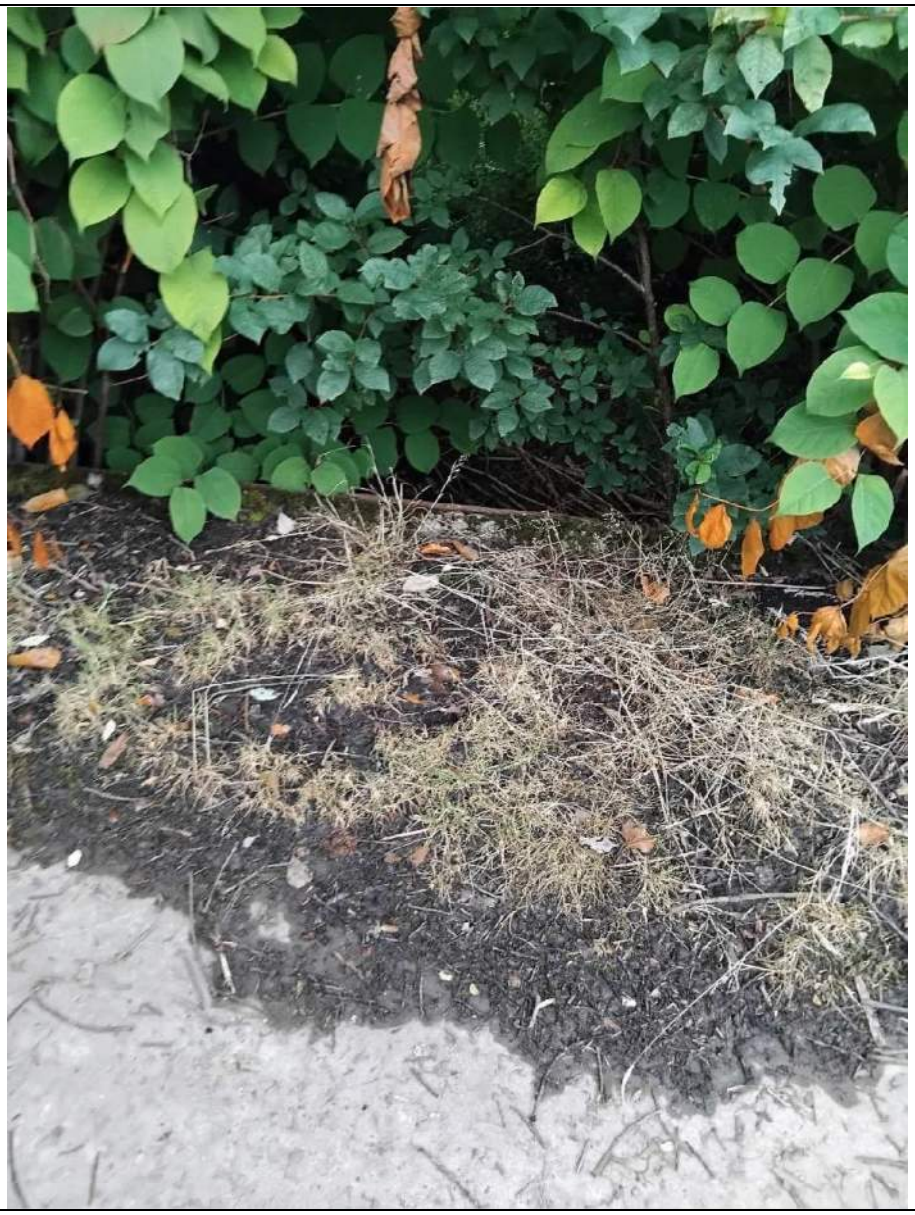


Plate 6: Concrete footbridge crossing southern watercourse.



Plate 7: Groundwater/Ground gas monitoring well, southern section of site



Plate 8: Groundwater/Ground gas monitoring well, east of southern site entrance



Plate 9: Southern site entrance from Goat Mill Road



Plate 10: Marshy area west of the northern site entrance.



Plate 11: Vegetation growth at potential adit location, reference 306206-006

Appendix C

COAL MINING RISK ASSESSMENT

Public

Merthyr Tydfil County Borough Council

GOAT MILL ROAD

Coal Mining Risk Assessment



UK-70116992-CMRA
SEPTEMBER 2024

PUBLIC

Merthyr Tydfil County Borough Council

GOAT MILL ROAD

Coal Mining Risk Assessment

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HISTORIC BGS BOREHOLES

1. INTRODUCTION

1.1. AUTHORISATION AND SCOPE

Merthyr Tydfil County Borough Council have commissioned WSP UK Ltd (WSP) to provide geotechnical services to assess the coal mining risk at an approximate 14.6-hectacre site in Merthyr Tydfil, with a postcode of CF47 0TJ. The site, off Goat Mill Road, is being considered as a potential site for industrial development.

The Site is designated as a Development High Risk Area by the Coal Authority (CA). As such, the Local Planning Authority require a Coal Mining Risk Assessment (CMRA) to be prepared and submitted to support the planning application. The Local Planning Authority shall submit the CMRA to the CA for their comment and approval.

A Desk Study and Coal Mining Risk Assessment for the Site was produced on behalf of J&A Young (Leicester) Ltd by Sirius Geotechnical Ltd in February 2022[1]. Relevant coal mining information within this document has been summarised Section 2.8. The document, referenced below, was provided by the client:

- Sirius Geotechnical LTD, February 2022, Report C8341 Rev B, Preliminary Appraisal (Desk Study) of land off Goat Mill Road, Merthyr Tydfil.

To fully establish the extent of the mining risk and inform future ground investigation scoping, this CMRA will provide a guide to the mining risks at the Site and allow the targeting of ground investigation to fully define the risks and provide information to inform the design stage.

WSP have also undertaken a Desk Study pertaining to Site to inform the preliminary design stage[2].

This document is referenced below and should be read in conjunction with this report:

- WSP UK LTD, 2024, UK-70116992-DS-001, Goat Mill Road Desk Study.

1.2. LIMITATIONS

WSP has prepared this report for the sole use of the Client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of WSP. No other third-party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety. Information provided by others has been taken in good faith as being accurate. WSP cannot accept liability for any deficiencies in third party information.

[1] Sirius Geotechnical LTD, “Report c8341 rev b Preliminary Appraisal (Desk Study) of land off Goat Mill Road, Merthyr Tydfil,” Sirius Geotechnical LTD, Leeds, 2022.
[2] WSP UK LTD, “ Goat Mill Road Desk Study (UK-70116992-DS-001),” 2024.

1.3. SITE LOCATION AND DESCRIPTION

The plot of land, known as Goat Mill Road, is referred to as the 'Site' in this report. It is located approximately 1.1km east of Merthyr Tydfil; see Figure 1-1 below[3]. The Site is centred around an approximate National Grid Reference (NGR) of 306219E, 206929N. A detailed Site boundary location plan can be found in Appendix A. It is based on a client provided planning application boundary produced by Sirius Planning[1].

The Site is located east of Goat Mill Road and the A4102 and west of the A4060 dual carriageway. The Site is bound to the north by an access road to Phoenix Industrial Estate, and residential properties of Mount View to the south. The Site is known to be subject to former industrial and mining activities, most recently opencast workings.

The Site generally comprises open, sparsely grassed gravel, with a wooded margin along the western and eastern edges and pockets of dense vegetation growth scattered throughout. Two watercourses are located on Site. One is located towards the northern extent of Site and the other is located towards the southern side of Site.

Figure 1-1 - Site Location



[3] Google, "Google Earth Pro," 2022.

Based upon information held by OS Maps Online[4], the Site is typically shown to decrease in elevation from west to east, from approximately 282m to 279m Above Ordnance Datum (AOD), and typically decreases from north to south, from approximately 288m to 278m AOD.

1.4. SCOPE OF THE COAL MINING RISK ASSESSMENT

The purpose of this Coal Mining Risk Assessment Report is to:

- Identify and assess the risks to the proposed development from the legacy of coal mining, including the cumulative impact of issues.
- Review the information within the CA Consultants Coal Mining Report and publicly available information to assist in the assessment of coal mining risk at the site, such as geological and historical maps.
- Set out appropriate mitigation measures to address the coal mining legacy issues affecting the Site, including any necessary remedial works and/or demonstrate how coal mining legacy issues may influence the proposed development.
- Demonstrate to the Local Planning Authority that the application Site is, or can be made, safe and stable to meet the requirements of national planning policy regarding development on potentially unstable land.

[4] OS Maps, "Explore OS Maps," [Online]. Available: https://explore.osmaps.com/?lat=51.776100&lon=-1.894300&zoom=7.0000&style=Standard&type=2d [Accessed July 2024].

2. SOURCES OF INFORMATION

The following sources of information have been used in the preparation of this report:

- Google Earth Pro[3].
- OS Maps Online[4].
- Coal Authority Consultants Coal Mining Report (Ref 71009804598001), included in Appendix C.
- Mine Abandonment Plans, included in Appendix C.
- 1:50,000 Scale Drift Geological Map of Merthyr Tydfil (Sheet 231), 1979[5].
- 1:10,560 scale solid and drift geological map (sheet SO00NE), 1972[5].
- British Geological Survey (BGS) Geoindex[6].
- BGS Online Lexicon[7].
- Coal Authority online map viewer[8].
- Geology of the South Wales Coalfield, Part V, the country around Merthyr Tydfil. Memoir for 1:50 000 geological sheet 231 (England and Wales), W. J. Barclay, K. Taylor and L. P. Thomas, 1988[9].
- Merthyr Tydfil County Borough Council, Planning Simple Search[10].

2.1. SITE DESCRIPTION

WSP undertook a walkover survey on 08-July-2024. The weather at the time of the walkover was dry and partially cloudy. Photographs and site notes were recorded at the time of the visit. Vegetation growth obscured areas of the site reducing possible observations of the Site.

There was no evidence of past coal mining features onsite. Theoretical locations of mine entries were identified using the CA interactive viewer[8], however, there was no physical evidence of their presence, such as fenced perimeters or local subsidence.

A summary of other observations made during the inspection is provided below. Photographic plates are included in the Appendices of the WSP desk study[2].

- Topography was mostly flat; the northeastern corner was observed to sharply rise in level towards the extents of the Site boundary.
- The Site surfacing comprises mainly open sparsely grassed gravel, with a wooded areas present along the west and east flanks.

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[5] BGS, "Maps & Sections," [Online]. Available: https://webapps.bgs.ac.uk/data/MapsPortal/?_ga=2.114788738.446276208.1698227831-1716465959.1698227831 [Accessed July 2024].
[6] BGS, "BGS Geoindex - Onshore," [Online]. Available: https://www.bgs.ac.uk/map-viewers/geoindex-onshore/ [Accessed July 2024].
[7] BGS, "BGS - Lexicon," [Online]. Available: https://webapps.bgs.ac.uk/lexicon/ [Accessed July 2024].
[8] "Coal Authority Map Viewer," [Online]. Available: https://mapapps2.bgs.ac.uk/coalauthority/home.html [Accessed July 2024].
[9] W. Barclay, K. Taylor and L. Thomas, "Geology of the South Wales Coalfield, Part V, the country around Merthyr Tydfil. Memoir for 1:50 000 geological sheet 231 (England and Wales)," BGS, 1988. [Online]. Available: https://webapps.bgs.ac.uk/memoirs/docs/B01820.html [Accessed July 2024].
[10] Merthyr Tydfil County Borough Council , "Planning – Simple Search," [Online]. Available: https://publicaccess.merthyr.gov.uk/online-applications/ [Accessed July 2024].

- A drainage channel was observed along the northern side of Site. This is thought to be the previously identified watercourse. No obvious flow was observed at the time of the walkover. The watercourse towards the south of Site was also confirmed.
- Wet/marshy ground was observed towards the northwestern corner of Site.
- Potential soft ground was observed towards the extreme southern extent of Site.
- Two historic groundwater or ground gas monitoring wells were observed. WSP requested further information from the client, however, were told no records are available.

2.2. PUBLISHED GEOLOGY

Based on the available information listed above, the following geological sequence is anticipated at the Site.

2.2.1. MADE GROUND

The geological maps[5,6] suggest Made Ground consisting of spoil from coal and iron workings covers much of the Site and surrounding area. BGS Geoindex[6], indicates that the Made Ground is of Artificial Deposit. There is an area, labelled '*Many Bell Pits'* on the geological maps where Made Ground is absent. Though not labelled 'Many Bell Pits', a similar outlined area of land on BGS Geoindex also shows Made Ground to be absent.

2.2.2. SUPERFICIAL GEOLOGY

Glacial Till is shown across the central southern part of the Site according to the 1:10,560 geological map[5], dated 1974. BGS Geoindex[6] contradicts the geological map and shows that Glacial Till is present across the whole Site. Typically, this material typically comprises of a firm to very stiff, gravelly, sandy clay.

Given the subsequent opencast mining history of the Site, there is uncertainty as to whether superficial deposits are present.

2.2.3. SOLID GEOLOGY

The South Wales Lower Coal Measures (LCM) Formation of Carboniferous age is present beneath the Site[6]. The published geology indicates the LCM strata comprise coal-bearing mudstones and siltstones with seatearths and minor sandstone. The 1:10,560 geological map[5], also indicates presence of Ironstone Veins.

2.2.3.1. Structure

Figure 2-1 shows extracts of the 1:10,560 SO00NE geological map[5]. The strata are indicated to dip 6° towards the southeast.

Inferred on the geological maps is the northwest to southeast trending Dowlais Fault, with the downthrown side towards the southwest. This is the closest mapped fault to Site and is approximately 200m to the north.

Figure 10 from the Geology of the South Wales Coalfield memoir[9], shows the Penydarren Fault and an unlabelled fault in the vicinity of Site. However, a review of the 1:10,560 SO00NE geological map[5] suggests these are approximately 750m and 500m to the southeast of Site respectively. The Penydarren Fault is shown to have a downthrow towards the northeast, the unlabelled fault has a downthrow towards the southwest.

2.2.3.2. Coal Seams

- Figure 6 from the Geology of the South Wales Coalfield memoir[9], which presents a generalised vertical section of the Lower Coal Measures, suggests the following sequence of coal seams thought to be relevant to Site, in descending order:
- Amman Rider Seam
- Yard Seam
- Seven Feet Seam
- Five Feet Seam
- Gellideg Seam

The conjectured outcropping Amman Rider seam is shown to be located in the southeastern part of Site, trending in a north to south direction according to sheet SO00NE[5]. The recorded thickness of this seam on the generalised section is indicated to be 0.46m, however, it is not clear where this thickness was recorded or if it is an average thickness for the distrct. It is anticipated to be present beneath Site if it has not been subject to open cast mining. Figure 2-1 shows an extract of the SO00NE sheet of the area surrounding Site and the generalized vertical section for the lower coal measures.

There is no evidence on sheet SO00NE showing the Yard Seam and Five Feet between the Amman Rider and Gellideg coal seams. The Seven Feet is shown to crop southwest of the Site. However, it has not been mapped at surface in the area of Site.

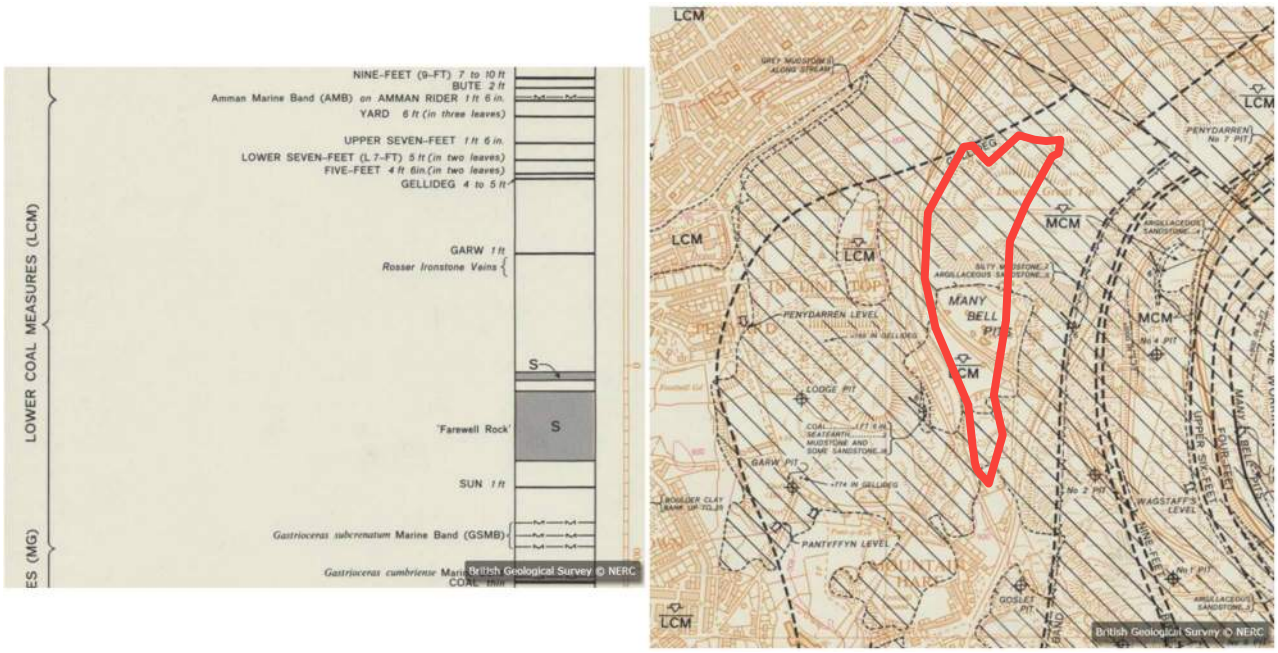
The Gellideg seam is shown as a conjectured outcrop along the north and western boundary. Its position appears to coincide with the northwestern area of Site, or it is shown marginally west of the Site. Sheet SO00NE suggests the seam thickness is 1.2m to 1.5m. Approximately 250m to the west of Site, the geological map notes that the Gellideg seam was encountered at 232m AOD in the Garw Pit.

According to the Geology of the South Wales Coalfield memoir[9]: *'In the Taff Valley around Merthyr Tydfil the Gellideg is the lowest of three closely spaced coals (the upper two forming the standard Five-Feet), which make up a composite seam, known formerly as the Lower Four-Feet'*.

The Gellideg seam underlies the Five Feet Seam, which has a recorded thickness of 1.4m according to the generalised section.

Approximately 100m east of Site, the conjectured Bute and Nine-Feet seams are shown. Given the dip and direction of the solid geology, unless some unknown structural feature is these seams will not be present beneath the Site.

Figure 2-1 - Extracts from 1:10,560 SO00NE geological map showing the approximate Site location (red boundary) and the coal sequence



- With reference to Figure 2-1, various earthworks and tips associated with the industrial history of the area on and around the Site are recorded. Railway embankments and cuttings are also shown.

According to the 1:10,560 scale plan, there is an area labelled '*Many Bell Pits'* which is shown to cross the central southern part of the Site, indicating a number of former mine entries in the form of bell pits.

Several mine entries are shown surrounding Site:

- West of Site, the Penydarren Level and Lodge Pit is shown approximately 400m and 300m away from Site respectively. Penydarren Level is shown aligned to the southeast.
- Two adits are shown west/southwest of Site, aligned the northeast. One is labelled the Pantyffyn Level. Garw Pit is also shown in the same area, approximately 400m away from Site.
- South of Site, Goslet Pit is labelled approximately 350m away from Site.
- Southeast of Site, Tom Price's Pit and No. 1 Pit is shown approximately 500m away.
- East of Site, Wagstaff's Level is shown 400m away, No. 2 Pit and No. 4 Pit are shown approximately 300m away from Site.

2.3. BGS HISTORICAL BOREHOLE LOGS

2.3.1. HISTORICAL BOREHOLE LOGS

A review of the BGS historical exploratory hole records has identified two available borehole records on or close to Site[6]. Both are appended in Appendix D.

2.3.2. BGS REF. SO00NE72

Located within the site, this record is titled; '*Strata Between the Lower 4ft Coal and Farewell Rock at Dowlais'*. The date and exact location of the borehole is not given, but the following location is indicated within the records NGR 306300E, 207000N.

The scan quality is poor. However, it shows what is understood to be ironstone veins encountered below the Lower 4ft Coal, i.e. the Gellideg coal seam. Table 2-1 summarises the information presented within the log. Approximate depth estimates for the ironstone veins below the Lower 4Fft Coal have been based on the vertical scale in conjunction with the grid lines shown on the log.

Table 2-1 - Summary of anticipated Ironstone Veins and approximate depths below the Lower 4ft Coal.

Description	Approximate depth below the Lower 4ft Coal (m)
Spotted or Black Ball Ironstone	3.0
Yellow Ironstone	9.0
Red Ironstone	12.0
Blue Ironstone	15.0
Lumpy Ironstone	27.5
Rosser Ironstone Veins	30.5 – 38.0

The log also records the presence of the Farewell Rock at an approximate depth of 43m below the Lower 4ft Coal, indicating the base of the economically workable Coal Measures.

2.3.3. BGS REF. SO00NE53

Approximately 150m southeast of Site, this borehole was drilled in early winter 1975, at an elevation of 303.9m AOD, for the National Coal Board at Longtown Tip (Tip No. 724). The record of the log is summarised below:

Table 2-2 - Summary of BGS borehole ref.SO00NE53

Strata	Depth (m bgl)	Elevation (m AOD)	Description
Spoil	0.0 – 16.8	303.9 – 287.1	Typically described a loose gravel or gravelly silty sand. Described as *'Run of Mine'* from 0.0 – 16.5m bgl.
Mantle: Boulder Clay (Glacial Till)	16.8 – 23.8	287.1 – 280.1	Soft to stiff sandy clayey silt to silty clay with varying amounts of gravel and cobbles including limestone and quartzite.
Sandstone	23.8 – 25.1	280.1 – 278.8	Dark grey, fine grained, thinly laminated, poorly jointed, faintly weathered, Sandstone. Moderately strong to strong, numerous carbonaceous/silty partings, coaly at base.

Strata	Depth (m bgl)	Elevation (m AOD)	Description
Mudstone	25.1 – 27.5	278.8 – 276.4	Grey, thinly laminated, well jointed, blocky, faintly weathered Mudstone, moderately weak to moderately strong, planty at base.
Little Seam/Seven Feet	27.5 – 27.9	276.4 – 276.0	Soft broken coal with shaley partings.
Seatearth/Fireclay	27.9 - 30.8	276.0 – 273.1	Seatearth/fireclay with suspected old iron stone working between 29.65 – 30.15m bgl.
Siltstone with Sandstone and silty Mudstone	30.8 – 40.7	273.1 – 263.2	Grey to black, thinly to thickly laminated, sparely jointed, faintly weathered, Mudstone moderately strong to strong, occasional ironstones and plants, some carbonaceous partings.
Coal *	40.7 - 41.5	263.2 – 262.4	Black, thinly laminated, high angle parted fresh, very weak, seaty at top.
Seatearth/Fireclay *	41.5 – 42.3	262.4 – 261.6	Grey, thickly laminated, uneven jointed, fresh, moderately weak with numerous listric surfaces and rootlets.
Coal *	42.3 – 44.5	261.6 – 259.4	Black, high angled parted to solid fresh coal, very weak to weak. Three thin bands of Seatearth/Fireclay present between coal between 0.1 and 0.2m thick.
Seatearth/Fireclay	44.5 – 45.3	259.4 – 258.6	Grey to black, thinly laminated, poorly jointed, fresh, very weak to moderately strong, silty horizons, well preserved plants, listric features.

* This log indicates from 40.7 to 44.5m bgl is representative of the '*Lower Four Feet Seam (Five Feet - Gellideg)*'.

2.4. HISTORICAL LAND USE

The National Library of Scotland records show historic Ordnance Survey plans and other maps of the Site, from 1840 to 1973. Google Earth Pro has been used to review the historical imagery of the Site from 2001 to 2023[3]. A summary of the Site history and surrounding land use from 1840 to 1973, and from 2001 to 2023 is shown in Table 2-3.

WSP were not able to report on any Site History from 1973 to 2001 using publicly available information. Please refer to Section 3.3.2 where an additional summary of the historical land use has been made based on abandonment plan ref.16532/1 which is dated 1994.

Table 2-3 - Summary of Historical Land Use

Date (Map Scale)	Within the Site boundary	Surrounding Site
County Layers: 1840s – 1880s (Six Inch)	The northern part of the Site is part of the wider Dowlais Great Tip. A railway track is present within the tip. There is a spur from this line, heading towards the centre of Site, but terminates within the extents of the Dowlais Great Tip. There are two Air Shafts towards the central area of Site. Ton-y-ffald Level (Coal) is labelled towards the western side of Site. Various earthworks/tips are noted onsite: ■ A cluster of apparent pits/ponds are shown towards the centre of Site. ■ A pit/pond feature is shown east of Ton-y-Ffald level. ■ The western side of Site is bound by a cutting, in which runs the labelled Dowlais Railway. ■ A series of earthworks, with areas of pastures are present in the western-northwestern extent of Site, east of the Dowlais Railway. ■ A Reservoir is shown to encroach the southern tip of the Site. A northeast to southwest trending watercourse appears to run through the southern part of the Site and feed into the north side of this Reservoir. This watercourse is believed to be the one observed during the walkover. The reservoir is mapped at the location where potentially softer ground was observed. Immediately north of the reservoir, unlabelled earthworks/tips appear to be present. An unlabelled tank is also present in this vicinity. ■ A series of unlabelled roads and buildings are present within the Site boundary.	Dowlais Great Tip extends beyond the northeastern boundary of Site. Pwll-yr-Hwyaid, which translates from Welsh as 'Duck Pond', is present outside of the northeastern boundary. The surrounding area is heavily affected by mining, with numerous air shafts and mine entries, railways, tramways, engine houses, reservoirs and a limekiln present. Dowlais Iron Works, Coed Cae pond and a Brick Works is shown approximately 150m of the north or northeast of the Site. Pen-y-Daren Iron Works is 200m west of the Site. Many springs are shown to surround Site.
Towns: 1840s – 1890s (1:1,500)	Old levels coal or coal and ironstone mines are labelled towards the southern and western extents of Site. The ground cover of the unlabelled tips/earthworks towards the southern end of Site is shown to comprise of shingle/pebbles. Another area of earthwork is shown towards the centre of Site. An area of land labelled 'railway in construction' is shown towards the northwest of the Site boundary. A form of road connects Ton-y-Ffald level with what appears to be a building labelled Ton-y-ffald on the eastern end of Site. Numerous unidentified, roughly circular features, interpreted as bell pits, are shown in the central southern part of the Site.	This map is incomplete to the east; therefore, information of the surrounding area is limited. A steelwork's is labelled immediately north of the Site boundary.
Outline: 1885 - 1900 (One Inch)	No obvious or significant changes.	No obvious or significant changes.
Hills: 1885 - 1903 (One Inch)	No obvious or significant changes.	No obvious or significant changes.
1888 - 1915 (Six Inch)	A railway, Dowlais Steel Works Branch/G.W.R & Rhymney Joint Line, crosses the southern half of the Site. The railway previously in construction towards the northwest of Site has been constructed. A Reservoir and filter beds are also labelled towards the northwestern side of Site. No earthworks/tips are indicated towards the south of Site, north of the reservoir, indicating this area may have been filled. The map shows the ground to comprise of areas of pasture. The two Air Shafts in the central part of theSite are now labelled as Old Air Shafts. Ton-y-Ffald Level is no longer shown, though the associated building towards the eastern extent of Site remains. The roads previously shown onsite are no longer present or have been labelled as footpaths. The ground cover within Dowlais Great Tip is shown to be of rough pasture. Surrounding the tip, the ground cover comprises of shingle/gravel. The railway tracks are no longer shown.	Pen-y-Daren Iron Works is no longer shown. Pwll-y-Hwyaid has been filled in with shingle. The steelwork is no longer labelled, but the footprint of the building remains, and Dowlais Iron Works is still labelled. Numerous air shafts, reservoirs and mine entries are now labelled old or disused. However, the surrounding area is still heavily affected by ongoing mining.