

St. Modwen Developments

Crymlyn Tip, Coed Darcy

Coal Mining Risk Assessment

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I Introduction

I.1 General

PJA has been instructed by St. Modwen Developments Limited (St. Modwen) to prepare a Coal Mining Risk Assessment to support a full planning application for proposed works at Crymlyn Tip ('the Site'), a closed landfill located in the Coed Darcy development site. The Site is outlined in red on PJA Drawing 04020-A-SK921-P1 included in Appendix B.

I.2 Report Objectives

The Site is located partly within the defined Development High Risk Area, defined by The Coal Authority as an area where *'recorded coal mining risks are present at the surface or shallow depth and are likely to affect new development'*.

This Coal Mining Risk Assessment has been produced to identify coal mining legacy risks at the Site and assess which of those risks, if any, may pose a risk to the proposed works.

I.3 Development Proposals

Working towards an intended future surrender of the environmental permit, proposals for Crymlyn Tip include the installation of a low permeability barrier to prevent the off-site migration of residual free phase hydrocarbon contamination and reprofiling of site levels to create a suitable cap and stable long-term landform.

Details of the proposed works are presented in Section 3.3.

I.4 Limitations

All conclusions and recommendations made within this report are based upon and limited to the factual information obtained as part of this study. PJA will state where it has utilised and relied upon information obtained by others. It has been assumed that all third-party information provided is true and accurate. No responsibility is accepted by PJA for the accuracy or completeness of such information.

There is a possibility that there may exist on Site conditions that could not be identified within the scope of the assessment or which were not reasonably identifiable from the available information. The conclusions drawn in the report are considered correct, although any subsequent additional information may allow refinement of the conclusions.

PJA has prepared the report for the sole use and reliance of St. Modwen Developments. The report may not be used or relied upon by any unauthorised third party without the explicit written agreement of PJA.



2 Sources of Information

The sources of information used in preparing this desk study are listed in Table 2-1 .

Table 2-1: Sources of Information

Description	Author	Date	Reference
Bedrock Map for Swansea Sheet 247	BGS	2011	BGS Sheet 247, 1:50,000
Bedrock Map for Swansea Sheet SS79 SW	BGS	1952	Sheet SS 79 SW, 1:10.560
British Geological Survey (BGS) Online Map Viewer Onshore Geoindex	BGS	Accessed July 2024	https://mapapps2.bgs.ac.uk/geoindex/home.html?
Consultants Coal Mining Report. 29 September 2021	Coal Authority	September 2021	51002684979001
Crymlyn Tip Restoration Implementation Plan	Englobe	April 2023	R1870/23/5260
Coed Darcy: Phase 1 Geo-environmental Desk Study	PJA	November 2021	05474-OUT-005
Whole Site Investigation BP Llandarcy Refinery,	URS	August 2005	FR1287
Llandarcy Tip Restoration Ground Investigation Report	URS	February 2008	44382540/BDRP0011
Containment Area Free Product Recovery Validation Report	Celtic	July 2011	R1296/11/3742

3 Site Setting

3.1 Site Extent

The Site, which is addressed by planning application P2023/0970 and is shown on PJA Drawing 04020-A-SK925-P0 included in Appendix B, comprises the following areas:

- 1 The Earthworks Area – This is area covered by the Environmental Permit and contains the waste deposits together with a perimeter ash bund to the north and west of the waste. This area will be subject to the proposed works set out in the planning application.
- 2 The Temporary Laydown Area – This area will be used during the proposed works as a contractor compound and material storage area.
- 3 Ecological Mitigation Area – This area has been identified as a Great Crested Newt (GCN) receptor site consisting of two ponds to mitigate the loss of GCN habitat on Crymlyn Tip.
- 4 Coed Darcy Wetlands – This is the collective name given to the waterbodies located to the south of the area covered by the permit, consisting of ‘South Bay’, ‘Crymlyn Bog Lagoon’ and ‘West Bay’. These waterbodies will remain unchanged under the proposed works.

The four areas are shown on Figure 1 below:

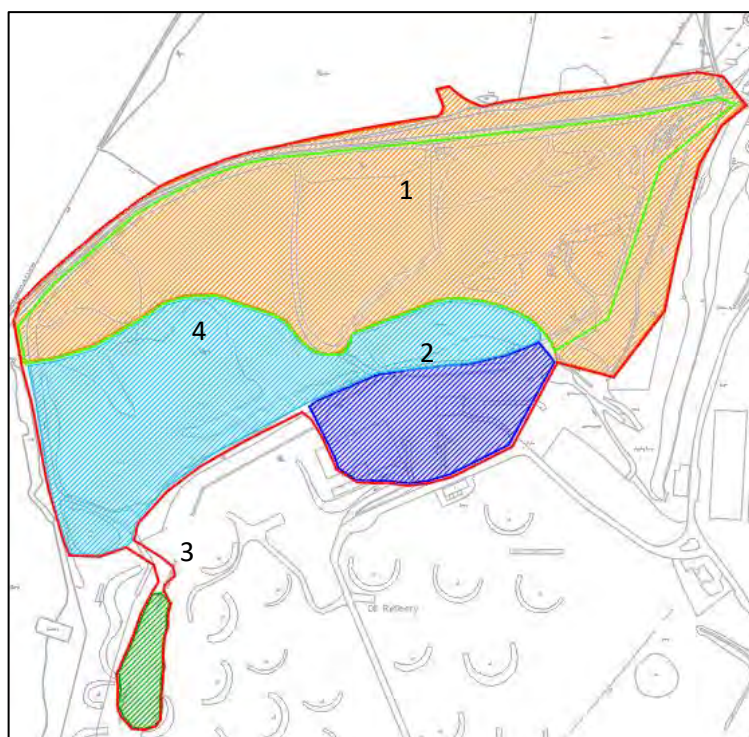


Figure 1: Site boundary and Earthworks Area (1), Temporary Laydown Area (2), Ecological Mitigation Area (3), and Coed Darcy Wetlands (4).



3.2 Site Location and Description

The Site is located in the southwestern part of the wider Coed Darcy development site and covers an area of approximately 140,000m².

The Earthworks Area corresponds with the area covered by the environmental permit and marks the extent of the area historically used to deposit waste, and is currently largely overgrown. In the centre of the Earthworks Area is a compound used by contractors who undertake day to day management of the closed landfill and complete the ongoing pollution prevention measures.

The highest point of the Earthworks Area is the north east which is also the main access into the site. The elevation beyond the northern boundary falls to the north to the adjacent Crymlyn Bog, which bounds the Site to the north and west. The elevation of the Earthworks Area also falls to the west and south towards the Coed Darcy Wetlands. The ground surface is uneven due to the variable thickness of waste deposits.

Beyond the wetlands to the south east is the Temporary Laydown Area, an area of rough ground covered with scrub vegetation sloping from south to north.

To the south of the Coed Darcy Wetlands is the Ecological Mitigation Area, a relatively flat area where scrub vegetation was cleared to create two GCN receptor ponds.

Along the northern site boundary is the 'peripheral trench' a water filled trench with a plyboard interception feature which prevents the migration of free phase hydrocarbons into Crymlyn Bog. The northern boundary of the Site is defined by the outer plyboards of the peripheral trench.

Between the Temporary Laydown Area and Ecological Mitigation Area is a small housing development known as the Demonstration Village. This housing remains unoccupied at the time of the writing, and it is understood that occupation of this housing is restricted until the provision of new infrastructure within this part of the wider Coed Darcy development site.

To the south and east of the Site is undeveloped, vacant land within the wider Coed Darcy development site.

3.3 Proposed Works

Following a series of risk assessments and an options appraisal carried out by Englobe on behalf of St. Modwen, the proposed works were put forward as a 'practicable solution' for restoration of Crymlyn Tip. It is envisaged that these restoration works will reduce the long-term management of the closed landfill and assist with the eventual surrender of the Environmental Permit.

Restoration works are limited to the Earthworks Area and comprise the following:



- Installation of a low permeability barrier, to act to reduce potential movement of residual free phase contamination, as shown on Englobe drawing D1870/23//5289/05. The below ground barrier is proposed to be installed through the waste deposits into the underlying peat and clay. The anticipated depth of the cut off wall is between 6 and 6.5m. The wall has been designed to leave a 2m gap between the base of the wall and the base of the natural superficial deposits, to allow groundwater flows beneath the wall while trapping NAPL within the waste;
- Targeted non-aqueous phase liquid (NAPL) recovery within areas of identified significant residual NAPL in the waste deposits and ash bund. This recovery would be carried out via a proposed network of abstraction and reinjection wells as shown on Englobe drawing D1870/23/5289/06;
- Reprofilng of the surface to provide a suitable landform to minimise the risks of potential future instability as shown on Englobe drawing D1870/23/5289/07. Proposals are to reprofile slopes of the waste material and ash bund to a 1:4 gradient to safeguard against future landslip risks and safety concerns regarding steep banking;
- Placement of restoration layers to mitigate potential risks to human health associated with direct exposure and fugitive emissions as shown on Englobe drawing D1870/23/5289/08;
- Decommissioning of the existing peripheral trench;
- Installation of monitoring infrastructure to confirm compliance with environmental remediation target values to support a future permit surrender.

Full details on the proposals are presented in the Englobe Crymlyn Tip Restoration Implementation Plan, referenced R1870/23/5260 dated April 2023.



4 Coal Mining Information Review

4.1 Published Geology

4.1.1 Landscaped Ground

Landscaped ground, defined as *'mainly redeveloped areas and others where extensive earth moving has occurred'*, is shown on published British Geological Survey (BGS) Geoindex mapping to be present across the Site.

4.1.2 Made Ground

Made Ground is not shown on published BGS mapping, however based on the historical use of the Site, Made Ground is anticipated to be present across much of the Site associated with the known history of landfilling.

4.1.3 Superficial Deposits

Published BGS mapping indicates that the vast majority of the Site is underlain by Peat, described by the BGS as *'a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps'*. The 1:50,000 scale Geoindex mapping suggests that the south eastern corner of the Site is underlain by Till, described by the BGS as *'unsorted and unstratified drift, generally over consolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier. It consists of a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape (diamicton).'*

4.1.4 Bedrock

Bedrock is recorded on published British Geological Survey (BGS) Geoindex mapping as the Hughes Member, Swansea Member and Brithdir Member of the Pennant Sandstone Formation, described by the BGS as *'green-grey and blue-grey, feldspathic, micaceous, lithic arenites of southerly provenance, with thin mudstone/siltstone and seatearth interbeds and mainly thin coals; the lithologies are commonly arranged in fining-upwards channel-fill sequences.'*

BGS 1:50,000 Map Sheet 247 (published in 1977 and 2011) show the bedrock under most of the Site dips to the north west in the area of the Site, with a recorded angle of dip varying between 23° and 30°. The 2011 edition identifies three coal seams sub cropping within the site boundary, roughly orientated east-west. The Swansea Two-Foot seam sub crops in the south of the Site beneath the Coed Darcy Wetlands. The Swansea Three-Foot seam sub crops beneath the centre of the Site and marks the distinction between the Hughes Member (in the south) and the Swansea Member (in the north). The Swansea Six-Foot Seam is shown sub cropping along the northern site boundary.



Two additional coal seams sub crop beneath the eastern part of the site orientated northwest-southeast. One is identified as the Hughes seam and the other is unidentified. The BGS 1:50,000 Map Sheet 247 shows the bedrock beneath the eastern part of the Site as dipping 8 degrees to the north.

4.1.5 Geological Faults

Published BGS mapping indicates that a fault is present in the east of the Site trending north-south. This fault is identified on the geological maps as 'Gardeners Fault' and is downthrown on the western side so that the Hughes Member and Swansea Member underlying the south and north of the Site to the west of the fault are juxtaposed with the Brithdir Member to the east of the fault.

Coal Seams and faults are shown on PJA Drawing Coal Mining Risk Assessment Site Plan Reference 04020-A-SK295-P0, included in Appendix B.

4.2 Historical Mapping

Historical maps were included in the 2021 Landmark Envirocheck Report obtained for a Phase 1 Desk Study Report produced by PJA for the wider Coed Darcy Development site, including the area of the Site. These historical maps have been reviewed to establish the historical development of the Site and the surrounding area. The findings are summarised in Table 4.1. Copies of the historical maps and a full description of the Site history are provided in the PJA Coed Darcy Phase 1 Geo-environmental Desk Study Reference 05474-OUT-005, dated November 2021.

Table 4-1 Historical Development of the Site and Surrounding Area

Source Map	Site	Surrounding Area
1884. Glamorganshire 1:10,560	The Site is shown as undeveloped marshland of Crymlyn Bog.	To the north and west of the Site is Crymlyn Bog. To the south of the site are fields, presumed to be associated with Glan Y Wern Farm which is identified to the southeast of the Site. Approximately 700m to the northwest of the Site are shafts and buildings associated with the Glan Y Wern Colliery.
1900. Glamorganshire 1:10,560	No significant change.	The shafts of the Glan Y Wern Colliery are now labelled as 'old'. An 'Old Quarry' is shown to the southeast (>100m) of the Site.
1921. Glamorganshire 1:10,560	No significant change.	Old Coal Pits and Old Coal Shafts are now labelled between 100 and 400m to the east of the Site. Another Old Coal Pit is labelled approximately 600m to the south of the Site.
1938-1940. Glamorganshire 1:10,560	No significant change.	The farm to the southeast of the Site is no longer shown.
1938-1952. Glamorganshire 1:10,560	An embankment is shown in the west of the Site, although not labelled this is assumed to	No significant change.



Source Map	Site	Surrounding Area
	represent the initial construction of the ash bund that confines the northern extent of waste deposition.	
1945-1949. Historical Aerial Photo 1:10,560	No significant change.	No significant change.
1949. Historical Aerial Photo 1:10,560	Partial coverage.	Partial coverage.
1952. Glamorganshire 1:10,560	Partial coverage.	Partial coverage.
1964-1965 Ordnance Survey Plan 1:10,000	The ash bund is now shown along the northern Site boundary, curving around to the western site boundary. The centre of the Site remains marked as marshland.	Llandarcy Oil refinery is now shown extending to the east and south of the Site. Immediately to the east are railway sidings associated with the refinery, and beyond this to the east and northeast is the main refinery processing area. To the south and southeast of the Site are a number of storage tanks. The Old Coal Shafts and Old Coal Pits are no longer shown to the east and south of the Site.
1970-1979 Ordnance Survey Plan 1:10,00	No significant change.	Partial coverage. No significant change.
1976 1:10,000 1980-1989 Ordnance Survey Plan 1:10,00	A large waterbody occupies the western half of the Site. A smaller waterbody is shown in the centre of the Site. Access tracks are shown originating from the northeastern corner of the Site.	No significant change.
1992-1993 Ordnance Survey Plan 1:10,00	No significant change.	No significant change.
1999 10k OS Raster Mapping 1:10,000	The waterbodies are shown in their present day layouts in the south of the Site.	Some of the refinery infrastructure appears to have been removed.
2006 10k OS Raster Mapping 1:10,000	No significant change.	Further removal/demolition of oil refinery infrastructure has taken place and the refinery is now labelled as 'disused'.
2021 OS Vector Map Local 1:10,000	The Site is now shown as it is today, with accurate layout of access roads and waterbodies.	The refinery is now shown as cleared and the surrounding areas as largely vacant, undeveloped land.

Whilst the available historical maps do not indicate waste deposition at the Site, this is understood to have been undertaken since the early 1920s corresponding with operation of the Llandarcy oil refinery which commenced in 1921. The oil refinery was not recorded during mapping surveys prior to the 1964-1965 map edition for reasons of national security.



4.3 Ground Investigations

A number of ground investigations have occurred on the site, particularly since the closure of the oil refinery. A summary of the main ground investigations carried out at the Site is presented below.

Table 4-2: Summary of Ground Investigations

Consultant/ Contractor	Year	Summary of Work Completed	Ground Conditions Encountered	Report
URS	1998- 2001	Ground investigations carried out on behalf of BP. 38 monitoring wells were installed between 1998 and 1999. Between 2000 and 2001, an additional 54 boreholes were installed to inform design of a free phase recovery system and an interception feature.	Logs from ten boreholes in the eastern part of the Earthworks Area recorded ash along the northern boundary more than 17.5m thick. This was underlain by superficial deposits of silt and sand. Seven boreholes encountered bedrock which was recorded as sandstone or mudstone. Bedrock was encountered between 11.2m and 22.6mbgl with an average of 15.3mbgl.	Whole Site Investigation BP Llandarcy Refinery, URS August 2005 (FR1287)
URS	2008	Ground investigation of the environmental permit area (including wetlands) and the surrounding area. 18 cable percussive boreholes drilled to depths of between 2.0m and 26.4mbgl.	In the central and eastern parts of the Earthworks Area the subsurface sequence was recorded as comprising waste fill, peat, organic clays, sands and gravels and Glacial Till. Peat was limited to the central area. Although not recorded in the borehole logs as bedrock, the following description has been plausibly interpreted as weathered bedrock to provide an indication of the depth to the bedrock: <i>'Medium dense grey and brown clayey sandy GRAVEL with some rounded to subrounded cobbles of sandstone'</i> . This stratum was encountered in eight boreholes between 9.2m and 15.7mbgl, with an average depth of 11.8mbgl.	Llandarcy Tip Restoration Ground Investigation Report, URS February 2008 (44382540/BDRP 0011)
Celtic	2009	45 boreholes drilled to delineate and recover free phase oils from the central and eastern part of the Tip. An additional 20 boreholes were installed in high productivity areas.	Base of the waste fill was proven in 26 boreholes, with depths ranging from 7.5 to 12mbgl. In each of these locations the waste was underlain by Peat. Bedrock was not encountered in any of the borehole locations.	Containment Area Free Product Recovery Validation Report, Celtic July 2011 (Report No. R1296/11/3742)
Englobe	2022	13 boreholes were drilled to gather further data on the Tip, particularly	In the northern ash bund, Made Ground was recorded as comprising loose to very loose	Crymlyn Tip Restoration Implementation



Consultant/ Contractor	Year	Summary of Work Completed	Ground Conditions Encountered	Report
		from the periphery where data gaps were identified.	ash with slag, clinker and brick and clay, silt, sand and gravel. In the western, southern and eastern perimeters the Made Ground was recorded as variable in composition, containing clay, sand, gravel, ash, clinker, bitumen, cobbles of brick, slag, concrete and sandstone. Bedrock was not encountered in any of the borehole locations.	Plan. Englobe. April 2023. R1870/23/5260.

4.4 Summary of Investigation Findings

Waste deposits were encountered across the Site. the waste deposits were found to be of greatest thickness in the northern part of the Site, recorded as ranging from 13m to 17.5m. In the southern part of the Site, the waste deposits reduce in thickness to between 0.5 and 3.5m.

Generally, across the Site the waste is described as a heterogeneous mixture of peat, demolition waste, contaminated material (impacted with various contaminants including petroleum hydrocarbons and asbestos), colliery spoil, china clay and coal derived from other parts of the wider refinery site. In the north the waste deposits were described as predominantly ash.

Waste deposits are directly underlain by peat, organic clays, sands and gravels, and Glacial Till. Peat is predominantly confined to the central area of the Site.

Not all investigations have proven the depth to bedrock. During a URS investigation in 2005, bedrock recorded as either sandstone or mudstone was encountered in seven boreholes at depths ranging from 11.2m to 22.6mbgl. During a 2008 investigation URS recorded '*sandy gravel with some cobbles of sandstone*' (or a similar description) in eight boreholes at depths ranging between 9.2m and 15.7mbgl. This unit has been interpreted as possible weathered bedrock to provide a conservative indication as to the depth of the bedrock and therefore depth to coal seams. No coal was encountered in any boreholes during either of the URS ground investigations.

It is considered that the variability of the recorded depth to bedrock (particularly during the 2005 investigation) is attributable to the varying thickness of overlying waste deposits as opposed to large variances in the rockhead elevation.

Coal seams and the depths to confirmed or suspected bedrock recorded during the 2005 and 2008 URS investigations are presented on PJA Drawing 04020-A-SK926-P0 included in Appendix B.



4.5 Coal Mining Report

A Consultants Coal Mining Report was obtained from the Coal Authority in 2021 for the wider Coed Darcy Development site. This report provides coverage of the Site and is presented in Appendix A. A summary of relevant aspects of the report relating to the Site is provided below:

The plan accompanying the coal mining report shows a coal seam sub cropping across the Site orientated east-west. Cross referencing this with the geological maps suggests that this represents the Swansea Three-Feet seam. In the eastern part of the Site, to the east of the north-south trending 'Gardeners Fault' two additional sub cropping coal seams are shown. These are the Hughes seam and an unnamed coal seam. Three mine entries are shown to the east of the Site.

An extract from this Coal Authority plan is provided as Figure 2.



Figure 2: Extract from the Coal Authority Plan

- The coal mining report states all three of these seams have been subject to past underground mining at depths ranging from 5m to 131m. The last recorded mining dates range from 1900 to 1914. Extraction thicknesses are recorded as 94cm to 110cm.
- There are no probable unrecorded shallow mine workings within the Site.
- There are no spine roadways recorded at shallow depth.
- There are no recorded mine entries within the site boundary. Three shafts are recorded between 80 and 190m to the east of the site. There are no records of the treatment of these mine shafts.
- There are no opencast mines recorded within 500m of the enquiry boundary.



- There are no Coal Authority managed tips recorded within 500m of the enquiry boundary.
- The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50m of the enquiry boundary, since 31 October 1994.
- There is no current Stop Notice delaying the start of remedial works or repairs to the property.
- The Coal Authority is not aware of any request having been made to carry out preventative works before coal is worked under Section 33 of the Coal Mining Subsidence Act 1991.
- There is no recorded mine gas within 500m of the enquiry boundary.
- There are no mine water treatment schemes recorded with 500m of the enquiry boundary.
- There are no records of future underground mining licensing.
- There are no coal mining licenses recorded within 200m of the enquiry boundary.
- No notices have been given, under Section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
- The property does not lie within the geographical area where a notice to withdraw support has been given.
- The property is not in an area where a notice has been given under Section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.
- The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

4.6 Coal Mine Abandonment Plans

The Coal Authority was commissioned by PJA in July 2024 to carry out an abandoned mines catalogue search for the Site. The Coal Authority have provided abandonment plans held on record. Relevant extracts of these plans are shown in Figure 3 and Figure 4 below.

Figure 3 shows an excerpt from an abandonment plan covering several collieries including Llansamlet, Crymlyn and Glay Y Wern. The date of abandonment is given on the plan as 1821. This shows no workings under the Site, and the nearest workings are associated with the Glan Y Wern colliery to the northeast of the Site.

Figure 4 shows an excerpt from an abandonment plan for Cwrt-y-Bettws Colliery from circa 1914. This shows workings in the northeastern corner of the Site, to the east of Gardeners Fault.



Figure 3: Excerpt from the abandoned mine recordings of various collieries (circa 1821) overlain with coal seam sub crops, geological faults and the Site boundary.



Figure 4: Excerpt from Cwrt-Y-Bettws abandoned mine recordings circa (1914) overlain with coal seam sub crops, geological faults and the Site boundary

4.7 Summary of Coal Seams

The Swansea Two-Feet and Swansea Three-Feet seams underlie most of the Site to the west of Gardeners Fault. The Swansea Six-Feet seam is also located to the west of the fault but is shown on geological maps as sub cropping just to the north of the Site boundary. The bedrock to the west of the fault dips to the north between 23 and 30 degrees. The Swansea Six-Feet seam is therefore not expected to have an impact on the Site.

The Swansea Three-Feet seam is known to have been worked in the wider area, although abandonment plans indicate that workings did not extend under the Site. Coal Authority records show the seams worked in this area had an extraction thickness of up to 110cm. Based on this thickness and the dip of the bedrock in this part of the Site, the zone of influence for the potential collapse of workings in both the Swansea Three-Feet and Two-Feet seams has been calculated and shown on Figure 5.

To the east of Gardeners Fault are the Hughes coal seam and an unnamed coal seam. Mine abandonment plans show mine workings under this part of the Site, although the abandonment plans do not show a depth to workings. Geological maps show that the bedrock to the east of Gardeners Fault dips 8 degrees to the north. Based on this dip angle and an extraction thickness of 110cm, the zone of influence for both seams has been calculated and shown on Figure 5.

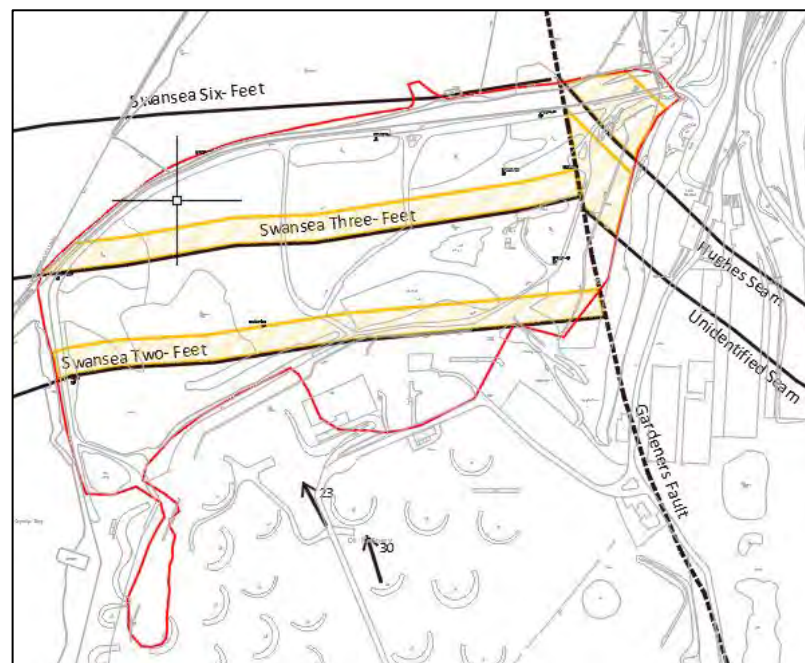


Figure 5: Coal seams and zones of influence of mine working collapse



These zones of influence show where there is 10 times the extracted thickness of rock cover over these coal seams. This does not consider the 10m of superficial cover (clay, peat and Made Ground) that overlies the bedrock.

In 1985 Arup & Partners carried out a Mining Subsidence Desk Study for the Welsh Office & The Department of The Environment (Arup & Partners, (ASWDSR) 1985. Mining Subsidence- South Wales Desk Study). In this report it was said that few incidents occurred where mine collapse migrated through a superficial deposit thicker than 5m and none through more than 10m. However, due to a lack of data the authors stresses that no firm conclusions can be drawn about the modifying effect of superficial deposits.



Site Specific Coal Mining Risk Assessment

4.8 Summary of Coal Mining Hazards

Coal Mining Features	Hazard	On-Site	Off-Site	Comments
Past underground coal mining (recorded at shallow depth)	Upward migration of voids. Potential for catastrophic collapse of mine entries/mine workings. Ground subsidence, crown hole development.	Yes	Yes	The Swansea Three-Feet, Swansea Two-Feet, and Swansea Six-Feet sub crop and dip beneath the Site, and to the east of Gardeners Fault, the Hughes seam and an unnamed seam sub crop and dip beneath the Site. Based on available ground investigation information, bedrock is inferred at depths of between approximately 10m and 22mbgl.
Probable unrecorded shallow workings	Upward migration of voids. Potential for catastrophic collapse of mine entries/mine workings. Ground subsidence, crown hole development.	Yes	Yes	
Deep recorded mine workings	Upward migration of voids.	Yes	Yes	
Outcrops	Mining at or close to the surface, upward migration of voids.	No	No	The coal mine abandonment plans show mine workings beneath the Site to the east of Gardeners Fault. There are no recorded workings in the Swansea Three-Feet, Two-Feet or Six-Feet seams under the northern and southern parts of the Site. However, it is possible that there are unrecorded workings in these seams.
Mine entries (Shafts /Adits)	Collapse, void at surface. Potential for entries to have been backfilled or capped with no control, or the backfill/capping treatment may be missing or failed.	No	Yes	There are three recorded mine entries to the east of the Site, the closest of which is 80m to the east. Based on the proposed works, these are not anticipated to impact the Site.
Geological faults, fissures and breaklines	Open pathways from broken ground may enhance gas migration and allow mine water flow. Ground subsidence and differential settlement.	Yes	Yes	Gardeners Fault underlies the eastern part of the Site orientated north to south. It is downthrown on the western side and intersects the coal seams listed on the Site. This feature could transmit ground gases, or mine water under artesian pressure from the bedrock up into the overlying strata.
Mine gas emissions	Migration of mine gases vertically and /or laterally to surface or receptors near surface.	Yes	Yes	Potential mine gases from both the worked and unworked coal seams have the potential to migrate up through the ground. However, the peat and waste deposits overlying the bedrock are also potential sources of gas and may pose a similar risk to that of the mine gas. Gases could potentially collect in excavations during construction or in manholes installed as part of the low permeability barrier.



4.9 Mitigation and Risk Rating

Hazard	Initial Risk Rating	Mitigation	Revised Risk Rating
Past underground coal mining (recorded at shallow depth)	Medium/High	Abandonment plans show recorded mine workings only in the easternmost part of the Site. Reprofiling works are limited to the upper surface of the waste material only. The installation of the low permeability barrier will extend below the waste deposits, but it is designed so the base of the barrier has a 2m gap to the base of the peat. The works will not penetrate the bedrock.	Low
Potential presence of shallow unrecorded coal seams and associated workings	Medium	Although mine abandonment plans show mine workings are limited to the eastern part of the Site, there is the potential for unrecorded mine entries to exist beneath larger areas of the Site. As there are recorded mines to the north and east of the Site, it is possible that unrecorded workings are present under the Site. Reprofiling works are limited to the upper surface of the waste material only. The installation of the low permeability barrier will extend below the waste deposits, but it is designed so the base of the barrier has a 2m gap to the base of the peat. The works will not penetrate the bedrock.	Low
Ground subsidence from recorded and potential unrecorded shallow underground workings causing undulations in the final landform or causing damage to the low permeability barrier.	Medium	Mine abandonment plans show no workings beneath the Site in the Swansea Two-Feet, Three-Feet or Six-Feet seams. There is a possibility of unrecorded workings in these seams. Mine workings are shown to be present to the east of Gardeners Fault in the Hughes seam and unnamed seam. The proposed works are not as sensitive to ground subsidence as a traditional (residential or commercial) development would be. Ground subsidence caused by the collapse of workings could cause settlement of the final desired landform and could potentially cause damage to the proposed low permeability barrier; affecting the integrity of the wall and ability for it to retain oil. The proposed low permeability barrier will be constructed by excavating a trench into the waste deposits and pumping a cement and bentonite slurry into the trench. There will be no driving into the ground of piles or sheet piles, and there is no requirement to compact clay to form a barrier which could create excessive vibrations that could induce mine collapse. The barrier wall has been designed to be installed in waste material overlying peat which is inherently unstable and should therefore be able to withstand some degree of ground settlement. Nevertheless, full verification criteria of the barrier wall will be agreed with the regulators as part of detailed planning works. A period of monitoring could be agreed to identify any settlement of the ground surface that could indicate damage to the barrier wall. This could be focused on the zones of influence of each of the seams sub cropping	Low



Hazard	Initial Risk Rating	Mitigation	Revised Risk Rating
		beneath the site which have been calculated to show where rock cover is less than 10 times the seam thickness. The zones of influence are considered to be conservative, in that they do not consider the 10m of superficial cover overlying the bedrock. If this additional cover is taken into account, the area of ground surface likely to be affected by underground workings is anticipated to be minimal.	
Mine gas migration and emission (on-site and off-site receptors)	Medium	There is a risk of ongoing release of gas from coal seams and mine workings. There is also a ground gas source in the form of the waste deposits and underlying peat. As part of previous investigations at the Site ground gas monitoring has been undertaken. As part of a recent ground gas risk assessment for the Site, Englobe reported that based on the gas profile, elevated gas concentrations were attributable to significant historical hydrocarbon contamination, and underlying peat. Regardless of the source, the potential risk to ground workers and the potential for ground gases to collect in recovery boreholes should be considered for future works.	Low



5 Conclusions

The site is underlain by coal seams within the Swansea, Hughes and Brithdir Formations. The geology of the Site is divided by the north-south trending Gardeners Fault. To the west of the fault the Swansea Two-Feet, Three-Feet and Six-Feet seams sub crop and dip below the Site. Coal mine abandonment plans show that these seams were worked to the north of the Site but they suggest that workings did not extend beneath the Site. To the east of the fault the Hughes and an unnamed coal seam sub crop and dip below the Site. Coal mine abandonment plans show these seams were worked beneath the eastern part of the Site from the Cwrt -Y- Bettws colliery, located to the east of the Site. There is no indication as to the depth of the workings on the mine abandonment plans.

Despite the presence of coal workings beneath the eastern part of the Site, the perceived risk to the proposed development is considered to be low. Development proposals involve reprofiling the landfill material and installing a cut off barrier wall to prevent the off-site migration of oil from the waste material. Neither of these proposals include work which will penetrate the bedrock and the proposals are not sensitive to ground settlement. The workings are over 100 years old and historically several metres of waste has been deposited on the ground surface. It is therefore plausible that any mine working collapse and any associated ground settlement would have already occurred. Nevertheless, following reprofiling, the topography of the Site will be monitored as part of landfill closure and aftercare monitoring. Localised settlement that occurs can be recorded and rectified during that period to ensure the tip maintains its desired profile.

There is potential for mine gas to be produced by the coal seams that could migrate to the surface; however, the overlying peat and waste deposits are also a known source of ground gas. The proposed development is not sensitive to ground gas, however groundworkers during construction should be made aware of the risk (regardless of the source) prior to commencing works such that appropriate mitigation can be put in place.



Appendix A Consultants Coal Mining Report



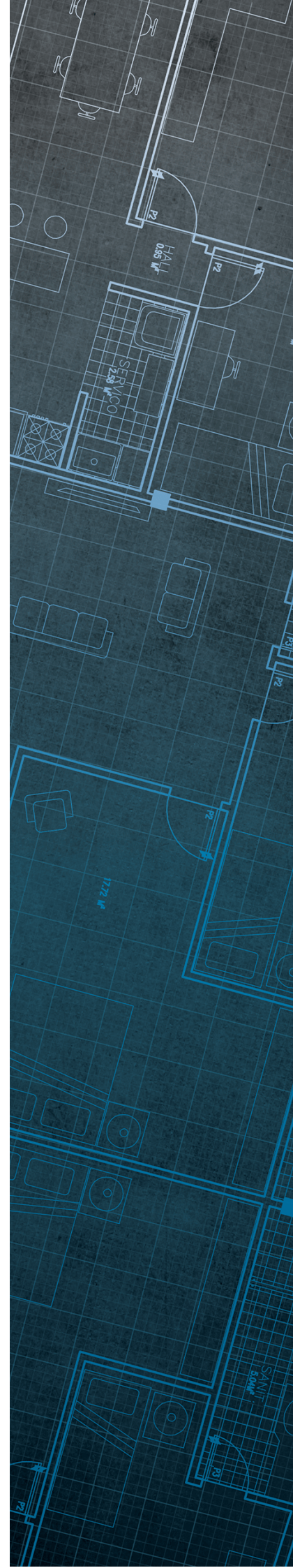
The Coal
Authority

Consultants Coal Mining Report

Site At 271220, 195880
Carmarthenshire

Date of enquiry:	29 September 2021
Date enquiry received:	29 September 2021
Issue date:	29 September 2021

Our reference:	51002684979001
Your reference:	285559471_1



Consultants

Coal Mining Report

This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

NLIS Hub

Enquiry address

Site At 271220, 195880
Carmarthenshire

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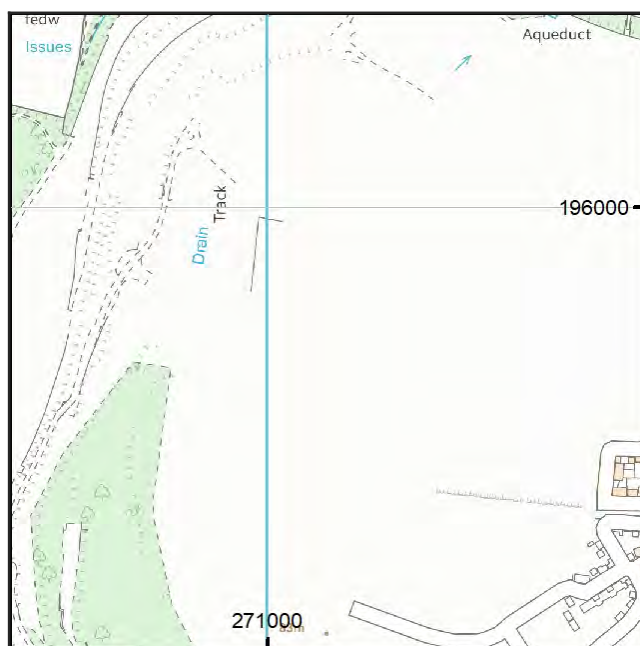
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Approximate position of property



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Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	SWANSEA NO.3	Coal	4DHW	5	Beneath Property	7.8	North	94	1900
unnamed	HUGHES	Coal	4DHX	10	Beneath Property	9.2	North	110	1904
unnamed	HUGHES	Coal	4ECJ	37	Beneath Property	0.0	East	110	1900
unnamed	HUGHES	Coal	4DHZ	48	Beneath Property	9.4	North	110	1900
CWRT- Y-BETWS	UNNAMED	Coal	4DI0	54	Beneath Property	11.7	North-West	100	1900
unnamed	HUGHES	Coal	4DHY	66	Beneath Property	8.7	North	110	1900
CWRT- Y-BETWS	HUGHES	Coal	4JDJ	87	Beneath Property	4.0	North	110	1900
unnamed	HUGHES	Coal	4DI6	101	Beneath Property	5.5	North	110	1913
CRWT-Y-BETWS	HUGHES	Coal	4JDE	117	North-East	3.7	North	110	1905
CRWT-Y-BETWS	HUGHES	Coal	4JDG	118	North-East	3.8	North	110	1905
unnamed	HUGHES	Coal	4DI7	121	Beneath Property	5.2	North	110	1900
CWRT- Y-BETWS	HUGHES	Coal	4JDI	129	Beneath Property	4.0	North	110	1914
CWRT- Y-BETWS	HUGHES	Coal	4JDH	131	Beneath Property	3.9	North	110	1914

Probable unrecorded shallow workings

None.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

Entry type	Reference	Grid reference	Treatment description	Mineral	Conveyancing details
Shaft	270195-001	270700 195542		Coal	
Shaft	270195-002	270775 195481		Coal	
Shaft	270195-003	270795 195497		Coal	
Adit	271195-004	271061 195434		Coal	
Shaft	271195-009	271045 195526		Coal	
Shaft	272196-001	272028 196012	This shaft was filled to an unknown specification in June 1972.	Coal	
Shaft	272196-006	272001 196150	This shaft was plugged and capped in May/June 1995. The dimensions of cap 6.2m x 4.2m x 0.5m	Coal	
Shaft	272196-007	272049 196099	Shaft plugged with 3m deep concrete mass and capped with reinforced concrete cap 6.2m x 4.2m x 0.5m deep. Underside of plug 3.75m below ground level and foundation depth of cap is 0.75m .Work carried out in 1995 by IMCL for the Coal Authority.	Coal	

Abandoned mine plan catalogue numbers

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

SWR1671	SW1986	SWR2221
10495	R12044	R12048
PO0	6634	SWR2654

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

Seam name	Mineral	Seam workable	Distance to outcrop (m)	Direction to outcrop	Bearing of outcrop
HUGHES	Coal	Yes	Within	N/A	91
HUGHES	Coal	Yes	Within	N/A	125
SWANSEA NO.3	Coal	Yes	Within	N/A	82
UNNAMED	Coal	Yes	Within	N/A	79
UNNAMED	Coal	Yes	Within	N/A	98

Geological faults, fissures and breaklines

Please refer to the 'Summary of findings' map (on separate sheet) for details of any geological faults, fissures or breaklines either within or intersecting the enquiry boundary.

Fault under or close to the property recorded.

Opencast mines

None recorded within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations

Distance to site investigation (m)	Direction
Within	N/A
4.0	South-West
Within	N/A

See Section 4 for further information.

Remediated sites

Distance to site remediation (m)	Direction
11.6	North-West

See Section 4 for further information.

Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining

None recorded.

Coal mining licensing

None recorded within 200 metres of the enquiry boundary.

Court orders

None recorded.

Section 46 notices

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

Site investigations

The site is within an area of previous interest. It is close to where the Coal Authority has received information relating to past site investigations.

The site requires further investigation and may influence how you approach your risk assessment.

Remediated sites

The site is within an area of previous interest. It is close to where the Coal Authority has investigated and where necessary remediated mine entries and/or shallow coal mine workings following specific reported hazards.

The site requires further investigation and may influence your risk assessment. We recommend that you order the Coal Authority **Surface Hazards Incident Report**, which will include more information about the hazard.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk**.

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines

Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips

Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations

Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites

Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence

Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas

Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

Mine water treatment schemes

Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining

Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing

Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders

Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices

Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices

Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land

Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

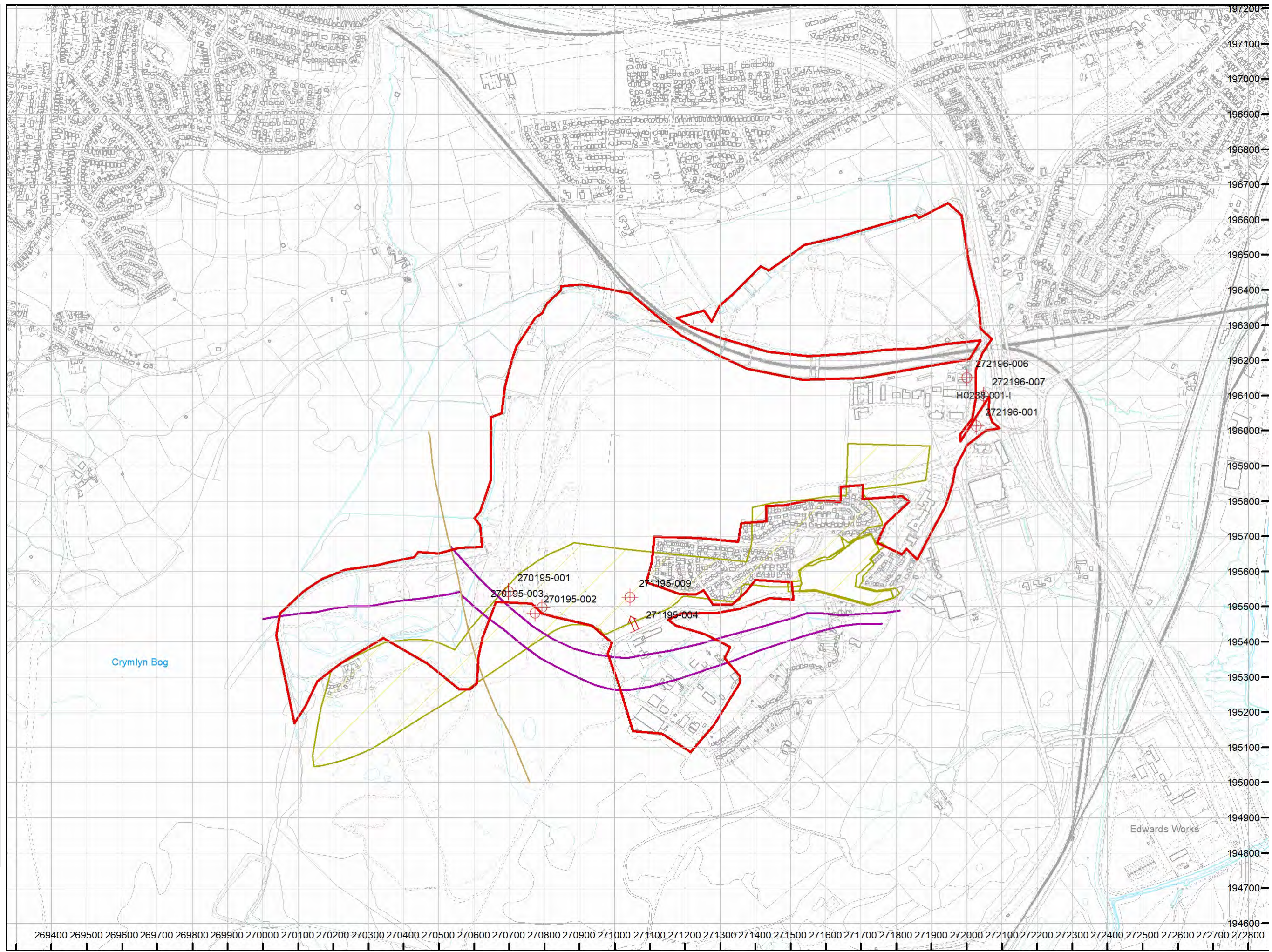
The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

- Approximate position of the enquiry boundary shown 
- Disused mine shaft 
- Disused adit 
- Outcrop (Proven) 
- Geological faults 
- Site investigations 
- Remediated sites 

How to contact us

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Appendix B Drawings

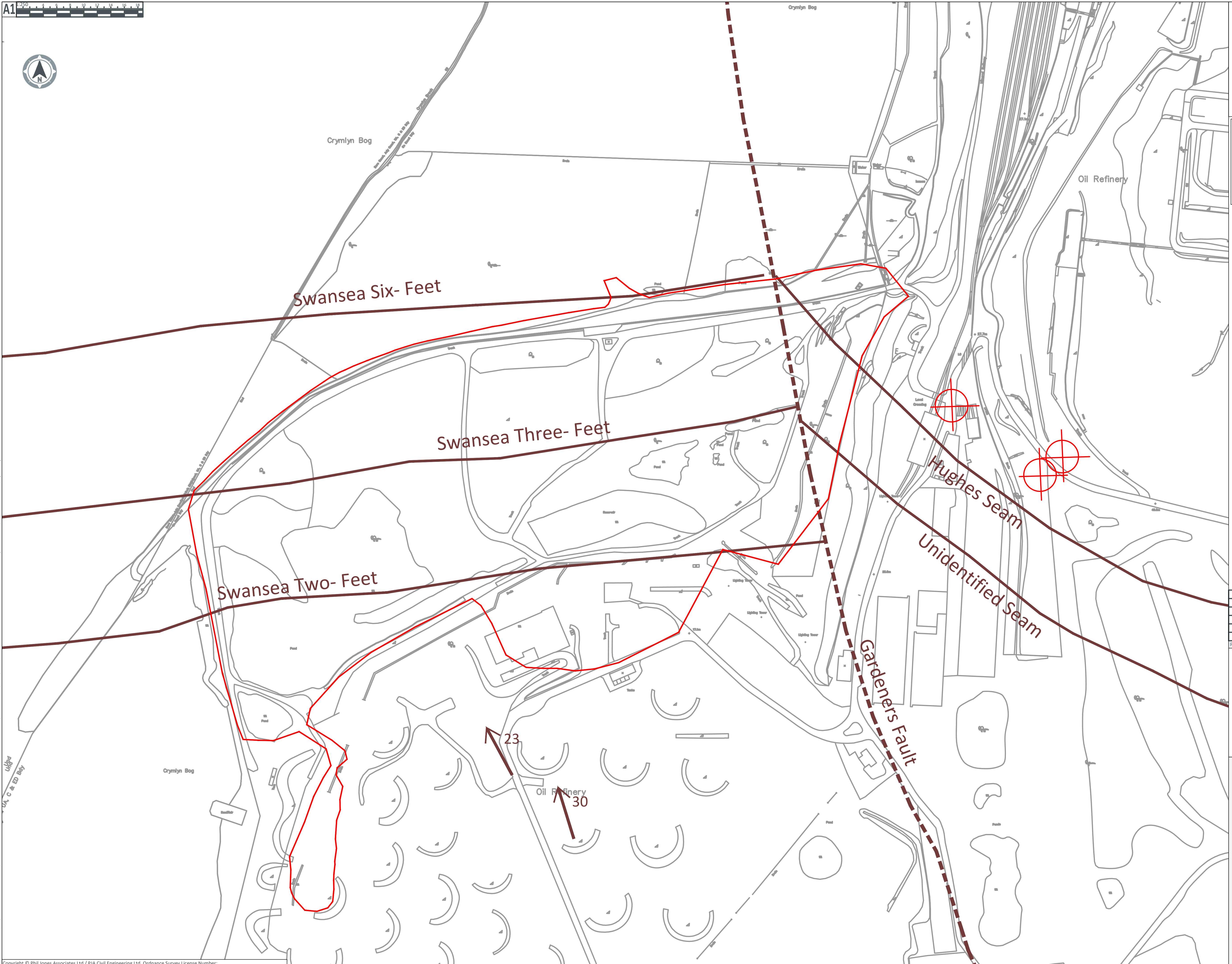


CDM Note

These drawings have been produced with reference to the CDM Regulations 2015.

Please note that these are pre-construction phase drawings and should be subject to further design risk management as required in accordance with Regulation 9.

-  Site Boundary
 Coal Seam
 Geological Fault
 Mine Entry



Rev	Date	Revision Note	Drw	Chk	App



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Birmingham | Bristol | Cambridge | London | Manchester | Reading
Melbourne | Perth
pja.co.uk | pja.com.au

Client

St. Modwen Developments

Project
Crymlyn Tip
Coal Mining Risk Assessment

Title

Coal Seams and Mine Entries

Drawing Issue Status

Draft

PJA Ref	Scale @ A1	Date
04020	NTS	22/07/2024

Drawing No.
04020-A-SK925-P0

Primary Contact
barney.irlam@pja.co.uk

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