

Earth Science Partnership

Consulting Engineers | Geologists | Environmental Scientists

**Proposed Training Facility (Commercial) Development
Mid & West Wales Fire Service, Earlswood Depot, Neath
Geotechnical & Geo-Environmental Desk Study**

Report Reference: ESP.8178.3720

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Proposed Training Facility (Commercial) Development Mid & West Wales Fire Service, Earlswood Depot, Neath Geotechnical & Geo-Environmental Desk Study

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Report Reference: **ESP.8178.3720**

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Figure 1 Topographical Survey

Appendix A Risk Evaluation Methodology

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Appendix E British Geological Survey (BGS) Borehole Records (BGS, 2022)

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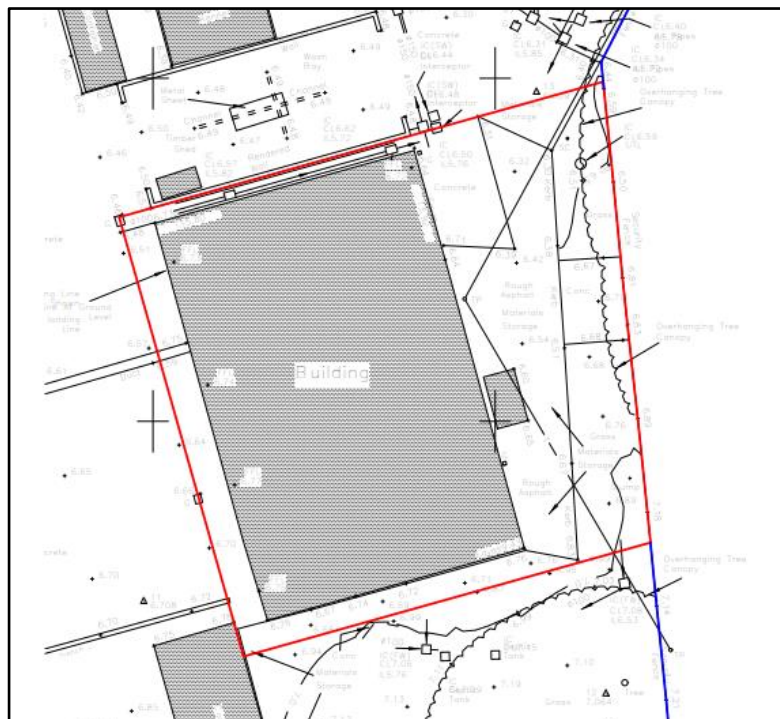
General Notes

1 Introduction

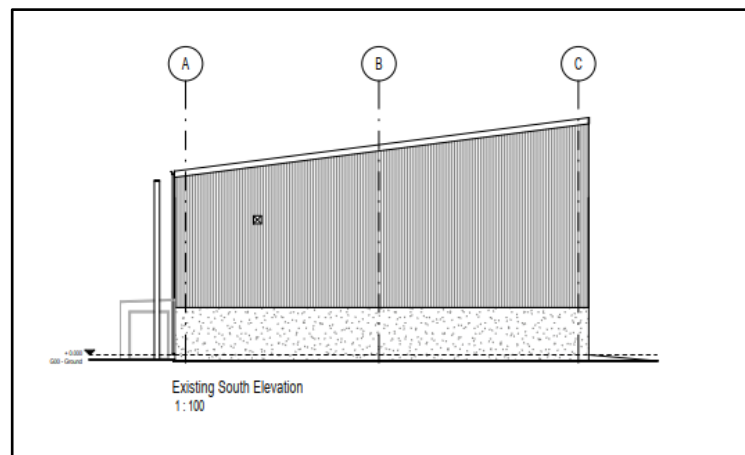
1.1 Background

Mid & West Wales Fire Service (hereafter known as the Client) are proposing to redevelop the subject site with a new training facility. The Earth Science Partnership Ltd (ESP), Consulting Engineers, Geologists and Environmental Scientists, were instructed by Lawray Architects, acting on behalf of the Client, to undertake an integrated geotechnical and geo-environmental investigation and assessment to identify and evaluate potential ground hazards which could impact on the proposed development. The site location is shown on Insert in Section 2.1.

The site is located within the east portion of the wider Earlswood Training Facility site and is currently occupied by an existing building (see Insert 1 below), which we understand to be a large portal framed structure (see Insert 2), which is unoccupied at present.

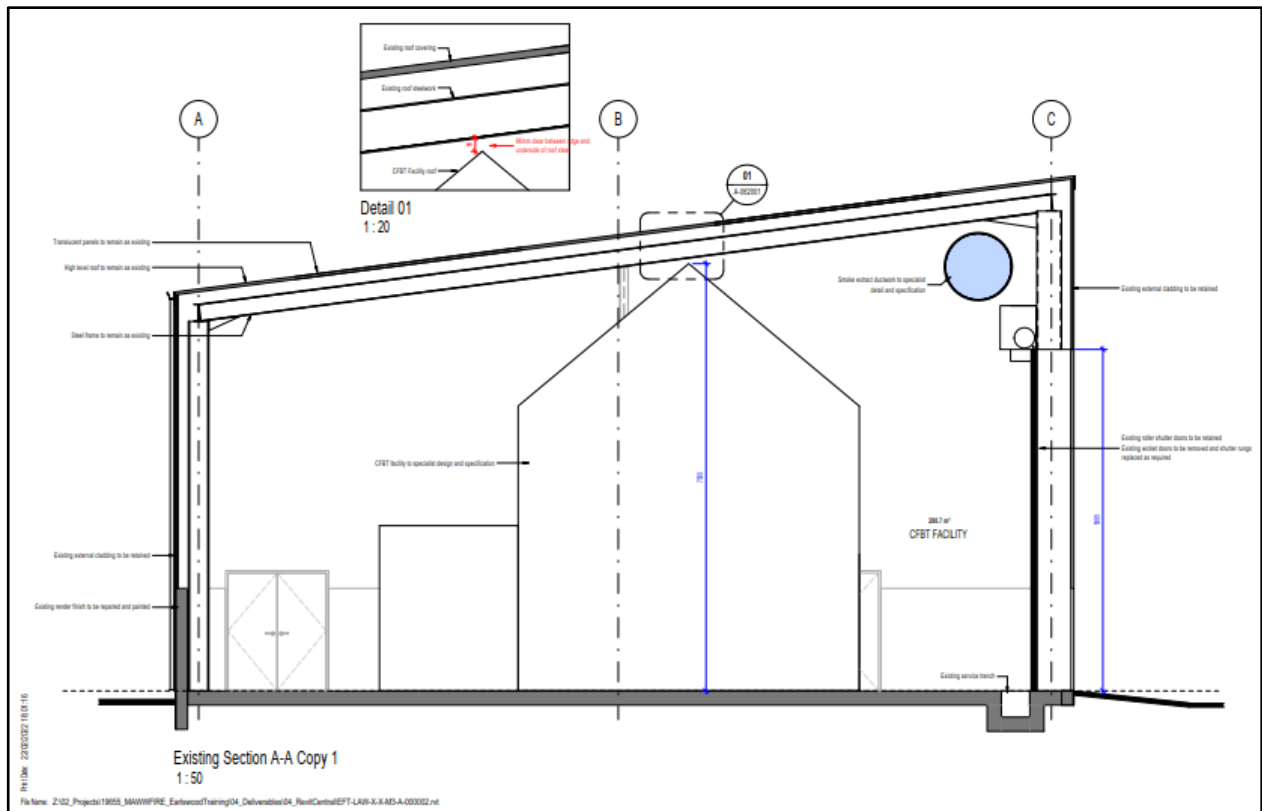


Insert 1 – Existing Site Layout Plan (not to scale) – provided by Lawray Architects



Insert 2 – Existing South Elevation Plan (not to scale) – provided by Lawray Architects

We understand that the proposed development will comprise the construction of a new training facility within this existing structure (see Insert 3).



Insert 3 – Proposed Training Facility Within Existing Structure (not to scale) – provided by Lawray Architects

Based on the above, we understand that the proposed structures would be classified as Geotechnical Category 2 (BS5930:2020).

1.2 Objective and Scope of Works

The objective of the investigation was to obtain Desk based information on the geotechnical character and properties of the ground beneath the site, potential risks posed by contamination and ground gas, and to allow an assessment of these ground conditions with reference to the potential impact on the proposed development.

We understand that a pre-planning application has been submitted to Neath Port Talbot Council (NPTC) which indicated a requirement for an assessment of the potential risks from contaminated land and geotechnical hazards.

The scope of works for the investigation was designed by ESP within an agreed budget and comprised a desk study review of available historical Ordnance Survey maps, environmental data, geological maps, memoirs and data, assessment, and reporting.

The contract was awarded based on a competitive tender quotation. The terms of reference for the assessment are as laid down in the Earth Science Partnership proposal of 21st April 2022 (ESP Ref: ESP.8178.It1.Proposal).

The Desk Study assessment was undertaken in May 2022.

1.3 Report Format

This report includes the desk study (Section 2), along with the Preliminary Risk Assessment stage (Section 3). A preliminary risk register, identifying potential geotechnical hazards from the desk study review, is presented as Section 2.9. The geotechnical risk register is presented in Section 2.10.

The assessment of the potential for hazardous substances (contamination) or conditions to exist on, at or near the site at levels or in a situation likely to warrant mitigation or consideration appropriate to the proposed end use has been undertaken using the guidance published by CIRIA (2001). This is discussed in more detail in Section 3.2.1 and in Appendix A.

This report is issued as a digital version only.

1.4 Limitations of Report

This report represents the findings of the brief relating to the proposed end use and geotechnical category of structure(s) as detailed in Section 1.1 above. The brief did not require an assessment of the implications for any other end use or structures, nor is the report a comprehensive site characterisation and should not be construed as such. It should be appreciated that no intrusive investigation has been undertaken to date. Should an alternative end use or structure be considered, the findings of the assessment should be re-examined relating to the new proposals.

Where preventative, ameliorative or remediation works are required, professional judgement will be used to make recommendations that satisfy the site-specific requirements in accordance with good practice guidance.

Consultation with regulatory authorities will be required with respect to proposed works as there may be overriding regional or policy requirements which demand additional work to be undertaken. It should be noted that both regulations and their interpretation by statutory authorities are continually changing.

This report represents the findings and opinions of experienced geo-environmental and geotechnical specialists. Earth Science Partnership does not provide legal advice and the advice of lawyers may also be required.

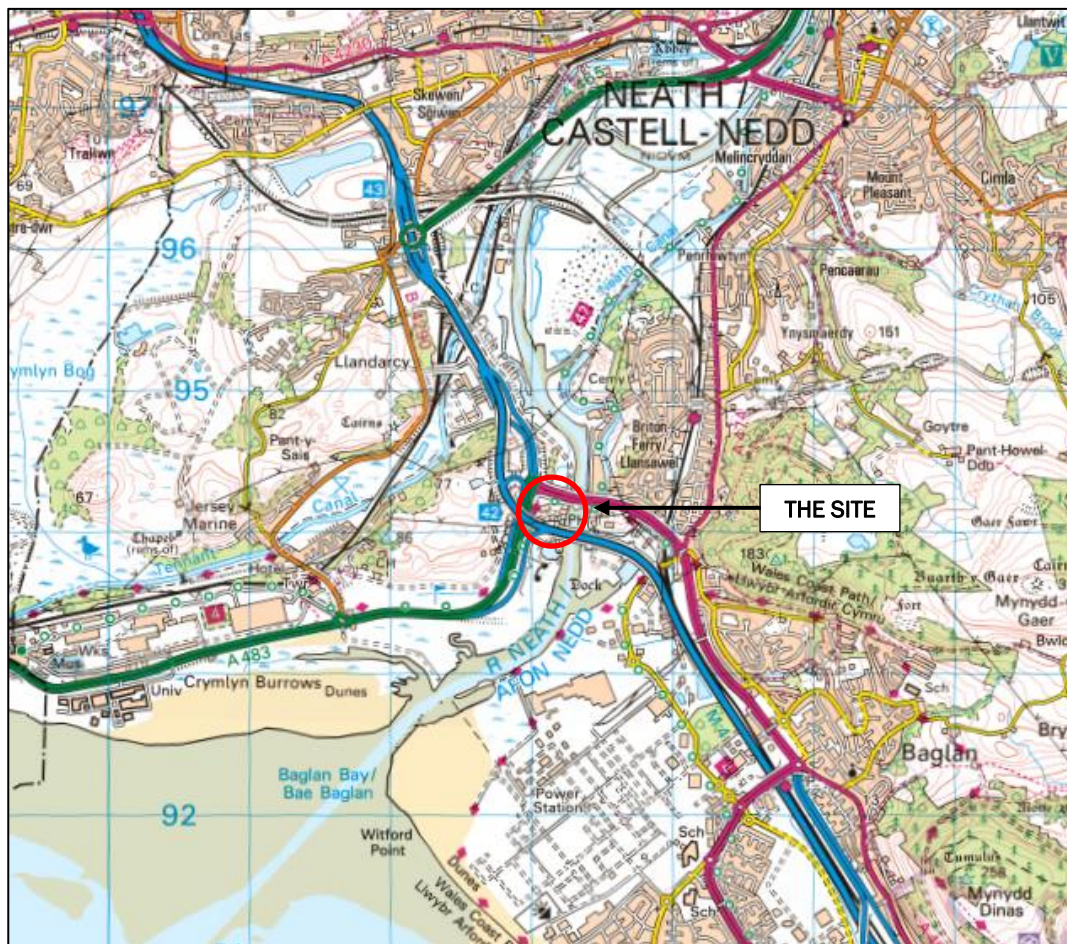
2 Desk Study

The information presented in this section was obtained from desk-based research of sources detailed in the text, including historical maps, a combined environmental and geological data report, and a mining report obtained from the Coal Authority. Further desk study reports/data/records are included as subsequent appendices as referenced in the text.

The site description is largely based on available aerial imagery and street view mapping. No walkover has been undertaken as part of this Desk Study assessment.

2.1 Site Location and Description

The site is located on the southern margins of Neath, just west of Briton Ferry on the west bank of the river Neath. The National Grid Reference of the approximate centre of the site is (SS) 273109E, 194177N and the postcode is SA10 6NG. A Site Location Plan is presented as Insert 4 below.



Insert 4 - Site Location Plan from Ordnance Survey 1:25,000 scale map.
Reproduced with permission (OS License No.: AL100015788).

The site comprises an irregular shaped parcel of land of around 30m length (northeast to southwest) and 25m width (northeast to southwest), occupying an area of around 0.07ha. The site is currently occupied by an existing building (see Insert 1), which we understand to be a large portal framed structure (see insert 2), which is unoccupied at present.

Vehicular access to the site is currently gained through security gates located to the southwest, in the southwest corner of the wider Earlswood Depot site.

The site is bounded by:

- To the north: the wider Earlswood Training Centre site, followed by the overhead A48 bridge/road and open fields.
- To the east: by a small, wooded area followed by an unnamed property, likely commercial. The river Neath is approximately 130m east.
- To the south: by Earlswood Depot Access Road and Monkstone Cruising and Sailing Club.
- To the west: by the wider Earlswood Training Facility site, followed by the M4.

Much of the site is occupied by the existing building, with areas of hardstanding (concrete and rough asphalt) to the east. Small areas of grass are also noted to the east of the site.

We are not aware of a tree survey having been undertaken at this stage, but available information we have tentatively identified trees on the east boundary of the site. A tree survey should be completed by a specialist arboriculturist prior to development.

The general topography in the area is relatively flat, sloping gently to the river Neath to the east. A topographic survey has been provided by the Client and indicates a spot height of around 6.5m AOD across the site. The survey is presented as Figure 1 and also indicates the following services present at the site:

- Overhead telecommunication cables in the southeast/east.
- Drainage services along the north edge of the existing building.
- A probable service duct entering the west side of the building from the west.
- An oil interceptor off the northeast corner of the existing building.
- A septic Tank in the south/southeast portion.

2.2 Site History

2.2.1 Published Historical Maps

The site history has been assessed from a review of available historical Ordnance Survey County Series and National Grid maps. Extracts from the historical maps are presented in Appendix B and the salient features since the First Edition of the County Series maps are summarised in the table below.

Table 1: Review of Historical Maps

Date	On-Site	In Vicinity of Site
1880 – 1884	A railway line is shown to cross the approximate centre of the site, trending southeast to northwest. Sidings associated with the railway line are not adjacent. A small unknown structure is shown in the southwest corner.	Earlswood Colliery is identified some 145m west of the site, with an associated railway line which trends southeast, across the site and further southeast to the river Neath, which identified some 140m east at its closest point. A Coal Pit and Chimney are shown west of the colliery, approximately 150m west/northwest of the site. A grouping of buildings is noted between approximately 80m and 100m southeast, adjacent to the railway line. A road/track is noted to be under construction adjacent to the buildings. Earlswood House is shown 100m north. A further Coal Pit is shown approximately 250m west and an Old Coal Pit and Old Col level is shown 250m north. East of the river a large amount of commercial, industrial, and residential premises are identified, associated with the area of Briton Ferry. An Air shaft is identified approximately 500m southeast.
1897 – 1941	The railway line now appears to be dismantled and the former structure is no longer indicated. The site is currently vacant.	Earlswood Colliery is now shown to be disused, and the associated coal pit, chimney and railway lines are no longer indicated. A footpath is shown where the railway line was previously. A well is noted approximately 80m west, with a small channel seemingly extending from it, trending northeast, then southeast. Ferry Boat House (Public House) is shown adjacent to the buildings to the southeast of the site. The coal pit to the west and the old coal level/old coal pit to the north are no longer shown. Significant industrial developments are noted east of the river Neath, within the area of Briton ferry. The air shaft 500m southeast is now named as an old air shaft and shows an adjacent old coal drift.
1962 – 1965	The 1:1,250 scale map indicates a track now occupying most of the site, with a small structure marginally encroaching onto the site in the south.	Several tracks have been constructed around the site, with areas of filling/earthworks also noted in the vicinity. A crane is indicated some 50m west of the site. These features are likely associated with the construction of a dual carriageway road some 30m north of the site, which cross the river Neath by viaduct to the northwest. A further road development is shown approximately 100m west and is named as the A 483. A significant cutting/excavation is noted some 100m south of the site, although there is no indication of its purpose. Reference to the data report (Appendix C), indicates that this could be the former Briton Ferry Quarry, opened to quarry sandstone. No further details available. The group of houses to the south east are identified to be named Earlswood Cottages and the Monkstone Cruising and Sailing club is now shown southeast of the cottages.
1970 – 1971	No significant changes identified.	The crane is no longer indicated to the west. The road to the north is now named the A48. Earlswood House is no longer present.
1980 – 1986	The site is now shown to be vacant, within a large, cleared area, resembling the current day boundary of the wider Earlswood Training facility site.	An area of apparent cutting/earthworks is noted some 10m northeast of the site, with a drainage arrow pointing southeast. This could indicate an excavated drainage channel. Much of the industrial areas east of the river are shown to have gone, with residential and commercial developments expanding the area of Briton Ferry.
1993 – 2003	From 1995, the site is shown to have what appears to be the existing building within its boundary. The layout now resembles the present-day layout.	A large building is now shown to the west, with a further structure to the west of that. The wider site is now named 'Corporation Depot'. A tank is noted approximately 90m west of the site. The cutting to the west is now shown to have water channel within it and it appears to be culverted at the west and east extents of the cutting. From 2001, the 1:10,000 scale mapping now shows the M4 motorway, which is present approximately 150m south of the site, 100m west and links to the A48 some 100m northwest. A marina is indicated some 300m south of the site from 2001 onwards.
2010 – present	No significant changes identified. The layout now resembles the present-day layout.	The wider Earlswood Training facility site is now shown to resemble the present-day layout.
Notes: 1. Extracts from historical maps presented in Appendix B. 2. Features may have been present on site between the dates of the individual mapping, and it should be appreciated that these cannot be identified from the map review.		

2.3 Previous Investigations and Assessments

We are not aware of any previous geotechnical or geo-environmental investigations or assessments at the site.

2.4 Contact with Regulatory Bodies & Local Information Sources

At the time of issue of this report, we have not yet received a response from the consultees. Once received, any response will be forwarded under separate cover. It should be appreciated that their responses may contain salient information on the site which could not be considered during the preparation of this report.

2.5 Hydrology

2.5.1 Surface Water Features

The nearest major surface water feature to the site is the small channel noted in the historical mapping, which flows from a well to the west of the site eastward. This extends to a further stream, which flows east to the river Neath.

The data report (Appendix C) confirms the above and notes that the river Neath is some 140m east of the site.

2.5.2 Surface Water Abstractions

The data report (Appendix C) indicates that there are no surface water abstractions within 250m of the site.

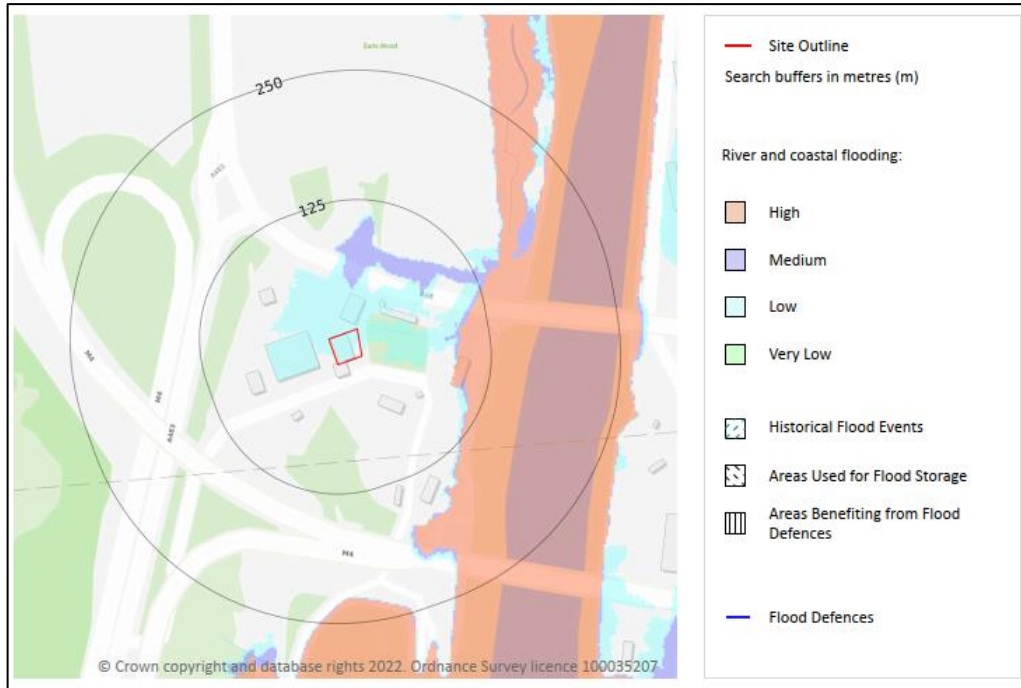
2.6 Flooding

2.6.1 Rivers and Seas

From a review of topographical plans and flooding maps presented in the data report and on the Natural Resources Wales (NRW) website (NRW, 2022), the site is indicated to be at risk flooding from rivers or seas and is located within a Flood Zone 3/Flood Zone 2 (see Inserts 5 & 6).

Flood Zone 3 is defined as an area during any given year, at risk of flooding from rivers (fluvial) during the 1% (1 in 100) chance or greater event, and sea (tidal) during the 0.5% (1 in 200) chance or greater event.

Flood Zone 2 is defined as an area during any given year, at risk of flooding from rivers (fluvial) between the 1% (1 in 100) and the 0.1% (1 in 1000) chance event, and tidal between a 0.5% (1 in 200) and 0.1% (1 in 1000) chance event. Zone 2 also contains areas known to have flooded in the past and is important from a planning context as it forms the basis of Zone C in the Welsh Government Development Advice Map (DAM)



Insert 5 – Extract from Appendix C, indicating the River and Coastal Flooding Risk



Insert 6 – Extract from Appendix C, indicating the site within a Flood Zone 2 and 3.

The potential for flooding from rivers or seas has not been addressed further in this report and if required ESP are able to implement an appropriate Flood Consequence Assessment.

2.6.2 Surface Water

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead.

This type of flooding can be difficult to predict, much more so than river or sea flooding as it is hard to forecast exactly where or how much rain will fall in any storm. The information available depends on available records including ground levels and drainage.

From a review of information presented in Appendix C, the site is indicated to be in an area of Low risk from surface water flooding. A Low risk means that in each year, the area has a chance of flooding of between 0.1% (1 in 1000) and (1%) and 1 in 100.

2.6.3 Groundwater

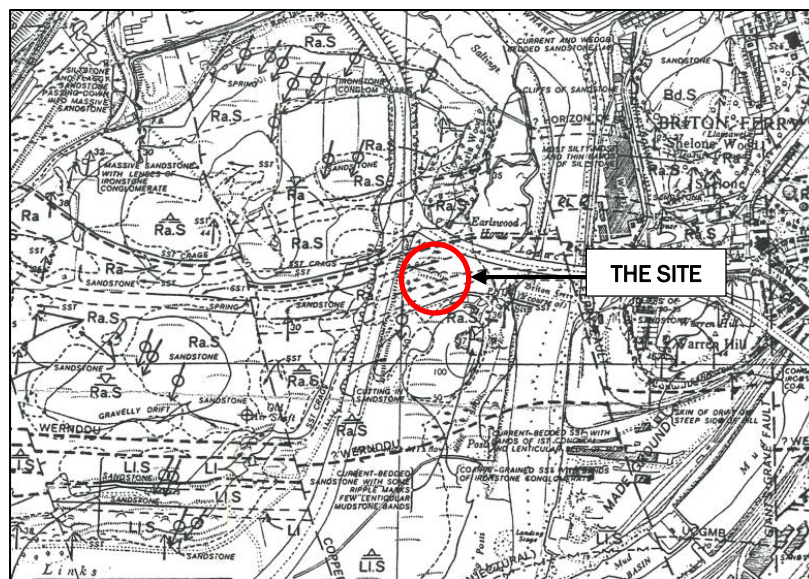
Groundwater flooding is defined as the emergence of groundwater at the ground surface away from river valleys or the rising of groundwater into man-made ground under conditions where the 'normal' range of groundwater levels and groundwater flows is exceeded and predicted risk from groundwater flooding aims to identify locations where this form of groundwater flooding could happen. It does not incorporate anomalous discharge from springs leading to groundwater flooding down the topographic slope or flooding associated with urban groundwater rebound, mine water discharge, urban drainage, or any other flooding associated with changes in the engineered environment.

The environmental report in Appendix C indicates that the site is at a potential low risk at surface from superficial deposits flooding deposits flooding/clearwater flooding. Superficial Deposits Flooding is defined as flooding associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers. Clearwater Flooding is defined as flooding associated with groundwater from unconfined aquifers.

2.7 Geology

2.7.1 Published Geology

The published 1:10,560 scale geological map for the area of the site (Sheet SS79SW, presented as Insert 7) indicates the site to be underlain by marine or estuarine alluvium, overlying bedrock of the Upper Coal Measures. A covering of Made Ground is also anticipated, given the historical development at the site and the surrounding area.



Insert 7 - Extract from BGS Geological Map Sheet SS68NW, original 1:10,560 scale.
Reproduced with permission (BGS licence number: C15/05 CSL)

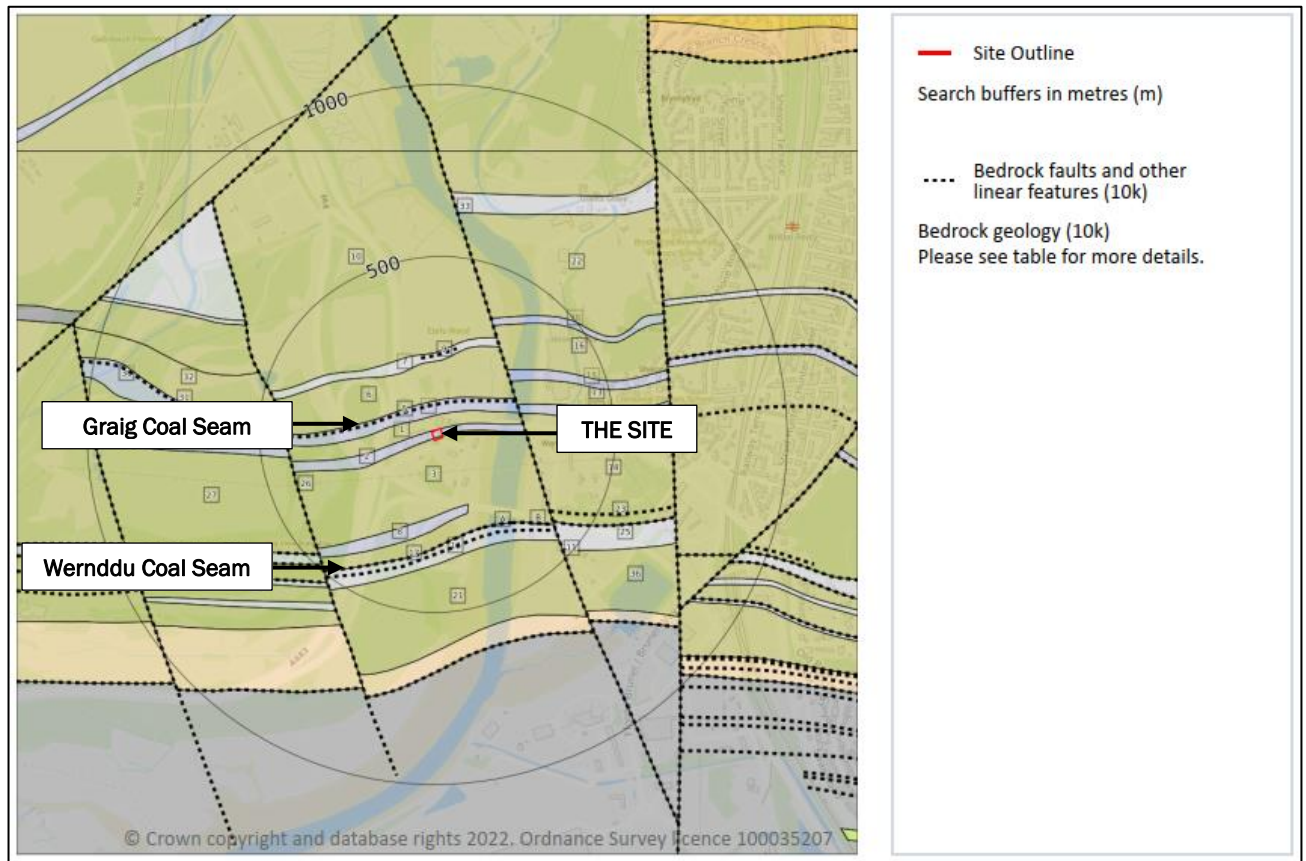
Reference to the up-to-date mapping available on the website of the British Geological Survey (BGS, 2022) indicates a similar succession, with Alluvium superficial deposits indicated (clay, silt, sand, and gravel), overlying Rhondda Member bedrock (a sub-group of the Upper Coal Measures).

The above is also confirmed in the data report, Appendix C.

The Alluvium superficial strata would be expected to be variable, and potential comprise a mix of fine- and coarse-grained soils, ranging from clay and silt, to sand and gravel. Horizons/layers of origin materials/Peat could also be present. Based on available BGS information, the alluvial deposits could also be underlain by glacial superficial soils (see Section 2.7.2).

The Coal Measures bedrock comprises an interbedded succession of sandstone, siltstone, and mudstone, with coal seams and associated seat earths.

The geological map indicates the site to be within a fault block, with northwest to southeast trending faults some 231m east and 417m west of the site. The conjectural outcrop of the Wernddu coal seam is shown to trend roughly south, southwest to north, northeast, some 285m south of the site (see Insert 8). The map also indicates the strata to dip to the north at an angle of around 36°. Therefore, the Wernddu seam would be expected to underlie the site, albeit at a significant depth.



Insert 8 - Extract from Appendix C, showing bedrock geology and linear features (faults & coal seams)

The next named seam to be identified on the geological map is the Graig seam, located some 72m north of the site. Although this would not underlie the site (due to the dip to the north), it provides reference when assessing the published vertical section for the 1:10,000 scale published geological map.

Based on the published vertical section for sheet SS79SW, the Field seam is located above the Wernddu seam, but is locally absent. No indication of the Field seam is shown on geological map and is likely absent within the fault block within which the site is located. No further named seams are present between the Wernddu and the Grag coal seams, however, thin coals are identified on the vertical section, indicated to be locally absent. This is discussed further in Section 2.10.1.

2.7.2 Available BGS Borehole Records

Reference to the website of the British Geological Survey (BGS, 2022) indicates several available records to the north (within 50m of the site) and south (within 150m of the site).

For information, a selection of the closest boreholes to the site have been presented in Appendix D and summarised below.

Boreholes SS79SW278, SS79SW279 & SS79SW280 (approximately 40m north of the site)

These boreholes were completed as part of the investigation works for the road construction of the A48 to the north of the site. Based on the geological mapping, they were constructed within a similar geological setting to conditions anticipated at the site.

All three boreholes show interbedded clay, silt, sand, and gravels to depths greater than 30m below surface level, indicating deep alluvial soils to be present.

Boreholes SS29SW220, SS29SW221, SS29SW222, SS29SW108 & SS29SW92 (approximately 145m south of the site)

These boreholes were completed as part of the investigation works for the road construction of the M4 to the south of the site. Based on the geological mapping, they were constructed within a similar geological setting to conditions anticipated at the site, however no Alluvium is present in this area (as is anticipated at the site) and the superficial soils comprise glacial deposits.

The boreholes identified variable thicknesses of glacial soils to between approximately 5m depth to 12m depth, underlain by sandstone of the upper coal measures.

Borehole SS79SW126 (approximately 220m southeast of the site)

Although located around 220m from the site, this borehole is again within a similar geological setting to that anticipated at the site. Constructed as part of the investigation works for the M4 motorway, the borehole records identify Alluvium soils to a depth of around 38m below surface level, comprising interbedded clay, silt, sand, and gravel, with fractions of cobbles throughout. The Alluvium is underlain by glacial deposits, comprising dense cobbles and gravels to a depth of around 44m below surface level, where bedrock is encountered (Upper Coal Measures). The bedrock is proven to a depth of 50m below surface level, identified as siltstone and mudstone.

2.7.3 Available Previous Investigation Records

We are not aware of any previous investigations at the site.

2.8 Hydrogeology

2.8.1 Aquifer Classification

Reference to the aquifer maps published in the data report (Appendix C) indicates that the superficial deposits beneath the site (Alluvium) are classed as a Secondary Undifferentiated Aquifer, whilst the bedrock (Upper Coal measures) is classed as a Secondary A aquifer.

Secondary A Aquifers generally correspond with the previously classified minor aquifers and comprise permeable layers capable of supporting water at a local, rather than strategic, scale and in some cases form an important base flow to rivers. Secondary A Aquifers are sensitive to pollution.

The Environment Agency assign Secondary Undifferentiated Aquifers where it has not been possible to categorise an aquifer in either Secondary A or B. In most cases this is attributable to a unit being classified as both minor and non-aquifers in different locations due to the variable characteristics of the rock type. These strata can be sensitive to pollution.

2.8.2 Anticipated Groundwater Bodies

Based on the available information, we consider that the shallowest main groundwater body is likely to be located within the Alluvium strata. However, localised perched water bodies within the overlying Made Ground (if present) cannot be discounted.

The river Neath is some 140m east of the site a level of 0m AOD. Given the level of the site at around 6.5m AOD, we would anticipate that groundwater would be at around 5-6m below the surface level of the site.

2.8.3 Abstractions and Groundwater Vulnerability

The data report (Appendix C) indicates that there are no groundwater abstractions or Source Protection Zones within 500m of the site. The groundwater vulnerability is shown in the data report to be medium, for both the superficial aquifer and bedrock aquifer.

2.8.4 Groundwater Movement

Groundwater movement within Alluvium will be controlled by intergranular flow whilst, in the Coal Measures bedrock, fracture flow is likely to be dominant.

Given the site setting, the groundwater beneath the site is likely providing base flow to the river Neath to the east and is likely in hydraulic continuity.

It should be appreciated that in former mining areas, such as this, groundwater conditions may still be changing in response to the cessation or reduction in pumping from underground coal workings (see Section 2.10.1).

2.9 Environmental Setting

2.9.1 Summary of Environmental Data

A data report has been obtained for the site and is presented in Appendix C, and the relevant data therein is summarised in the table below. The report should be consulted for further detail.

Table 2 - Summary of Environmental Data

Feature	On the Site	In the Immediate Vicinity
Environmentally Sensitive Sites ^{2,3}	None identified.	See Section 2.9.2.1.
Potentially Contaminative Land Use	See Section 2.9.2.2.	See Section 2.9.2.2.
Historical Tanks, PFS, Garages, Energy Facilities	None identified.	See Section 2.9.2.3.
Potentially Infilled Land	See Section 2.9.2.4.	See Section 2.9.2.4.
IPPC Authorisations	None identified.	None recorded within 500m of the site.
Discharge Consents	None identified.	See Section 2.9.2.5.
List 1 and 2 Dangerous Substances Sites	None identified.	None recorded within 500m of the site.
Radioactive Substance Sites	None identified.	None recorded within 500m of the site.
Enforcements	None identified.	None recorded within 500m of the site.
Pollution Incidents	None identified.	See Section 2.9.2.6.
Contaminated Land under Part 2A EPA 1990.	None identified.	None recorded within 500m of the site.
Waste Management Facilities	None identified.	See Section 2.9.2.7.
Current Industrial/Commercial Sites	None identified.	See Section 2.9.2.8.
Notes: 1. Full details of features presented in the data report (Appendix X). 2. Sensitive land uses include Sites of Special Scientific Interest, Nature Reserves, National Parks, Special Areas of Conservation, Special Protection Areas, Ramsar sites, World Heritage sites and Ancient Woodland. 3. Nitrate vulnerable areas relate to the agricultural use of fertilizers and are not considered further in this assessment.		

2.9.2 Further Discussion on Salient Environmental Features

2.9.2.1 Environmentally Sensitive Sites:

Five records for Sites of Special Scientific Interest (SSSI) are identified within 250m of the site, all associated with 'Earlswood Road Cutting and Ferryboat Inn Quarries'. No further details are available.

One record of a designated ancient woodland is also noted around 120m north of the site.

2.9.2.2 Potentially Contaminative Land Use

On site, historical evidence (see Table 1) and the data report (Appendix C) indicate that the site has formerly been within colliery and railway land. An unspecified heap is also noted.

Off site, several potentially contaminative land uses are identified, including ground workings, unspecified heaps/quarries, ground workings, cuttings, dockland, railway land, colliery land, coal pits and rail sidings.

2.9.2.3 Historical Tanks, PFS, Garages, Energy Facilities

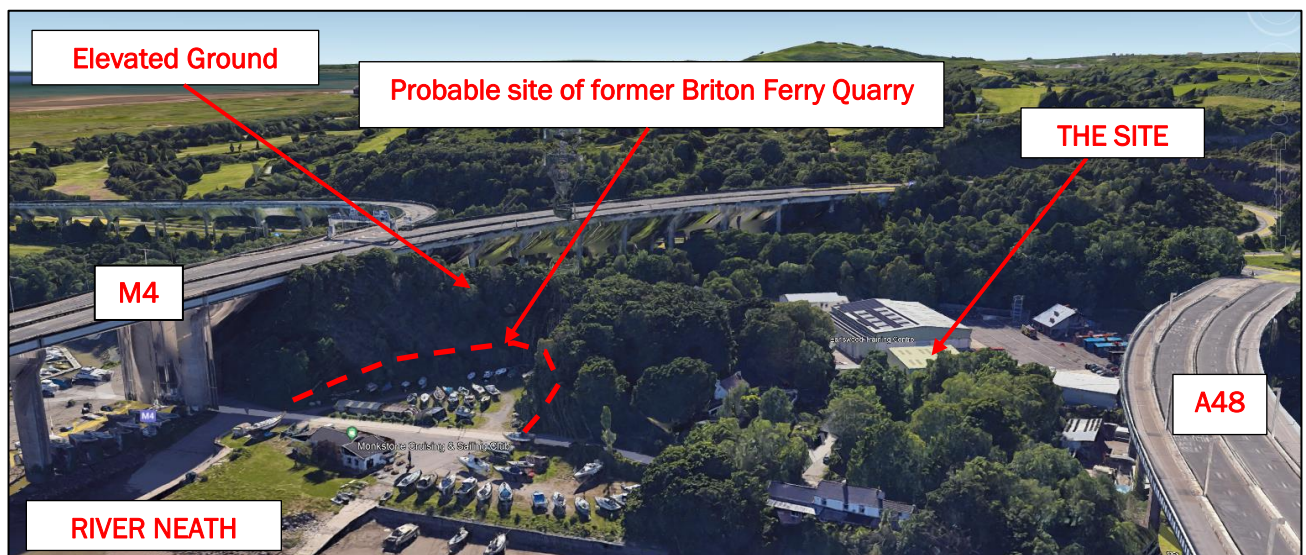
No tanks have been identified on site during the historical review, however based on the survey plan provided by Lawray Architects, a septic tank is noted in the south of the site.

Off site, an unspecified tank is recorded approximately 78m west (identified on the historical map review, Table 1), within the wider Earlswood Training facility site.

2.9.2.4 Potentially Infilled land

No infilled land is identified at the site or in the vicinity, however, given the historical land uses as railway and colliery land, there are likely areas of unrecorded filling. Earthworks (cutting and filling) are noted on site and adjacent to it from the historical mapping during the various changes that have occurred at or near the site in the past, most notably during the construction of the A48 to the north and the M4 to the south.

A significant cutting/excavation is noted some 100m south of the site on the 1:1,250 published map for 1965, although there is no indication of its purpose. Reference to the data report (Appendix C), indicates that this could be the former Briton Ferry Quarry, opened to quarry sandstone. No further details are available, however based on recent aerial imagery, it appears that the cutting into a localised area of elevated ground remains and forms a boat storage/maintenance area associated with the existing Monkstone Cruising and Sailing Club (see Insert 9 below).



Insert 9 – Image from Google Earth showing local topographical features and site setting.

2.9.2.5 Discharge Consents:

No discharge consents identified on site. One identified 27m east, with the address published as named as Earlswood off Jersey Marine, Neath. The effluent type is unknown, and the receiver water is an unnamed tributary of the river Neath. This discharge consent was revoked in 1994 (issued in 1973).

2.9.2.6 Pollution Incidents:

Four pollution incidents have been identified from Appendix C, within 250m of the site, as summarised below:

- 43m northeast (2003) – unidentified pollutant, with no impact to water, land, or air.
- 50m northeast (2001) – 4no. incidents occurring from one source. Pollutant type identified to be batteries, tyres, and mixed/waste oils. Minor impacts noted to water and land. No impact registered to air.
- 97m west (2002). Pollutant identified to be tyres. Minor impact to land.
- 108m east (2001). Pollutant identified to be tyres. Minor impact to land.

2.9.2.7 Waste Management Facilities:

1no. historical waste site recorded 15m west. The address published in Appendix C is Freightliner Depot, Jersey Marine, Neath. The report indicates that the type of waste was a Waste Recovery Energy Plant (Planning application reference: 00/1042).

2.9.2.8 Current Industrial/ Commercial Sites

The site is currently used by the Mid and west Wales Fire service as a training facility. At this stage, we are not aware of the type of training undertaken and whether any fire fighting training is undertaken i.e., whether there are fuel storage facilities, chemical storage facilities (for use in fire fighting or any other potentially contaminative products used in the training of fire fighters).

Within 250m of the site, 7no. potentially contaminative land uses are noted, as summarised below:

- 73m west – unspecified tank.
- 103m south – electrical pylon.
- 130m east – unloading and mooring slip road facility.
- 168m southeast - unloading and mooring slip road facility (likely associated with the marina).
- 171m south – gantry for travelling cranes (likely associated with the marina).
- 189m southeast - unloading and mooring slip road facility (likely associated with the marina).
- 216m southwest – gantry for travelling cranes (likely associated with the marina).

2.9.3 On-Site Bulk Liquid Storage

No historical evidence indicates evidence of any past or recent above ground or underground bulk liquid (e.g., fuels/oils) storage on site. However, based on the topographical survey provided by Lawray Architects, a septic tank is in the south of the site. We are not aware whether this is above, or below, ground level.

We understand that are 2no. above ground oil tanks within the wider Earlswood Training facility site, both of which are bunded. One oil tank is on the east elevation of the main workshop building and the other oil tank is on the western boundary of the wider site.

2.9.4 On-Site Bulk Materials and Waste Storage

No evidence of recent materials or waste storage on the site has been identified during the Desk Study review. However, given the wider site use as a training facility for the Mid and West Wales Fire Service, we cannot discount that further storage tanks may be present at the site, or within proximity.

2.10 Preliminary Geotechnical Risk Register

The potential for various geotechnical and geomorphological hazards at the site is provided in the data report (Appendix C). The potential hazards, as defined by the British Geological Survey (BGS) and reported in the above report, along with any salient further information has been considered in the preparation of this report.

Where a potential geotechnical hazard has been identified, it is discussed further in subsequent sections.

2.10.1 Past Coal Mining

As discussed in Section 2.7, the site is underlain by bedrock of the Upper Coal Measures, which contains several seams of coal (and bands of ironstone).

2.10.1.1 Historical and Geological Information

The Wernddu coal seam is shown on geological maps to crop out around 285m to the south as shown on Insert 8 in Section 2.7. The published geological map suggests that the seam is 2ft 3inches (0.69m) in thickness in the area.

No information on the Earlswood Colliery has been identified during this desk study and therefore we cannot confirm the target seam(s) for the colliery.

2.10.1.2 Coal Authority Website

Reference to the Coal Authority website (CA, 2022) provides the following salient information:

- No coal seams are shown to outcrop on site. The nearest seam is to the south and is likely the Wernddu seam, some 285m south.
- No past surface hazard or surface mining is identified in the vicinity of the site.
- No recorded or probable past shallow coal mining is indicated in the vicinity of the site.
- No mine entries are shown within the site boundary.
- The site lies/does not lie within a 'Development High Risk Area'.

2.10.1.3 Coal Authority Mining Report

A consultant's mining report has also been obtained from the Coal Authority and is presented in Appendix D. This indicates that, based on the available Coal Authority records:

- No past underground mining is recorded at the site.
- There are no probable unrecorded shallow workings.
- There are no spine roadways recorded at shallow depth.
- There are no mine recorded entries within 100m of the site.
- There are no recorded geological faults or fissures recorded beneath the site.
- There are no recorded damage notices or claims for the subject property, or any property within 50m of the site boundary since 31st October 1994.
- There is no record 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.
- No mine gas emission has been recorded within 500m of the property.
- There is no proposed future mining or licensing proposed.

- 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 site located in an area of historical coal mining activity.

2.10.1.4 Preliminary Coal Mining Risk Assessment

Given the available information, we consider the following information to be pertinent in understanding the likely coal mining risk:

- Historical boreholes published on the BGS website (BGS, 2022), indicate that the site is likely underlain by significant depths of superficial soils, comprising alluvial silts and clays, with possible underlying glacial deposits, to a depth of around 40m below surface level. This is typical of an estuarine/river setting.
- Rockhead is anticipated at depths of around 40m below surface level.
- Significant water ingress is anticipated below around 6m below the site surface level (the level of the river Neath). Mining beneath the site would therefore present a significant challenge.
- Due to potential water ingress and risks to life, mine workings beneath rockhead and the overlying superficial aquifer are less likely.
- If a crown hole from possible unrecorded workings reached rockhead at a depth of 40m (or greater), the resulting surface expression would result in settlement over a large area, rather than concentrated subsidence.
- Using the shaft collapse zone calculations provided in C758D the zone of settlement is estimated to likely be in the order of 100-150m diameter (based on a conservative angle of shearing resistance).
- As far as we are aware, the existing building (or any other buildings in the wider site) has not undergone any remediation works in the past and we are not aware of any issues regarding subsidence or settlement to have been identified in the past. This should be confirmed by the Client/Lawray Architects.
- There are no recorded damage notices or claims for the subject property, or any property within 50m of the site boundary since 31st October 1994.
- There is no record 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.

Given the available information, we consider that the shallowest workings beneath the site would be within the Wernddu seam at around 150m depth, and that any workings are likely to have sufficient rock cover above them to mitigate the subsidence risk. However, as detailed above, we consider it unlikely that the seam would have been worked beneath the site.

Therefore, based on the Desk Study information to date, we consider that the likely risk from subsidence at the site is Low.

To confidently confirm a low risk, the bedrock profile would need to be proved beneath the site and the presence/absence of coal seams within an influential depth would need to be investigated. However, constructing boreholes through deep superficial deposits (with significant water ingress) poses significant challenges and defining rockhead, let alone any possible workings underlying the rockhead, is unlikely feasible without significant cost. If encountered, treatment of any workings at a depth more than 40m would be highly challenging and very costly.

Therefore, we consider the most reasonable approach is to limit any potential subsidence effects (areal settlement) in the design (e.g., reinforced foundations/floor slabs) and adopt a long-term management approach to allow reactive consideration/remediation in the unlikely scenario that any localised subsidence effect is realised.

2.10.2 Past Quarrying

No indication that quarrying has been undertaken at the site has been identified in the Desk Study to date. However, quarrying has been identified close to the site (see Section 2.9.2.4). Given the depth of superficial soils anticipated at the site, historical quarrying is unlikely, however, during the development works, a careful watch should be maintained for any anomalous ground conditions.

2.10.3 Shrinkable and Swelling Soils

The fine-grained alluvial soils anticipated at shallow depth beneath the site could be susceptible to volume change with changes in moisture content (shrinkage and swelling). Therefore, we consider that the potential for shrinkable/swelling soils at the site is moderate and testing of the shallow fine-grained soils should be undertaken during the intrusive investigation works.

2.10.4 Compressible Ground

The alluvial deposits anticipated beneath the site could comprise soils of probable low strength and contain organic materials and, hence, are potentially compressible. Any Made Ground soils present beneath the site are also potentially compressible, particularly where containing organic materials are present, which could lead to significant settlement at the surface. Therefore, we consider that the potential for compressible ground at the site is moderate/high.

2.10.5 Running Sand

Given the geological setting, it is possible that layer of sand may be present beneath the site surface and, where water ingress occurs within these layers, there is a potential for running sands. Therefore, we consider that the potential for running sands beneath the site is low.

2.10.6 Historical Underground Structures

Historical information indicates that a railway line and a small unknown structure were present at the site. Although these are likely to have been fully removed, we cannot discount that associated buried structures/foundations may remain.

Any remaining structures will need to be grubbed up as part of the redevelopment and if extensive, this may have cost (larger machinery, backfill materials, disposal costs etc.) and time implications for the re-development.

Care should be executed to avoid damaging the underlying formation, to avoid the requirement for further deepening of the foundations beyond the disturbed ground.

2.10.7 Pyritic Ground

The data report does not consider the potential risk from sulphate rich or pyritic ground.

The alluvial soils underlying the site are not anticipated to contain significantly elevated levels of sulphate. Depending on its origin, any Made Ground present beneath the site may also contain elevated levels of pyrite.

Given the above, we consider that the potential for sulphate/pyrite attack on buried concrete would be Moderate.

2.10.8 Unexploded Ordnance

The data report does not consider the potential risk from unexploded ordnance at the site.

A Preliminary (Pre-Desk Study) UXO Desk Study assessment of risk has been completed by a specialist Ordnance consultant in accordance with CIRIA guidelines (Stone et al, 2009) and is presented in Appendix F (Zetica, 2022).

The assessment concludes that '*a detailed desk study, whilst always prudent, is not considered essential in this instance*'.

2.11 Radon Hazard

Radon is a colourless, odourless, radioactive gas, which can pose a risk to human health. It originates in the bedrock beneath the site, where uranium and radium rich minerals are naturally present, and can move through fractures in the bedrock, and overlying superficial deposits, to collect in spaces within/beneath structures.

Given the currently available information, the risk from radon is considered low and no protective measures will be required for the proposed development.

3 Preliminary Geo-Environmental Risk Assessment

3.1 Phase One Conceptual Site Model

3.1.1 Background

The Phase One Conceptual Site Model lists the potential sources of geo-environmental risk (both contamination and hazardous gas), the receptors at risk (both human and non-human), and any feasible pathways between the two. These are discussed in the following sections. It should be noted that the proposed development comprises the re-use of the existing building as a training centre and will not significantly alter the existing conceptual model at the site.

3.1.2 Potential Soil Contamination Sources

The site history has indicated that it has been developed in the past, with a former railway line, small structure and track known to have been present at the site. These are noted to be potentially contaminative uses. From the available information, we consider that the following features on site could prove sources of diffuse and point source contamination that could impact on the development, environment, or site users:

- Made Ground – general diffuse contamination.
- Former railway line – general diffuse contamination.
- Current use by the Fire Service – the purpose of use is not currently understood and so potential for point source contaminants.

3.1.3 Potential Contaminants Present

The potential contaminants associated with the above potential sources have been identified from various guidelines published by DEFRA, the Environment Agency, and others. Based on this guidance and our experience, we consider that the following contaminants could be present on the site:

- heavy metals and semi-metals (arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium, zinc).
- cyanide, sulphate, sulphide.
- polyaromatic hydrocarbon (PAH) compounds.
- Total Petroleum Hydrocarbons (TPH).
- Phenols.
- asbestos.
- PFOS.

No evidence has been identified from the desk study to suggest that radioactive substances may be present on the site. The potential presence of radon is discussed in Section 2.11.

3.1.4 Potential Sources of Hazardous Ground Gas

This section considers the potential sources of hazardous gases such as methane, carbon dioxide and hydrocarbon vapours. The potential for radon was discussed in Section 2.11.

Based on the available desk study information, the following potential sources of hazardous ground gas have been identified on, or in close vicinity of, the site:

- Alluvial soils and possible organic materials/peat – on site source.
- General Made Ground – on site source.
- Unspecified tank is recorded approximately 78m west – off site source.
- 1no. historical waste site recorded 15m west – off site source.

As detailed in Section 2.9.3, 2no. above ground oil tanks are located within the wider training facility site. As these are above ground and bunded, they are unlikely to be a potential source of hazardous ground gas.

Based on the guidelines presented by O’Riordan and Milloy (1995) and revised by Wilson et al (2009), the above potential gas sources would generally be classified as of low/moderate gas generation potential.

3.1.5 Potential Receptors

We consider that the most vulnerable receptors with regards to any contamination or hazardous ground gas present are likely to be as follows.

- Future employees and site visitors, the critical receptors being employees outside during their break periods.
- Construction and maintenance workers.
- Buried concrete (foundations, drainage etc.).
- The water quality in the river Neath located 140m to the east.
- The groundwater within the Alluvium superficial strata and the Coal measures bedrock beneath the site (likely in hydraulic continuity with the river Neath to the east).

3.1.6 Potential Migration Pathways

Based on the Conceptual Site Model discussed in the previous sections, the following are considered the most likely migration pathways regarding any contamination or hazardous ground gas present beneath the site.

Site Users:

- Ingestion of soils and inhalation of dust in landscaping areas.
- Dermal contact with contaminated soils.
- Exposure to asbestos containing materials within the shallow soils.
- Potential explosive risk from flammable ground gas/vapours from on-site sources.
- Potential risk from toxic ground gas/vapours from on-site sources.
- Potential exposure to flammable or toxic ground gas/vapours originating from off-site sources – the near surface alluvial soils are likely to limit free migration of any gas/vapours present.
- Chronic (long term) exposure to unacceptable levels of radon (low risk identified in environmental report).

Construction and Maintenance Workers:

- Exposure to asbestos containing materials within the shallow soils.
- Ingestion of soils and inhalation of dust across site.
- Dermal contact with contaminated soils.
- Potential explosive risk from flammable or toxic ground gas/vapours from on-site sources.

- Potential explosive risk from flammable or toxic ground gas/vapours from off-site sources.

Groundwater:

- Leaching of mobile contaminants into the water-bearing strata within the bedrock.

River Neath:

- Leaching of mobile contaminants to the groundwater beneath the site, and then on to the nearby surface water course.
- Surface run-off of contaminated leachate to adjacent stream/river.

Buildings:

- Sulphate attack on buried concrete (foundations, drainage etc.).
- Potential explosive risk from flammable ground gas/vapours from on-site sources.
- Potential explosive risk from flammable ground gas/vapours from off-site sources.

Although much of the site is to be hard surfaced, any soakaways constructed for the development have the potential to leach contaminants from the infiltration strata, which could then impact on the groundwater beneath the site.

3.2 Preliminary Risk Evaluation & Plausible Pollutant Linkages

The land use history of the site and surrounding area, as established from the desk study and walkover, has identified several potential contamination linkages due to ground conditions or former operations either on, adjacent to, or in the vicinity of the site. Note that these potential linkages will need to be later assessed and re-established using actual site data obtained from an exploratory investigation.

3.2.1 Introduction to Risk Evaluation Methodology

The general methodology set out in CIRIA C552 *Contaminated Land Risk Assessment – A Guide to Good Practice* (Rudland et al, 2001), has been used to assess whether risks are acceptable, and to determine the need for collating further information or remedial action.

Whilst at a later stage, this methodology may be informed by quantitative data (such as laboratory test results) the assessment is a qualitative method of interpreting findings to date and evaluating risk.

The methodology requires the classification of:

- The magnitude of the potential consequence (severity) of risk occurring (Table A1 in Appendix A):
- The magnitude of the probability (likelihood) of risk occurring (Table A2 in Appendix A).

The classifications defined above are then compared to indicate the risk presented by each pollutant linkage, allowing evaluation of a risk category (Tables A3 and A4 in Appendix A). These tables have been revised slightly by ESP from those presented in CIRIA C552, to allow for the circumstances where no plausible linkage has been identified and, therefore, no risk would exist.

The methodology described above has been used to establish Plausible Pollutant Linkages (PPL) based on the Conceptual Site Model generated for the site and proposed development, and to evaluate the risks posed by those linkages, using information known about the site, at this desk study stage. This is presented as Table 3 in Section 3.2.2 below.

3.2.2 Tabulated Preliminary Risk Evaluation & Plausible Pollutant Linkages

Table3: Preliminary Risk Evaluation & Plausible Pollutant Linkages (PPL)

Source	Pathway	Receptor	Classification of Consequence	Classification of Probability	Risk Category	Further Investigation or Remedial Action to be Taken
Potential contaminants in shallow soils including those specific to current use – possible PFOS etc.	Direct contact/ inhalation/ ingestion of contaminated soil or dust	Site Users	Medium – potential for chronic levels.	Likely ²	Moderate Risk	Sampling of near-surface soils to confirm levels of total contamination present.
	Direct contact/ inhalation/ ingestion of contaminated soil or dust	Construction/ Maintenance Workers	Minor – standard PPE likely to be sufficient	Likely ²	Low Risk	
	Leaching of soil contaminants	Impact on Groundwater /Potable Water	Medium – site lies on Secondary Aquifer	Likely ²	Moderate Risk	
	Leaching of soil contaminants	Impact on River Neath	Medium – site lies 140m from river	Likely ²	Moderate Risk	
Asbestos in shallow soils	Inhalation of fibres	Construction/ Maintenance Workers	Medium – potential for chronic levels	Likely ³	Moderate Risk	Sampling of shallow soils for asbestos.
Soil sulphate and pyrite	Aggressive groundwater	Buried Concrete	Mild – damage to structures	Likely ⁴	Moderate/Low Risk	Sampling of soils to confirm levels of sulphate, pH, and groundwater.
Hazardous ground gas/vapours	Asphyxiation/poisoning. Injury due to explosion.	Site Users/Visitors.	Severe – acute risk.	Likely ⁵	High Risk	Install and monitor gas wells.
	Damage through explosion.	Building/Property	Severe – acute risk.		High Risk	
	Asphyxiation/poisoning. Injury due to explosion.	Construction and Maintenance Workers.	Severe – acute risk.		High Risk	
Radon gas	Migration into Buildings	Site Users	Medium – potential for chronic levels	Unlikely ⁶	Low Risk	See Section Error! Reference source not found.

Notes:

1. Methodology and details of risk consequence, probability and category based on CIRIA C552 (2001) and presented in Section 3.2.1.
2. The presence of Made Ground or contamination has not yet been confirmed on site. The site is likely to be mainly covered with hardstanding, with limited landscaping areas, therefore the risk to the site end user will be low. A risk to construction workers during development remains.
3. The presence of asbestos within the shallow soils must be confirmed; however, given that site is likely to be mainly covered with hardstanding, with limited landscaping areas, therefore the risk to the site end user will be low/moderate, pending further testing.
4. The alluvial soils underlying the site are not anticipated to contain significantly elevated levels of sulphate. Depending on its origin, any Made Ground present beneath the site may also contain elevated levels of pyrite.
5. Several on and off-site potential sources of ground gas have been identified. To determine the risk to the development, gas wells should be installed during the investigation works, followed by a period of monitoring to determine the risk to the site end user/development.
6. Radon risk identified in data report. See Section 2.11.

4 Recommendations

We consider that the following further investigation and assessment would be required or prudent prior to development:

Required Further Actions:

- Tree survey to identify species and to zone the site in terms of shallow foundation depth.
- Ground investigation to determine the nature of the shallow soils beneath the site and allow collection of samples for laboratory testing, assessment and reporting, including determination of appropriate foundation options.
- Sampling and analysis for contaminants within shallow soils in areas of proposed development.
- The installation and monitoring of gas wells, followed by gas monitoring regime.
- We understand that the development will comprise the construction of a building within a building, however, should any external works subsequently be proposed, the investigation would need to be extended to these areas.

Recommended Further Actions:

- If soakaways are required for the development, soakaway testing should be included within the ground investigation scope of works.
- If soakaways are required, Enquiries to NRW should be made to confirm acceptance of soakaways and any risk mitigation measures required.

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