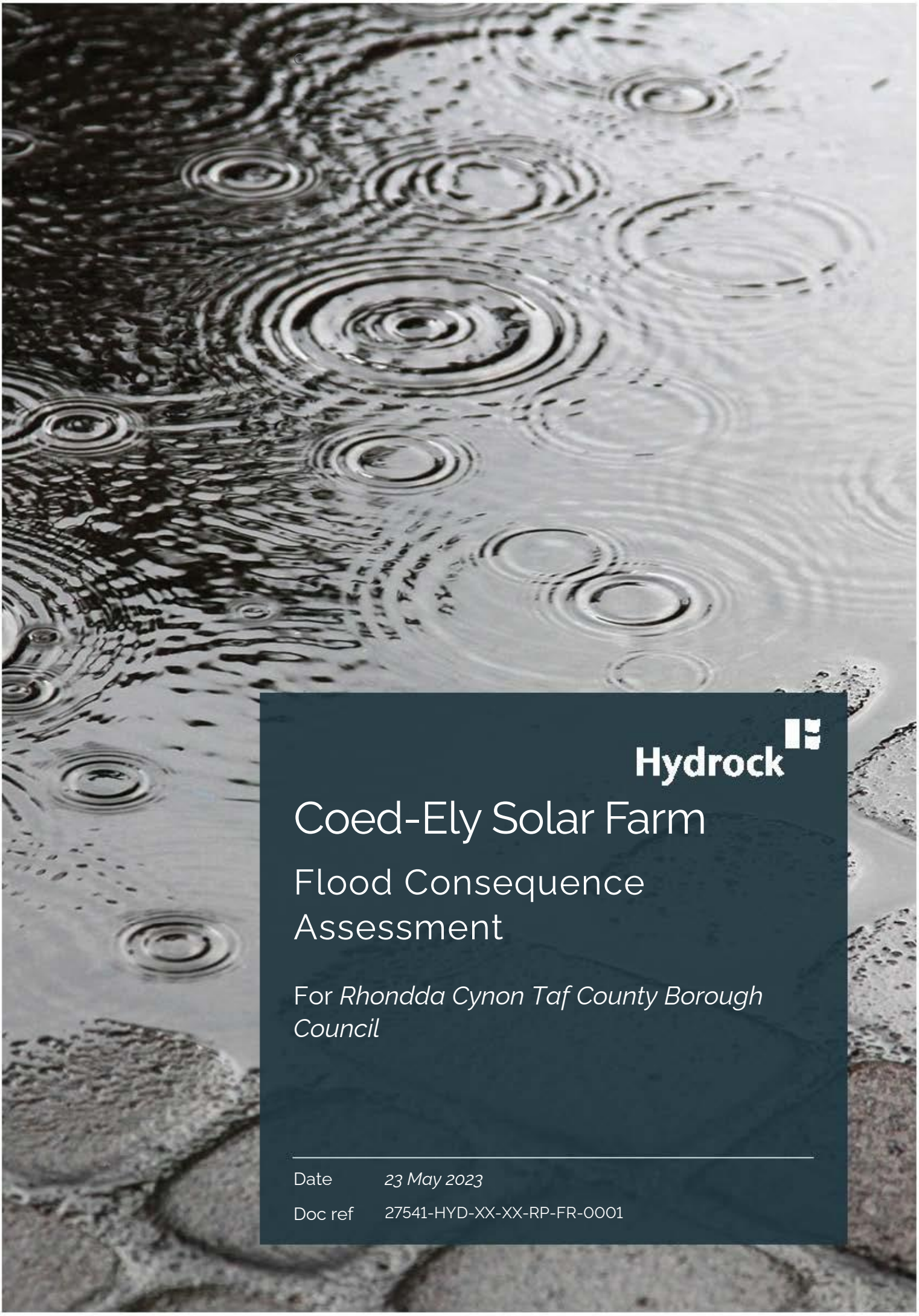

Hydrock

Coed-Ely Solar Farm

Flood Consequence Assessment

For *Rhondda Cynon Taf County Borough Council*

Date	*23 May 2023*
Doc ref	27541-HYD-XX-XX-RP-FR-0001

Document control sheet

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Issue number	P01	Name
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Appendices

1. Introduction

This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of our client Rhondda Cynon Taf County Borough Council in support of the installation of a solar farm at Coed Ely, near Tonyrefail.

This Flood Consequence Assessment (FCA) report has been prepared to address the requirements of Technical Advice Note 15: Development and Flood Risk (TAN15), through:

- Assessing whether the site is likely to be affected by flooding.
- Assessing whether the proposed development is justifiable in the proposed location.
- Presenting any flood risk mitigation measures necessary to ensure that the proposed development and occupants will be safe, whilst ensuring flood risk is not increased elsewhere.

2. Site Information

2.1 Site Location

The site is located approximately 400m southwest of the village of Coed Ely, near Tonyrefail, in the County Borough of Rhondda Cynon Taf. The site is an irregular parcel of open grassed land approximately 33 hectares in size, located on a 'terraced' former colliery spoil tip. A network of drainage ditches is shown to be present on the site.

The site is bound to the north and south by open grassland. A wind farm is present to the west of the site. To the east is an area of woodland, beyond which is an area of currently undeveloped land.

The approximate site address and Ordnance Survey Grid Reference is in Table 1, with the site location shown in Figure 1.

Table 1: Site Referencing Information

Site Referencing Information	
Site Address	Near Coedely, Tonyrefail Porth CF39 8EX
Grid Reference	ST 00728 85963 300728E 185963N

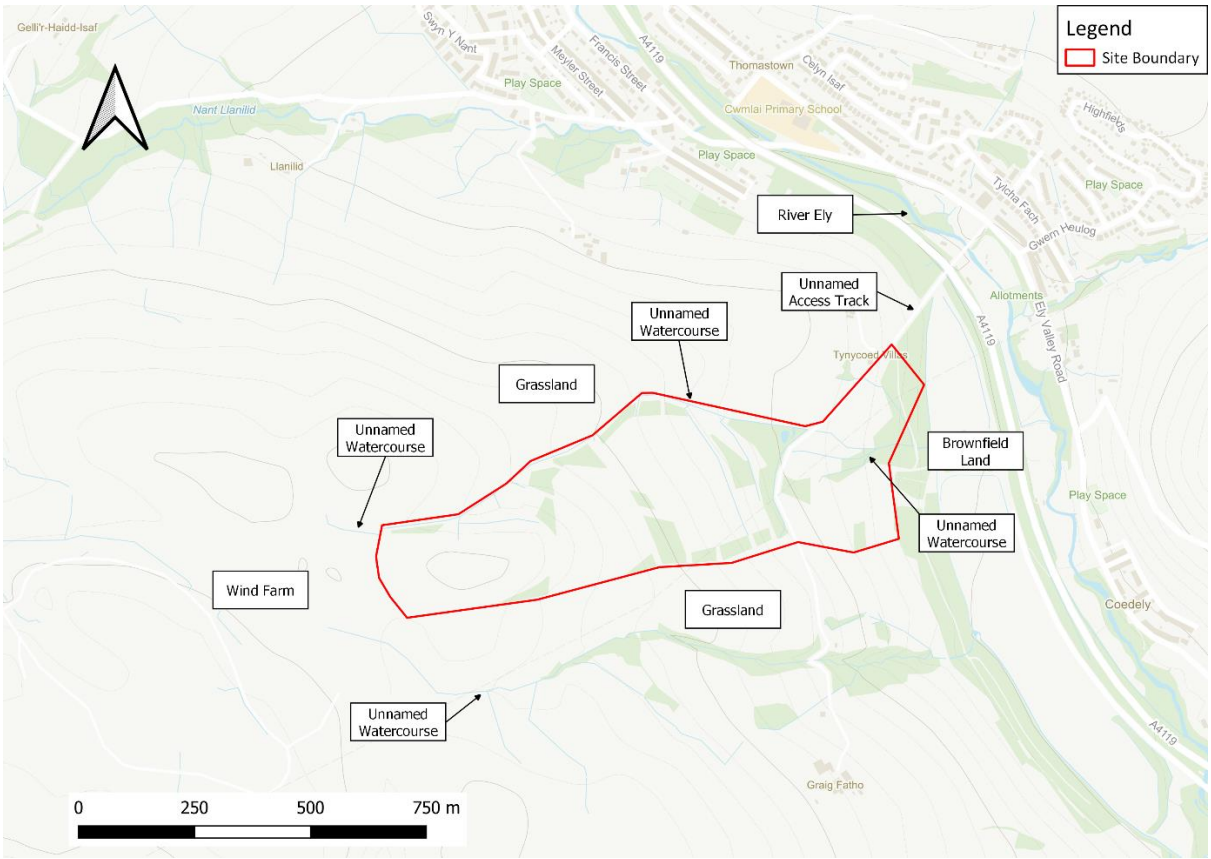


Figure 1 Site Location Plan

2.2 Topography

The site's topography is dominated by stepped terraces formed by remedial earthworks to the area in the past.

At the time of writing, a topographic survey has been undertaken on site to the west of the access track (see Appendix A). The survey does not cover the entire site and as such, Natural Resources Wales (NRW) 2m DTM data has been used in conjunction with the surveyed data (Figure 2)

The elevation of the site falls from c.250mAOD at the western boundary to c.110mAOD at the eastern boundary.

A leachate containment cell is present adjacent to the northern boundary on the west of the site.

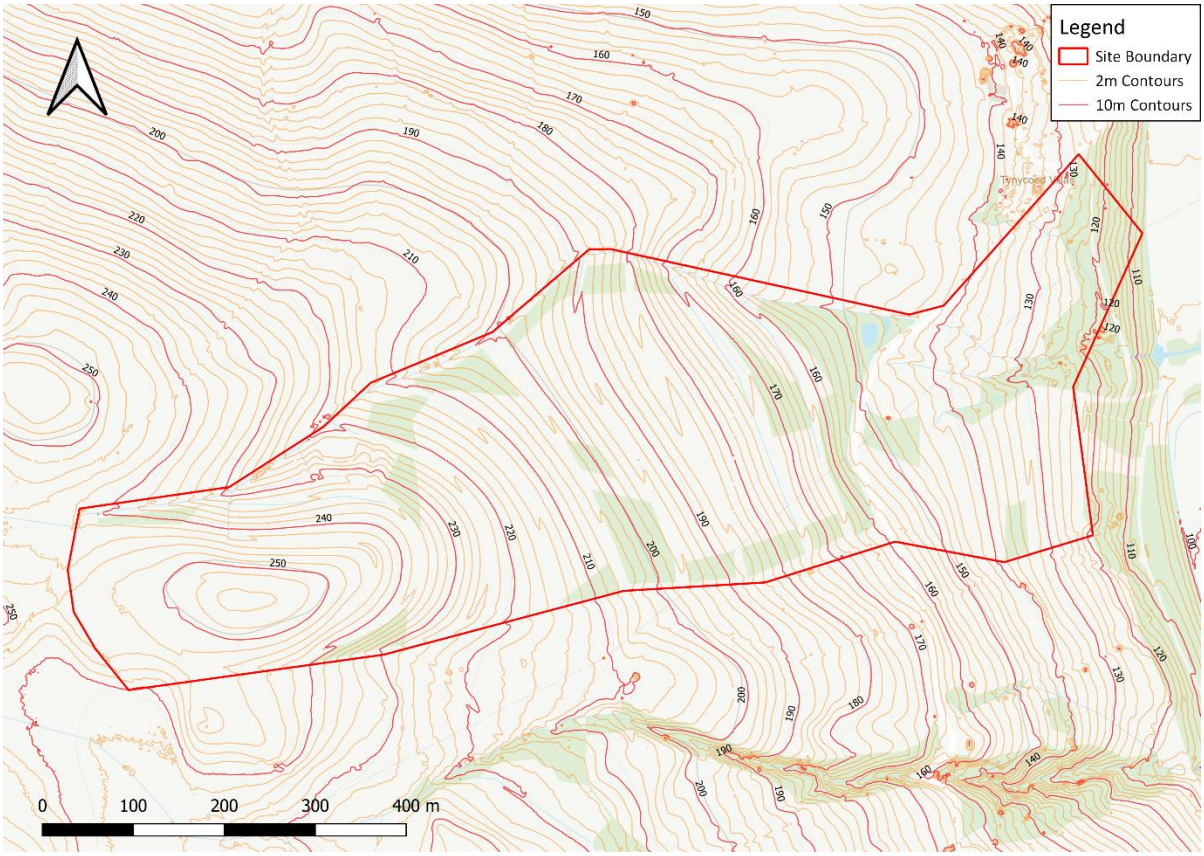


Figure 2 Site Topography (NRW LiDAR)

2.3 Geology

A review of the British Geological Survey (BGS) mapping shows the site to be predominantly underlain with superficial deposits of Till, comprising Diamicton (a mixed deposit ranging from clay to boulder sized materials) (Figure 3). No Superficial deposits are present on the western extent of the site.

The geological mapping indicates the solid geology beneath the entire site to be the Brithdir Member from the Upper Coal Measures (formerly the Lower Pennant Measures) (Figure 4). These are predominantly Sandstones, with subordinate Mudstones and Siltstones with productive coal seams.

The Geotechnical / Geo-environmental Preliminary Risk Assessment (PRA) (Quantum Geotech, 2021) reports that two coal seams are mapped outcropping to the south and north of the site; the Brithdir and Brithdir Rider seams respectively, implying that the Brithdir seam will underlie the site.

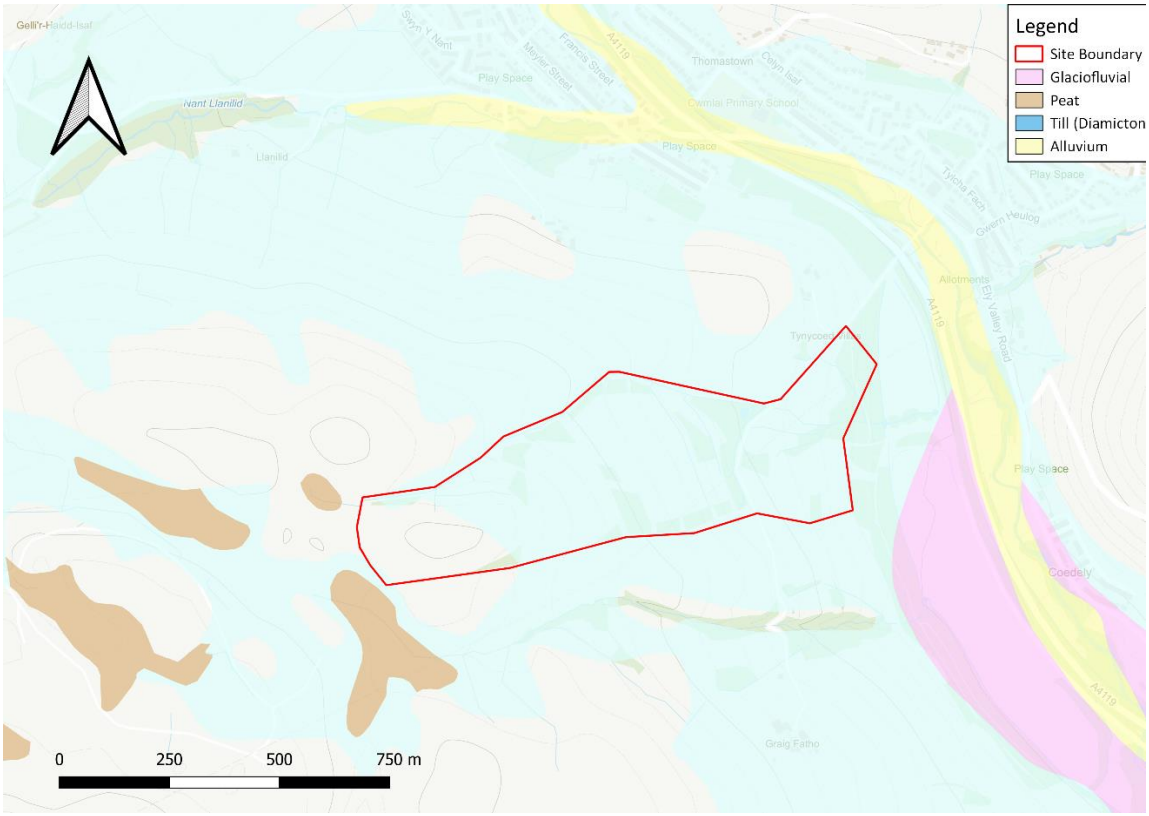


Figure 3 BGS Superficial Deposits

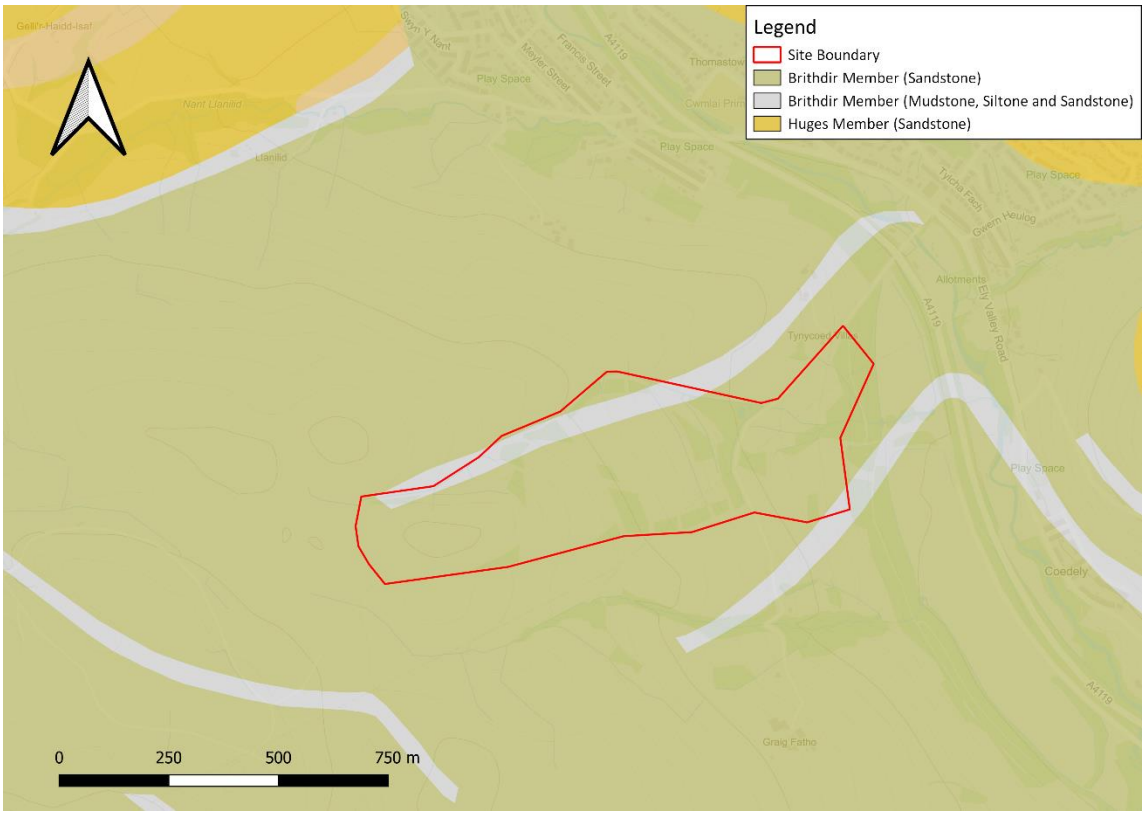


Figure 4 BGS Solid Geology

The site has been identified to have formerly had spoil heaps, refuse tip and railway/tramway sidings within the boundary (Quantum Geotech, 2021). As such, artificial or 'Made Ground' may overlie natural deposits on the site. However, major remediation and reprofiling have been undertaken on site which may have removed Made Ground associated with the site's historical uses.

No borehole records were available for review at the time of writing.

2.4 Current Site Use

The site is currently undeveloped. An unnamed access track crosses the east of the site in a north-south orientation. The track provides access from Heol Isaf to the farm to the south of the site.

A 25,000L lite leachate containment cell is located on the west of the site adjacent to the northern boundary of the site. The containment cell holds leachate abstracted from a waste encapsulation cell on the west of the site. The leachate appears to be shown to discharge into a line watercourse on the northern boundary (see Figure 5)

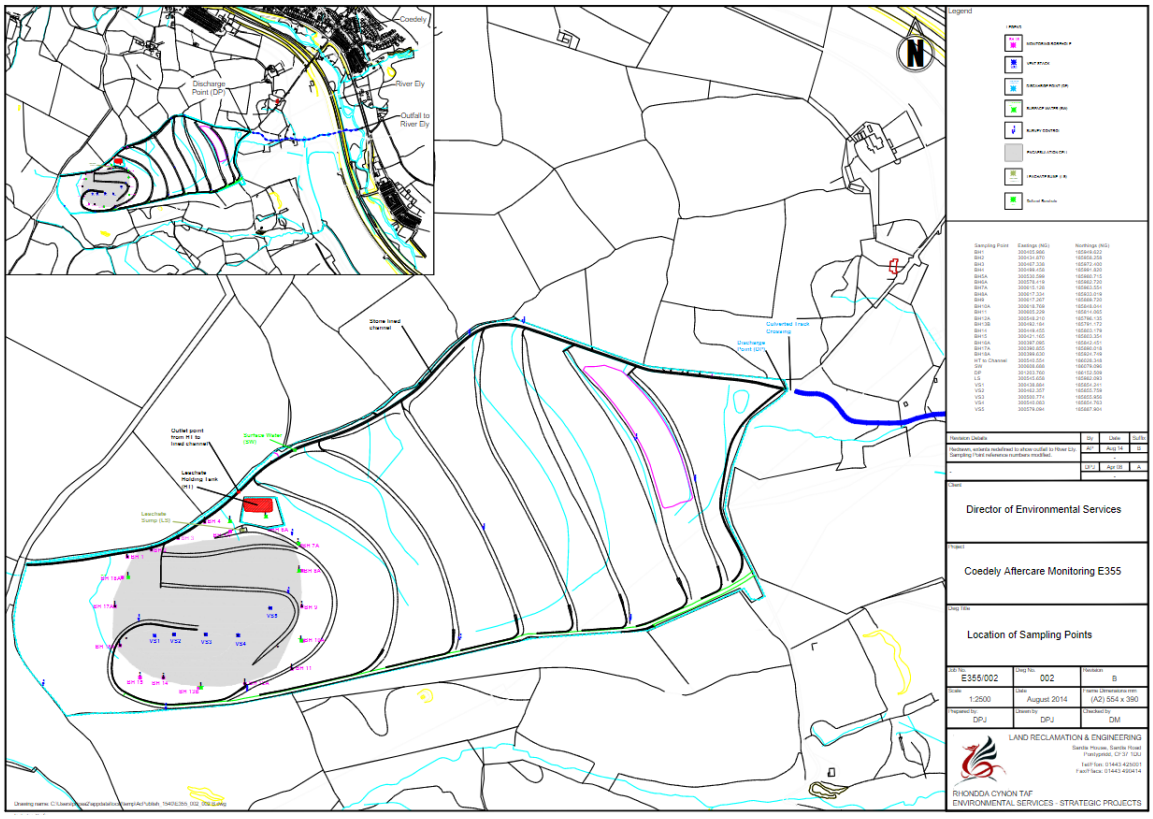


Figure 5: Plan Showing Waste Cell and Leachate Containment Cell (Drawing provided by client)

2.5 Proposed Development

The proposals are for the installation of a solar farm with a total ground mounted solar capacity of 7MW. A new access road is proposed that provides access from the east. The proposed site layout is shown in Appendix B.

The proposed development will avoid the area of the containment cell and encapsulated waste cell.

3. Sources of Flood Risk

3.1 Fluvial and Tidal Flooding

The site topographic survey completed on the west of the site confirms there to be a network of drainage ditches present on the site. The drainage ditches are shown to predominately extend across the site in a south to north orientation (see Figure 5 and 7). It is likely that these ditches are associated with the reprofiling of the colliery spoil tip.

Publicly available mapping indicates there is an unnamed watercourse that runs adjacent to the northern boundary of the site. Plans indicate that the watercourse is stone lined. It is considered likely that the south-to-north ditches drain into the watercourse before flowing to the east. Further watercourses are located within the eastern extent of the site, with flow anticipated to follow the topography to the east where they meet an unnamed watercourse adjacent to the eastern site boundary. The drainage network will eventually drain into the River Ely.

Another network of channels is located, at the closest, 90m south of site. The River Ely is located approximately 200m east of the site (Figure 1).

NRW Mapping shows the site to be at 'very low' risk of flooding from main rivers (Figure 6) and sea. The closest area of increased risk is an area of High Flood Risk from Rivers located approximately 180m east of the site, this is associated with the River Ely.

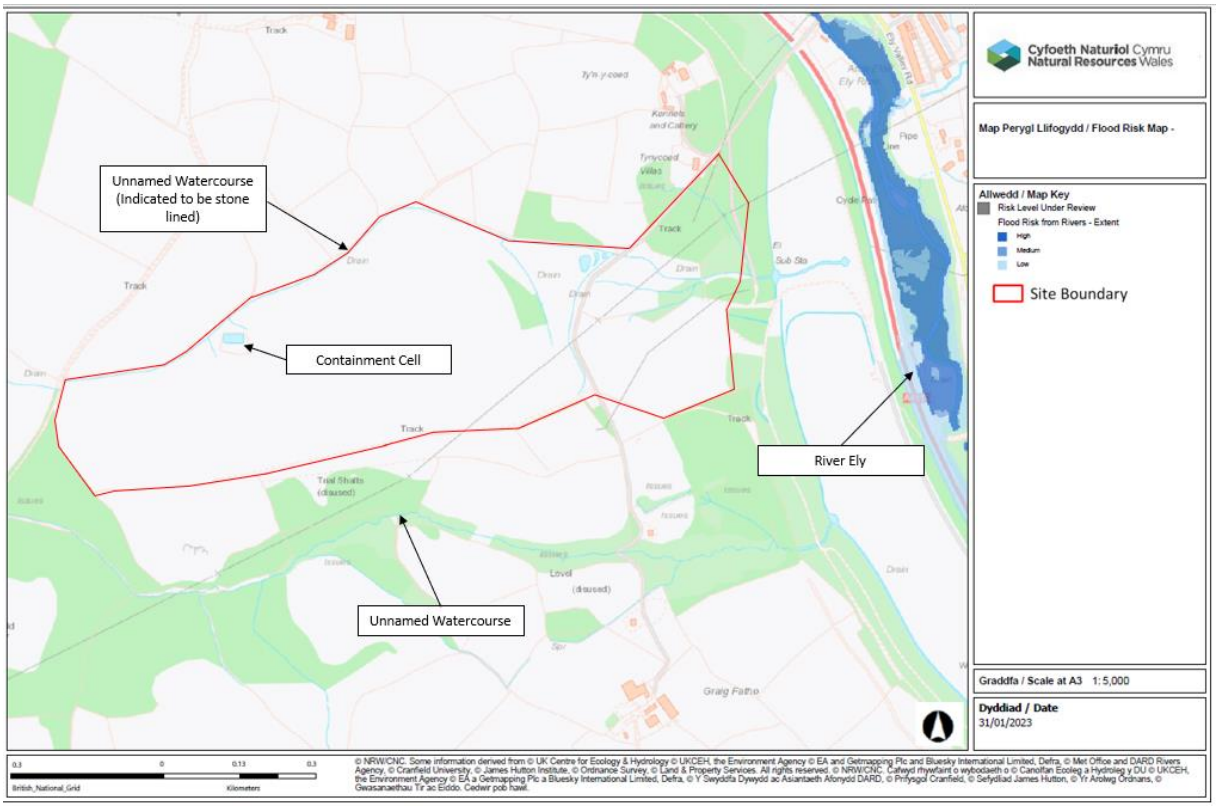


Figure 6 NRW Flood Risk from Main Rivers

It must be noted that the watercourses on the site and those to the east have not been modelled within the NRW Risk from Main Rivers. As such, the Flood Risk from Surface Water & Small Watercourses Mapping (Figure 5) is considered to be a good indication of the worst-case (i.e., 0.1% AEP (1,000-year) fluvial event) outlines for flood risk associated with the unnamed watercourses as the flows in the watercourses will be largely the result of local surface water flows. Flood Risk from Surface Water & Small Watercourses is discussed in Section 3.2.

NRW Surface Water & Small Watercourses mapping (Figure 4) confirms the majority of the site sits outside the maximum flood extents from the ditches, and therefore at 'very low' risk of flooding. Extents of increased risk are limited to areas in the immediate vicinity of the ditches. The solar panel tables will be designed to avoid the areas at risk of flooding, as detailed in Section 3.2.

Furthermore, the NRW Development Advice Mapping shows the site to lie within Zone A, meaning the site is considered to be 'at little or no risk of fluvial or coastal/tidal flooding'.

NRW also shows that there have been no previous incidents of flooding affecting the site.

Whilst the potential effects of climate change could increase frequency, depth and extent of fluvial flooding, given the small catchment size of the watercourses in proximity to the site, any increase in flood risk is considered unlikely to be of a magnitude so as to result in on-site fluvial flooding. The site can therefore be concluded to be at 'low' risk of fluvial and tidal flooding.

3.2 Surface Water Flooding

Surface water flooding occurs as the result of an inability of intense rainfall to infiltrate the ground. This often happens when the maximum soil infiltration rate or storage capacity is reached. Flows generated by such events either enter existing land drainage features or follow the general topography which can concentrate flows and lead to localised ponding/flooding.

NWR Surface Water Flood Mapping (Figure 7) shows the majority of the site to be at 'Very Low' risk of surface water flooding. There are some areas of increased risk confined to areas in close proximity to the drainage ditches located on the site. The areas of increased risk, which range from 'Low' to 'High' risk, are likely an indication of fluvial flows and have been discussed in Section 3.1.

The risk of surface water flooding is concluded to be 'low' across the majority of the site. The surface water flow paths associated with the existing drainage ditch network should be respected. The current site masterplan shows solar panels to cross the ditches in places however, the panel design is to be bespoke, with differing pile widths, as part of a watercourse mitigation strategy. As such, the solar panels will not obstruct the watercourse and therefore, will not impede surface water flows,

Whilst the potential effects of climate change could increase the frequency, depth and extent of on-site surface water flooding, given the steep topography of the site, any increase in flood risk is not considered to be of a magnitude which would result in a significant increase in the risk of on-site surface water flooding as any surface water run-off will likely continue to be directed towards the existing network of watercourses and flow with the prevailing topography towards the River Ely.

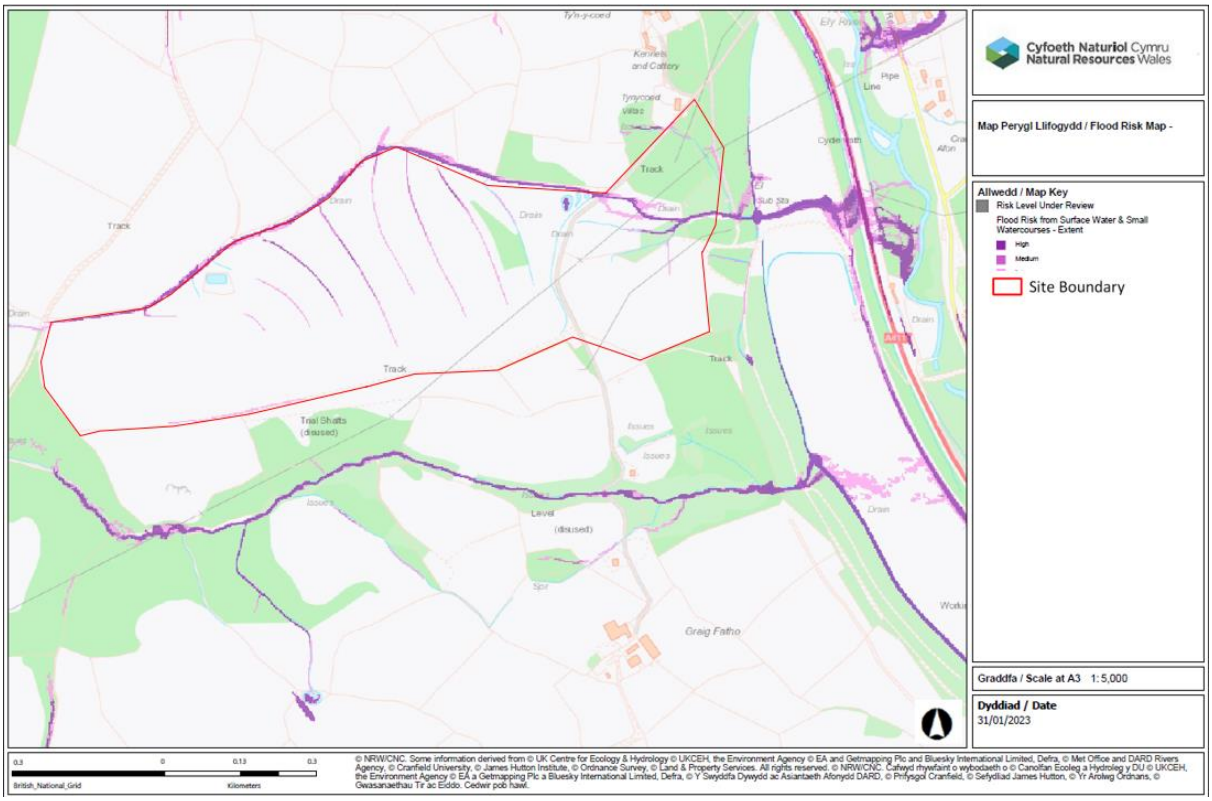


Figure 7: NRW Surface Water and Small Watercourses Mapping

3.3 Groundwater Flooding

Superficial deposits underlying the site are a designated 'Secondary Undifferentiated' Aquifer (*aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type*).

Bedrock deposits are identified to be a as a 'Secondary A' aquifer (*aquifer described as exhibiting permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flows to rivers*).

Soilscapes shows the site to underlain with *'Slowly permeable seasonally wet acid loamy and clayey soils'.* As such, groundwater levels are unlikely to be responsive to rainfall. The soils underlying the site may also act as an aquitard to emerging groundwater.

The PRA reported that historical OS maps for the west of the site identified the presence of a spring. The spring was recorded on mapping dating from 1987-92 in the central western part of the site, indicating the potential for groundwater emergence. However, major remediation and reprofiling have been undertaken on site since the turn of the century and as such it is uncertain if the spring is still present.

The area around the site is shown in the Local Flood Risk Management Strategy (RCT C.B.C, 2013) to be located in area less than 25% susceptible of groundwater flooding. The Preliminary Flood Risk Assessment (PFRA) (RCT C.B.C, 2011) goes on to state ' *that there is little documented evidence of groundwater flooding in the catchment* (Taff and Ely CFMP) *and therefore the risk of flooding from this source is considered small at the catchment scale in comparison to other sources'*,

The site is concluded to be at 'low' risk of flooding from groundwater sources.

As the determination of groundwater flood risk is driven by geological factors which will be unaffected by the potential effects of climate change, the risk of groundwater flooding posed to the site is considered unlikely to increase as a result of climate change.

3.4 Infrastructure Failure Flooding

The undeveloped nature of the site suggests that it is unlikely that there is a public drainage system serving the site. A drainage network is likely to be associated with the containment cell and/or reprofiled spoil tips.

Any surcharging of drainage networks will likely follow surface water flow routes and drainage ditches and be directed through the site, following the local topography and draining east. Given that the risk of flooding from drainage networks is only likely in the event of failure or blockage, this is considered a 'residual' risk.

NRW Flood Risk from Reservoirs mapping shows the site to lie outside of the extent of potential reservoir flooding. However, this mapping only shows the extents for large raised reservoirs. A small leachate containment cell is present in the west of the site (see Figure 5) and is to be retained as part of the proposed development. The containment cell is small (25m^3) when considering the size of site. In addition, the cell is maintained and managed under a permit and is therefore likely to be in good working condition. The risk of flooding from infrastructure failure is therefore considered to be 'negligible'.

4. TAN 15 Requirements

4.1 Justifying the Location of the Development

TAN 15 advises that new developments should be directed away from Zone C and towards suitable land in Zone A, otherwise to Zone B, where river or coastal flooding will be less of an issue.

The site is shown to lie within Zone A. As such no further justification is needed, in line with TAN 15 requirements.

4.2 Assessing Flood Consequences

For developments within Zone C, it is required that consequences of the development flooding must be addressed. This is not required in this instance as the proposed development lies within Zone A however, mitigation measures are outlined below in order to respond to any residual flood risk.

4.3 Mitigation Measures

4.3.1 Solar Panel Levels

Given the low risk of surface water flooding, identified to be limited to the channels within the site, it is recommended best practice for the proposed solar panels to be elevated above surrounding ground levels by a minimum of 0.5m where practicable to address any residual risk of surface water flooding.

4.3.2 Flood Warning and Evacuation

The site is proposed to be accessed via an access road entering the site from the east which is shown to be at low or negligible risk of flooding from all assessed sources. As such, the site is concluded to have safe access and egress.

4.3.3 Floodplain Storage

On the basis that the site lies outside of the functional floodplain, the proposed development is not considered to increase flood risk within the catchment through a loss of floodplain storage, and accordingly no further mitigation measures are required in this respect.

5. Surface Water Drainage

5.1 Pre-development

Currently, no positive surface water drainage system serves any of the parcels of land, and therefore rainfall will likely preferentially infiltrate to ground (albeit noting the low permeability of the geological conditions at the site, infiltration is expected to be limited). In the scenario that the infiltration capacity of the site is exceeded (i.e. as a result of prolonged and/or intense rainfall), any surface water run-off will likely be directed overland as shallow 'sheet flow' with the prevailing topographies to existing network of ditches. Flows will then likely be conveyed away from the site by the existing ditches to the River Ely.

5.2 Post Development

5.2.1 Proposed Solar Photovoltaic Panels

Whilst a portion of the site will comprise proposed solar photovoltaic panels, the remainder of the site area will comprise spacing between rows, field margins, and access track. The nature of solar photovoltaic panel arrays means that the area represented by the proposed panels is not considered impermeable, as the ground beneath all panels will remain permeable. Rainfall will drain freely off the panels onto the ground beneath the panels where the surface remains permeable, and therefore the total surface area of the proposed solar photovoltaic panel array is not considered to act as an impermeable area.

A study of the hydrological implications of solar farms (Cook, L.M. and McCuen, R.H. (2013) 'Hydrologic Response of Solar Farms', Journal of Hydrologic Engineering, 18: 536 - 541) confirmed that solar photovoltaic panels themselves will not have a significant effect on the surface water run-off rate, volume or time to peak from a site. The study did however identify that the nature of the underlying groundcover can have a demonstrable influence on the surface water run-off characteristics of a site, such that if the ground cover beneath panels is proposed as bare earth, peak discharges can increase significantly. It is therefore recommended that grass cover be established across the portion of the site in which solar photovoltaic panels are to be located. This practice was identified by the study as ensuring that such schemes will not increase the surface water run-off rate, volume or time to peak compared to the pre-development situation.

The proposed establishment of grassland at the site will not represent a change in land cover. The surface water run-off rate, volume and time to peak compared to the pre-development situation will be largely unaltered.

It is proposed to direct rainfall run-off from the solar photovoltaic panels to discharge directly onto the surrounding ground. Rainfall will continue to preferentially infiltrate to ground, or run-off overland once the infiltration capacity of the ground has been exceeded, and into the existing surrounding ditches/watercourse, as in the existing situation.

Whilst it is accepted that there will be a concentration of run-off from the bottom edge of the panels (albeit the likelihood of this is minimised as a result of the vertical and horizontal gaps between the panels, as shown at Figure 4), any rainwater unable to infiltrate at that point will flow across the ground between the downslope proposed panel rows and infiltrate there as in the existing 'natural' situation (i.e. approximately the same surface area will be available for infiltration compared to the pre-development situation).

Figure 8. Photovoltaic Panel Gaps

This arrangement will ensure that existing drainage patterns will not be altered, and therefore that flood risk is not increased off-site.

5.2.2 Proposed Access Tracking and Temporary Construction Compounds

To negate any concerns regarding soil compaction during construction and operation, which has the potential to increase surface water run-off, proposed access tracking and temporary construction compounds should be formed pre-construction using permeable materials (most likely gravel) so as to avoid creating impermeable areas across the site, and to limit ground compaction and hence surface water run-off intensification. Any rainwater falling onto the permeable areas will preferentially infiltrate to ground, or run-off overland once the infiltration capacity of the ground has been exceeded, and into the existing surrounding ditches/watercourse, as in the existing situation. Temporary compound and access areas should be reinstated as grass following completion where they are not required for regular maintenance access.

5.2.3 Summary

In summary, the proposed drainage strategy utilises the existing topography and existing drainage regime to ensure that any overland flows, although not increased compared to the existing situation, will be allowed to infiltrate to ground, or run-off overland once the infiltration capacity of the ground has been exceeded, and into the existing surrounding ditches/watercourse, as in the existing situation. Assuming that grass cover and gravel surfacing will be established across the site, this will therefore maintain or improve the existing hydrological regime, without resulting in any increased volume or intensity of run-off; alteration of catchment drainage patterns; or, unintentional creation of preferential flow paths.

On the basis of the above, a specific engineered drainage strategy is considered unnecessary to control the hydrological response of the site to rainfall. Given the recommendation is for the onsite drainage to utilise existing topography and the drainage regime and is not predicted to cause an adverse impact with regards to surface water management, it is concluded that the information provided above and within this document is sufficient in the requirements of a Water Management Statement.

6. Summary

This Flood Consequences Assessment (FCA) has been prepared by Hydrock on behalf of our client Rhondda Cynon Taf County Borough Council in support of the installation of a solar farm at Coed Ely, near Tonyrefail.

A detailed assessment of flood risk has identified that, based on current NRW flood mapping, the site is indicated to be in Zone A. The site is at low risk from all other assessed sources. A justification test is not required.

It is recommended that where possible, solar panels are raised a minimum of 0.5m above adjacent ground levels to address any residual risk of surface water flooding on the site.

The proposed drainage strategy utilises the existing topography and natural drainage regime to ensure that any overland flows, although not increased compared to the existing situation, will be allowed to infiltrate to ground, or run-off overland once the infiltration capacity of the ground has been exceeded, and into the existing surrounding ditches/watercourse, as in the existing situation. Assuming that grass cover and gravel surfacing will be established across the site, this will therefore maintain or improve the existing hydrological regime, without resulting in any increased volume or intensity of run-off; alteration of catchment drainage patterns; or, unintentional creation of preferential flow paths. The information provided within this FCA is deemed to also meet the requirements of a Water Management Statement and satisfy the need for a further report.

It has also been demonstrated that a means of safe access and egress is possible to and from the site via the eastern boundary and that the proposed development is also not considered to increase flood risk within the catchment through a loss of floodplain storage.

The report therefore demonstrates that, in respect to flood risk, the proposed development of the site:

- Is not likely to be affected by flooding.
- Is justified in the proposed location.
- Will allow the proposed development and occupants to be safe, whilst ensuring flood risk is not increased elsewhere.

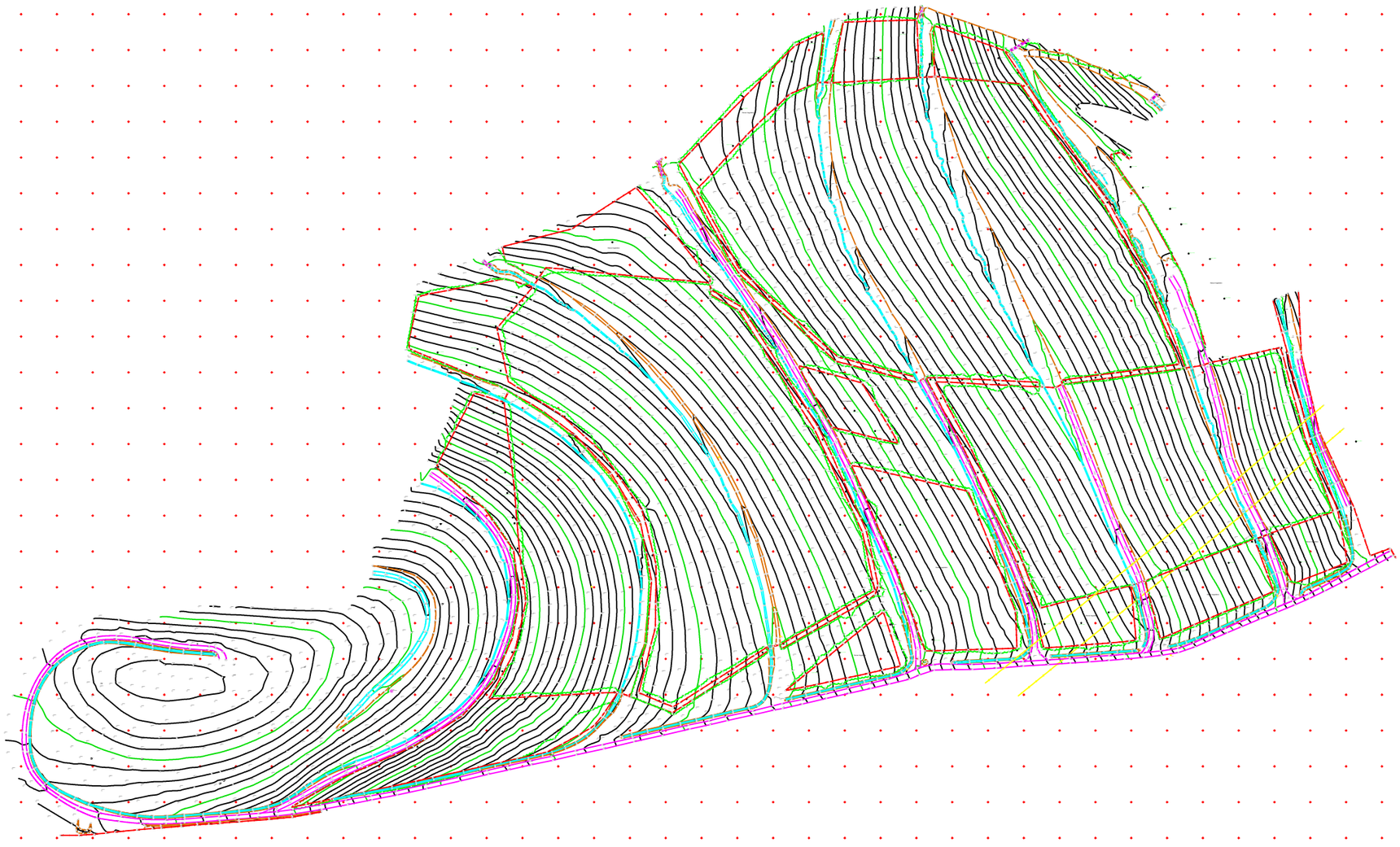
Based on the above, the application is concluded to meet the requirements of TAN 15.

7. References

Author	Date	Document
Rhondda Cyon Taf County Borough Council (RCT CBC)	October 2011	Preliminary Flood Risk Assessment https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/RelatedDocuments/PreliminaryFloodRiskAssessment.pdf
Rhondda Cyon Taf County Borough Council (RCT CBC)	January 2013	Local Flood Risk Management Strategy https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/LocalFloodRiskManagementStrategy.aspx
Quantum Geotech	November 2021	Phase 1: Preliminary Risk Assessment & Coal Mining Risk Assessment (Desk Study) (Report No. Q0533/PRA-CMRA)

Appendix A

Topographic Survey

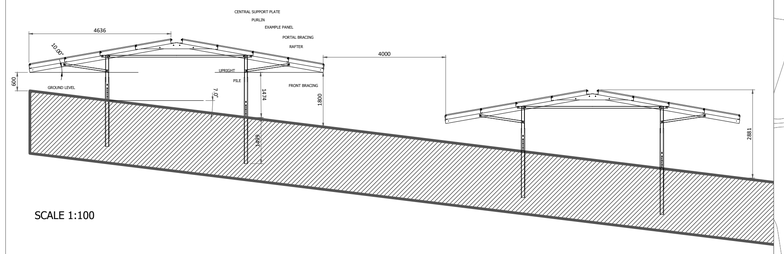


Appendix B

Proposed Site Layout

SECTION VIEW OF TABLES

NOTE:
1. ALL DIMENSIONS SHOWN ARE FOR PROPOSAL PURPOSES ONLY AND ARE IN MM.
2. SYSTEM IS SUBJECT TO DETAILED STRUCTURAL DESIGN.
3. PILE DEPTHS SUBJECT TO PULL-OUT TESTS



SCALE 1:100

KEY PLAN

- NEW ACCESS TRACK TO BE CONSTRUCTED
- CURRENT ROADS/ACCESS TRACK
- ORDINARY WATER COURSE (OWC)
- 8M BOUNDARY AROUND OWC
- SITE RED LINE BOUNDARY
- SOLAR FENCE
- GATE ACCESS TO SOLAR FARM
- DNO SUBSTATION
- GRID CONNECTED SCHEME SUBSTATION
- PRIVATE WIRE SCHEME SUBSTATION
- GRID CONNECTED SCHEME CUSTOMER SUBSTATION
- BESPOKE PV TABLES TO AVOID PILES INTERFERING WITH OWC

NOTES

- PV PANEL SPECIFICATIONS: 660Wp (1303MM X 2384MM)
- GRID CONNECTED SCHEME CAPACITY: 6.05MWp (9168PANELS X 660Wp)
- PRIVATE WIRE SCHEME CAPACITY: 1.20MWp (1824 PANELS X 660Wp)
- INVERTER MODULE SPECIFICATIONS: 4X250KW (PRIVATE WIRE), 14X350KW (GRID CONNECTED SCHEME)
- SITE CONNECTION CAPACITIES: 5.0MWac (GRID CONNECTED), 1.0MWac (PRIVATE WIRE)
- BACKGROUND IS FROM ORDINANCE SURVEY (OS) AND IS LICENSED, BY OS, UNDER THE PSGA MEMBER LICENSE TO USE LICENSED DATA FOR ITS LICENSED USE. THE LICENSOR IS THE PLANNING AUTHORITY, RHONDDA CYNON TAF.
- WATERCOURSE MITIGATION STRATEGY TBC BY NRW

REVISIONS

P04	ISSUED FOR INFORMATION					
	GT	27/04/23	BF	27/04/23	TS	27/04/23
P03	ISSUED FOR INFORMATION					
	GT	24/04/23	BF	24/04/23	TS	24/04/23
P02	ISSUED FOR INFORMATION					
	GT	20/04/23	BF	20/04/23	TS	20/04/23
P01	ISSUED FOR INFORMATION					
	GT	18/04/23	BF	18/04/23	TS	18/04/23
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT
Rhondda Cynon Taf County Borough Council

PROJECT
Coed-Ely Solar

TITLE
Solar Block Plan

HYDROCK PROJECT NO.	SCALE @ A1
27541	1:2500

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
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27/04/2023