Annex 1: Flood Consequence Assessment and Drainage Strategy

Glyn Taff Solar Farm

05/03/2025

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EXECUTIVE SUMMARY

4.1. This Flood Consequence Assessment (FCA) and Drainage Strategy (DS) has been carried out for the Proposed Development consisting of a proposed solar farm and associated infrastructure on lands at Bryntail Farm, Bryn Tail Lane, Pontypridd

4.2. Within the Development Advice Map (DAM) and Flood Map for Planning, it shows the Application Site to be wholly situated within Flood Zone A and Flood Zone 1. Therefore, in accordance with TAN15, the Application Site is situated in an area that has less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year. of fluvial or tidal/coastal flooding. Consequently, a justification test is not required for this Proposed Development, however a Drainage Strategy will still be required to ensure that the Proposed Development will not increase flood risk elsewhere.

4.3. In addition to fluvial and coastal flood risk, Natural Resources Wales (NRW) also provide surface water flood maps. This indicates areas across the Application Site, which appear to be restricted mainly to the field drains except for a small area of surface water flooding in Field 37 and 38.

4.4. Where the NRW map demonstrates areas of surface water risk, the topographical survey, as well as aerial maps, were studied to determine if there will indeed be surface water flooding within the Application Site. There is an area located within Field 33 and 35 that is at risk of surface water flooding which contains only solar panels. As the solar panels will be pile driven into the ground and raised to a height of at least 0.8m off the ground, it will not increase the flood risk elsewhere and will remain safely operational during time of a flood. Therefore, this would be appropriate and in line with the TAN 15 guidance.

4.5. This soil class has a Standard Percentage Runoff (SPR) of 0.37 which suggests that they provide excellent opportunity for infiltration. Prior to the detailed drainage design stage, which should be conditioned as part of any planning consent, infiltration testing will be undertaken in accordance with BRE 365. Should infiltration drainage not be appropriate, the drainage design will need be altered and discharge locations agreed with a revised limiting discharge rate appropriate to the drainage design. A limiting discharge rate of 2l/s would seem appropriate; however, this will be agreed with the council post consent when the detailed drainage design is being undertaken.

4.6. It is proposed to construct soakaway channels/ filter drains within the Application Site. The location of the channels has been chosen to intercept flows before they enter the existing drainage system surrounding the site.

4.7. The proposed soakaways will have an overall combined length of approximately 3,125m, with a base width of 0.5m, a 0.5m design depth and a 0.15m freeboard. They will be filled with crushed rock with a void ratio of 20%.

4.8. It will provide a total storage volume of approximately 156.25m^3. This is greater than the volume of additional runoff generated as a result of the impermeable buildings (60.0m^3). It is therefore considered that this adequately mitigates the increase in flow rates as a result of the minor increase in impermeable area and provides improvement.

4.9. By providing far more storage capacity than is required will improve the current flood concerns within the town of Rhydyfelin by ensuring the run-off rate has a net reduction thanks to the implementation of the drainage strategy.

4.10. Should infiltration drainage not be appropriate then the discharge point will be into the existing site field drainage close to each of the infiltration drains.

4.11. Additional drainage measures to be implemented on-site include the following:

- Solar Panels: current grass cover is to be retained or reinstated adjacent to and under panels in order to maximise bio-retention;
- Access Tracks: access tracks are to be unpaved and constructed from local stone. Temporary swales or similar shall be utilised to collect runoff from access tracks with discharge to ground through percolation areas. Where swales are utilised, frequent check dams formed from gravels and other excavated material should be undertaken; and
- Transformer Stations: the scale of these types of structures is unlikely to warrant a formalised drainage system. Runoff from this infrastructure and any associated hard standing should be directed to a percolation area for discharge to ground. Should surface water accumulate around any of these locations then a simple soakaway can be constructed to allow water soak into the underlying subsoils.

4.12. The FCA and DS has therefore demonstrated that the Proposed Development will not increase flood risk away from the Application Site during the construction, operation and decommissioning phases. The Proposed Development is therefore considered to be acceptable in planning policy terms.

INTRODUCTION

Background

4.13. Neo Environmental Ltd have been appointed by Renantis UK Limited (the "Applicant") to complete a Flood Consequence Assessment and Drainage Strategy ("FCA" & "DS") on lands at Bryntail Farm, Bryn Tail Lane, Pontypridd (the "Application Site"). Please see **Figure 1** for the layout of the Proposed Development.

Development Description

4.14. Installation, operation and subsequent decommissioning of a renewable energy scheme comprising ground mounted photovoltaic solar arrays together with substation compound, transformer stations, internal access track, landscaping, biodiversity measures, boundary fencing, security measures, CCTV posts, monitoring house, storage containers access improvement and ancillary infrastructure. The solar arrays will have a combined capacity of up to 39.9MWp.

Site Description

4.15. The area of the Proposed Development (the "Application Site") lies at an elevation of approximately 140m – 330m AOD and covers a total area of c. 70.9 hectares. It is centred around Bryntail Farm at approximate National Grid Reference (NGR) E 309333, N 189800. It is south of Eglwysilan Road. The site extends wet of Bryn Tail Farm and east of the Bryn Tail Lane. The site is within the administrative area of Rhondda Cynon Taf Council.

4.16. The site comprises 38 agricultural fields that are currently in use for livestock farming. It is on the east side of the Taff Valley c. 1.6 km east of Ynysangharad War Memorial Park. Access will be gained from the Bryn Tail Lane.

4.17. The site is adjacent to the Twyn Hywel Energy Park a consented wind farm including 14 turbines (DNS/3272053).

Scope of Report

4.18. The aim of this assessment is to identify the baseline geological and hydrological conditions of the site and surrounding area; to assess the potential impacts of the Proposed Development during the construction, operation and decommissioning phases; to identify the risk of flooding at the proposed Application Site; and to recommend mitigation measures where appropriate.

4.19. This report is supported by the following figures and appendices:

- Appendix 4A Figures:
  - Figure 4.1: Watercourses Map;
  - Figure 4.2: Topographical Survey
  - Figure 4.3: Development Advice Map
  - Figure 4.4: Flood Risk Map
  - Figure 4.5: Outline SuDS Design
- Appendix 4B: Flow Output

Statement of Authority:

4.20. This FCA & DS has been produced by Michael McGhee and Tom Saddington of Neo Environmental. Having completed a civil engineering degree in 2012, Michael has worked on over 1GW of renewable development flood risk and drainage impact assessments across the UK and Ireland whilst working towards becoming a Chartered Engineer. Michael has over 10 years of environmental consultancy experience, mainly producing technical assessments for energy projects. Tom has an undergraduate degree in Bioengineering and graduated with an MSc in Environmental and Energy Engineering in January 2020. He has been working on various technical assessments including FRA and DS reports for numerous renewable developments in Ireland and the UK.

LEGISLATION

4.21. A review of relevant legislation has been conducted to ensure the Proposed Development complies with the following:

- EU Directive on the Assessment and Management of Flood Risks [2007/60/EC][1] implemented in Wales via the Flood and Water Management Act 2010[2] and the Flood Risk Regulations 2009[3];
- The Water Framework Directive [2000/60/EC][4] as implemented in Wales via the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[5];
- The Groundwater Directive (GWD) (2006/118/EC)[6] as implemented by the Groundwater (Water Framework Directive) (Wales) Direction 2016 and Environmental Permitting (England and Wales) Regulations 2016.
- Future Wales – the National Plan 2040[7]
- Planning Policy Wales 12th Edition (PPW), 2024[8]

[1] European Parliament (2007). Directive 2007/60/EC of the European Parliament and of the Council establishing a framework for the assessment and management of flood risks. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32007L0060

[2] UK Government (2010). Flood Water a Management Act 2010. Available at https://www.legislation.gov.uk/ukpga/2010/29/contents

[3] UK Government (2009). The Flood Risk Regulations 2009. Available at http://www.legislation.gov.uk/uksi/2009/3042/contents

[4] European Parliament (2000). Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy ("The Water Framework Directive"). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060.

[5] UK Government (2017). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Available at http://www.legislation.gov.uk/uksi/2017/407/contents/made

[6] European Parliament (2006). Directive 2006/118/EC of the European Parliament and of the Council establishing a framework for the protection of groundwater against pollution and deterioration ("The Water Framework Directive"). Available athttps://www.eea.europa.eu/policy-documents/groundwater-directive-gwd-2006-118-ec

[7] Ministry of Housing, Communities & Local Government, National Planning Policy Framework, Feb 2019. Available at https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf

[8] Wales Government, Planning Policy Wales 12th Edition, 2024, Available at https://www.gov.wales/planning-policy-wales

- Technical Advice Note 15: Development and Flood Risk (TAN15), 2004[9]
- Sustainable Drainage (SuDS) Statutory Guidance[10]

Future Wales – the National Plan 2040 (NP)

4.22. Future Wales – the National Plan 2040 (NP)[11] is the national development framework, setting the direction for development in Wales to 2040. It is a development plan with a strategy for addressing key national priorities through the planning system, including sustaining and developing a vibrant economy, achieving decarbonisation and climate-resilience, developing strong ecosystems and improving the health and well-being of our communities.

4.23. Policy 8 (Flooding) states that '*the Welsh Government will work with Flood Risk Management Authorities and developers to plan and invest in new and improved infrastructure, promoting nature-based solutions as a priority*'. It goes on to state that '*it must be ensured that projects do not have adverse impacts on international and national statutory designated sites for nature conservation and the features for which they have been designated*'.

4.24. This report takes into account this policy and will ensure the no adverse impacts on international and national statutory designated sites will occur.

Planning Policy Wales (PPW): Edition 12

4.25. Planning Policy Wales (PPW) Edition 12 was adopted by the Welsh Government in February 2024. This replaced the previously adopted PPW and sets out the land use planning policy for Wales. Chapter 6 of the PPW outlines the planning policy in relation to 'Distinctive and Natural Places'. With regards to water and flood risk, it states:

"The Welsh Government aims to secure the provision of water services whilst minimising adverse impacts on the environment, amenity, health and communities, in light of the consequences of climate change. Development which is poorly designed or badly located can exacerbate problems associated with resource depletion, exposure to surface water flooding and diffuse pollution. The planning system should:

- *protect and improve water resources by promoting and encouraging increased efficiency and demand management of water as part of new developments, particularly*

[9] Wales Government, Technical Advice Note 15: Development and Flood Risk, 2004 https://gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf

[10] Welsh Government, Sustainable Drainage (SuDS) Statutory Guidance, 2019, Available at https://www.monmouthshire.gov.uk/app/uploads/2020/01/Statutory-Guidance.pdf

[11] Ministry of Housing, Communities & Local Government, National Planning Policy Framework, Feb 2019. Available at https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf

in those areas where water resources may be under pressure or may not be available and where failure of water quality standards needs to be addressed;

- *ensure that the infrastructure networks, including nature-based solutions on which communities and businesses depend is adequate to accommodate proposed development, and takes into consideration the impacts of climate change, so as to minimise risk to human health and the environment and prevent pollution at source;*
- *ensure sustainable drainage systems are an integral part of design approaches for new development; and*
- *ensure the protection of the quantity and quality of surface and ground water supplies is taken into account as part of development proposals.*

4.26. Again, these policy measures have been taken into account in this report and are integral to the design of the Proposed Development.

Review of Local Plan Policy

Rhondda Cynon Taf Council Local Development Plan 2006 - 2021

4.27. The Rhondda Cynon Taf Council Local Development Plan 2006 - 2021 (the "LDP") is the adopted plan at present. With the following policies being relevant to this Flood Consequence Assessment and Drainage Scheme report:

Table 4-1: Local Plan Flood Management Policies/Objectives (key points summarised)

Planning Policy/Objective	Comment
Policy AW2 – Sustainable Locations *"In order to ensure that development proposals on non-allocated sites support the objectives of the plan, development proposals will only be supported in sustainable locations. Sustainable locations are defined as sites that:-* *…* *5. Do not permit highly vulnerable development and Emergency Services within Zone C2 floodplain. Within Zone C development will be permitted where it can be justified that: - a) It is necessary to assist the regeneration of a Principal Town or Key Settlement including the key employment objectives, or where development involves a large brownfield site.*	The Proposed Development is not located within any areas outlined as Zone C2 (Flood zone 2/3).

b) he potential consequences of a flooding event have been considered and found to be acceptable in accordance with national guidance and meet the definition of previously developed land."	
Policy AW8 – Protection and Enhancement of the Natural Environment *"Rhondda Cynon Taf's distinctive natural heritage will be preserved and enhanced by protecting it from inappropriate development. Development proposals will only be permitted where:* *…* *2. There would be no unacceptable impact upon features of importance to landscape or nature conservation, including ecological networks, the quality of natural resources such as air, water and soil, and the natural drainage of surface water."*	The natural drainage will be considered and will not be significantly impacted as a result of the Proposed Development. SuDS will also be implemented as part of the DS.
Policy AW10 – Environmental Protection and Public Health *"Development proposals will not be permitted where they would cause or result in a risk of unacceptable harm to health and / or local amenity because of:* *…* *8. Flooding;* *unless it can be demonstrated that measures can be taken to overcome any significant adverse risk to public health, the environment and / or impact upon local amenity."*	The flood risk will be assessed in the Flood Consequence Assessment.

4.28. This report also considers the following local assessments and plans:

- Preliminary Flood Risk Assessment (PFRA)[12]
- Strategic Flood Risk Assessment[13]

[12] Rhondda Cynon Taf County Borough Council (2011). Preliminary Flood Risk Assessment. Available at https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/RelatedDocuments/PreliminaryFloodRiskAssessment.pdf

[13] Rhondda Cynon Taf County Borough Council (2008), Strategic Flood Risk Assessment, Available at: https://www.rctcbc.gov.uk/EN/Resident/PlanningandBuildingControl/LocalDevelopmentPlans/LDPEvidenceBaseLibraryandAnnualMonitoringRe/RelateddocumentsEvidenceBase/EB59a.pdf

- Flood Risk Management Strategy[14]
- Flood Risk Management Plan[15]

[14] Rhondda Cynon Taf County Borough Council, Local Flood Risk Management Strategy (2013) Available at: https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/RelatedDocuments/localfloodriskmanagementstrategyv1.pdf

[15] Rhondda Cynon Taf County Borough Council, Flood Risk Management Plan (2015) Available at: https://www.rctcbc.gov.uk/EN/Resident/ParkingRoadsandTravel/Roadspavementsandpaths/FloodAlleviation/RelatedDocuments/FloodRiskManagementPlanFinal.pdf

METHODOLOGY

4.29. PPW 12th Edition was published in February 2024 and outlines the flood risk to developments under the "Development and Flood Risk" section. It states:

"Development Advice Maps enable planning authorities to take a strategic approach to flood risk and consider the catchment as a whole by providing a preliminary representation of flood risks, which inform decisions on the location of new development and the requirements necessary to support any applications which may be proposed. Together with flood consequences assessments they should assist understanding of how natural and man-made defences work as integral components of places and provide a means by which the cumulative effects of development can begin to be understood.

Development should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development site itself. The priority should be to protect the undeveloped or unobstructed floodplain from development and to prevent the cumulative effects of incremental development.

In areas of flood plain currently unobstructed, where water flows in times of flood, built development should be wholly exceptional and limited to essential transport and utilities infrastructure. Such infrastructure should be designed and constructed so as to remain operational even at times of flood, to result in no net loss of floodplain storage, to not impede water flows and to not increase flood risk elsewhere. TAN 15: Development and Flood Risk should be referred to for further policy advice on development and flood risk. It will be important to note that developments located within flood risk areas remain at risk from flooding even if mitigation measures are applied."

4.30. TAN15 is used in conjunction with PPW to set out the technical guidance which supplements the policy set out in PPW, with specific mention towards developments and flooding. The general approach of PPW, supported by the TAN, is to advise caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions.

4.31. Table 4–2 shows the flood zone classification in detail with each flood zone being outlined for what it can be used for in regard to developments.

Table 4-2: Flood Zone Classification

Flood Zone	Development Type	Advice	Acceptability Criteria
*Zone 1 Less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year.	All	No constraints relating to flooding from rivers or sea, other than to avoid increasing risk elsewhere.	No increase in flooding elsewhere.
TAN 15 Defended Zones Areas where flood risk management infrastructure provides a minimum standard of protection against flooding from rivers 1 in 100 (plus climate change and freeboard) or sea 1 in 200 (plus climate change and freeboard).	All	Plan allocations and applications for development can proceed subject to justification.	Acceptable consequences for type of use. Agreement for construction and maintenance costs secured. Occupiers aware of flood risk. Escape/evacuation routes present. Flood emergency plans and procedures. Flood resistant and resilient design. No increase in flooding elsewhere.
Rivers and Sea - Zone 2 (Less than 1 in 100 (1%) (River) or 1 in 200 (0.5%) (Sea) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change.)	All	Plan allocations and applications for development can proceed subject to justification.	Acceptable consequences for type of use. Agreement for construction and maintenance costs secured. Occupiers aware of flood risk. Escape/evacuation routes present. Flood emergency plans and procedures. Flood resistant and resilient design. No increase in flooding elsewhere.
Rivers and Sea – Zone 3	Highly Vulnerable Development	The flooding consequences associated with highly vulnerable development are not considered to be acceptable. Plan	

(Greater than 1 in 100 (1%) (River) or 1 in 200 (0.5%) (Sea) of flooding in a given year, including climate change.)		allocations must not be made for such development and planning applications not proposed. Flood Consequence Assessments (FCAs) should not be prepared as there is no requirement for Natural Resources Wales (NRW) to provide advice.	
	Less Vulnerable Development Water Compatible Development	Plan allocations or applications for less vulnerable development can only proceed subject to justification.	Acceptable consequences for type of use. Agreement for construction and maintenance costs secured. Occupiers aware of flood risk. Escape/evacuation routes present. Flood emergency plans and procedures. Flood resistant and resilient design. No increase in flooding elsewhere.
*Surface Water and Small Watercourses – Flood Zone 2 (Less than 1 in 100 (1%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change.) and Flood Zone 3 Greater than 1 in 100 (1%) chance of flooding in a given year, including climate change.)	All	Local policies to indicate areas where development would not be appropriate. Development to be set back form areas at risk.	Acceptable consequences for type of use. No increase in flooding elsewhere. Flood risk management and mitigation measures must not increase flooding elsewhere.

* - Justification Test not applicable

4.32. The Guidelines provide three development categories, which are detailed as follows:

- **Highly Vulnerable – Ability of occupants to decide if they wish to accept the risks associated with flooding or be able to manage the consequences of such a risk, is limited.**

- All Residential premises (including hotels, Gypsy and Traveller sites and Caravan Parks and caping sites);
- Schools and childcare establishments, colleges and universities;
- Hospitals and GP surgeries;
- Especially vulnerable industrial development (e.g. power generating and distribution elements of power stations, transformers, chemical plants, incinerators), and waste disposal sites;
- Emergency services, including; ambulance stations, fire stations, police stations, command centres, emergency depots); and
- Buildings used to provide emergency shelter in time of flood.

- **Less Vulnerable Development - Ability of occupants to decide if they wish to accept the risks associated with flooding is greater than those in the Highly Vulnerable.**
  - General Industrial, Employment, Commercial and Retail Development;
  - Transport and Utilities Infrastructure;
  - Car Parks;
  - Mineral Extraction Sites and associated Processing Facilities (excluding waste disposal sites);
  - Public buildings including libraries, community centres and leisure centres (excluding those identified as emergency shelters);
  - Places of wordship;
  - Cemeteries;
  - Equipped play areas; and
  - Renewable energy generation facilities (excluding hydro generation).

- **Water Compatible Development – Developments which are required to be in a fluvial, tidal or coastal location by virtue of their nature, and developments which are resilient to the effects of an occasional flood.**
  - Boatyards, marinas and essential works required at mooring basins;

- Development associated with canals;
- Flood defences and management infrastructure;
- Open spaces (excluding equipped play areas); and
- Hydro renewable energy generation.

4.33. As set out within TAN15 an FCA must consider:

- Flooding risk and consequences on the Proposed Development; and
- Impacts from the Proposed Development upon flood risk to the surrounding area.

4.34. An FCA will therefore assess the Proposed Development to determine if it is as risk of flooding and will also ensure that flooding is not increased elsewhere as a result of the Proposed Development.

BASELINE CONDITIONS

4.35. This section presents the information gathered on the existing topographical, geological, hydrological and hydrogeological conditions of the Application Site and its immediate surroundings.

4.36. A site walkover survey was also undertaken in order to identify hydrological, geological, flood risk and drainage features within the Application Site.

Topography

4.37. A topographical survey was undertaken at the Application Site (see Figure 4.2 Appendix 4A). The lowest point within the Application Site of 142.0m AOD is in the southern corner of Field 30. The high point at 328m AOD is located on the northeast boundary of Field 14. All fields slope down to the south and west across the Application Site.

Geology & Soil

4.38. The geological conditions of the Application Site were identified utilising the British Geological Society ("BGS") Spatial Resources online geological mapping[16] system. It is underlain by Birthdir Member – Mudstone, siltstone and sandstone and Hughes Member – Sandstone, siltstone and sandstone. Birthdir Member formed between 309.5 and 308 million years ago during the Carboniferous period. Hughes Member formed between 309.5 and 308 million years ago during the Carboniferous period. This is overlain by Till, Devensian – Diamicton in some areas of the Application Site. Till formed between 116 and 11.8 thousand years ago during the Quaternary period.

4.39. A borehole log located within 0.5km of the Application Site confirms that drift is located down to 4.5m with mudstone found until approximately 10m deep.

Soil

4.40. Different soil types have different capabilities of soaking up water, the efficiency of which is dependent upon the structure and infiltration capacity. The Soilscapes[17] map has been utilised to obtain soil data. It classes the soil at the site as '*Freely draining slightly acid loamy soils over rocks'* and *'Slowly permeable wet very acid upland soils with a peaty surface'.*

[16] BGS Geology of Britain Map., Available at http://mapapps.bgs.ac.uk/geologyofbritain/home.html

[17] Cranfield Soil and Agrifood Institute, Soilscapes website. Available at http://www.landis.org.uk/soilscapes/

4.41. According to the Wallingford Procedure 'Winter Rain Acceptance Potential' (WRAP) map[18], the soil classification for the site is Class 3. This soil class has a Standard Percentage Runoff (SPR) of 0.37 and will likely provide average infiltration opportunities. Prior to the detailed drainage design stage, which should be conditioned as part of any planning consent, infiltration testing will be undertaken in accordance with BRE 365. Should infiltration drainage not be appropriate, the drainage design will need be altered and discharge locations agreed with a revised limiting discharge rate appropriate to the drainage design. A limiting discharge rate of 2l/s would seem appropriate; however, this will be agreed with the Council post consent when the detailed drainage design is being undertaken.

Hydrology

4.42. The Application Site lies within the Severn River Basin District. Within this, the site lies in the River Taf catchment.

4.43. The River Taf runs a southeast direction and eventually discharges into the Mouth fo the River Severn approximately 18.7km southeast of the Application Site.

Local River Network

4.44. The Application Site itself has a number of small watercourse/field drains, some eventually lead into the River Taf through the local drainage network and other drains lead into the Nant Lonydd. The Nant Lonydd eventually converges with the River Taf approximately 2.1km southeast of the Application Site.

4.45. **Figure 4.1: Appendix 4A** shows the local watercourse network in relation to the Application Site.

Flood Zone Classification

4.46. Welsh Government produced a Development Advice Map (DAM)[19] and Flood Map for Planning, based off Natural Resource Wales' (NRW) extreme flood outlines and the British Geological Survey drift data). Within the DAM and Flood Map for Planning, it shows the Application Site (see **Figure 4.2 and 4.3: Appendix 4A**) to be wholly situated outside any areas at risk of fluvial or sea flooding and is located within Flood Zone 1.

[18] UK Sustainable Drainage and Guidance Tools. Greenfield Runoff Estimation for the Sites. Available at: http://www.uksuds.com/greenfieldrunoff_js.htm

[19] Natural Resources Wales, Development Advice Map, Available at https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=2

Historic Flooding

4.47. The NRW recorded flood extents[20] is a GIS layer showing the maximum extent of individual recorded flood outlines from rivers, sea or surface water. The map shows that no part of the Application Site has been subject to flooding historically, with the closest area of historic flooding occurring along the River Taf to the south.

4.48. A review of the Strategic Flood Risk Assessments covering the area has confirmed that there are no specific records of flooding within the Application Site.

4.49. It is noted that the Rhydyfelin Flood Alleviation Scheme was completed in May 2013 to help reduce the risk of flooding to people and properties within Rhydyfelin. Further works have been completed along Bryn Tail Lane, Masefield Way and Cemetery Road to help alleviate the flooding impact upon Rhydyfelin and Glyn Taff further. These flood alleviation schemes will be considered during the drainage design later in the report.

Hydrogeology

4.50. The Application Site is within the SE Valleys Carboniferous Coal Measures groundwater body defined in the Water Framework Directive which has an overall status of 'Poor'. The underground aquifer across the site is classed as a 'moderately productivity aquifer'.

4.51. The Application Site is not located within any Source Protection Zones, based on NRW mapping.

Groundwater Vulnerability

4.52. Groundwater Vulnerability refers to the intrinsic geological and hydrogeological characteristics that determine the ease at which groundwater may be contaminated by human activities. The more vulnerable the groundwater is, the more easily it can be contaminated by surface water.

4.53. According to the British Geological Survey (BGS) maps, the groundwater vulnerability across the Application Site is considered to be 'high'.

4.54. The sensitivity of this area from impacts of contamination will be high. During the operational stage of the Proposed Development, there will be a **negligible risk of contamination** due to the benign nature of a solar farm. Any risks will come from the construction stage and an outline Construction and Environmental Management Plan (OCEMP) has been submitted alongside this application in order to reduce any potential impact on the environment during

[20] Natural Resources Wales, Historic Flood Extents, Available at https://lle.gov.wales/catalogue/item/HistoricFl/?lang=en

the construction and decommissioning phases of the Proposed Development (see Annex 2: Volume 3).

FLOOD CONSEQUENCE ASSESSMENT

Fluvial and Coastal Flood Risk

4.55. Within the DAM and Flood Map for Planning (**Figure 4.3 and 4.4: Appendix 4A**), it shows the Application Site to be wholly situated within Flood Zone A and Flood Zone 1. Therefore, in accordance with TAN15, the Application Site is situated in an area that has less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year. of fluvial or tidal/coastal flooding. Consequently, a justification test is not required for this Proposed Development, however a Drainage Strategy will still be required to ensure that the Proposed Development will not increase flood risk elsewhere.

Pluvial Flood Risk

4.56. In addition to fluvial and coastal flood risk, NRW also provide surface water flood maps, see **Figure 4.4: Appendix 4A**. This indicates areas across the Application Site, which appear to be restricted mainly to the field drains except for a small area of surface water flooding in Field 37 and 38.

4.57. **Figure 4.2: Appendix 4A** shows the topographical survey of the Application Site. Where the NRW map demonstrates areas of surface water risk, the topographical survey, as well as aerial maps, were studied to determine if there will indeed be surface water flooding within the Application Site. There is an area located within Field 33 and 35 that is at risk of surface water flooding which contains only solar panels. As the solar panels will be pile driven into the ground and raised to a height of at least 0.8m off the ground, it will not increase the flood risk elsewhere and will remain safely operational during time of a flood. Therefore, this would be appropriate and in line with the TAN 15 guidance.

Groundwater Flood Risk

4.58. Groundwater flooding is a “hidden” risk that is often difficult to distinguish from other types of flooding. For example, rising groundwater often forms in low-lying areas which are also susceptible to the accumulation of surface water.

4.59. Local groundwater levels often respond to water levels within nearby watercourses. As there is no fluvial flood risk to the Application Site, groundwater flooding is unlikely to be a significant risk. The PFRA contains a figure showing the “Areas susceptible to Groundwater flooding”, which shows that the Application Site is located in an area identified as having less than 25% chance of groundwater flooding. The PFRA also states:

“There is no local information available which provides evidence on future groundwater flood risk across Rhondda Cynon Taf and groundwater rebound is not believed to be an issue in the County Borough.”

4.60. Based on the above, the risk of flooding from groundwater is likely to be low.

Site Access Point

4.61. The access points are off Bryn Tail Lane which splits the Application Site. No surface waters will be diverted onto the public road network from the site tracks.

DRAINAGE STRATEGY

Introduction

4.62. All developments in Wales which consist of more than one dwelling house, or where the construction area is 100 square metres or more, requires SuDS to manage surface waters. The SuDS must be designed and built in accordance with Statutory SuDS Standards[21] published by the Welsh Ministers and SuDS Schemes must be approved by the local authority acting in its SuDS Approving Body (SAB) role, before construction work begins.

4.63. The objective of this is to deliver effective, multi-purpose SuDS in new developments that will be maintained and remain effective for the lifetime of the developments they serve.

Methodology

Catchment Characteristics

4.64. Catchment characteristics were obtained from the Flood Studies Report[22] conducted by the Institute of Hydrology. Catchment sizes were measured using ArcGIS and catchment boundaries were produced based on the site-specific topographical survey.

Greenfield Runoff and Stormwater Storage

4.65. Greenfield runoff rates and stormwater storage requirements have been obtained using the following tools:

- HR Wallingford UK Sustainable Drainage Greenfield Runoff Estimation Tool (using IH124[23] methodology due to the small-scale nature of the catchment).
- Flow – Causeway Drainage design software (using IH124 methodology due to the small-scale nature of the catchment).

[21] Welsh Government, Sustainable Drainage (SuDS) Statutory Guidance, 2019, Available at https://gov.wales/sites/default/files/publications/2019-06/statutory-guidance.pdf

[22] Institute of Hydrology, Flood Studies Report (1975)

[23] Institute of Hydrology (1994). *Flood estimation for small catchments. Report No IH124*, Wallingford.

- The areas of permeable and impermeable surfaces have been estimated and are based upon the Proposed Development layout (**Figure 4 of Volume 2: Planning Application Drawings** for the layout of the Proposed Development).

Greenfield Runoff rates

4.66. The IH24 methodology is used for calculating the Greenfield runoff rates. This is recommended by the Institute of Hydrology for catchments below 200ha.

4.67. The IH124 equation estimates Qbar with the following equation:

$$Qbar - rural = 0.00108\ x\ (0.01\ x\ AREA)0.89\ x\ SAAR1.17\ x\ SPR2.17, m3/s$$

where:

- Qbar-rural is the mean annual flood flow from a rural catchment (approximately 2-3-year return period).
- AREA is the area of the catchment in ha.
- SAAR is the standard average annual rainfall for the period 1961 to 1990, available from the Flood Studies Report
- SPR is Standard Percentage Runoff coefficient for the SOIL category.

Calculating storage estimates

4.68. The storage estimates are calculated using the inputs below:

- Return Period
- Climate Change
- Impermeable Area
- Peak Discharge

4.69. The return period and climate change are combined with the Flood Studies Report (FSR) parameters and storm durations to generate the rainfall used. The result from these calculations is the attenuation storage required for the Application Site as a result of the additional runoff generated by the Proposed Development.

Site and Project Descriptions

4.70. The Proposed Development will have a very limited extent of impermeable ground cover. The area beneath the solar panels will remain grassed and the post development site infiltration rate will not change. Rainwater falling onto each panel will drain freely onto the ground beneath the panel and infiltrate into the ground at the same rate as it does in the site's existing greenfield state as indicated in TIN101[24]. Thus, the total surface area of the photovoltaic array will not be considered an impermeable area in this assessment (only the area taken up by the piles). Similarly, it can be assumed that any rainwater falling onto the permeable access tracks will soak into the ground beneath or adjacent to the tracks at the same rate that it presently does.

4.71. The extent of impermeable area created as a result of the Proposed Development is summarised in Table 4-3.

Table 4-3: Extent of less permeable areas created by the Proposed Development

Building	Solar Farm Total Area (m^2)
13 x Transformers (3.8m(L) x 3.8m(W))	187.7
4 x Storage Containers (13.7m (L) x 2.4m(W))	131.5
1 x Auxiliary Transformer (2.9m (L) x 2.3m (W))	6.7
1 x Substation (7.7m (L) x 2.6m (W))	20.0
1 x Monitoring House (3.9m (L) x 3.2m (W))	12.5
Solar mounting structure piles (11,580 piles)	92.7
58 x CCTV Foundations (0.65m x 0.75m)	28.3
Fence posts (2143 posts)	64.3
Total Impermeable Area (m^2)	543.7
Site Area (m^2)	709,391

[24] Natural England, Technical Information Note TIN101: Solar Parks: Maximising environmental benefits, 2011. Available at https://webarchive.nationalarchives.gov.uk/20150902172007/http://publications.naturalengland.org.uk/publication/32027

4.72. In its current greenfield state, the Application Site is considered to be 100% undeveloped. As a result of the Proposed Development, the extent of impermeable hardstanding introduced will be approximately 543.7m^2 or 0.07% of the total site area.

4.73. Due to the small size of the transformers and the widespread nature of their locations across the Application Site, it is impractical to connect them into a drainage scheme. Water runoff from these buildings will slowly drain into the underlying geology through infiltration and the impact of this will be **Negligible**. Should surface water accumulate around any of these locations, a simple soakaway can be constructed to allow water soak into the underlying subsoils.

Existing Drainage Arrangements

Existing Runoff Rates

4.74. The existing runoff rates and hydrological characteristics of the Proposed Development are detailed in **Table 4-4** below (there are no hardstanding areas on the site at present).

Table 4-4: Pre-Development Greenfield runoff rates.

Site Make Up	Solar Farm Green Field
Greenfield Method	IH124
Positively Drained Area (ha)	0.054
SAAR (mm)	1519
Soil Index	3
Standard Percentage Runoff	0.37
Region	9
	Runoff rate (l/s)
QBar	0.5
1 year	0.4
1 in 30 year	0.9
1 in 100 year	1.1

4.75. The limiting discharge should be calculated as the flow rates from the pre-developed site, as detailed in Table 4-4.

Post Development Runoff Rate

4.76. The surface water runoff rate resulting from the Proposed Development has been based on the areas of hardstanding introduced, which will have a lower permeability than the existing greenfield composition.

4.77. Surface water runoff was derived using the Modified Rational Method as outlined within the methodology.

4.78. Using this approach, the runoff rate for the 1-in-100-year, 360-minute storm event, inclusive of the 25% climate change allowance would be a combined $27m^3$, across the three site areas, if left unmanaged.

Proposed Drainage Arrangements

4.79. The SuDS Manual[25] is the current best practice guidance on the use of SuDS. It promotes the use of a hierarchical approach to managing runoff. This approach is outlined below:

- Prevention - Preventing runoff by reducing impermeable areas.
- Source Control - Effective control of runoff at or very near its source.
- Site Control- Planned management of water in a local area or site.
- Regional Control - Designing a system that can efficiently manage the runoff from a site, or several sites.

4.80. The use of SuDS is generally accepted to have greater benefits than conventional drainage systems and these include[26]:

- Managing runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding;
- Providing opportunities for using runoff where it falls;
- Protecting or enhancing water quality (reducing pollution from runoff);

25 CIRIA (2015). Report C753, The SuDS Manual

26 Susdrain. Sustainable drainage. Accessed http://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html

- Protecting natural flow regimes in watercourses;
- SuDs are sympathetic to the environment and the needs of the local community;
- Providing an attractive habitat for wildlife in urban watercourses;
- Providing opportunities for evapotranspiration from vegetation and surface water; and
- Encouraging natural groundwater/aquifer recharge (where appropriate).

4.81. The surface water drainage strategy for the Proposed Development seeks to provide a sustainable and integrated surface water management scheme for the whole Application Site and aims to ensure no increase in downstream flood risk by managing discharges from the Proposed Development to the local water environment in a controlled manner.

4.82. To comply with current policies, guidance and best practice, the volume and quality of surface water runoff discharged off-site from the Proposed Development at this Application Site will need to be controlled using SuDS.

4.83. In compliance with the above, the drainage strategy has been developed to meet the following key principles;

- Mimic existing (greenfield) drainage arrangements as far as possible;
- Avoid increases in the greenfield rate, volume and frequency of offsite discharge;
- Avoid significant deterioration in water quality of discharges and no detrimental impact in downstream water quality;
- Achieve the above criteria for all storms up to and including the 100-year event; and,
- Incorporate an allowance for climate change (25%).

Indicative Surface Water Storage Requirements

4.84. Indicative storm water storage volumes have been estimated using Causeway's Drainage Design Flow software. The storage calculations include up to the critical storm 100-year return period event (including a 25% allowance for climate change) and the design limits discharge rates back to greenfield runoff rates (QBar). The results are enclosed in Appendix 4B These are estimated from the new surfaces added to the Proposed Development.

- Attenuation storage limits the rate of surface runoff discharge from the Proposed Development to match the pre-development greenfield runoff rates (QBar); and,
- All storage calculations have been given a climate change allowance factor of 20% that has been added to the rain depths.

Table 4-5: Storage Estimates

Storage Estimates	
	Solar Farm
Return Period (years)	100 years
Climate Change (%)	25
Impermeable Area (ha)	0.054
Peak Discharge (l/s)	0.5
Total storage Requirement (m^3)	60.0

Proposed Drainage Strategy

4.85. It is proposed to construct soakaway channels/ filter drains within the Application Site. The location of the channels has been chosen to intercept flows before they enter the existing drainage system surrounding the site, see Figure 4.5 in Appendix 4A.

4.86. The proposed soakaways will have an overall combined length of approximately 3,125m, with a base width of 0.5m, a 0.5m design depth and a 0.15m freeboard. They will be filled with crushed rock with a void ratio of 20%.

4.87. It will provide a total storage volume of approximately 156.25m^3. This is greater than the volume of additional runoff generated as a result of the impermeable buildings (60.0m^3). It is therefore considered that this adequately mitigates the increase in flow rates as a result of the minor increase in impermeable area and provides improvement.

4.88. By providing far more storage capacity than is required will improve the current flood concerns within the town of Rhydyfelin by ensuring the run-off rate has a net reduction thanks to the implementation of the drainage strategy.

4.89. The soakaway channels/ filter drains will be implemented during the construction phase of the Proposed Development and planted with vegetation to protect against soil erosion. They will be maintained throughout the lifespan of the Proposed Development, generally in accordance with the recommendations in the appropriate guidance.

4.90. Should infiltration drainage not be appropriate, the drainage design will need to be altered and discharge locations agreed with a revised limiting discharge rate appropriate to the drainage design. A limiting discharge rate would need to be agreed with the council post consent when the detailed drainage design is being undertaken.

4.91. Due to very infrequent site attendance that is required, the pollution risk is deemed negligible. On-plot surface water treatment is provided in the form of filter drains wrapped to intercept the conveyance of any silts within the drainage system. Further downstream, water quality polishing is provided within the detention basin prior to discharge from site.

4.92. Additional drainage measures to be implemented on-site include the following:

- Solar Panels: current grass cover is to be retained or reinstated adjacent to and under panels in order to maximise bio-retention;
- Access Tracks: access tracks are to be unpaved and constructed from local stone. Temporary swales or similar shall be utilised to collect runoff from access tracks with discharge to ground through percolation areas. Where swales are utilised, frequent check dams formed from gravels and other excavated material should be undertaken; and
- Transformer Stations: the scale of these types of structures is unlikely to warrant a formalised drainage system. Runoff from this infrastructure and any associated hard standing should be directed to a percolation area for discharge to ground. Should surface water accumulate around any of these locations then a simple soakaway can be constructed to allow water soak into the underlying subsoils.

Construction Phase

4.93. Due to the addition of the temporary construction compound during the construction phase, additional drainage measures will be implemented to help attenuate the increase in surface water flows. Runoff from these areas is anticipated to have high silt loading due to mobilised soils from excavated surfaces, fines from track aggregate and sludge due to traffic.

4.94. Hardstanding runoff will be directed to a swale on the compound's lowest boundary. This drainage scheme will be removed at the end of the construction stage and the area reinstated.

Designing for Exceedance Events

4.95. Overland flow routes will not be altered by the construction of the Proposed Development as it is not proposed to significantly vary ground levels. The outline drainage has been designed so that flooding will not occur for up to and including the 1-in-100-year storm event (including 25% climate change consideration).

4.96. Should an exceedance of this 1 in 100-year critical storm event occur, surface water will flow the same way as at present, into the surrounding field drains. There are no sensitive receptors between the Application Site and the field drains.

Long Term Maintenance of SuDS

4.97. The long-term management and maintenance of the proposed SuDS will be the responsibility of the site owner and/or operators. These responsibilities include:

- Periodic cutting or grazing of vegetation;
- Observation of infiltration performance;
- Litter and debris removal;
- If poor infiltration is observed then any accumulated silt/litter will be removed and aeration of the soil will be undertaken to improve permeability; and
- Maintain the structural integrity of the infiltration trenches/ attenuation structure.

4.98. The timing of the provision of the swales is important and dependent upon the existing condition of the site immediately prior to construction commencing, and weather conditions prior to, and during, construction, as any existing vegetation needs to be retained as far as possible during the construction period.

SAB Approval

4.99. A SAB application will be made to Rhondda Cynon Taf County Council following planning permission being granted and will be on the basis of the details of the SuDS measures set out above.

Potential for Soil Erosion

4.100. The key to avoiding increased runoff and the transport of soil into watercourses is to maintain soil permeability and vegetative cover. Permeable land surfaces underneath and between panels should be able to absorb rainfall as long as they are not compacted and there is some vegetation to bind the soil surface.

4.101. Soil compaction will be limited during construction and operation of the solar farm. During construction, only light machinery will be required to install the solar arrays. Any Heavy Goods Vehicles (HGVs) delivering components will be restricted to site access tracks and the temporary construction compounds.

4.102. To alleviate the effects of any limited compaction during the construction process any affected areas will be harrowed prior to being reseeded.

4.103. The risks of runoff and soil erosion are lowest on land with a gradual gradient with cohesive soils and are highest on dry, sandy and steeply sloping soil surfaces. Furthermore, the slope aspect of the land can also have an effect on runoff rates and soil erosion. The aspect of static solar panels in Wales will mostly always be south-facing and, therefore, north or south facing slopes will result in runoff flowing in a parallel direction to that of the runoff from the panels; thereby remaining relatively diffuse and unlikely to result in concentrated flows that could cause soil erosion, apart from where very steep slopes occur.

4.104. East or west facing slopes will result in runoff flowing in a perpendicular direction to that of runoff from the panels; this will result in runoff becoming concentrated along the drip-line of each row, which could lead to increased soil erosion.

4.105. With regard to the Proposed Development, there is a gentle gradient across most of the fields with steeper gradients towards the high point in Field 5. The orientation of the solar panels could concentrate surface water flow in some areas of the Application Site and increase the risk of soil erosion. However, due to the low gradient across these fields, the likelihood of increased overland flow or soil erosion occurring is considered low. The addition of the filter drains / soakaway trenches on the downstream boundary of the fields with the steeper gradients will reduce the risk of soil erosion on these fields and reduce any risk of water quality issues on any downstream watercourses or agricultural land.

SUMMARY & CONCLUSIONS

4.106. The FCA and DS requirements are set out by the PPW and TAN15 and guidance.

4.107. The Guidance aims to avoid inappropriate development in flood zones and instead direct it to areas of low risk by adopting a sequential approach.

4.108. Within the DAM and Flood Map for Planning, it shows the Application Site to be wholly situated within Flood Zone A and Flood Zone 1. Therefore, in accordance with TAN15, the Application Site is situated in an area that has less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year. of fluvial or tidal/coastal flooding. Consequently, a justification test is not required for this Proposed Development, however a Drainage Strategy will still be required to ensure that the Proposed Development will not increase flood risk elsewhere.

4.109. In addition to fluvial and coastal flood risk, NRW also provide surface water flood maps. This indicates areas across the Application Site, which appear to be restricted mainly to the field drains except for a small area of surface water flooding in Field 37 and 38.

4.110. Where the NRW map demonstrates areas of surface water risk, the topographical survey, as well as aerial maps, were studied to determine if there will indeed be surface water flooding within the Application Site. There is an area located within Field 33 and 35 that is at risk of surface water flooding which contains only solar panels. As the solar panels will be pile driven into the ground and raised to a height of at least 0.8m off the ground, it will not increase the flood risk elsewhere and will remain safely operational during time of a flood. Therefore, this would be appropriate and in line with the TAN 15 guidance.

4.111. This soil class has a SPR of 0.37 which suggests that they provide excellent opportunity for infiltration. Prior to the detailed drainage design stage, which should be conditioned as part of any planning consent, infiltration testing will be undertaken in accordance with BRE 365. Should infiltration drainage not be appropriate, the drainage design will need be altered and discharge locations agreed with a revised limiting discharge rate appropriate to the drainage design. A limiting discharge rate of 2l/s would seem appropriate; however, this will be agreed with the council post consent when the detailed drainage design is being undertaken.

4.112. It is proposed to construct soakaway channels/ filter drains within the Application Site. The location of the channels has been chosen to intercept flows before they enter the existing drainage system surrounding the site.

4.113. The proposed soakaways will have an overall combined length of approximately 3,125m, with a base width of 0.5m, a 0.5m design depth and a 0.15m freeboard. They will be filled with crushed rock with a void ratio of 20%.

4.114. It will provide a total storage volume of approximately 156.25m^3. This is greater than the volume of additional runoff generated as a result of the impermeable buildings (60.0m^3). It is therefore considered that this adequately mitigates the increase in flow rates as a result of the minor increase in impermeable area and provides improvement.

4.115. By providing far more storage capacity than is required will improve the current flood concerns within the town of Rhydyfelin by ensuring the run-off rate has a net reduction thanks to the implementation of the drainage strategy.

4.116. Should infiltration drainage not be appropriate then the discharge point will be into the existing site field drainage close to each of the infiltration drains.

4.117. Additional drainage measures to be implemented on-site include the following:

- Solar Panels: current grass cover is to be retained or reinstated adjacent to and under panels in order to maximise bio-retention;
- Access Tracks: access tracks are to be unpaved and constructed from local stone. Temporary swales or similar shall be utilised to collect runoff from access tracks with discharge to ground through percolation areas. Where swales are utilised, frequent check dams formed from gravels and other excavated material should be undertaken; and
- Transformer Stations: the scale of these types of structures is unlikely to warrant a formalised drainage system. Runoff from this infrastructure and any associated hard standing should be directed to a percolation area for discharge to ground. Should surface water accumulate around any of these locations then a simple soakaway can be constructed to allow water soak into the underlying subsoils.

4.118. The FCA and DS has therefore demonstrated that the Proposed Development will not increase flood risk away from the Application Site during the construction, operation and decommissioning phases. The Proposed Development is therefore considered to be acceptable in planning policy terms.

APPENDICES

Appendix 1A Figures:

- Figure 1.1: Watercourses Map;
- Figure 1.2: Topographical Survey
- Figure 1.3: Development Advice Map
- Figure 1.4: Flood Risk Map
- Figure 1.5: Outline SuDS Design

Appendix 1B: Flow Output