



# 10. HYDROLOGY AND FLOOD CONSEQUENCES

## 10.1 INTRODUCTION

- 10.1.1 This chapter sets out the assessment of the environmental impacts of the proposed development relating to hydrology, drainage and flood risk. It describes the baseline conditions, identifies key water resources and sensitivities, and assesses the direct and indirect impacts of the development on the hydrological environment. This chapter also assesses the potential for flood risk in accordance with Welsh Government guidance and the requirements of Natural Resources Wales (NRW). The need for any water resource mitigation measures is addressed and any post-mitigation residual impacts are identified.
- 10.1.2 A Flood Consequence Assessment (FCA) has been undertaken in accordance with CIRIA 624, Planning Policy Wales (PPW) (Edition 11) and the accompanying Technical Advice Note 15: Development and Flood Risk (TAN15). An FCA is required for less vulnerable development proposals in Flood Zones C1 and C2 that meet the justification test. A copy of the FCA is included in Appendix 10.1 to this ES.
- 10.1.3 The FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed, taking climate change into account. The FCA should identify opportunities to reduce the probability and consequences of flooding.
- 10.1.4 A SuDS Design has been undertaken which details the methods that will be used to discharge the surface water runoff in accordance with the six standards requiring evaluation as part of a SuDS Approval Body (SAB) application. This has been subject to pre-application dialogue with the SAB. Copies of the pre-application correspondence and the draft applications for SAB consent are included in **Appendix 10.3**.

### Statement of Competence

- 10.1.5 This chapter was written by Keelan Serjeant BSc (Hons), MSc, MCIWEM who has over 17 years of experience in hydrology, flood risk and the planning process. He is a member of the British Hydrological Society and a Member of the Chartered Institute of Water and Environmental Management (CIWEM). He has written more than 1,000 Flood Risk Assessments and Environmental Statements and has taken training courses in the Flood Estimation Handbook (FEH), Urban Hydrology, SuDS, FRAs, water quality and planning. He has successfully delivered both site and strategic assessments for a range of private and public sector clients nationwide including developers, planning consultants, architects, private individuals, local planning authorities and the Environment Agency.

## 10.2 CONTEXT

### Legislation

- 10.2.1 There is a wide range of legislation associated with drainage and hydrological impact that apply in the UK. The legislation includes:
- Water Industry Act (1991)*
- 10.2.2 The Water Industry Act relates to the supply of water and the provision of sewerage services and applies to all Sewerage Undertakers.

#### Water Resources Act (1991 as amended)

- 10.2.3 The Water Resources Act relates to the National Rivers Authority, whose activities are now assumed by the Environment Agency (now NRW in Wales) and sets out the responsibilities of NRW in relation to water pollution, resource management, flood defence, fisheries, and in some areas, navigation. The Act regulates activities that may affect the water environment. Discharge to controlled waters is only permitted with the consent of NRW. An aim of the Act is to ensure that the polluter pays the cost of the consequences of their discharges.

#### Land Drainage Act (1991)

- 10.2.4 The Land Drainage Act outlines the constitution of Internal Drainage Boards (IDB) and the powers of the National Rivers Authority (now assumed by NRW). It also includes a definition of watercourses; all rivers and streams and all ditches, drains, culverts, dykes, sewers (other than public sewers) and passages through which water flows.

#### The EU Water Framework Directive (WFD) (2000)

- 10.2.5 WFD has been the cornerstone legislation in the EU and UK planning policy. The aim of the Directive is to generate a more integrated approach to water management ensuring that where possible links with ecology are increased. It also strives to ensure that water quality is improved and that any proposed developments will not have a detrimental impact upon water quality. The WFD was transposed into English & Welsh law via The Water Environment (Water Framework Directive) (England & Wales) Regulations 2003. The purpose of these regulations is to implement a strategic planning process to be established for managing, protecting and improving the quality of water resources within defined river basin catchment areas.

#### Water Act (2003)

- 10.2.6 The Water Act is an act whose provisions are mainly to amend other legislation, such as the Reservoirs Act 1975, Water Industry Act 1991 and the Water Resources Act 1991.

#### Flood Risk Regulations (2009)

- 10.2.7 The Flood Risk Regulations transpose the EC Floods Directive into domestic law and implement its provisions.

#### Water Framework Directive (2000)

- 10.2.8 The European Water Framework Directive was transposed into UK law in December 2003, as the Water Environment Regulations 2003. The framework commits the UK Government (and all other European Union members) to improving the quality of all water bodies and coastal waters such that they attain at least 'Good' status for chemical and ecological criteria.
- 10.2.9 Any modification to a waterbody and its floodplain are now required to be Water Framework Directive (WFD) compliant. Assessments should be undertaken to determine the impacts on interventions within a waterbody on the designated Ecological Status of that waterbody. All water bodies have to achieve a Good Ecological Status or Good Ecological Potential (for heavily modified water bodies) by 2027. Some water bodies have targets to reach a Good Status by either 2015 or

2021.

- 10.2.10 The Act puts a duty on local authorities to take into consideration the aims and objectives of the act and any relevant River Basin Management Plan during the completion of their duties and to ensure no adverse effect upon the environment.

#### European Floods Directive (2007)

- 10.2.11 The aim of the European Floods Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The directive sets out requirements for the UK Government (and all other European Union members) to assess and map flood risk from all major rivers. Preliminary Flood Risk Assessments (PFRAs) have been produced by all Lead Local Flood Authorities, with the flood mapping stage completed by 2013. By 2015, Flood Management Plans will need to be produced, focussing on flood prevention, protection and preparedness. The EU Floods Directive has been transposed into UK law in the Flood Risk Regulations (2009).

#### Planning Policy

- 10.2.12 PPW11 (February 2021) objective to support sustainable development is for the 'avoidance of development in areas of flooding from the sea or from rivers'. Local Planning authorities are advised to take a precautionary approach on a strategic scale which requires consideration of the catchment as a whole. Development proposals need to decrease not increase flood risk arising from fluvial or coastal flooding or from additional run-off created by new developments.
- 10.2.13 PPW considers flood risk to developments using a sequential characterisation of risk. This is presented in the TAN15 Development Advice Maps (DAMs) which identify flood zones A, B, C1 and C2. The initial study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.
- 10.2.14 TAN15 requires a detailed Flood Consequence Assessment (FCA) to be produced for all developments located within DAM zones C1 and C2. Flood Zone B only requires an FCA if site levels are below the extreme (0.1%) flood level (as defined in Technical Guidance TAN15, Figure 1). The proposed development is located within DAM Zone A however as small areas are located within DAM Zones B and C2, a detailed FCA is therefore required.
- 10.2.15 The vulnerability classification of different development types is identified in Figure 2 of TAN15. Utilities infrastructures are classed as less vulnerable development and are permitted within DAM Zones A, and Zone B and in Zone C2 subject to the application of the justification test. The Planning Statement submitted with the application demonstrates that the proposed development meets the justification test.
- 10.2.16 The Anglesey and Gwynedd Joint Local Development Plan (JLDP) 2011 - 2026 Written Statement (31 July 2017) includes development management policies which seek to engender sustainable living by '*Minimize, adapt and mitigate the impacts of climate change. This will be achieved by: - ensuring that highly vulnerable development is directed away from areas of flood risk wherever possible.*'
- 10.2.17 Identified relevant policies are:

- Strategic Policy PS5: Sustainable Development, Item 9 - Proposals are required to: 'manage flood risk and maximise use of sustainable drainage schemes'.
- Policy PCYFF2: Design and Policy Shaping – development proposals to be permitted subject to meeting relevant criteria of which item 8 states 'its drainage systems are designed to limit surface water run-off and flood risk and prevent pollution'.

### 10.3 ASSESSMENT APPROACH

- 10.3.1 In order to establish the environmental impact of the proposed development on the hydrological regimes of the application site and its immediate environs, it was necessary to undertake the assessment in a number of stages. The initial stage comprised a desk study review of available information in order to determine (where possible) site conditions in terms of water features (both surface and ground), water quality and flood risk.
- 10.3.2 The sources of information used in the desktop study are listed in in **Table 10.1**. A site walkover survey was undertaken to identify local surface water features (i.e. watercourses, drainage ditches etc.) on the Site, and within the study area, observations included land use, hydrological regime, land drainage features, watercourse morphology and the Site topography.
- 10.3.3 Consultation has taken place with the relevant statutory bodies via pre-application discussions and the submission of an EIA Scoping Report submitted to the Planning Inspectorate Wales.

**Table 10.1: Data Sources**

Topic	Sources of Information
Topography	Ordnance Survey Maps Site topographic survey
Geology	BGS Bedrock and Superficial Geological Map BGS online data
Hydrogeology	NRW online data Relevant scientific literature
Hydrology	Metrological Office Historic Rainfall Data Flood Estimation Handbook (FEH) Webservice National Soil Resource Institute NRW Flood Risk Maps Development Advice Maps (DAM) The SuDS Manual

- 10.3.4 The hydrological regime was considered in terms of existing conditions, and the effects of the proposed development. An assessment of the application-site location in terms of flood risk was also undertaken. Existing conditions local to the site (within the site boundary) were also considered in terms of hydrological management and the collection of surface water.
- 10.3.5 In terms of assessing the development site, the following phases of the proposal have been considered, namely the construction, operational and decommissioning phases.

- 10.3.6 There are a number of potential impacts that have to be considered that could have a direct or indirect effect on hydrology, flood risk, water quality and drainage. These impacts may be transitional, but also can be more permanent in nature. The primary concerns relate to potential impacts on controlled water receptors which are considered to be of high significance.
- 10.3.7 The purpose of the EIA is to identify the likely ‘significance’ of environmental effects (beneficial or adverse) arising from a development. In broad terms, environmental effects are described as:
- Adverse – detrimental or negative effects to an environmental resource or receptor;
  - Beneficial – advantageous or positive effect to an environmental resource or receptor; or
  - Negligible – a neutral effect to an environmental resource or receptor.
- 10.3.8 Effects have been assessed in terms of:
- The magnitude of the impact –the degree of alteration (both positive and negative) from the baseline state; and
  - The sensitivity of the receptor(s) subjected to the impact –this may relate to the value of a resource and the reversibility of impacts.
- 10.3.9 Any effect of Moderate or Major significance is considered to represent a likely significant effect for the purposes of the EIA Regulations. Significance of effects would be considered before and after mitigation.
- 10.3.10 The criteria for determining magnitude of impact are set out below in **Table 10.2**.
- 10.3.11 The sensitivity of a receptor is based on the importance of the receptor using the criteria below in **Table 10.3**.

Table 10.2: Magnitude of Impacts and Criteria

Magnitude of Effect	Criteria
High	Total loss or major/substantial alteration to elements/features of the baseline (pre-development) conditions such that the post development character/composition/attributes will be fundamentally changed.
Medium	Loss or alteration to one or more elements/features of the baseline conditions such that post development character/composition/attributes of the baseline will be materially changed.
Low	A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible/detectable but the underlying character/composition/attributes of the baseline condition will be similar to the pre-development.
Negligible	Very little change from baseline conditions. Change not material, barely distinguishable or indistinguishable, approximating to a ‘no change’ situation.

Table 10.3: Degree of Sensitivity Criteria

Sensitivity	Criteria
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character or is of international or national importance.
Medium	The receptor/resource has moderate capacity to absorb change without significantly altering its present character or is of high and more than local (but not national or international) importance.
Low	The receptor/resource is tolerant of change without detrimental effect, is of low or local importance.
Negligible	The receptor/resource can accommodate change without material effect, is of limited importance.

10.3.12 Significance of effect is evaluated as a combination of the sensitivity of the receptor and the magnitude of change the development results in. Although the matrix in **Table 10.4** is designed to demonstrate an objective rationale to reach a conclusion about the potential significance of impact a degree of professional judgement is a key element in the evaluation process.

Table 10.4: Significance of Effect

		Sensitivity of Receptor			
		High	Medium	Low	Negligible
Magnitude of Impact	High	Major	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor/Moderate	Negligible
	Low	Moderate	Minor/Moderate	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

#### Data Limitations

- 10.3.13 Geological and hydrogeological data beneath the site is limited to information which has been obtained from available 'desk' based sources, including maps and limited data from boreholes surrounding the site. Full determination of the under geological and hydrogeological regime beneath site would require further intrusive investigation, which is not proposed for this assessment.
- 10.3.14 The NRW flood maps and the TAN15 DAMs can change over time. However, it is not considered that the above limitations would have a significant bearing on the outcome of this assessment.

## 10.4 BASELINE CONDITIONS

- 10.4.1 The assessment of baseline conditions included a review of the pertinent information available.

#### Site Description and Topography

- 10.4.2 The area proposed for development is located to the south of the A55 and distributed across three parcels of land (known as 'development areas') to the south-west of the village Bryngwran and in the vicinity of the village Llanfihangel yn Nhowyn, Anglesey. The development areas (DAs) are located to the west and south-east of the village of Llanfihangel yn Nhowyn and to the south and south-east of the village of Bryngwran. RAF Valley is situated to the south and the A55 lies to the north. The development areas are denoted as DA4, DA5 and DA6.

- 10.4.3 The application site is a rural expanse of agricultural fields, with a mix of arable and pasture, drained by network of drainage ditches and served by farms and other rural buildings.
- 10.4.4 The proposed solar farm occupies an area comprising fields with boundary hedges and ditches. The fields are accessed from the nearby roads, and then either through fields or along tracks to give access to each field. The ditches are crossed by culverts of various sizes.
- 10.4.5 Each development area is considered in further detail below:

#### Development Area 4

- 10.4.6 DA4 comprises 4 grazing field, measuring 23ha and is irregular in shape and lies adjacent to the farm buildings at Plas Llechlched, to the east of the Afon Crigyll, and is bound by roads to the north and east. The highest part is towards the eastern boundary at 14mAOD. The western boundary, adjacent to the Afon Crigyll is the low point of the site at 4.00mAOD. South western boundary of western field has large pond encroaching.

#### Development Area 5

- 10.4.7 DA5 comprises a grazing field measuring 7ha and is irregular in shape and lies to the north of the farm buildings at Ty Croes and is bounded by roads to the north and west. The highest part of the area is located towards the western boundary at approximately 16.00mAOD, the lowest point is located centrally at 12.00mAOD.

#### Development Area 6

- 10.4.8 DA6 comprises 15 grazing fields with an area of 25ha and is irregular in shape and lies to the west of the village of Llanfihangel yn Nhowyn, to the east of Llyn Dinam, to the north of Llyn Penrhyn, and to the south of a road named Lon Bach. DA6 has a low point of 7.00mAOD at the southern boundary and a highpoint of 12.00mAOD on the northern boundary. This parcel of land is low lying fields with drainage ditches.

#### Catchment Hydrology

- 10.4.9 All the rivers are fed by a network of agricultural drains and springs/issues which flow through or adjacent to the development areas. Currently the surface water runoff from all the sites discharges via infiltration to the ground or to the adjacent drainage ditches.
- 10.4.10 DA4 and DA5 are located within the Afon Crigyll catchment. The Afon Crigyll is located to the east of the DAs and flows from north to south before discharging into Cymyran Bay at Rhosneigr and has a catchment area of 50.13km<sup>2</sup>. Within this catchment and located adjacent to the development areas is the Llyn Traffwl (reservoir).
- 10.4.11 DA6 is located within an unnamed catchment, the unnamed watercourse flows from north to south before discharging into Cymyran Bay adjacent to RAF Valley and has a catchment area of 8.77km<sup>2</sup>. Within this catchment and located adjacent to the development area is the Llyn Dinam, Llyn Penrhyn and Llyn Cerrig Bach.
- 10.4.12 DA6 is immediately upstream of Llyn Dinam Special Area of Conservation (SAC).

The area has a network of ditches and drains, many of which are currently partially silted up and well vegetated. There is a history of flooding in the nearby Dol Eithin housing area and surface water from the estate flows into DA6, and on a number of occasions surface water has surcharged into the surface floodwater. At present the water discharged from the estate flows slowly through DA6 and much of the silt and nutrients settles out or is lost en route before it reaches the SAC.

### Rainfall

- 10.4.13 The Application Site is located within an area of average rainfall. The 1961-1990 Standard Average Annual Rainfall (SAAR) for the Site as recorded in the Flood Estimation Handbook (FEH) web service is 900mm per annum. The UK national average is 832mm per annum.

### Source Protection Zone

- 10.4.14 The site is not located within a NRW Source Protection Zone (SPZ).

### Soil

- 10.4.15 Information from the National Soil Resources Institute details the site area as being situated on slowly permeable seasonally wet acid loamy and clayey soils and sand dune soils. The soil classification for WRAP type is 2: i) Very permeable soils with shallow ground water; ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. The layer is low in organic matter, mottled and slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material); and iii) Moderately permeable soils, some with slowly permeable subsoils.

### Surface Water Quality

- 10.4.16 The Water Framework Directive (WFD) water quality information for the Afon Crigyll is shown in Table 10.5 and for the unnamed - Crigyll/Caradog catchment is shown in **Table 10.6**. The WFD water quality information for Llyn Dinam is shown in **Table 10.7** and for Cymyran Bay is shown in **Table 10.8**.
- 10.4.17 There are no drinking water protected areas or nitrate vulnerable zones within the catchments.

Table 10.5: Afon Crigyll WFD Water Body Classification

	2009 Cycle 1	2015 Cycle 2	2018 Cycle 2	Objectives
Overall Water Body	Good	Moderate	Moderate	Good by 2027
Ecological	Did not require assessment	Moderate	Moderate	Good by 2027
Chemical	Good	Good	Good	Good by 2027

Table 10.6: Unnamed - Crigyll/Caradog catchment WFD Water Body Classification

	2009 Cycle 1	2015 Cycle 2	2018 Cycle 2	Objectives
Overall Water Body	Moderate	N/A	N/A	Good by 2027
Ecological	Did not require assessment	N/A	N/A	Good by 2027
Chemical	Moderate	N/A	N/A	Good by 2027

Table 10.7: Cymyran Bay WFD Water Body Classification

	2009 Cycle 1	2015 Cycle 2	2018 Cycle 2	Objectives
Overall Water Body	Moderate	N/A	N/A	Good by 2027
Ecological	Moderate	N/A	N/A	Good by 2027
Chemical	Good	N/A	N/A	Good by 2027

Table 10.8: Llyn Dinam WFD Water Body Classification

	2009 Cycle 1	2015 Cycle 2	2018 Cycle 2	Objectives
Overall Water Body	Good	N/A	N/A	Good by 2015
Ecological	Did not require assessment	N/A	N/A	Good by 2015
Chemical	Good	N/A	N/A	Good by 2015

### Surface Water Abstractions

10.4.18 **Table 10.9** shows the licensed surface water abstractions for sites extracting more

than 20 cubic metres of water a day and includes active and historical records.

Table 10.9: Surface Water Abstractions

Details	
Status: Historical Licence No: WA/102/0004/001 Details: Lake & Pond Throughflow Direct Source: EAW Surface Water Point: UN-NAMED TRIBUTARY OF THE AFON CRIGYLL Data Type: Point Name: RSPB Easting: 233127 Northing: 376323	Annual Volume (m <sup>3</sup> ): 80000 Max Daily Volume (m <sup>3</sup> ): 1036.8 Original Application No: - Original Start Date: 31/07/2001 Expiry Date: 31/03/2026 Issue No: 1 Version Start Date: 07/05/2015 Version End Date: -
Status: Active Licence No: WA/102/0004/001 Details: Lake & Pond Throughflow - Very Low Direct Source: - Point: - Data Type: Point Name: - Easting: 233127 Northing: 376323	Annual Volume (m <sup>3</sup> ): 80,000 Max Daily Volume (m <sup>3</sup> ): 1,036.80 Original Application No: - Original Start Date: May 7 2015 12:00AM Expiry Date: Mar 31 2026 12:00AM Issue No: - Version Start Date: - Version End Date: -
Status: Historical Licence No: 23/102/4/0008 Details: Lake & Pond Throughflow Direct Source: EAW Surface Water Point: UN NAMED STREAM FROM LLYN TRAFFWLL Data Type: Point Name: RSPB Easting: 233140 Northing: 376320	Annual Volume (m <sup>3</sup> ): 124416 Max Daily Volume (m <sup>3</sup> ): 1036.8 Original Application No: - Original Start Date: 31/07/2001 Expiry Date: 31/03/2015 Issue No: 1 Version Start Date: 10/04/2007 Version End Date: -
Status: Active Licence No: 23/102/4/0009 Details: Unknown (Impounding) - Direct Source: - Point: - Data Type: Point Name: - Easting: 233790 Northing: 377110	Annual Volume (m <sup>3</sup> ): 0 Max Daily Volume (m <sup>3</sup> ): - Original Application No: - Original Start Date: Dec 31 2008 12:00AM Expiry Date: - Issue No: - Version Start Date: -

## Flooding

10.4.19 An FCA has been carried out for the Proposed Development in accordance with guidance contained in Planning Policy Wales and TAN15. The FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks would be managed so that the development remains safe throughout its lifetime, taking climate change into account. The FCA

includes an assessment of the existing and proposed surface water drainage of the Site.

- 10.4.20 A review of the Development Advice Map (DAM) which accompanies TAN15 is shown in **Table 10.11**. The DAM zones represent the undefended fluvial and tidal flood extents derived from a combination of detailed and generalised modelled data. The DAs are not located within the tidal zones but the fluvial Flood Zones.
- 10.4.21 The fluvial zones have been produced by the Generalised Model and give only an indication of flood risk. Although areas of the DAs have been shown to be located within the DAM Zones it should be taken into account that the DAM Zones have been produced by the Generalised Model and only give an indication of flood risk. Therefore, it is likely that the actual risk of fluvial/tidal flooding at the site is much reduced compared to the DAM Zones.
- 10.4.22 Further detailed assessments of flood risk shows that the DAs are not at risk of tidal flooding, this has been confirmed by NRW. Furthermore, DA6 has been shown to be not at risk of fluvial flooding.
- 10.4.23 The only DA potentially at risk of fluvial flooding is DA4, modelling undertaken by NRW for the Fluvial NRW Flood Risk Assessment Wales map shows that the majority of DA4 is not at risk of fluvial flooding and has a very low risk of fluvial flooding with a chance of flooding of less than 1 in 1000 (0.1%) years. The majority of DA4 would be flood free during the 1 in 1000 year event.
- 10.4.24 A small area, approximately 10%, within the centre of DA4 is shown to have a low risk of fluvial flooding with a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%) years. A very small area, less than 5%, on the western boundary of DA4 is shown to have a high risk of fluvial flooding with a chance of flooding of greater than 1 in 30 (3.3%) years and is associated with areas immediately adjacent to the Afon Crigyll. The therefore, the risk of flooding from fluvial flooding for DA4 is considered to be of low significance.

**Table 10.11: DAM Zones Across the Sites**

Development Area	DAM Zones
4	Half Zone A, half Zone C2
5	Half Zone A, half Zone C2
6	Majority Zone A, small proportion Zone B

- 10.4.25 TAN15 categorises development according to its vulnerability to flooding. There are three categories: emergency services; highly vulnerable development; and less vulnerable development. All residential premises are categorised as highly vulnerable development. Commercial, retail and general industrial development are categorised as less vulnerable development.
- 10.4.26 TAN15 does not explicitly define the flood risk vulnerability of renewable energy developments such as solar parks. However, it confirms that less vulnerable development describes development, such as the case with the proposed development, where the ability of occupants to decide on whether they wish to accept such risk is greater than in the highly vulnerable category, such as residential uses.

- 10.4.27 Furthermore, the proposed development will not have permanent staff located on the site, the solar arrays are lifted off the ground and any sensitive equipment can be located to respect the Flood Zones and not within the areas at risk of flooding. The proposed development is not especially vulnerable to flooding and the proposed development would be considered as utilities infrastructure.
- 10.4.28 Recent planning applications for solar parks (some of which have also been assessed by the Planning Inspectorate) have been classified as 'less vulnerable' such as Rhyd Y Groes, Anglesey (ref: 20C310B/EIA/RE), Gwent Farmers' Community Solar Scheme, Llanwern, Newport, NP26 3D (ref: 18/0129) and Mamhilad Solar Park on land south of Little Mill Brickworks, Little Mill near Pontypool in Torfaen (ref: 15/P/00436). The Isle of Anglesey County Council (IACC) confirmed that the planning application for a solar park at Rhyd Y Groes, Anglesey (ref: 20C310B/EIA/RE) was classified as 'less vulnerable'.
- 10.4.29 As part of pre-applications discussions with IACC it was confirmed that the proposed development is considered to be less vulnerable development. Pre-application discussions are presented in **Appendix 10.2**. The existing uses within the vicinity of the sites are predominantly agricultural fields and can be classified as 'less vulnerable'. The DAM classification therefore indicates that the site is suitable for the proposed use subject to the application of justification test, including acceptability of consequences. The Planning Statement submitted with the application demonstrates that the proposed development meets the justification test.

### Geology

- 10.4.30 The British Geological Survey (BGS) map shows that the superficial deposits vary across the DAs and consist of:
- Alluvium - clay, silt, sand and gravel. Superficial deposits formed up to 2 million years ago in the Quaternary Period in a local environment previously dominated by rivers (U).
  - Blown Sand - Sand. Superficial Deposits formed up to 3 million years ago in the Quaternary Period.
  - Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period.
  - Tidal Flat Deposits - Clay and Silt. Superficial Deposits formed up to 2 million years ago in the Quaternary Period.
- 10.4.31 The bedrock deposits vary across the Sites and consist of:
- Ordovician Rocks (undifferentiated) - Sandstone and Conglomerate, Interbedded. Sedimentary Bedrock formed approximately 444 to 485 million years ago in the Ordovician Period.
  - New Harbour Group - Mica Schist and Psammite. Metamorphic Bedrock formed approximately 541 to 635 million years ago in the Ediacaran Period.
  - New Harbour Group - Lava. Igneous Bedrock formed approximately 541 to 635 million years ago in the Ediacaran Period.
  - Coedana Complex - Granite, Gneissose. Metamorphic Bedrock formed approximately 541 to 635 million years ago in the Ediacaran Period.
  - Ordovician Rocks (undifferentiated) - Mudstone and Sandstone, Interbedded. Sedimentary Bedrock formed approximately 444 to 485 million years ago in the Ordovician Period.
  - Unnamed Igneous Intrusion of Unknown Age - Gabbro, Microgabbro and Diorite.

- Unnamed Igneous Intrusion of Unknown Age - Serpentinite. igneous bedrock.

### Groundwater

- 10.4.32 NRW has designated the superficial Secondary A Aquifers and Secondary Undifferentiated Aquifers. The bedrock deposits are designated as Secondary B Aquifers.
- 10.4.33 Secondary A Aquifers are described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
- 10.4.34 Secondary Undifferentiated Aquifers are assigned where it is not possible to attribute either category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- 10.4.35 Secondary B Aquifers are described as predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
- 10.4.36 According to the BGS Hydrogeological Map of England and Wales, 1:625,000 scale, the bedrock is considered a low productivity aquifer with limited groundwater in the near surface. NRW has designated the bedrock as a Secondary B aquifer, lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
- 10.4.37 The superficial deposits are designated unproductive strata, defined as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow. The alluvial drift deposits are classed as a Secondary A aquifer, defined as permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important base flow to rivers.

### Groundwater Quality

- 10.4.38 The WFD groundwater quality information is shown in **Table 10.12**.

**Table 10.12: WFD Groundwater Body Classification**

	2016	2015 Cycle 2	2018 Cycle 2	Objectives
Overall Water Body	Poor	Moderate	Moderate	Good by 2027
Quantitative	Good	Moderate	Moderate	Good by 2027
Chemical	Poor	Good	Good	Good by 2027

### Groundwater Abstractions

- 10.4.39 There are no groundwater water abstraction licences within 2km of the Sites.

## Designated Sites

10.4.40 The designated sites located within 2km are shown in **Table 10.13**.

**Table 10.13: Designated Sites**

Name	Designation
Llyn Traffwll	Site Scientific Special Interest (SSSI)
Llynnau Y Fali - Valley Lakes	SSSI
Beddmanarch-Cymyran	SSSI
Llyn Dinam	SAC
Anglesey Terns / Morwenoliaid Ynys Môn	Special Protection Area (SPA)

## 10.5 IDENTIFIED RECEPTORS

10.5.1 Based on the baseline conditions presented above, **Table 10.14** presents the sensitive receptors which have been considered in the following assessment, along with their sensitivity to change.

**Table 10.14: Identified Receptors**

Receptor	Sensitivity	Description
Site workers (i.e. construction workers)	Medium	Flooding may impact upon workers during the operation phase, but their sensitivity is lowered as a result of their competency in their role as well as operating in teams and/or prescribed systems.
Groundwater	Medium	Any water quality or quantity issues would only be felt over short distance and would be diluted rapidly.
Surface waters	Medium	Any water quality or quantity issues would only be felt over short distance of the watercourses compared to the overall length of the watercourses. Water quality issues would also be diluted rapidly within the watercourses.
Llyn Dinam SAC	High	Surface water runoff from the DA6 and through the site from upstream may impact upon the integrity of the SAC.

## 10.6 PROPOSED DEVELOPMENT

10.6.1 The proposal will comprise the following:

- Photovoltaic (PV) panels to a maximum height of circa 3m;
- Mounting frames - matt finished small section metal structure;
- Scheme of landscaping and biodiversity enhancement;
- Central Inverters (inverters and transformers will be housed together in prefabricated containers to a maximum height of circa 3m), substations (DNO

and Customer to a maximum height of circa 3m) and associated cabling (below ground);

- Point of connection;
- Stock fencing up to a height of circa 2m to secure the development areas;
- Infra-red CCTV (CCTV cameras would operate using motion sensors and would be positioned inward only to ensure privacy to neighbouring land and property);
- Temporary set down areas;
- Internal service roads; and
- Site access for the construction, operational and decommissioning phases.

10.6.2 The proposed point of connection is located at an existing substation to the south of Caergeiliog on the eastern side of Cymyran Road. The DAs will be connected to the substation by cabling in the highway. All DAs will utilise the same grid connection.

10.6.3 The panels will be arranged in rows in an east-west alignment across the DAs and orientated south for maximum efficiency. All panels will be mounted on frames and have a maximum height of 3m above ground level; the lowest part of the panel will be circa 0.9m above ground level. The scheme will be operational for 40 years after which all equipment can be removed from site.

10.6.4 The DAs will be secured by up to a 2m high stock fence or similar with wooden posts.

## 10.7 ASSESSMENT OF EFFECTS

### Hazard/Risk Source

10.7.1 The following potential sources of hazard/risk have been identified based on a review of the baseline environment, and construction and operational phases of the proposed development:

- Leaks and spills of fuels and oils associated with vehicles and equipment;
- Sediment loading of watercourses;
- Improvement in drainage;
- Discharge of poor-quality water to watercourses; and
- Flooding of development site.

10.7.2 The significance of any potential pollution or changes in groundwater levels and flow would be dependent on the nature of the incident, the mitigation measures, timing of the measures, and effectiveness of the measures and sensitivity of the potential receptors.

### Conceptual Model and Preliminary Impact (Risk) Assessment

10.7.3 The site conceptual model and assessment of the environmental risk during both the construction and operation phases of the development is presented in **Table 10.15** and **Table 10.16**. The potential effects from the decommissioning phase are likely to be similar to the construction phase.

Table 10.15: Conceptual Model and Preliminary Impact (Risk) Assessment – Construction and Decommissioning Phase

Hazard/Risk Source	Receptor	Pathway	Magnitude	Sensitivity	Significance of Effect
Leaks and spills of fuels and oils associated with vehicles and equipment	Site Users, groundwater and surface waters	Direct contact, ingestion and inhalation and also contaminant transport through permeable geology and groundwater	Medium	Medium	<b>Moderate Adverse</b> - small quantities of fuels and oils to be held onsite and geology will impede transfer of significant level of contaminants to groundwater
Sediment loading of watercourses	Surface waters	Surface flows	Medium	Medium	<b>Moderate Adverse</b> - inappropriate management of surface waters during construction could result in sediment loading of watercourses
Improvements in drainage	Llyn Dinam SAC	Surface flows	Medium	High	<b>Major Adverse</b> - improved drainage could result in nutrient enrichment and pollution of the SAC
Discharge of poor quality water to watercourses	Surface waters	Surface flows	Medium	Medium	<b>Moderate Adverse</b> - inappropriate management of surface waters during construction could result in discharge of poor quality water to watercourses
Flooding of development sites generating physical hazards and contamination of floodwaters	Construction workers and equipment	Direct contact	Low	Medium	<b>Minor/Moderate Adverse</b> - the risk of flooding of the sites is low, is well understood and a warning system will be in place
	Neighbouring site users	Direct contact	Low	Medium	<b>Minor/Moderate Adverse</b> - the risk of flooding of the sites is low, is well

Hazard/Risk Source	Receptor	Pathway	Magnitude	Sensitivity	Significance of Effect
					understood and a warning system will be in place
	Surface waters	Surface flows	Low	Medium	<b>Minor/Moderate Adverse</b> - the risk of flooding of the sites is low, is well understood and a warning system will be in place

Table 10.16: Conceptual Model and Preliminary Impact (Risk) Assessment – Operation Phase

Hazard/Risk Source	Receptor	Pathway	Magnitude	Sensitivity	Significance of Effect
Leaks and spills of fuels and oils associated with vehicles and equipment	Site Users, groundwater and surface waters	Direct contact, ingestion and inhalation	Low	Medium	<b>Minor/Moderate Adverse</b> - small quantities of fuels and oils to be held onsite and geology will impede transfer of significant level of contaminants to groundwater
Sediment loading of watercourses	Surface waters	Surface flows	Low	Medium	<b>Minor/Moderate Adverse</b> - inappropriate management of surface waters could result in sediment loading of watercourses
Improvements in drainage	Llyn Dinam SAC	Surface flows	Medium	High	<b>Major Adverse</b> - improved drainage could result in nutrient enrichment and pollution of the SAC
Discharge of poor quality water to watercourses	Surface waters	Surface flows	Low	Medium	<b>Minor/Moderate Adverse</b> - inappropriate management of surface waters could result in discharge of poor quality water to watercourses

Hazard/Risk Source	Receptor	Pathway	Magnitude	Sensitivity	Significance of Effect
Flooding of development sites generating physical hazards and contamination of floodwaters	The site	Direct contact	Negligible	Medium	<b>Negligible</b> - the risk of flooding of the sites is low, is well understood and a warning system will be in place
	Neighbouring site users	Direct contact	Negligible	Medium	<b>Negligible</b> - the risk of flooding of the sites is low, is well understood and a warning system will be in place
	Surface waters	Surface flows	Negligible	Medium	<b>Negligible</b> - the risk of flooding of the sites is low, is well understood and a warning system will be in place

## 10.8 PROPOSED MITIGATION

- 10.8.1 The design of the solar farm has incorporated opportunities to mitigate the potential impacts to the water environment. It is considered that the potential impacts associated with the construction/decommissioning and operational phases of the development on potential receptors can be adequately mitigated by the measures discussed below.
- 10.8.2 The solar arrays and vulnerable infrastructure will be located above ground level. The modules are raised off the ground such that the leading edge of each panel will be approximately 0.9m off the ground and the top edge approximately 3m above ground level. Consequently, the panels will be unaffected by floodwater depths.
- 10.8.3 The frame supporting the solar panels should not impede overland flow or reduce flood storage capacity, as it would only be the legs which would be within the path of overland flow or floodwaters. The legs are of narrow dimension (60mm) and well-spaced (between 4 to 6m apart).
- 10.8.4 The panels are designed so that they have minimal foundations. This limits disturbance of soils/loss of resource and reduces the volume of concrete required. This would also therefore limit the potential for disruption of surface and groundwater flows.
- 10.8.5 The ancillary structures such as substation and transformers are also small structures and therefore only require shallow foundations, limiting ground disturbance and disruption to overland flow routes. The proposals are based on maintaining the existing drainage, the structures associated with the solar farm will introduce only small areas of impermeable surfacing. It is not proposed to install new drainage infrastructure but maintain existing greenfield runoff rates.
- 10.8.6 Existing farm access tracks will be used, and the position of new access tracks will avoid the necessity for watercourse crossings to avoid changes to in-channel flow and disturbance of the riparian habitat.
- 10.8.7 The sites and surrounding area are located within DAM Zone A and therefore a permanently safe and dry access can be maintained. The existing highways are generally raised about 600mm above the neighbouring fields. The highways will therefore be coincident with the upper confidence interval flood level in the 1 in 100 year and 1 in 200 year event at the end of the lifetime of the development.
- 10.8.8 Furthermore, solar farms are controlled remotely and attendance at the site in adverse weather conditions is not conducive to maintenance activities etc. If the weather is inclement, or a warning of flooding is issued, the solar farm will not be visited.
- 10.8.9 It is recommended that the operator is registered with the NRW flood warning service and that if a warning is issued, all visits are cancelled until the risk and/or hazard have passed. Return to site should not be attempted until the roads are declared clear and safe, and the senior management for the operator has declared the site safe.
- 10.8.10 A 4m minimum buffer strip on DA4 and DA5, and 6m on DA6, adjacent to the top of any small watercourse will need to be retained for maintenance purposes. This will be free of built development and is required by NRW and the Local Planning

Authority/Lead Local Flood Authority. The buffer strip will also mitigate the impact of flooding from fluvial sources.

### Construction Phase

- 10.8.11 Construction best practice measures/mitigation will be in operation during the period of construction of the solar farm. All details of best practice will be based on current guidance produced by CIRIA and NRW which cover good construction techniques and pollution prevention and control measures. The proposed measures will be detailed within the Construction Environmental Management Plan (CEMP) which is likely to be required by means of a planning condition.
- 10.8.12 The contractor for the works will provide 24 hour emergency contact details to NRW's Senior Environment Officer prior to the commencement of the works on site.
- 10.8.13 A Surface Water Management Plan (SWMP) has been developed to manage the additional site runoff anticipated during the construction phase. The detail will be confirmed within the SAB submission. The SAB pre-application advice received stated 'Following review of the attached information [the SAB pre-application and SuDS strategy] I am pleased to confirm that we believe you would satisfy the SuDS legislation with this submission and would support your applications in this instance.'
- 10.8.14 The main elements to the CEMP would be:
- Soil management.
  - Erosion and sediment control.
  - Storage/Use of Construction Materials.
  - Vehicle Maintenance.
  - Environmental Monitoring.
  - Spillage – Emergency Action.
  - DA6.
- 10.8.15 During construction (and decommissioning) it is anticipated that a temporary compound will be established to allow the materials to be off-loaded from HGVs, and then transferred to the DAs using smaller vehicles. The construction compound will have a temporary surfacing of hardcore; on completion of the construction works the hardcore surface will be removed and panels will be installed and the ground seeded. Any rainfall on the temporary compound will runoff to adjacent grassed permeable areas.

### Soil Management

- 10.8.16 Topsoil stripping will be minimised to reduce site runoff volumes. The main areas of soil disturbance will be when new access tracks are formed and for excavation of foundations for substation/transformers, this should be limited in areal extent based on the current proposal. In order to avoid/minimise compaction of the soils, the access tracking and compounds will be formed pre-construction using permeable materials; gravel laid onto geotextile to limit compaction and hence surface water runoff intensification.
- 10.8.17 Preserving the quantity and quality of the site topsoil is critical to preserving the site runoff rates both during and after construction and to promote stabilisation vegetation

establishment. Topsoil stripping will be limited to the areas necessary for access road and construction and for the creation of temporary laydown areas, as required. All stripped topsoil must remain on the Site and be reused for landscaping or restoration. Erosion and sediment control measures for topsoil stockpiles are described below.

### Erosion and Sediment Control Plan

- 10.8.18 The existing and proposed (post-construction) ground surface slope gradients at the Site are classified as shallow and gentle (< 4%), with predominantly long slopes (greater than 30m). Site soils are sands and silty sands, which have low and high erosion potentials, respectively.

### Erosion and Sediment Control Measures

- 10.8.19 The various construction activities required to construct the Proposed Development include minor grading activities and general construction traffic. If left unmitigated, these activities will result in impacts ranging from disturbance of soils to potential erosion and sediment transport to offsite locations.
- 10.8.20 All existing drainage in the surrounding area should be identified and protected to avoid unintentional damage/interruption as a consequence of the site operations and ensure they continue to operate effectively.
- 10.8.21 The current proposals do not require the installation of additional drainage infrastructure as it is not anticipated that the development will create additional runoff. However, during construction works where temporary surface water drainage is provided it should be designed with suitable sediment, oil and fuel control (such as proprietary silt traps, catch pits, straw bales, swales etc). This will ensure that any sediment, oils and fuels carried by overland flow during rainfall events are collected and trapped prior to discharge of surface water to the field boundary drains/main rivers.
- 10.8.22 It is unlikely given the low permeability of the soils and the shallow foundations required for the ancillary structures that excavations will require dewatering. However, if this is required, any waters pumped from excavations will be disposed to the temporary drainage system which will include sediment traps prior to discharge to watercourses.
- 10.8.23 Spillage and Emergency Procedures outlined in the CEMP would be followed in the event of a pollution incident. The plan would include the provision of appropriate emergency response equipment on-site and staff training in emergency procedures.
- 10.8.24 During construction, all site runoff would be intercepted and treated to remove sediment prior to discharge off site. The following guidelines will be observed during the operation of the Site:
- CIRIA. Control of water pollution from construction sites C532 (2001).
  - CIRIA. Environmental Good Practice on Site C650 (2005).
  - CIRIA. The SuDS Manual C753 (2015).
  - Pollution Prevention Guidelines PPG1: Understanding Your Environmental Responsibilities (July 2013).

- Guidance for Pollution Prevention GPP2: Above ground oil storage tanks (January 2018).
- Guidance for Pollution Prevention GPP5: Works and maintenance in or near water (January 2017).
- Pollution Prevention Guidelines PPG6: Working at construction and demolition sites (March 2012).
- Pollution Prevention Guidelines PPG7: The safe operation of refuelling facilities (July 2011).
- Guidance for Pollution Prevention GPP8: Safe storage and disposal of used oils (July 2017).
- Guidance for Pollution Prevention GPP13: Vehicle washing and cleaning (April 2017).
- Guidance for Pollution Prevention GPP21: Incident Response Planning (July 2017).
- Guidance for Pollution Prevention GPP22: Dealing with spills (October 2018).
- Guidance for Pollution Prevention GPP23: Safe storage - drums and intermediate bulk containers (February 2019).
- Government Guidance 'Oil storage regulations for businesses' (2015).
- Government Guidance 'Manage water on land: guidance for land managers' (2015).

10.8.25 Erosion control will be achieved primarily by:

- Managing disturbed soils using soil conservation practices to reduce runoff and sediment transport during construction.
- Constructing barriers to filter runoff.

10.8.26 Erosion and sediment control measures will be implemented prior to any grading or servicing works commencing and include, but are not necessarily limited to, the following measures:

- A perimeter silt fence will be installed at the downstream side of the work limits.
- A 5m wide vegetated buffer will be provided on the downstream side of all disturbed areas. The vegetated buffer will consist of undisturbed native vegetation and any areas of sparse vegetation will be seeded. The vegetation will trap mobilised silt and sediment.
- A construction entrance feature ("mud mat") will be provided at the site entrance to minimise the offsite transport of sediment via construction vehicles.
- The access road will be cleaned of any sediment deposited by site construction traffic.
- Stabilise topsoil stockpiles expected to be left in place longer than 30 days with vegetative cover (i.e., hydroseeding) or a rolled erosion control product in the event of unfavourable growing conditions (i.e., during the winter).
- Re-vegetate all disturbed areas where construction is not expected for 30 days with a minimum 50mm of topsoil and hydro-seeding or other stabilizing vegetation / erosion protection measures. If vegetation establishment is not possible, given seasonal restriction or other revegetation limiting factors, the disturbed area should be stabilised against erosion impacts by non-vegetated means such as erosion control blankets.
- In the event of inclement weather or unfavourable terrain for construction, construction best practices, such as temporary rig-mats may be used to prevent disruption of surface soils and vegetative cover by construction vehicles and equipment.

10.8.27 The erosion and sediment control measures shall be maintained in good repair during the entire construction period and removed as contributing drainage areas are restored and stabilised where they are not required anymore otherwise they will be left in-situ for the operational phase. In addition, the condition of erosion control works, their overall performance, and any repairs, replacement, or modifications to the installed item shall be noted in logbooks to be kept on-site.

#### Erosion and Sediment Control Contingency Plan

10.8.28 The purpose of the Erosion and Sediment Control contingency plan is to help minimise the risk or consequence of failure of the erosion and sediment control works. Failure could result from insufficient measures, lack of maintenance, or severe weather conditions. The contingency plan includes two areas of consideration: the contingency measures that will be implemented where there is potential for failure; and the procedures that will be followed where a failure has occurred.

10.8.29 The Contractor shall be responsible for following the Erosion and Sediment Control contingency plan, and will prepare the following items:

- Workers shall be on call for emergency situations for all aspects of the emergency from design to construction of emergency sediment and erosion control measures. Any associated health and safety issues are the responsibility of the Contractor.
- Heavy duty silt fence, pumps, double-net straw matting erosion control blankets, straw bales and stakes, sandbags, appropriately sized riprap, and clean gravel fill shall be available on-site for emergency installation.
- Heavy equipment shall be on standby for emergency works.
- A contact list for any further required equipment or materials shall be prepared and made available for emergency use.

#### Contingency Measures where there is a High Risk of Failure

10.8.30 Conditions that may potentially cause failures can be identified through two methods:

- High Risk Identified Through Monitoring

10.8.31 Where monitoring has identified a high potential for failure, steps shall be immediately taken to reduce the risk. These measures may include repair to existing measures, modification of existing measures, and the addition of new measures.

- Severe Weather Anticipated

10.8.32 In cases where the weather forecast indicates that significant rainfall (>10mm) is expected within a 24-hour period, the Contractor shall immediately complete the following:

- Verify that all erosion and sediment control measures are secure and that there is no exposed soil that could erode and be deposited downstream.
- Verify that all other measures are in good working order.
- Monitor all measures during the rainfall event, and where a potential for failure is identified, take corrective measures.

10.8.33 If unforeseen events cause the strategies set out in the contingency plan to be insufficient or inappropriate to meet the objective of containing sediment within the work limits, the Contractor will respond in a timely manner with all reasonable

measures consistent with safety, to prevent, counteract or remedy any negative effects on the natural environment or adjacent properties.

### Contingency Measures in Case of Failure

10.8.34 In the event of a failure, the Contractor will cease all construction related work and focus on erosion and sediment control as required to effectively stabilise the site where a failure has occurred or is imminent.

10.8.35 If significant long-term damage to downstream habitat or property is suspected, the Contractor will immediately assess and document the situation and report the incident to NRW. Development of the initial restoration plan will begin within 24 hours of the discovery of failure and will be implemented as soon as possible. The plan will address:

- Removal and disposal of sediment from outside the work limits.
- Restoration of the affected area.
- Restoration of any areas disturbed through deposition or removal.

### Erosion and Sediment Control Monitoring Programme

10.8.36 To ensure the effectiveness of the various erosion and sediment control measures, a routine programme should be implemented which includes the inspection of the erosion and sediment controls daily and after each significant rainfall event (10mm), and immediate repair of any deficiencies. Non-urgent repairs (i.e. no immediate risk of sediment discharges to the downstream environment) will be completed within 48 hours of identifying the deficiency, or prior to the next anticipated rainfall event, whichever is less. This program will consist of the following activities:

- Visual inspection of the measures to ensure discharged flows are generally free of sediment and turbidity.
- Inspection of vegetation protection, erosion control blankets and silt fencing to ensure that they are maintained in good repair.
- Removal of construction debris that may accumulate.
- Implementation of remedial measures including erosion stabilisation, repair of damaged measures and any other remediation where required.

### Storage/Use of Construction Materials

10.8.37 All soil stockpiles, construction materials, equipment and chemicals will be placed away from watercourses and outside the DAM Zone C2 (including welfare facilities). All regulations will be adhered to for the storage of fuels and chemicals including adequate bunding, location onto gravelled areas within the construction compound. All vehicle refuelling will be within the construction compound, away from watercourses.

10.8.38 When excavating to form the service roads, work should be programmed to ensure that volumes of excavated and imported material are not stored for significant lengths of time.

10.8.39 High risk construction activities such as concrete batching which can produce alkaline runoff which is highly toxic to aquatic organisms will be undertaken on gravelled areas at a suitable distance from surface watercourses/drains. Its transportation to the point

of use on site will be controlled, no wet concrete will be used in and around watercourses.

10.8.40 All welfare facilities to be adequately designed and maintained to ensure all sewage disposed of appropriately, likely to be tankered for off-site disposal.

10.8.41 Standard pollution prevention procedures are to be implemented during the operational phase based on industry best practice and the GPPs PPGs, other NRW guidance, CIRIA document C532 “Control of Water Pollution from Construction Sites” and CIRIA document C753 “The Site SuDS Manual” would mitigate the risks to surface water quality. Examples of some of the measures that would be adopted at the Site are included below, to mitigate potential impacts on the water environment:

- Silt traps, straw bales placed within stream channel and temporary settlement lagoons.
- Protective coverings to stockpiles and locations away from watercourses.
- Retention of vegetated strips along watercourses.
- Tanked areas for plant and wheel washing.
- Bunded fuel storage and refuelling areas.
- Provision of spill kits.
- Location refuelling areas away from watercourses.
- Provision of vegetation/grass cover on earth stockpiles.

### Vehicle Maintenance

10.8.42 It is expected that all vehicles used will be in good order and fit for purpose, therefore only emergency maintenance will be undertaken within designated areas away from watercourses etc.

10.8.43 In accordance with the GPPs and PPGs, all fuel tanks on site shall have a bunded containment of a minimum of 110% fuel tank capacity. There would be no drainage point from the bunded containment area; tamperproof taps and valves would be installed, and all empty fuel containers or drums would be stored within a containment area prior to their removal or disposal from the Site. Oil traps would be incorporated in pertinent drainage systems to prevent accidental spillage being discharged into surface runoff. Spill kits would be stored at refuelling areas and would include sand or other suitable containment and absorbent material.

10.8.44 Best practice measures would be undertaken when refuelling of plant and machinery. Where fuelling of large machinery is required, drip trays and absorbent mats and pellets would be used to contain or absorb accidental spillages. Plant maintenance would also be undertaken in a designated area and similar contamination prevention measures would be adopted.

### Spillage – Emergency Action

10.8.45 All materials and equipment used for site preparation and construction will be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt, etc.) from migrating to offsite receivers.

10.8.46 Spillage and Emergency Procedures outlined in the CEMP would be followed in the event of a pollution incident and would be developed in consultation with NRW. The

plan would include the provision of appropriate emergency response equipment on-site and staff training in emergency procedures. GPP21 would be integrated into the Site emergency procedures.

- 10.8.47 Refuelling and maintenance of construction equipment should occur in designated areas, a minimum of 30m from a water body, wetland, or other sensitive receiver.
- 10.8.48 Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by NRW with residual spillage allowed to bioremediate in the drainage system.
- 10.8.49 In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s), (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric.)

### Development Area 6

- 10.8.50 Following site surveys and pre-application discussions with NRW and LLFA it was noted that currently water discharged from the Dol Eithin housing estate and flows slowly through DA6 and the poor state of the ditch network means that much of the silt and nutrients settles out in very localised temporary ponding/ flooding area or is lost en route before it reaches the Llyn Dinam SAC.
- 10.8.51 The proposed development has the potential to improve the drainage which could result in nutrient enrichment and pollution of the SAC. Discussions have taken place with NRW, the LLFA and SAB it has been agreed that mitigation measures specific to DA6 would be developed which would include silt mitigation, pollution control measures and an emergency response plan.
- 10.8.52 As part of providing vehicular access during the construction phase ditch crossing points are required. Proposed drainage ditch crossing routes has the potential to speed up the flow of water through DA6 and in the Llyn Dinam SAC. Therefore, upstream of any pipework used to allow for the vehicle crossing points a small vegetated sediment forebay will be constructed to trap mobilised silt and sediment.
- 10.8.53 This could be easily formed by making sure that the upstream invert level of the drainage ditch is below the invert level of the pipework, so that water would only discharge through the pipework when water levels are high. For the majority of the time the pipework would be dry and would allow sediment to become trapped upstream. This will be planted up to slow any catastrophic flood/sediment before it re-enters the drainage ditch.
- 10.8.54 Details on the positioning of these crossing points and ditch management options will be provided as part of the SAB approval submission.

### Operational Phase

- 10.8.55 The proposed access tracks that will be used to service the inverter and transformer

units will be constructed from permeable material. This will ensure that the access tracks remain permeable allowing surface water to infiltrate into the soil substrate, therefore the access tracks will not result in an increase in the impermeable area.

- 10.8.56 The proposed transformers, cabins and substations will be constructed from impermeable surfaces however, these will stand on an area of permeable surfaces.
- 10.8.57 The transformer and cabin plinths will be founded on concrete pads surrounded by permeable surfaces.
- 10.8.58 The proposed PV modules will consist of an aluminium frame, with stainless steel supports and concrete shoes. Greenfield conditions will be retained as alluded to in the BRE Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems. Although the solar panels will divert the downward path of falling rain, being raised off the ground on frames, they will not reduce the permeable area where they are sited. Any rainfall that does fall onto the site will, as now, infiltrates into the soil substrate.
- 10.8.59 It is anticipated that rain falling on each of the solar PV modules will fall underneath the downslope of the panels. A gap of approximately 20mm will allow water to drain off each PV module (the 20mm gap surrounds all sides of the panels). The erection of the solar panels will require the use of light machinery; however, it is anticipated that this would not lead to irreversible compaction of soils on the site. Therefore, infiltration should not be limited by compaction of soils. The land on the site can continue to be used for agricultural purposes (sheep grazing or similar) or for biodiversity enhancement following installation of the panels.
- 10.8.60 There should, therefore, be no perceivable changes to the upstream or downstream hydrology and to flood risk as a result of the proposals. In terms of surface water runoff, the proposals will not increase the impermeable area on the site, as the size of the transformers and PV modules are considered to be negligible in the context of the site areas.
- 10.8.61 It is generally accepted that the presence of solar panels on a site may slightly change the pattern of runoff with the potential for minor erosion at the base of the panels. There is empirical evidence (Cook and McCuen (2013) Hydrologic Response to Solar Farms, pg 536-541, Journal of Hydrologic Engineering, ACSE, May 2013), however, on the effect of solar development which found that with well-maintained grass underneath the panels, the solar panels themselves did not have a significant impact on the runoff volumes, peaks or time to peak. The analysis found that, with bare ground or gravel cover beneath the panels as a result of design decisions or lack of maintenance, peak discharge may increase resulting in the need for stormwater management.
- 10.8.62 Natural England has provided guidance on solar parks in the form of Technical Information Note (TIN) 101, although TIN101 is not specific to Wales, it provides useful information. This guidance provides an overview of the potential effects and possible mitigation measures for soil erosion and increased runoff, amongst others. TIN101 states that “The key to avoiding increased run-off and 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.”

- 10.8.63 TIN101 concludes that “the risks of run-off and soil erosion are lowest on low gradient land with cohesive soils and highest on dry, sandy and steeply sloping soil surfaces”; this highlights the effect of slope on runoff rates and soil erosion. Furthermore, the slope aspect of the land can also have an effect on runoff rates and soil erosion. The aspect of the solar panels will always be south-facing (in the UK) 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.
- 10.8.64 The proposed development is considered to have a relatively low gradient, with south-facing slope. A grassed surface will be maintained at the site to reduce the likelihood of overland flow or soil erosion occurring which, based on this assessment, is considered to be low.
- 10.8.65 Any local erosion which might result from this trend will be mitigated by the thick sward of tussocky grass germinated both beneath and between the panels and its regime of regular maintenance and therefore, there will be no increase in flood risk off the site.
- 10.8.66 As there is no history of surface water flooding at the site it is likely that the current drainage system is sufficient for the current and proposed site use. The surface water runoff will not increase post-application compared to pre-application and there will be no increase in surface water flood risk to the site and off-site locations. No changes to the current surface water network are proposed. Following development, surface water flows from the site will continue to discharge to the ground.
- 10.8.67 Recent solar project experience has shown that several growing seasons are necessary for the site restoration vegetation to become fully established. Consequently, the proposed vegetated buffers used to manage runoff during the site construction will remain post-construction to mitigate the risk of downstream flooding or erosion caused by the proposed development.
- 10.8.68 Temporary erosion and sediment control measures implemented during construction will remain in place until the site restoration vegetation has become sufficiently established to provide adequate stabilisation. The temporary erosion and sediment control measures can then be removed and disposed of off-site.
- 10.8.69 Natural England’s ‘Technical Information Note TIN101: Solar Parks: Maximising Environmental Benefits’ encourages existing land drainage to be maintained. Existing onsite features will therefore be retained in their existing state and will continue to intercept overland flows from the site.
- 10.8.70 An SWMP has been developed to manage the site runoff anticipated during the operational phase. The detail will be confirmed within the SAB submission. A draft of the SAB submission is presented in **Appendix 10.3**.

### Vegetated Buffers

10.8.71 Vegetation can be used to provide water quality benefits, this is achieved by the runoff/vegetation interaction which reduces the velocity of runoff, thereby promoting the sedimentation of particulate matter. The vegetation also provides nutrient uptake benefits to help reduce biological pollutants such as nitrogen and phosphorous. Where required the vegetation will be re-instated and replanted to improve the current situation. The vegetation will trap mobilised silt and sediment.

#### Stabilisation Vegetation

10.8.72 All permeable surfaces within the Site will be stabilised with a restoration seed mix that will provide year-round surface cover. The stabilisation vegetation will improve the Site hydrologic characteristics, reducing both the peak flows and volumes.

10.8.73 Prior to restoration seeding, the work limits will be scarified to a minimum depth of 150mm, to mitigate soil compaction caused by construction traffic and to promote seed establishment. In accordance with the guidance presented, scarification will be performed with a chisel plow to retain as much vegetation residue on the soil surface as possible.

#### Long Term Erosion and Sediment Control

10.8.74 Approximately one year after completion of construction, the Applicant will complete a site inspection to ensure that long-term erosion control measures have been effective. Seeded or replanted areas will be inspected to ensure that vegetation measures were successful and reseeded or replanting will occur where necessary.

10.8.75 If erosion control measures are found to be less than fully effective during this survey, reseeded or replanting of problem areas will take place. Should there be residual effects noted during post-construction monitoring, advice on contingency measures will be sought and applied.

#### Development Area 6

10.8.76 The small vegetated sediment forebay will be maintained and monitored so that water would only discharge through the pipework when water levels are high. For the majority of the time the pipework would be dry and would allow sediment to become trapped upstream.

#### Monitoring and Maintenance

10.8.77 The proposed SWMP incorporates passive and simple surface water runoff management practices, with operational and maintenance requirements to match. The site Owner's inspection, operational, and maintenance activities generally consist of:

- A semi-annual walking inspection of the entire site should be completed during the spring and autumn to identify areas of bare soil and/or erosion. Remediation efforts would typically involve re-grading the affected area and/or re-vegetating with sod or appropriate seed mix, with fertilizer and water applied as necessary to ensure germination and stabilisation.
- Concurrent with the walking inspections, a visual assessment of any areas of persistent sediment build-up should be identified. Excessive sedimentation is an issue requiring attention if it remains in a non-vegetated condition and is,

therefore, prone to re-suspension and transport downstream. If any such condition occurs, the sediment should be removed and the area re-stabilised.

- The walking inspections will also include a review of the ground surface conditions along the entire downstream site perimeter to identify any areas of erosion or concentrated surface water discharge. Downstream impacts will be identified, and the Owner will develop a remediation plan to address them.
- The density and health of vegetation should be evaluated during the walking inspections. Deficiencies in this regard could be indicative of poor species selection or poor growth, and replanting should be undertaken to ensure sufficient vegetation densities.
- Driving on the site should be avoided during wet periods to reduce the possibility of excessive rutting.

## 10.9 RESIDUAL IMPACTS

10.9.1 This section summarises the significance of the anticipated residual environmental effects, which are those that remain after all proposed mitigation measures are implemented. The residual effects are summarised below in **Table 10.16** below.

Table 10.16: Summary of Residual Effects

Potential Effect	Significance of Effects	Mitigation	Residual Effect
<b>Construction Phase and Decommissioning Phase</b>			
Leaks and spills of fuels and oils associated with vehicles and equipment	Moderate Adverse	CEMP, Surface Water Management Plan	Negligible
Sediment loading of watercourses	Moderate Adverse	CEMP, Surface Water Management Plan	Negligible
Improvements in drainage	Major Adverse	CEMP, Surface Water Management Plan	Negligible
Discharge of poor-quality water to watercourses	Moderate Adverse	CEMP, Surface Water Management Plan	Negligible
Flooding of development site generating physical hazards and contamination of floodwaters	Minor/Moderate Adverse	CEMP, Surface Water Management Plan	Negligible
<b>Operation Phase</b>			
Leaks and spills of fuels and oils associated with vehicles and equipment	Minor/Moderate Adverse	EMP, Surface Water Management Plan	Negligible

Sediment loading of watercourses	Minor/Moderate Adverse	EMP, Surface Water Management Plan	Negligible
Improvements in drainage	Major Adverse	CEMP, Surface Water Management Plan	Negligible
Discharge of poor-quality water to watercourses	Minor/Moderate Adverse	EMP, Surface Water Management Plan	Negligible
Flooding of development site generating physical hazards and contamination of floodwaters	Negligible	EMP, Surface Water Management Plan	Negligible

## 10.10 SUMMARY AND CONCLUSIONS

- 10.10.1 All sources of flooding have been considered, these are fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure. NRW identifies parts of DA4 and DA5 are with DAM Zones B and C2 from undefended fluvial flood extents.
- 10.10.2 A Flood Consequence Assessment (FCA) has been carried out for the Proposed Development in accordance with guidance contained in Planning Policy Wales and TAN15. The FCA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks would be managed so that the development remains safe throughout the life of the development taking climate change into account.
- 10.10.3 Due to the higher flood risk areas in DA4 and DA5, the FCA and the Planning Statement demonstrate that the Justification Test as prescribed in section 6 of TAN 15 is met.
- 10.10.4 There is empirical evidence of the effect of solar development, which has found that, with well-maintained grass underneath the panels, the solar panels themselves do not have a significant impact on the runoff volumes of surface water.
- 10.10.5 At present surface water runoff is discharged from the Dol Eithin housing estate and flows slowly through DA6 to Llyn Dinam (SAC). Currently the poor state of the ditch network means that much of the silt and nutrients settles out in very localised temporary ponding/ flooding area or is lost en route before it reaches Llyn Dinam. As part of a package of enhancements the ditch network will be managed to ensure surface waters are retained for a sufficient period to maximise sediment and nutrient fall out prior to entering the SAC. Details of the enhancement are presented in the Sustainable Urban Drainage Approval Body (SAB) submission in **Appendix 10.3**.



