Foel Fach Wind Farm Limited.

Foel Fach Wind Farm - Environmental Statement Volume III

Appendix 7.10: Outline Drainage Strategy

Project Reference: 664094

DECEMBER 2025

RSK GENERAL NOTES

Project No.:	664094
Title:	Foel Fach Wind Farm: Outline Drainage Strategy
Client:	Foel Fach Wind Farm Limited
Date:	November 2025
Office:	Stirling
Status:	Version 1.0

Author	Etisang Abraham	**Technical reviewer**	Catherine Isherwood
Date:	05/11/2025	Date:	07/11/2025

Project manager	Catherine Isherwood
Date:	07/11/2025

CONTENTS

TABLES

1 INTRODUCTION

1.1 Introduction

1.1.1 This report provides a Drainage Strategy for Foel Fach Wind Farm and associated infrastructure, hereafter referred to as the 'Proposed Development'.

1.1.2 The report forms a Technical Appendix to **Volume II** of the Environmental Statement (ES) for the Proposed Development and should be read in conjunction with **ES Volume II, Chapter 7: Land, Soils, and Water** and associated figures in **Volume IV**. It has been produced to outline how sustainable drainage systems (SuDS) have been integrated in the proposed development in compliance with the Welsh Government's Technical Advice Note (TAN) 15 – Development, flooding and coastal erosion and the Welsh Government's Sustainable Drainage (SuDS) Statutory Guidance 2019.

1.1.3 For the purposes of this report, the study area is considered to include the Site plus an area up to 2 kilometres (km) from the boundary of the Site.

1.2 Site Location

1.2.1 The Application Site ('Site') is located within the administrative boundary of Gwynedd Council, North Wales, approximately 3.1 km north-east of Bala. Eryri National Park is situated to the west of the Site, with the nearest turbine (T01) located approximately 1.9 km east of the national park boundary. The Site elevation varies from approximately 225 metres (m) above Ordnance Datum (AOD) to approximately 550 m AOD. The majority of the Site is located on an area of grazing moorland with two parcels of registered common land. Two registered common land parcels are located in the eastern area of the Site. The majority of the land within the Site is Countryside and Rights of Way Open Access land, with areas of agricultural land. A number of Public Rights of Way (PRoW) are present within and adjacent to the Site, although none are nationally designated trails. Small wooded areas are present within the Site. Ancient woodland and larger areas of forestry are present outside the Site, to the south.

1.3 Development Proposals

1.3.1 The Proposed Development would include:

- described more fully in the following sections:
- 10 no. three bladed horizontal axis wind turbines, up to 200 or 220 metres in height to the blade tip (where specified)
- wind turbine foundations and hardstanding areas which will include crane pad hardstanding areas and laydown/storage areas

- an onsite substation
- a battery energy storage system (BESS)
- permanent wind monitoring equipment (LiDAR)
- site access improvements, through the upgrading of the existing junction off the B4501
- onsite access tracks (new roads and upgraded existing roads/tracks), passing places and vehicle turning heads
- underground power cables linking the wind turbines and the substation
- watercourse crossings and associated infrastructure
- drainage system
- micrositing up to 50 m
- onsite signage, and
- biodiversity enhancements proposals.

1.3.2 Full details of the Proposed Development design are provided in **ES Volume II, Chapter 2: Description of the Proposed Development**.

1.4 Aims

1.4.1 This report aims to undertake a review of the current hydrological setting of the Site, including available information concerning existing drainage information, in order to provide an outline strategy for water and drainage management during all stages of the development process, as well as the integration of SuDS. This is in line with the following requirements for a Drainage Statement outlined in Figure 3 of TAN15:

- Details of the site location and existing drainage arrangements
- Details of how surface water is to be managed and discharged, ensuring compliance with the existing SuDS standards, and
- Information for the proposed SuDS elements of the surface water drainage system and an indication of the intended future maintenance regime.

1.4.2 The outline drainage strategy provided should be used to underpin relevant sections of the detailed design and the detailed drainage strategy, which will be secured by condition, as well as to fulfil the requirements for a SuDS Approving Body (SAB) application post-consent.

1.5 Assessment Method

1.5.1 This assessment has involved the following stages:

- desk study
- site reconnaissance
- hydrological assessment, and
- assessment of drainage characteristics and water storage.

2 SITE DRAINAGE CHARACTERISTICS

2.1 Existing Drainage and Natural Catchments

2.1.1 This section describes the existing drainage arrangements within the Site in accordance with Figure 3 of TAN15.

2.1.2 Catchment data obtained from the Flood Estimation Handbook (FEH) Web Service (FEH, 2025), shows that the Proposed Development lies within five catchment areas: Medrad to the north, Meloch to the east, Dee-Alwen to Llyn Tegid to the south, Tryweryn-Dee to Mynach to the south-west, and Mynach to the north-west. Catchment areas and key watercourses are shown in **ES Volume IV, Figure 7.6: Hydrological Catchments and Watercourses**. An overview of the watercourse catchments, their areas and the infrastructure proposed within them is provided in **Table 7.10.1.**

Afon Medrad

2.1.3 The Afon Medrad catchment, covering a small area at the northern edge of the Site, has a total area of 15.2 km^2 and drains 0.03% of the Site.

2.1.4 Drainage for the catchment is provided by the Afon Medrad and its tributaries.

2.1.5 Within the Site, the Medrad catchment is described by Natural Resource Wales' (NRW) Environmental Information Portal (NRW, 2025) as an area of unimproved acid grassland with areas of wet modified bog, acid flush and bracken.

Afon Meloch

2.1.6 The Afon Meloch catchment, covering the eastern part of the Site, has a total area of 16.1 km^2 and drains 39.42% of the land within the Site.

2.1.7 Drainage is provided by the Nant Cefn Coch, which is a minor tributary of the Afon Meloch, and the Afon Meloch itself.

2.1.8 The Afon Meloch catchment has been described by NRW (NRW, 2025) as an area of unimproved acid grassland on Moel Darren, including large areas of wet modified bog, acid flush and bracken.

River Dee-Alwen to Llyn Tegid

2.1.9 The River Dee-Alwen to Llyn Tegid catchment, covering the central southern part of the Site, has a total area of 6.2 km^2 and drains 26.70% of the land within the Site.

2.1.10 Drainage is provided by unnamed minor watercourses feeding Llyn Maen Bras, and by the Nant Hafhesp and its tributaries downstream of Llyn Maen Bras.

2.1.11 The River Dee-Alwen to Llyn Tegid catchment is described by NRW (NRW, 2025) an area of unimproved acid grassland with large areas of wet modified bog, acid flush and bracken.

Afon Tryweryn-Dee to Mynach

2.1.12 The Afon Tryweryn-Dee to Mynach catchment, covering the south-western corner of the Site, has a total area of 20 km^2 and drains 0.12% of the land within the Site.

2.1.13 Drainage is provided by unnamed minor watercourses feeding into the Afon Tryweryn.

2.1.14 The Afon Tryweryn-Dee to Mynach catchment is described by NRW (NRW, 2025) as a mixture of enclosed improved grassland, improved and marshy grasslands with small areas of woodland, and an area of unimproved acid grassland with wet, modified bog.

Afon Mynach

2.1.15 The Afon Mynach catchment, covering the north-western part of the Site, has a total area of 17.1 km^2 and drains 33.72% of the land within the Site.

2.1.16 Drainage is provided by the Afon Mynach and its tributaries.

2.1.17 Within the Site, the eastern part of the Afon Mynach catchment is described by NRW (NRW, 2025) as an area of unimproved acid grassland with large areas of wet modified bog, acid flush and bracken. Conversely, the western part towards the Site is described as semi-improved neutral grassland.

Table 7.10.1 Overview of Watercourse Catchment Areas and Infrastructure

Catchment	Total area (km^2)	% of Site within catchment	% of catchment within Site	Infrastructure within Catchment
Afon Mynach	17.1 km^2	33.72%	12.90%	Main site access track Entrance construction compound Borrow pit Watercourse crossing WC01 Part of wind turbine T02.
Afon Meloch	16.1 km^2	39.42%	16.02%	Wind turbines T02, T03, T04, T05, T06, T07, T08, T09, and T10 Access track Watercourse crossing WC02 and WC03 Part of substation Batching compound Bridge temporary working area LiDAR compound.

Catchment	Total area (km^2)	% of Site within catchment	% of catchment within Site	Infrastructure within Catchment
River Dee - Alwen to Llyn Tegid	6.2 km^2	26.70%	28.12%	Wind turbine T01 Part of substation Section of access track.
Afon Tryweryn - Dee to Mynach	20 km^2	0.12%	0.041%	None
Afon Medrad	15.2 km^2	0.03%	0.013%	None

Rainfall Characteristics

2.1.18 A review of the watercourse catchment and rainfall characteristics has been undertaken using data from the FEH Web Service (CEH, 2025). Catchment statistics have been provided for the five catchments in the Proposed Development.

2.1.19 Standard average annual rainfall (SAAR) for the three main catchment areas are as follows:

- Afon Mynach: 1,635 mm
- Afon Meloch: 1,422 mm and,
- River Dee-Alwen to Llyn Tegid: 1,425 mm.

2.1.20 The average SAAR for the catchment areas is 1,487.5 mm which is comparable with records collected from Bala climate monitoring station. This value has been used for calculations in **Section 3** below.

Catchment Land Use

2.1.21 Land at the Proposed Development is primarily used for agricultural purposes as pasture and rough grazing. Two parcels of registered common land are present in the north-east of the Site. The majority of the land falls under Countryside and Rights of Way Open Access land.

2.1.22 Terrestrial habitats within the Site are relatively dry, although there are some boggy areas. The western and south-western sections are characterised by fields used for pasture and improved grazing with hedgerows providing field boundaries. The rest of the Site is open moorland with rough grazing on hill summits and valley slopes. A small area of deciduous trees is present in the western section of the Site.

2.1.23 There are two residential properties and farms in proximity to the Site, both are located towards the western section of the Site.

Existing Drainage Infrastructure

Wastewater

2.1.24 There is no existing wastewater infrastructure for foul drainage within the Site. Most of the nearby properties are on private water supply (PWS) and are anticipated to have private wastewater disposal via septic tanks or similar.

Surface Water

2.1.25 Surface drainage within the Site is variable. Parts of the Site drain via infiltration and overland flow to existing natural watercourse channels and groundwater with limited or no artificial drainage or modification to natural channels. Some of the Site is seasonally boggy, and indistinct overland flow paths merge to form more distinct drainage channels. One waterbody, Llyn Maen Bras, is present within the southern part of the Site.

2.1.26 In other parts of the Site, the natural drainage has been significantly modified to improve drainage for agricultural purposes. This is most notable in the areas of improved pasture, but extensive drainage ditches are apparent in some moorland areas.

2.1.27 All watercourse systems, whether natural or artificial, ultimately drain into Afon Dyfrdwy (River Dee) via associated tributaries.

2.1.28 The photographs in **Table 7.10.2** below provide examples of key hydrological features within the Site.

Table 7.10.2 Key Hydrological Features Within the Site

Photograph 7.10.1 View of wetland area west of T03. National Grid Reference (NGR) SH 93490 41030.

Photograph 7.10.2 Boggy area in the headwaters of a tributary to Llyn Maen Bras. NGR SH 93450 40710.

Photograph 7.10.3 Small vegetated watercourses in a headwater tributary of Llyn Maen Bras south of T01. NGR SH 93184 40726.

Photograph 7.10.4 Artificial drainage into an unnamed tributary of Afon Mynach. Manhole in the foreground is a disused well. NGR SH 91096 40898.

Photograph 7.10.5 Vegetated drainage ditch in poor condition. NGR SH 91841 40884.

Photograph 7.10.6 Outlet of a culvert diverting a small watercourse under a track. NGR SH 92145 40933.

Photograph 7.10.7 Pooled surface water and culvert outlet feeding an unnamed watercourse. NGR SH 92166 41022.

Photograph 7.10.8 Boggy area in the headwaters of a tributary to the Nant Cefn-coch. NGR SH 93758 40870.

Photograph 7.10.9 The Nant Cefn-coch, in the form of a narrow channel east of T09. NGR SH 94705 41420.

Photograph 7.10.10 Boggy area and Surface water pooling on track. NGR SH 93722 41906

3 OUTLINE DRAINAGE STRATEGY

3.1 Introduction

3.1.1 This section provides an outline drainage strategy for the Site. The proposal is to maintain Site runoff within the natural catchment areas, and to maintain drainage to the Site watercourses following treatment and attenuation in order to mimic natural flow patterns as closely as possible. This section addresses the last two requirements of a Drainage Statement set out in Figure 3 of TAN15.

3.2 Wastewater Drainage

3.2.1 It is anticipated that wastewater drainage for construction and operation would be provided by a suitably sized containment tank, which would be emptied by tanker and all wastewater would be removed for disposal at a suitably licensed treatment facility. No discharge to ground or to a watercourse is proposed.

3.3 Surface Water Drainage

3.3.1 In line with Figure 3 of TAN 15, the surface water drainage network for the Site would be designed considering the requirements of the Flood and Water Management Act 2010 (Schedule 3) and current best practice guidance from the Welsh Government (2018) and the Construction Industry Research and Information Association Publication C753 – the SuDS Manual (CIRCA, 2015).

3.3.2 The following sections describe the requirements that lead to determination of the proposed drainage strategy, and which informs the Sustainable Drainage Systems (SuDS) provision recommendations.

3.3.3 The Welsh Government's document 'Statutory National Standards for Sustainable Drainage Systems' (2018) sets out a hierarchy of surface water runoff designations that must be followed. The Levels are as follows:

- Priority Level 1: Surface water runoff is collected for use
- Priority Level 2: Surface water runoff is infiltrated to ground
- Priority Level 3: Surface water runoff is discharged to a surface water body
- Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain or another drainage system, and
- Priority Level 5: Surface water runoff is discharged to a combined sewer.

3.3.4 Priority Levels 4 and 5 should only be used in exceptional circumstances. Priority Level 1 is the preferred option.

Site Options for Priority Levels

Priority Level 1

3.3.5 There is limited potential within the Site to make use of collected surface water runoff. The substation and control building would include a rainwater harvesting system, which would provide water for use within the operational phase welfare facilities.

3.3.6 Water collecting in settlement ponds could be used for dust suppression where required during the construction of the Proposed Development. This is most likely to be of use in the borrow pit area, around the construction compound and along track sections during dry periods. If suitable, surface water harvesting would be used to supplement the water requirements for the construction phase welfare facilities.

Priority Level 2

3.3.7 Use of suitable SuDS features would encourage infiltration to ground in areas where ground conditions are suitable. Areas of existing boggy ground are likely to have limited options for additional infiltration, but other parts of the Site are more likely to provide options for infiltration to ground.

Priority Level 3

3.3.8 It is anticipated that surface water runoff that cannot be collected for use and is in an area where ground conditions make infiltration unsuitable would be collected within the Site drainage system for treatment to remove suspended sediment and discharge into the existing surface water network.

Detailed Design

3.3.9 Site-specific details and design proposals would be provided as part of the detailed design. This would include infiltration testing as required at suitable locations within the Site.

SuDS Components

3.3.10 The following SuDS features have been considered for inclusion within certain sections of the Proposed Development's drainage network to control, manage and treat surface water runoff during construction, operation, and decommissioning of the Proposed Development.

Swales and Filter Strips

3.3.11 Swales are shallow, broad, and linear vegetated drainage features that can be designed to store and/or convey surface runoff as well as providing water treatment. Where soil and groundwater conditions allow, swales can also promote infiltration. Vegetation within swales varies but typically comprises grass or dense vegetation that can act to slow down flow rates and trap particulate pollutants in the water.

3.3.12 Filter strips are gently sloping vegetated strips of land that provide off-the-edge diffuse drainage. They provide some flow attenuation and treatment but provide little or no water storage.

Filter Drains

3.3.13 Filter drains are also linear drainage features, but rather than incorporating vegetation they include coarse graded rock which provides good drain stability while also providing water storage and conveyance. Filter drains have a narrower footprint than swales and can be used in areas where space constraints prevent wider swales from being used. Filter drains provide some limited water treatment.

Check Dams

3.3.14 For either swales or filter drains that cross slopes, check dams provide a valuable means of attenuating water flow. These are typically placed across the swale or drain at intervals of 10-20 m. The design is such that the toe of the upstream dam is level with the crest of the next downstream dam. A small opening or pipe is placed at or near the base of each dam to allow limited flow to pass through rather than over the dam, to maintain low flow conveyance.

3.3.15 Check dams should be built into the sides of the swale or filter drain, to ensure that water flow cannot bypass the dam.

3.3.16 When made of soil (as opposed to stone or rock), check dams are often called bunds or berms.

Silt Fences

3.3.17 Silt fences, constructed from a closely woven synthetic geotextile material, provide flow attenuation and excellent particulate filtration treatment for surface water runoff. These are particularly valuable for sediment management in runoff during construction works, as silt fences can be positioned along the main runoff routes to capture, slow and treat runoff. They can also provide temporary check dams if required in short-term drainage infrastructure.

Settlement Ponds, Sumps and Detention Basins

3.3.18 Settlement ponds provide storage for Site runoff and are a highly effective method of treatment and attenuation of surface water. They are particularly useful for developments where bulk earthworks form a significant part of the works, as for the Proposed Development.

3.3.19 Sumps are small pits or ponds used for localised water storage, often in conjunction with drains and ditches. These can be valuable in areas adjacent to watercourse crossings or where space for larger ponds is not available.

3.3.20 Detention basins are more usually used as long-term temporary storage for surface runoff during and after storm or high intensity rainfall events. They may be developed from construction phase settlement ponds where conditions are suitable.

3.3.21 Emergency water supplies can be stored onsite for use in high-risk situations, such as fire suppression at the BESS. Any attenuation basins or tanks provided must have the capacity to hold at least the same volume as the emergency water supply. In the event of a fire, these systems should be designed to contain the full volume of fire water, enabling potential reuse and ensuring that the water can be tested for contaminants prior to discharge or offsite disposal.

Site Conditions for SuDS

3.3.22 It is anticipated that settlement ponds would be used at each turbine location, the substation, construction compound and the borrow pit to provide water storage, attenuation and treatment to remove suspended sediment from surface water runoff. The ponds would be established during construction to provide water management for the construction phase works. It is anticipated that most of the ponds would be fully reinstated at the end of the construction period. Settlement ponds and silt fencing may also be required at locations for temporary storage of soil, peat soil and aggregate.

3.3.23 Swales and filter strips would provide attenuation, storage and treatment for access tracks and turbine hardstandings, with swales forming the preferred option. During construction, small sumps with silt fencing would be established periodically along track routes to manage entrained sediment within the surface water. The sumps and silt fencing would be removed at the end of the construction phase once vegetation on the filter strips and swales has become established.

3.3.24 Temporary cut-off drains and bunds would be required around excavation areas for the turbine bases and hardstanding areas, to capture clean runoff and divert it around construction areas. These may be converted into swales at the end of the construction phase if long-term drainage is required.

3.3.25 Should detailed design calculations determine the requirement for long-term temporary stormwater storage or treatment, one or more of the settlement ponds would be retained as a detention basin or SuDS pond through the operational phase of the Proposed Development, with appropriate fencing in place.

3.4 Surface Water Runoff Hydraulic Control

3.4.1 The Welsh Government's document 'Statutory National Standards for Sustainable Drainage Systems' (2018) (Welsh Government, 2018) sets out several expectations for surface water systems in relation to runoff hydraulic controls, as follows:

- Surface water should be managed to prevent, so far as possible, any possible discharge from the Site for most rainfall events of less than 5 mm. The surface water runoff rate for the 1-in-1 year return period event (or agreed equivalent) should be controlled to help mitigate the negative impacts of the Proposed Development runoff on the morphology and associated ecology of the receiving water bodies.
- The surface water runoff for events up to the 1% (1-in-100 year) return period event (or agreed equivalent) should be controlled to help mitigate negative impacts of the Proposed Development on flood risk in the receiving water body.
- The surface water runoff for events up to the 1% (1-in-100 year) return period (or agreed equivalent) should be managed to protect people and property on and adjacent to the Site from flooding from the drainage system.
- The risks (both on and offsite) associated with the surface water runoff for events greater than the 1% (1-in-100 year) return period should be considered. Where the consequences are excessive in terms of social disruption, damage or risk to life, mitigating proposals should be developed to reduce these impacts.
- Drainage design proposals should be examined for the likelihood and consequences of any potential failure scenarios (e.g. structural failure or blockage) and the associated flood risks managed where possible.

Site Results

3.4.2 HR Wallingford's greenfield runoff rate estimation tool for sites (HR Wallingford, 2025) allows estimation of runoff rates for greenfield sites. The tool makes use of site-specific data including the total Proposed Site area, SAAR and standard percentage runoff (SPR). SAAR and SPR are both provided by the FEH Web Service data sheets (CEH, 2025). A copy of the tool's output report is provided in **Annex A**.

3.4.3 In addition, it is possible to calculate the long-term storage volume required to maintain discharge from the Site at the pre-development greenfield rates. Calculations make use of the design storm, defined as a 1-in-100 year storm event of 6 hours duration. The figures used in the calculation are derived from the FEH Web Service. A copy of the calculation is provided in **Annex A**.

3.4.4 For the Proposed Development, the details used in the calculations are provided in **Table 7.10.3**.

Table 7.10.3 Input Parameters Used for Greenfield Runoff Rate and Long-term Storage Volume Calculations

Parameter	Value	Notes
Total site area	53.3 ha	Release land area
SAAR	1487.5 mm	From FEH
SPR	0.476	From FEH
Design Storm rainfall	64.14 mm	From FEH, 1-in-100 year return period storm for 6 hours duration
Total impermeable surface	49.3%	Percentage release land required for long-term infrastructure

3.4.5 Results from the calculations are provided in **Table 7.10.4**.

Table 7.10.4 Results from the Greenfield Runoff Rate and Long-term Storage Calculations.

Parameter	Value	Notes
Q_{BAR} runoff rate	634 l/s	Results from greenfield runoff rate estimation for sites tool (HR Wallingford, 2023)
1 in 1 year runoff rate	557.9 l/s	
1 in 30 year runoff rate	1,128.5 l/s	
1 in 100 year runoff rate	1,382.1 l/s	
Long-Term Storage Volume	5,455.23 m^3	See **Annex A** for calculation details
Long-Term Storage Volume plus climate change allowance	6,600.83 m^3	Includes climate change uplift of 21%

3.4.6 Details of proposed temporary (construction phase) and long-term (operational phase) water storage locations, storage capacity and discharge locations would be provided as part of the drainage infrastructure detailed design.

4 CONCLUSIONS

4.1.1 This report has assessed the relevant aspects of drainage associated with the Proposed Development. It sets out an outline drainage strategy on which to base detailed design plans, recognising the requirements of Figure 3 of TAN15 and taking current best practice guidance into account.

4.1.2 The Site currently drains via overland flow and drainage ditches to the existing natural and artificial watercourses in and around the Site. The proposed drainage development promotes maintenance of natural runoff characteristics where possible, and drainage infrastructure to mimic these characteristics where required. Runoff attenuation and treatment proposals are designed to prevent any detrimental effects to the water quality or quantity of existing waterbodies. The proposed strategy makes use of SuDS features within the detailed engineering design to mimic the existing runoff characteristics.

4.1.3 Proposed SuDS to be incorporated into the detailed drainage strategy include use of settlement ponds, swales, filter strips, sumps, cut-off drains/bunds and silt fences at different phases of the development.

4.1.4 All necessary water environment authorisations and SAB approval would be put in place prior to any site works taking place.

REFERENCES

CEH, 2025. *Flood Estimation Handbook Web Service. Centre for Ecology and Hydrology.* [Online]
Available at: https://fehweb.ceh.ac.uk/
[Accessed July 2025].

CIRCA, 2015. *The SuDS Manual (v5). CIRCA publication C753.* [Online]
Available at: https://www.scotsnet.org.uk/__data/assets/pdf_file/0023/51764/CIRIA-report-C753-the-SuDS-manual-v6.pdf
[Accessed July 2025].

FEH, 2025. *Flood Estimation Handbook Web Service.* [Online]
Available at: https://fehweb.ceh.ac.uk/
[Accessed May 2025].

HR Wallingford, 2025. *UK SuDS: Greenfield runoff rate estimation.* [Online]
Available at: https://www.uksuds.com/tools/greenfield-runoff-rate-estimation
[Accessed July 2025].

Met Office, 2016. *Wales: climate.* [Online]
Available at:
https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/weather/regional-climates/wales_-climate-met-office.pdf
[Accessed May 2025].

Met Office, 2025. *Location-specific long-term averages. Bala..* [Online]
Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/location-specific-long-term-averages/gcmkyrqvw
[Accessed May 2025].

Met Office, 2025. *Met Office Weather & Climate.* [Online]
Available at: https://www.metoffice.gov.uk/
[Accessed 10 March 2025].

NRW, 2025. *Flood Map for Planning.* [Online]
Available at: https://naturalresources.wales/flooding/flood-map-for-planning-development-advice-map/?lang=en
[Accessed May 2025].

NRW, 2025. *Flood Risk Assessment Wales Map.* [Online]
Available at: https://flood-risk-maps.naturalresources.wales/?locale=en
[Accessed May 2025].

NRW, 2025. *Wales Environmental Information Portal: Landscape (LandMap Visual Sensory.* [Online]
Available at: https://smnr-

nrw.hub.arcgis.com/apps/c7770d2881394c899123bae210afe370/explore
[Accessed May 2025].

Welsh Government, 2018. *Statutory standards for sustainable drainage systems - designing, constructing, operating and maintaining surface water drainage systems.* [Online]
Available at: https://www.gov.wales/sites/default/files/publications/2019-06/statutory-national-standards-for-sustainable-drainage-systems.pdf
[Accessed July 2025].

Welsh Government, 2025. *Technical Advice Note 15 Development, flooding and coastal erosion.* [Online]
Available at: https://www.gov.wales/sites/default/files/publications/2025-03/technical-advice-note-15-development-flooding-and-coastal-erosion.pdf
[Accessed July 2025].

ANNEX A – GREENFIELD RUNOFF RATE ESTIMATION TOOL

Greenfield runoff rate estimation tool

hr wallingford www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

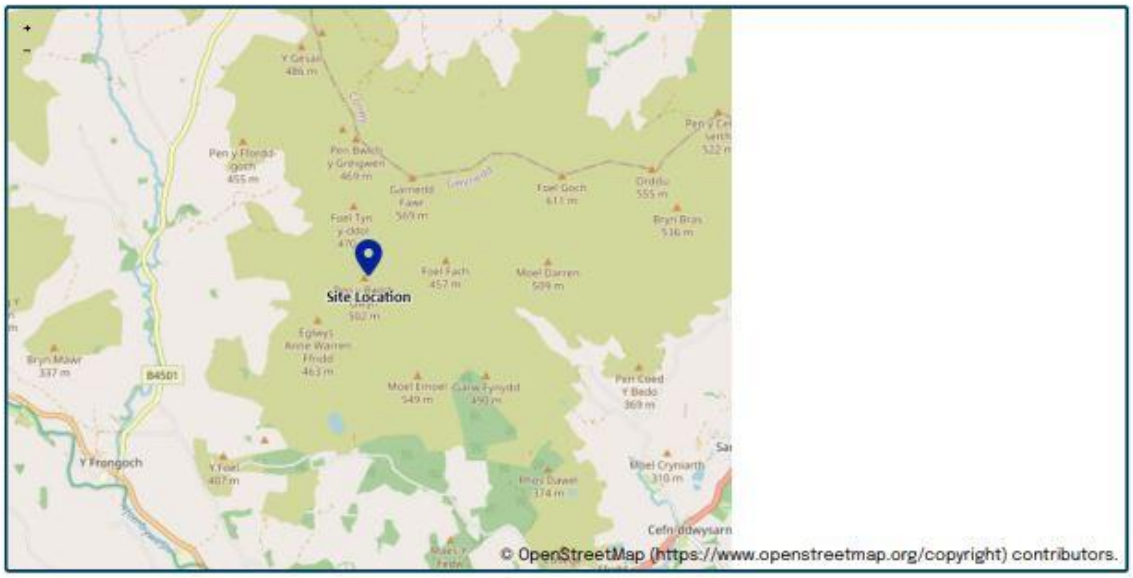
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	17/06/2025
Calculated by	Etisang Abraham
Reference	Foel Fach Wind Farm
Model version	2.0.1

Location

Site name	
Site location	



Site easting	293296
Site northing	341100

Site details

Total site area (ha)	53.28 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	1487 mm		1483
How should SPR be derived?	Estimate using BFI		
BFIHOST	0.367		
SPR	0.476		
QBar (IH124) (l/s)	634 l/s		

Growth curve factors

	My value		Map value
Hydrological region	9		9
1 year growth factor	0.88		
2 year growth factor	0.93		
10 year growth factor	1.42		
30 year growth factor	1.78		
100 year growth factor	2.18		
200 year growth factor	2.46		

Results

Method	IH124
Flow rate 1 year (l/s)	557.9 l/s
Flow rate 2 year (l/s)	589.8 l/s
Flow rate 10 years (l/s)	900.3 l/s
Flow rate 30 years (l/s)	1128.5 l/s
Flow rate 100 years (l/s)	1382.1 l/s
Flow rate 200 years (l/s)	1559.6 l/s

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.0.1) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Long-term Storage Volume Calculations

$$VOLxs = RD\ x\ A\ x\ 10\left[\frac{PIMP}{100}(\alpha\ 0.8) + \left(1 - \frac{PIMP}{100}\right)(\beta\ SPR) - SPR\right]$$

Equation 24.10 from CIRIA Report C753 The SUDS Manual.

Parameter	Units	Value used	Notes
VOLxs	m^3	5455	Extra runoff volume of development runoff over greenfield runoff
RD	mm	64.14	Design storm rainfall, for 1-in-100 year return period storm of 6 hour duration
A	ha	53.28	Actively drained area
PIMP		49.3%	Impermeable area as a percentage of the total area
α		1	Proportion of paved area draining to the network, with 80% assumed runoff. Taken as 1 for the calculation.
β		1	Proportion of the pervious area draining to the network or directly to the river. Taken as 1 for the calculation.
SPR		0.476	Standard percentage runoff (from FEH Web Service)