National Grid

Great Grid Partnership (GGP)

PTNO/PTC1

Trawsfynydd – Drainage Technical Note
PTNO-WSP-SS51-C00484-MEM-CP-000001-P01

2025-09-15

Distribution

National Grid

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Prepared for

Mick Tuke

National Grid,
Pentir Substation,
LL57 4ED

Prepared by

WSP UK – Great Grid Upgrade
Birmingham (Mailbox)

Quality control	Name	Date	Signature
Prepared by:	Ryan Palmer	15/09/25	Ryan Palmer
Reviewed by:	Vic Mohun	15/09/25	Mohun, Vic (UKVNM400) Digitally signed by Mohun, Vic (UKVNM400) DN: cn=Mohun, Vic (UKVNM400), ou=Active, email=Vic.Mohun@wsp.com Date: 2025.09.16 17:04:24 +01'00'
Approved by:	Richard Whinnett	15/09/25	Digitally signed by Richard.Whinnett@wsp.com DN: cn=Richard.Whinnett@wsp.com Reason: pp. Bruce Kirkpatrick Date: 2025.09.16 16:56:49 +01'00'

Revisions

Rev	Date	Details
P01	2025-09-15	First Issue

Trawsfynydd – Drainage Technical Note

1. Introduction

WSP UK Ltd (WSP) has been commissioned by National Grid to provide a Technical Note outlining preliminary surface water drainage details for proposed works at Trawsfynydd substation. The development is at an existing National Grid substation, located between Trawsfynydd and Gelliydan in North Wales. The site is approximately 7ha and is largely impermeable. The site is located at National Grid Reference: 269188, 338423.

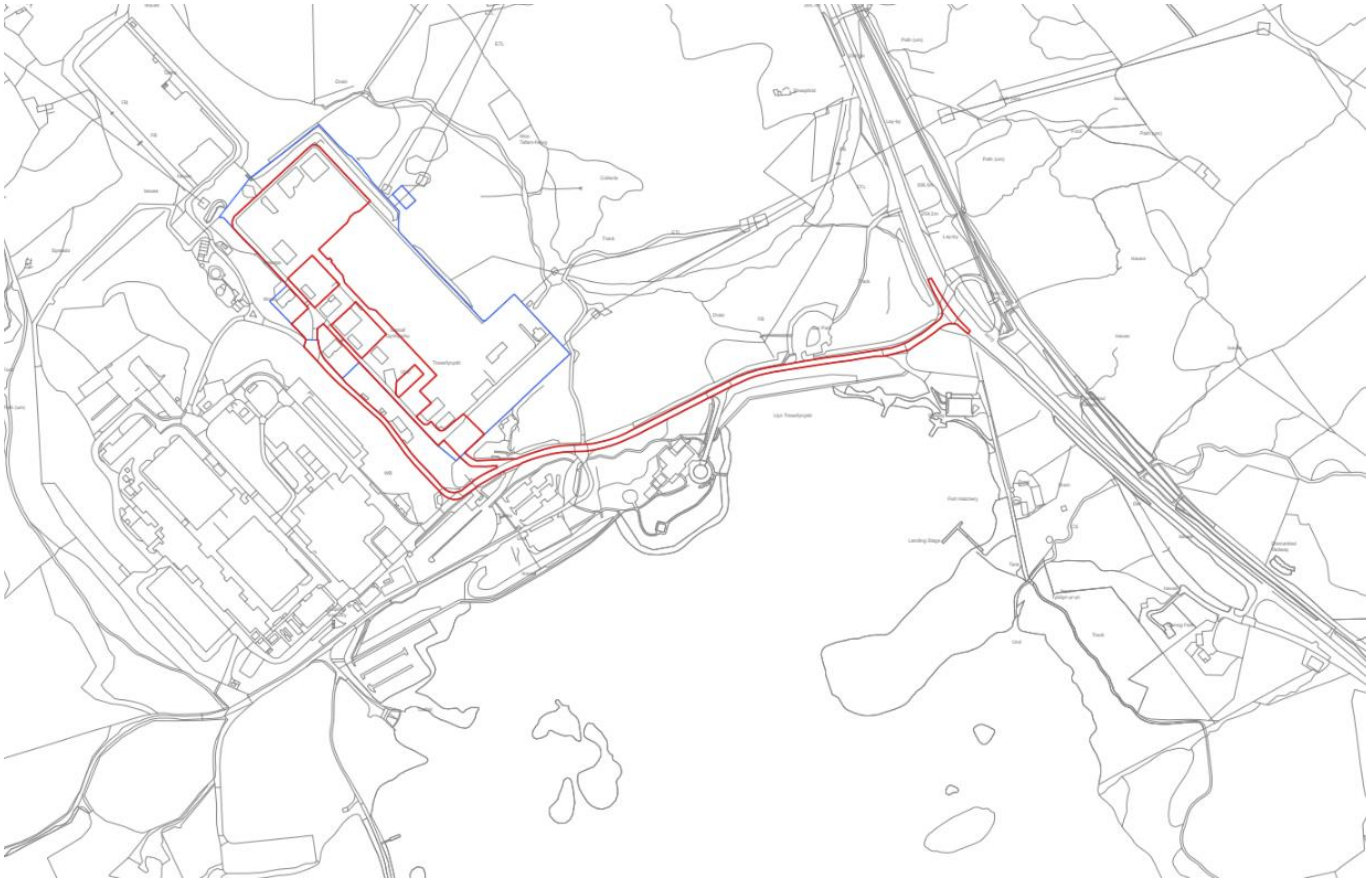


Figure 1 - Trawsfynydd Location Plan

1.1 Proposed Development

The scope of works involves connecting one part of the existing substation to another part with new High Voltage (HV) cables. Additionally, a new Shunt Reactor (similar to a Transformer) will be constructed with associated HV electrical infrastructure. The works support the uprating of the existing Pentir to Trawsfynydd Overhead Line. The proposed development plan is shown in Appendix A.

This scope of works falls within the footprint of the existing substation, however there is a need to move some of the existing electrified fence to provide clearance to new overhead line conductors. There is a slight increase to the substation footprint for this fence relocation, as per Figure 2. The expanded area is to be confirmed in detailed design (estimated between 200m2 and 700m2) but will remain permeable and will therefore not be considered any further in this Technical Note for surface water management purposes.

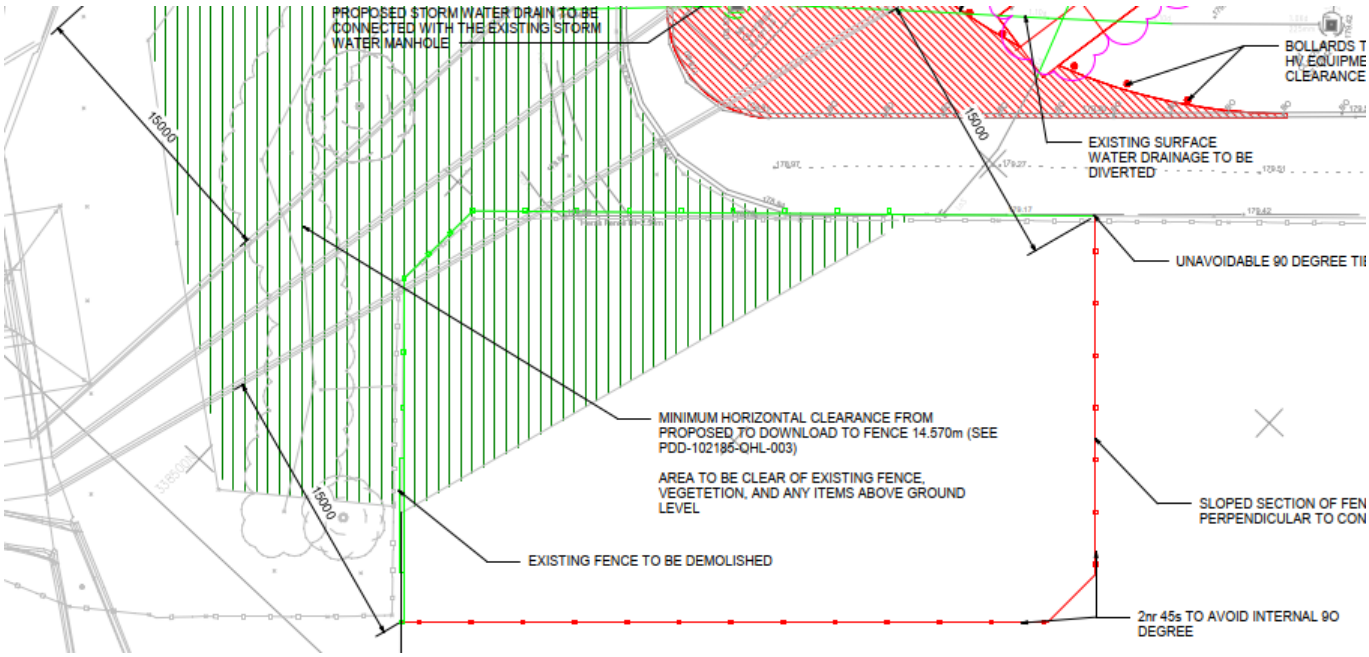


Figure 2 - Proposed Fenceline (in red)

There is a small increase to the impermeable area within the Substation – new concrete roads and foundations will replace gravelled areas. This is required in part to support access for Abnormal Indivisible Loads (AIL) to site. Again, this area will be confirmed in detailed design but is estimated to be **~1000m2**, as shown in Figure 3.

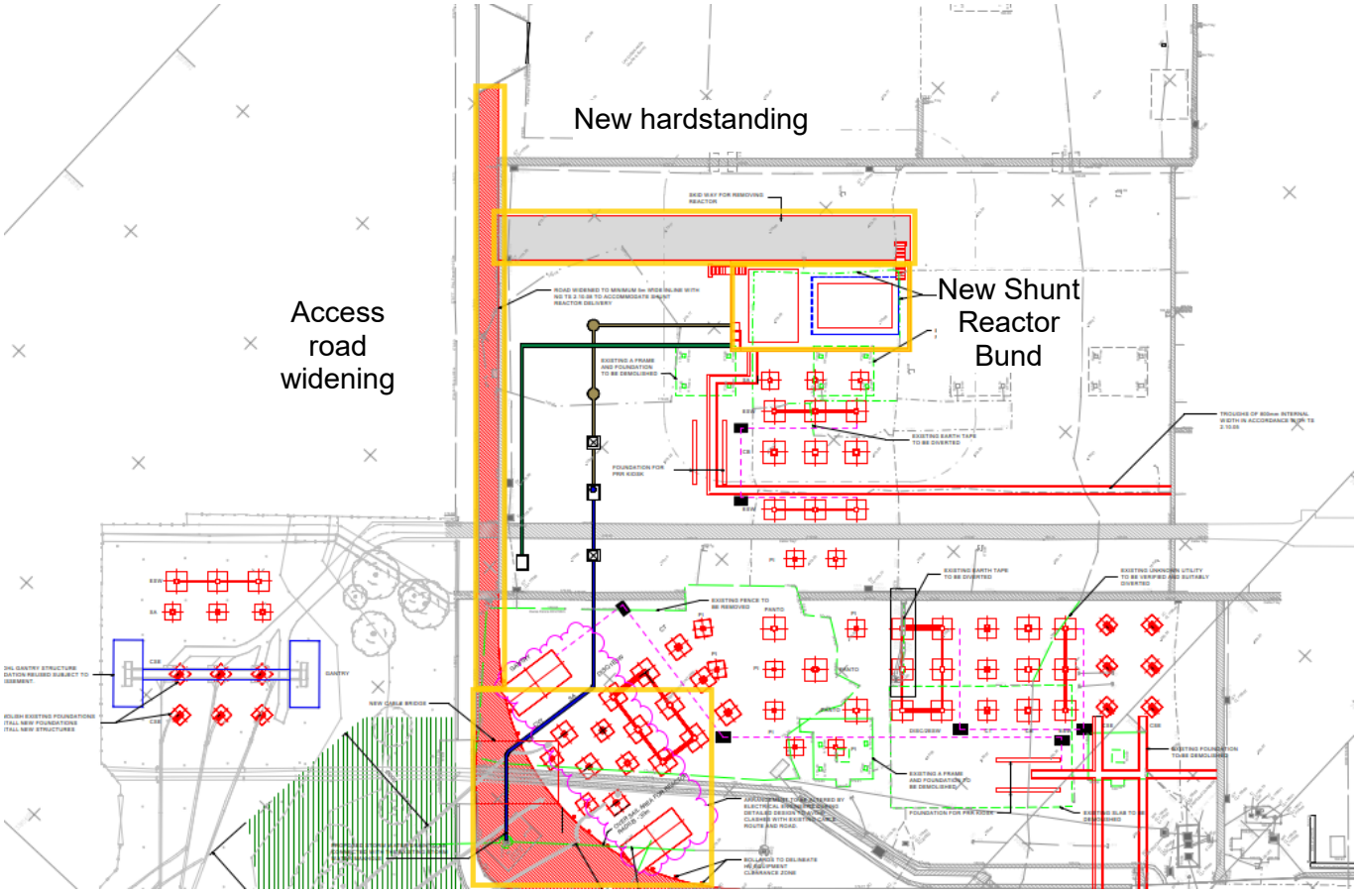


Figure 3 – Proposed Hardstanding (highlighted yellow)

The new Shunt Reactor introduces oily water which will be fully contained within a concrete bund. An intelligent pump will lift rainwater out of the bund and into a new suitably sized Class 1 Full Retention Oil Separator, before entering the existing surface water network. The existing surface water network, including the location and rate at which it discharges, will not be altered.

1.2 Flood Risk and Existing Drainage Information

The site does not fall within a fluvial or tidal floodplain; however, the substation site is shown to be affected by localised areas of surface water flood risk as shown in Figure 4:

Figure 4 - NRW Flood Map, September 2025

It is understood from records that the existing site drains into surrounding watercourses via four outfall structures. An emergency plan is in place to prevent the discharge of any spillage on site and several oil interceptors and penstocks are also present to prevent contamination.

During detailed design, the adequacy of existing drainage pipework and outfall arrangements will be assessed, however the additional impermeable area introduced on site is not considered to be material in the context of the overall site area and therefore it is assumed that the existing drainage arrangements will have sufficient capacity. Further site investigation and calculations are planned to verify existing drainage arrangements, available attenuation capacity and support the production of proposed drainage drawings and calculations to fully comply with the following requirements:

- Welsh Ministers' Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems
- Gwynedd Council's Sustainable Drainage Approval Body (SAB)
- Gwynedd Council's Lead Local Flood Authority
- Natural Resources Wales

2. Potential Surface Drainage Option

2.1 Drainage Hierarchy

It is a requirement of the SAB to consider the drainage hierarchy when determining the surface water runoff destination with priority given to the higher levels. The hierarchy is as follow:

- Surface water runoff collected for use.
- Surface water runoff is infiltrated to ground.
- Surface water runoff is discharged to a surface water body.
- Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system.
- Surface water runoff is discharged to a combined sewer.

It is recommended that the client considers potential uses for collected rainwater within the site as this will present a stronger application for SAB approval, but it is understood that this is not always feasible on a remote site which may not be manned at all times.

For this Technical Note it has been assumed that infiltration is not possible within the site. A ground investigation will be required by the SAB as evidence to determine the infiltration characteristics of the ground within the site prior to submission of the application. Should these tests indicate that infiltration is feasible the drainage design can be updated to incorporate infiltration SuDS assets. The risk of pollution to the nearby Llyn Trawsfynnyd and ground water will also need to be taken into account for infiltration systems.

The next appropriate method is discharge to a surface water body. There is also an existing surface water network present at the site, as evidenced by the existing 4no. outfalls into the adjacent watercourse and these will remain in place. For this preliminary surface water drainage strategy, the existing drainage network has been selected as the surface water runoff destination. The existing drainage network, including the location of rate at which it discharges, will not be altered. This complies with the third level of the drainage hierarchy. It is however recommended that the Client consults with the Lead Local Flood Authority to determine if other assets within the area could potentially act as alternative discharge locations.

2.2 Proposed Discharge Rates

It is recommended that the SAB is consulted regarding post development discharge rates prior to the design of the surface water drainage network. For this Technical Note it has been assumed that restricting flows to the greenfield Qbar rate, pro-rated for the impermeable area of the site, is sufficient.

The approximate total increase in impermeable area of the site is 0.1ha. A greenfield runoff estimate has been carried out, using the UK SuDS Greenfield runoff rate estimation Tool and the FEH Statistical method. This provided a Qbar rate of 2.11l/s. A preliminary restricted discharge rate for surface water runoff of 2.11l/s for all storms up to and including the 1 in 100 year plus 40% climate change is proposed for this site and this is subject to confirmation with the LLFA and SAB. The greenfield runoff rate calculations output from the UK SuDS tools website can be found in Appendix B of this Technical Note

2.3 Proposed Attenuation

Using the UK SuDS Tool Surface Water Storage Volume Design Tool and FEH22 rainfall data, and applying the discharge rate above, it has been estimated that a storage volume of 100m³ will be required onsite to attenuate surface water runoff. This figure may vary depending on the style and method of storage, as well as any final confirmed discharge rates.

This volume could be provided in the form of above ground features such as basins and swales as SAB generally prefer above ground storage techniques, due to the biodiversity and amenity benefits they provide. However, below ground storage is also allowable, especially using valid reasoning for brownfield, pre-developed sites. For the purposes of this Technical Note, it has been assumed that this storage volume will be provided in the form of a basin located within vicinity of the proposed electrical infrastructure to enable a gravity drainage system. The use of

partial or total infiltration on site (subject to favourable BRE 365 testing) will determine the final attenuation capacity required for this development. Design guidance for the basin can be found within the CIRIA 753 SuDS Manual.

For this Technical Note it has been assumed that some runoff generated on site from the Shunt Reactor will be collected within the bund and fitted to a proprietary oil separator system before the treated surface water is conveyed using below ground piped networks. It has also been assumed that this treated runoff will be conveyed around the site to the single attenuation basin located at the south of the site. If required, the estimated storage volume could be pro-rated to provide a second basin closer to the road.

The storage calculations output from the UK SuDS tools website can be found in Appendix C of this Technical Note.

2.4 Proposed Discharge Location

A review of online mapping indicates that there is an ordinary watercourse known as Afon Tafarn-helyg located within proximity of the substation. It is assumed that the site currently drains its surface water to a network which eventually enters this watercourse.

It is recommended that the Client consults with the Lead Local Flood Authority to discuss their requirements for surface water management for this site via a formal pre-SAB application. The outcome of this application will inform design parameters e.g. suitable discharge points, attenuation sizes and discharge rates.

2.5 Drainage Summary

- Whilst the substation site is classed as brownfield, the proposed works will be on greenfield land and the LLFA and SAB will prescribe a corresponding surface water flowrate. A preliminary discharge rate 2.11l/s discharge is proposed to minimise the risk of blockages within the surface water drainage system, subject to approval with the SAB.
- The total proposed impermeable area increase is approximately 0.1ha.
- Using this discharge rate, the attenuation volume required for the proposed impermeable area has been estimated to be 100m³. This can be provided in the form of a basin.
- The proposed discharge location has been identified as the existing wider surface water drainage water network serving the site, before discharge into the receiving watercourse (Afon Tafarn-helyg).

2.6 Considerations for an Outline Drainage Strategy

The scope of this Technical Note has been the collection, storage and conveyance of surface water but wider considerations will be required for the production of an outline drainage strategy.

Given the proposed site use, one consideration will need to be surface water contamination risk and therefore and water quality improvements measures. This is typically determined through the pollution indices approach, where common site uses are assigned three pollution indices for suspended solids, hydrocarbons and metals. The CIRIA 753 SuDS Manual's Simple Index Approach contains examples of these requirements:

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 3 - Table 26.2 from the CIRIA C753 SuDS Manual

It is recommended that the Client liaises with the SAB officer to determine at what hazard level they would place other aspects of the site, but it is assumed the majority will a medium to high hazard. Various SuDS features can then be assigned treatment indices, which need to total up to be greater than each individual pollution indices. This means that by providing a robust management train of various SuDS features it is possible to demonstrate that the site will provide water quality improvements to the surface water runoff generated by the site.

At this stage, it is known that the new Shunt Reactor will produce water polluted with hydrocarbons, aligned with a High Pollution Hazard Level of 'Sites with heavy pollution' as per Figure 3. This polluted water will be fully contained within a concrete bund.

In addition, to mitigate against this known pollution risk, an intelligent pump will lift rainwater out of the bund and into a new suitably sized Class 1 Full Retention Oil Separator, before entering the existing surface water network. Exact mitigation indices should be confirmed by the manufacturer's specifications and a Simple Index Approach assessment should be carried out to ensure sufficient mitigation is place.

If the site contains a form of fire prevention system consideration will need to be given to the discharge or disposal of water generated by the prevention system and ensure that this flow does not enter the wider surface water drainage system.

As discussed in previous sections a ground investigation report will be required to satisfy the requirements of SAB officer. It is recommended that the investigation is conducted as early as possible within the design process to better inform the proposed drainage strategy. It is also recommended drainage design team are consulted to provide suitable locations for infiltration trial pits.

Amenity and biodiversity benefits will also need to be considered for the site. Typically providing soft engineered SuDS features at the surface will satisfy these requirements as the promote wildlife and break up continuous areas of hardstanding. The maintenance requirements of these SuDS features and the traditional below drainage will need to be documented for the SAB application. They will also expect to see a maintenance plan to ensure that the proposed drainage system will remain fully operational for the lifespan of the proposed development.

Typically, for a substation the following may generally be required and are provided for guidance purposes only:

- Oil separators,
- Shutdown system in form of Penstock Valves located upstream and downstream to each oil separator,

- Sampling chamber placed immediately downstream of every oil separator and at, or before the final discharge point to the watercourse,
- Sump or a tank downstream of every oil separator.
- Downstream defender unit for final polishing step.

The final details will need to be confirmed following the findings of an outline drainage strategy and consultations with the pre-SAB.

3. Recommendations

3.1 Stakeholder Consultations

It is recommended that the drainage design team engages with the various relevant stakeholders as early as possible within the design process as their responses can heavily impact the drainage design. Contacting the Lead Local Flood Authority and SAB officer early within the process will allow them to advise the design team on any specific requirements or preferences to be included within the detail design, which tends to make them more amenable.

The more information that can be obtained from stakeholders reduces the number of assumptions that need to be made during the design process. This will reduce the chance that the SAB application will fail due to unforeseen issues. This is normally undertaken during the Pre-SAB submission stage where an outline surface water drainage strategy is submitted as part of the pre-SAB for formal comments (see section 3.3).

3.2 Ground Investigation

The SAB will require evidence to whether infiltration is viable within the site before accepting discharge methods from a lower level in the hierarchy. To determine this infiltration testing to BRE 365 standards will be required across the site. Typically, trial pits are located where SuDS features are specified and at the same depth as the invert level but testing may also be required at other locations just in case areas of infiltration can be located elsewhere. This may especially be required for this site as the geology beneath appears to be variable.

Infiltration testing may determine that the surface water runoff can fully or partially be discharged from the site via infiltration-based SuDS features. If this is the case, then the approach can be amended to incorporate said structures into the design.

On this particular site, if there is suspected or known contamination in the ground or groundwater, this would limit the use of infiltration measures to drain surface water runoff from the site as this could in turn impact on water quality within the nearby Llyn Trawsfynydd. Further information on the geology, groundwater and contamination status will be required to inform the detail drainage design.

3.3 SAB Application Requirements

Both the SAB pre-application and full application processes require that the proposed drainage strategy complies with 6 standard principles. These principles are:

- Surface Water Runoff Destination
- Surface Water Runoff Hydraulic Control
- Water Quality
- Amenity
- Biodiversity
- Design of Drainage for Construction and Maintenance and Structural Integrity

The potential drainage option presented in this Technical Note aims to satisfy these requirements through the inclusion of soft engineered surface based drainage features and through restricting flows to 2.11l/s. Further consideration may be required regarding water quality as the level of treatment required prior to discharge will be dependent upon the types of activities occurring within the site.

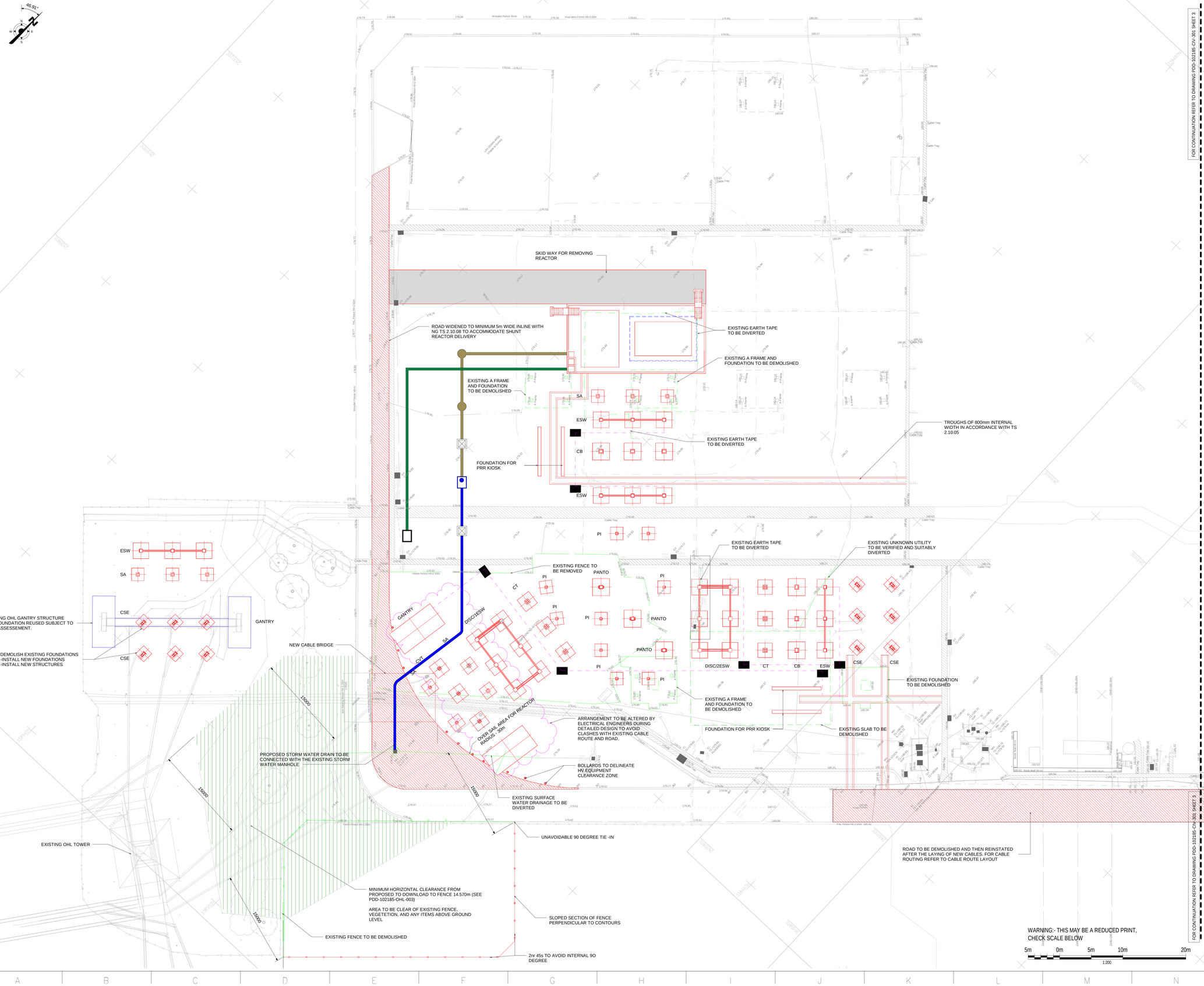
The specific information and evidence required for the SAB pre-application are less defined than the requirements of the full application but it is recommended that as much evidence as possible from the full requirements list is submitted at the pre-application stage to give the SAB officer an opportunity to comment on all the evidence available. The requirements for the full application are as follows:

- Flood Consequences Assessment
- Detailed geotechnical factual and interpretive report
- Detailed whole site SuDS drainage design proposals

- Detailed SuDS assets maintenance plan
- Unstable and contaminated land reports
- Water quality treatment and pollution prevention strategy and plan
- Landscape plan
- Construction phasing plan
- Information and communications plan
- CDM regulations 2015 file
- Statutory consents and permissions
- Title documents
- Technical drawings:
- Catchment plans
  - Site location plans
  - Drainage layouts
  - General engineering layout drawings
  - Cross sections
  - Landscaping layouts
  - Any specialist drawings

During consultation with the SAB officer, it may be determined that certain items are not required or due to site specifics additional evidence is required. As such it is again recommended that the SAB officer is consulted early within the design process to avoid abortive work or missing evidence via a pre-SAB application, supported with an outline drainage strategy.

Appendix A – Indicative Site Layout



NOTES:

1. CONCEPT DESIGN ONLY. I.E.: FEED / NDP4.3. NOT FOR CONSTRUCTION.
2. DETAILED DESIGN AND CONSTRUCTION TO COMPLY WITH MOST RECENT NGTS.
3. ALL DIMENSIONS IN MILLIMETERS UNLESS STATED OTHERWISE.
   ALL LEVELS IN METERS ABOVE ORDNANCE DATUM (mAOD) UNLESS STATED OTHERWISE.
   DO NOT SCALE.
4. PERIMETER FENCE SHALL BE 'CATEGORY 2 - STANDARD' ELECTRIFIED PALISADE FENCE. INTERNAL FENCE SHALL BE 'CATEGORY 3 – REDUCED' PALISADE FENCE.
5. SITE LIGHTING NOT BEEN SHOWN BUT MUST INCLUDED IN DETAILED DESIGN AND CONSTRUCTION.
6. DUCTING FOR ELECTRIC FENCE AND LIGHTING NOT BEEN SHOWN BUT MUST BE INCLUDED IN DETAILED DESIGN AND CONSTRUCTION.
7. ASSUMED TELECOM AS FOLLOWS:
   FO1: BT / VODAFONE (VIA ACCESS ROAD)
   FO2: OPTEL / OPGW (VIA OHL)
   FO3: PROTECTION / DPS (VIA HV CABLE)
8. POTABLE WATER NOT SHOWN BUT MUST BE INCLUDED IN DETAILED DESIGN AND CONSTRUCTION
9. INCOMING DNO POWER ASSUMED TO BE BY OTHERS (ROUTE TO BE CONFIRMED)..
10. PIPES TO BE ENCASED IN CONCRETE WHEN THE MINIMUM COVER IS LESS THAN 0.9M BELOW THE ROADS.
11. THE EXPOSED TOPS OF FOUNDATION SHALL HAVE A NON-SLIP BRUSHED FINISH INCORPORATING
    SUFFICIENT CROSS FALL OR CAMBER PRE BENT PONDING OF WATER.
12. SUBSTATION FINISHES SHALL GENERALLY COMPRISE A 75MM THICK LAYER OF 'SUBSTATION SURFACING' AS DEFINED IN TS 3.10.02 OVER A MINIMUM THICKNESS OF 300MM UNBOUND FREE-DRAINING SUB-BASE (TYPE 3) IN ACCORDANCE WITH SERIES OF THE SPECIFICATION FOR HIGHWAY WORKS.
13. 0.9M WIDE CONCRETE FOOTPATHS SHALL BE PROVIDED BETWEEN ALL BUILDINGS PLUS RAMPED ACCESSES TO ALL DOORS TO FACILITATE EQUIPMENT INSTALLATION, TO ALL GAS FILLING POINTS TO FACILITATE MAINTENANCE ACTIVITIES, AND OUTSIDE THE PERIMETER FENCE.
14. EXISTING PIT AND TROUGH COVERS IN ROAD WIDENING TO BE ASSESSED FOR RE-USE. ASSUME ALL TO BE REPLACED WITH D400 COVERS AS PER TS 2.10.08.
15. EXISTING BELOW GROUND SERVICES IN ROAD WIDENING TO HAVE NEW PROTECTION SLABS (OR SIMILAR) INSTALLED ABOVE. EXISTING BELOW GROUND SERVICES EXPOSED DURING ROAD WIDENING EXCAVATION TO HAVE CONCRETE SURROUND ALSO.
16. FSL - TO MATCH WITH EXISTING SUBSTATION LEVEL

LEGEND:

- NEW PLANT
- PLANT TO BE REMOVED
- EXISTING PLANT
- PLANT TO BE REUSE
- FIRE DAMAGE ZONE
- NOISE ENCLOSURE
- PROPOSED OILY WATER CHAMBER
- PROPOSED OILY WATER DRAIN
- PROPOSED SURFACE WATER CHAMBER
- PROPOSED SURFACE WATER DRAIN
- PROPOSED OIL DRAW OFF POINT
- PROPOSED OIL / WATER INTERCEPTOR
- PENSTOCK VALVE CHAMBER
- OIL DRAW OFF CHAMBER
- PROPOSED SAMPLING CHAMBER WITH PENSTOCK
- DRAW PITS
- INDICATIVE TROUGHS
- INDICATIVE DUCTS

400kV EQUIPMENT FOUNDATIONS

DESCRIPTION	FOUNDATION SIZE (mm)	QUANTITY (Nos)
EARTH SWITCH (ESW)	2500x2500x900	15
CAPACITIVE VOLTAGE TRANSFORMER (CVT)	2300x2300x900	08
DISCONNECTOR WITH 1 EARTH SWITCHES (DISC/1 ESW)	2500x2500x900	06
DISCONNECTOR WITH 2 EARTH SWITCHES (DISC/2 ESW)	2500x2500x900	06
CURRENT TRANSFORMER (CT)	2300x2300x900	06
CIRCUIT BREAKER (CB)	2700x2700x900	06
POST INSULTAOR (PI)	2000x2000x900	12
PANTOGRAPH DISCONNECTOR (PANTO)	2700x2700x900	03
SURGE ARRESTOR (SA)	2000x2000x900	08
GANTRY FOUNDATION	4000x8000x900	02
CABLE SEALING END (CSE)	1800x1800x1200	18

ASSOCIATED DRAWINGS

DRAWING No.	DESCRIPTION
PDD-102185-CIV-302	SHUNT REACTOR BUND AND GA

Rev	Description	Cre'd	Chk'd	App'd	Date
P01	FOR REVIEW	CU	HD	KN	26.06.25

WARNING:- THIS MAY BE A REDUCED PRINT, CHECK SCALE BELOW

5m 0m 5m 10m 20m

1:200

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
10215	-	TRAWSFYNDD 400kV SUBSTATION

Scheme Name: PENTIR-TRAWSFYNDD NORTH WALES REINFORCEMENY

Document Title:

PROPOSED CIVIL LAYOUT TRAWSFYNDD 400kV SUBSTATION

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
CU	27-06-2025	HD	27-06-2025	KN	27-06-2025

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
Designer	LAY	1:200	A0	2 OF 3	P0

National Grid Document Number: PDD-102185-CIV-301

FEED Document Number: **

Appendix B – Runoff Calculations

Greenfield runoff rate estimation tool

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	16/09/2025
Calculated by	VM
Reference	Trawsfynnyd Substation
Model version	2.1.2

Location

Site name	Trawsfynnyd Substation
Site location	Trawsfynnyd Substation

Site easting (British National Grid)	269094
Site northing (British National Grid)	338190

Site details

Total site area (ha)	0.1 ha

Greenfield runoff

Method

Method	FEH statistical

FEH statistical

	My value		Map value
SAAR (mm)	1870 mm		1870
BFIHOST	0.42		
QMed-QBar conversion	1.075		1.075
QMed (l/s)	1.96 l/s		
QBar (FEH statistical) (l/s)	2.11 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	FEH statistical
Flow rate 1 year (l/s)	1.9 l/s
Flow rate 2 year (l/s)	2.0 l/s
Flow rate 10 years (l/s)	3.0 l/s
Flow rate 30 years (l/s)	3.8 l/s
Flow rate 100 years (l/s)	4.6 l/s
Flow rate 200 years (l/s)	5.2 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Appendix C – Storage Calculations

Surface water storage volume design tool

www.uksuds.com | Surface water storage volume design tool (https://www.uksuds.com/)

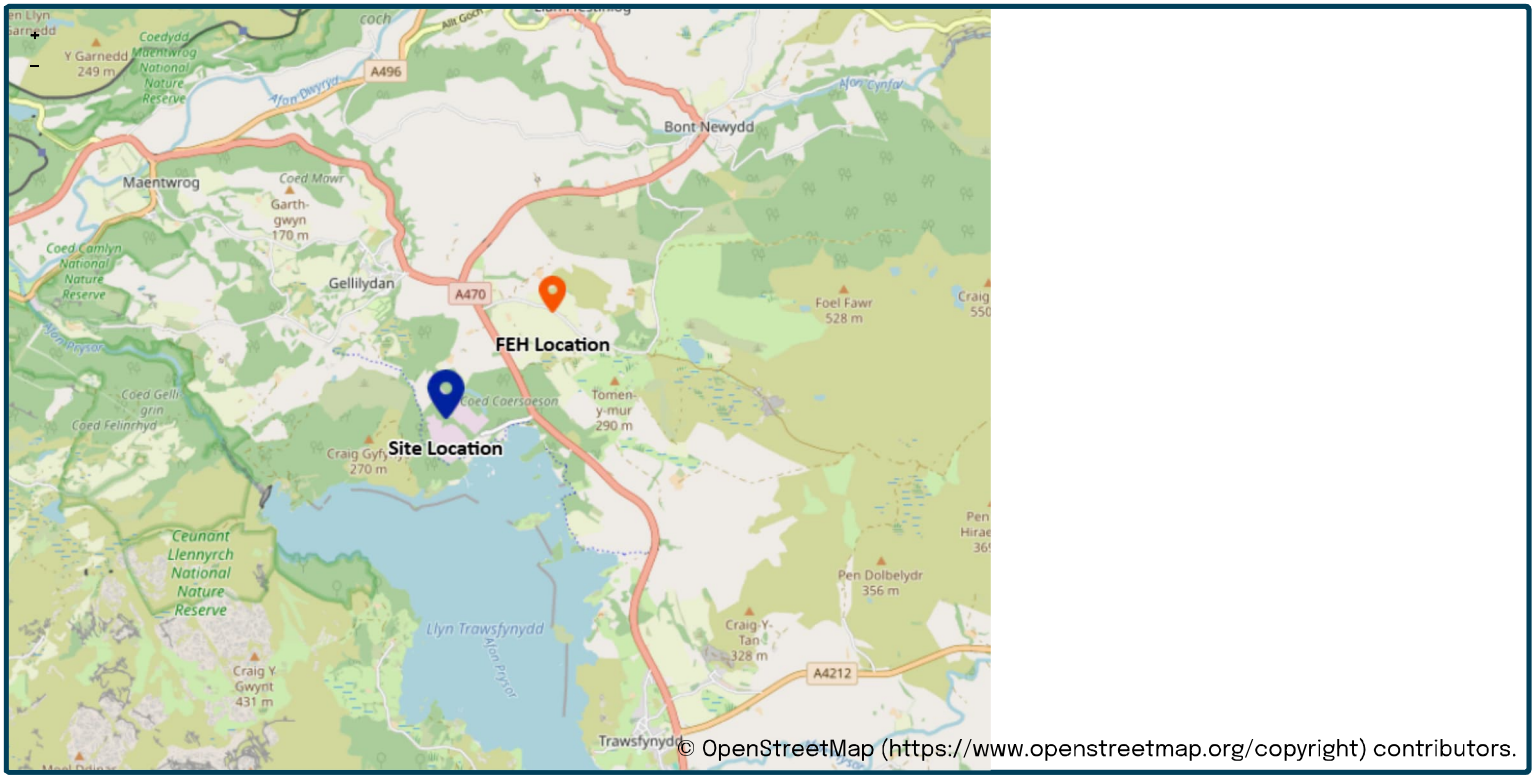
This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is recommended that the total storage volume for the site is distributed across the site using multiple SuDS and that hydraulic modelling software is used to undertake and finalise the detailed design of the drainage system.

Project details

Date	16/09/2025
Calculated by	VM
Reference	Trawsfynydd substation
Model version	2.1.2

Location

Site name	Trawsfynydd substation
Site location	Trawsfynydd substation



Site easting (British National Grid)	269037
Site northing (British National Grid)	338182

Site areas

Total site area (ha): ha

Roof area

Total roof area (ha): ha

Contributing roof area (ha): ha

Non-contributing roof area (ha): 0 ha

Paved area

Total paved area (ha): 0.1 ha

Contributing paved area (ha): 0.1 ha

Non-contributing paved area (ha): 0 ha

Grass / vegetated area

Total grass / vegetated area (ha): 0 ha

Contributing grass / vegetated area (ha): 0 ha

Non-contributing grass / vegetated area (ha): 0 ha

Total area

Total contributing area (ha): 0.1 ha

Contributing areas with urban creep allowance

Urban creep allowance factor: +0% (no creep)

Storage design parameters

Storage base shape: Circular

Storage design depth (m): 1 m

Storage side slope (1 in x): 1 in 3

Storage voids ratio (%): 100% (all voids)

Storage volume design return period (years): 1:100 years

Discharge flow rate from the site

Method

Type of site	Greenfield
Specify the method	FEH statistical

FEH statistical

	My value		Map/default value
SAAR (mm)	1870 mm		1870
BFIHOST	0.42		
QMed (l/s)	1.96 l/s		
QMed-QBar conversion	1.075		1.075
Total area for greenfield runoff calculation (ha)	0.1 ha		0.1
QBar (l/s)	2.11 l/s		
Hydrological region	9		9
Return period (years)	Qbar (1:2.3 years)		
Growth curve factor	1		
Flow rate (FEH statistical) (l/s)	2.11 l/s		

Final discharge rate

Runoff calculation method	FEH statistical
Design flow rate (l/s)	2.11 l/s

Blockage risk

Specify the method	Flow rate
Minimum discharge flow rate to prevent blockage	2l/s

	My value		Calculated value
Design orifice diameter (mm)	31 mm		31
Flow rate of orifice (l/s)	1.99 l/s		

Rainfall and runoff

Rainfall input type	FEH22 CSV file
	FEH_Point_Rainfall_FEH22_AM_270002_339000.csv
Distance from FEH location to site (km)	1.3 km
Climate change allowance factor	140%

Model results

- **Maximum discharge flow rate:** 2.0 (l/s)
- **Outflow orifice diameter:** 31 (mm)
- **Storage base diameter:** 8.1 (m)
- **Storage base area:** 52 (m^2)
- **Storage total volume:** 100 (m^3)
- **Storage total water volume:** 100 (m^3)
- **Storm return periods run:** 1, 2, 10, 30, 100, 200 (years)
- **Storm durations run:** 15, 30, 60, 120, 180, 240, 360, 540, 720, 900, 1080, 1440, 1800, 2160, 2880, 3600, 4320, 5040, 5760 (minutes)

Return Period (years)	Critical Duration (minutes)	Peak Flow Rate (l/s)	Max Depth (m)	Max water volume (m^3)	Max storage volume (m^3)
1	900	1.4	0.47	34	34
2	900	1.4	0.53	40	40
10	900	1.7	0.75	65	65
30	900	1.9	0.87	81	81
100	1080	2.0	1.00	100	100
200	1080	2.1	1.08	114	114

Please note runoff estimation and storage volume estimation are subject to uncertainty. Storage volume results are therefore reported to the nearest 1 m^3 value, unless storage volumes are less than 10 m^3, in which case, storage volumes are provided to 1 decimal place.

Disclaimer

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