



**BRYNHYFRYD, CHWILOG**  
Flood Consequence Assessment and Drainage Strategy  
July 2025



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This document has been produced by Land Studio on behalf of Williams Homes. The contents of the document are intended for submission with a planning application related to a residential development at Brynhyfryd, Chwilog. Land Studio has prepared this report in accordance with the instructions of the above-named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

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Brynhyfryd, Chwillog: **INTRODUCTION**

01



# BRYNHYFRYD, CHWILOG: INTRODUCTION



Figure 1 Site Location

Land Studio have been appointed by Williams Homes (Bala) Limited to produce a Flood Consequence Assessment and Drainage Strategy in support of a PAC submission for the construction of 25 new residential dwellings, associated infrastructure and landscaping at land adjacent to Brynhyfryd Farm in Chwilog, off B4354, Gwynedd.

This report records the results of a Flood Consequence Assessment which has been carried out in accordance with Planning Policy Wales (PPW) and Technical Advice Note (TAN 15). This report considers the risk of various sources of flooding to the site and the consequent risk of flooding to the downstream receptors (such as people, property, habitats, infrastructure and statutory sites) and recommends any necessary measures to reduce or mitigate flood risk to both the site and downstream catchment.

This report also details the proposed drainage strategy which is in line with the Lead Local Flood Authority requirements, CIRIA SuDS Manual (C753) and the Welsh Government Statutory Standards for Sustainable Drainage Systems.

In preparation of the report and performance of any other services, Land Studio has relied upon publicly available information, information provided by the client and information provided by third parties. Accordingly, the conclusions reached in this report are valid only to the extent that the information provided was accurate and complete. Land Studio cannot accept liability for the accuracy or otherwise of any information derived from third party sources.



# BRYNHYFRYD, CHWILOG: THE SITE



The development site is existing agricultural land located at Chwilog, off B4354, Gwynedd.

The grid reference for the centre of the development is SH429385. The site location can be found in Figure 1.

The site is bounded by agricultural land to the south and east with existing Brynhyfryd farmhouse to the south west corner, the B4354 to the north. A telecom exchange is located to the north east corner. An existing gated farm access to the site exists off the B4354

An existing water main crosses the site north to south and there is a surface water ditch to the south and east perimeters. No other known services cross the site.

The proposed development is the construction of 25 new residential dwellings with associated infrastructure including an access road, landscaping, SuDS features and services.

The proposed planning application red line boundary equates to 0.754 hectares.

The proposed development plan can be seen in Figure 2.

Figure 2 Proposed Development



# BRYNHYFRYD, CHWILOG: RELEVANT PLANNING POLICY & GUIDANCE

The following legislation and planning guidance have been reviewed and considered in preparation of this report and the subsequent design.

## Planning Policy and Guidance

The following legislation and planning guidance has been reviewed in regards to Flood Risk. Additional policy and guidance in relation to drainage design is available and will be covered by the separate drainage strategy report.

### Planning Policy Wales (PPW)

Planning Policy Wales (PPW) sets out governments planning policies for Wales and how these are expected to be applied. TAN 15 provides technical guidance which supplements the policy within PPW and seeks to ensure that flood risk is taken into account at all stages in the planning process and is appropriately addressed.

National policy requires that planning applications for new developments should incorporate sustainable drainage systems (SuDS) to appropriate operational standards and with maintenance arrangements in place unless there is clear evidence that this would be inappropriate.

The PPW states that the planning system protects water features and fosters sustainable water management as key attributes of attractive and resilient places to live and is closely aligned with securing the multiple benefits of green infrastructure. The outcome of which should make a contribution towards achieving the requirements imposed by EU Water Framework Directive along with Welsh Government Policy for the integrated planning and management of water both in the urban and rural areas.

New developments of more than one dwelling or where the area covered by construction work equals or exceeds 100m<sup>2</sup> also requires approval from the SuDS Approval Body (SAB) before construction can commence.

The provision of SuDS must be considered as an integral part of the design of new developments and proposals should incorporate design of surface water management based on the principles which work with nature to facilitate the natural functioning of the water cycle.

Any developments discharging domestic sewage should connect to the foul sewer where it is reasonable to do so. Developments proposing the use of non-mains drainage schemes will only be considered acceptable where connection to the main sewer is not feasible. Non mains drainage schemes should be subject to an assessment of their effects on the environment, amenity and public health in the locality.

All developments should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development itself.

All developments should not cause additional run-off and therefore requires control as close to source as possible by the use of SuDS.

## Technical Advice Note 15: Development and Flood Risk

TAN 15 sets out a precautionary framework to guide planning decisions in areas at high risk of flooding. The aim of the framework is to direct new developments away from those areas which are at high risk of flooding and where developments are considered in high risk flood areas only those developments which can be justified should be located in such areas. The aim of TAN15 is also to ensure that flood risk is considered at all stages in the planning process and to direct development run-off away from the areas at highest risk. Where new development is proposed in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible to reduce flood risk overall.

For “highly vulnerable development (residential) TAN 15 requires the developer must ensure that future occupiers of the development are aware of the flooding risks and any consequences, effective flood warnings if necessary are provided, escape routes are known, development is designed to minimise structural damage during any flooding, there is no flooding elsewhere due to the development and that any flood mitigation is designed, maintained and paid for by the developer.

The Flood Map for Planning provided by Natural Resources Wales (NRW) indicates the level of risk associated fluvial, coastal and surface water on the location of the site and how to assess the consequences of flooding on the site.

To reduce surface water run-off from the site Sustainable Drainage solutions both hard and soft should be employed to manage and treat surface water run-off prior to discharge.

### Statutory Authority Guidance

The approach outlined in the Welsh Government Sustainable Drainage Systems Standards for Wales (SuDS Standards) and the CIRIA SuDS manual seek to manage the quality and quantity of rainwater runoff close to where it falls and to bring not just drainage design solutions but also amenity benefits to site users and encourage biodiversity. The SuDS Standards require compliance with the following objectives and are covered further in Section 04 of this report and the drainage design strategy. S1: Surface water runoff destination, S2: Surface water runoff hydraulic control, S3: Water Quality, S4: Amenity and S5: Biodiversity.

## Local Policy

The Anglesey and Gwynedd Joint Local Development Plan was adopted by Gwynedd Council in July 2017 and reviewed in March 2022. Policy PS6: Alleviating and adapting to the effects of climate change relates to flooding.

In order to alleviate the effects of climate change, proposals will only be permitted where it is demonstrated that they have fully taken account of and responded to the following;

1. Implementing sustainable water management measures in line with the objectives in the Western Wales Basin Management Plan;
2. Locating away from flood risk areas, and aim to reduce the overall risk of flooding within the Plan area and areas outside it, taking account of a 100 years and 75 years of flood risk in terms of the lifetime of residential and non residential developments, respectively, unless it can be clearly demonstrated that there is no risk or that the risk can be managed;
3. Be able to withstand the effects of climate change as much as possible because of its high standards of sustainable design, location, layout and sustainable building methods (in line with Policy PCYFF 3).
4. Aim for the highest possible standard in terms of water efficiency and implement other measures to withstand drought, maintain the flow of water and maintain or improve the quality of water, including using sustainable drainage systems (in line with Policy PCYFF 6).

Policy PCYFF 6: Water Conservation indicates that proposals should incorporate water conservation measures where practicable, including SuDS. All proposals should implement flood minimisation or mitigation measures where possible, to reduce surface water runoff and minimise its contribution to flood risk elsewhere.

Brynhyfryd, Chwilog: **BASELINE REVIEW**

02



# BRYNHYFRYD, CHWILOG: BASELINE

## Flood Risk

Flood risk is a combination of the probability and the potential consequence of flooding. Areas at risk of flooding are those at risk of flooding from any source now or in the future.

The key aims of this flood consequence assessment are to:

- Assess the flood risk to the development and to demonstrate the feasibility of designing the development so that the risk of flooding is acceptable.
- Assess the potential impact of the development on flood risk elsewhere and demonstrate that this can be mitigated by using sustainable drainage systems.
- Satisfy the requirements of the Technical Advice Note (TAN 15).

## Flood Risk from Rivers (Fluvial)

The NRW Flood Maps for Planning indicates that the area within the redline boundary is in a Flood Zone 1 for fluvial flooding which is land that has been assessed as having a less than 1 in 1000 annual probability of river flooding (<0.1%). The closest river is the Avon Wen approximately 350m to the east or an unnamed watercourse 450m to the west of the site. Both of which are lower in topography than the site.

The site is therefore at a very low risk of river flooding.

## Flood Risk from Seas (Tidal)

The NRW Flood Maps for Planning indicates that the area within the redline boundary is in a Flood Zone 1 for tidal flooding which is land that has been assessed as having a less than 1 in 1000 annual probability of tidal flooding (<0.1%). The sea is approximately 2km to the south of the site.

The site is therefore at a very low risk of tidal flooding.

## Flood Risk for Surface Water (Pluvial)

Overland flow occurs when the infiltration capacity of the ground or capacity of the drainage systems is exceeded in a storm event. This can result in water travelling over land or ponding in low spots within the land.

The NRW Flood Maps for Planning indicates no surface water flooding within the site boundary.

There are surface water flow paths to the south of the site on the boundary of the adjacent field which flows into the unnamed watercourse.

The site is therefore at a very low risk of surface water flooding.

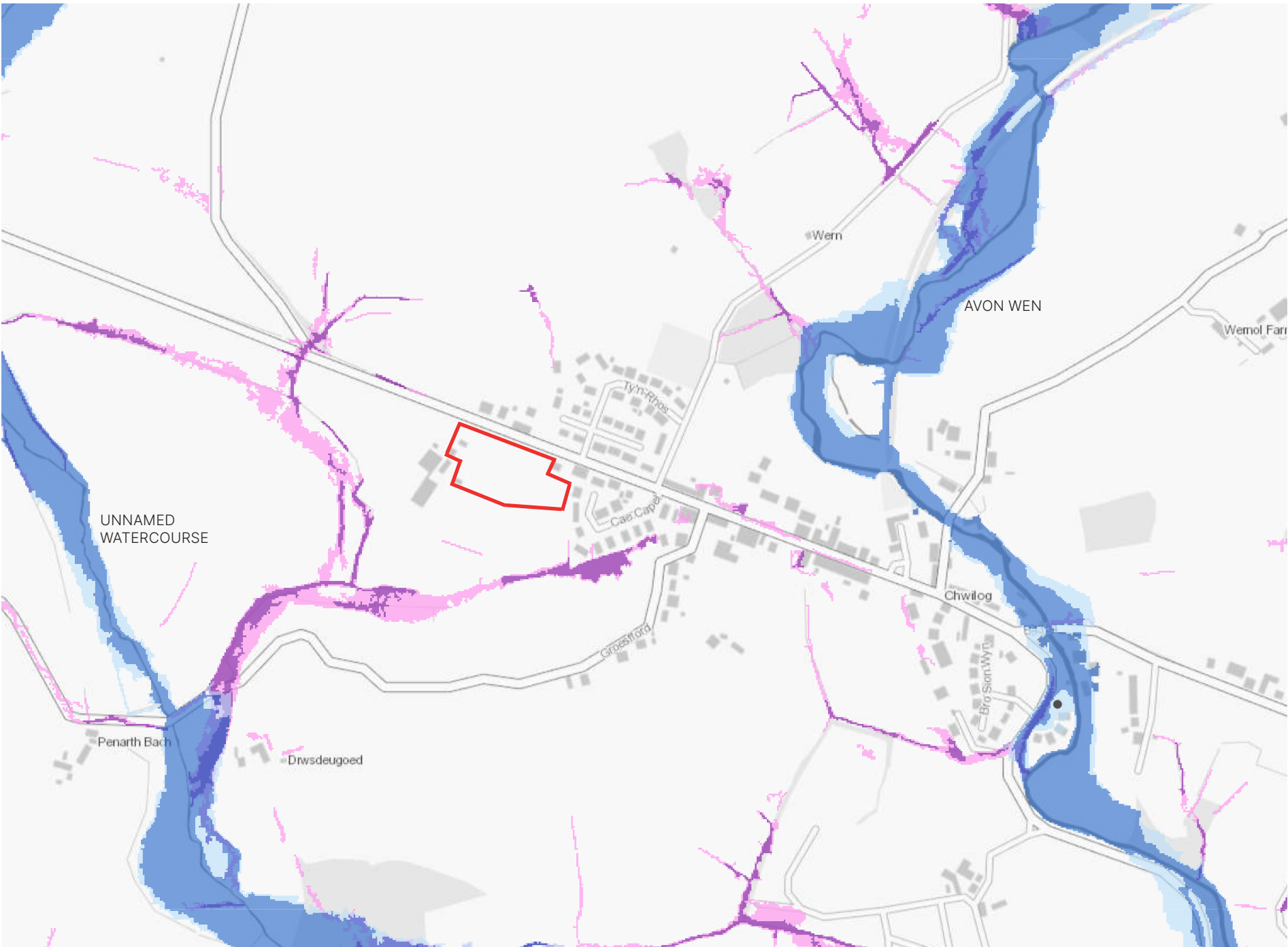


Figure 3 Flood Risk for Planning Map indicating river and surface water flooding



# BRYNHYFRYD, CHWILOG: BASELINE

## Flooding from Reservoirs

The site is not located in proximity of any reservoirs and the Flood Maps for Planning indicate that flooding from reservoirs is at very low risk at this site.

## Flooding from Sewers and Drains

If the capacity of the sewer or private drains are exceeded in an extreme event, or a blockage occurs, surcharging of the drainage network can result in flooding.

Welsh Water sewer records have been purchased and indicate a combined 225mm sewer within the B4354 on the northern boundary of the site.

The site is greenfield and there are no known private drainage systems within site.

Welsh Water have not identified that there is any known flooding with this sewer or the site.

An extract from the sewer records can be seen in Figure 4 with the full sewer information in the Appendices of this report.



Figure 4 : Extract from Welsh Water Sewer Records

## Geological Setting

The LandIS soilsmap mapping indicates the site is underlain by slowly permeable seasonally wet acid loamy and clayey soils. The site is shown to have impeded drainage and is drained to the local stream network. This is indicated in green in Figure 5.

A geotechnical assessment and site investigation was undertaken by e-geo Solutions Limited in March 2025. This indicated 300mm of topsoil to between 1.2m and 2.0m of stiff gravelly to very gravelly sand silty clay on top of weathered bedrock.

Three permeability tests were undertaken in accordance with BRE365. All tests failed and therefore the site is not suitable for infiltration soakaways.

## Flooding from Groundwater

Groundwater flooding occurs as a result of water rising up from the underlying superficial deposits, bedrock or from springs. No groundwater was recorded in trial pits or borehole logs undertaken during the site investigation in March 2025.

## Nitrate Vulnerability

Data Map Wales indicates the site is not located in a Nitrate Vulnerable Zone (NVZ).

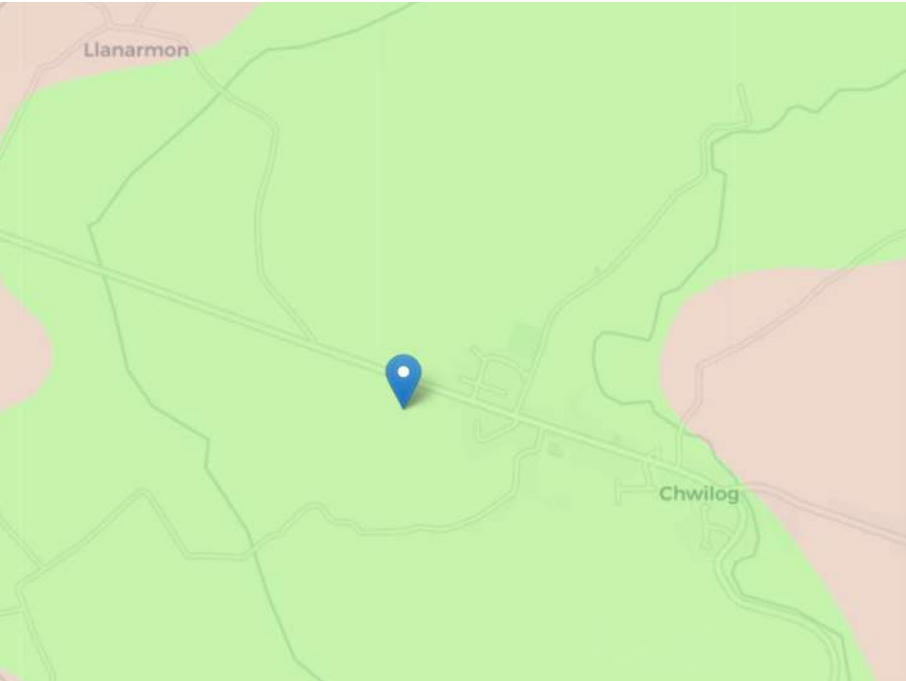


Figure 5: Extract from Soilsmap Mapping

## Source Protection Zone

Data Map Wales indicates the site is not located in a Source Protection Zone (SPZ).

## Topography

The site generally falls from the north west corner to the south east corner falling 45.0 AOD in the north west corner to 43.40 AOD in the north east corner and 43.0 AOD in the south west corner to 40.0 AOD in the south east corner.

A full topographical survey has been undertaken and included within the Appendices of this report.

## Watercourses

Data Map Wales indicates there are no main rivers adjacent or on the site with the Avon Wen approximately 650m to the east of the site.

Land drainage ditches are mapped to west and south of the site. These are indicated on the flood map in Figure 3 and in Figure 6.

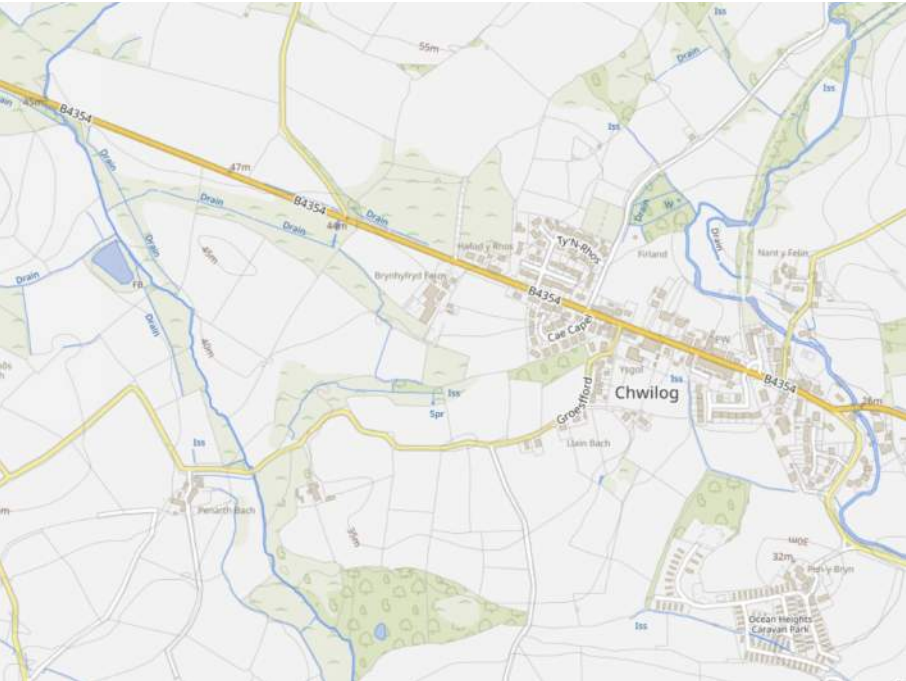


Figure 6: Watercourse locations and topography



Brynhyfryd, Chwillog: **ASSESSMENT OF FLOOD RISK**

03



# BRYNHYFRYD, CHWILOG: ASSESSMENT OF FLOOD RISK

## Assessment of Flood Risk

As a residential development, the development type is classed as “more vulnerable”.

In accordance with TAN15 guidance, the development is located within Zone A (1) land from all sources of flooding apart from surface water flooding and therefore is an acceptable location for development.

Surface water flooding will be managed through implementation of SuDS for collection of surface water from the new development and the design of the proposed levels to ensure that exceedance flow routes are retained or diverted within the proposed landscape design to ensure they are directed away from new properties and do not increase any flooding of existing properties.

## Access and Egress

In accordance with TAN15 guidance, the development will need to demonstrate that during a flood event the site will:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage; and
- Not impede water flows and not increase flood risk elsewhere.

Whilst there is no current flood risk on the site the proposed levels on the site fall from the north west corner to the south east corner and will continue to do so in the proposed scheme, albeit at a shallow gradient than the existing contours.

## Maintaining Exceedance Events

Exceedance events are storm or flood events that go beyond what can be practicably quantified and flows from such events will need to be directed through the proposed development, away from any high risk areas, such as building thresholds and towards low risk areas and then off site.

To ensure localised flooding does not occur from the private drainage systems regular maintenance of both the foul and surface water networks will need to be undertaken.

Exceedance events will follow the proposed levels towards the open fields to the south of the development. An existing ditch along the southern boundary will remain to capture any exceedance flow events as in the current situation.

## Flood Risk Conclusion

With flooding from all existing sources being classed as very low and the implementation of localised flood mitigation measures within the proposed levels and drainage design it is therefore deemed that the proposed development will not have a material impact on the hydrology of the existing land and that all foreseeable sources and receptors of flood risk as a result of the development have been considered.

Brynhyfryd, Chwillog: **SURFACE WATER DRAINAGE**

04



# BRYNHYFRYD, CHWILOG: SURFACE WATER DRAINAGE

## Surface Water Drainage Discharge

The proposed surface water drainage shall be designed so that there is no surcharging of pipework during storms up to a 1:2-year annual probability and no flooding on the surface, apart from within green SuDS features during storms up to a 1:30-year annual probability.

The design will also be checked to ensure no flooding of third-party land or buildings during storms up to a 1:100-year annual probability plus allowance for 30% climate change.

## S1: Surface Water Runoff Destination

The SuDS Standard has five priority levels for surface water runoff. These are:

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

### Priority 1: Water Reuse

Solutions that reuse rainwater prior to discharge include rainwater harvesting for on-site non-potable use, flushing toilets for example or for landscape maintenance in the form of water butts or raingardens. Section G1.6 of the Statutory Standards for SuDS states that “in most cases, rainwater harvesting alone will not be adequate to deal with the site drainage and provision will be required for an overflow to a Priority Level 2 or lower priority runoff destination”. There is no known requirement by Welsh Water for harvesting water in this location.

### Priority 2: Infiltration to Ground

Ground information obtained through review of the soilscape website, site walkover and onsite physical investigation indicated that infiltration techniques cannot be utilised on this site.

The levels across the site would negate the use of shallow infiltration as this could allow water to pass along a band of material beneath the surface and not infiltrate directly into the ground. Therefore infiltration is not proposed on this site.

### Priority 3: To Surface Water Body/Watercourse

There are no known watercourses within the site boundary. The closest unnamed watercourse is 180m to the south of the site with a land drainage

ditch along the southern boundary of the site and eastern boundary of the agricultural field to the south. As this land is within the same land ownership continued discharge, albeit regulated, can be made.

Surface water discharge is therefore proposed into this land drainage ditch.

### Priority 4 and 5: To sewer

A combined sewer exists within the highway to the north. There are no separate surface water sewers indicated on the records. Connection to sewer is not required as discharge to watercourse via existing land drainage ditches is possible.

## S2: Surface Water Runoff Hydraulic Control

The aim of Standard S2 is to manage the surface water runoff from and on the site to protect people on the site from flooding from the drainage system for events up to a suitable return period, to mitigate any increased flood risk to people and property downstream of the site as a result of the development, and to protect the receiving water body.

Flood Risk will not be significantly increased as a result of the development proposals if mitigation measures are implemented and the drainage is designed with these in mind and includes SuDS features.

The proposed runoff rate will be limited to Qbar greenfield runoff rates which equates to 2.55 l/s. Calculation of this is included in the appendices of this report.

The restriction of runoff rates and increase in impermeable area will generate storm-water storage volumes that will need to be attenuated on-site prior to release.

## Sustainable Drainage Systems (SuDS)

SuDS within the development site can be used for storage and collection of surface water before the restricted discharge into the land drainage ditch.

The SuDS features will be designed for all storm events up to and including the 1 in 100 year storm event plus an allowance for climate change which has been taken as 30%. **??m3** of storage will be provided within the site.

It is proposed that a detention basin will be included within the site layout with raingardens collecting roof drainage to treat runoff prior to discharge. The basin is to be located at the lowest part of the site and to be incorporated within the landscape design and levels design.

Permeable paving will be provided to all parking areas with subbase attenuation to help treat the water and slow down the water before discharge to the basin.

The proposed drainage design strategy is included within the Appendices of this report.



Figure 7: Typical Detention Basin Image



Figure 8: Typical Raingarden Image

# BRYNHYFRYD, CHWILOG: SURFACE WATER DRAINAGE

## S3: Water Quality

Standard S3 addresses the drainage design requirements to minimise the potential pollution risk posed by the surface water runoff to the receiving water body

Where possible, surface water runoff should be managed using interception, sedimentation and treatment components close to its source. This will help to prevent sediment and other pollutants from being conveyed to, and building up in, downstream components and causing:

- Increased risk of blockage in the downstream system,
- Increased maintenance requirements,
- Lower amenity and biodiversity potential for downstream drainage components,
- Increased risk of contaminant re-mobilisation and discharge

The quality of runoff from the site to support and protect the natural environment effectively has been reviewed when choosing the SuDS features.

Water Quality design criteria is set out in Water Quality Management: Design Methods in Chapter 26 of The SuDS Manual CIRIA C753 2015.

Table 26.2 of The SuDs Manual CIRIA C753 indicates the pollution hazard indices for the varying land uses in the proposed development.

Roofs and pedestrian pathways are deemed to have a **very low** pollution hazard

- 0.2 Total Suspended Solids
- 0.2 Metals
- 0.05 Hydrocarbons

Access roads are deemed to have a **low** pollution hazard

- 0.5 Total Suspended Solids
- 0.4 Metals
- 0.4 Hydrocarbons

The SuDS design for the development will need to provide pollution prevention and site control techniques prior to discharge from the site.

To deliver adequate treatment the selected SuDS components which have been identified and included for in the design have a pollution mitigation index that exceeds the pollution hazard index given above.

Table 26.3 of CIRIA C753 indicates the following mitigation indices.

### Permeable Surfaces

- 0.7 Total Suspended Solids
- 0.6 Metals
- 0.6 Hydrocarbons

### Raingardens

- 0.8 Total Suspended Solids
- 0.8 Metals
- 0.8 Hydrocarbons

### Detention Basin

- 0.5 Total Suspended Solids
- 0.5 Metals
- 0.6 Hydrocarbons

The mitigation provided in the soils beneath the raingardens and then the detention basin gives a higher mitigation index than its use and therefore is deemed suitable for collection of roof water.

The mitigation provided permeable paving gives a higher mitigation index than its use and therefore is deemed suitable for collection of parking.

The mitigation provided in the detention basin gives a higher mitigation index than its use and therefore is deemed suitable for collection of the access road. If deemed required by the SAB additional proprietary treatment could be provided within the below ground drainage system prior to discharge into the detention basin.

## S4: Amenity

The provision of above ground SuDS features such as the detention basin which can provide amenity space allows for the SuDS feature to be integrated into the landscape design and be utilised during exceedance events. The levels on this site are restrictive due to the depth of water within the basin to utilise this area with play.

## S5: Biodiversity

The provision of above ground SuDS features such a s raingardens and biodetention basins can include planting which allows for increased biodiversity but also help channel water in times of flood and allow wet areas to be incorporated which also helps enhance biodiversity.



# BRYNHYFRYD, CHWILOG: SURFACE WATER DRAINAGE

## S6 - Construction, Operation and SuDS Maintenance

The design for robust surface water drainage systems so they can be easily and safely constructed, maintained and operated, taking into account the need to minimise negative impacts on the environment and natural resources has been reviewed. The design of the proposed surface water drainage system is to follow the good practice contained in SuDS Standards and the CIRIA SuDS manual with maintenance strategies to follow that indicated below.

CIRIA C753 Table 20.15 Operation and maintenance requirments for pervious pavements		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vaccuming	Once a year after autumn leaf fall or reduced frequency as required based on observations of clogging or as manufacturers requirements
Occasional Maintenance	Stabilise and mow adjacent areas	As required
	Removal of weeds or management using spraying directly	As required but minimum once a year
Remedial Actions	Remediate any landscape which through vegetation maintenance of sil slip has been raised to within 50mm of the level of the paving	As required
	Remedial works to any depressions or rutting detrimental to the structural performance or hazard of the user, and replace lost jointing material	As required
	Rehabilitation of surface and upper structure by remedial sweeping	Every 10 -15 years or as required if infiltration performance is reduced due to significant clogging
Monitoring	Initial Inspection	Monthly for 3 months after installation
	Inspect evidence of poor operation and/or weed growth - if required take remedial action	3 monthly, 48hrs after large storms in first 6 months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Figure 9 Permeable paving typical maintenance requirements

CIRIA C753 Table 13.2 Operation and maintenance requirments for basins		
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove Litter and Debris	Monthly, or as required
	Cut grass- to retain grass height within specified design range for landscaped areas and access routes	Monthly (during growing season), or as required
	Cut grass- meadow grass in and around basin	6 monthly: spring before nesting season and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of swale treatment area
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre treatment system when 50% full	As required
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and pretreatment systems for silt accumulation, establish appropriate silt removal frequencies	6 Monthly
	Inspect infiltration surfaces for compaction and ponding	Monthly

Figure 10 Detention basin typical maintenance requirements

CIRIA C753 Table 18.3 Operation and maintenance requirments for bioretention systems		
Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections and Maintenance	Remove Litter and Debris	Monthly, or as required
	Check operation of underdrains by inspection of flows after rain	Monthly at start, then annually
	Inspect vegetation and plants for disease infection, poor growth, invasive species etc. and replace as neccessary	Quarterly
	Replace any plants to maintain planting density	As required
	Inspect infiltration surfaces for silting and ponding and record to determine if maintenance/remedials neccessary	Quarterly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Quarterly
Occasional Actions	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely >20 years

Figure 11 Raingarden typical maintenance requirements

Brynhyfryd, Chwilog: **FOUL WATER DRAINAGE**

05



## BRYNHYFRYD, CHWILOG: FOUL WATER DRAINAGE

### Foul Water Discharge Hierarchy

The following hierarchy for discharge has been reviewed.

- Local Foul Public Sewer System
- Local Combined Public Sewer System
- Package Treatment Plant to either
  - Infiltration to ground
  - Discharge to watercourse
- Septic tank
- Cesspool

A Dwr Cymru/Welsh Water foul public sewer network exists to the north of the development site. A predevelopment enquiry has been submitted to Dwr Cymru/Welsh Water which confirmed that the site is located in the immediate vicinity of a foul public sewerage system which drains to Chwilog Wastewater Treatment Works (WwTW) and have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system.

The flows should be connected to the foul sewer at or downstream of manhole SH42388501 located in highway to the front of the site.

No problems are envisaged with the Waste Water Treatment Works.

### Proposed Foul Water Design

The private drainage within the development site will be designed in accordance with BS EN 752:2017.

Separate foul and surface water systems will be provided until point of discharge.

### Proposed Foul Flows

Using British Water of Code of Practice: Flows and Loads and an allowance of 150 l/per person/day is to be used in calculation of the foul flows.

Based on 25 dwellings a peak daily flow of 0.2l/s has been calculated.



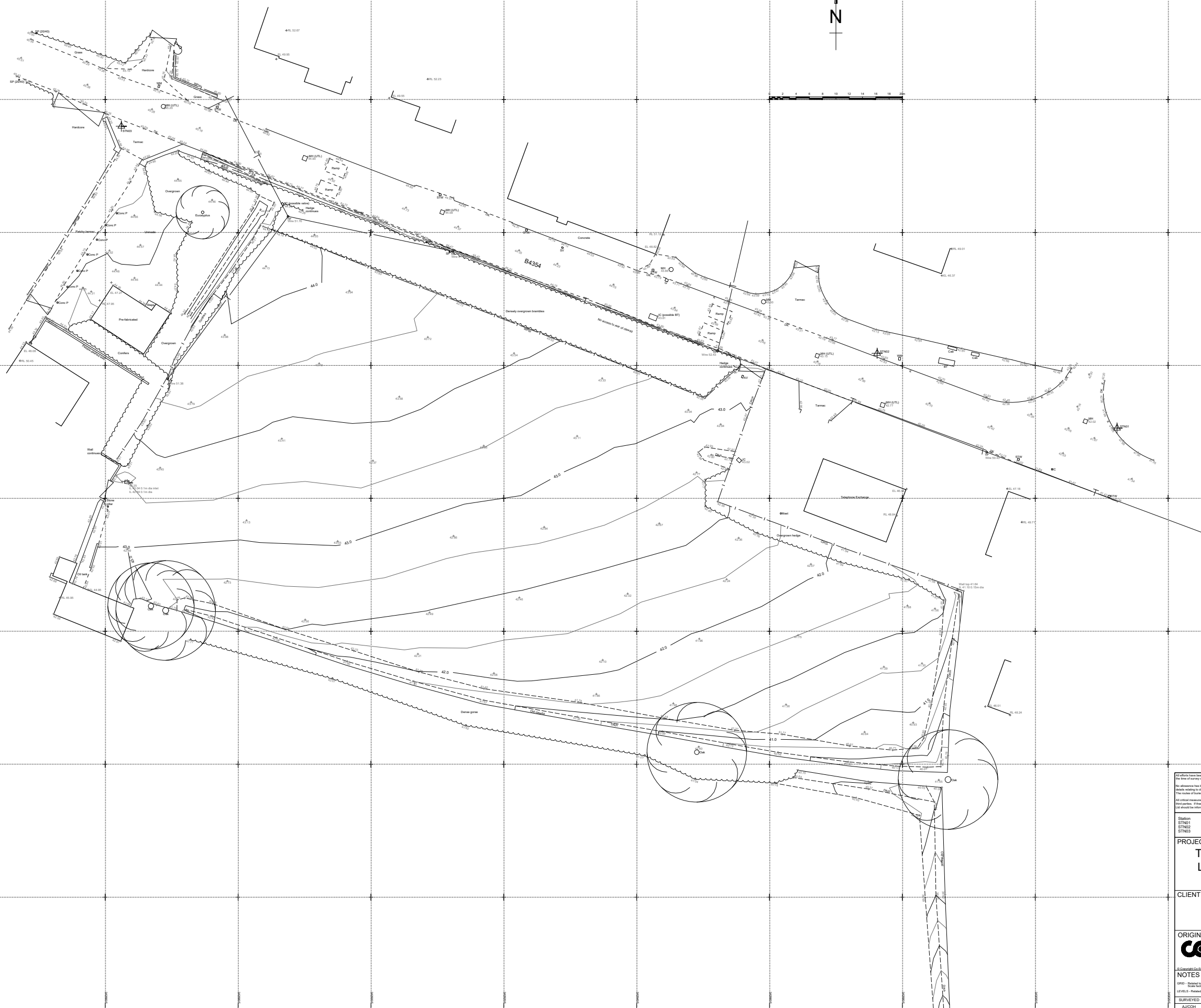
Figure 12 Foul Public Sewer Location: Extract form Welsh Water Records

Brynhyfryd, Chwilog: **APPENDICES**

06



Brynhyfryd, Chwilog: **APPENDIX 1 - TOPOGRAPHY**

[illegible][illegible]



Brynhyfryd, Chwilog: **APPENDIX 2 - EXISTING DRAINAGE**

Land off B4354, Brynhyfryd, Chiwlog LL53 6FA



**LEGEND(Representative of most common features)**

Waste network:		
Foul chamber	Surface water chamber	Outfall
Combined chamber	Combined sewer overflow	Lamphole
Special purpose chamber	Treatment works	Storm Overflow
Pumping station	Private sewer subject to Sect. 104 adoption agreement	Rising main
Private sewer	Private sewer Transfer	Gravity sewer
Lateral Drain	Inspection Chamber	S 104
Former S24 sewers (for indicative purposes only)		

**Notes:**

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.

Dŵr Cymru Cyfyngedig (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

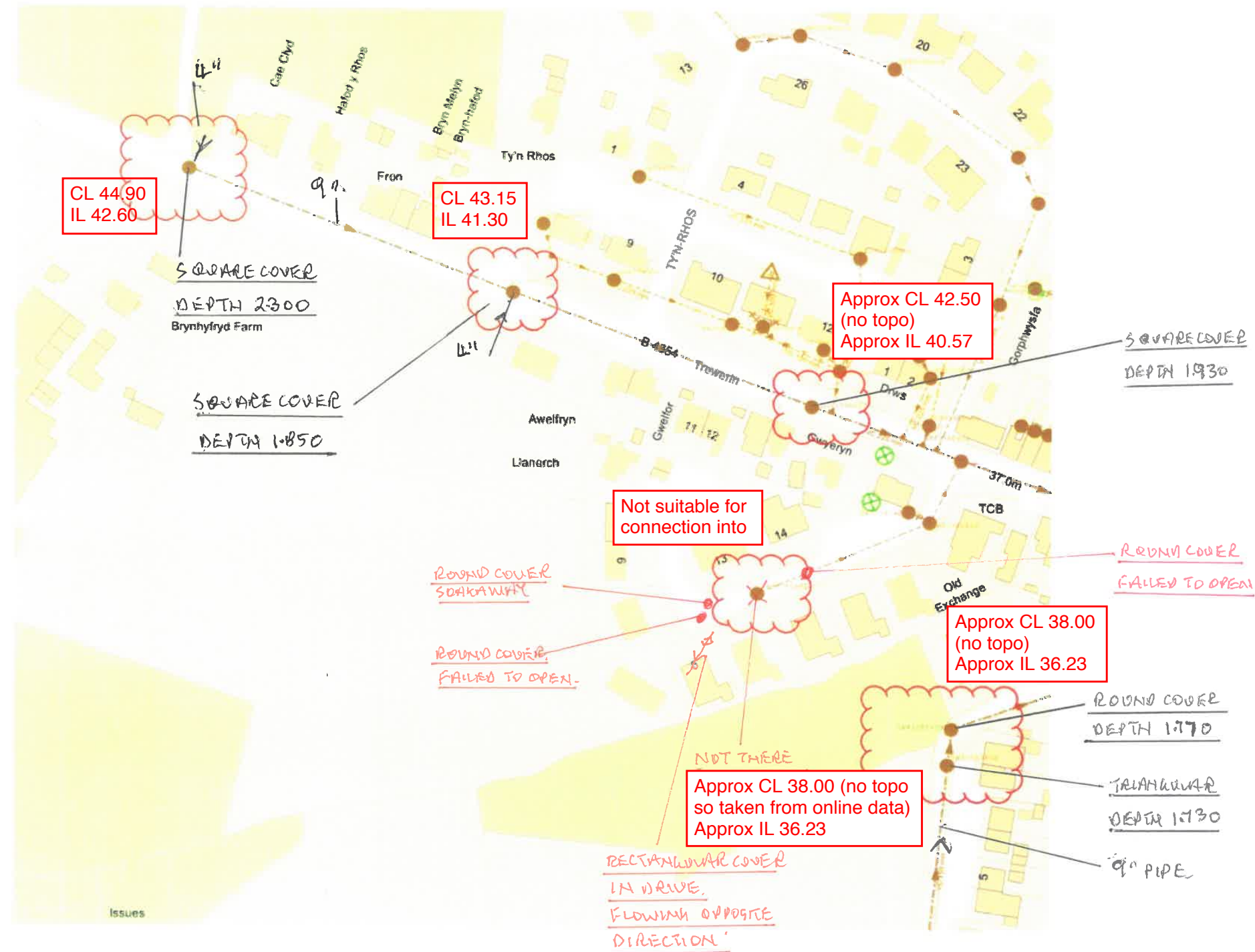
Service pipes are not generally shown but their presence should be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS  
TO BE DETERMINED ON SITE.**

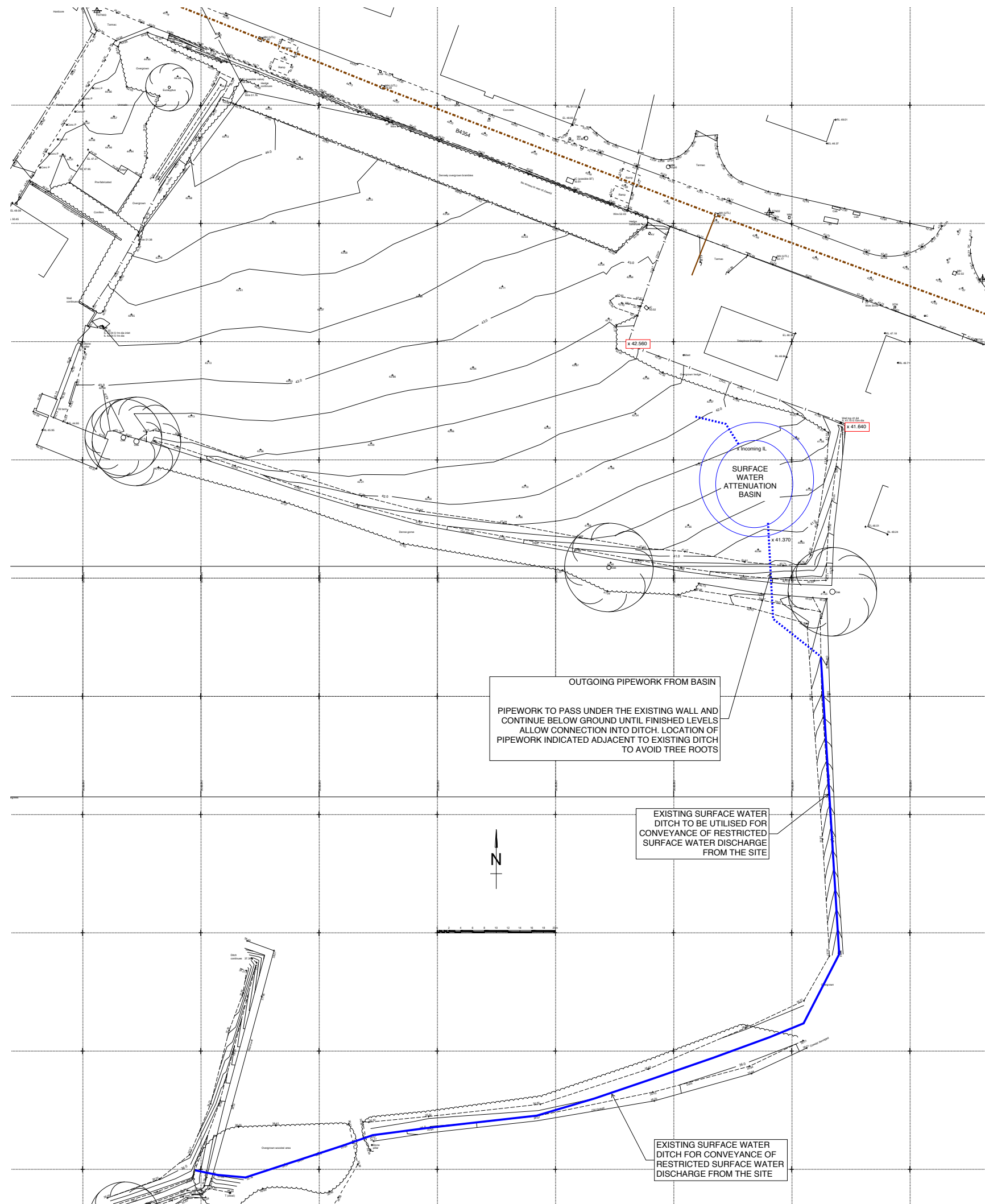
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Map Ref: 242919,338517  
Map scale: 1:1250  
Printed by: Emily Marsden  
Printed on: 07 Feb 2025





CHWILLOU DRAINAGE SURVEY  
4/3/2025





Mrs Lisa Sawyer  
Land Studio  
Chester  
Cheshire  
CH1 2DW

**Date: 18/03/2025**  
**Our Ref: PPA0009257**

Dear Mrs Sawyer

**Grid Ref: 242917 338520**  
**Site Address: Land off B4354 Chwillog, Chwillog, Gwynedd**  
**Development: 25 Residential Units**

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

### **APPRAISAL**

Firstly, we note that the proposal relates to a residential development comprising of 25 units on Land off B4354 Chwillog and acknowledge that the site is allocated (Ref:T64) within the Local Development Plan (LDP) for 21 units. In reference to our representations during the LDP consultation process, we can confirm that an assessment has been undertaken of the public sewerage and watermains systems to accommodate 21 No. of Units and informs our appraisal as follows.

### **PUBLIC SEWERAGE NETWORK**

The proposed development site is located in the immediate vicinity of a foul public sewerage system which drains to Chwillog Wastewater Treatment Works (WwTW).

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

## **SURFACE WATER DRAINAGE**

As of 7th January 2019, this proposed development is subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore requires approval of Sustainable Drainage Systems (SuDS) features, in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy preferring infiltration (PL2) and, where infiltration is not possible, disposal to a surface water body (PL3), in liaison with the Lead Local Flood Authority and/or Natural Resources Wales, or surface water sewer or highway drain (PL4) in liaison with the riparian owner and/or Local Highways Authority.

Please note, DCWW is a statutory consultee to the SAB application process and will provide comments to any SuDS proposals by response to SAB consultation. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note and our Developer Services website at <https://developers.dwrcymru.com/en/help-advice/regulation-to-be-aware-of/sustainable-drainage-systems>.

In the absence of an accompanying surface water drainage strategy, please be advised that due to capacity constraints with the downstream public sewerage network, under no circumstances would we allow surface water runoff highway run-off from the proposed development to communicate directly or indirectly with the public combined sewerage system. In addition, please note, no amount of land drainage run-off is permitted to discharge directly or indirectly into the public sewerage system.

Furthermore, Planning Policy Wales (PPW) acknowledges that discharge of surface water to foul sewers is prohibited and highlights that any additional surface water from new developments should not be discharged to combined systems because of the risk of pollution when combined systems overflow (Para 6.6.3). Moreover, PPW recognises the challenges faced from rainfall intensity causing surface water flooding and diffuse pollution (Para 6.6.14) along with the importance of well-maintained sewerage networks (Para 6.6.15), particularly as a result of run-off from built surfaces and the sewage discharges from overloaded sewers (Para 6.6.16).

## **FOUL WATER DRAINAGE – SEWERAGE NETWORK**

We have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system. We advise that the flows should be connected to the foul sewer at or downstream of manhole SH42388501 located in highway to the front of the site.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account. However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.



Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.  
Mae Dŵr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in  
Welsh and English

Dŵr Cymru Cyf, a limited company registered in  
Wales no 2366777. Registered office: Pentwyn Road,  
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y  
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng  
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn  
Nelson, Treharris, Morgannwg Ganol CF46 6LY.



You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water Industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of [www.dwrcymru.com](http://www.dwrcymru.com).

## **SEWAGE TREATMENT**

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

## **POTABLE WATER SUPPLY**

This site is crossed by a public pressurised main with the approximate position(s) being marked on the attached statutory public watermain record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. No part of any building, structure, trees, ecological mitigation or SuDS features will be permitted within the protection zone of the public pressurised main measured 4 metres either side of the centreline. We would also advise that the public pressurised main and its required protection should be located within a public and accessible area and not within any private amenity space or residential curtilage. Please note, the distance specified for this protection zone is indicative and based on industry standard guidelines. However, the depth of the asset will need to be verified on site which may infer a greater protection zone. For completeness, we recommend the developer refer to their title deeds to confirm if there are any covenants or restrictions associated with the asset(s) crossing the proposed development site.

Accordingly, it is recommended that the developer contact our Plan and Protect team ([PlanandProtect@dwrcymru.com](mailto:PlanandProtect@dwrcymru.com)) to carry out a survey to verify the location of this asset and establish its relationship to the proposed development. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

Capacity is currently available in the water supply system to accommodate the development. Initial indications are that a connection can be made from the '150mm' diameter watermain in '242948,338505' location. We reserve the right however to reassess our position as part of the formal application for the provision of new water mains under Section 41 and Section 51 of the Water Industry Act (1991) to ensure there is sufficient capacity available to serve the development without causing detriment to existing customers' supply as demands upon our water systems change continually.



I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at [developer.services@dwrcymru.com](mailto:developer.services@dwrcymru.com)

Please quote our reference number in all communications and correspondence.

Yours faithfully,

**Rhys Evans**  
**Planning Liaison Manager**  
**Developer Services**

***Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.***

Brynhyfryd, Chwillog: **APPENDIX 3 - PROPOSED DRAINAGE STRATEGY**





- Notes
1. This drawing is to be read in conjunction with all relevant surveys and architectural drawings.
  2. Third party information has been used to complete this design. Land Studio are not liable for this information.
  3. Levels are in metres AOD.
  4. Existing drainage locations and levels and water main location and levels must be checked prior to any works commencing and any discrepancies in dimensions or details should be drawn to the attention of the engineer.
  5. Only main drainage currently indicated. Additional plot drainage may be required at detailed design.
  6. Surface water features designed to manage a 1 in 100 year (1% AEP) plus 45% climate change event without flooding off site with a discharge of 2.5l/s into existing land drainage ditch to the south.
  7. Foul water is designed to collect via gravity and to discharge into the public sewer system. Proposed ground levels have been raised to allow a gravity connection to be designed.

Key

- Site Boundary
- Proposed foul chamber and pipework
- Proposed surface water chamber and pipework
- Proposed permeable paving with 30% void ratio subbase
- Existing Welsh Water Public Sewer
- Proposed Raingarden
- 00.000 Spot Level
- 00.000 Existing Tie In Level

Revision	P01	03.07.2025	Issued for PAC Submission	PE	LS	
Date			Description	Drawn	Apprvd.	
	N					
	THIS DRAWING IS COPYRIGHT PROTECTED AND MAY NOT BE REPRODUCED IN WHOLE OR PART WITHOUT WRITTEN AUTHORITY FROM THE OWNER.					
Client	Williams Homes					
Project	Brynhyfryd, Chwilog					
Drg Title	Drainage General Arrangement					
Created on	25.06.25	Created by	PE	Approved by	LS	
Scale	1:250	Size	A1	Workstage	Stage 3	
Drg No.	465-LST-XX-XX-DR-D-0100		Suitability	S3	Revision	P01

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Brynhyfryd, Chwilog: **APPENDIX 4 - CALCULATIONS**

Calculated by:	Gareth Dugine
Site name:	Chwilog
Site location:	1

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.

## Site Details

Latitude:	52.92119° N
Longitude:	4.33827° W
Reference:	1045547493
Date:	Feb 20 2025 13:22

## Runoff estimation approach

IH124

## Site characteristics

Total site area (ha):	.8
-----------------------	----

## Methodology

Q <sub>BAR</sub> estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

## Notes

(1) Is  $Q_{\text{BAR}} < 2.0 \text{ l/s/ha}$ ?

When  $Q_{\text{BAR}}$  is  $< 2.0 \text{ l/s/ha}$  then limiting discharge rates are set at  $2.0 \text{ l/s/ha}$ .

## Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

(2) Are flow rates  $< 5.0 \text{ l/s}$ ?

Where flow rates are less than  $5.0 \text{ l/s}$  consent for discharge is usually set at  $5.0 \text{ l/s}$  if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

## Hydrological characteristics

	Default	Edited
SAAR (mm):	1130	1130
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

(3) Is  $\text{SPR/SPRHOST} \leq 0.3$ ?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

Default

Edited



<b>Q<sub>BAR</sub> (l/s):</b>	2.55	2.55
<b>1 in 1 year (l/s):</b>	2.25	2.25
<b>1 in 30 years (l/s):</b>	4.54	4.54
<b>1 in 100 year (l/s):</b>	5.57	5.57
<b>1 in 200 years (l/s):</b>	6.28	6.28

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://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 [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of 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, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

### Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	1.000
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

### Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
Rainfall Events	Singular	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	17.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.200	Starting Level (m)	
Summer CV	1.000	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

### Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

### Node S17 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	2.5		
Invert Level (m)	39.667	Diameter (m)	0.030		

### Node S16 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	20.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	39.700	Main Channel Slope (1:X)	400.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.030

### Inlets

S15

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	64.1	0.0	1.800	314.9	0.0

### Node S2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	43.229	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	8	Depth (m)	0.300
Safety Factor	2.0	Width (m)	7.000	Inf Depth (m)	
Porosity	0.50	Length (m)	20.000		

#### Node S4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	43.033	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.50	Length (m)	10.000		

#### Node S5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	42.778	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.50	Length (m)	10.000		

#### Node S6 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	42.843	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.50	Length (m)	10.000		

#### Node S8 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	42.525	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.50	Length (m)	10.000		

#### Node S9 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	41.976	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	8	Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.50	Length (m)	10.000		

#### Node S12 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	42.686	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	6.000	Inf Depth (m)	
Porosity	0.50	Length (m)	10.000		



**Results for 1 year Critical Storm Duration. Lowest mass balance: 98.82%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1	10	42.876	0.035	3.8	0.0656	0.0000	OK
30 minute summer	S2	19	43.259	0.030	5.2	0.4001	0.0000	OK
15 minute summer	S3	11	42.309	0.090	14.1	0.1892	0.0000	OK
30 minute summer	S4	20	43.046	0.013	0.4	0.1023	0.0000	OK
30 minute summer	S5	23	42.785	0.007	0.3	0.0329	0.0000	OK
30 minute summer	S6	19	42.851	0.008	0.3	0.0423	0.0000	OK
30 minute summer	S7	19	41.863	0.095	16.8	0.1641	0.0000	OK
30 minute summer	S8	20	42.537	0.012	0.4	0.0867	0.0000	OK
60 minute summer	S9	36	42.021	0.045	2.8	0.9258	0.0000	OK
60 minute summer	S11	37	41.988	0.052	2.1	0.0739	0.0000	OK
60 minute summer	S12	35	42.693	0.007	0.2	0.0407	0.0000	OK
30 minute summer	S13	18	41.306	0.108	32.1	0.3323	0.0000	OK
30 minute summer	S14	19	40.908	0.159	31.8	0.2275	0.0000	OK
1440 minute summer	S15	960	40.372	0.622	6.4	0.0000	0.0000	OK
1440 minute summer	S16	960	40.372	0.672	3.9	0.0000	0.0000	SURCHARGED
1440 minute summer	S17	960	40.372	0.705	1.6	1.0088	0.0000	SURCHARGED
15 minute summer	S18	1	39.631	0.000	0.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	S1	1.000	S3	3.7	0.555	0.120	0.1434	
30 minute summer	S2	2.000	S3	4.9	2.599	0.170	0.0080	
15 minute summer	S3	1.001	S7	14.1	1.238	0.649	0.3443	
30 minute summer	S4	3.000	S5	0.3	0.724	0.028	0.0038	
30 minute summer	S5	3.001	S7	0.3	0.940	0.004	0.0049	
30 minute summer	S6	4.000	S7	0.3	0.925	0.012	0.0052	
30 minute summer	S7	1.002	S13	16.7	1.314	0.723	0.4296	
30 minute summer	S8	5.000	S11	0.3	0.147	0.028	0.0450	
60 minute summer	S9	6.000	S11	1.9	0.497	0.379	0.0227	
60 minute summer	S11	5.001	S13	2.1	1.737	0.095	0.0068	
60 minute summer	S12	7.000	S13	0.2	0.684	0.010	0.0133	
30 minute summer	S13	1.003	S14	31.8	1.306	0.470	0.6507	
30 minute summer	S14	1.004	S15	31.9	1.101	0.792	0.2112	
1440 minute summer	S15	Flow through Pond	S16	3.9	0.020	0.000	70.8268	
1440 minute summer	S16	1.006	S17	1.6	0.252	0.108	0.0861	
1440 minute summer	S17	Orifice	S18	1.6				110.4

**Results for 30 year Critical Storm Duration. Lowest mass balance: 98.82%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	21	43.051	0.210	9.1	0.3920	0.0000	SURCHARGED
30 minute summer	S2	20	43.283	0.054	12.7	1.1714	0.0000	OK
30 minute summer	S3	20	43.026	0.807	33.3	1.6987	0.0000	SURCHARGED
30 minute summer	S4	20	43.053	0.020	1.0	0.2241	0.0000	OK
30 minute summer	S5	22	42.788	0.010	0.7	0.0665	0.0000	OK
30 minute summer	S6	19	42.855	0.012	0.7	0.0864	0.0000	OK
30 minute summer	S7	21	42.431	0.663	30.6	1.1392	0.0000	SURCHARGED
30 minute summer	S8	20	42.543	0.018	1.0	0.1876	0.0000	OK
30 minute summer	S9	21	42.062	0.086	8.1	2.0505	0.0000	OK
30 minute summer	S11	21	42.001	0.065	5.7	0.0926	0.0000	OK
15 minute summer	S12	12	42.697	0.011	0.6	0.0913	0.0000	OK
30 minute summer	S13	19	41.498	0.300	64.7	0.9192	0.0000	SURCHARGED
30 minute summer	S14	19	41.044	0.295	61.5	0.4218	0.0000	SURCHARGED
1440 minute summer	S15	1020	40.850	1.100	11.8	0.0000	0.0000	OK
1440 minute summer	S16	1020	40.850	1.150	6.9	0.0000	0.0000	SURCHARGED
1440 minute summer	S17	1020	40.849	1.182	2.0	1.6910	0.0000	SURCHARGED
15 minute summer	S18	1	39.631	0.000	1.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	S1	1.000	S3	8.9	0.646	0.287	0.3583	
30 minute summer	S2	2.000	S3	10.4	2.604	0.363	0.0260	
30 minute summer	S3	1.001	S7	23.6	1.343	1.087	0.5311	
30 minute summer	S4	3.000	S5	0.7	0.934	0.067	0.0070	
30 minute summer	S5	3.001	S7	0.6	1.068	0.009	0.0541	
30 minute summer	S6	4.000	S7	0.6	0.851	0.028	0.0302	
30 minute summer	S7	1.002	S13	29.4	1.672	1.274	0.5956	
30 minute summer	S8	5.000	S11	0.7	0.237	0.069	0.0620	
30 minute summer	S9	6.000	S11	5.0	0.793	1.023	0.0380	
30 minute summer	S11	5.001	S13	5.7	1.935	0.258	0.0268	
15 minute summer	S12	7.000	S13	0.5	0.665	0.025	0.0635	
30 minute summer	S13	1.003	S14	61.5	1.547	0.910	1.0603	
30 minute summer	S14	1.004	S15	61.3	1.544	1.523	0.2817	
1440 minute summer	S15	Flow through Pond	S16	6.9	0.020	0.000	160.3127	
1440 minute summer	S16	1.006	S17	2.0	0.219	0.141	0.0861	
1440 minute summer	S17	Orifice	S18	2.0				149.4

**Results for 100 year Critical Storm Duration. Lowest mass balance: 98.82%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	20	43.383	0.542	11.7	1.0109	0.0000	SURCHARGED
30 minute summer	S2	22	43.328	0.099	16.4	3.7484	0.0000	OK
30 minute summer	S3	20	43.316	1.097	37.5	2.3093	0.0000	SURCHARGED
60 minute summer	S4	36	43.055	0.022	1.1	0.2751	0.0000	OK
60 minute summer	S5	37	42.789	0.011	0.8	0.0819	0.0000	OK
30 minute summer	S6	19	42.856	0.013	0.9	0.1079	0.0000	OK
30 minute summer	S7	20	42.769	1.001	32.8	1.7206	0.0000	SURCHARGED
30 minute summer	S8	20	42.545	0.020	1.2	0.2286	0.0000	OK
60 minute summer	S9	37	42.087	0.111	8.9	2.7299	0.0000	SURCHARGED
30 minute summer	S11	20	42.010	0.074	6.7	0.1056	0.0000	OK
30 minute summer	S12	20	42.699	0.013	0.8	0.1188	0.0000	OK
30 minute summer	S13	19	41.754	0.556	76.5	1.7026	0.0000	SURCHARGED
30 minute summer	S14	19	41.110	0.361	73.3	0.5169	0.0000	SURCHARGED
1440 minute summer	S15	1050	41.045	1.295	14.7	0.0000	0.0000	OK
1440 minute summer	S16	1050	41.045	1.345	8.4	0.0000	0.0000	SURCHARGED
1440 minute summer	S17	1050	41.044	1.377	2.2	1.9701	0.0000	SURCHARGED
15 minute summer	S18	1	39.631	0.000	1.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	S1	1.000	S3	10.3	0.731	0.331	0.3583	
30 minute summer	S2	2.000	S3	13.6	2.587	0.477	0.0336	
30 minute summer	S3	1.001	S7	24.5	1.391	1.125	0.5311	
60 minute summer	S4	3.000	S5	0.8	0.986	0.084	0.0083	
60 minute summer	S5	3.001	S7	0.8	1.021	0.011	0.0544	
30 minute summer	S6	4.000	S7	0.8	0.867	0.037	0.0305	
30 minute summer	S7	1.002	S13	30.9	1.757	1.339	0.5956	
30 minute summer	S8	5.000	S11	0.9	0.258	0.086	0.0718	
60 minute summer	S9	6.000	S11	5.8	0.810	1.187	0.0414	
30 minute summer	S11	5.001	S13	6.9	1.885	0.311	0.0291	
30 minute summer	S12	7.000	S13	0.6	0.635	0.035	0.0643	
30 minute summer	S13	1.003	S14	73.3	1.843	1.084	1.0603	
30 minute summer	S14	1.004	S15	73.2	1.840	1.817	0.2861	
1440 minute summer	S15	Flow through Pond	S16	8.4	0.020	0.000	206.0255	
1440 minute summer	S16	1.006	S17	2.2	0.244	0.152	0.0861	
1440 minute summer	S17	Orifice	S18	2.2				162.3



**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 98.82%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	19	43.757	0.916	17.0	1.7085	0.0000	SURCHARGED
60 minute summer	S2	41	43.449	0.220	29.4	12.5434	0.0000	SURCHARGED
30 minute summer	S3	19	43.603	1.384	40.6	2.9125	0.0000	FLOOD RISK
30 minute summer	S4	20	43.058	0.025	1.8	0.3614	0.0000	OK
30 minute summer	S5	22	42.871	0.093	10.2	2.1521	0.0000	OK
30 minute summer	S6	21	42.878	0.035	3.1	0.6037	0.0000	OK
30 minute summer	S7	18	42.894	1.126	36.0	1.9348	0.0000	FLOOD RISK
30 minute summer	S8	20	42.549	0.024	1.8	0.3272	0.0000	OK
30 minute summer	S9	21	42.172	0.196	15.1	5.0585	0.0000	SURCHARGED
30 minute summer	S11	19	42.132	0.196	9.3	0.2798	0.0000	SURCHARGED
30 minute summer	S12	19	42.701	0.015	1.1	0.1601	0.0000	OK
30 minute summer	S13	19	42.116	0.918	95.2	2.8139	0.0000	SURCHARGED
1440 minute summer	S14	1170	41.474	0.725	21.2	1.0370	0.0000	SURCHARGED
1440 minute summer	S15	1170	41.473	1.723	21.0	0.0000	0.0000	OK
1440 minute summer	S16	1170	41.473	1.773	11.7	0.0000	0.0000	FLOOD RISK
1440 minute summer	S17	1170	41.472	1.805	2.5	2.5831	0.0000	FLOOD RISK
15 minute summer	S18	1	39.631	0.000	1.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	S1	1.000	S3	14.5	0.823	0.464	0.3583	
60 minute summer	S2	2.000	S3	18.7	2.667	0.656	0.0336	
30 minute summer	S3	1.001	S7	25.2	1.434	1.160	0.5311	
30 minute summer	S4	3.000	S5	1.4	1.029	0.140	0.0431	
30 minute summer	S5	3.001	S7	9.1	0.744	0.128	0.0869	
30 minute summer	S6	4.000	S7	2.4	0.847	0.104	0.0370	
30 minute summer	S7	1.002	S13	34.0	1.931	1.471	0.5956	
30 minute summer	S8	5.000	S11	1.3	0.257	0.126	0.0913	
30 minute summer	S9	6.000	S11	8.2	1.065	1.676	0.0475	
30 minute summer	S11	5.001	S13	10.1	2.091	0.453	0.0410	
30 minute summer	S12	7.000	S13	0.9	0.563	0.049	0.0655	
30 minute summer	S13	1.003	S14	87.8	2.208	1.299	1.0603	
1440 minute summer	S14	1.004	S15	21.0	0.957	0.521	0.2900	
1440 minute summer	S15	Flow through Pond	S16	11.7	0.019	0.001	325.0675	
1440 minute summer	S16	1.006	S17	2.5	0.143	0.174	0.0861	
1440 minute summer	S17	Orifice	S18	2.5				188.9