coopers
chartered consulting engineers

Our ref: 8658_FCA

Flood Consequences Assessment

for

Mindale Farm, Ffordd Hendre,

Meliden, Prestatyn,

Denbighshire

For : Castle Green Homes Ltd
Unit 20, St Asaph Business Park
St Asaph
Denbighshire
LL17 0LJ

10th December 2025

Park House, Sandpiper Court,
Chester Business Park,
Chester, CH4 9QU

tel: 01244 684 910
web: www.coopers.co.uk
email: admin@coopers.co.uk

Document Verification

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This document is not to be used for contractual or engineering purposes unless the document verification sheet is signed where indicated by the approver of the document.	

Prepared by

A Jones

Senior Infrastructure Engineer

Checked and Approved

P R Sykes

BSc (Hons), MSc (Eng), CGeol, FGS

THE GEOLOGICAL SOCIETY
CGeol
CHARTERED GEOLOGIST
Fellow No. 17046

Document Revision

Report Reference	Date	Description	Prepared	Checked and Approved
8658_FCA	10/12//2025	Flood Consequences Assessment	A Jones	P R Sykes

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1.0 Introduction

Coopers (Chester) Ltd, (Coopers) have been appointed by Castle Green Homes Ltd to assess the risk of flooding for a parcel of land at Mindale Farm off Ffordd Hendre in Meliden. Castle Green Homes Ltd are proposing a new housing development, comprising of approximately 154 No. dwellings.

Castle Green Homes Ltd are planning the construction of a mixture of semi-detached and detached residential properties with an associated access road (off Ffordd Talargoch -A547), parking, vehicular access and landscaping subject to conditions. It is understood the site does not currently benefit from any planning decision.

This flood consequences assessment (FCA) evaluates the proposals regarding to flood risk, identifying and appraising potential flood risk both to and from the whole site. Coopers have carried out the following:

i. Assessment of the development potential of the site in line with the Welsh Government's Technical Advice Note 15: Development and Flood Risk (TAN15) and;
ii. An assessment of surface water runoff and drainage strategy

Since January 7th, 2019, all new developments will require sustainable drainage for surface water if there are at least 2 No. properties or the construction area is more than 100m^2. The surface water drainage systems must be designed and built to meet Welsh Government standards for sustainable drainage.

These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems.

2.0 Site Characteristics

2.1 Site Location

The site is a parcel of agricultural land in Meliden to the southwest of Prestatyn. The site is situated to the north of Ffordd Ty Newydd and is accessed via Ffordd Hendre which currently provided assess to Mindale Farm. The site is located at approximate grid reference SJ055809.

Figure 1 – Site Location

2.2 Site Description

The site covers an area of approximately 6.05 Hectares of land located approximately 2.2km southwest of Prestatyn Town Centre. The site is presently pasture ground, with hedgerows, ditches and trees located along the field boundaries. There is also a small access road, hardstanding's and farm buildings associated with Mindale Farm.

The surrounding area is primarily a mixture of agricultural land, woodland and existing properties to the south (Ffordd Ty Newydd estate).

The site is located adjacent to two existing water courses identified as main rivers on the Natural Resources Wales mapping named Meliden / Talargoch Mine Drain (northwest) and Prestatyn Gutter (north). An existing ordinary watercourse (shallow ditch) is also located along the northern site boundary which is a tributary to the Prestatyn Gutter.

Figure 2 – Aerial View

The site is naturally sloping at an average gradient of 1 in 12 in a north westerly direction parallel to the Prestatyn Gutter. Levels fall from 44.0m AOD at the southern end of the site (Ffordd Talargoch – A547) down to a level of 13.0m AOD at the northern end of the site at the ordinary watercourse.

Refer to Appendix 1 for the Topographical Survey.

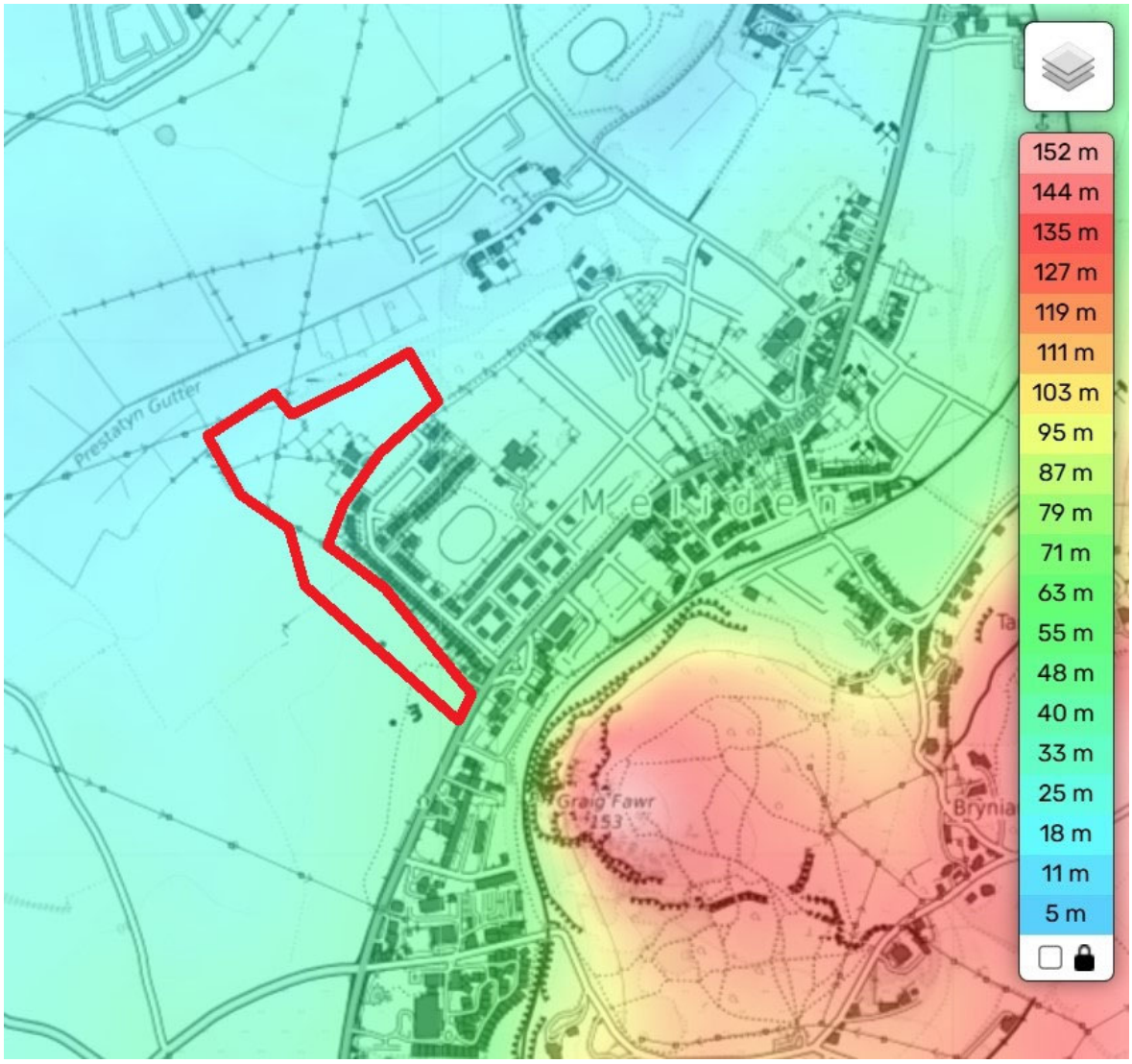


Figure 3 – Site Topography

3.0 Sources of Flood Risk Information

3.1 The Welsh Government Development Advice Map

The Welsh Government Development Advice Map shows the site is generally located within Flood Zone A (an area considered to be at little or no risk of fluvial or tidal flooding, with a less than 1 in 1000 (0.1%) annual probability of flooding in any given year), other than a small portion of the northern end of the site which is located in Zone B. No development should be proposed within this area.

The proposed residential development is considered to be a 'highly vulnerable' development in accordance with Figure 2 of the Welsh Governments Technical Advice Note 15. Highly vulnerable development is considered to be appropriate within Flood Zone A.

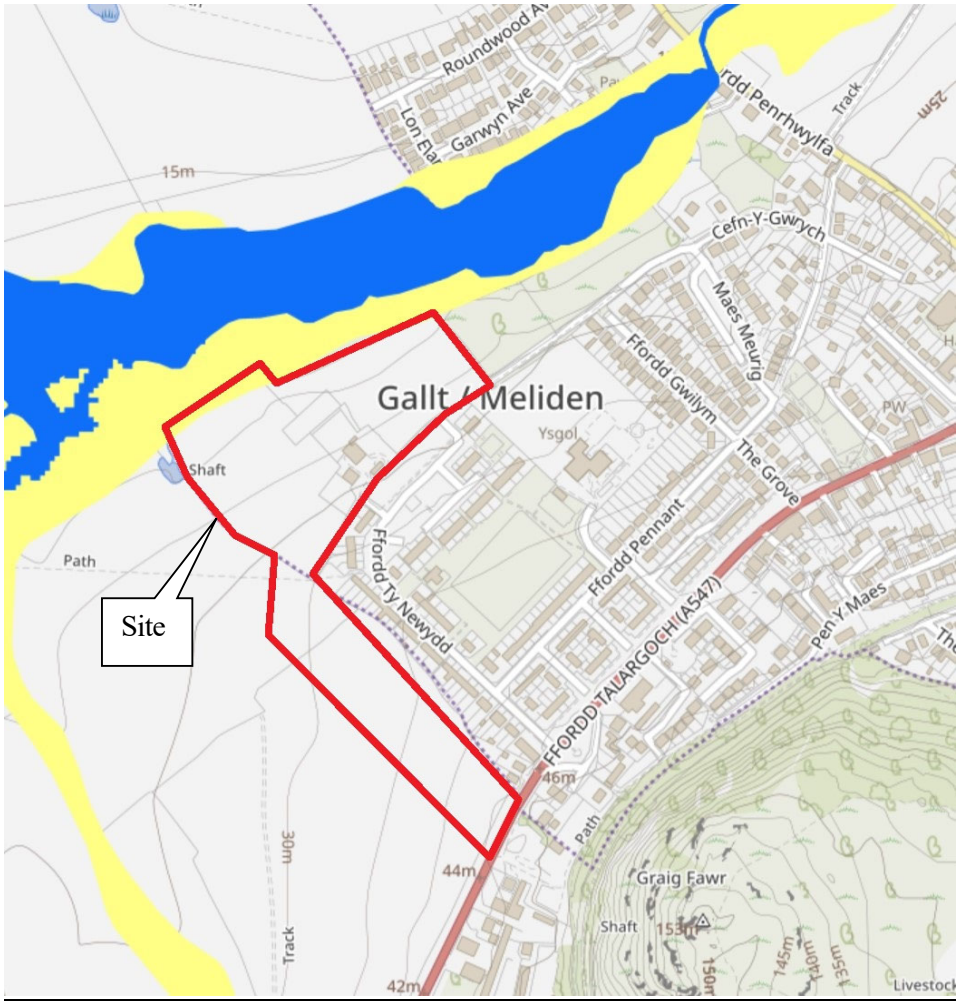


Figure 4 – Natural Resources Wales Development Advice Flooding (DAM) Map

3.2 Natural Resources Wales

The NRW Flood Map shows the site is located within Flood Zone 1 – an area considered to have the lowest probability of fluvial flooding. It is assessed as having a less than 0.1% annual probability of flooding in any given year.

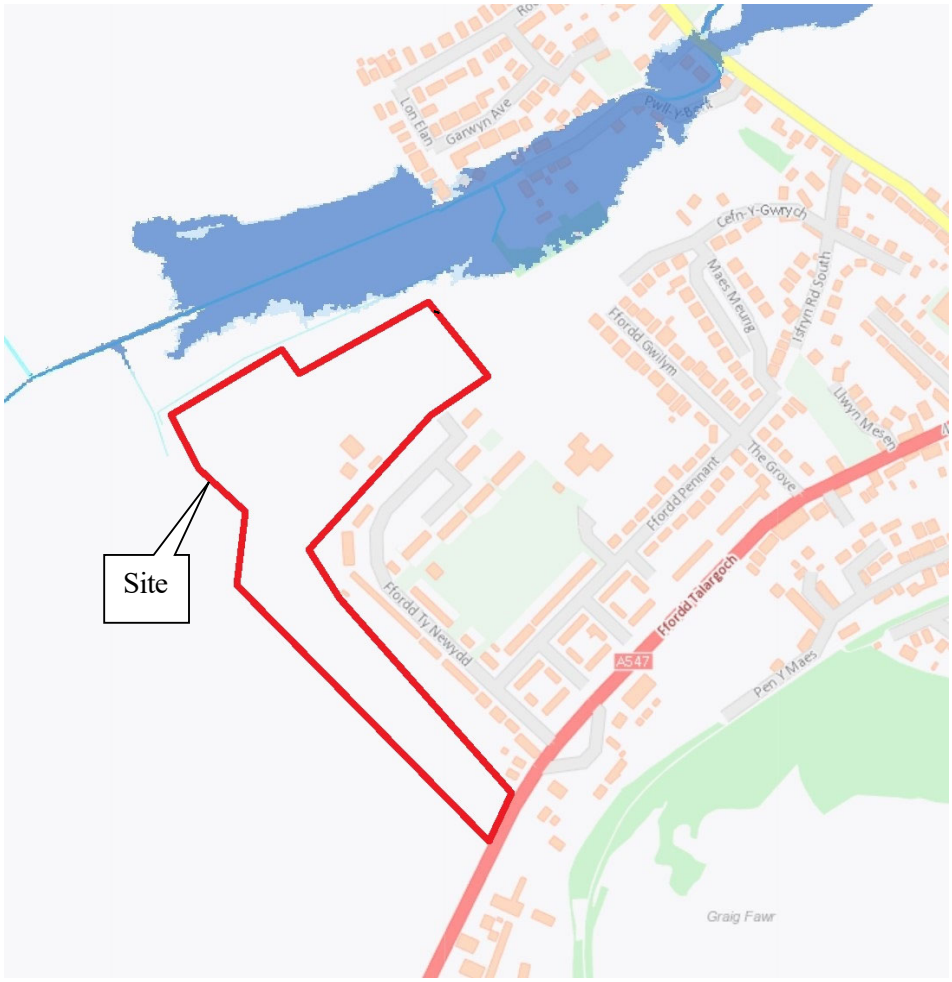


Figure 5 – Natural Resources Wales Flood Map for Planning (Sea and Rivers)

The Natural Resources Wales long term flood risk maps indicates that the majority of the site is at a very low risk of flooding from surface water.

Natural Resources Wales have been contacted for any relevant flood information for the site and have provided hydraulic modelling data for the Prestatyn Gutter. Extracts are presented in Appendix 4 and confirms the developable area within the site is not as risk.

Figure 6 – Natural Resources Wales Surface Water Flooding Map

The overall risk from surface water flooding is considered as low.

It should be noted that flooding can occur at any time and in any place from sources such as rising groundwater levels, burst water mains, blocked road drains, run-off from hillsides, sewer overflows, etc.

3.3 Denbighshire County Council LLFA

We have contacted Flintshire County Council for confirmation of any known historical flooding within the vicinity of the site.

Refer to Appendix 4 for all correspondence.

4.0 Sources of Flood Risk

4.1 Fluvial

Extreme fluvial flood events have the potential to cause rapid inundation of the site whilst posing a threat to welfare and users. As outlined in Section 3.2; the site is within Flood Zone 1 and is, therefore not at risk from extreme fluvial or tidal flooding. Therefore, the risk from extreme fluvial flooding to the site is considered to be low.

4.2 Infrastructure Failure (Existing and Proposed)

The failure of infrastructure such as culverts or bridges could increase the risk of flooding at the site. The existing watercourse within the site boundary is at the lowest elevation. As riparian owner the client should consider construction of headwalls with safety grilles and ensuring a maintenance plan is in place to reduce the risk of blockages.

An existing 315mm diameter water main currently crosses the development site. This will require a diversion and will be routed away from development.

An existing 225mm diameter combined sewer currently crosses the southern portion of the site. This will require a diversion to suit the proposed layout and will accommodate the diverted sewer within the carriageway.

The risk of flooding is considered as low.

4.3 Overland Flow

Overland flow occurs when the infiltration capacity of the ground is exceeded in a storm event. This can result in water travelling as a sheet flow overland or excess water being conveyed from one location to another via local road networks. The site currently drains naturally from a high point at the southern end of the site towards the watercourse at the northern end of the site. Overland flow is not considered a significant risk as flows from the site will be significantly reduced post development with the incorporation of positive drainage and an internal road network reducing any overland flow.

There is also a risk of flooding due to flows from off site. The Ffordd Ty Newydd residential development to the southeast is at a higher elevation and topography falls towards the development site. 22 prefabricated properties on Ffordd Ty Newydd were demolished in 2014 and the land remains unused. The remainder of the estate has a drainage network to collect foul and surface water flows which discharge into the combined sewer network. There are also some areas benefiting from separate surface water drainage which discharges directly into a watercourse located in the southeast corner of the site which flows north along the eastern boundary into the ordinary watercourse along the northern boundary. Refer to Appendix A for the Ffordd Ty Newydd drainage survey.

The overland surface water flow into the site from the higher land to the south of the development will be concentrated to the eastern boundary and channelled along Ffordd Hendre. The flow path along the eastern boundary aligns with the existing ditch and will remain as existing. Any potential overland flows from Ffordd Hendre will potentially flow into the development so careful level design will need to be considered to ensure properties within the development are not at risk and safe flow paths are maintained.

4.4 Sewer Flooding

If the capacity of the sewers is exceeded in an extreme event, or a blockage occurs, surcharging of the network can result in surface flooding. Welsh Water sewer plans which are included in Appendix 1, indicate the presence of a 225mm diameter combined sewer in the southern end of the site flowing northeast. This sewer will need to be diverted to suit the masterplan and will be subject to a S185 sewer diversion application with Welsh Water.

We are proposing to discharge all foul flows into this 225mm diameter combined sewer subject to Welsh Water approval. A foul pumping station will be required as site levels at the northern end of the site do not allow for a gravity connection from the site.

Welsh Water have responded to a historical flooding enquiry and have confirmed there have no recorded flooding incidents in the area. Refer to Appendix 4 for correspondence.

The overall risk from sewer flooding is considered as low as the site levels are higher than the highway.

4.5 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from the underlying superficial deposits, bedrock or from springs.

The Envirocheck Flood Report presented in Appendix 2 indicates there is negligible risk of ground water flooding within the site boundary.

Groundwater flooding will need to be considered further after the site investigation has been undertaken and further information is available on water depths.

The overall risk from groundwater flooding is considered as low.

4.6 Coastal Flooding

The development site is located approximately 2.5km south of the coastline (Irish Sea) at a minimum elevation of 13.0m AOD. No flooding is indicated on NRW flood mapping and is therefore not at risk from tidal inundation.

Refer to Figure 2 – NRW Flood Map for Planning (Sea and River).

4.7 Reservoirs

The site is not located in proximity of any reservoirs. Additionally, the NRW maps indicate the site is not at risk of flooding from reservoirs.

4.8 Web Search

A web search for flooding incidents near to the site has identified floodings at Pwll Y Bont during Storm Babet (20th October 2023). Pwll Y Bont is located approximately 110m northeast of the site. The Prestatyn Gutter flows north-east along the northern extent of the road and the Gutter is also culverted beneath several property driveways leading off Pwll y Bont.

A total of five properties were flooded as a result of Storm Babet, with anecdotal evidence suggesting that the flood water came from an upland area behind Pwll y Bont and flowed overland towards the

Gutter, flooding three properties along the way, before entering the Gutter, which then over-top and flooded two further properties. On review of the site topography the overland flows from the development site will flow directly into the Gutter upstream of Pwll y Bont.

Whilst development proposals should mimic the existing situation, the developer will need to ensure that flows discharged from the site are not increased post development to mitigate any potential future flood risk to properties susceptible to flooding further downstream and in particular Pwll y Bont. We are proposing to limit flows from the development to greenfield QBAR flow rate. With the introduction of a positive drainage network designed for 100-year storm event including additional allowances for climate change and urban creep, flows will be reduced post development for storm events greater than a 2.3-year (QBAR) event.

Refer to Appendix 6 for S19 flood report, and section 5 for surface water proposals.

5.0 Surface Water Drainage

5.1 General

The design for a surface water drainage system for the proposed development will be guided by the principles set out in the Welsh Government's 'Recommended non-statutory standards for sustainable drainage (SuDS) in Wales – designing, constructing, operating and maintaining surface water drainage systems' (2017)

The SuDS Standards Wales sets out the following hierarchy for surface water runoff destination:

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

Note that Priority Level 1 is the preferred (highest priority) and that 4 and 5 should only be used in exceptional circumstances.

5.2 Existing Surface Water Drainage

The site does not benefit from any existing drainage and will rely on infiltration and surface water run-off to dispose of surface water flows. The flows will follow topography with the majority of the site draining to the two ordinary watercourses located to the northern and southern ends of the site. We are not aware of any existing land drainage within the site to assist with drainage.

5.3 Existing Site Runoff

The greenfield run-off rates for the site have been calculated using the HR Wallingford Greenfield runoff rate estimation tool. Calculations below are based on a 4.12Ha developable site area and a soil type 3 indicating mixed materials exhibiting limited infiltration properties.

1-year	= 10.8 l/s
30-year	= 21.8 l/s
100-year	= 26.8 l/s
QBAR	**= 12.3 l/s**

Refer to Appendix 5 for surface water run-off calculations.

5.4 Proposed Surface Water Drainage and Runoff Rates

Priority Level 1

Whilst rainwater harvesting has been considered for the proposed development it should be noted that any device enabling water re-use cannot be taken into account when sizing attenuation as the storage facility may be full when a storm event occurs. Therefore, an overflow to an infiltration device (where ground conditions allow) or to a watercourse / sewer will be required.

Castle Green Homes Ltd are not proposing to incorporate rainwater harvesting within the development; however, they are proposing to install a water butt to each dwelling which will allow for water collection for garden re-use.

Priority Level 2

Currently no site investigation report is available but on review of the Soilscapes Viewer provided by LandIS ground conditions are noted as being 'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'

Furthermore, the BGS borehole scans and geology mapping indicate the development site to be underlain by Marl and Clay

A desktop review has determined the potential for ground conditions to be suitable for infiltration techniques for the disposal of surface water flows from the development is low. However, a site investigation report will be commissioned including infiltration testing in accordance with BRE365 to confirm if the site is suitable for infiltration, or unsuitable due to cohesive underlying strata or high ground water conditions.

Refer to Appendix 3 for desktop ground condition information.

Priority Level 3

There are watercourses within the site. The watercourse along the northern boundary is a tributary of the Prestatyn Gutter and is located at the lower end of the site. Currently the site drains via overland flow towards this open watercourse at greenfield run off rates. As infiltration is not possible, we are proposing to mimic the existing regime and direct all flows to the watercourse at a controlled rate. Limiting the flows to the greenfield QBAR rate will significantly reduce flows being passed forward to the watercourse for storm events greater than 1 in 2.3-year storm event and will not increase flood risk to the Prestatyn Gutter further downstream.

A review of levels has determined the entire site can drain to the watercourse located within the site, using a single outfall downstream of the flow control chamber.

Priority Level 4

A review of the Welsh Water sewer records indicates no surface water sewers within the site.

Priority Level 5

A review of the Welsh Water sewer records indicates a 225mm diameter combined sewer in the southern portion of the site. Whilst a gravity connection for some of the surface water flows may be possible it is not considered sustainable to drain into this asset and Welsh Water would likely resist any request for a discharge into this asset, especially as a gravity connection to the watercourse can be achieved.

5.5 SuDS Approval Bodies

Since January 7th, 2019, all new developments will require sustainable drainage for surface water if there are at least 2 No. properties or the construction area is more than 100m^2. The surface water drainage systems must be designed and built to meet Welsh Government standards for sustainable drainage.

These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems.

Every SuDS application should go to every attempt to satisfy the Principles and Standards of the legislation. When vetting an application, the SAB officer will look at the clear red line boundary area of the site when considering space for SuDS and water management features and not the space that's left on the proposed site layout.

The principles are as follows:

SuDS schemes should aim to:

1. *manage water on or close to the surface and as close to the source of the runoff as possible;*
2. *treat rainfall as a valuable natural resource;*
3. *ensure pollution is prevented at source, rather than relying on the drainage system to treat or intercept it;*
4. *manage rainfall to help protect people from increased flood risk, and the environment from morphological and associated ecological damage resulting from changes in flow rates, patterns and sediment movement caused by the development;*
5. *take account of likely future pressures on flood risk, the environment and water resources such as climate change and urban creep;*

6. *use the SuDS Management Train, using drainage components in series across a site to achieve a robust surface water management system (rather than using a single "end of pipe" feature, such as a pond, to serve the whole development);*
7. *maximise the delivery of benefits for amenity and biodiversity;*
8. *seek to make the best use of available land through multifunctional usage of public spaces and the public realm;*
9. *perform safely, reliably and effectively over the design life of the development taking into account the need for reasonable levels of maintenance;*
10. *avoid the need for pumping where possible; and*
11. *be affordable, taking into account both construction and long-term maintenance costs and the additional environmental and social benefits afforded by the system.*

Applicants seeking SAB Approval must demonstrate how they have complied with these principles or provide justification for any departure.

An indicative drainage strategy is presented in Appendix 1. We are proposing to ultimately drain the entire site into the ordinary watercourse at the northern end of the site via a new outfall. The proposed surface water networks will discharge restricted flows into the watercourse. Attenuation is provided with two on-line SuDS basins.

The proposal will mimic the existing situation as the existing topography of the site falls towards the watercourses. Flow controls will limit the flows to the greenfield QBAR run-off rate. This is the 2.3-year rainfall event, so any storm event greater than this will have a post development flow rate reduction in the receiving watercourse and therefore will provide a reduced post development flood risk.

Incorporation of additional source control SuDS components such as water butts, permeable paving, filter drains, and bioretention components (tree pits and rain gardens) will need to be considered further at detailed design stage to meet the 5mm interception design criteria.

Due to the site location and surrounding topography the potential flow paths from the Ffordd Ty Newydd estate on the higher ground will need to be considered. A cut off drain to intercept any flows into the site should be considered as a precautionary measure. Any exceedance flows from the existing development to the south (highwater elevation) will flow along the highway and towards the watercourse in the southeastern corner of the site.

Flood Defence Consent will be required from Denbighshire LLFA for the surface water outfalls into the watercourse. Early discussions are advised to ensure that the proposed points of connection and flow rates are acceptable to the approving authority.

Denbighshire LLFA will also advise on any requirements on the existing watercourse including minimum distances on buffer zones for future maintenance and wildlife corridors. This will generally be a minimum of 3m from top of bank for an ordinary watercourse.

5.6 Foul Drainage

Welsh Water have confirmed that flows can be accommodated within the public sewerage system. and advise that the flows should be connected to the combined sewer between manholes SJ05806901

and SJ05807902 located within the site. The northern portion of the site will require a foul pumping station due to the site topography. The foul drainage proposals will require a formal S104 Adoption Agreement with Welsh Water.

The existing sewer will require a diversion to suit the site layout. This will require a S185 sewer Diversion Agreement with Welsh Water.

6.0 Conclusions and Recommendations

The site is located in Flood Zone 1 and has been shown to be at low risk of flooding from sea, rivers, groundwater, sewers and climate change. Therefore, mitigation measures are not considered necessary for any future development at the site. However, as a precautionary measure the client should consider the construction of a cut off drain to intercept any overland flows from the higher ground to the south of the development

All potential sources of flooding have been considered as part of this report. There are no known records of historical flooding at the site. Flooding events further downstream at Pwll y Bont are not caused by flows from the development site and it should be noted that post development flows for storm events greater than a 1 in 2.3-year will be reduced.

The ground conditions are not expected to be suitable for infiltration techniques for the disposal of surface water due to poor infiltration characteristics in the underlying soils. This will need confirming during intrusive site investigation works including infiltration tests. Therefore, surface water run-off from highways, roof and private drives will discharge into the existing ordinary watercourses within the site. We are proposing a dry SuDS basin at the northern end of the development designed to cater for a 100-year storm event. A second dry SuDS basin will be constructed to accommodate flows from the site access into the site.

The development will increase the impermeable area of the site. This results in an increase in surface water runoff rates and volumes. In order to ensure the increase in runoff will not have an impact elsewhere all flows will discharge via gravity to the watercourses and surface water sewer at greenfield QBAR flow rates.

The possible effects of climate change have been considered by acknowledging the requirements to make allowance for increased rainfall in the calculation of surface water discharge rates over the lifespan of the development in line with current guidance. An allowance for urban creep should also be incorporated in the design with a proportional increase to node catchments.

All surface water run-off from highways, roof and private drives will be collected into gravity piped networks and discharged into networks of pipes and SuDS attenuation features and ultimately discharge to the ordinary watercourses located within the site at the northern end of the site. Flows will then flow into the Prestatyn Gutter (main river) mimicking the existing flow regime.

Additional on-site source control components such as permeable paving and bioretention components (tree pits and rain gardens) should be considered further at detailed design stage.

All foul sewers should be designed in accordance with Sewers for Adoption 7th Edition / Welsh Ministers Standards and will be subject to S104 Agreement.

A SuDS Maintenance and Management Plan should be produced to outline the activity and frequency of inspections and maintenance works required on any SuDS components subject to SAB Approval / Adoption. All SUFDS components will be subject to SAB adoption by Denbighshire County Council.

The strategy demonstrates that surface water run-off from the site and land above it can be managed without increasing the risk of additional discharge to watercourses leading to the Prestatyn Gutter, and therefore will not increase the potential for flooding downstream.

This Flood Consequences Assessment should be submitted to the Local Planning Authority in support of the planning application.

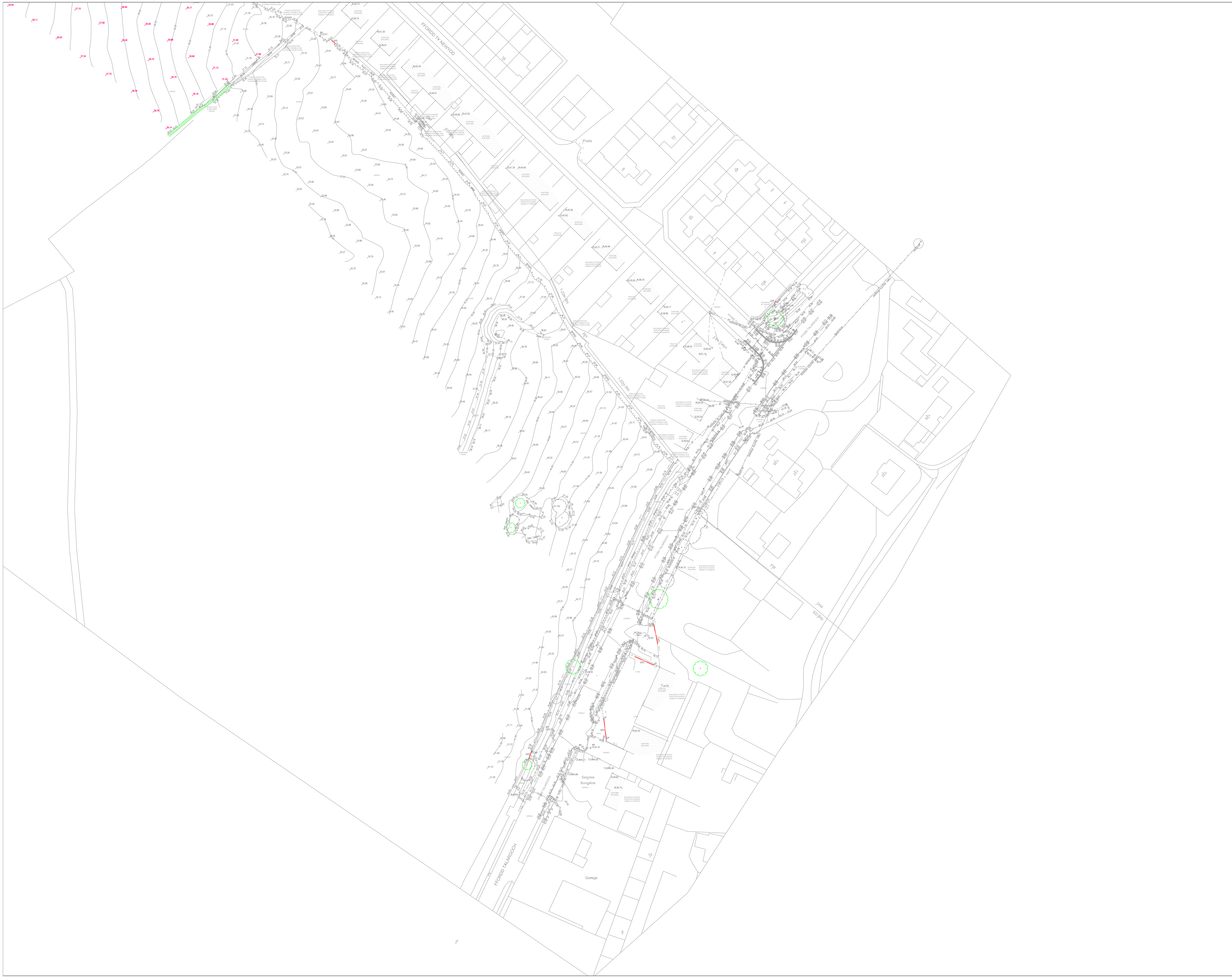
Since January 7th, 2019, all new developments will require sustainable drainage for surface water if there are at least 2 properties or the construction area is more than 100m^2. The surface water drainage systems must be designed and built to meet Welsh Government standards for sustainable drainage.

These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems.

Appendix 1

Reference Drawings

Drawing No.	Revision	Title
CGH.TS.13	A	Topographical Survey (Sheet 1 of 3)
CGH.TS.13	A	Topographical Survey ((Sheet 2 of 3)
CGH.TS.13	A	Topographical Survey ((Sheet 3 of 3)
B518-00	-	Ffordd Ty Newydd Drainage Manhole Survey
	-	Welsh Water Sewer Map
8658 / SK01-1		Drainage Strategy. Sheet 1 of 2
8658 / SK01-1		Drainage Strategy. Sheet 2 of 2



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SURVEY ORIENTATED TO OS GRID (OSGB36-15)

SURVEY LEGEND

FEATURES

TOP OF BANK
BOTTOM OF BANK
SURVEY STATION
TREE
HEDGE
TREE CANOPY
BUSHES
VEGETATION

BOUNDARY ANNOTATIONS

BARB WIRE FENCE	BW.F
CHAIN LINK FENCE	C/L.F
CONC POST AND PANEL	CP&P.F
CONC POST TIMB PANEL	CP&TP.F
ELECTRIC FENCE	EL.F
HERAS FENCE	HER.F
IRON RAIL FENCE	IR.F
KNEE RAIL FENCE	KR.F
MISCELLANEOUS FENCE	MISC.F
POST AND WIRE FENCE	P&W.F
RANCH STYLE FENCE	RS.F
SECURITY FENCE	SEC.F
TIMBER FENCE	T.F
BRICK WALL	B.W
BLOCK WALL	BL.W
CONCRETE WALL	C.W
GABIEN WALL	G.W
MISCELLANEOUS WALL	MISC.W
RETAINING WALL	R.W
RETAINING LOG WALL	RL.W
STONE WALL	S.W

LEVEL PREFIX ANNOTATIONS

ASL	ARCH SPRING LEVEL
BL	BED LEVEL
BD	BACK DROP
CL	COVER LEVEL
DH	TOP OF DOOR
DTC	DEPTH TO CROWN
FFL	FINISHED FLOOR LEVEL
IL	INVERT LEVEL
PL	PARAPET LEVEL
RL	ROOF/RIDGE LEVEL
SL	SOFFIT LEVEL
TOF	TOP OF FENCE
TOP	TOP OF PIPE
TOW	TOP OF WALL
TRH	TREE HEIGHT
THR	THRESHOLD LEVEL
WL	WATER LEVEL
WS	WINDOW SILL
WSF	WINDOW SOFFIT

SURVEY ANNOTATIONS

AV	AIR VALVE
B	BOLLARD
BS	BUS STOP
BT	BRITISH TELECOM IC
CPS	CONCRETE PAVING SLABS
CP	CATCH PIT
DR	DRAIN
EB	ELECTRIC CONTROL BOX
EL	ELECTRICAL IC
EP	ELECTRICITY POLE
ER	EARTH ROD
FH	FIRE HYDRANT
FP	FLAG POLE
G	GULLY
GH	GREENHOUSE
GP	GATE POST
GV	GAS VALVE
IC	INSPECTION COVER
JB	JUNCTION BOX
JKW	JAPANESE KNOT WEED
KO	KERB OUTLET
LH	LAMP HOLE
LP	LAMP POST/LIGHT COLUMN
MH	MANHOLE
MP	MONITOR POINT
NP	NAME PLATE
OHC	OVERHEAD CABLES
PB	POST BOX
PM	PARKING METER
PS	POST
PYL	ELECTRICITY PYLON
RE	RODDING EYE
RS	ROAD SIGN
RWP	RAIN WATER PIPE
ST	STOP TAP
SM	SERVICE MARKER
SP	SIGN POST
SV	STOP VALVE / SLUICE VALVE
SVP	SOIL VENT PIPE
TB	TELEPHONE BOX
TL	TRAFFIC LIGHTS
TM	TELEPHONE MAST
TP	TELEGRAPH POLE
TPS	TACTILE PAVING SLABS
VP	VENT PIPE
WM	WATER METER
WO	WASH OUT
UTL	UNABLE TO LIFT
UTS	UNABLE TO SURVEY

GEOTECHNICAL INFORMATION

TRIAL HOLE / PIT	TH
BORE HOLE	BH
WINDOW SAMPLE	WS
MONITORING POINT	MP
PROBE HOLE	PH

DISCLAIMER:

ONLY MANHOLES AND SERVICES SHOWN WERE VISIBLE AT THE TIME OF SURVEY.

MAN ENTRY TO SEWERS HAS NOT BEEN UNDERTAKEN, DEPTHS, PIPESIZES ETC ARE MEASURED FROM GROUND LEVEL.

DRAINAGE INFORMATION MUST BE CHECKED AND VERIFIED PRIOR TO ANY WORK COMMENCING.

BOUNDARIES SHOWN ARE PHYSICAL AND MAY NOT REPRESENT LEGALLY CONVEYED OWNERSHIP.

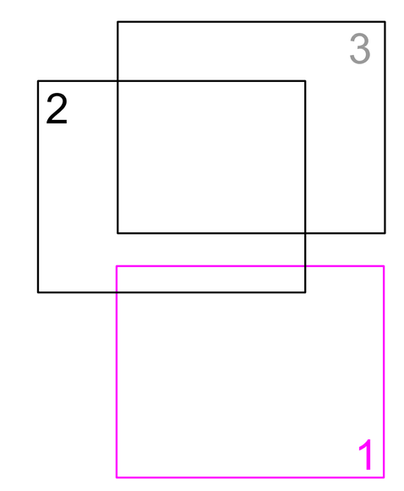
TREE SPREADS ARE SYMBOLIC ONLY AND ARE REPRESENTATIVE OF THE AVERAGE SPREAD, THE TREE CANOPY LAYER DENOTES THE TREES EXTREMITY.

SURVEY NOTES

ALL LEVELS ARE RELATED TO O.S DATUM (OSGB36-15)
ESTABLISHED AT SE1 USING THE LEICA SMARTNET GPS NETWORK

SURVEY STATIONS

Name	Easting	Northing	Height
SE1	305917.909	380703.803	44.587
SE2	305799.223	380577.731	46.038
TRAV1	305866.466	380766.097	37.577
TRAV2	306017.054	380921.449	33.032
TRAV3	305995.841	380995.975	27.278
TRAV4	305937.581	381084.093	18.932
TRAV5	305895.709	381063.705	18.644
TRAV6	305805.637	380993.995	22.136
TRAV7	305731.396	380940.819	22.074
TRAV8	305509.012	380894.813	17.221
TRAV9	305502.038	380761.433	26.640
TRAV10	305524.448	380651.430	29.140
TRAV11	305716.652	380440.979	44.504



DESCRIPTION	REV	DATE	DRWN	APPR
TOPO SURVEY AMENDED	A	05.06.24	LG	-

SurveyEng Ltd
Land Surveyors & Engineers
14 GREEN MILL
WESTHOUGHTON
BOLTON
LANCS
BL5 3GE
TEL/FAX: 0800 772 3040
MOB: 07850069993
info@surveyeng.co.uk

CLIENT
CASTLE GREEN HOMES

PROJECT TITLE
FFORDD TY NEWYDD, PRESTATYN, DENBIGHSHIRE

DRAWING DETAIL
TOPOGRAPHICAL LAND SURVEY SHEET 1 OF 3

PROJECT ENGINEER	CT / CC	DATE	29.05.2024
DRAWN	LG	SCALE	1:500@A0
DRAWING NUMBER	CGH.TS.13	REVISION	A

SURVEY ORIENTATED TO OS GRID (OSGB36-15)

SURVEY LEGEND

FEATURES

TOP OF BANK
BOTTOM OF BANK
SURVEY STATION
TREE
HEDGE
TREE CANOPY
BUSHES
VEGETATION

BOUNDARY ANNOTATIONS

BARB WIRE FENCE	BW.F
CHAIN LINK FENCE	C/L.F
CONC POST AND PANEL	CP&P.F
CONC POST TIMB PANEL	CP&TP.F
ELECTRIC FENCE	EL.F
HERAS FENCE	HER.F
IRON RAIL FENCE	IR.F
KNEE RAIL FENCE	KR.F
MISCELLANEOUS FENCE	MISC.F
POST AND WIRE FENCE	P&W.F
RANCH STYLE FENCE	RS.F
SECURITY FENCE	SEC.F
TIMBER FENCE	T.F
BRICK WALL	B.W
BLOCK WALL	BL.W
CONCRETE WALL	C.W
GABIEN WALL	G.W
MISCELLANEOUS WALL	MISC.W
RETAINING WALL	R.W
RETAINING LOG WALL	RL.W
STONE WALL	S.W

LEVEL PREFIX ANNOTATIONS

ASL	ARCH SPRING LEVEL
BL	BED LEVEL
BD	BACK DROP
CL	COVER LEVEL
DH	TOP OF DOOR
DTC	DEPTH TO CROWN
FFL	FINISHED FLOOR LEVEL
IL	INVERT LEVEL
PL	PARAPET LEVEL
RL	ROOF/RIDGE LEVEL
SL	SOFFIT LEVEL
TOF	TOP OF FENCE
TOP	TOP OF PIPE
TOW	TOP OF WALL
TRH	TREE HEIGHT
THR	THRESHOLD LEVEL
WL	WATER LEVEL
WS	WINDOW SILL
WSF	WINDOW SOFFIT

SURVEY ANNOTATIONS

AV	AIR VALVE
B	BOLLARD
BS	BUS STOP
BT	BRITISH TELECOM IC
CPS	CONCRETE PAVING SLABS
CP	CATCH PIT
DR	DRAIN
EB	ELECTRIC CONTROL BOX
EL	ELECTRICAL IC
EP	ELECTRICITY POLE
ER	EARTH ROD
FH	FIRE HYDRANT
FP	FLAG POLE
G	GULLY
GH	GREENHOUSE
GP	GATE POST
GV	GAS VALVE
IC	INSPECTION COVER
JB	JUNCTION BOX
JKW	JAPANESE KNOT WEED
KO	KERB OUTLET
LH	LAMP HOLE
LP	LAMP POST/LIGHT COLUMN
MH	MANHOLE
MP	MONITOR POINT
NP	NAME PLATE
OHC	OVERHEAD CABLES
PB	POST BOX
PM	PARKING METER
PS	POST
PYL	ELECTRICITY PYLON
RE	RODDING EYE
RS	ROAD SIGN
RWP	RAIN WATER PIPE
ST	STOP TAP
SM	SERVICE MARKER
SP	SIGN POST
SV	STOP VALVE / SLUICE VALVE
SVP	SOIL VENT PIPE
TB	TELEPHONE BOX
TL	TRAFFIC LIGHTS
TM	TELEPHONE MAST
TP	TELEGRAPH POLE
TPS	TACTILE PAVING SLABS
VP	VENT PIPE
WM	WATER METER
WO	WASH OUT
UTL	UNABLE TO LIFT
UTS	UNABLE TO SURVEY

GEOTECHNICAL INFORMATION

TRIAL HOLE / PIT	TH
BORE HOLE	BH
WINDOW SAMPLE	WS
MONITORING POINT	MP
PROBE HOLE	PH

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ESTABLISHED AT SE1 USING THE LEICA SMARTNET GPS NETWORK

SURVEY STATIONS

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SE1	305917.909	380703.803	44.587
SE2	305799.223	380577.731	46.038
TRAV1	305866.466	380766.097	37.577
TRAV2	306017.054	380921.449	33.032
TRAV3	305995.841	380995.975	27.278
TRAV4	305937.581	381084.093	18.932
TRAV5	305895.709	381063.705	18.644
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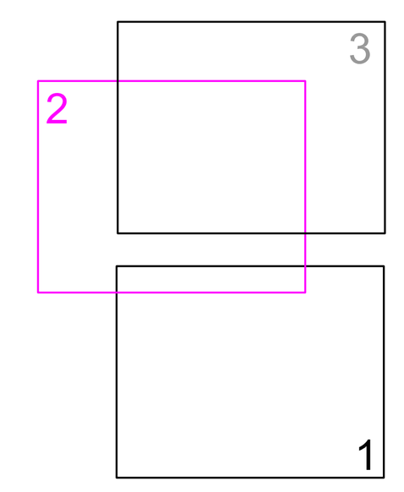

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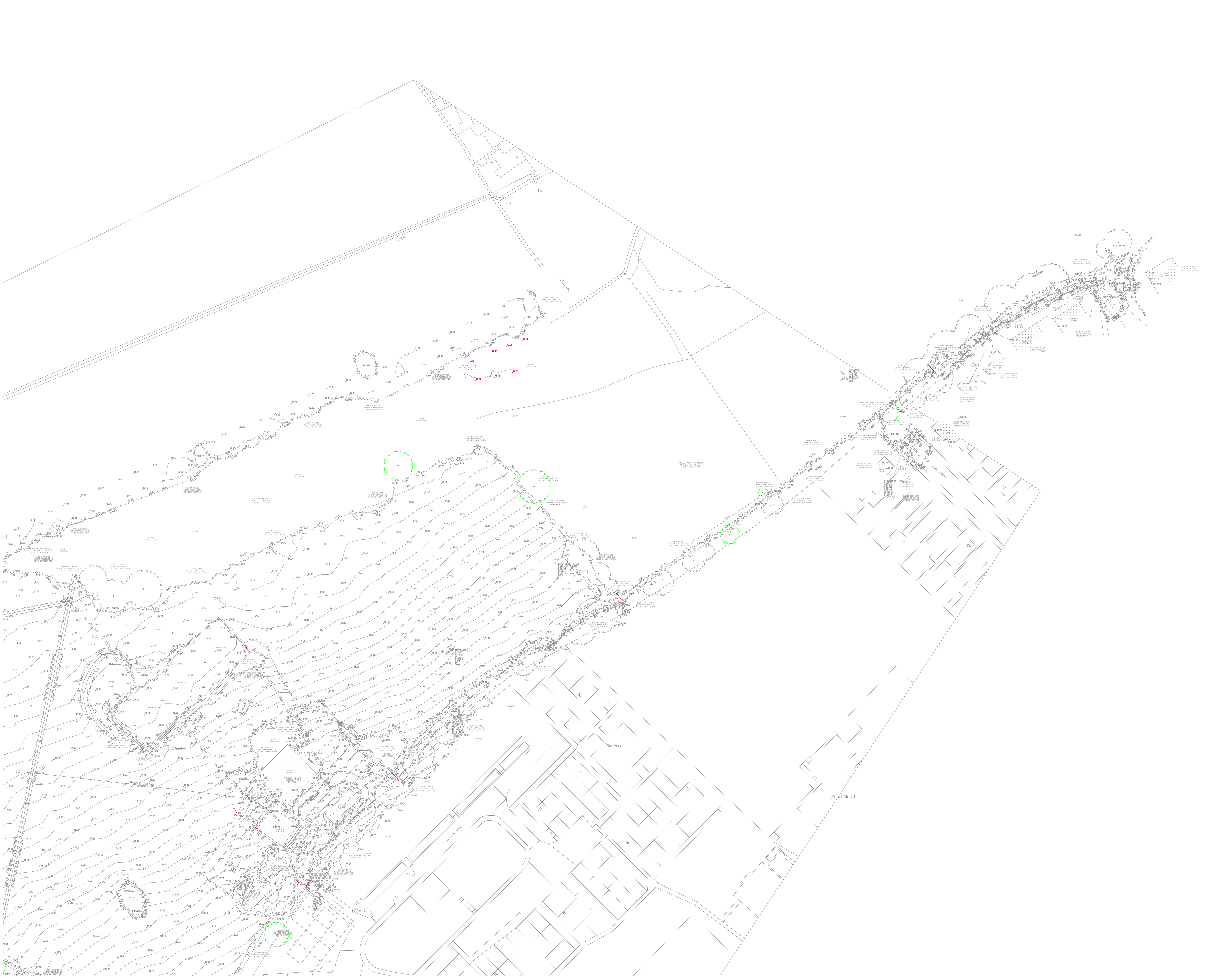
PRESTATYN, DENBIGHSHIRE

DRAWING DETAIL
TOPOGRAPHICAL LAND SURVEY
SHEET 2 OF 3

PROJECT ENGINEER	CT / CC	DATE	29.05.2024
DRAWN	LG	SCALE	1:500@A0

DRAWING NUMBER	REVISION
CGH.TS.13	A



N
W E
S

SURVEY ORIENTATED TO OS GRID (OSGB36-15)

SURVEY LEGEND

FEATURES

TOP OF BANK
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TREE
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VP	VENT PIPE
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WO	WASH OUT
UTL	UNABLE TO LIFT
UTS	UNABLE TO SURVEY

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BORE HOLE — BH
WINDOW SAMPLE — WS
MONITORING POINT — MP
PROBE HOLE — PH

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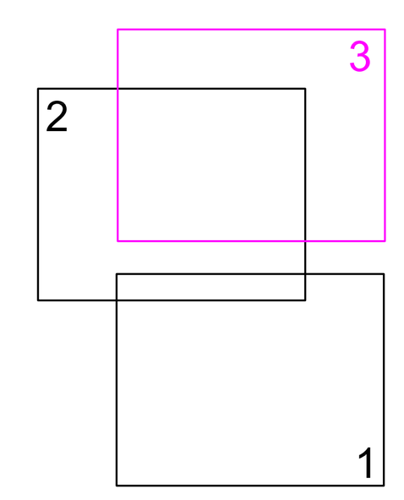

DESCRIPTION	REV	DATE	DRWN	APPR
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SurveyEng Ltd
Land Surveyors & Engineers
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CLIENT
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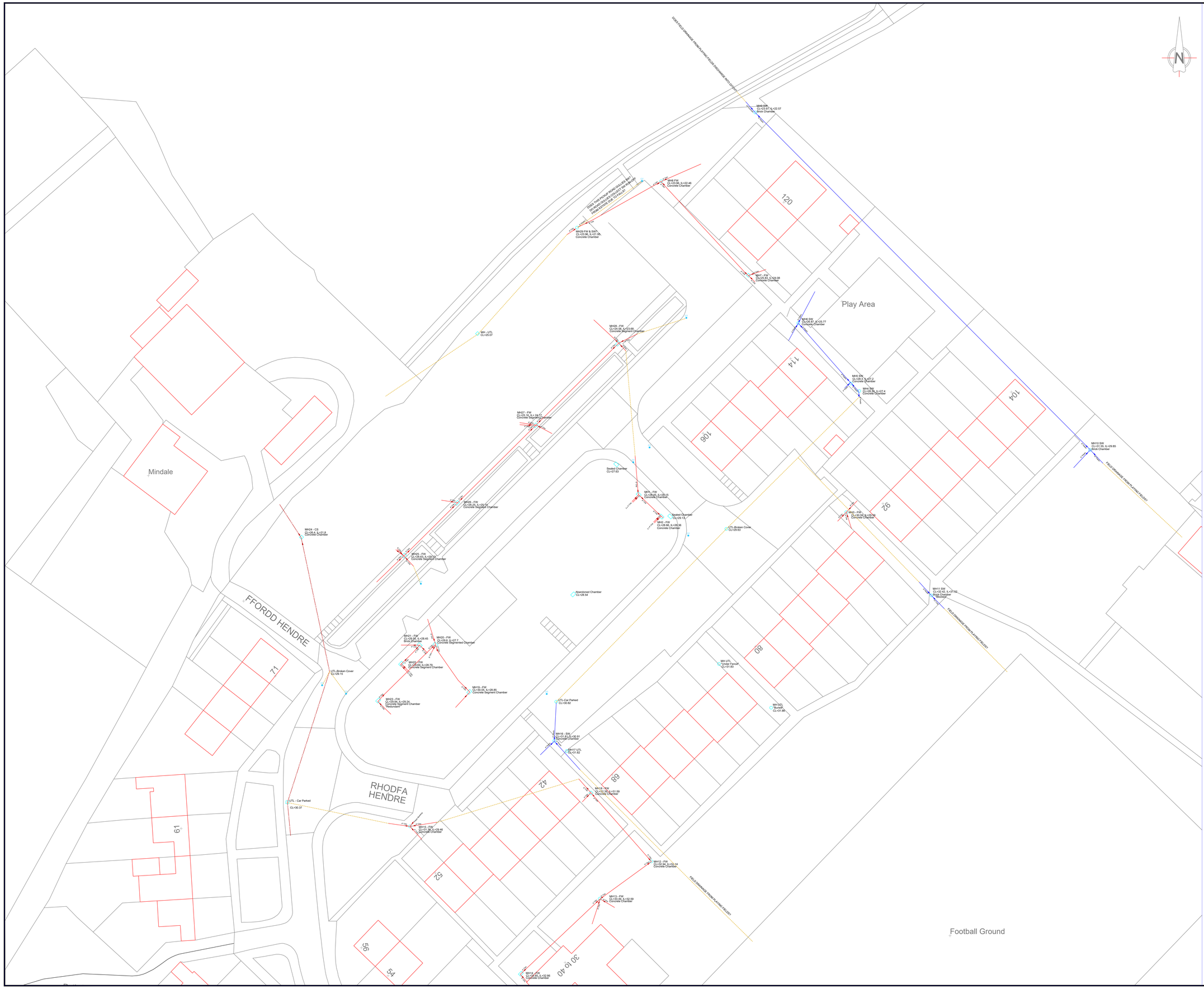
PROJECT TITLE
FFORDD TY NEWYDD, PRESTATYN, DENBIGHSHIRE

DRAWING DETAIL
TOPOGRAPHICAL LAND SURVEY SHEET 3 OF 3

PROJECT ENGINEER	CT / CC	DATE	29.05.2024
DRAWN	LG	SCALE	1:500@A0

DRAWING NUMBER	REVISION
CGH.TS.13	A



Survey Site Control:

Coordinates & Levels to Ordnance Survey Datum OSGB36NG via OSTN15 & OSGM15

- Foul Water Drainage
- Surfacel Water Drainage
- Assumed Route but not proven
- Combined Sewer

Survey Notes:

OS file Supplied by Client

Revision	Date	Description

Carl Williams Land Surveys Ltd

The Studio
15 Millfield
Neston
Cheshire
CH64 3TF
www.cwlandsurveys.com e:info@cwlandsurveys.com

Client

Castle Green Homes

Project

Ffordd Ty Newydd, Prestatyn
Drainage Manholes Survey

Scale	To Fit	Surveyed By	CW
		Date	22.01.23
Drawing No.	B518-00	Checked By	VW
		Date	28.01.23
		Drawn By	CW
		Date	29.01.23

Dŵr Cymru
Welsh Water

PPA0008743 Sewer Plan

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow (C O)
- Special purpose chamber (SPC)
- Treatment works
- Pumping station
- Outfall
- Lamphole (LH)
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement (S 104)
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - 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

Map Ref:	305607,380881
Map scale:	1:2275
Printed by:	Stacey Harris
Printed on:	24 May 2024

DO NOT SCALE

NORTH

Adoptable FW Pumping Station (SfA7)
CL 15.000
Sump Base Level ??.???
(incoming 12.469)

Rising Main to F104 Gravity network to proposed combined sewer diversion.

Emergency storage required.
(160l x 88 = 14.08 cu.m)
Additional upstream storage may be required.

Wet well base level to be supplied by pump supplier.

For further pump station details refer to pump supplier drawings.

Rising Main
110mm HPPE SDR17
Rising main to be fusion welded
Length = 250m

Outfall to watercourse subject to LLFA approval. Client to confirm levels of existing watercourse.

S45 (1.8 Dia flow control manhole)
Hydrobrake Optimum
Flow Regulator
MD-SHE-0150-1230-1650-1230
Restricted to:
12.30 l/s @ 1.65m design head
Orifice size = 150mm

Proposed foul flows to discharge into proposed adoptable FW pumping station.

ONLINE SUDS BASIN 1
TOB = 15.100
Base Level = 13.200
Basin Base Area = 661m²
1 in 3 Side Slopes
Top Water Levels:
100yr+50%cc+10%uc = 14.787
100yr = 14.290
30yr = 14.037

S11 (1.5 Dia flow control manhole)
Hydrobrake Optimum
Flow Regulator
MD-SHE-0103-5000-1200-5000
Restricted to:
5.00 l/s @ 1.20m design head
Orifice size = 103mm

ONLINE SUDS BASIN 1
TOB = 27.950
Base Level = 27.000
Basin Base Area = 183m²
1 in 3 Side Slopes
Top Water Levels:
100yr+50%cc+10%uc = 27.638
100yr = 27.411
30yr = 27.299

SJ05807902
CL: 20.71
IL: 17.15

MH1 CC
CL: 24.19
IL: 21.36

SJ05808002
CL: 27.08
IL: 24.98

Proposed diversions required to suit site layout.

Land drain to be constructed on boundary.

CONTINUED ON SHEET 2

Notes

1. Setting out shall be undertaken using only the information given. Distances should not be scaled from this drawing.
2. All sewers shall be constructed in accordance with Design and Construction Guidance (DCG) Standards and United Utilities Details & Guidelines.
3. The minimum gravity pipe diameter under adoptable highways shall be 150mm
4. It is the responsibility of the Contractor to verify all information given with regards to existing services and drainage connections etc. prior to commencing the works. The rates shall include for hand dig around services where necessary. The Contractor shall adhere to the CDM Regulations at all times
5. The outsides of all sewers shall be a minimum of 1.0m from kerb lines and the outside of manholes shall be a minimum of 0.5m from kerb lines
6. Existing flows in watercourses, sewers and land drains shall be maintained at all times
7. Only trained personnel shall be permitted to enter confined spaces
8. All materials to bear the relevant B.S. Kitemark and comply fully with the specifications. All concrete & concrete products must use Sulphate resistant cement to withstand Class 3 condition (unless the site investigation report proves that sulphate attack from soils and groundwater will not occur).
9. All opening notices etc. as required under Highways Acts etc. are to be obtained prior to commencement of works. All works are to be inspected by L.A., NHBC or the Network Operator as applicable.
10. Where "Structured Wall" UPVC pipes (or similar approved) are used in adoptable drainage they shall be handled and laid in accordance with the manufacturers instructions and will be subject to post installation deformation testing prior to adoption.
A Class S Bed and Surround must be used for "Structured Wall" pipes
11. Trench backfill in highways to within 1m of highway shall, as directed by the Highway Authority be a suitable granular material all in accordance with Design and Construction Guidance (DCG) Standards.
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13. Pipes have not been designed to accommodate construction traffic loading. The contractor is responsible for providing adequate protection to the pipes during construction.

Legend

- Site Boundary

Existing

- Existing Combined Sewer
- Existing Combined Sewer To Be Abandoned
- Existing Watercourse

Proposed

- S01 — Adoptable Surface Water Sewer
- F01 — Adoptable Foul Sewer
- 600 W — Brick Retaining Wall
- 450 FOE — Flag Retaining Wall
- 150 UB — Underbuild
- 150 STEP — Step In Slab
- 150 GB — Gravel Board
- FFL 18.65 — Plot Slab Level
- FC — Flow Control Manhole
- Sewer Easement
- +0.95 -0.95 — Depth of fill (Existing level to proposed)
- SUDS Basin
- Rising Main
- Land Drain

STRATEGY

coopers
chartered consulting engineers
Park House
Sandpiper Court
Chester Business Park
Chester
CH4 9QU
Tel: 01244 684910
Email: admin@coopers.co.uk
Web: http://coopers.co.uk

Client: Castle Green

Project: MINDALE FARM
MELIDEN.

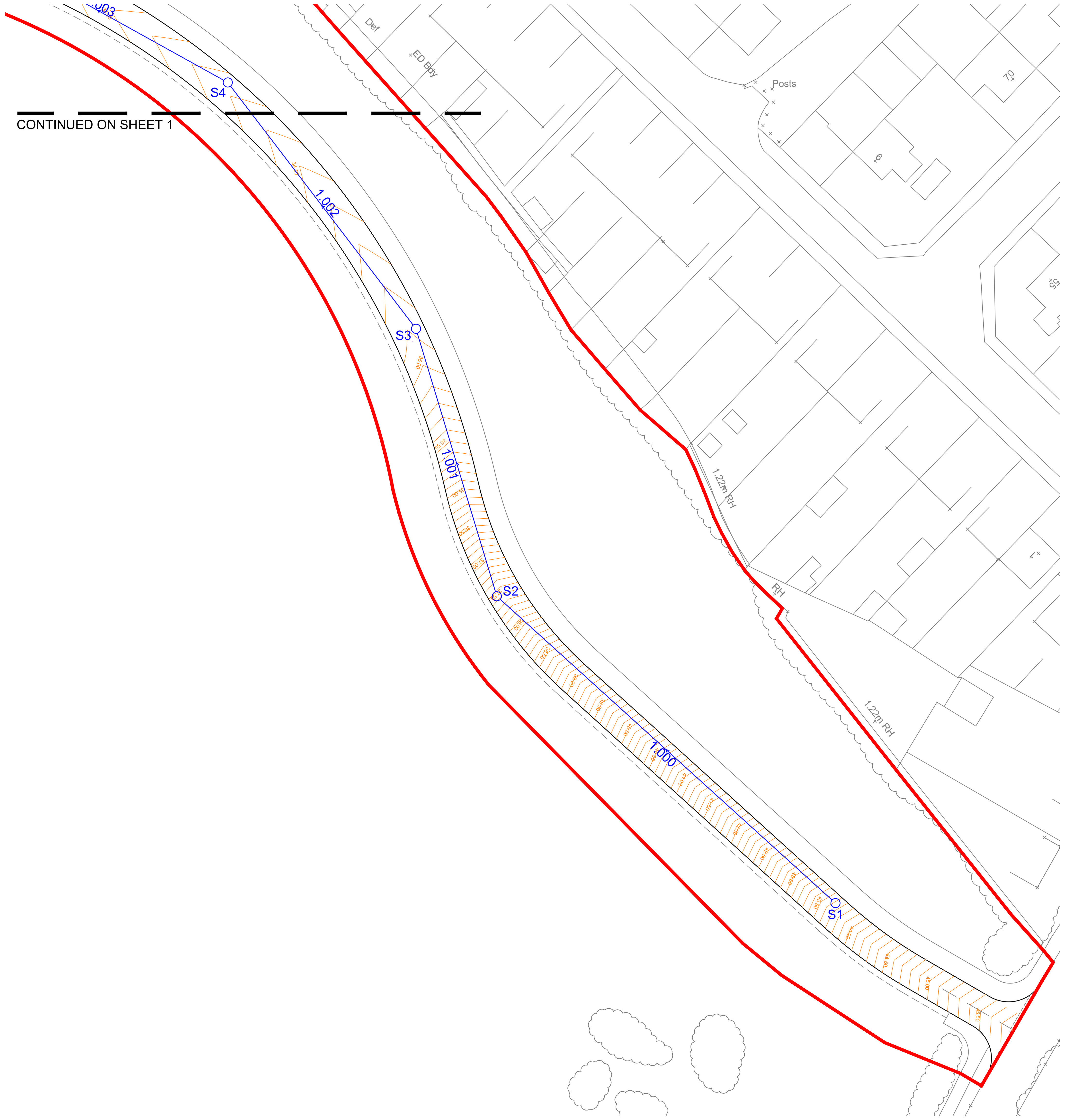
Title: Drainage Strategy
Sheet 1 of 2

DRAWING NUMBER	SCALE at A0	1:500	
8658 / SK01-1	DATE	09.12.25	REVISION
	DRAWN	PW	-
	CHECKED	AJ	

SCALE BAR (m) 0 5 10 15 20 25 30 35 40 45 50

DO NOT SCALE

NORTH



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STORM Network 1

Pipe Code	Diameter (mm)	Gradient (1:)	Pipe Type	Pipe Length	Upstream Manhole Number	Upstream Manhole Invert	Upstream Manhole Cover	Downstream Manhole Number	Downstream Manhole Invert	Downstream Manhole Cover
1.000	150	11	Circular	74.215	S1	42.27	43.62	S2	35.50	37.45
1.001	225	23	Circular	45.376	S2	35.43	37.45	S3	33.45	34.87
1.002	225	80	Circular	50.344	S3	33.45	34.87	S4	32.82	34.24
1.003	225	42	Circular	48.346	S4	32.82	34.24	S5	31.67	33.10
1.004	225	14	Circular	43.255	S5	31.67	33.10	S6	28.68	30.26
1.005	225	15	Circular	14.194	S6	28.68	30.26	S7	27.73	29.28
1.006	225	24	Circular	10.094	S7	27.73	29.28	S8	27.31	28.74
1.007	225	169	Circular	13.695	S8	27.31	28.74	S9	27.23	
2.000	225	23	Circular	12.990	S10	27.00		S11	26.44	27.87
2.001	225	16	Circular	26.291	S11	26.44	27.87	S13	24.77	26.20
2.002	225	12	Circular	16.772	S13	24.77	26.20	S14	23.36	24.80
2.003	225	12	Circular	21.109	S14	23.36	24.80	S15	21.61	23.03
2.004	225	11	Circular	13.942	S15	21.61	23.03	S16	20.36	21.89
2.005	225	11	Circular	12.271	S16	20.36	21.89	S17	19.25	20.88
2.006	225	11	Circular	10.407	S17	19.25	20.88	S18	18.29	20.02
2.007	225	16	Circular	69.472	S18	18.29	20.02	S19	13.95	15.71
2.008	300	76	Circular	25.239	S19	13.87	15.71	S20	13.54	15.09
2.009	450	396	Circular	19.029	S20	13.39	15.09	S21	13.34	
3.000	150	34	Circular	11.934	S12	25.19	26.54	S13	24.85	26.20
4.000	225	170	Circular	21.885	S22	17.84	19.26	S27	17.71	19.54
4.001	300	16	Circular	54.490	S27	17.64	19.54	S29	14.23	15.88
4.002	600	397	Circular	26.209	S29	13.93	15.88	S30	13.86	16.00
4.003	600	400	Circular	65.668	S30	13.86	16.00	S31	13.70	15.75
4.004	600	402	Circular	37.365	S31	13.70	15.75	S40	13.60	15.52
4.005	600	397	Circular	22.247	S40	13.60	15.52	S41	13.55	15.45
4.006	600	401	Circular	40.491	S41	13.55	15.45	S42	13.45	15.40
4.007	675	396	Circular	11.895	S42	13.37	15.40	S43	13.34	
5.000	150	16	Circular	20.298	S23	20.59	21.94	S25	19.32	21.17
5.001	225	44	Circular	22.216	S25	19.25	21.17	S26	18.74	20.16
5.002	300	34	Circular	34.578	S26	18.66	20.16	S27	17.64	19.54
6.000	225	150	Circular	11.325	S24	19.32	20.75	S25	19.25	21.17
7.000	600	400	Circular	13.055	S28	13.96	15.76	S29	13.93	15.88
8.000	150	17	Circular	29.843	S32	23.89	25.24	S33	22.18	23.75
8.001	225	21	Circular	25.636	S33	22.10	23.75	S34	20.90	22.65
8.002	225	11	Circular	55.760	S34	20.90	22.65	S37	15.73	18.69
8.003	375	21	Circular	19.167	S37	15.58	18.69	S38	14.65	17.13
8.004	375	28	Circular	16.300	S38	14.65	17.13	S39	14.08	16.12
8.005	450	60	Circular	11.933	S39	14.00	16.12	S40	13.80	15.52
9.000	225	147	Circular	26.089	S35	17.09	18.51	S36	16.91	18.33
9.001	225	23	Circular	27.274	S36	16.91	18.33	S37	15.73	18.69
10.000	675	408	Circular	6.536	S44	13.20		S45	13.18	15.10
10.001	225	98	Circular	18.095	S45	13.18	15.10	S46	13.00	13.40

FOUL Network 2

Pipe Code	Diameter (mm)	Gradient (1:)	Pipe Type	Pipe Length	Upstream Manhole Number	Upstream Manhole Invert	Upstream Manhole Cover	Downstream Manhole Number	Downstream Manhole Invert	Downstream Manhole Cover
1.000	225	37	Circular	17.562	EX MH1	24.98	27.08	C1	24.50	26.47
1.001	225	9	Circular	38.951	C1	24.50	26.47	C2	20.07	22.34
1.002	225	33	Circular	43.737	C2	20.07	22.34	C3	18.77	21.15
1.003	225	33	Circular	25.384	C3	18.77	21.15	C4	18.00	20.07
1.004	225	56	Circular	26.450	C4	18.00	20.07	C5	17.52	19.63
1.005	225	170	Circular	53.886	C5	17.52	19.63	C6	17.21	19.85
1.006	225	170	Circular	9.890	C6	17.21	19.85	EX MH2	17.15	20.71
2.000	150	16	Circular	41.251	F101	24.30	25.96	F102	21.68	23.89
2.001	150	20	Circular	20.891	F102	21.68	23.89	F103	20.66	22.92
2.002	150	40	Circular	20.278	F103	20.66	22.92	C2	20.15	22.34
3.000	150	9	Circular	28.879	EX MH3	21.34	24.19	C4	18.07	20.07

FOUL Network 3

Pipe Code	Diameter (mm)	Gradient (1:)	Pipe Type	Pipe Length	Upstream Manhole Number	Upstream Manhole Invert	Upstream Manhole Cover	Downstream Manhole Number	Downstream Manhole Invert	Downstream Manhole Cover
1.000	150	16	Circular	68.275	F1	17.85	20.22	F2	13.51	15.80
1.001	150	63	Circular	18.178	F2	13.51	15.80	F3	13.22	15.34
1.002	150	150	Circular	20.052	F3	13.22	15.34	F4	13.09	15.20
1.003	150	150	Circular	20.055	F4	13.09	15.20	F5	12.95	15.40
1.004	150	150	Circular	42.034	F5	12.95	15.40	F6	12.67	15.45
1.005	150	150	Circular	15.478	F6	12.67	15.45	F18	12.57	15.39
1.006	150	150	Circular	14.984	F18	12.57	15.39	F19	12.47	15.00
2.000	150	10	Circular	8.922	F7	14.47	16.77	F9	13.60	16.07
2.001	150	150	Circular	83.898	F9	13.60	16.07	F10	13.04	15.75
2.002	150	150	Circular	40.743	F10	13.04	15.75	F17	12.77	15.63
2.003	150	61	Circular	12.208	F17	12.77	15.63	F18	12.57	15.39
3.000	150	35	Circular	18.189	F8	14.11	15.91	F9	13.60	16.07
4.000	150	150	Circular	24.417	F11	16.66	18.49	F12	16.50	18.28
4.001	150	150	Circular	34.090	F12	16.50	18.28	F14	16.27	18.50
4.002	150	23	Circular	14.622	F14	16.27	18.50	F15	15.63	17.29
4.003	150	19	Circular	15.784	F15	15.63	17.29	F16	14.80	16.23
4.004	150	22	Circular	11.559	F16	14.80	16.23	F17	14.28	15.63
5.000	150	7	Circular	9.746	F13	17.67	19.32	F14	16.27	18.50

0 5 10 15 20 25 30 35 40 45 50
SCALEBAR(m)

Legend

Site Boundary

Existing

COMBINED — Existing Combined Sewer

COMBINED — Existing Combined Sewer To Be Abandoned

Existing Watercourse

Proposed

S01 — Adoptable Surface Water Sewer

F01 — Adoptable Foul Sewer

600 W — Brick Retaining Wall

450 FOE — Flag Retaining Wall

150 UB — Underbuild

150 STEP — Step In Slab

150 GB — Gravel Board

FFL 18.65 — Plot Slab Level

FC — Flow Control Manhole

Sewer Easement

+0.95 -0.95 — Depth of fill (Existing level to proposed)

SUDS Basin

Rising Main

Land Drain

PRELIMINARY

coopers
chartered consulting engineers

Park House
Sandpiper Court
Chester Business Park
Chester
CH4 9QU

Tel: 01244 684910
Email: admin@coopers.co.uk
Web: http://coopers.co.uk

Client

Castle Green

Project

MINDALE FARM,
MELIDEN.

Title

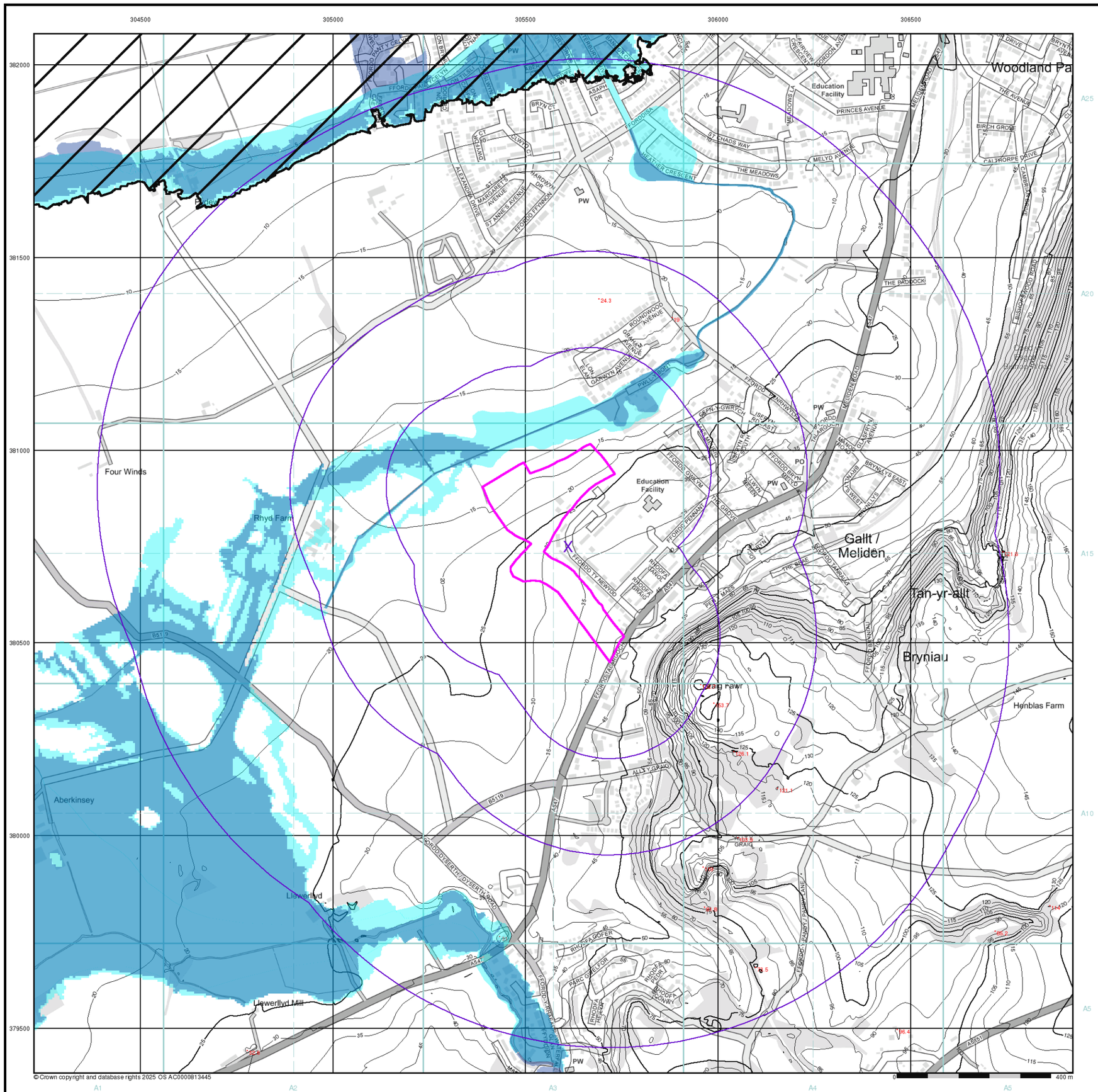
Engineering Layout
Sheet 2 of 2

DRAWING NUMBER	SCALE at A1	1:500	
8658 / SK01-2	DATE	09.12.25	REVISION
	DRAWN	PW	-
	CHECKED	AJ	

Appendix 2

Envirocheck Flood Screening Report

Order Number: 387135511_1_1



Envirocheck®

LANDMARK INFORMATION GROUP®

EA/NRW Flood Data Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Flood Data

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

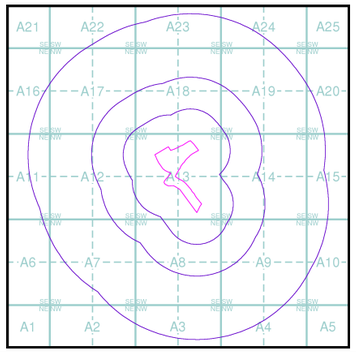
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height *167.8

EA/NRW Flood Data Map - Slice A



Order Details

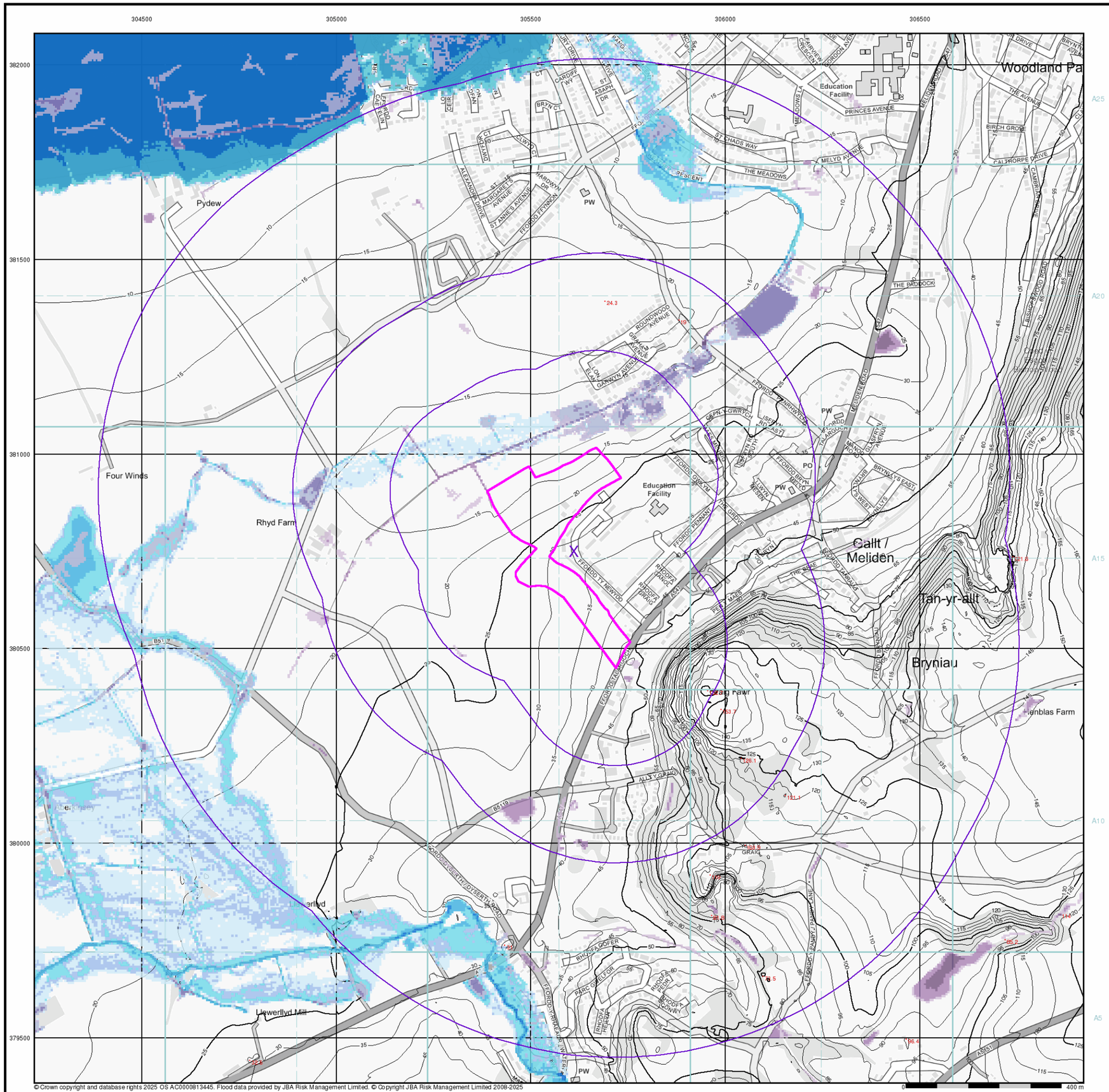
Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

Mindale Farm, Ffordd Hendre, PRESTATYN, LL19 8PG

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck®

LANDMARK INFORMATION GROUP®

JBA 75 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

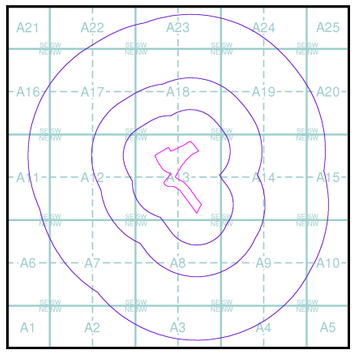
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 157.8

JBA 75 Year Return Flood Map (Undefended) - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

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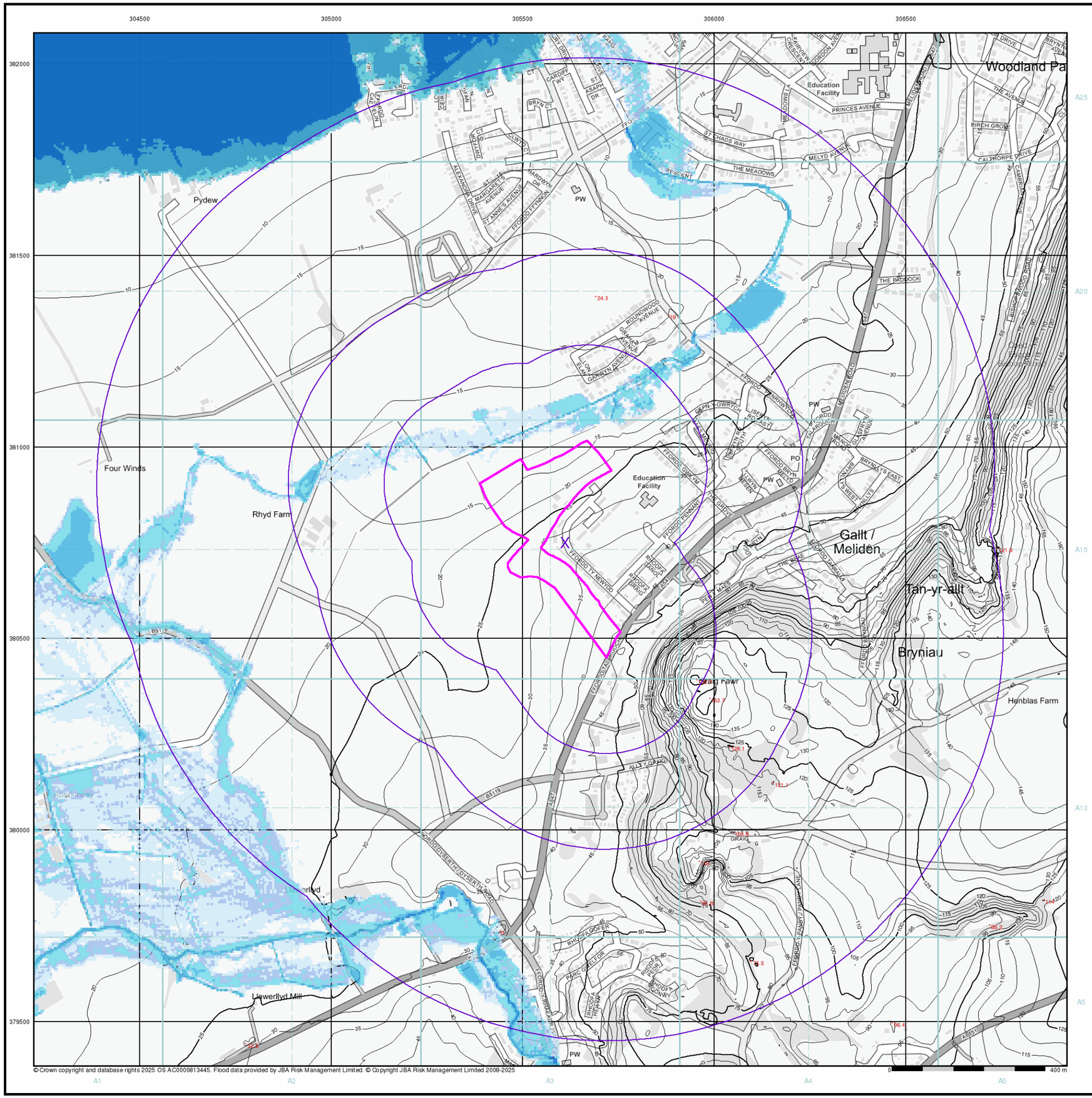

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LANDMARK INFORMATION GROUP®

JBA 100 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Modelled Flood Depth

Fluvial Depth	Coastal Depth
0.01m - 0.05m	0.01m - 0.05m
0.05m - 0.1m	0.05m - 0.1m
0.1m - 0.3m	0.1m - 0.3m
0.3m - 1m	0.3m - 1m
>1m	>1m

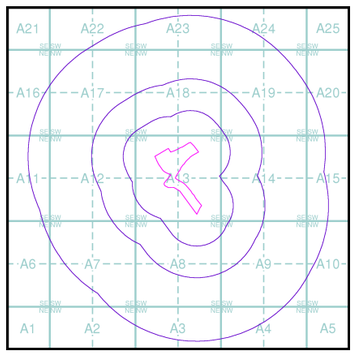
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 167.8

JBA 100 Year Return Flood Map (Undefended) - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

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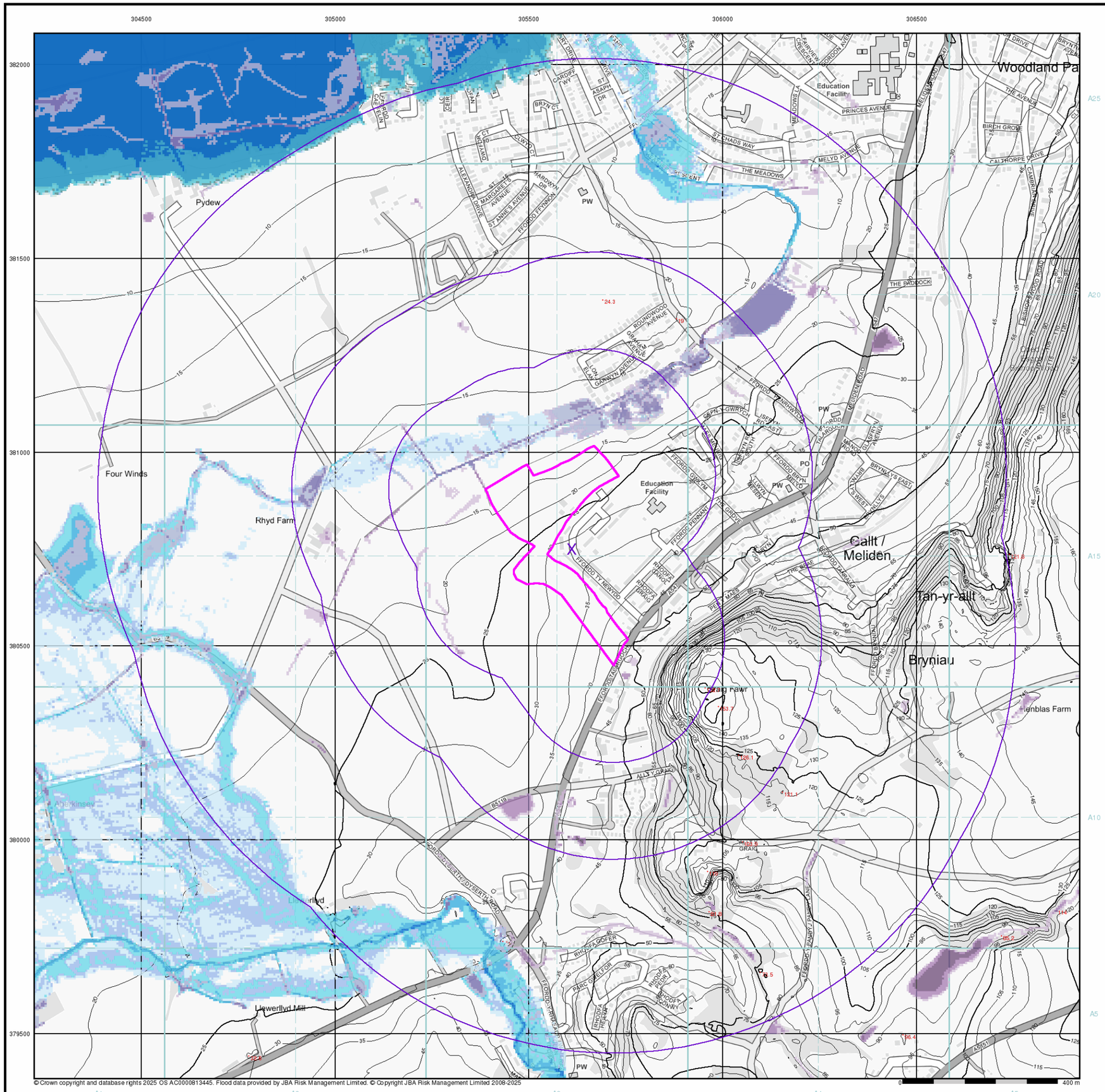

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LANDMARK INFORMATION GROUP®

JBA 200 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

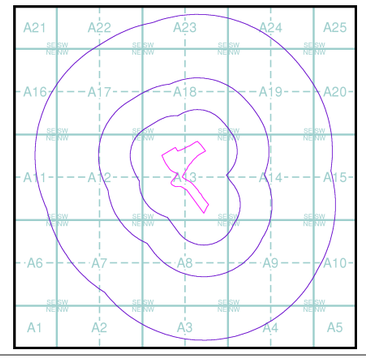
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 157.8

JBA 200 Year Return Flood Map (Undefended) - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

Mindale Farm, Ffordd Hendre, PRESTATYN, LL19 8PG

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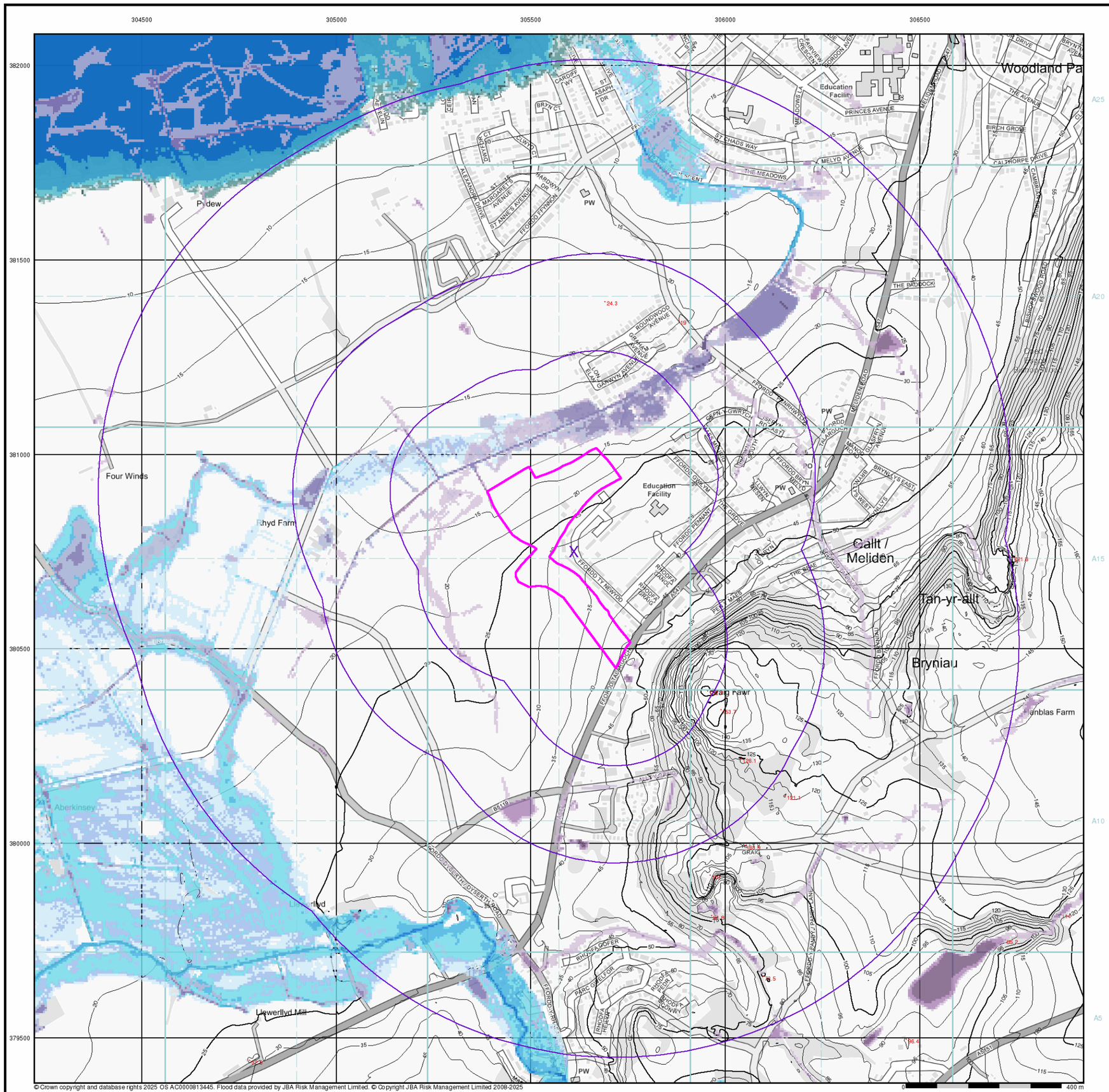

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JBA 1000 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

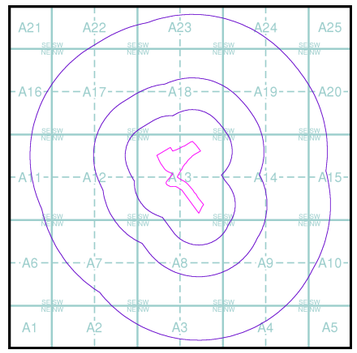
Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

Spot Height 157.8

JBA 1000 Year Return Flood Map (Undefended) - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

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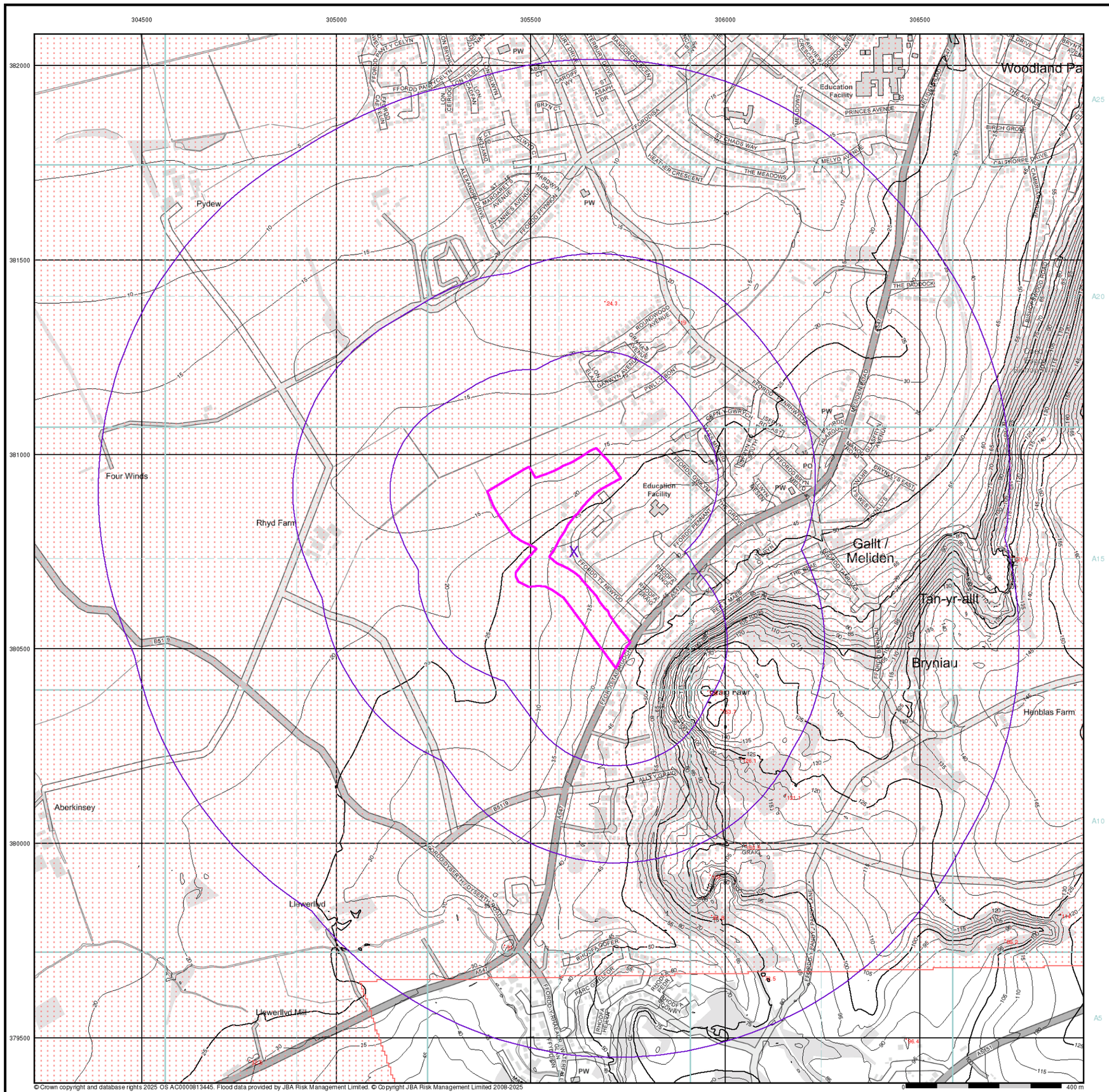

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LANDMARK INFORMATION GROUP®

JBA Canal Failure Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

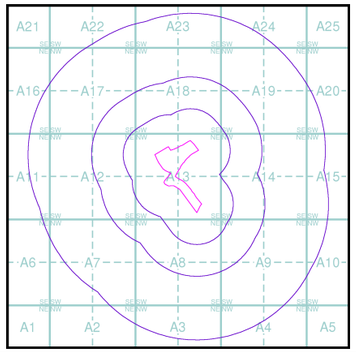
Flood Data

- Canal Failure
- Coverage

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height 167.8
- MLW Mean Low Water
- MHW Mean High Water

JBA Canal Failure Flood Map - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

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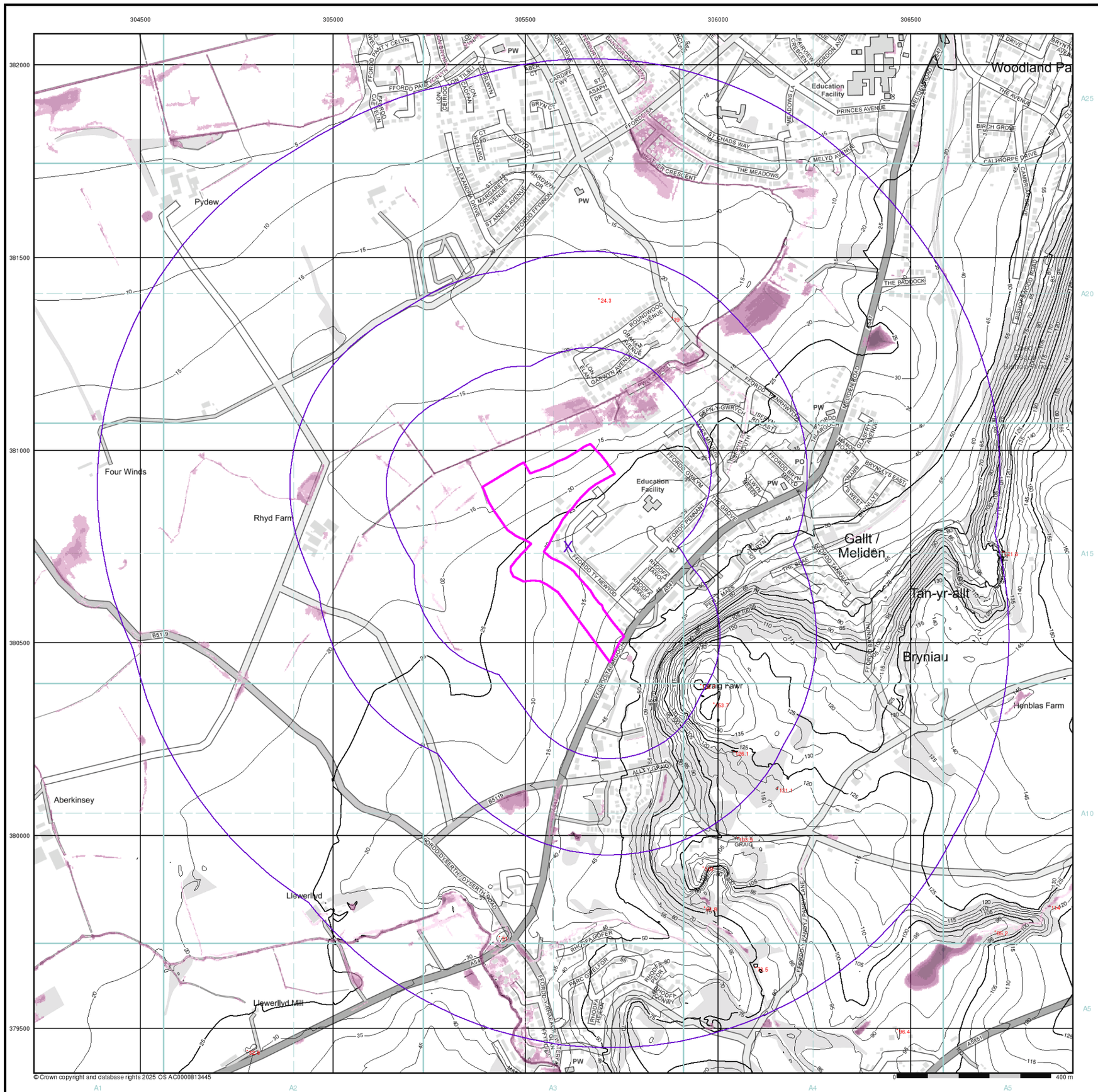

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LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 30 Year Return Depth Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Depth

- 0 - 0.15m
- 0.15 - 0.30m
- 0.30 - 0.60m
- 0.60 - 0.90m
- 0.90 - 1.20m
- > 1.20m

Contours (height in metres)

Standard Contour | Master Contour | Spot Height *167.8

MLW Mean Low Water

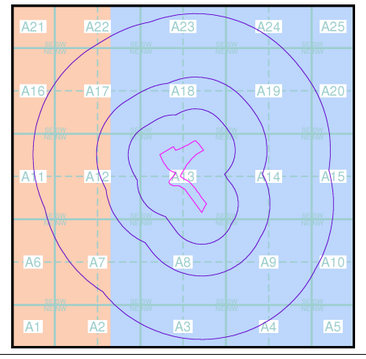
MHW Mean High Water

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

Mindale Farm, Ffordd Hendre, PRESTATYN, LL19 8PG

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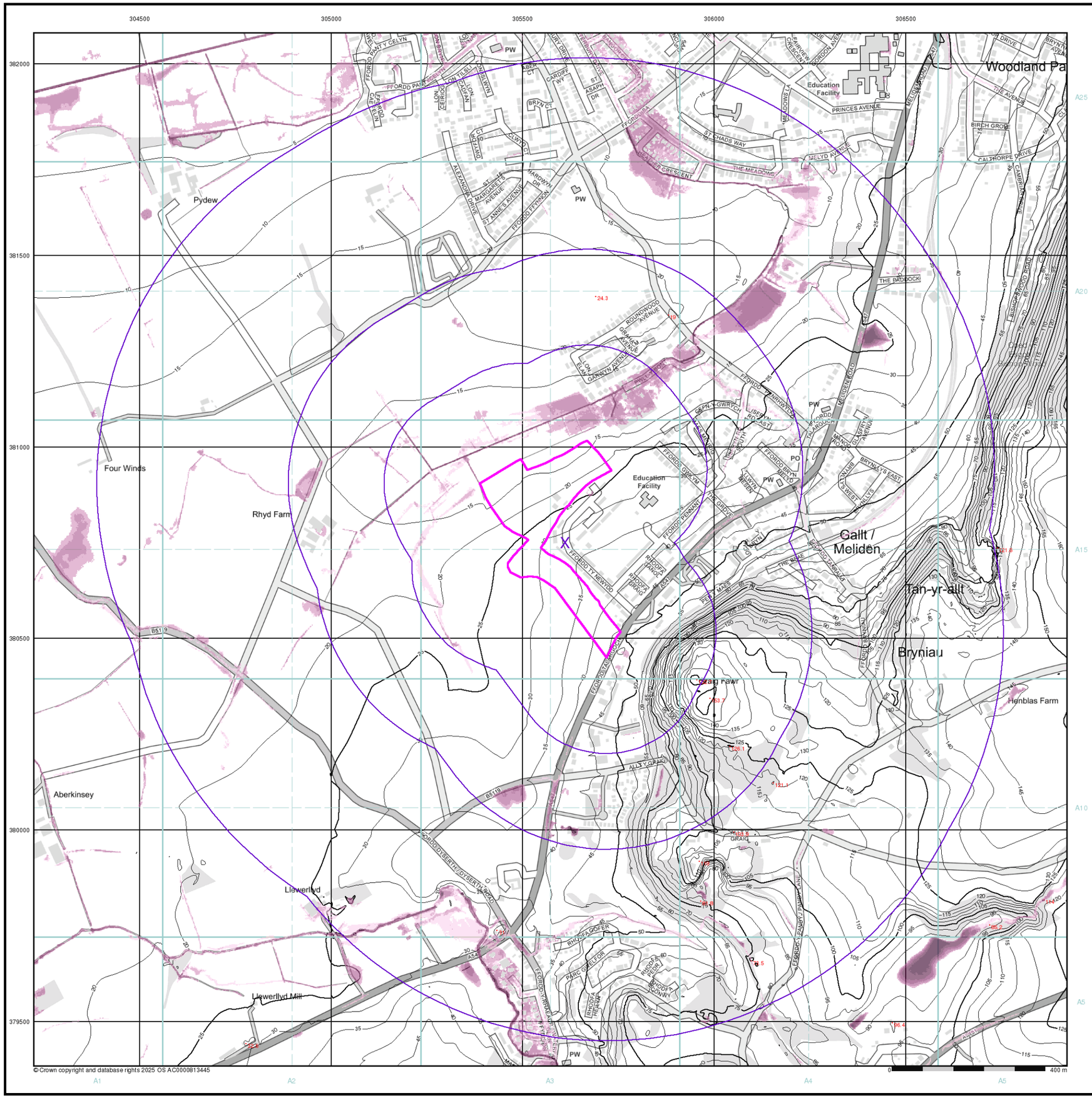


Envirocheck®

LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 100 Year Return Depth Map

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Depth

- 0 - 0.15m
- 0.15 - 0.30m
- 0.30 - 0.60m
- 0.60 - 0.90m
- 0.90 - 1.20m
- > 1.20m

Contours (height in metres)

Standard Contour | Master Contour | Spot Height 167.8

MLW Mean Low Water

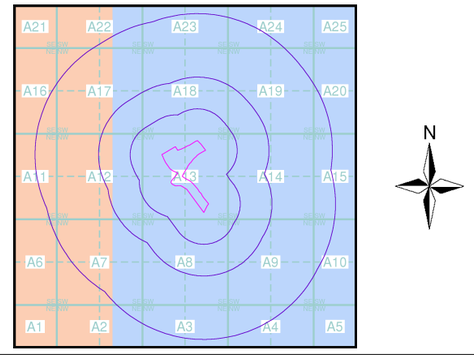
MHW Mean High Water

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

Mindale Farm, Ffordd Hendre, PRESTATYN, LL19 8PG

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Tel: 0844 844 9952
Fax: 0844 844 9951
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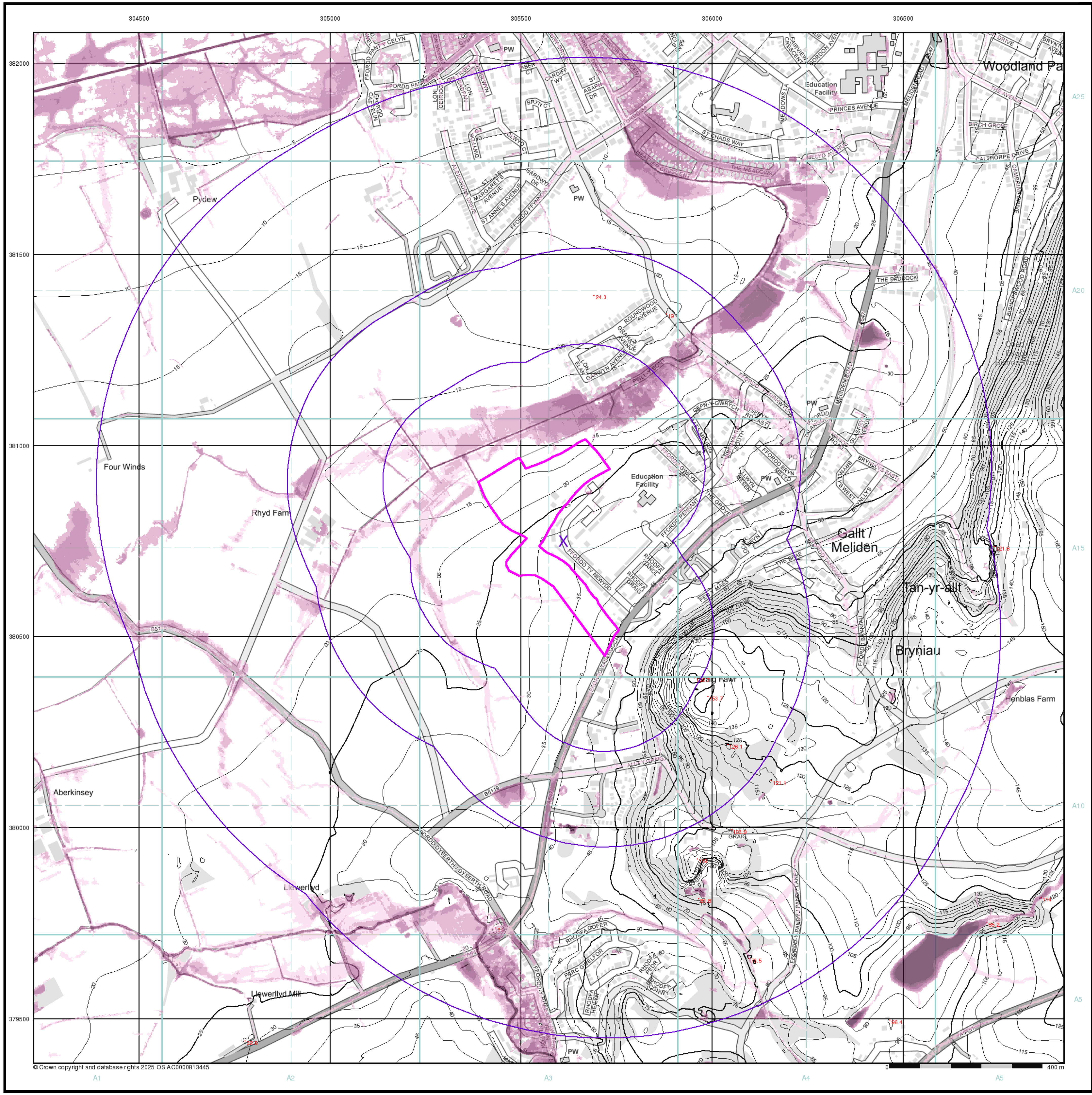

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LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 1000 Year Return Depth Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Depth

- 0 - 0.15m
- 0.15 - 0.30m
- 0.30 - 0.60m
- 0.60 - 0.90m
- 0.90 - 1.20m
- > 1.20m

Contours (height in metres)

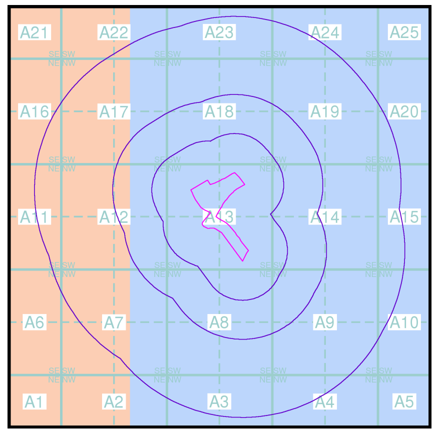
- Standard Contour
- Master Contour
- Spot Height 167.8
- MLW Mean Low Water
- MHW Mean High Water

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



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Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

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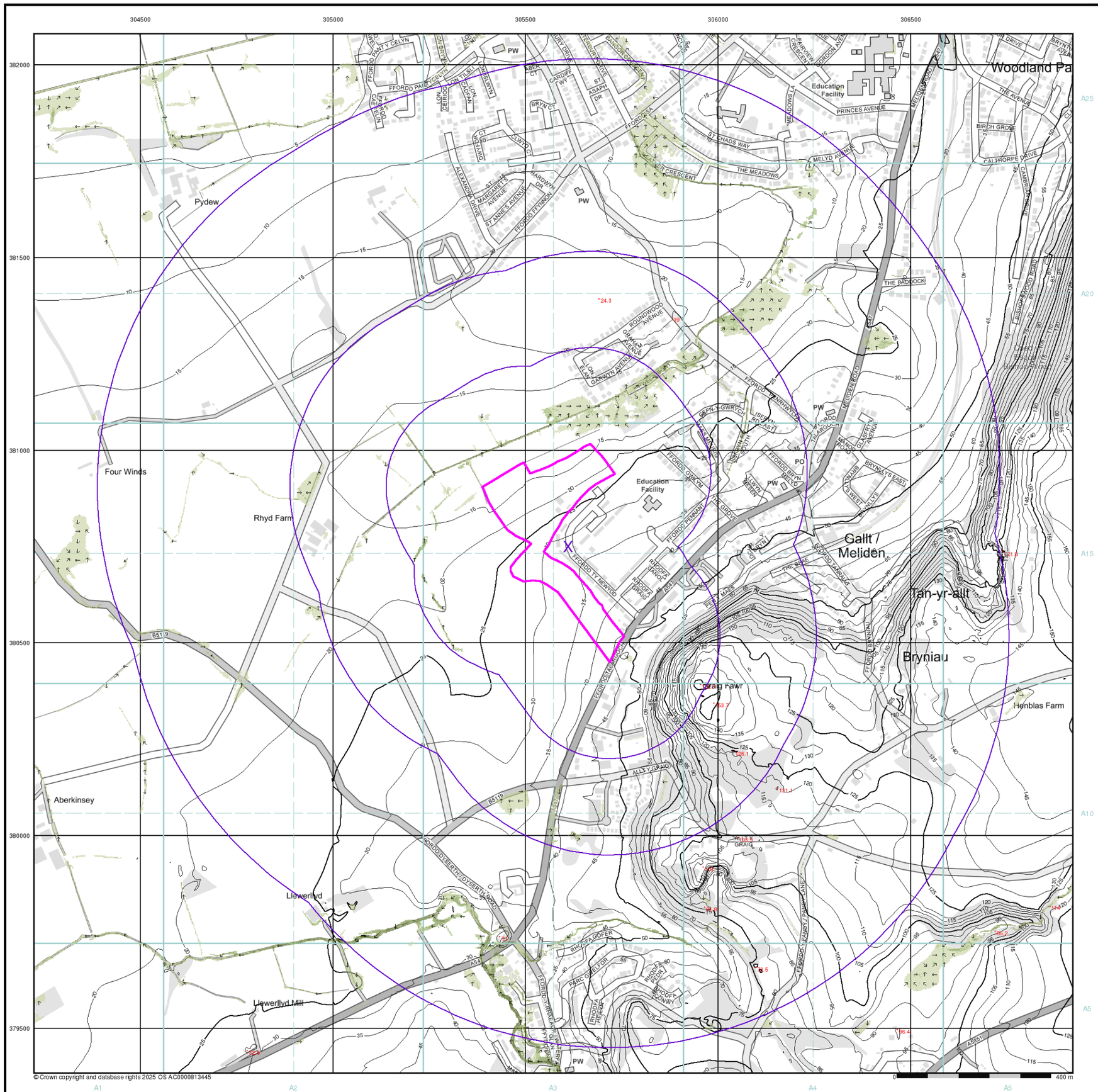

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LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 30 Year Return Velocity and Flow Direction Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Velocity and Direction

- 0.00 - 0.25m/s
- 0.25 - 0.50m/s
- 0.50 - 1.00m/s
- 1.00 - 2.00m/s
- > 2.00m/s

Flow Direction at maximum velocity

Contours (height in metres)

Standard Contour 105
Master Contour 100 95
Spot Height *167.8

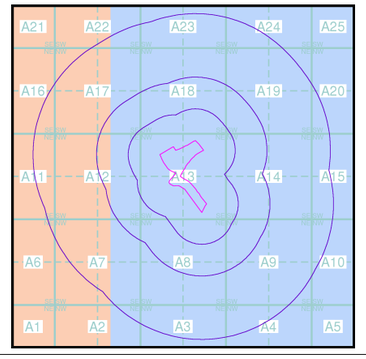
MLW Mean Low Water
MHW Mean High Water

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



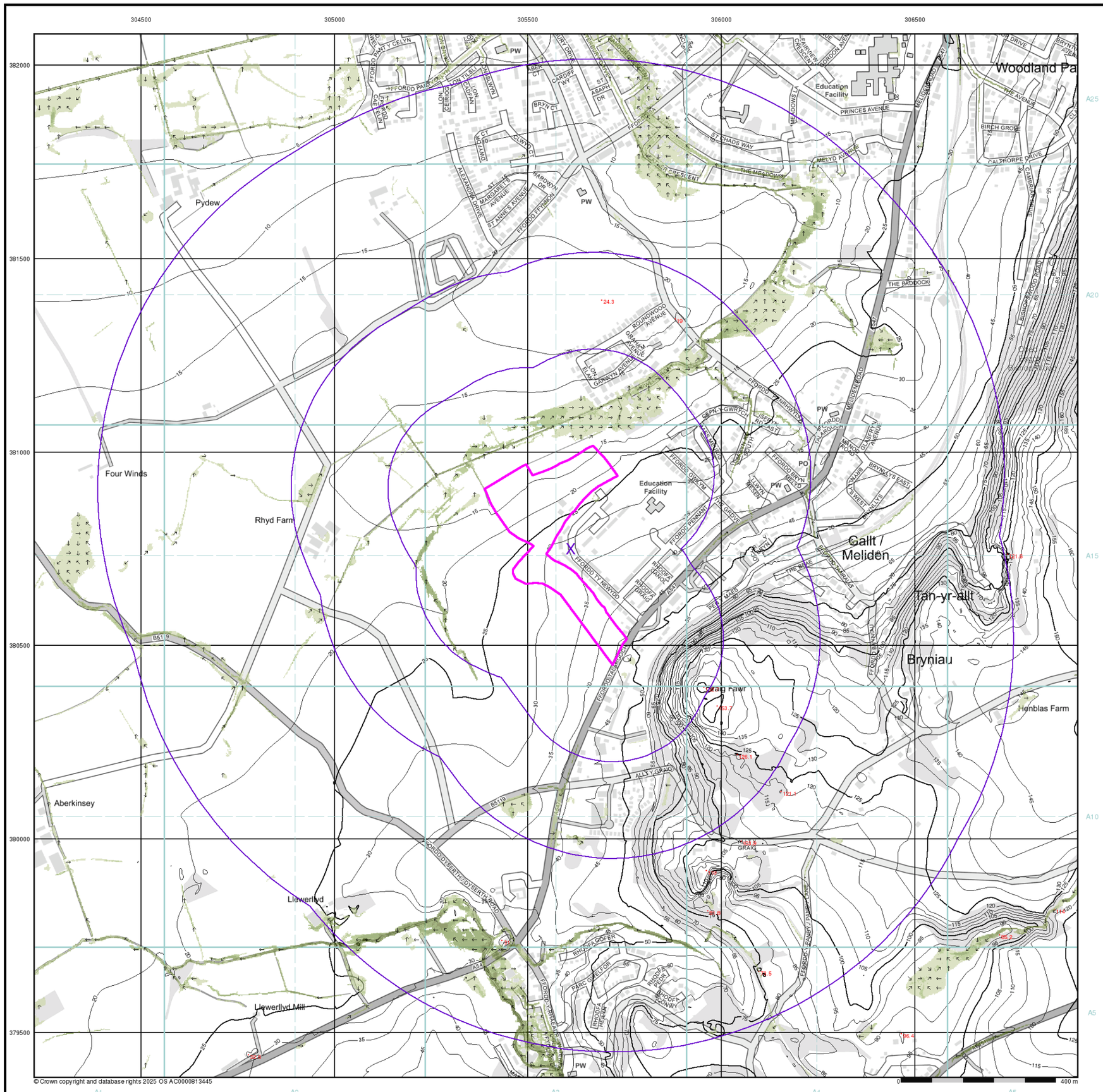
Order Details

Order Number:	387135511_1_1
Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

Mindale Farm, Ffordd Hendre, PRESTATYN, LL19 8PG

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck®

LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 100 Year Return Velocity and Flow Direction Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Velocity and Direction

- 0.00 - 0.25m/s
- 0.25 - 0.50m/s
- 0.50 - 1.00m/s
- 1.00 - 2.00m/s
- > 2.00m/s

Flow Direction at maximum velocity

Contours (height in metres)

Standard Contour | Master Contour | Spot Height *167.8

MLW Mean Low Water

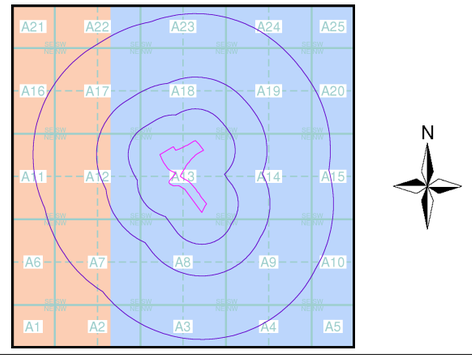
MHW Mean High Water

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



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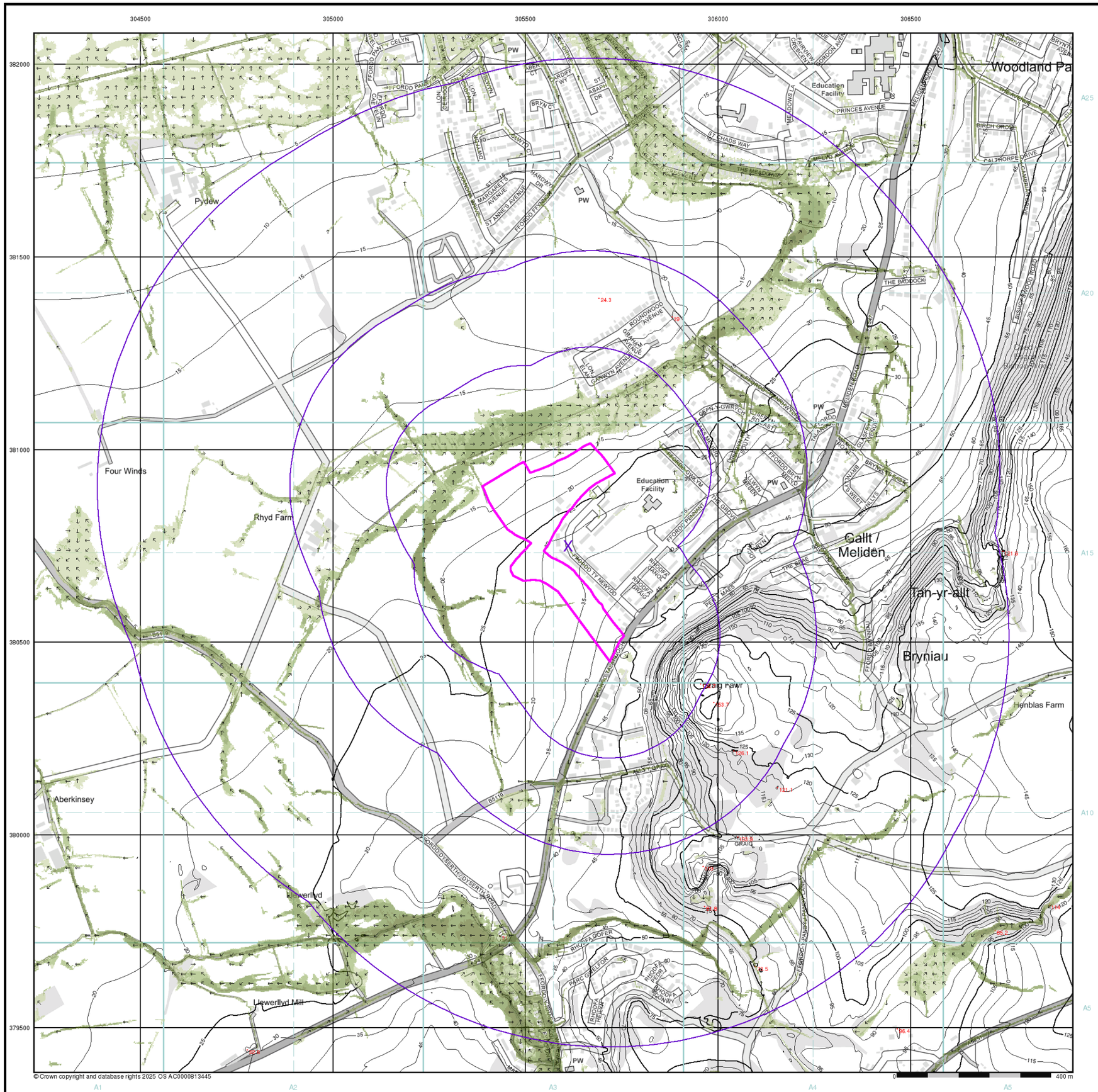

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LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 1000 Year Return Velocity and Flow Direction Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Velocity and Direction

- 0.00 - 0.25m/s
- 0.25 - 0.50m/s
- 0.50 - 1.00m/s
- 1.00 - 2.00m/s
- > 2.00m/s

Flow Direction at maximum velocity

Contours (height in metres)

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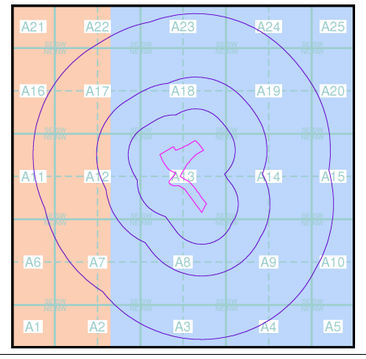

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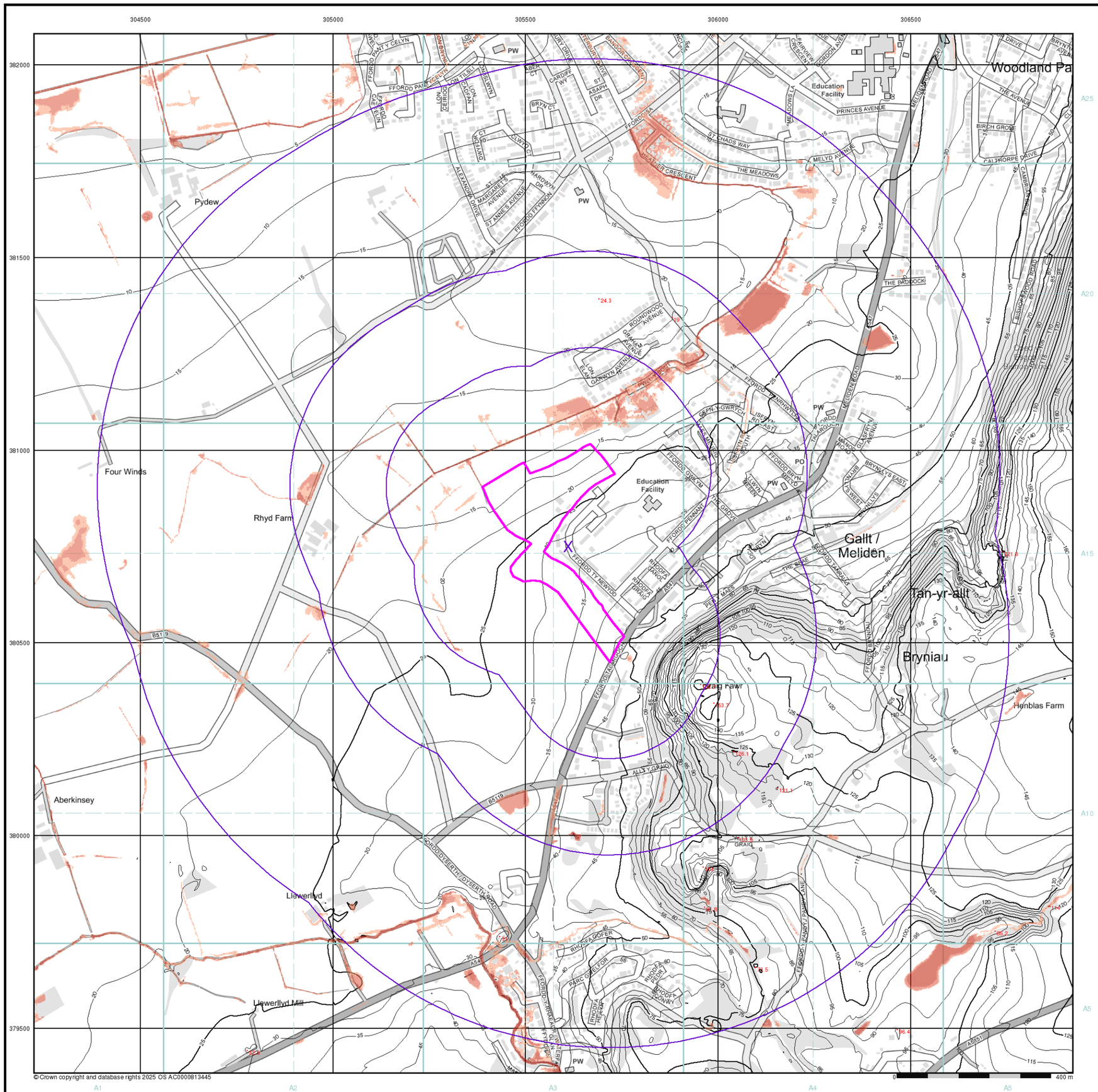


Envirocheck®

LANDMARK INFORMATION GROUP®

EA/NRW Surface Water 30 Year Return Hazard Rating Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Hazard Rating

- Low (0.5 – 0.75)
- Moderate (0.75 – 1.25)
- Significant (1.25 – 2.0)
- Extreme (>2.0)

Contours (height in metres)

Standard Contour | Master Contour | Spot Height *167.8

MLW Mean Low Water

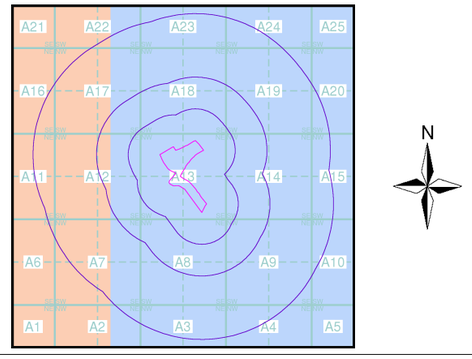
MHW Mean High Water

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



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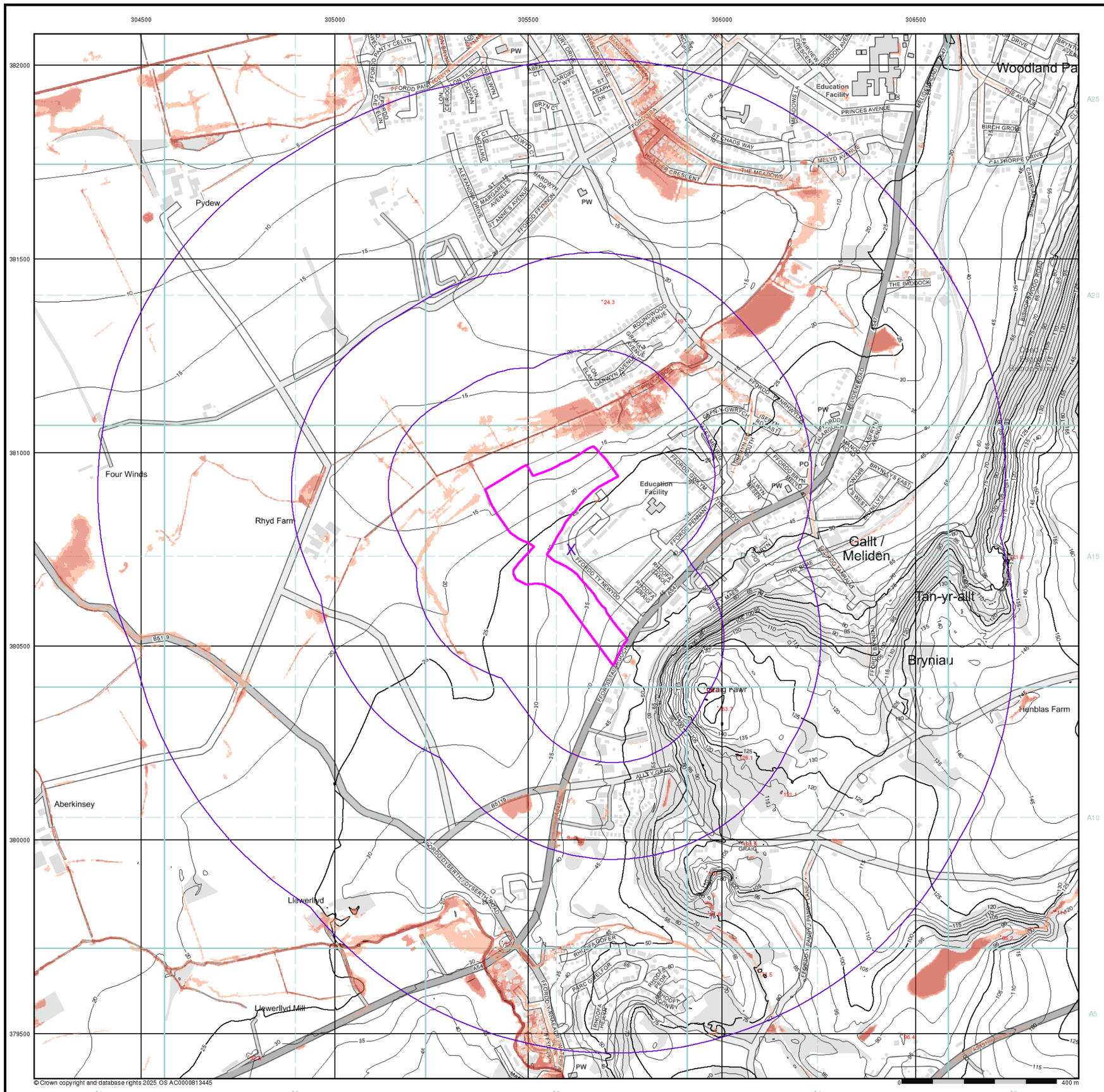

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EA/NRW Surface Water 100 Year Return Hazard Rating Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

Surface Water Hazard Rating

- Low (0.5 – 0.75)
- Moderate (0.75 – 1.25)
- Significant (1.25 – 2.0)
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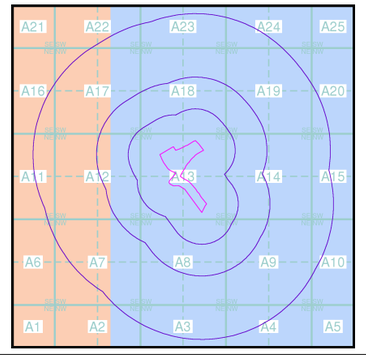
EA/NRW Suitability Map - Slice A



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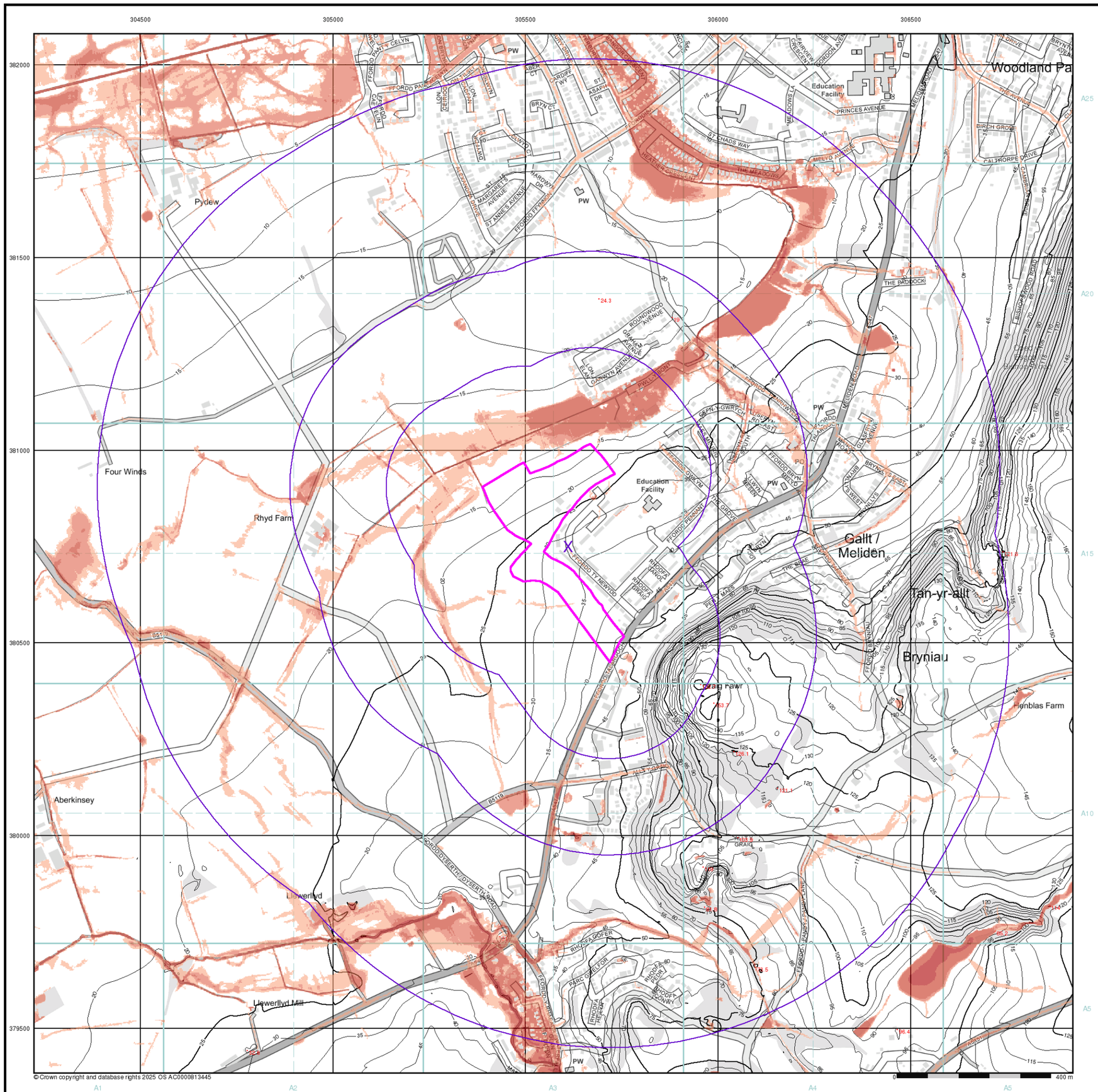

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EA/NRW Surface Water 1000 Year Return Hazard Rating Map (1:10,000)

General

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Surface Water Hazard Rating

- Low (0.5 – 0.75)
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Standard Contour | Master Contour | Spot Height *167.8

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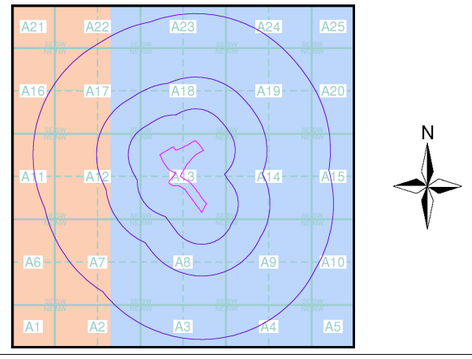
EA/NRW Suitability Map - Slice A



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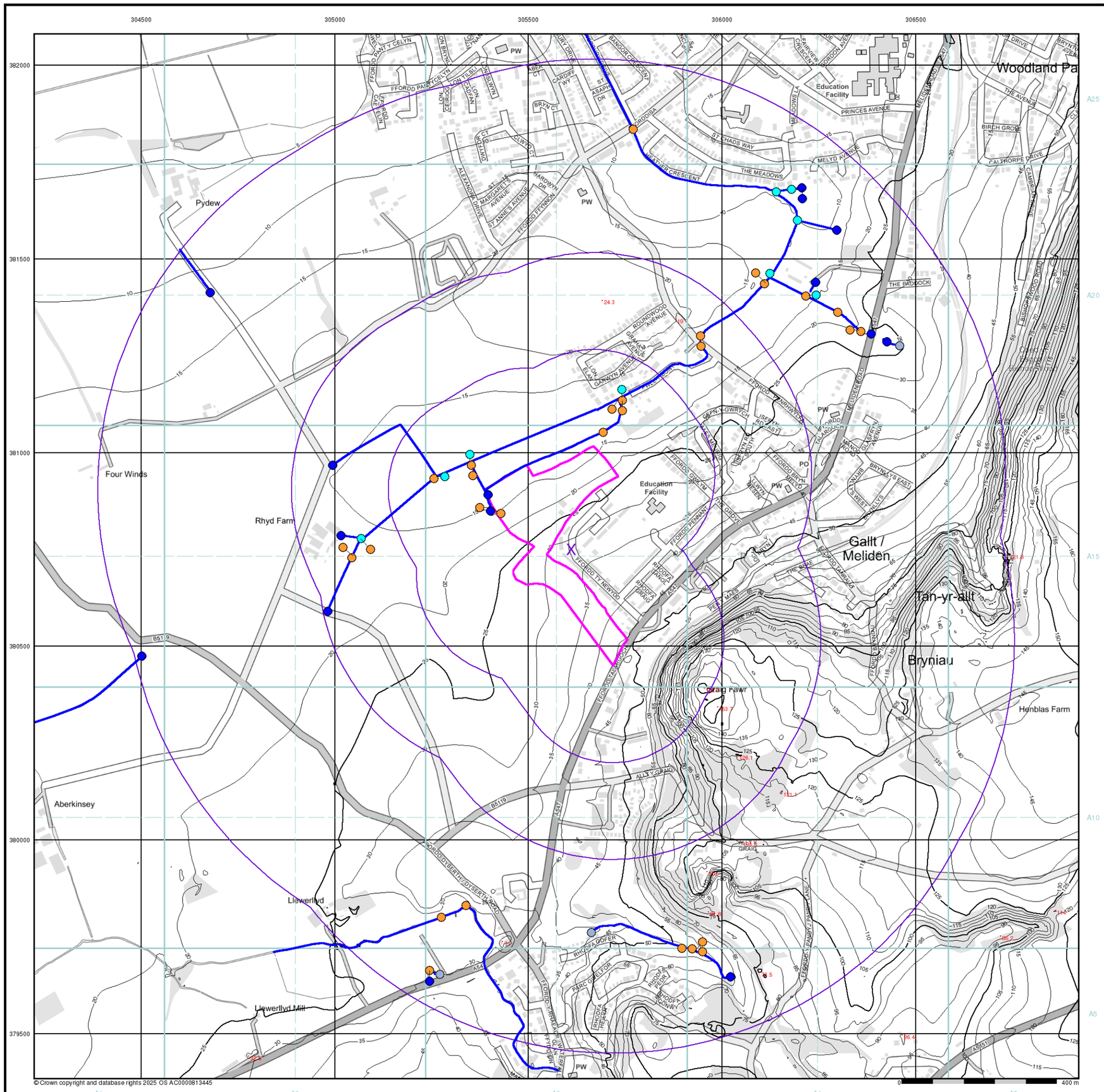

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LANDMARK INFORMATION GROUP®

OS Water Network Lines Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

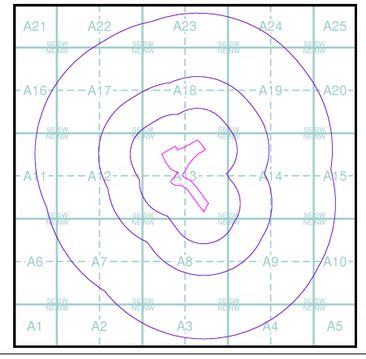
OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea
- Junction
- Outlet
- Pseudo
- Source
- Other

Contours (height in meters)

- Standard Contour (105, 100, 95)
- Master Contour
- Spot Height *167.3
- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



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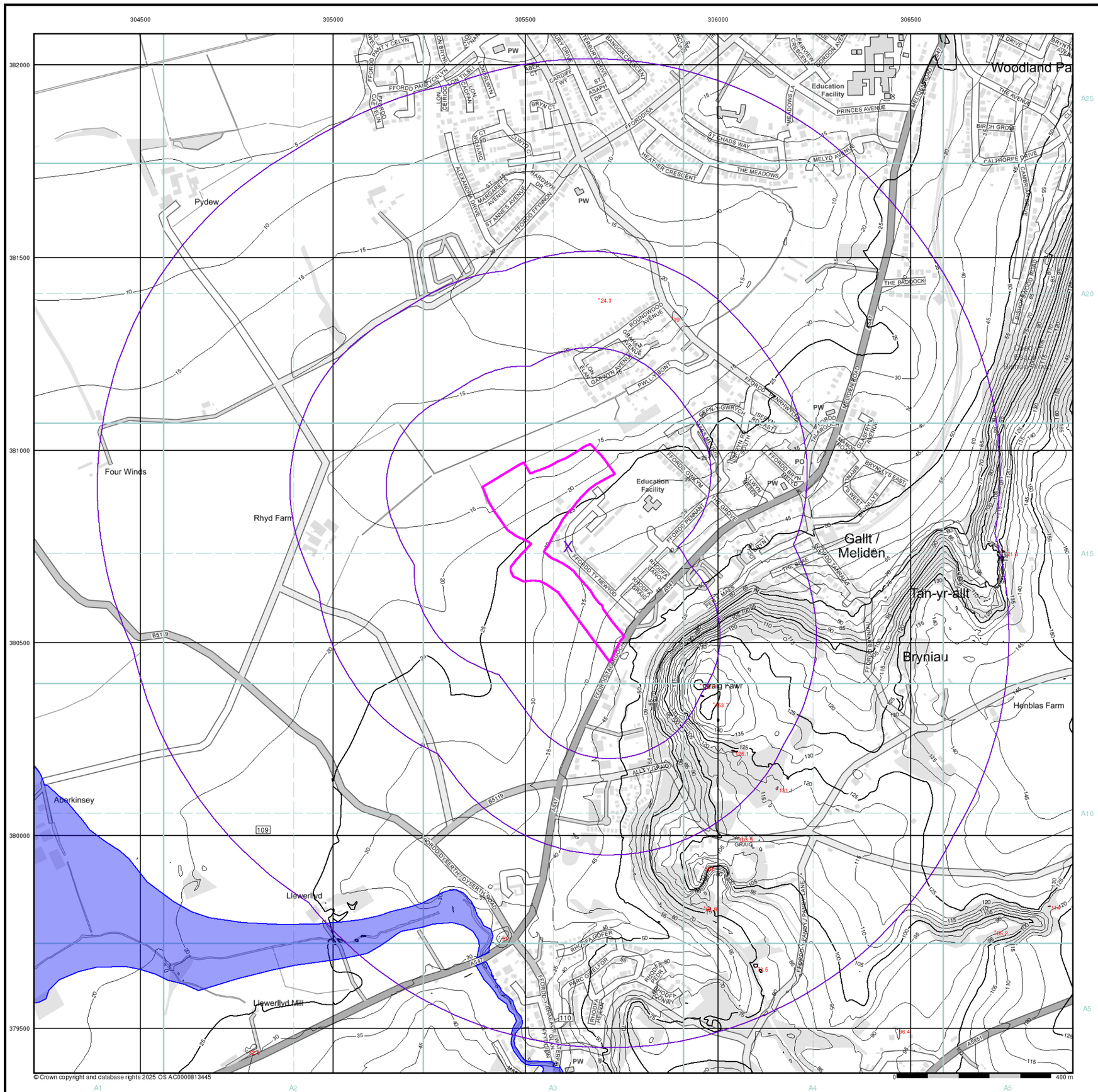

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LANDMARK INFORMATION GROUP®

EA/NRW Historic Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

Historic Flood Events Data

- Channel Capacity Exceeded (no raised defences)
- Channel Capacity Exceeded /Surface Water
- Groundwater/High Water Table
- Local Drainage/Surface Water
- Mechanical Failure
- Obstruction/Blockage - Bridge
- Obstruction/Blockage - Channel
- Historical Flood Liabilities
- Obstruction/Blockage - Culvert
- Obstruction/Blockage - Debris Screen
- Operational Failure/ Breach of Defence
- Other
- Overtopping of Defences
- Surface Water
- Unknown

Contours (height in metres)

Standard Contour 105 100 95

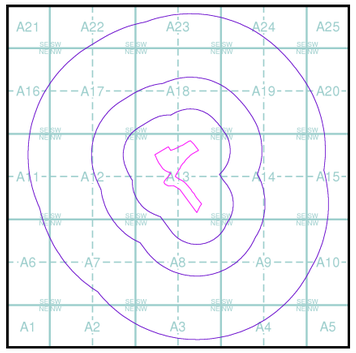
Master Contour

Spot Height *167.8

MLW Mean Low Water

MHW Mean High Water

EA/NRW Historic Flood Map - Slice A



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Slice:	A
Site Area (Ha):	7.14
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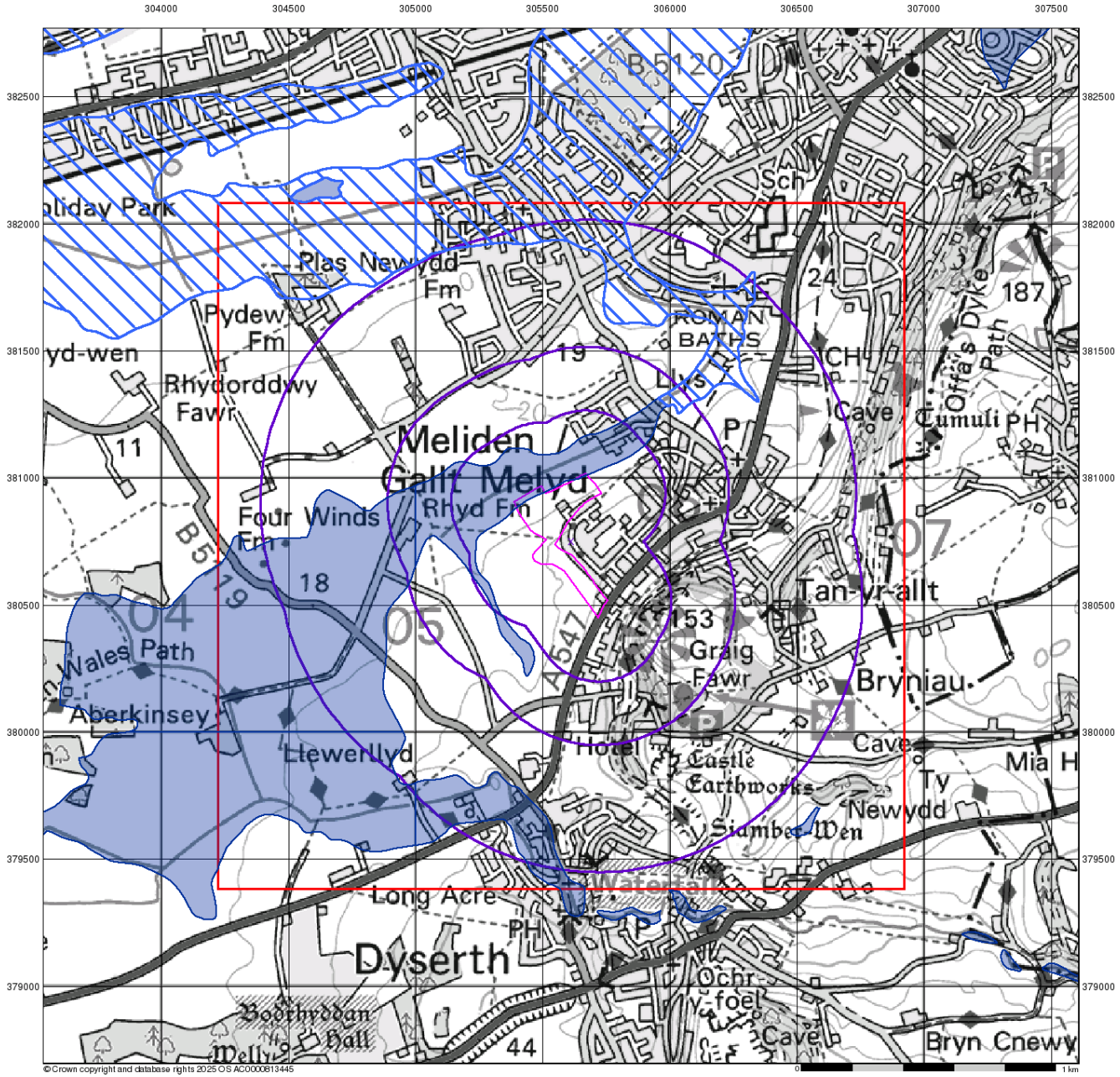

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BGS Flood Data (1:50,000)

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

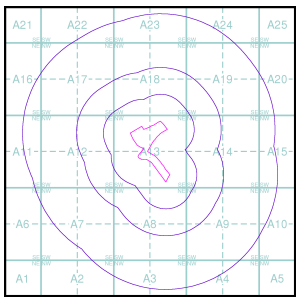
BGS Geological Indicators of Flooding

Coastal

Inland

Bodies of Water

BGS Flood Data Map - Slice A



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Customer Ref:	8658
National Grid Reference:	305610, 380750
Slice:	A
Site Area (Ha):	7.14
Search Buffer (m):	1000

Site Details

Mindale Farm, Ffordd Hendre, PRESTATYN, LL19 8PG

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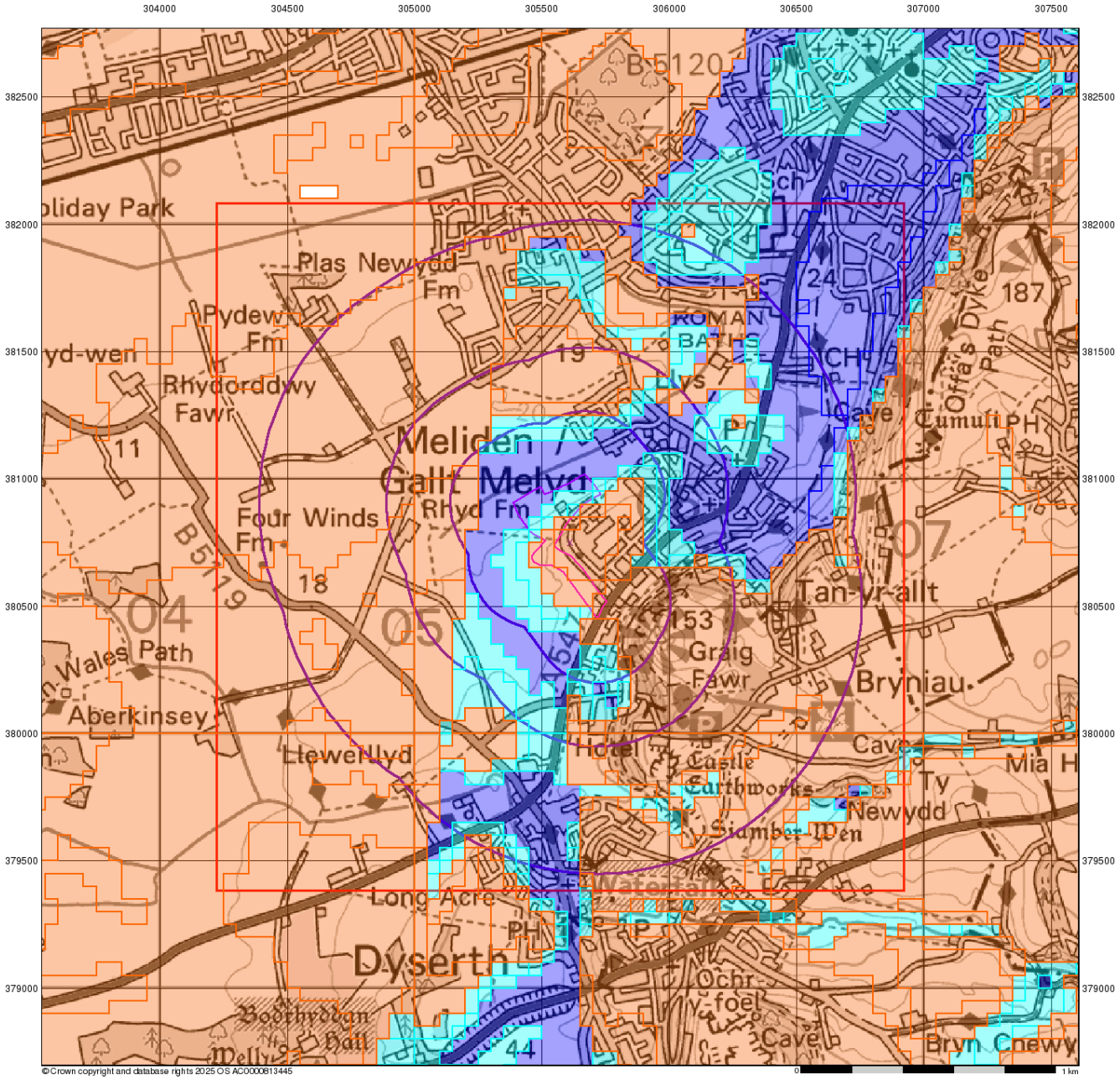

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LANDMARK INFORMATION GROUP®

BGS Flood Data (1:50,000)

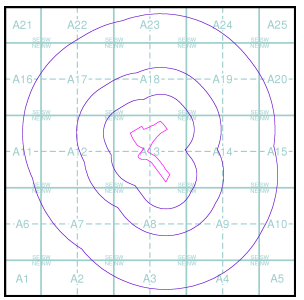
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

BGS Groundwater Flooding Susceptibility

- Potential for Groundwater Flooding to Occur at Surface
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Limited Potential for Groundwater Flooding to Occur

BGS Flood Data Map - Slice A



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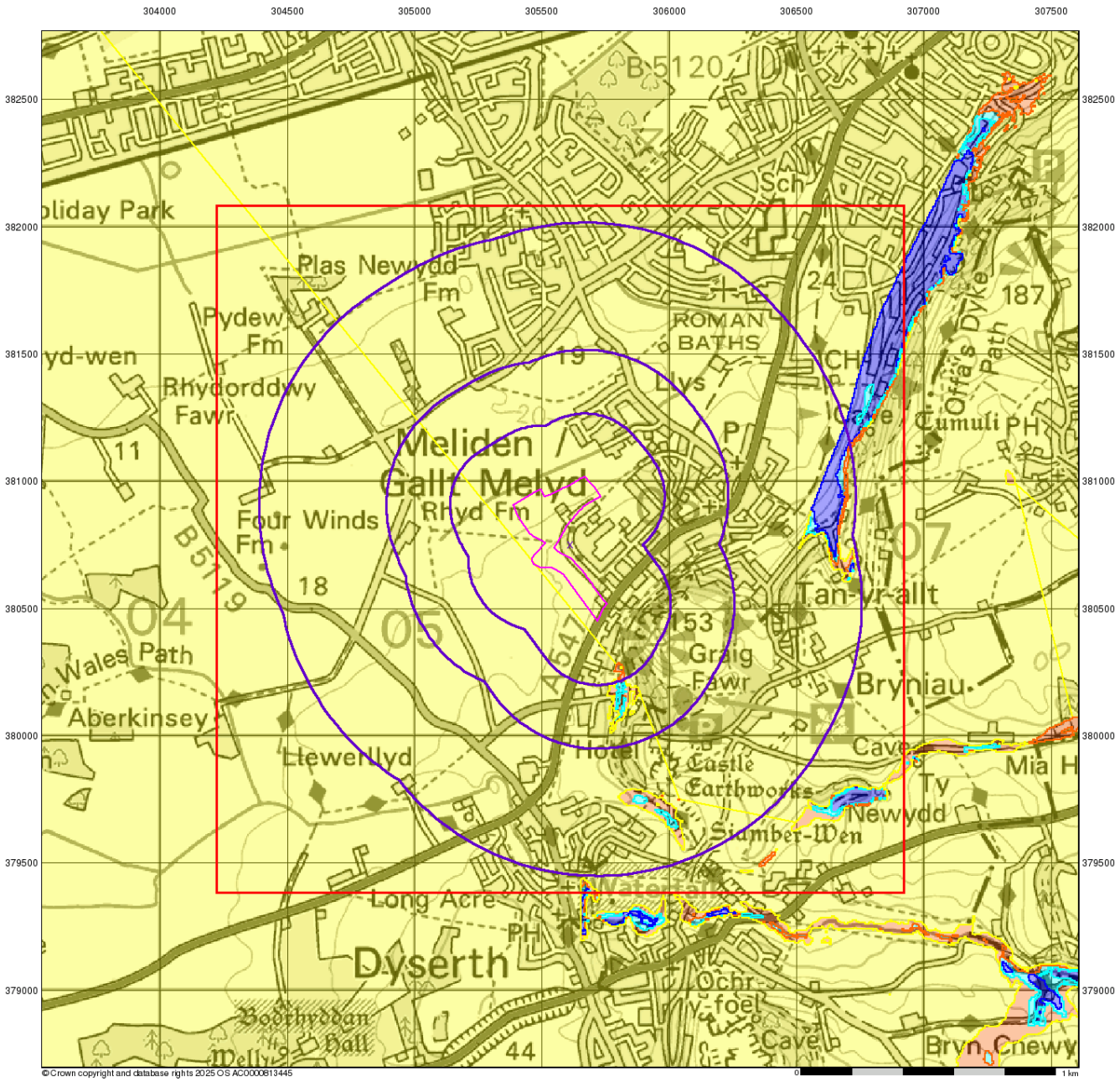

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GeoSmart Information Groundwater Flood Map (1:50,000)

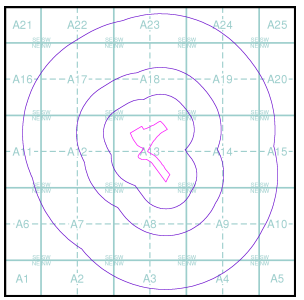
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice

GeoSmart Information Groundwater Flooding Risk

- High Risk
- Moderate Risk
- Low Risk
- Negligible Risk

GeoSmart Information Groundwater Flood Map - Slice A



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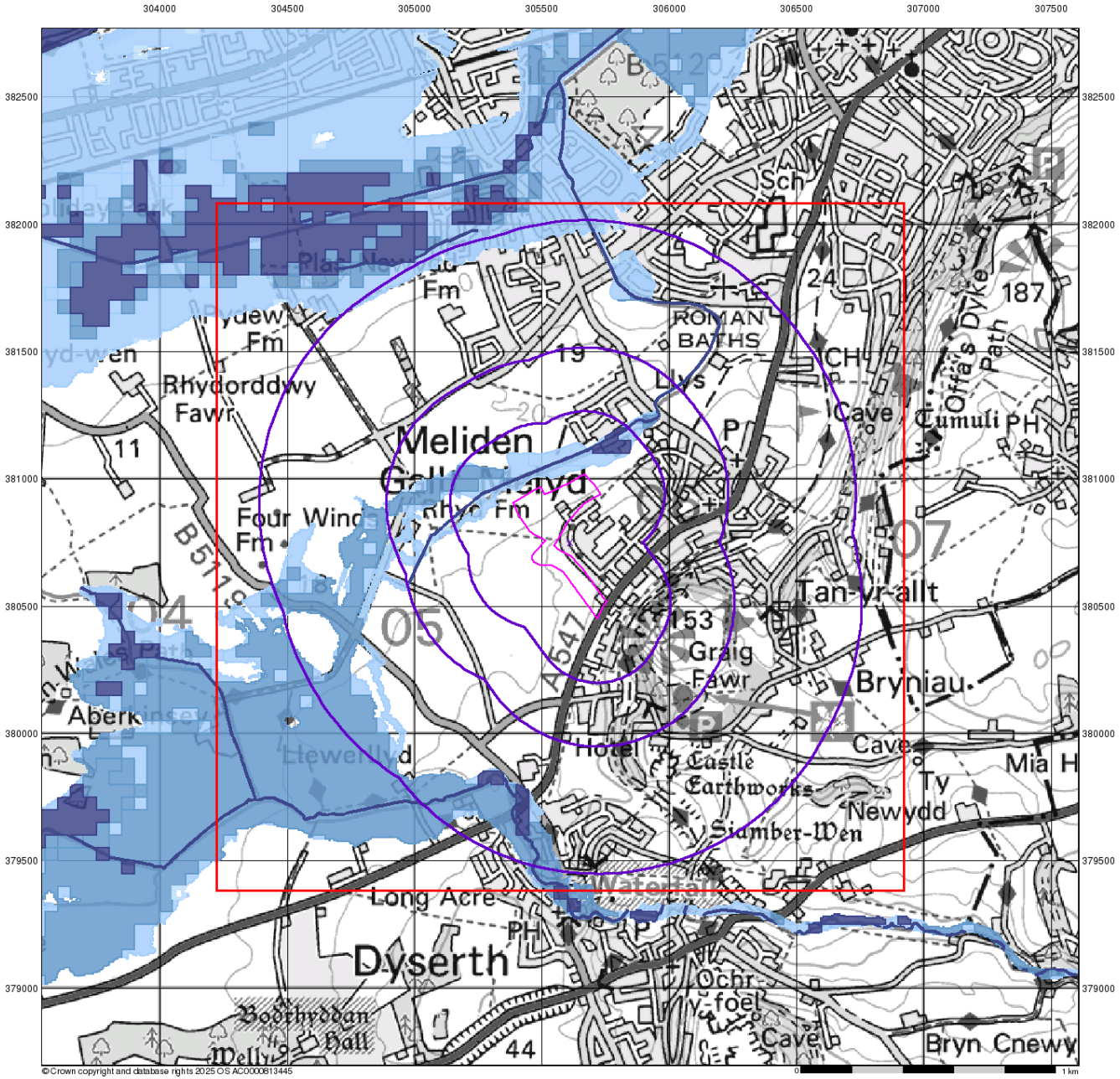

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EA/NRW RoFRS Data (1:50,000)

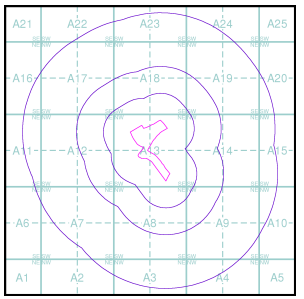
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

Risk of Flooding from Rivers and Sea (RoFRS)

- High Risk
- Medium Risk
- Low Risk
- Very Low Risk

EA/NRW RoFRS Data Map - Slice A



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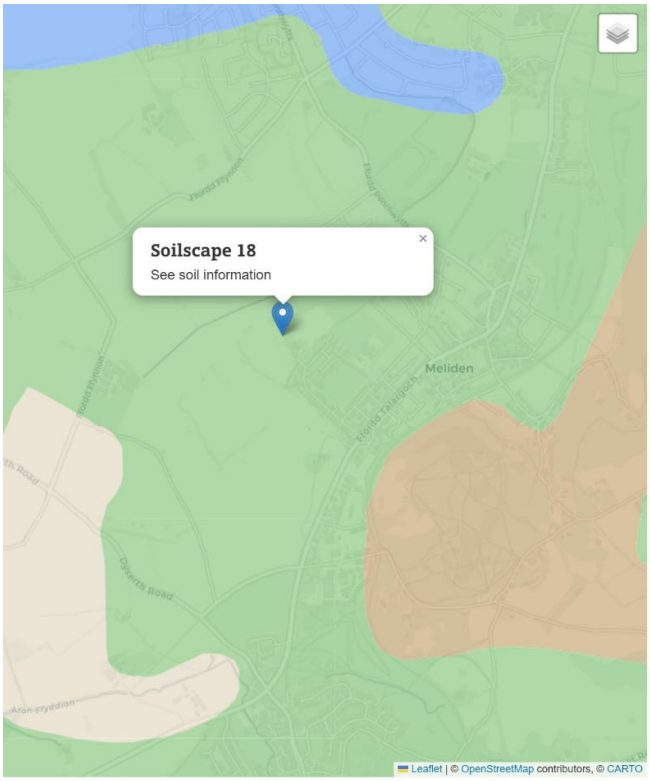
Appendix 3

Infiltration Consideration

Infiltration Testing Summary Report

Ref: ***E0861.PTR.R1*** *dated November 2016*



ld University and Sponsored by DEFRA Provide Feedback

Soil Information

Soilscape 18:

Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils

Texture:
Loamy and clayey

Coverage:
England: 19.9%,**Wales:** 2.4%,**England & Wales:**17.5%

Drainage:
Impeded drainage

Fertility:
Moderate

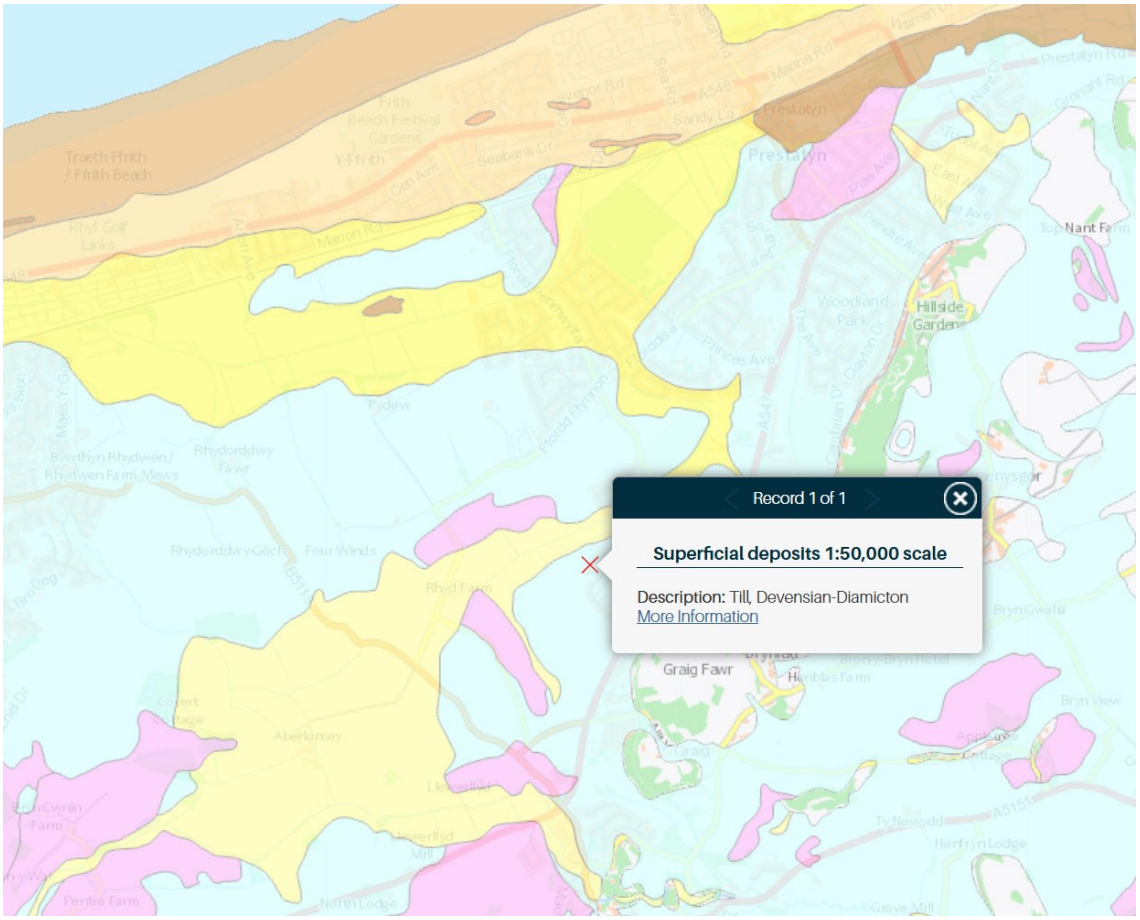
Landcover:
Grassland and arable some woodland

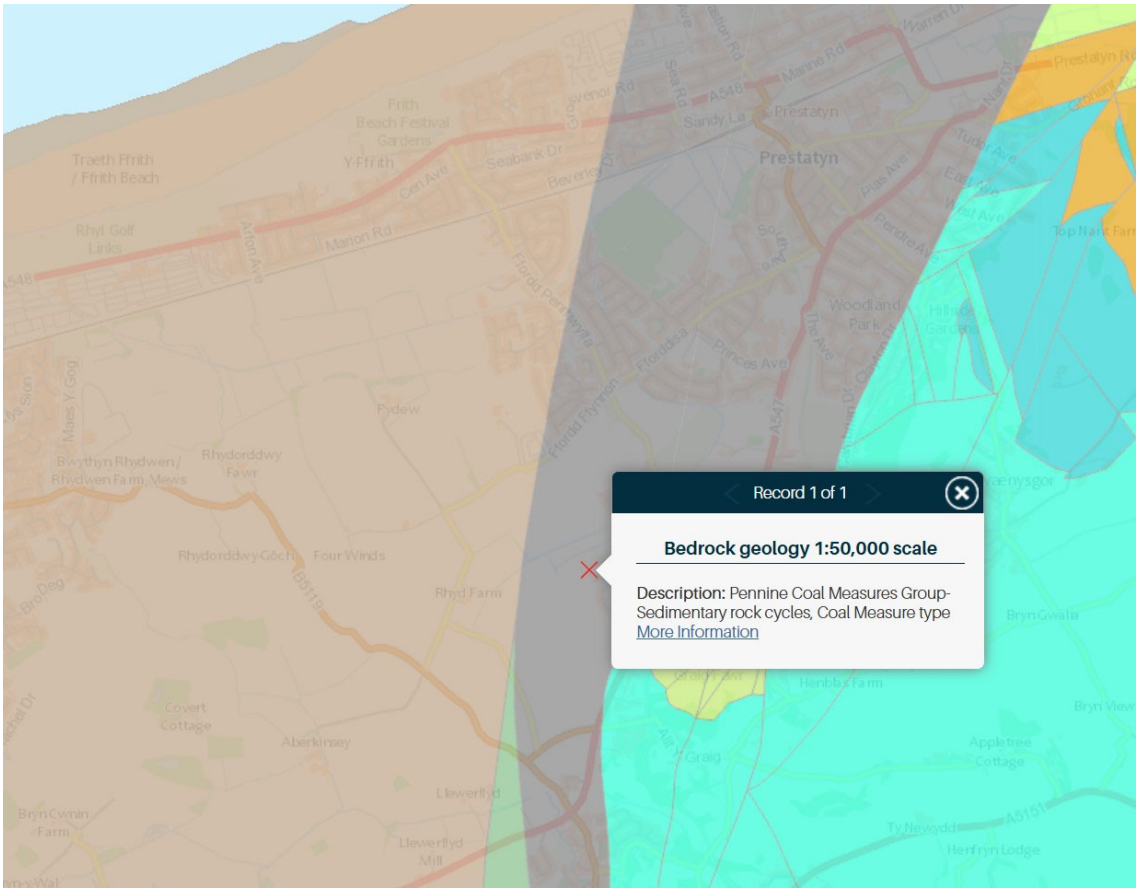
Habitats:
Seasonally wet pastures and woodlands

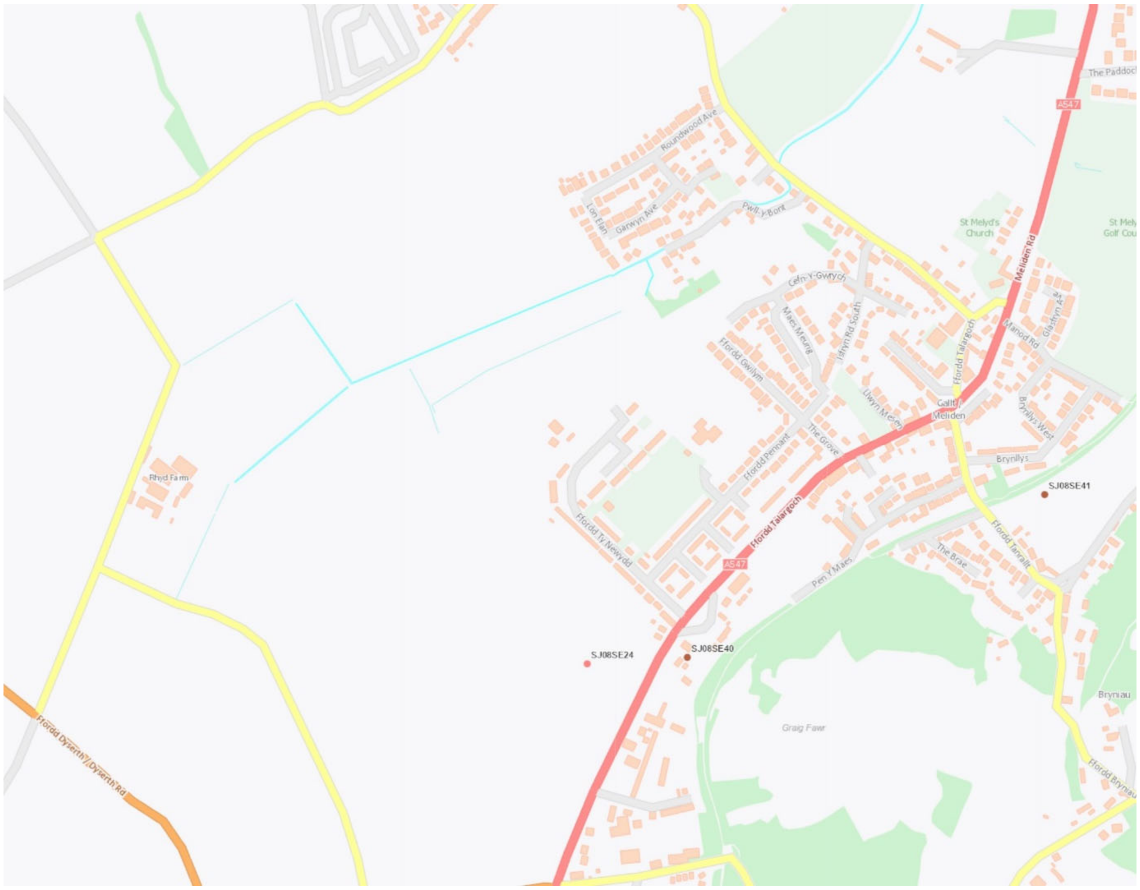
Carbon:
Low

Drains to:
Stream network

Water protection:
Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water


Record 1 of 1
Superficial deposits 1:50,000 scale
Description: Till, Devensian-Diamicton
More Information
Traeth Ffrith / Ffrith Beach
Prestatyn
Nant Farm
Hillside Gardens
Graig Fawr
Aberkinsey
Pentre Farm


Record 1 of 1
Bedrock geology 1:50,000 scale
Description: Pennine Coal Measures Group- Sedimentary rock cycles, Coal Measure type
More Information
Prestatyn
Rhyl Golf Links
Rhyd Farm
Four Winds
Aberkinsey
Llewerllyd
Llewerllyd Mill
Bryn Cwnin Farm
Covert Cottage
Henblas Farm
Appletree Cottage
Ty Newydd
Henfryn Lodge
Bryn Gwalia
Pydew
Rhydorddwy Fawr
Rhydorddwy-Goch
Woodland Park
Marion Rd
Princes Ave
Sandy La
Seabank Dr
Manne Rd
Sea Rd
A548
A547
A5151


Rhyd Farm
Roundwood Ave
Lon Elan
Garwyn Ave
Pwll-y-Bont
St Melyd's Church
Meliden Rd
A547
Cefn-Y-Gwrych
Ffordd Gwilym
Maes Meurig
Ffordd Talargoch
Gallt Meliden
Manod Rd
Brynllys West
Brynllys
SJ08SE41
Ffordd Pennant
The Grove
Ffordd Ty Newydd
A547
Ffordd Talargoch
Pen Y Maes
The Brae
SJ08SE24
SJ08SE40
Graig Fawr
Ffordd Dyserth / Dyserth Rd

SJ 08 SE / 24

SL c. 38 m

Walker's Shaft, Meliden — **Grid Ref: 0564 8049**

			Ft	in	Ft	in	
	Soil		(.45m) 1	6	1	6	(.45m)
	Marl and clay	+31.6	(6.40m) 21	0	22	6	(6.85m)
	Dry sand		(3.20m) 10	6	33	0	(10.05m)
QUATERNARY	Quick sand	+18.8	(9.14m) 30	0	63	0	(19.20m)
	Strong clay	+17.0	(1.82m) 6	0	69	0	(21.03m)
	Gravel	+9.69	(7.31m) 24	0	93	0	(28.34m)
	Gravelly clay, with water	+0.55	(9.14m) 30	0	123	0	(37.49m)
	Sand and gravel		(10.97m) 36	0	159	0	(48.46m)
	Gravel, containing bones	−14.12	(3.65m) 12	0	171	0	(52.12m)
CARBONIFEROUS LIMESTONE	Hard blue limestone		(15.54m) 51	0	222	0	(67.66m)
	Shale		(51.20m) 168	0	390	0	(118.87m)
	White limestone		(115.21m) 378	0	768	0	(234.08m)

(From Rhyl memoir O.S. 79 N.W. pp. 22 and 29)

7_1.TIF

95/28 SJ08/7

SJ08/7

WELSH NATIONAL WATER DEVELOPMENT AUTHORITY

DEE AND CLWYD RIVER DIVISION

DETAILED HYDROGEOLOGICAL RECORD SHEET: INDIVIDUAL SITE RECORD

NAME Talargoch Mine, Walker's Shaft. N.G.R. 055 804 SJ08 SE/24

DYSERTH, FLINTSHIRE

EXACT SITE KNOWN YES/~~NO~~ LOCATION SKETCH ~~YES~~/NO

HEIGHT A.O.D. .....29..... METRES ESTIMATED FROM MAP/~~SURVEY~~

REFERENCE POINT NONE/~~DETAILS~~/~~SKETCH~~

LOG YES/~~NO~~ LOCATION OF LOG ~~HERE~~/I.~~G~~.S./ROWLANDS 83

SUMMARY OF LOG

Drift to 181
Carb lst 232
Shale 407
carb lst 477 8

Rockhead -27·23m AOD.

WATER QUALITY INFORMATION ~~YES~~/NO

WATER LEVEL INFORMATION

ABSTRACTION YES/NO/OCCASIONALLY/NOT KNOWN/STAND-BY

LICENCE NO. LICENSED ABSTRACTION /HOUR /DAY /YEAR

PUMPING TEST ~~YES~~/NO DATE

LOCATION OF DATA

WATER LEVELS RECORDED NONE/~~ISOLATED~~ READINGS/~~MONTHLY~~/~~AUTOGRAPHIC~~

LOCATION OF RECORDS

ACCESS

Appendix 4

Correspondence

Dwr Cymru Welsh Water

Flintshire County Council

Natural Resources Wales

Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

Tel: +44 (0)800 917 2652
Fax: +44 (0)2920 740472
E.mail: developer.services@dwrcymru.com

Gwasanaethau Datblygu
Blwch Post 3146
Caerdydd
CF30 0EH

Ffôn: +44 (0)800 917 2652
Ffacs: +44 (0)2920 740472
E.bost: developer.services@dwrcymru.com

Mr Mark Fitzsimons
Castle green Homes
Bridgemere House
Chester Road
Preston Brook
Halton
WA7 3BD

Date: 04/06/2024
Our Ref: PPA0008743

Dear Mr Fitzsimons,

Grid Ref: 305562 380892
Site Address: Mindale House, Ffordd Hendre,Prestatyn
Development: Residential 150 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.

Firstly, we note that the proposal relates to 150 dwellings at Mindale Farm and acknowledge that the site is allocated in the Denbighshire Local Development Plan (LDP) for 156 units. In reference to our representations during the LDP consultation process, namely the 'Statement of Common Ground', we can confirm that an assessment has been undertaken of the public sewerage and watermains systems to accommodate 150 units and informs our appraisal as follows.

Public Sewerage Network

The proposed development site is located in the immediate vicinity of a separate sewerage system, comprising combined, foul and surface water public sewers, which drains to Llanasa Wastewater Treatment Works (WwTW) via Marine Park Sewerage Pumping Station (SPS).

Asset Protection

This site is crossed by a public sewers and watermains with their approximate position being marked on the attached Statutory Public Sewer 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. However, having regard to the proposed site plan (drawing number: PL01.006 Rev J), it appears the proposed development would be situated within the protection zone of the public sewers measured 3 metres either side of the centreline and the public watermain measured 4 metres either side of the centre line.

Our strong recommendation is that your site layout is amended to take 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. Alternatively, it may be possible to divert the sewer or watermain if the developer applies under Section 185 of the Water Industry Act and we request that you contact us to discuss and consider possible solutions.

In the first instance, it is recommended that the developer carry out a survey to ascertain the location of this sewer and establish its relationship to the proposed development. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

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 which states that discharge to a combined sewer shall only be made as a last resort. Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to a surface water drainage body in liaison with the Land Drainage Authority and/or Natural Resources Wales.

It is therefore recommended that the developer consult with Denbighshire Council, as the determining SuDS Approval Body (SAB), in relation to their proposals for SuDS features. 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.

In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

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 combined sewer between manholes SJ05806901 and SJ05807902 located within 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.

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.

Foul Water Drainage – Sewage Treatment

Please note that the Natural Resources Wales have recently released Planning Advice relating to increased phosphate levels in several river Special Areas of Conservation (SAC). Applications for new development in these areas need to consider the requirements set out in the planning advice and should form part of the local planning authority's decision making when determining planning applications. The flows from this development would eventually drain to our Llanasa Wastewater Treatment Works which does not have a phosphate consent. Notwithstanding this no problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

Water Supply

Capacity is currently available in the water supply system to accommodate the development. 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**

Please quote our reference number in all communications and correspondence.

Yours faithfully,

Owain George
Planning Liaison Manager
Developer Services

<u>Please Note</u> 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.

ENC. SEWER PLAN
WATER PLAN
PRE PLANNING NOTES

Andy Jones

From: Environmental Information Requests <EnvironmentalInformationRequests@dwrcymru.com>
Sent: 30 October 2025 16:28
To: Andy Jones
Subject: EIR/2461/2025 Response

Our Reference: EIR/2461/2025

Dear Andy Jones

Request for information
We write further to your request for information dated 3rd October 2025, which we have been considering under the Environmental Information Regulations 2004 (EIR).

We can confirm that Dŵr Cymru Welsh Water does hold the information you have requested as follows:

8658 Mindale Fram, Meliden, Denbighshire
SJ055809
X=305600, Y=380900
We are undertaking a Flood Consequences Assessment and Drainage Strategy for the above site and request

1. any information you may have in relation to historical flooding

We have reviewed our flooding database for all postcodes in the area on the map you provided and confirm we have no history or incidents of flooding in the area.

2. any information you may consider relevant to assist with the production of the FCA report.

As we have no history or incidents of flooding in the area, we therefore also have no information to contribute to a Flood Consequences Assessment. Therefore, this information is not held by Dŵr Cymru Welsh Water and Regulation 12(4)(a) of the EIR applies where information is not held. Unfortunately, on this occasion we are unable to identify any other public authority from whom you may be able to request this information under the EIR.

We hope that this response is clear. Should you have any questions, you can contact us by email at EnvironmentalInformationRequests@dwrcymru.com.

If you are dissatisfied with the handling of your request, you have the right to ask for an internal review. Internal review requests should be submitted within 40 working days of the date of receipt of this response and should be addressed to Company Secretary, Linea, Fortran Road, St Mellons, Cardiff CF3 0LT.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision.

Yours faithfully,
Dŵr Cymru Welsh Water

Andy Jones

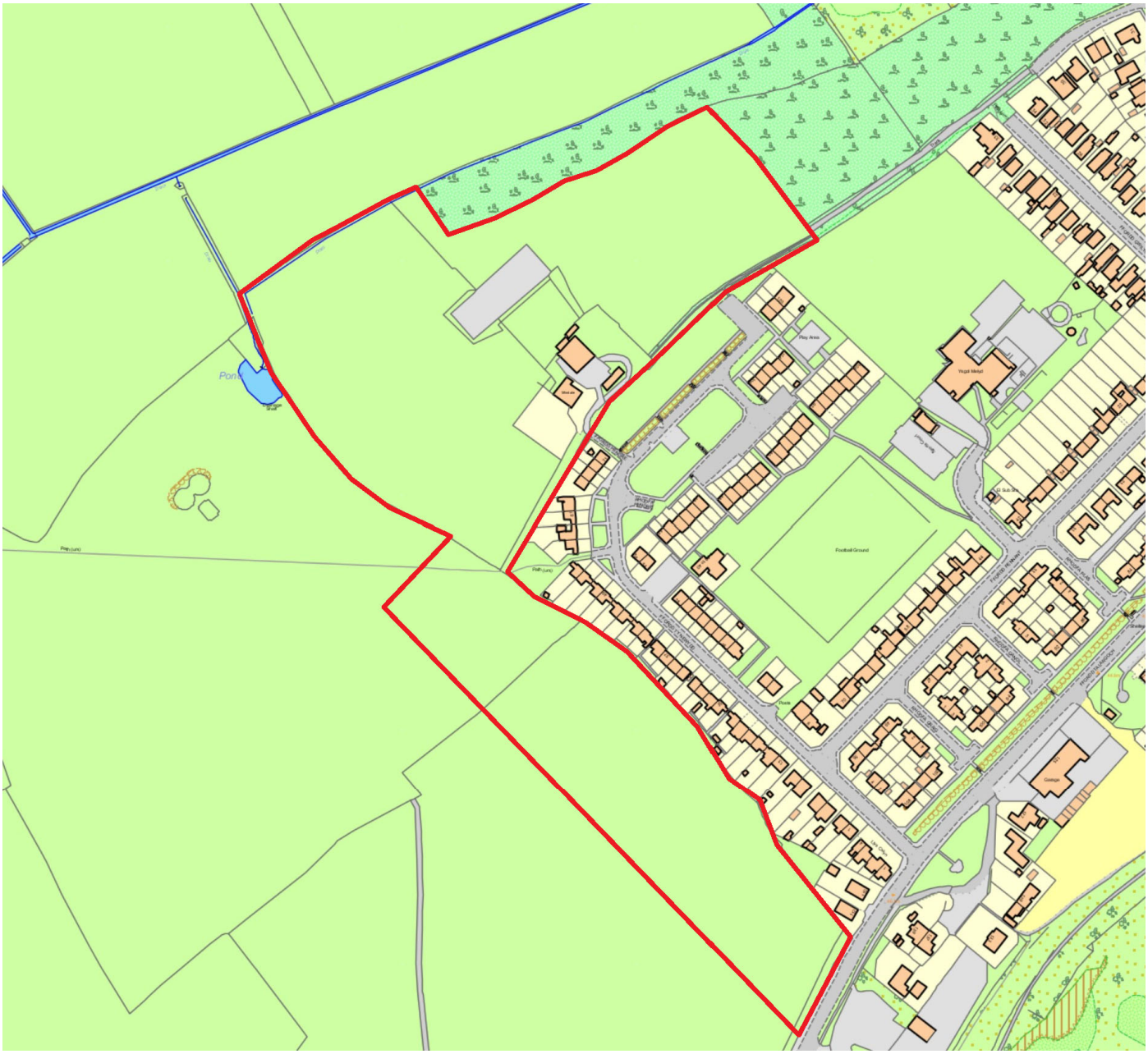
From: Andy Jones
Sent: 03 October 2025 13:08
To: Land Drainage Consultations
Cc: Ryan Moore
Subject: FCA Historical Flood Information

8658 Mindale Fram, Meliden, Denbighshire
SJ055809
X=305600, Y=380900

FCA Historical Flood Information

To whom it may concern

We are undertaking a Flood Consequences Assessment and Drainage Strategy for the above site (see below Site Location Plan) and request any information you may have in relation to historical flooding or any information you may consider relevant to assist with the production of the FCA report.



Please let me know if you require any further information or please contact me on the details below should you want to discuss further.

Regards

Andy Jones

Senior Infrastructure Engineer

COOPERS

Park House, Sandpiper Court, Chester Business Park, Chester, CH4 9QU

Andy Jones

From: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Sent: 04 November 2025 15:35
To: Andy Jones
Subject: RE: ATI-29053a - P5 P6 8658 Mindale Fram, Meliden, Denbighshire
Attachments: ATI-29053a licence.pdf

Dear Andy,

Thank you for returning the completed Section 3 Agreement to me.

Please now find attached completed licence and relevant links below:

RhylPrestatyn_5_V1.1_2020 - https://cyfoethnaturiolcymru.sharefile.eu/d-sc7195b6d2abd42d9bb08566ff8e752d9

The flood model report is authorised for re-use with the attached licence and for the raw flood product data, please re-use with the licence below:

Please find a link to our Open Government Licence (OGL) here
- http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/
Please also include the attribution statement: “Contains Natural Resources Wales information © Natural Resources Wales and database right. All rights reserved.”

I trust this information is of use to you.

Kind regards

Garin Fitter
Teitl swydd / Job title Data Licensing Officer
Adran / Department Customer, Communications and Commercial
Dyddiau gweithio (os yn berthnasol) / Working days Mon-Fri
Yn Ardystiedig o ran Llythrennedd Carbon/Certified Carbon Literate

Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi.
Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay.

From: Andy Jones <ajones@coopers.co.uk>
Sent: 03 November 2025 16:53

To: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Subject: RE: ATI-29053a - P5 P6 8658 Mindale Fram, Meliden, Denbighshire

Please see attached signed licence agreement.

Regards

Andy Jones
Principal Infrastructure Engineer
COOPERS
Park House, Sandpiper Court, Chester Business Park, Chester, CH4 9QU

☎: (01244) 684910 ☎: Direct Dial No. (01244) 684933
🖷: (01244) 684911
✉: ajones@coopers.co.uk
Web: http://www.coopers.co.uk

From: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Sent: 03 November 2025 16:47
To: Andy Jones <ajones@coopers.co.uk>
Subject: ATI-29053a - P5 P6 8658 Mindale Fram, Meliden, Denbighshire

Dear Andy

Further to your recent email, please note that as all flood model reports, (old Product 5); contain flood flow estimates data, there is a licensing requirement to cover the re-use.

Therefore, please find attached a draft licence for this. Once happy, please sign the Section 3 Agreement, by means of a scanned signature, and return to me, I can then finalise your licence and send the report and raw flood model output data to you.

Kind regards

Garin Fitter
Teitl swydd / Job title Data Licensing Officer
Adran / Department Customer, Communications and Commercial
Dyddiau gweithio (os yn berthnasol) / Working days Mon-Fri
Yn Ardystiedig o ran Llythrennedd Carbon/Certified Carbon Literate

Croesewir gohebiaeth yn Gymraeg a byddwn yn ymateb yn Gymraeg, heb i hynny arwain at oedi.
Correspondence in Welsh is welcomed, and we will respond in Welsh without it leading to a delay.

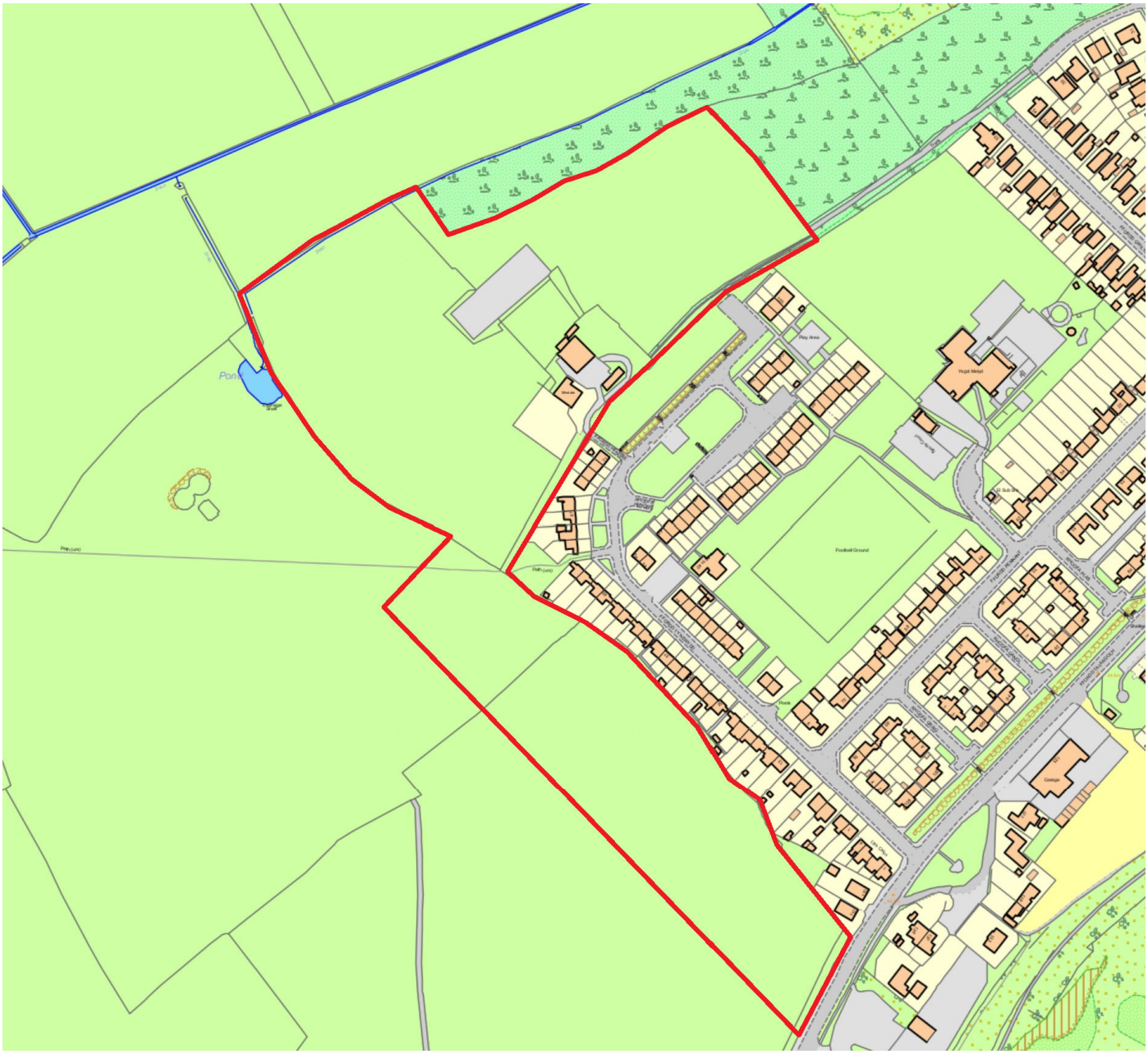
From: Andy Jones <ajones@coopers.co.uk>
Sent: 03 October 2025 13:06
To: Data Distribution <datadistribution@cyfoethnaturiolcymru.gov.uk>
Subject: FCA Historical Flood Information

8658 Mindale Fram, Meliden, Denbighshire
SJ055809
X=305600, Y=380900

FCA Historical Flood Information

To whom it may concern

We are undertaking a Flood Consequences Assessment and Drainage Strategy for the above site (see below Site Location Plan) and request any information you may have in relation to historical flooding or any information you may consider relevant to assist with the production of the FCA report.



Please let me know if you require any further information or please contact me on the details below should you want to discuss further.

Regards

Andy Jones

Senior Infrastructure Engineer

COOPERS

Park House, Sandpiper Court, Chester Business Park, Chester, CH4 9QU

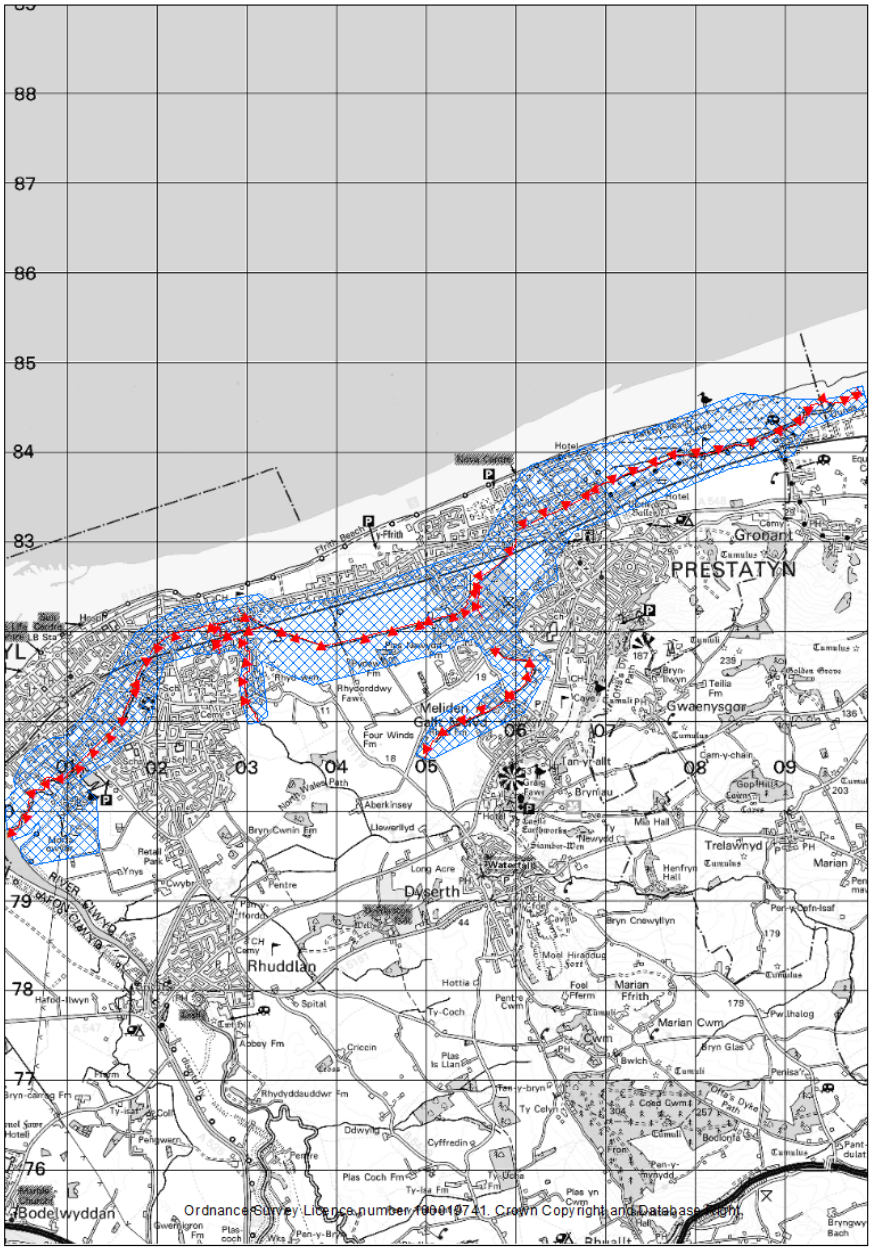
Cyfoeth Naturiol Cymru
Natural Resources Wales

Hydraulic Model Summary Sheet for RhylPrestatyn_5_V1.1_2020

The information provided below represents an accurate summary of the modelling details at the time of issue. NRW are not responsible for any use of this information other than its intended use.

Model Uncertainty	
Known areas of uncertainty/ model limitations	Various survey dates, most recent is from 2019. Various DTM dates - LiDAR used was flown between March 2006 and March 2011.
Important Notes/ Disclaimers	All information supplied by NRW **needs to be verified** by the recipient PRIOR to using in a Flood Consequences Assessment (FCA) or modelling study. We would expect to see a review of hydrology, in-channel survey, floodplain topography including Digital Elevation Model (DEM), OS MasterMap™ etc. to demonstrate the data is suitable for its intended use. There is a likelihood additional rainfall data has been collected, since the study was undertaken, which may impact flow estimations. This should be considered when reviewing the hydrology. Hydraulic model software improvements may impact outputs, updated software and new methodologies maybe be available and should be utilised if appropriate. Climate change allowances applied within the model will need to be reviewed carefully to ensure compliance with the latest Welsh Government climate change allowances and flood consequence assessments. Extreme Sea Level information around the Welsh Coastline must be reviewed prior to the study being undertaken to ensure it is still appropriate and up to date ensuring it meets the latest guidance. Please note that the 'defended return periods' could consist of formal and/or informal defences/defacto walls. Please read report for further information. **It is the sole responsibility of the user of the data to ensure it is fit for purpose for the intended end use.**

Model Summary	
Model Ref.	RhylPrestatyn_5_V1.1_2020
Study completed in	2020

Watercourse(s)	Rhyl Cut, Prestatyn Gutter etc. Please note this may not be the complete list of watercourses modelled in this study.
Extent	 Model Extent (blue crosshatch), Model Centre-Line (Red triangles, where shown, indicate the extent of the river channel and/or the tidal boundary that was modelled).
Model type	1D-2D

Modelling software used	FM-Tuflow
Return periods	Q30, Q30CC, Q100, Q100CC, Q1000, Q1000CC
Model Details	
Reason for study	To re-run the original RhylPrestatyn_5_V1.0_2019 model to gain extra return periods for inclusion into FRAW
Version changes **(if applicable)**	Removal of superfluous commands and changes to parameters to enable model to run.
Hydrology date	2018
Survey date	2019
DTM date	2011
Any model calibration carried out?	Partial
Breach runs carried out?	No
Blockage runs carried out	No
Structure failure runs carried out?	No

Appendix 5

Calculations

Source Control Greenfield Run-off Calculation

Surface Water Design - MicroDrainage Calculations

Greenfield runoff rate estimation tool

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

hr wallingford

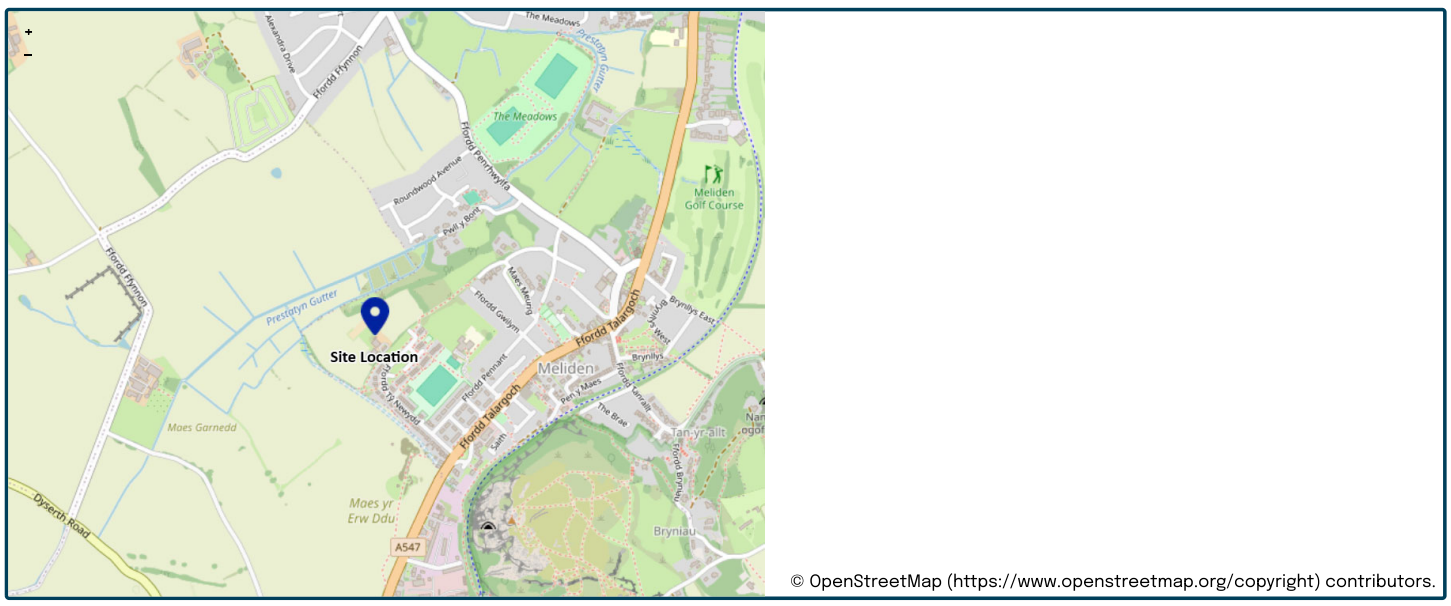
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). 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	03/12/2025
Calculated by	
Reference	
Model version	2.2.2

Location

Site name	Mindale Farm
Site location	Meliden



© OpenStreetMap (https://www.openstreetmap.org/copyright) contributors.

Site easting (British National Grid)	305585
Site northing (British National Grid)	380845

Site details

Total site area (ha)	4.12 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value	Map value
SAAR (mm)	722 mm	722
How should SPR be derived?	WRAP soil type	
WRAP soil type	3	2
SPR	0.37	
QBar (IH124) (l/s)	12.3 l/s	

Growth curve factors

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

Results

Method	IH124
Flow rate 1 year (l/s)	10.8 l/s
Flow rate 2 year (l/s)	11.4 l/s
Flow rate 10 years (l/s)	17.4 l/s
Flow rate 30 years (l/s)	21.8 l/s
Flow rate 100 years (l/s)	26.8 l/s
Flow rate 200 years (l/s)	30.2 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

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	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)	17.200	Minimum Backdrop Height (m)	0.200
Ratio-R	0.366	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
1	0.100	5.00	43.617	1500	305722.177	380525.301	1.350	42.267
2	0.038	5.00	37.454	1500	305667.166	380575.117	2.025	35.429
3	0.043	5.00	34.871	1500	305654.028	380618.549	1.425	33.446
4	0.041	5.00	34.243	1500	305623.447	380658.540	1.425	32.818
5	0.037	5.00	33.100	1500	305581.160	380681.974	1.425	31.675
6	0.012	5.00	30.265	1500	305538.195	380686.978	1.580	28.685
7	0.008	5.00	29.285	1500	305524.672	380691.291	1.557	27.728
8	0.000		28.739	1500	305517.035	380697.892	1.425	27.314
9	0.000		28.998		305526.453	380707.835	1.996	27.002
10	0.000	5.00	28.761		305525.453	380725.417	1.761	27.000
11	0.056	5.00	27.866	1500	305516.153	380734.486	1.425	26.441
12	0.087	5.00	26.544	1500	305528.078	380766.633	1.350	25.194
13	0.021	5.00	26.199	1500	305517.706	380760.731	1.428	24.771
14	0.018	5.00	24.802	1500	305505.762	380772.506	1.446	23.356
15	0.076	5.00	23.033	1500	305487.581	380783.232	1.425	21.608
16	0.013	5.00	21.886	1500	305476.580	380791.797	1.525	20.361
17	0.010	5.00	20.878	1500	305467.996	380800.566	1.625	19.253
18	0.101	5.00	20.019	1500	305461.474	380808.676	1.725	18.294
19	0.142	5.00	15.711	1500	305420.676	380864.906	1.837	13.874
20	0.007	5.00	15.085	1800	305409.065	380887.316	1.695	13.390
21	0.000		15.100		305421.075	380902.076	1.843	13.257
22	0.116	5.00	19.265	1500	305679.275	380947.093	1.425	17.840
23	0.089	5.00	21.939	1500	305606.679	380880.138	1.350	20.589
24	0.096	5.00	20.746	1500	305612.510	380902.218	1.425	19.321
25	0.023	5.00	21.175	1500	305620.905	380894.617	1.929	19.246
26	0.131	5.00	20.163	1500	305635.918	380910.993	1.500	18.663
27	0.098	5.00	19.539	1500	305661.781	380933.944	1.903	17.636
28	0.059	5.00	15.760	1500	305639.788	380984.652	1.800	13.960
29	0.068	5.00	15.877	1500	305628.924	380977.413	1.950	13.927
30	0.025	5.00	16.000	1500	305605.973	380964.757	2.139	13.861
31	0.143	5.00	15.750	1500	305546.134	380937.710	2.053	13.697
32	0.098	5.00	25.242	1500	305552.046	380807.242	1.350	23.892
33	0.156	5.00	23.751	1500	305566.708	380833.235	1.650	22.101
34	0.133	5.00	22.652	1500	305581.626	380854.084	1.752	20.900
35	0.123	5.00	18.511	1500	305499.494	380851.665	1.425	17.086
36	0.078	5.00	18.333	1500	305519.888	380867.936	1.425	16.908
37	0.124	5.00	18.687	1500	305537.775	380888.526	3.107	15.580
38	0.013	5.00	17.127	1500	305524.472	380902.325	2.477	14.650
39	0.100	5.00	16.121	1800	305515.021	380915.605	2.121	14.000
40	0.009	5.00	15.515	1800	305510.450	380926.628	1.911	13.604
41	0.000		15.450	1800	305489.283	380919.779	1.902	13.548

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
42	0.080	5.00	15.400	1800	305455.764	380897.063	2.028	13.372
43	0.000		15.100		305450.340	380907.649	1.843	13.257
44	0.000	5.00	15.100		305468.068	380933.709	1.900	13.200
45	0.000		15.100	1800	305470.858	380939.620	1.916	13.184
46			13.400	1200	305473.370	380957.540	0.400	13.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	74.215	0.600	42.267	35.504	6.763	11.0	150	5.40	50.0
1.001	2	3	45.376	0.600	35.429	33.446	1.983	22.9	225	5.68	50.0
1.002	3	4	50.344	0.600	33.446	32.818	0.628	80.2	225	6.25	50.0
1.003	4	5	48.346	0.600	32.818	31.675	1.143	42.3	225	6.65	50.0
1.004	5	6	43.255	0.600	31.675	28.685	2.990	14.5	225	6.86	50.0
1.005	6	7	14.194	0.600	28.685	27.728	0.957	14.8	225	6.93	50.0
1.006	7	8	10.094	0.600	27.728	27.314	0.414	24.4	225	6.99	50.0
1.007	8	9	13.695	0.600	27.314	27.233	0.081	169.1	225	7.22	50.0
2.000	10	11	12.990	0.600	27.000	26.441	0.559	23.2	225	5.08	50.0
2.001	11	13	26.291	0.600	26.441	24.774	1.667	15.8	225	5.21	50.0
3.000	12	13	11.934	0.600	25.194	24.846	0.348	34.3	150	5.12	50.0
2.002	13	14	16.772	0.600	24.771	23.356	1.416	11.8	225	5.28	50.0
2.003	14	15	21.109	0.600	23.356	21.608	1.748	12.1	225	5.38	50.0
2.004	15	16	13.942	0.600	21.608	20.361	1.247	11.2	225	5.44	50.0
2.005	16	17	12.271	0.600	20.361	19.253	1.108	11.1	225	5.49	50.0
2.006	17	18	10.407	0.600	19.253	18.294	0.959	10.9	225	5.53	50.0
2.007	18	19	69.472	0.600	18.294	13.949	4.345	16.0	225	5.88	50.0
2.008	19	20	25.239	0.600	13.874	13.540	0.334	75.6	300	6.12	50.0
2.009	20	21	19.029	0.600	13.390	13.342	0.048	396.4	450	6.43	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	3.058	54.0	13.6	1.200	1.800	0.100	0.0	51	2.556
1.001	2.747	109.2	18.7	1.800	1.200	0.138	0.0	63	2.068
1.002	1.461	58.1	24.5	1.200	1.200	0.181	0.0	102	1.399
1.003	2.017	80.2	30.1	1.200	1.200	0.222	0.0	95	1.876
1.004	3.458	137.5	35.1	1.200	1.355	0.259	0.0	77	2.897
1.005	3.414	135.7	36.7	1.355	1.332	0.271	0.0	80	2.910
1.006	2.660	105.8	37.8	1.332	1.200	0.279	0.0	93	2.443
1.007	1.002	39.9	37.8	1.200	1.540	0.279	0.0	175	1.136
2.000	2.725	108.4	0.0	1.536	1.200	0.000	0.0	0	0.000
2.001	3.311	131.6	7.6	1.200	1.200	0.056	0.0	36	1.820
3.000	1.723	30.5	11.8	1.200	1.203	0.087	0.0	65	1.615
2.002	3.822	152.0	22.2	1.203	1.221	0.164	0.0	58	2.743
2.003	3.785	150.5	24.7	1.221	1.200	0.182	0.0	61	2.807
2.004	3.935	156.5	35.0	1.200	1.300	0.258	0.0	72	3.178
2.005	3.954	157.2	36.7	1.300	1.400	0.271	0.0	73	3.234
2.006	3.994	158.8	38.1	1.400	1.500	0.281	0.0	75	3.307
2.007	3.288	130.7	51.8	1.500	1.537	0.382	0.0	98	3.098
2.008	1.810	128.0	71.0	1.537	1.245	0.524	0.0	160	1.855
2.009	1.015	161.4	72.0	1.245	1.308	0.531	0.0	210	0.987

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
4.000	22	27	21.885	0.600	17.840	17.711	0.129	170.0	225	5.36	50.0
5.000	23	25	20.298	0.600	20.589	19.321	1.268	16.0	150	5.13	50.0
6.000	24	25	11.325	0.600	19.321	19.246	0.075	150.0	225	5.18	50.0
5.001	25	26	22.216	0.600	19.246	18.738	0.508	43.7	225	5.36	50.0
5.002	26	27	34.578	0.600	18.663	17.636	1.027	33.7	300	5.58	50.0
4.001	27	29	54.490	0.600	17.636	14.227	3.409	16.0	300	5.81	50.0
7.000	28	29	13.055	0.600	13.960	13.927	0.033	400.0	600	5.18	50.0
4.002	29	30	26.209	0.600	13.927	13.861	0.066	397.1	600	6.17	50.0
4.003	30	31	65.668	0.600	13.861	13.697	0.164	400.4	600	7.07	50.0
4.004	31	40	37.365	0.600	13.697	13.604	0.093	401.8	600	7.58	50.0
8.000	32	33	29.843	0.600	23.892	22.176	1.716	17.4	150	5.20	50.0
8.001	33	34	25.636	0.600	22.101	20.900	1.201	21.3	225	5.36	50.0
8.002	34	37	55.760	0.600	20.900	15.730	5.170	10.8	225	5.59	50.0
9.000	35	36	26.089	0.600	17.086	16.908	0.178	146.6	225	5.40	50.0
9.001	36	37	27.274	0.600	16.908	15.730	1.178	23.2	225	5.57	50.0
8.003	37	38	19.167	0.600	15.580	14.650	0.930	20.6	375	5.67	50.0
8.004	38	39	16.300	0.600	14.650	14.075	0.575	28.3	375	5.75	50.0
8.005	39	40	11.933	0.600	14.000	13.801	0.199	60.0	450	5.82	50.0
4.005	40	41	22.247	0.600	13.604	13.548	0.056	397.3	600	7.89	50.0
4.006	41	42	40.491	0.600	13.548	13.447	0.101	400.9	600	8.45	50.0
4.007	42	43	11.895	0.600	13.372	13.342	0.030	396.5	675	8.60	50.0
10.000	44	45	6.536	0.600	13.200	13.184	0.016	408.5	675	5.08	50.0
10.001	45	46	18.095	0.600	13.184	13.000	0.184	98.3	225	5.31	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
4.000	1.000	39.7	15.7	1.200	1.603	0.116	0.0	98	0.941
5.000	2.530	44.7	12.1	1.200	1.704	0.089	0.0	53	2.151
6.000	1.065	42.3	13.0	1.200	1.704	0.096	0.0	86	0.941
5.001	1.983	78.9	28.2	1.704	1.200	0.208	0.0	93	1.821
5.002	2.718	192.2	45.9	1.200	1.603	0.339	0.0	99	2.244
4.001	3.951	279.3	74.9	1.603	1.350	0.553	0.0	106	3.368
7.000	1.211	342.4	8.0	1.200	1.350	0.059	0.0	62	0.514
4.002	1.216	343.7	92.2	1.350	1.539	0.680	0.0	211	1.037
4.003	1.211	342.3	95.5	1.539	1.453	0.705	0.0	216	1.044
4.004	1.208	341.7	114.9	1.453	1.311	0.848	0.0	239	1.094
8.000	2.427	42.9	13.3	1.200	1.425	0.098	0.0	57	2.142
8.001	2.844	113.1	34.4	1.425	1.527	0.254	0.0	85	2.503
8.002	4.007	159.3	52.4	1.527	2.732	0.387	0.0	88	3.596
9.000	1.078	42.8	16.7	1.200	1.200	0.123	0.0	97	1.011
9.001	2.730	108.6	27.2	1.200	2.732	0.201	0.0	77	2.287
8.003	4.006	442.4	96.5	2.732	2.102	0.712	0.0	118	3.231
8.004	3.414	377.0	98.3	2.102	1.671	0.725	0.0	130	2.888
8.005	2.629	418.1	111.8	1.671	1.264	0.825	0.0	158	2.238
4.005	1.215	343.6	228.0	1.311	1.302	1.682	0.0	358	1.295
4.006	1.210	342.0	228.0	1.302	1.353	1.682	0.0	359	1.291
4.007	1.310	468.7	238.8	1.353	1.083	1.762	0.0	341	1.315
10.000	1.290	461.7	0.0	1.225	1.241	0.000	0.0	0	0.000
10.001	1.318	52.4	0.0	1.691	0.175	0.000	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	74.215	11.0	150	Circular_Default Sewer Type	43.617	42.267	1.200	37.454	35.504	1.800
1.001	45.376	22.9	225	Circular_Default Sewer Type	37.454	35.429	1.800	34.871	33.446	1.200
1.002	50.344	80.2	225	Circular_Default Sewer Type	34.871	33.446	1.200	34.243	32.818	1.200
1.003	48.346	42.3	225	Circular_Default Sewer Type	34.243	32.818	1.200	33.100	31.675	1.200
1.004	43.255	14.5	225	Circular_Default Sewer Type	33.100	31.675	1.200	30.265	28.685	1.355
1.005	14.194	14.8	225	Circular_Default Sewer Type	30.265	28.685	1.355	29.285	27.728	1.332
1.006	10.094	24.4	225	Circular_Default Sewer Type	29.285	27.728	1.332	28.739	27.314	1.200
1.007	13.695	169.1	225	Circular_Default Sewer Type	28.739	27.314	1.200	28.998	27.233	1.540
2.000	12.990	23.2	225	Circular_Default Sewer Type	28.761	27.000	1.536	27.866	26.441	1.200
2.001	26.291	15.8	225	Circular_Default Sewer Type	27.866	26.441	1.200	26.199	24.774	1.200
3.000	11.934	34.3	150	Circular_Default Sewer Type	26.544	25.194	1.200	26.199	24.846	1.203
2.002	16.772	11.8	225	Circular_Default Sewer Type	26.199	24.771	1.203	24.802	23.356	1.221
2.003	21.109	12.1	225	Circular_Default Sewer Type	24.802	23.356	1.221	23.033	21.608	1.200
2.004	13.942	11.2	225	Circular_Default Sewer Type	23.033	21.608	1.200	21.886	20.361	1.300
2.005	12.271	11.1	225	Circular_Default Sewer Type	21.886	20.361	1.300	20.878	19.253	1.400
2.006	10.407	10.9	225	Circular_Default Sewer Type	20.878	19.253	1.400	20.019	18.294	1.500
2.007	69.472	16.0	225	Circular_Default Sewer Type	20.019	18.294	1.500	15.711	13.949	1.537
2.008	25.239	75.6	300	Circular_Default Sewer Type	15.711	13.874	1.537	15.085	13.540	1.245
2.009	19.029	396.4	450	Circular_Default Sewer Type	15.085	13.390	1.245	15.100	13.342	1.308
4.000	21.885	170.0	225	Circular_Default Sewer Type	19.265	17.840	1.200	19.539	17.711	1.603
5.000	20.298	16.0	150	Circular_Default Sewer Type	21.939	20.589	1.200	21.175	19.321	1.704
6.000	11.325	150.0	225	Circular_Default Sewer Type	20.746	19.321	1.200	21.175	19.246	1.704
5.001	22.216	43.7	225	Circular_Default Sewer Type	21.175	19.246	1.704	20.163	18.738	1.200
5.002	34.578	33.7	300	Circular_Default Sewer Type	20.163	18.663	1.200	19.539	17.636	1.603
4.001	54.490	16.0	300	Circular_Default Sewer Type	19.539	17.636	1.603	15.877	14.227	1.350

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	Adoptable	2	1500	Manhole	Adoptable
1.001	2	1500	Manhole	Adoptable	3	1500	Manhole	Adoptable
1.002	3	1500	Manhole	Adoptable	4	1500	Manhole	Adoptable
1.003	4	1500	Manhole	Adoptable	5	1500	Manhole	Adoptable
1.004	5	1500	Manhole	Adoptable	6	1500	Manhole	Adoptable
1.005	6	1500	Manhole	Adoptable	7	1500	Manhole	Adoptable
1.006	7	1500	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9		Junction	
2.000	10		Junction		11	1500	Manhole	Adoptable
2.001	11	1500	Manhole	Adoptable	13	1500	Manhole	Adoptable
3.000	12	1500	Manhole	Adoptable	13	1500	Manhole	Adoptable
2.002	13	1500	Manhole	Adoptable	14	1500	Manhole	Adoptable
2.003	14	1500	Manhole	Adoptable	15	1500	Manhole	Adoptable
2.004	15	1500	Manhole	Adoptable	16	1500	Manhole	Adoptable
2.005	16	1500	Manhole	Adoptable	17	1500	Manhole	Adoptable
2.006	17	1500	Manhole	Adoptable	18	1500	Manhole	Adoptable
2.007	18	1500	Manhole	Adoptable	19	1500	Manhole	Adoptable
2.008	19	1500	Manhole	Adoptable	20	1800	Manhole	Adoptable
2.009	20	1800	Manhole	Adoptable	21		Junction	
4.000	22	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
5.000	23	1500	Manhole	Adoptable	25	1500	Manhole	Adoptable
6.000	24	1500	Manhole	Adoptable	25	1500	Manhole	Adoptable
5.001	25	1500	Manhole	Adoptable	26	1500	Manhole	Adoptable
5.002	26	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
4.001	27	1500	Manhole	Adoptable	29	1500	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
7.000	13.055	400.0	600	Circular_Default Sewer Type	15.760	13.960	1.200	15.877	13.927	1.350
4.002	26.209	397.1	600	Circular_Default Sewer Type	15.877	13.927	1.350	16.000	13.861	1.539
4.003	65.668	400.4	600	Circular_Default Sewer Type	16.000	13.861	1.539	15.750	13.697	1.453
4.004	37.365	401.8	600	Circular_Default Sewer Type	15.750	13.697	1.453	15.515	13.604	1.311
8.000	29.843	17.4	150	Circular_Default Sewer Type	25.242	23.892	1.200	23.751	22.176	1.425
8.001	25.636	21.3	225	Circular_Default Sewer Type	23.751	22.101	1.425	22.652	20.900	1.527
8.002	55.760	10.8	225	Circular_Default Sewer Type	22.652	20.900	1.527	18.687	15.730	2.732
9.000	26.089	146.6	225	Circular_Default Sewer Type	18.511	17.086	1.200	18.333	16.908	1.200
9.001	27.274	23.2	225	Circular_Default Sewer Type	18.333	16.908	1.200	18.687	15.730	2.732
8.003	19.167	20.6	375	Circular_Default Sewer Type	18.687	15.580	2.732	17.127	14.650	2.102
8.004	16.300	28.3	375	Circular_Default Sewer Type	17.127	14.650	2.102	16.121	14.075	1.671
8.005	11.933	60.0	450	Circular_Default Sewer Type	16.121	14.000	1.671	15.515	13.801	1.264
4.005	22.247	397.3	600	Circular_Default Sewer Type	15.515	13.604	1.311	15.450	13.548	1.302
4.006	40.491	400.9	600	Circular_Default Sewer Type	15.450	13.548	1.302	15.400	13.447	1.353
4.007	11.895	396.5	675	Circular_Default Sewer Type	15.400	13.372	1.353	15.100	13.342	1.083
10.000	6.536	408.5	675	Circular_Default Sewer Type	15.100	13.200	1.225	15.100	13.184	1.241
10.001	18.095	98.3	225	Circular_Default Sewer Type	15.100	13.184	1.691	13.400	13.000	0.175

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7.000	28	1500	Manhole	Adoptable	29	1500	Manhole	Adoptable
4.002	29	1500	Manhole	Adoptable	30	1500	Manhole	Adoptable
4.003	30	1500	Manhole	Adoptable	31	1500	Manhole	Adoptable
4.004	31	1500	Manhole	Adoptable	40	1800	Manhole	Adoptable
8.000	32	1500	Manhole	Adoptable	33	1500	Manhole	Adoptable
8.001	33	1500	Manhole	Adoptable	34	1500	Manhole	Adoptable
8.002	34	1500	Manhole	Adoptable	37	1500	Manhole	Adoptable
9.000	35	1500	Manhole	Adoptable	36	1500	Manhole	Adoptable
9.001	36	1500	Manhole	Adoptable	37	1500	Manhole	Adoptable
8.003	37	1500	Manhole	Adoptable	38	1500	Manhole	Adoptable
8.004	38	1500	Manhole	Adoptable	39	1800	Manhole	Adoptable
8.005	39	1800	Manhole	Adoptable	40	1800	Manhole	Adoptable
4.005	40	1800	Manhole	Adoptable	41	1800	Manhole	Adoptable
4.006	41	1800	Manhole	Adoptable	42	1800	Manhole	Adoptable
4.007	42	1800	Manhole	Adoptable	43		Junction	
10.000	44		Junction		45	1800	Manhole	Adoptable
10.001	45	1800	Manhole	Adoptable	46	1200	Manhole	Adoptable

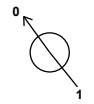
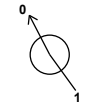
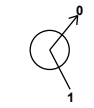
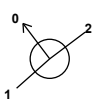
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	305722.177	380525.301	43.617	1.350	1500				
						0	1.000	42.267	150
2	305667.166	380575.117	37.454	2.025	1500		1.000	35.504	150
						0	1.001	35.429	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
3	305654.028	380618.549	34.871	1.425	1500	1	1.001	33.446	225
						0	1.002	33.446	225
4	305623.447	380658.540	34.243	1.425	1500	1	1.002	32.818	225
						0	1.003	32.818	225
5	305581.160	380681.974	33.100	1.425	1500	1	1.003	31.675	225
						0	1.004	31.675	225
6	305538.195	380686.978	30.265	1.580	1500	1	1.004	28.685	225
						0	1.005	28.685	225
7	305524.672	380691.291	29.285	1.557	1500	1	1.005	27.728	225
						0	1.006	27.728	225
8	305517.035	380697.892	28.739	1.425	1500	1	1.006	27.314	225
						0	1.007	27.314	225
9	305526.453	380707.835	28.998	1.996		1	1.007	27.233	225
10	305525.453	380725.417	28.761	1.761		0	2.000	27.000	225
11	305516.153	380734.486	27.866	1.425	1500	1	2.000	26.441	225
						0	2.001	26.441	225
12	305528.078	380766.633	26.544	1.350	1500	0	3.000	25.194	150
13	305517.706	380760.731	26.199	1.428	1500	1	3.000	24.846	150
						2	2.001	24.774	225
						0	2.002	24.771	225
14	305505.762	380772.506	24.802	1.446	1500	1	2.002	23.356	225
						0	2.003	23.356	225
15	305487.581	380783.232	23.033	1.425	1500	1	2.003	21.608	225
						0	2.004	21.608	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
16	305476.580	380791.797	21.886	1.525	1500		1	2.004	20.361	225
							0	2.005	20.361	225
17	305467.996	380800.566	20.878	1.625	1500		1	2.005	19.253	225
							0	2.006	19.253	225
18	305461.474	380808.676	20.019	1.725	1500		1	2.006	18.294	225
							0	2.007	18.294	225
19	305420.676	380864.906	15.711	1.837	1500		1	2.007	13.949	225
							0	2.008	13.874	300
20	305409.065	380887.316	15.085	1.695	1800		1	2.008	13.540	300
							0	2.009	13.390	450
21	305421.075	380902.076	15.100	1.843			1	2.009	13.342	450
22	305679.275	380947.093	19.265	1.425	1500		0	4.000	17.840	225
23	305606.679	380880.138	21.939	1.350	1500		0	5.000	20.589	150
24	305612.510	380902.218	20.746	1.425	1500		0	6.000	19.321	225
25	305620.905	380894.617	21.175	1.929	1500		1	6.000	19.246	225
							2	5.000	19.321	150
							0	5.001	19.246	225
26	305635.918	380910.993	20.163	1.500	1500		1	5.001	18.738	225
							0	5.002	18.663	300
27	305661.781	380933.944	19.539	1.903	1500		1	5.002	17.636	300
							2	4.000	17.711	225
							0	4.001	17.636	300
28	305639.788	380984.652	15.760	1.800	1500		0	7.000	13.960	600

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
29	305628.924	380977.413	15.877	1.950	1500	1	7.000	13.927	600
						2	4.001	14.227	300
						0	4.002	13.927	600
30	305605.973	380964.757	16.000	2.139	1500	1	4.002	13.861	600
						0	4.003	13.861	600
31	305546.134	380937.710	15.750	2.053	1500	1	4.003	13.697	600
						0	4.004	13.697	600
32	305552.046	380807.242	25.242	1.350	1500	0	8.000	23.892	150
33	305566.708	380833.235	23.751	1.650	1500	1	8.000	22.176	150
						0	8.001	22.101	225
34	305581.626	380854.084	22.652	1.752	1500	1	8.001	20.900	225
						0	8.002	20.900	225
35	305499.494	380851.665	18.511	1.425	1500	0	9.000	17.086	225
36	305519.888	380867.936	18.333	1.425	1500	1	9.000	16.908	225
						0	9.001	16.908	225
37	305537.775	380888.526	18.687	3.107	1500	1	9.001	15.730	225
						2	8.002	15.730	225
						0	8.003	15.580	375
38	305524.472	380902.325	17.127	2.477	1500	1	8.003	14.650	375
						0	8.004	14.650	375
39	305515.021	380915.605	16.121	2.121	1800	1	8.004	14.075	375
						0	8.005	14.000	450
40	305510.450	380926.628	15.515	1.911	1800	1	8.005	13.801	450
						2	4.004	13.604	600
						0	4.005	13.604	600
41	305489.283	380919.779	15.450	1.902	1800	1	4.005	13.548	600
						0	4.006	13.548	600

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
42	305455.764	380897.063	15.400	2.028	1800	1	4.006	13.447	600
						0	4.007	13.372	675
43	305450.340	380907.649	15.100	1.843		1	4.007	13.342	675
44	305468.068	380933.709	15.100	1.900		0	10.000	13.200	675
45	305470.858	380939.620	15.100	1.916	1800	1	10.000	13.184	675
						0	10.001	13.184	225
46	305473.370	380957.540	13.400	0.400	1200	1	10.001	13.000	225

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
Rainfall Events	Singular	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	20.0
M5-60 (mm)	17.200	Starting Level (m)	
Ratio-R	0.370	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m³)	
Analysis Speed	Detailed		

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	50	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m^3)	

Node 11 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	26.441	Product Number	CTL-SHE-0103-5000-1200-5000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node 45 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	13.184	Product Number	CTL-SHE-0150-1230-1650-1230
Design Depth (m)	1.650	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	12.3	Min Node Diameter (mm)	1500

Node 10 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	22.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	27.000	Main Channel Slope (1:X)	10000.0
Safety Factor	2.0	Time to half empty (mins)	0	Main Channel n	0.035

Inlets

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Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	183.0	0.0	0.600	287.0	0.0	1.200	413.0	0.0
0.200	216.0	0.0	0.800	327.0	0.0	1.400	459.0	0.0
0.400	250.0	0.0	1.000	369.0	0.0	1.600	508.0	0.0

Node 44 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	56.650
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	13.200	Main Channel Slope (1:X)	1000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.035

Inlets

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Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	661.0	0.0	0.600	900.0	0.0	1.200	1162.0	0.0	1.800	1445.0	0.0
0.200	738.0	0.0	0.800	985.0	0.0	1.400	1254.0	0.0	2.000	1544.0	0.0
0.400	818.0	0.0	1.000	1072.0	0.0	1.600	1348.0	0.0			

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	42.314	0.047	11.8	0.1533	0.0000	OK
15 minute winter	2	11	35.486	0.057	15.9	0.1230	0.0000	OK
15 minute winter	3	11	33.540	0.094	20.7	0.2239	0.0000	OK
15 minute winter	4	11	32.909	0.091	25.2	0.2132	0.0000	OK
15 minute winter	5	11	31.745	0.070	29.0	0.1604	0.0000	OK
15 minute winter	6	11	28.758	0.073	30.0	0.1407	0.0000	OK
15 minute winter	7	11	27.812	0.084	30.6	0.1565	0.0000	OK
15 minute winter	8	12	27.468	0.154	30.6	0.2716	0.0000	OK
60 minute winter	9	52	27.090	0.088	17.1	0.0000	0.0000	OK
60 minute winter	10	55	27.090	0.090	23.3	0.0000	0.0000	OK
60 minute summer	11	66	27.122	0.681	16.8	1.7383	0.0000	SURCHARGED
15 minute winter	12	10	25.257	0.063	10.2	0.1912	0.0000	OK
15 minute winter	13	10	24.823	0.052	16.9	0.1063	0.0000	OK
15 minute winter	14	11	23.409	0.054	18.9	0.1081	0.0000	OK
15 minute winter	15	10	21.674	0.066	27.6	0.1872	0.0000	OK
15 minute winter	16	11	20.430	0.069	28.9	0.1336	0.0000	OK
15 minute winter	17	11	19.320	0.067	30.0	0.1269	0.0000	OK
15 minute winter	18	11	18.382	0.088	41.6	0.2596	0.0000	OK
15 minute winter	19	11	14.024	0.150	57.4	0.4969	0.0000	OK
480 minute winter	20	352	13.584	0.194	12.1	0.5086	0.0000	OK
480 minute winter	21	360	13.583	0.326	12.1	0.0000	0.0000	OK
15 minute winter	22	10	17.932	0.092	13.6	0.3133	0.0000	OK
15 minute winter	23	10	20.639	0.050	10.5	0.1557	0.0000	OK
15 minute winter	24	10	19.405	0.084	11.3	0.2630	0.0000	OK
15 minute winter	25	10	19.334	0.088	24.1	0.1767	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 winter	1	1.000	2	11.4	2.416	0.210	0.3494	
15 minute winter	2	1.001	3	15.7	1.356	0.144	0.5393	
15 minute winter	3	1.002	4	20.7	1.341	0.356	0.7760	
15 minute winter	4	1.003	5	24.9	1.950	0.310	0.6184	
15 minute winter	5	1.004	6	28.7	2.635	0.208	0.4706	
15 minute winter	6	1.005	7	29.7	2.415	0.219	0.1749	
15 minute winter	7	1.006	8	30.6	1.462	0.289	0.2135	
15 minute winter	8	1.007	9	30.8	1.095	0.774	0.3856	
60 minute winter	9	Flow through Pond	10	19.2	0.036	0.003	16.5648	
60 minute winter	10	2.000	11	17.2	0.587	0.158	0.3545	
60 minute summer	11	2.001	13	5.0	1.589	0.038	0.1095	
15 minute winter	12	3.000	13	10.0	1.494	0.329	0.0800	
15 minute winter	13	2.002	14	16.8	2.394	0.111	0.1178	
15 minute winter	14	2.003	15	18.9	2.238	0.125	0.1784	
15 minute winter	15	2.004	16	27.4	2.747	0.175	0.1392	
15 minute winter	16	2.005	17	28.9	2.862	0.184	0.1241	
15 minute winter	17	2.006	18	30.1	2.485	0.190	0.1268	
15 minute winter	18	2.007	19	41.7	2.916	0.319	0.9926	
15 minute winter	19	2.008	20	57.7	1.713	0.451	0.8497	
480 minute winter	20	2.009	21	12.1	0.636	0.075	1.4419	
480 minute winter	21	Flow through Pond	44	25.1	0.043	0.001	258.8383	
15 minute winter	22	4.000	27	13.2	0.888	0.331	0.3248	
15 minute winter	23	5.000	25	10.3	2.021	0.230	0.1035	
15 minute winter	24	6.000	25	11.1	0.790	0.261	0.1585	
15 minute winter	25	5.001	26	23.7	1.701	0.301	0.3099	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	26	10	18.755	0.092	38.9	0.3250	0.0000	OK
15 minute winter	27	11	17.735	0.099	63.0	0.2761	0.0000	OK
15 minute winter	28	11	14.132	0.172	6.9	0.4165	0.0000	OK
15 minute winter	29	11	14.131	0.204	77.1	0.5023	0.0000	OK
15 minute winter	30	11	14.052	0.191	80.0	0.3831	0.0000	OK
15 minute winter	31	12	13.963	0.266	94.0	0.8398	0.0000	OK
15 minute winter	32	10	23.946	0.054	11.5	0.1726	0.0000	OK
15 minute winter	33	10	22.181	0.080	29.5	0.2927	0.0000	OK
15 minute winter	34	10	20.982	0.082	44.8	0.2698	0.0000	OK
15 minute winter	35	10	17.179	0.093	14.5	0.3257	0.0000	OK
15 minute winter	36	11	16.980	0.072	23.3	0.2064	0.0000	OK
15 minute winter	37	10	15.692	0.112	81.3	0.2879	0.0000	OK
15 minute winter	38	11	14.780	0.130	82.4	0.2432	0.0000	OK
15 minute winter	39	11	14.164	0.164	94.1	0.5730	0.0000	OK
15 minute winter	40	12	13.939	0.335	177.0	0.8848	0.0000	OK
15 minute winter	41	12	13.860	0.312	176.7	0.7946	0.0000	OK
15 minute winter	42	13	13.659	0.287	179.8	0.9582	0.0000	OK
15 minute winter	43	13	13.603	0.346	181.2	0.0000	0.0000	OK
360 minute winter	44	288	13.583	0.383	28.8	0.0000	0.0000	OK
360 minute winter	45	288	13.583	0.399	12.0	1.0151	0.0000	SURCHARGED
360 minute winter	46	288	13.073	0.073	11.9	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 winter	26	5.002	27	38.6	2.014	0.201	0.6651	
15 minute winter	27	4.001	29	63.2	3.189	0.226	1.0809	
15 minute winter	28	7.000	29	6.8	0.148	0.020	0.9847	
15 minute winter	29	4.002	30	77.2	0.956	0.225	2.1182	
15 minute winter	30	4.003	31	78.4	0.831	0.229	6.4750	
15 minute winter	31	4.004	40	90.3	0.679	0.264	5.2745	
15 minute winter	32	8.000	33	11.2	2.020	0.262	0.1662	
15 minute winter	33	8.001	34	29.3	2.274	0.259	0.3299	
15 minute winter	34	8.002	37	44.0	3.411	0.276	0.7196	
15 minute winter	35	9.000	36	14.1	1.071	0.330	0.3453	
15 minute winter	36	9.001	37	22.9	2.139	0.211	0.2926	
15 minute winter	37	8.003	38	81.0	2.644	0.183	0.5878	
15 minute winter	38	8.004	39	83.0	2.613	0.220	0.5179	
15 minute winter	39	8.005	40	94.6	1.979	0.226	0.5710	
15 minute winter	40	4.005	41	176.7	1.146	0.514	3.4492	
15 minute winter	41	4.006	42	174.4	1.296	0.510	5.4563	
15 minute winter	42	4.007	43	181.2	1.319	0.387	1.6343	
15 minute winter	43	Flow through Pond	44	227.7	0.213	0.008	115.3055	
360 minute winter	44	10.000	45	12.0	0.192	0.026	1.3997	
360 minute winter	45	10.001	46	11.9	1.048	0.228	0.2062	310.2

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	42.345	0.078	28.7	0.2525	0.0000	OK
15 minute winter	2	10	35.521	0.092	38.8	0.1963	0.0000	OK
15 minute winter	3	11	33.614	0.168	50.7	0.3986	0.0000	OK
15 minute winter	4	11	32.978	0.160	61.6	0.3742	0.0000	OK
15 minute winter	5	11	31.793	0.118	71.3	0.2688	0.0000	OK
15 minute winter	6	12	28.806	0.121	74.2	0.2320	0.0000	OK
15 minute winter	7	12	28.070	0.342	75.1	0.6399	0.0000	SURCHARGED
15 minute winter	8	12	27.768	0.454	74.0	0.8021	0.0000	SURCHARGED
120 minute winter	9	120	27.299	0.297	26.3	0.0000	0.0000	OK
120 minute winter	10	118	27.299	0.299	19.1	0.0000	0.0000	SURCHARGED
120 minute winter	11	120	27.298	0.857	10.1	2.1882	0.0000	SURCHARGED
15 minute winter	12	10	25.308	0.114	25.0	0.3477	0.0000	OK
15 minute winter	13	10	24.848	0.076	35.2	0.1568	0.0000	OK
15 minute winter	14	10	23.434	0.079	40.2	0.1589	0.0000	OK
15 minute winter	15	10	21.712	0.104	61.8	0.2956	0.0000	OK
15 minute winter	16	10	20.471	0.110	65.1	0.2127	0.0000	OK
15 minute winter	17	10	19.362	0.109	67.7	0.2051	0.0000	OK
15 minute winter	18	11	18.436	0.142	96.4	0.4158	0.0000	OK
15 minute winter	19	11	14.250	0.376	136.0	1.2458	0.0000	SURCHARGED
600 minute winter	20	585	14.038	0.648	18.3	1.7034	0.0000	SURCHARGED
600 minute winter	21	585	14.040	0.783	17.7	0.0000	0.0000	OK
15 minute winter	22	10	18.004	0.164	33.3	0.5584	0.0000	OK
15 minute winter	23	10	20.674	0.085	25.6	0.2625	0.0000	OK
15 minute winter	24	10	19.471	0.150	27.6	0.4672	0.0000	OK
15 minute winter	25	10	19.402	0.156	58.9	0.3126	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 winter	1	1.000	2	27.9	3.061	0.516	0.6766	
15 minute winter	2	1.001	3	38.4	1.650	0.351	1.0650	
15 minute winter	3	1.002	4	50.5	1.628	0.868	1.5598	
15 minute winter	4	1.003	5	61.3	2.394	0.765	1.2359	
15 minute winter	5	1.004	6	71.0	3.366	0.516	0.9125	
15 minute winter	6	1.005	7	72.9	2.638	0.537	0.4364	
15 minute winter	7	1.006	8	74.0	1.860	0.699	0.4014	
15 minute winter	8	1.007	9	73.7	1.854	1.849	0.5375	
120 minute winter	9	Flow through Pond	10	18.0	0.034	0.002	61.8791	
120 minute winter	10	2.000	11	6.8	0.255	0.063	0.5166	
120 minute winter	11	2.001	13	5.0	1.589	0.038	0.1118	
15 minute winter	12	3.000	13	24.5	1.810	0.805	0.1614	
15 minute winter	13	2.002	14	35.0	2.893	0.230	0.2028	
15 minute winter	14	2.003	15	40.0	2.647	0.266	0.3206	
15 minute winter	15	2.004	16	61.4	3.301	0.393	0.2594	
15 minute winter	16	2.005	17	64.8	3.399	0.412	0.2341	
15 minute winter	17	2.006	18	67.4	2.978	0.425	0.2354	
15 minute winter	18	2.007	19	95.3	3.132	0.729	2.2948	
15 minute winter	19	2.008	20	131.1	1.981	1.025	1.7353	
600 minute winter	20	2.009	21	17.7	0.594	0.110	3.0150	
600 minute winter	21	Flow through Pond	44	38.8	0.047	0.001	664.9430	
15 minute winter	22	4.000	27	32.3	1.092	0.812	0.6485	
15 minute winter	23	5.000	25	25.3	2.528	0.565	0.2028	
15 minute winter	24	6.000	25	27.1	0.942	0.639	0.3253	
15 minute winter	25	5.001	26	58.1	2.086	0.736	0.6194	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	26	10	18.817	0.154	95.5	0.5425	0.0000	OK
15 minute winter	27	11	17.801	0.165	154.9	0.4620	0.0000	OK
15 minute winter	28	12	14.335	0.375	16.9	0.9078	0.0000	OK
15 minute winter	29	12	14.334	0.407	185.7	1.0031	0.0000	OK
15 minute winter	30	12	14.313	0.452	184.6	0.9035	0.0000	OK
15 minute winter	31	12	14.279	0.582	195.1	1.8406	0.0000	OK
15 minute winter	32	10	23.983	0.091	28.1	0.2937	0.0000	OK
15 minute winter	33	10	22.238	0.137	72.4	0.5015	0.0000	OK
15 minute winter	34	10	21.041	0.141	109.9	0.4618	0.0000	OK
15 minute winter	35	10	17.247	0.161	35.3	0.5619	0.0000	OK
15 minute winter	36	10	17.029	0.121	56.9	0.3461	0.0000	OK
15 minute winter	37	10	15.772	0.192	199.6	0.4912	0.0000	OK
15 minute winter	38	10	14.873	0.223	202.4	0.4175	0.0000	OK
15 minute winter	39	11	14.327	0.327	229.9	1.1414	0.0000	OK
15 minute winter	40	12	14.237	0.633	401.4	1.6697	0.0000	SURCHARGED
15 minute winter	41	12	14.116	0.568	399.1	1.4447	0.0000	OK
600 minute winter	42	555	14.040	0.668	49.2	2.2274	0.0000	OK
600 minute winter	43	585	14.049	0.793	47.9	0.0000	0.0000	OK
600 minute winter	44	585	14.037	0.837	38.8	0.0000	0.0000	SURCHARGED
600 minute winter	45	585	14.037	0.853	12.5	2.1717	0.0000	SURCHARGED
60 minute summer	46	94	13.074	0.074	12.3	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)
15 minute winter	26	5.002	27	94.6	2.495	0.493	1.3119	
15 minute winter	27	4.001	29	154.8	4.002	0.554	2.1071	
15 minute winter	28	7.000	29	14.6	0.182	0.043	2.5362	
15 minute winter	29	4.002	30	177.4	1.134	0.516	5.6482	
15 minute winter	30	4.003	31	171.5	0.863	0.501	16.6441	
15 minute winter	31	4.004	40	208.9	0.794	0.611	10.4822	
15 minute winter	32	8.000	33	27.6	2.522	0.644	0.3267	
15 minute winter	33	8.001	34	71.8	2.793	0.635	0.6590	
15 minute winter	34	8.002	37	108.1	4.250	0.678	1.4199	
15 minute winter	35	9.000	36	34.5	1.322	0.806	0.6796	
15 minute winter	36	9.001	37	55.9	2.681	0.515	0.5709	
15 minute winter	37	8.003	38	198.7	3.195	0.449	1.1967	
15 minute winter	38	8.004	39	202.3	2.967	0.537	1.1948	
15 minute winter	39	8.005	40	230.1	2.180	0.550	1.6429	
15 minute winter	40	4.005	41	399.1	1.418	1.161	6.2030	
15 minute winter	41	4.006	42	399.5	1.554	1.168	10.3103	
600 minute winter	42	4.007	43	47.9	0.743	0.102	4.2426	
600 minute winter	43	Flow through Pond	44	38.8	0.047	0.001	664.9430	
600 minute winter	44	10.000	45	12.5	0.103	0.027	2.3332	
600 minute winter	45	10.001	46	12.3	1.056	0.234	0.2105	490.5

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	42.358	0.091	37.0	0.2969	0.0000	OK
15 minute winter	2	10	35.535	0.106	50.1	0.2267	0.0000	OK
15 minute winter	3	11	33.713	0.267	65.5	0.6337	0.0000	SURCHARGED
15 minute winter	4	11	33.009	0.191	75.2	0.4484	0.0000	OK
15 minute winter	5	10	31.804	0.129	87.0	0.2957	0.0000	OK
15 minute winter	6	12	28.871	0.187	91.2	0.3579	0.0000	OK
15 minute winter	7	12	28.370	0.642	91.4	1.2006	0.0000	SURCHARGED
15 minute winter	8	12	27.922	0.608	90.0	1.0741	0.0000	SURCHARGED
180 minute winter	9	176	27.411	0.409	25.8	0.0000	0.0000	OK
180 minute winter	10	172	27.411	0.411	22.8	0.0000	0.0000	SURCHARGED
180 minute winter	11	176	27.410	0.969	12.7	2.4741	0.0000	SURCHARGED
15 minute winter	12	11	25.409	0.215	32.2	0.6578	0.0000	SURCHARGED
15 minute winter	13	11	24.855	0.083	41.3	0.1717	0.0000	OK
15 minute winter	14	11	23.442	0.087	47.6	0.1746	0.0000	OK
15 minute winter	15	10	21.726	0.118	75.1	0.3343	0.0000	OK
15 minute winter	16	10	20.486	0.125	79.9	0.2428	0.0000	OK
15 minute winter	17	10	19.378	0.125	83.7	0.2356	0.0000	OK
15 minute winter	18	10	18.462	0.168	121.1	0.4940	0.0000	OK
15 minute winter	19	11	14.549	0.675	172.6	2.2364	0.0000	SURCHARGED
960 minute winter	20	945	14.291	0.901	17.0	2.3681	0.0000	SURCHARGED
960 minute winter	21	945	14.293	1.036	17.1	0.0000	0.0000	OK
15 minute winter	22	11	18.050	0.210	42.9	0.7132	0.0000	OK
15 minute winter	23	10	20.686	0.097	33.0	0.2991	0.0000	OK
15 minute winter	24	10	19.509	0.188	35.5	0.5844	0.0000	OK
15 minute winter	25	11	19.444	0.198	75.8	0.3962	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 winter	1	1.000	2	36.0	3.246	0.667	0.8239	
15 minute winter	2	1.001	3	49.6	1.715	0.454	1.3156	
15 minute winter	3	1.002	4	60.6	1.677	1.044	1.9074	
15 minute winter	4	1.003	5	74.1	2.477	0.924	1.4396	
15 minute winter	5	1.004	6	87.0	3.350	0.633	1.2627	
15 minute winter	6	1.005	7	88.6	2.637	0.653	0.5321	
15 minute winter	7	1.006	8	90.0	2.264	0.851	0.4014	
15 minute winter	8	1.007	9	89.5	2.251	2.246	0.5392	
180 minute winter	9	Flow through Pond	10	21.7	0.033	0.003	88.9911	
180 minute winter	10	2.000	11	10.2	0.367	0.094	0.5166	
180 minute winter	11	2.001	13	5.0	1.536	0.038	0.1079	
15 minute winter	12	3.000	13	29.4	1.827	0.966	0.2101	
15 minute winter	13	2.002	14	41.3	3.013	0.272	0.2300	
15 minute winter	14	2.003	15	47.7	2.755	0.317	0.3695	
15 minute winter	15	2.004	16	75.1	3.432	0.480	0.3051	
15 minute winter	16	2.005	17	80.0	3.533	0.509	0.2778	
15 minute winter	17	2.006	18	83.7	3.061	0.527	0.2831	
15 minute winter	18	2.007	19	120.1	3.143	0.918	2.4872	
15 minute winter	19	2.008	20	168.1	2.388	1.314	1.7593	
960 minute winter	20	2.009	21	17.1	0.538	0.106	3.0150	
960 minute winter	21	Flow through Pond	44	46.8	0.048	0.002	928.8939	
15 minute winter	22	4.000	27	41.4	1.156	1.042	0.7759	
15 minute winter	23	5.000	25	32.8	2.511	0.733	0.2766	
15 minute winter	24	6.000	25	34.5	0.966	0.815	0.4089	
15 minute winter	25	5.001	26	74.9	2.144	0.949	0.7742	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.14%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	26	11	18.845	0.182	122.3	0.6379	0.0000	OK
15 minute winter	27	10	17.830	0.194	198.3	0.5414	0.0000	OK
15 minute winter	28	12	14.809	0.849	41.8	2.0571	0.0000	SURCHARGED
15 minute winter	29	12	14.814	0.887	238.0	2.1862	0.0000	SURCHARGED
15 minute winter	30	12	14.772	0.911	226.9	1.8226	0.0000	SURCHARGED
15 minute winter	31	12	14.691	0.994	275.6	3.1402	0.0000	SURCHARGED
15 minute winter	32	10	24.002	0.110	36.3	0.3548	0.0000	OK
15 minute winter	33	10	22.267	0.166	93.3	0.6071	0.0000	OK
15 minute winter	34	10	21.071	0.171	141.7	0.5601	0.0000	OK
15 minute winter	35	10	17.285	0.199	45.5	0.6952	0.0000	OK
15 minute winter	36	10	17.051	0.143	73.1	0.4093	0.0000	OK
15 minute winter	37	10	15.807	0.227	256.7	0.5834	0.0000	OK
15 minute winter	38	12	15.095	0.445	260.6	0.8332	0.0000	SURCHARGED
15 minute winter	39	12	14.762	0.762	292.7	2.6593	0.0000	SURCHARGED
15 minute winter	40	12	14.613	1.009	535.1	2.6627	0.0000	SURCHARGED
15 minute winter	41	12	14.389	0.841	534.7	2.1398	0.0000	SURCHARGED
960 minute winter	42	930	14.302	0.930	42.0	3.0990	0.0000	SURCHARGED
960 minute winter	43	945	14.303	1.046	41.1	0.0000	0.0000	OK
960 minute winter	44	945	14.290	1.090	46.8	0.0000	0.0000	SURCHARGED
960 minute winter	45	945	14.290	1.106	12.5	2.8155	0.0000	SURCHARGED
30 minute winter	46	221	13.074	0.074	12.3	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)
15 minute winter	26	5.002	27	121.2	2.688	0.631	1.6010	
15 minute winter	27	4.001	29	198.3	4.185	0.710	3.1576	
15 minute winter	28	7.000	29	39.3	0.186	0.115	3.6773	
15 minute winter	29	4.002	30	219.7	1.158	0.639	7.3825	
15 minute winter	30	4.003	31	234.0	0.868	0.684	18.4972	
15 minute winter	31	4.004	40	271.4	0.964	0.794	10.5249	
15 minute winter	32	8.000	33	35.6	2.641	0.830	0.4022	
15 minute winter	33	8.001	34	92.5	2.905	0.818	0.8163	
15 minute winter	34	8.002	37	139.0	4.443	0.872	1.7489	
15 minute winter	35	9.000	36	44.3	1.377	1.033	0.8321	
15 minute winter	36	9.001	37	72.2	2.830	0.665	0.6955	
15 minute winter	37	8.003	38	255.8	3.262	0.578	1.6450	
15 minute winter	38	8.004	39	257.1	2.979	0.682	1.7978	
15 minute winter	39	8.005	40	283.0	2.224	0.677	1.8907	
15 minute winter	40	4.005	41	534.7	1.898	1.556	6.2665	
15 minute winter	41	4.006	42	534.9	1.899	1.564	11.4054	
960 minute winter	42	4.007	43	41.1	0.672	0.088	4.2463	
960 minute winter	43	Flow through Pond	44	46.8	0.048	0.002	928.8939	
960 minute winter	44	10.000	45	12.5	0.167	0.027	2.3332	
960 minute winter	45	10.001	46	12.3	1.056	0.234	0.2105	653.9

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.64%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	42.390	0.123	55.4	0.3986	0.0000	OK
15 minute winter	2	11	35.595	0.166	75.9	0.3556	0.0000	OK
15 minute winter	3	12	34.821	1.375	97.4	3.2610	0.0000	FLOOD RISK
15 minute winter	4	13	33.600	0.782	96.9	1.8311	0.0000	SURCHARGED
15 minute winter	5	13	31.822	0.147	104.3	0.3367	0.0000	OK
15 minute winter	6	13	29.468	0.784	109.0	1.5036	0.0000	SURCHARGED
15 minute winter	7	14	28.714	0.986	106.1	1.8445	0.0000	SURCHARGED
15 minute winter	8	14	28.103	0.789	105.2	1.3943	0.0000	SURCHARGED
240 minute winter	9	232	27.638	0.636	31.4	0.0000	0.0000	OK
240 minute winter	10	236	27.638	0.638	21.8	0.0000	0.0000	SURCHARGED
240 minute winter	11	232	27.637	1.196	13.6	3.0534	0.0000	FLOOD RISK
15 minute winter	12	11	25.856	0.662	48.3	2.0224	0.0000	SURCHARGED
15 minute winter	13	11	24.873	0.102	58.1	0.2093	0.0000	OK
15 minute winter	14	11	23.461	0.105	67.4	0.2114	0.0000	OK
15 minute winter	15	12	21.775	0.167	107.2	0.4733	0.0000	OK
15 minute winter	16	13	21.113	0.752	114.5	1.4564	0.0000	SURCHARGED
15 minute winter	17	13	20.556	1.303	114.1	2.4635	0.0000	SURCHARGED
15 minute winter	18	13	20.009	1.715	152.8	5.0372	0.0000	FLOOD RISK
15 minute winter	19	12	14.955	1.080	203.8	3.5797	0.0000	SURCHARGED
960 minute winter	20	945	14.788	1.398	22.1	3.6722	0.0000	FLOOD RISK
960 minute winter	21	945	14.789	1.532	22.1	0.0000	0.0000	OK
15 minute winter	22	12	18.720	0.880	64.3	2.9888	0.0000	SURCHARGED
15 minute winter	23	12	21.166	0.577	49.4	1.7821	0.0000	SURCHARGED
15 minute winter	24	12	20.090	0.769	53.2	2.3969	0.0000	SURCHARGED
15 minute winter	25	12	19.993	0.747	97.0	1.4991	0.0000	SURCHARGED

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 winter	1	1.000	2	54.8	3.409	1.014	1.2251	
15 minute winter	2	1.001	3	73.5	1.994	0.673	1.6150	
15 minute winter	3	1.002	4	77.4	1.947	1.333	2.0022	
15 minute winter	4	1.003	5	89.6	2.568	1.118	1.6269	
15 minute winter	5	1.004	6	103.6	3.392	0.754	1.4555	
15 minute winter	6	1.005	7	103.6	2.650	0.763	0.5645	
15 minute winter	7	1.006	8	105.2	2.646	0.995	0.4014	
15 minute winter	8	1.007	9	105.3	2.648	2.642	0.5392	
240 minute winter	9	Flow through Pond	10	20.6	0.035	0.003	151.0553	
240 minute winter	10	2.000	11	11.6	0.406	0.107	0.5166	
240 minute winter	11	2.001	13	5.0	1.584	0.038	0.1188	
15 minute winter	12	3.000	13	42.9	2.434	1.407	0.2100	
15 minute winter	13	2.002	14	58.0	3.266	0.381	0.2977	
15 minute winter	14	2.003	15	67.3	2.882	0.447	0.5186	
15 minute winter	15	2.004	16	107.3	3.586	0.686	0.4976	
15 minute winter	16	2.005	17	108.5	3.559	0.690	0.4880	
15 minute winter	17	2.006	18	100.2	3.072	0.631	0.4139	
15 minute winter	18	2.007	19	134.0	3.371	1.025	2.7630	
15 minute winter	19	2.008	20	200.3	2.845	1.566	1.7773	
960 minute winter	20	2.009	21	22.1	0.538	0.137	3.0150	
960 minute winter	21	Flow through Pond	44	59.0	0.045	0.002	1531.4214	
15 minute winter	22	4.000	27	53.2	1.338	1.339	0.8704	
15 minute winter	23	5.000	25	39.7	2.540	0.888	0.3573	
15 minute winter	24	6.000	25	45.6	1.147	1.077	0.4504	
15 minute winter	25	5.001	26	91.7	2.306	1.163	0.8836	

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.64%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	26	12	19.196	0.533	164.4	1.8716	0.0000	SURCHARGED
15 minute winter	27	12	18.488	0.852	269.2	2.3839	0.0000	SURCHARGED
15 minute winter	28	12	15.729	1.769	129.4	4.2870	0.0000	FLOOD RISK
15 minute winter	29	12	15.724	1.797	295.3	4.4294	0.0000	FLOOD RISK
15 minute winter	30	12	15.649	1.788	303.1	3.5785	0.0000	SURCHARGED
15 minute winter	31	12	15.504	1.807	369.9	5.7094	0.0000	FLOOD RISK
15 minute winter	32	12	24.805	0.913	54.3	2.9394	0.0000	SURCHARGED
15 minute winter	33	12	23.275	1.174	125.1	4.2947	0.0000	SURCHARGED
15 minute winter	34	12	22.129	1.229	176.2	4.0358	0.0000	SURCHARGED
15 minute winter	35	12	17.862	0.776	68.2	2.7121	0.0000	SURCHARGED
15 minute winter	36	12	17.558	0.650	105.4	1.8595	0.0000	SURCHARGED
15 minute winter	37	12	16.724	1.144	311.2	2.9348	0.0000	SURCHARGED
15 minute winter	38	12	16.144	1.494	310.5	2.7970	0.0000	SURCHARGED
15 minute winter	39	12	15.606	1.606	345.6	5.6026	0.0000	SURCHARGED
15 minute winter	40	12	15.361	1.757	697.5	4.6380	0.0000	FLOOD RISK
15 minute winter	41	12	14.978	1.430	696.6	3.6403	0.0000	SURCHARGED
960 minute winter	42	945	14.790	1.418	76.2	4.7261	0.0000	SURCHARGED
960 minute winter	43	960	14.797	1.540	83.6	0.0000	0.0000	OK
960 minute winter	44	945	14.787	1.587	59.0	0.0000	0.0000	SURCHARGED
960 minute winter	45	945	14.787	1.603	12.5	4.0800	0.0000	SURCHARGED
120 minute winter	46	58	13.074	0.074	12.3	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)
15 minute winter	26	5.002	27	161.7	2.671	0.841	2.4350	
15 minute winter	27	4.001	29	252.4	4.164	0.904	3.8371	
15 minute winter	28	7.000	29	-98.7	-0.351	-0.288	3.6773	
15 minute winter	29	4.002	30	290.0	1.188	0.844	7.3825	
15 minute winter	30	4.003	31	297.0	1.054	0.868	18.4972	
15 minute winter	31	4.004	40	358.1	1.272	1.048	10.5249	
15 minute winter	32	8.000	33	40.1	2.650	0.935	0.5254	
15 minute winter	33	8.001	34	104.8	2.936	0.927	1.0196	
15 minute winter	34	8.002	37	152.9	4.424	0.960	2.2176	
15 minute winter	35	9.000	36	62.1	1.562	1.450	1.0376	
15 minute winter	36	9.001	37	91.8	2.914	0.846	1.0847	
15 minute winter	37	8.003	38	303.7	3.287	0.686	2.1141	
15 minute winter	38	8.004	39	293.5	2.978	0.778	1.7978	
15 minute winter	39	8.005	40	335.4	2.265	0.802	1.8907	
15 minute winter	40	4.005	41	696.6	2.473	2.027	6.2665	
15 minute winter	41	4.006	42	695.8	2.471	2.034	11.4054	
960 minute winter	42	4.007	43	83.6	0.648	0.178	4.2463	
960 minute winter	43	Flow through Pond	44	59.0	0.045	0.002	1531.4214	
960 minute winter	44	10.000	45	12.5	0.102	0.027	2.3332	
960 minute winter	45	10.001	46	12.3	1.056	0.234	0.2105	730.6

Appendix 6

S19 Flood Investigation Report

Storm Bebet - 20th October 2023

Appendix 1

Cyngor sir ddinbych denbighshire County Council

SECTION 19 FLOOD INVESTIGATION REPORT

20th OCTOBER 2023
FLOOD EVENT

LOCATION: DENBIGHSHIRE

Paul Owen: Strategic Flood Risk Officer
Denbighshire Council

Revision History

Revision Ref/Date	Amendments	
	First Issue	May 2024

This report has been produced by Denbighshire County Council with the cooperation and assistance of Natural Resources Wales.

Executive Summary

This report has been produced in-line with the duties placed upon Denbighshire County Council (DCC) under Section 19 of the Flood and Water Management Act 2010. The Act states, "*On becoming aware of a flood in its area, a lead local flood authority (LLFA) must,to the extent that it considers it necessary or appropriate, investigate:*

> *a) which risk management authorities have relevant flood risk managementfunctions and*
>
> *b) whether each of those risk management authorities has exercised or is*
>
> *proposing to exercise those functions in response to the flood".*

This Section 19 investigation provides a factual report of the internal flooding to properties and businesses within Denbighshire, which occurred on 20th October 2023 as a result of Storm Babet. The investigation focuses on the flooding within the Communities of Rhyl, Prestatyn, Dyserth, St.Asaph an Denbigh, as well as isolated flooding incidents within Llandyrnog, Aberwheeler, Llanarmon Yn Ial, Nantglyn and Loggerheads Country Park Visitor Centre. It also reviews evidence provided by responders and residents regarding the Flood Event.

The arrival of Storm Babet on 20 October 2023 marked the first named storm to affect Wales this winter season. It was one of the most severe storms to hit the UK in recent years, causing widespread flooding and damage. Denbighshire experienced the effects of this Storm, with heavy and prolonged rain flooding around 62 homes and 6 businesses.There was also a large number of 'near misses' and significant damage caused to highway infrastructure. These last two points howeverdon't form part of the report as they fall outside the legislative framework for Section 19 Flood Investigations.

Following the flood event, DCC carried out a door knocking exercise to properties which were reported to have been flooded. This exercise identified that 62 homes had experienced internal flooding to living space, whereas 7 businesses had to close temporarily as a result of internal flooding.

The source of the flooding originated from the heavy Storm Event of the 20th, which caused fluvial and surface water flooding. The Maes Y Gog Drain in Rhyl an the Afon Ffyddion in Dyserth overtopped causing a number of properties to be flooded; surface water and sewerage systems were overwhelmed and surcharged causing flooding to properties in Rhyl, Prestatyn and St.Asaph. Other factors included blockages to highway drainage systems, causing systems to back-up and flood properties.

The Report examines the reasons why flooding occurred at each locaility, as well assess how likely it is for flooding to happen again. It also determines what improvements and actions are needed to ensure flood risk in the County is appropriately managed in future.

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Abbreviations

CSO – Combined System Overflow
DCC – Denbighshire County Council
DCWW – Dwr Cymru Welsh Water
LLFA – Lead Local Flood Authority
NR – Network Rail
NRW – Natural Resources Wales
PLP – Property Level Protection
RMA -- Risk Management Authority
WG – Welsh Government

Definitions

Annual Exceedance Probability: The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

Non-return flap valve: a valve installed on drains that allows fluid to flow through it in only one direction. It is commonly used to prevent surcharge coming up through drainage systems into properties.

Risk: In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.

Surface water flooding: Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing pluvial flooding.

Fluvial flooding: Flooding as a result of the water level in a river, lake or stream rising and overflowing onto the surrounding banks, shores and neighbouring land

1.0 Introduction

1.1 Background to the Investigation

As a Lead Local Flood Authority (LLFA), DCC has a duty to prepare and publish the results of investigations into significant flood incidents, as detailed within Section 19 (S19) of the Flood and Water Management Act 2010 (FWMA). The Act states, "On becoming aware of a flood in its area, a lead local flood authority (LLFA) must, to the extent that it considers it necessaryor appropriate, investigate:

a) *which risk management authorities have relevant flood risk management function and*

b) *whether each of those risk management authorities has exercised or is proposing to exercise those functions in response to the flood".*

This report has been prepared for the purpose of meeting the LLFA S19 requirements by providing a detailed, factual account of the flooding that occurred in October 2023 in the County of Denbighshire. During this event, it was reported that 62 properties and 7 businesses flooded internally. This report will focus on investigating the causes of the internal flooding of properties as a result of the storm event, known as Storm Babet.

To provide an accurate account of the flood event, this S19 Report will:

- Identify events leading up to the flood;
- Investigate the number of properties flooded;
- Investigate which Risk Management Authorities (RMAs) have flood risk management functions in respect of the flooding;
- Investigate whether each RMA has exercised or is proposing to exercise those functions in response to the flood

1.2 Site Locations

The Denbighshire County Council (DCC) administrative area in North Wales covers an area of approximately 846 km². Denbighshire is bounded by Conwy and Gwynedd unitary authorities to the West, Powys to the South, Wrexham to the South and East and Flintshire to the East.

There are a number of Main Rivers flowing through Denbighshire, fed by a number of tributaries. The geography of Denbighshire is defined by the broad valley of the Main River know as the River Clwyd, which is surrounded by rolling hills on all sides except the north, where it reaches the coast. Figure 1 below shows the topography of Denbighshire

The River Dee in the South of the County is the other significant river but as the impacts from Storm Babet were minimal here, it is not included within this report.

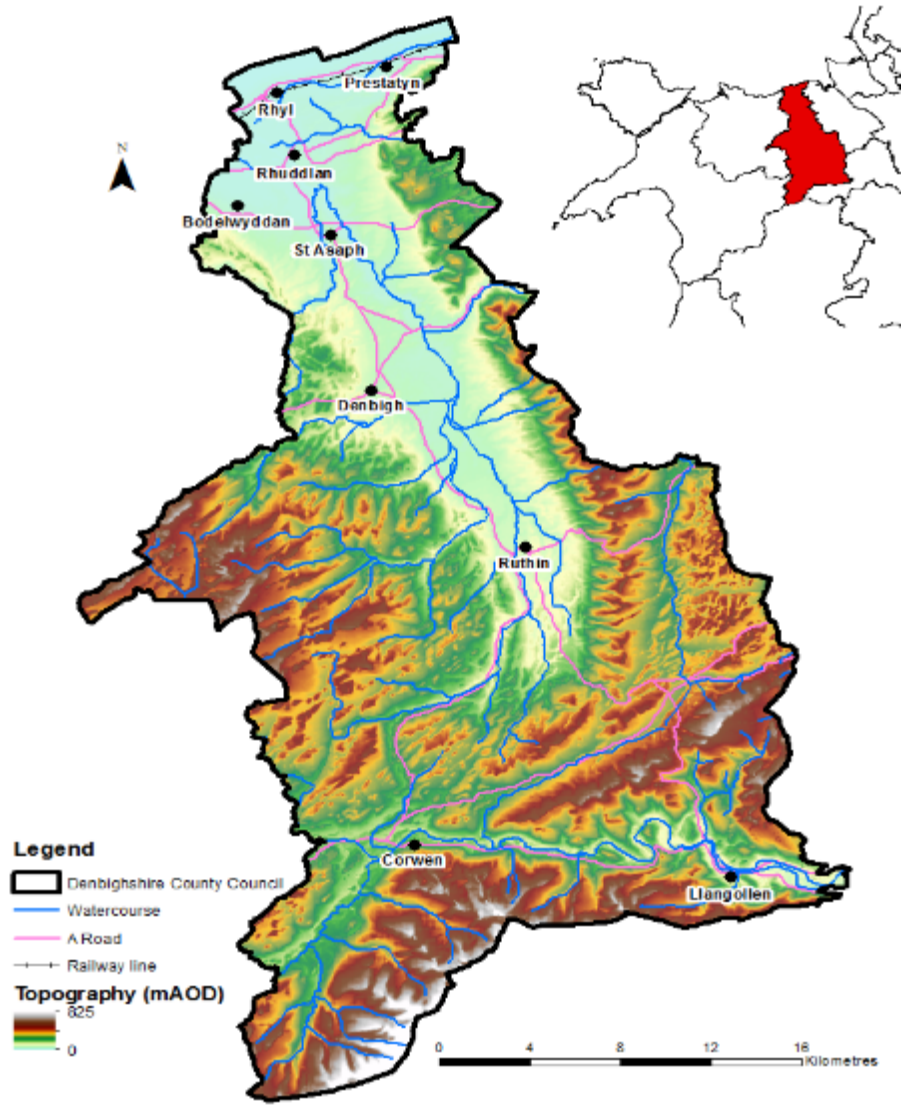

Figure 1: *Topography of Denbighshire*

This flood investigation report focuses on 10 communities within Denbighshire, with a breakdown of specific locations and property/business numbers flooded as shown in table 1 below, whereas Appendix 1 shows the locations of the flooded properties/businesses.

Location	No of Properties flooded	No of Businesses flooded
Rhyl		
Ffordd Derwen	1	0
Rhuddlan Rd Retail Park Area	0	3
River Street	2	0
Lon Eglan	6	0
Lon Gwernall	5	0
Maes Y Gog	1	0
Grange Road	1	0
Plas Cyril	3	0
Aspen Drive	1	0
Prestatyn/Meliden		
Winchester Drive	3	0
Ffordd Penwhylfa	6	0
Pwll Y Bont	5	0
Dyserth		
Waterfall Road	4	1
Pandy Lane	1	0
St.Asaph		
Llys Y Felin	7	0
Ashley Court	1	0
Denbigh		
Denbigh Green	4	0
Brookhouse	1	0
Llandyrnog/Aberwheeler		
	2	0
Llanarmon Yn Ial		
	1	0
Nantglyn		
	1	0

Table 1: *List of Flooded Properties per Community with Denbighshire*

2.0 Roles and responsibilities

2.1 Duties under 'Flood and Water Management Act (2010): Section 19 -Local Authorities: Investigations'

Under Section 19 of the Flood and Water Management Act 2010, the Lead Local Flood Authority, DCC, has a duty to investigate and publish reports on flood eventsthat occur within its area to the extent that it considers it necessary or appropriate.

1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate –

a) which risk management authorities have relevant flood risk management functions, and

b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

2) Where an authority carries out an investigation under subsection (1) it must-

a) publish the results of its investigation, and

b) notify any relevant risk management authorities.

2.2 Risk Management Authorities (RMAs)

A Welsh risk management authority is defined in Section 6 of the Flood and Water Management Act 2010 as the Environment Agency (now Natural Resources Wales), a Lead Local Flood Authority, a district council for an area for which there is no unitary authority, an IDB for an internal drainage district that is wholly or mainly in Wales and a water company that exercises functions in relation to an area in Wales

2.2.1 Lead Local Flood Authority

DCC has been established as the Lead Local Flood Risk Authority (LLFA) for its administrative area under the Flood and Water Management Act 2010. It is responsible for managing the risk of flooding from ordinary watercourses, surface water runoff and groundwater.

Additionally, the LLFA takes on the role of the Sustainable Drainage Systems (SuDS) Approval Body in which they are responsible for approving proposed SuDS systems on new developments and adopting and maintaining constructed systems.

As the LLFA, DCC has statutory duties:

1. to prepare local flood risk management strategies;
2. to comply with the National Strategy for Flood and Coastal Erosion Risk Management;

3. to co-operate with other authorities, including sharing data;

4. to investigate all flooding within its area, insofar as a LLFA consider itnecessary or appropriate;

5. to maintain a register of structures and features likely to affect flood risk;

6. to contribute to sustainable development; and

7. through consenting powers on ordinary watercourses.

2.2.2. Natural Resources Wales

Natural Resources Wales (NRW) has statutory duties and permissive powers including:

1) Operational powers to manage the risk of flooding from main rivers and the sea, and coastal erosion.

2) General supervision over all matters related to flood and coastal erosion risk management in Wales.

NRW's powers to manage flood risk include the management and maintenance of Main Rivers the construction of new flood risk management assets and maintaining existing flood assets.

NRW's powers to manage flood risk include the management and maintenance of Main Rivers the construction of new flood risk management assets and maintaining existing flood assets. NRW assesses developers' flood assessments (and supporting documentation) to decide whether developers have met the requirements of *Planning Policy Wales and Technical advice note 15: development and flood risk* (TAN15, 2004) in relation to the risks of flooding frommain rivers, the sea and reservoirs.

NRW is a statutory consultee in Local Authorities' planning processes and providessupport to Welsh Ministers in their preparation of the National Flood and Coastal Erosion Management (FCERM) Strategy.

NRW provides a direct flood warning service, primarily for areas at risk of fluvial and

coastal flooding.

Within Denbighshire's area of investigation, NRW have confirmed that maintenance work in the form of weed control was carried out in January 2023 on the Maes Gwilym Drain behind Maes Y Gog, whereas for the Afon Ystrad at Brookhouse, NRW using their permissive powers carried out routine maintenance work to the Brookfield Embankment, such as grass cutting, thining of riverside shrubbery and removal of fallen trees from the channel. This work was carried out in 2023, prior to Storm Babet.

Programmed maintenance work at the Maes Gwilym Drain falls under the maintenance regime for the Rhyl Cut Main River and appendix 2 shows an on overview of this regime for the Cut (and also the Prestatyn Gutter).

2.2.3 Highways Authority

DCC undertake the role of the Highways Authority, being responsible for the maintenance of all adopted highways in the County and associated infrastructure. This includes ensuring the highway has a drainage system that controls the surface water that enters onto the highway, providing and managing highway drainage and roadside ditches to ensure they are clear of obstructions. The above duties and responsibilities of the Highways Authority are not applicable to Trunk Roads, which are the responsibility of the Welsh Government.It is important to note that in mnay areas effected by Storm Babet, the highway systems feed into the Dwr Cymru Welsh Water (DCWW) drains as part of a duel function outfall.

Across Denbighshire, the Highways Authority undertake a cyclical maintenance regime, with cleansing of gullies carried out on a risk based approach, with gullies in flood prone areas being prioritised

2.2.4 Dŵr Cymru Welsh Water

DCWW as a risk management authority is to manage the risk of flooding to water supply and sewerage facilities and flood risk arising from their infrastructure. The main responsibilities of the Water Utility Company are to:

- Ensure their systems have the appropriate level of resilience to flooding, and
- maintain essential services during emergencies;
- maintain and manage their water supply and sewerage systems to manage the impact and reduce the risk of flooding and pollution to the environment;
- advise LLFAs on how their assets affect local flood risk and work with RMAs to

coordinate management of flood risk management assets; and

- work with developers, landowners and LLFAs to understand and manage risks

2.3 Other Authorities

2.3.1 Network Rail

Network Rail (NR) has an operational responsibility as a riparian owner and is required to undertake regular maintenance of all assets that pose a risk to flooding.

2.3.2 Landowners and riparian owners

Riparian Landowners are legally responsible under common law for the maintenance of the land generally up to the centreline of any watercourse adjacent to their property. This includes the maintenance of the bed, banks and any boundary features e.g., vegetated strips such as hedging, with routine clearance of debris and/or blockages. This does not mean that the owner must remove all debris from the watercourse, but it does require the owner to maintain as far as it does not pose a risk or 'nuisance' to a neighbour.

2.3.3 Residents

Residents and property owners are responsible for the protection of their own properties against flooding. Residents have the right to defend their property provided they do not increase the risk of flooding to other properties.

2.4 Permissive Powers

Risk Management Authorities have direct permissive powers under the Flood and Water Management Act 2010, as well as the Land Drainage Act 1991. For NRW and the LLFA, this includes:

- Powers to request information.
- The ability to raise levies for local flood risk management works (NRW only).
- Powers to designate certain structures or features that affect flood orcoastal erosion risk.
- expansion of powers to undertake works to include broader risk management actions.
- The ability to cause flooding or coastal erosion under certain conditions.

3.0 Stakeholder engagement

3.1 DCC Data Collection

Following Storm Babet on October 20th 2023, possible flooded property locations were listed with the help of the customer service database, which received 100s of flooding enquiries during the Storm Event. From this list, DCC conducted face to face interviews with property residents by means of a door knocking exercise. The following information was gained from the interviews:

- Date/time of flooding;
- extent of flooding to private land and properties;
- depth where possible of flooding on private land and in properties;
- perceived source/cause of flooding; and
- impacts

In addition, photographs and videos of the flooding were provided by residents,which were used in investigations for this report.

3.2 NRW Flood Reconnaissance

Following the 20th October flood event, NRW conducted flood reconnaissance work at targeted known flooding hotpots based on information and calls received. A door knocking exercise was carried out, which included a flood questionnaire to record flood related information. This S19 report draws on some of this information gathered from the NRW flood reconnaissance amd also from the Flood Risk Assessment, Asset Performance and Warning and Informing Teams

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NRW's flooding list matched the list ompiled by DCC staff.

3.3 Welsh Water

Post Storm Babet, communication with DCWW has taken place via e-mail and telephone/Teams to discuss the performance of their assets in terms of contributing to flooding.

4.0 Catchment characteristics

4.1 Rhyl & Prestatyn

The towns of Rhyl and Prestatyn lie side by side on the former Morfa (sea-marsh) on the North Wales coastal plain. Drainage channels cut in the 18th century drained the marshes enabling establishment of these two Towns – known as Rhyl Cut and Prestatyn Gutter. Over the decades both have expanded into their more elevated hinterlands and their current populations are c27,000 and c19,000 respectively. Meliden falls within the Community of Prestatyn.

Relevant to this report, is the issue of surface water/main river flooding within Rhyl and Prestatyn/Meliden. Historically this has been an issue that effects both Communities and to understand the problem, particularly in the urban areas of Rhyl and Prestatyn, we first need to look at their catchment characteristics

4.1.1 Main River

The Rhyl Cut and Prestatyn Gutter watercourses are the principal receptors and outlets for the majority of the surface water (SW) runoff for each town catchment. In Rhyl, the 'Cut' drains roughly east to west into the river Clwyd. In Prestatyn, the 'Gutter' drains roughly west from just below Meliden to east where a pumping station at Gronant discharges to the sea. Both Watercourses are classified as 'Main Rivers' and, as such, NRW is the RMA. A range of bodies hold a stake in the good performance of both drainage networks: NRW, DCC**,** DCWW, Network Rail (NR), riparian owners and owners of at-risk properties**.**

Figure 2 shows the location of the Cut, as well as other Main River drains feeding into It, such as the Maes Gwilym Drain, shown within the red rectangle.

***Figure 2**: Main River Network for Rhyl*[1]

Figure 3 below shows the location of the Prestatyn Gutter, from its origins south of Meliden, to where it interacts with the urban areas of Prestatyn Town.

Figure 3 *Main River Network for Prestatyn and Meliden*[1]

4.1.2 Drainage Systems

It should be noted that responsibility for different sections of drainage systems lies with individual RMA's, and that RMA's have different system capacity targets for their drainage networks. DCWW aim to maintain a 1 in 30 year (0.33% AEP) capacity, while the Highways Authority aims to maintain a 1 in 5 year (20% AEP) to 1 in 30 year capacity.It should also be noted that any DCWW surface water system is designed to take roof and yard drainage only, unless specifically designed to receive flows from the highway network. The highway network is designed to take flows from the highway only. These systems for Rhyl and Prestatyn have outfalls into The Cut and Gutter, respectively. Within the investigatory areas for Rhyl and Prestatyn there are very few standalone highway systems.

In terms of sewage systems, predominately Rhyl and Prestatyn/Meliden operate on a combined system, which spread extensively across the urban areas serving residential homes, business and highways, conveying waste and surface water to treatment works. Combined Sewer Overflows (CSOs), provide an NRW consented overflow release from

the drainage system into local watercourses or large surface water systems during times of high flows. Some areas may also be served by separate waste and surface water sewers which convey wastewater to treatment works and surface water into local watercourses, such as the Rhyl Cut and Prestatyn Gutter.

Without these release points, sewerage system could back up, and cause sewage flooding to streets, highways and cause toilets to overflow inside properties. Figures 4 & 5, respectively, show the location of CSOs for Rhyl & Prestatyn/Meliden within the associated river catchment boundary.

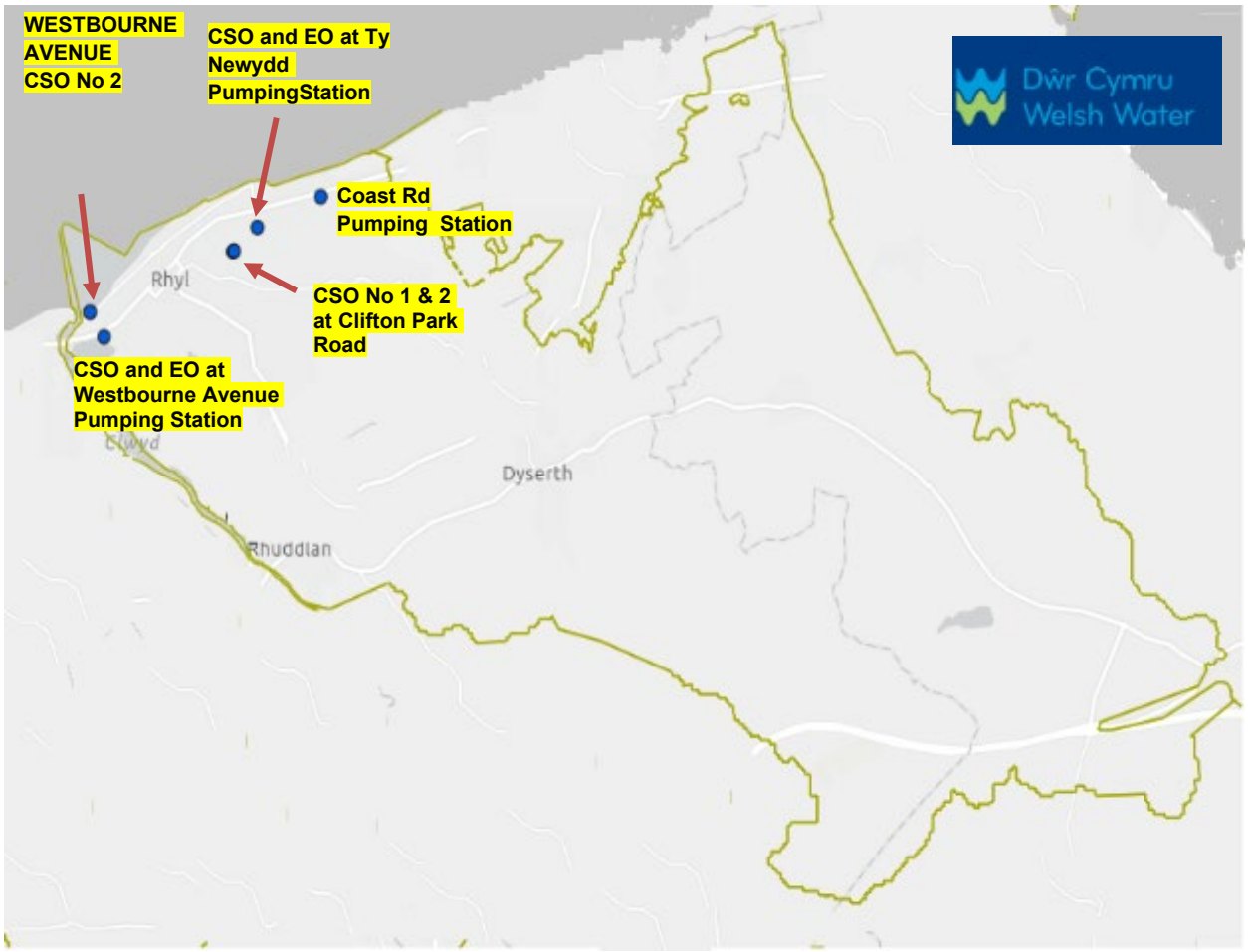

Figure 4: Location of CSOs for Rhyl within the river catchment boundary²

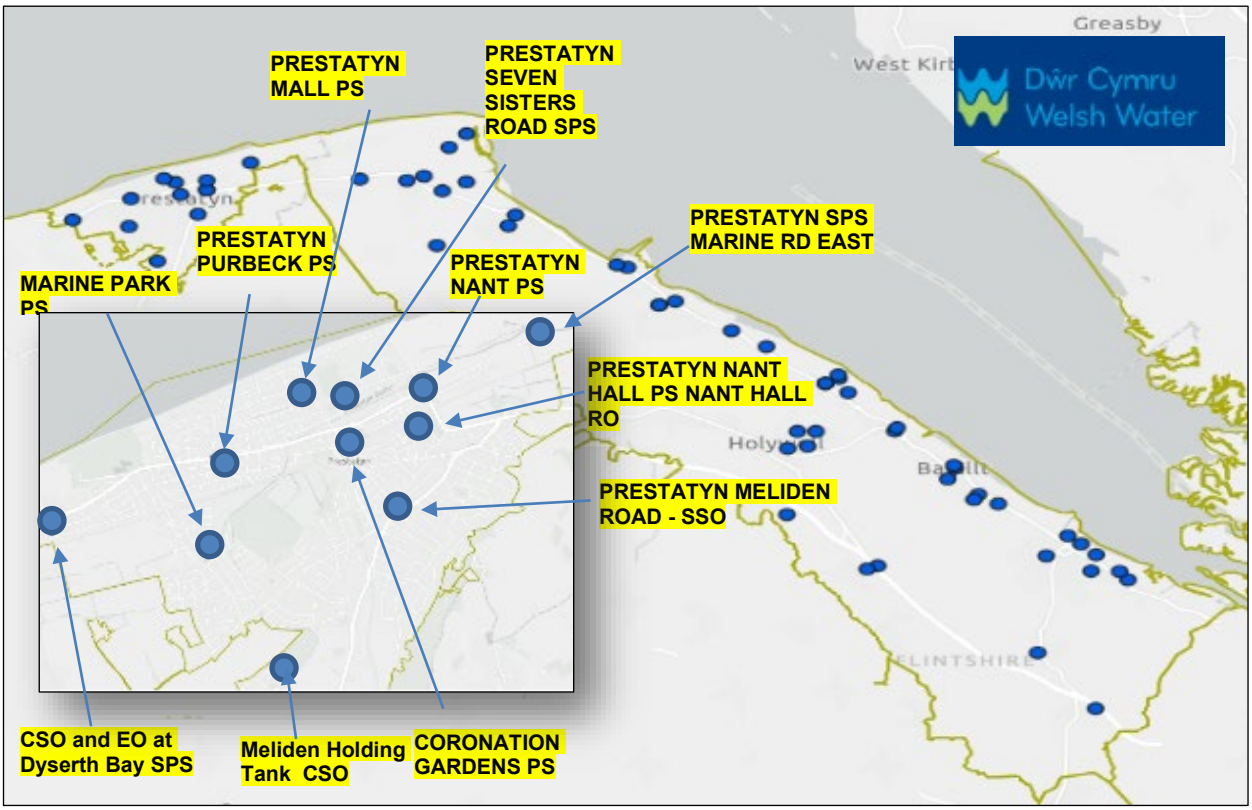

Figure 5: Location of CSOs for Prestatyn/Meliden within the river catchment boundary²

Across Denbighshire, the highway network is cleansed on a risk based system with flood priority based areas being done up to four times per annum, but othere locations perhaps being cleansed every two years. Most systems are not designed with the intention of receiving sheeting overland flows from greenfield areas or floodwater from fluvial systems.and can therefore get overwhelmed.

4.2. Dyserth

Dyserth lies on the slopes of the limestone hill Moel Hiraddug. The Afon Ffyddion rises 4.5 miles to the east of Dyserth, making its way to the village from the southeast to the north, via the 70ft Waterfalls immediately above Waterfalls Road. Past flood events at Dyserth have been the result of the village section of the watercourse over-topping. Surface water flooding has also contributed from highway drainage systems being blocked or over-whelmed.

4.2.1 Ordinary Watercourse – Afon Ffyddion

Glanffyddion Stream drains an area of 37.8km2 in the Northern Clwydian Hills to the north of the A55 in Denbighshire and flows in a north-westerly direction towards a confluence with the River Clwyd. The catchment is predominantly rural, with only the lower reaches of the catchment influenced by the urban area of Dyserth and is relatively steep in the

upstream part. 1.8km of the watercourse passes through Dyserth, from Pandy Lane, via the Waterfall where the stream exits the upland catchment area to the south-east. The urban section of the River runs in close proximity to roads and properties and the status of the watercourse changes to main river at point of the highway bridge on Waterfall Road, by the New Inn Pub. Figure 5 below shows the catchment area for Afon Ffyddion, with a blue pin marked at the location of the investigation area, which can be seen in more detail in Figure 6

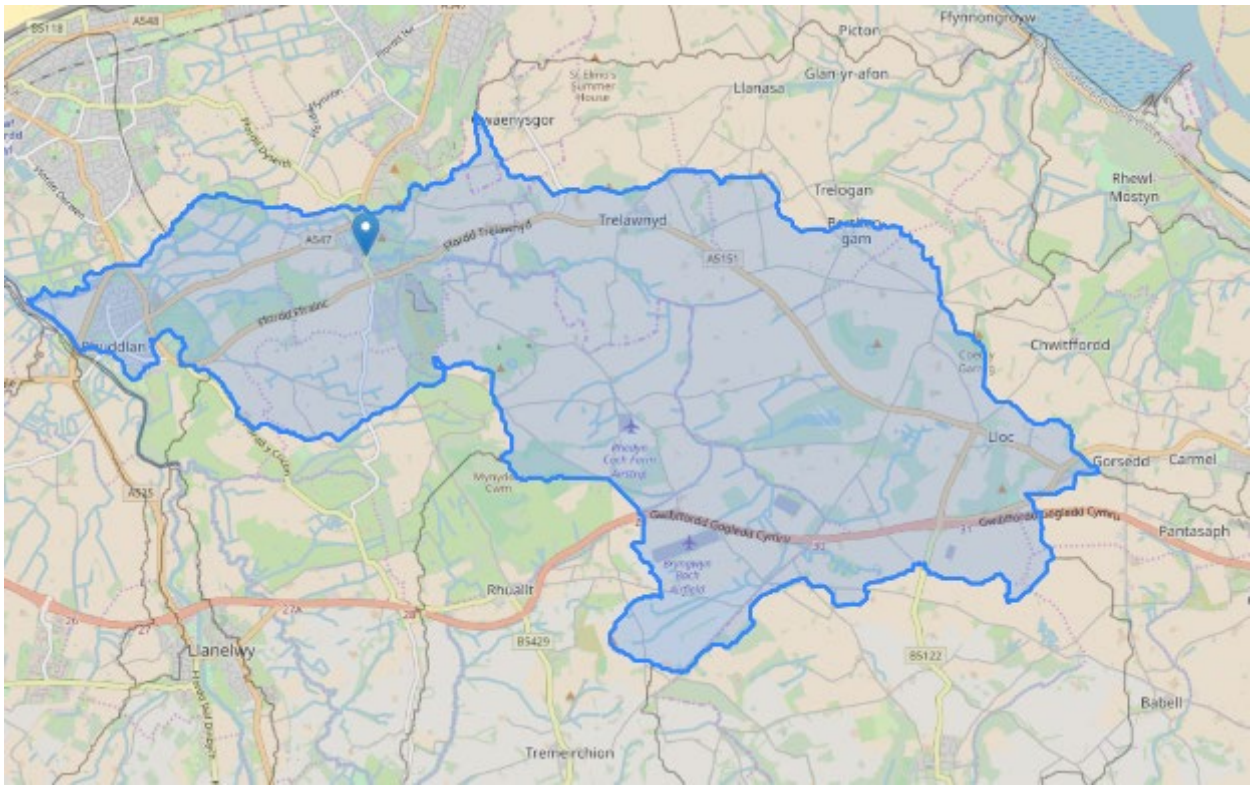

Figure 6: *Catchment area of the Afon Ffyddion* [3]

4.2.2 Drainage Systems

Highway drainage systems area relevant to the investigation area, as shown in figure 7 below:

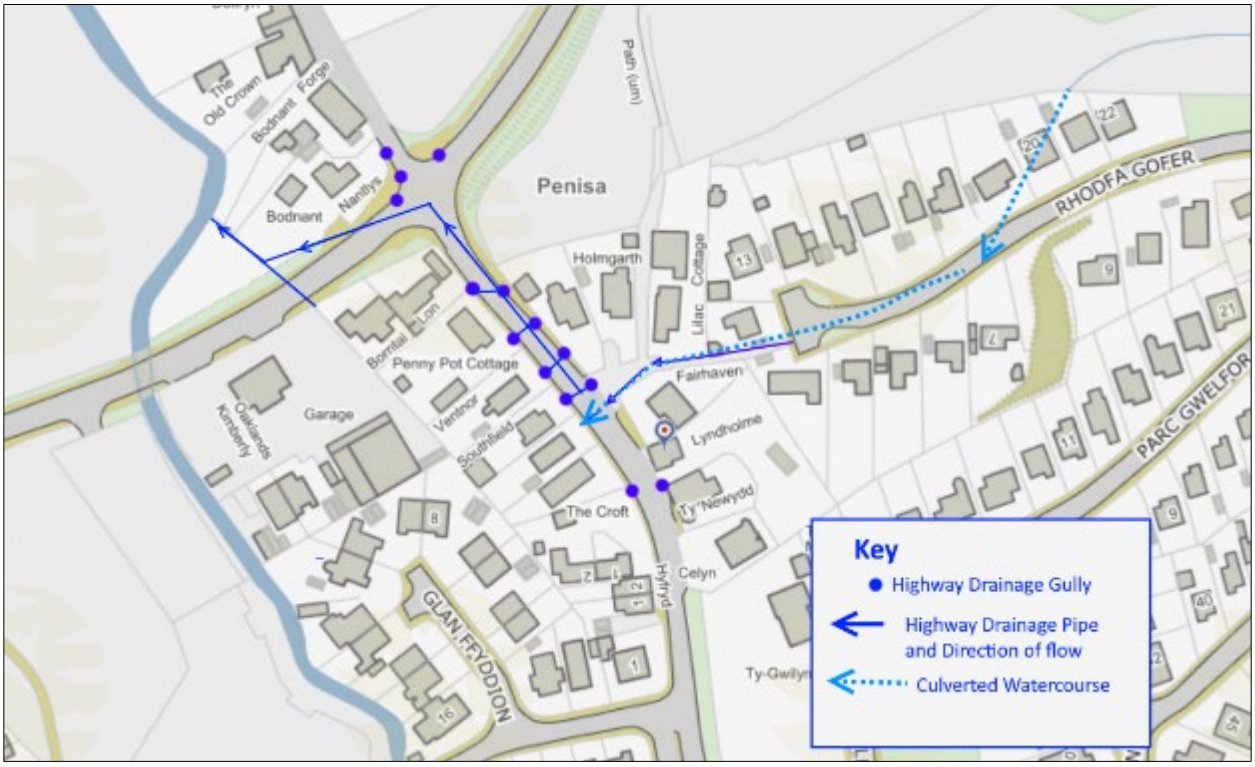

Figure 7: *Drainage systems opposite Lyndholme, Dyserth*

4.3 St Asaph

St Asaph is a city and community on the River Elwy in Denbighshire. This report will focus on lower St.Asaph, that is Llys y Felin and Ashley Court, which have a history of flooding due to the catchment characteristics explained below.

4.3.1 Main River

River Elwy passes through lower St.Asaph. The catchment for this River can be seen in figure 8 below and the usual depth range of the Elwy at St Asaph is between 0.95m and 2.05m. It has been between these levels for 90% of the time since monitoring began [4]. Llys y Felin (marked with a blue pin on figure 8) is indirectly effected by the fluctuating depths, which play a role in how storm water is drained into the Elwy via DCWW drainage systems, which will be looked in section 4.3.2 below.

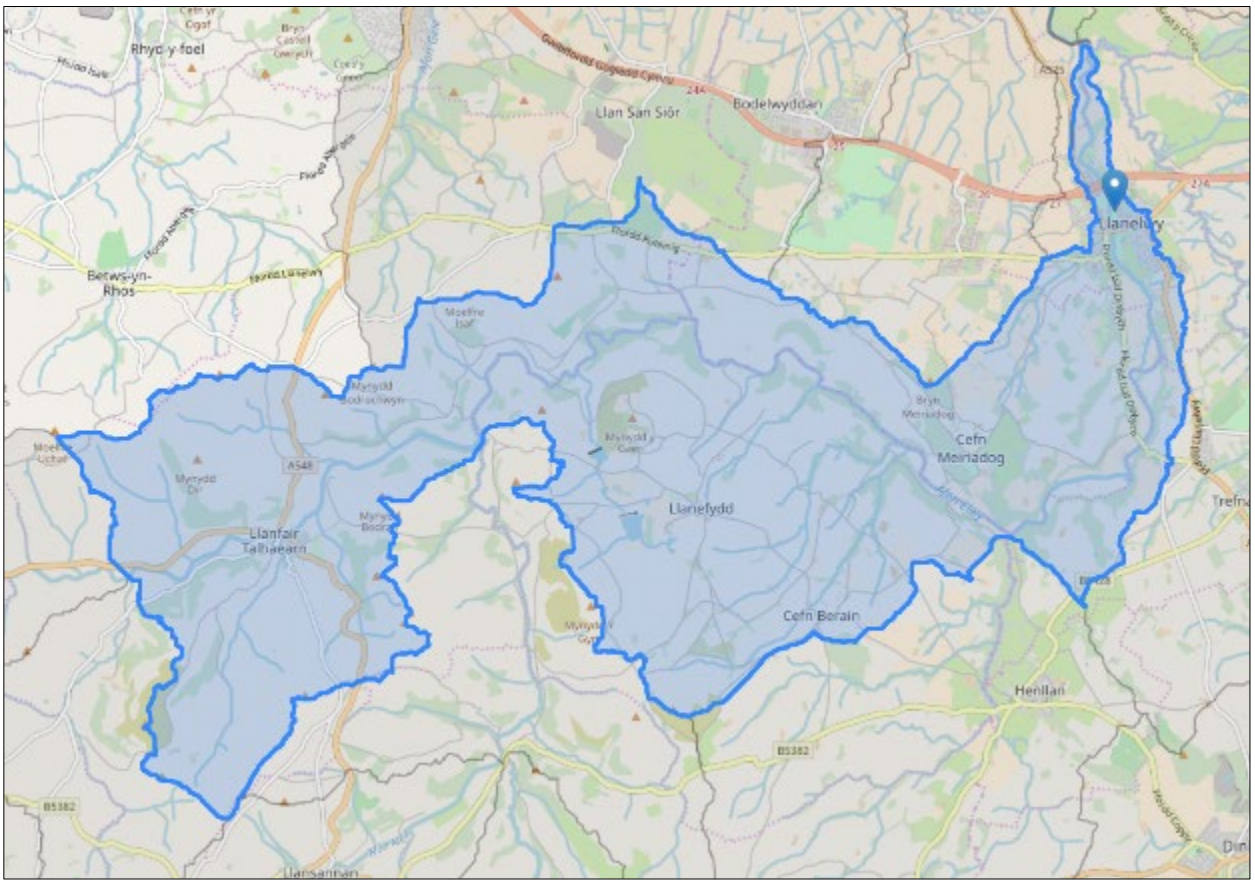

Figure 8: *River catchment for Afon Elwy*[3]

4.3.2 Drainage Systems

The drainage systems relevant to Llys y Felin is a DCWW combined system which utilises a CSO to prevent back up during heavy storms. A Storm overflow pipe discharges into the Elwy via an outfall with a non return flapvalve. Figure 9 below sows the layout of DCWW drainage systems. There is also highway drainage from the High Street feeding into the tank.

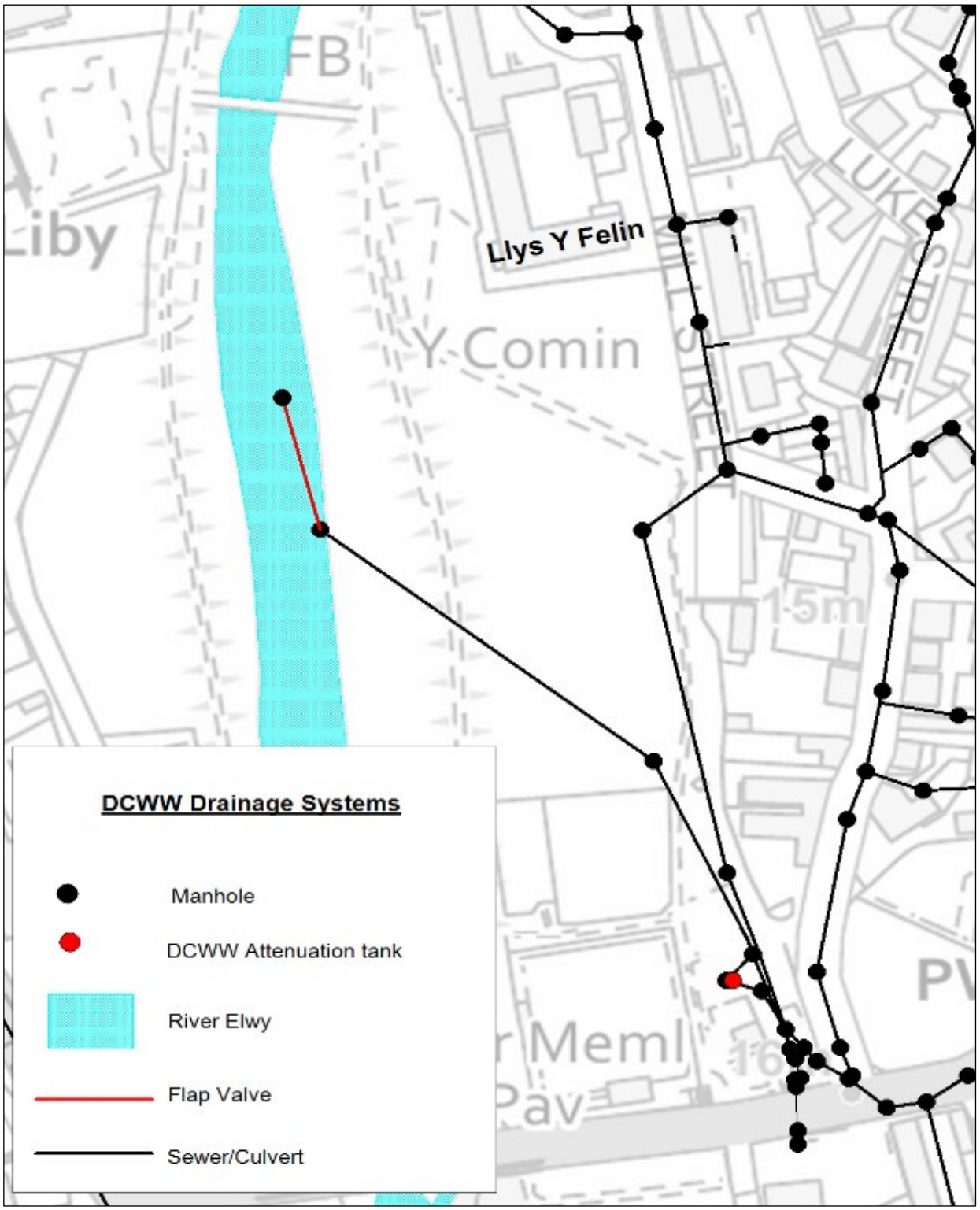

Figure 9: *DCWW drainage systems for the area around Llys Y Felin*

With regard to the catchment characteristics at Heol Esgob, a small stream from the land above Ashly Court (near to Heol Esgob), enters a piped system at the rear of a Wales and West gas installation as shown in Figure 10 below. The stream is piped for approximately 120m via a 225mm dia. pipe, into a manhole (termed hereafter 'connection

chamber') at the head of Heol Esgob, at the edge of the residential area. Within this chamber there are three other connections' - the first is a pipe to DCWW combined sewer system, a higher-level connection to a surface water sewer operated by DCC and a final outlet which flows to a series of drainage ditches and culverts in the rear gardens of the properties on the western side of Tan-y-Bryn road.

It is possible that the chamber originally served simply to turn the stream water through 90 degrees into the ditch line and the highway drain flowed into this chamber. The ditch now ceases to function, but at some time a cross connection to the combined sewer was installed to take the flow. However, it is understood that, when DCWW were alerted to the presence of this watercourse connection they installed a stopper to prevent stream water entering the combined sewer, on the basis that this increased the risk of foul water flooding. There is no record of where the DCC highway drain ultimately discharges, but it is believed to outfall into the River Elwy by the Roe.

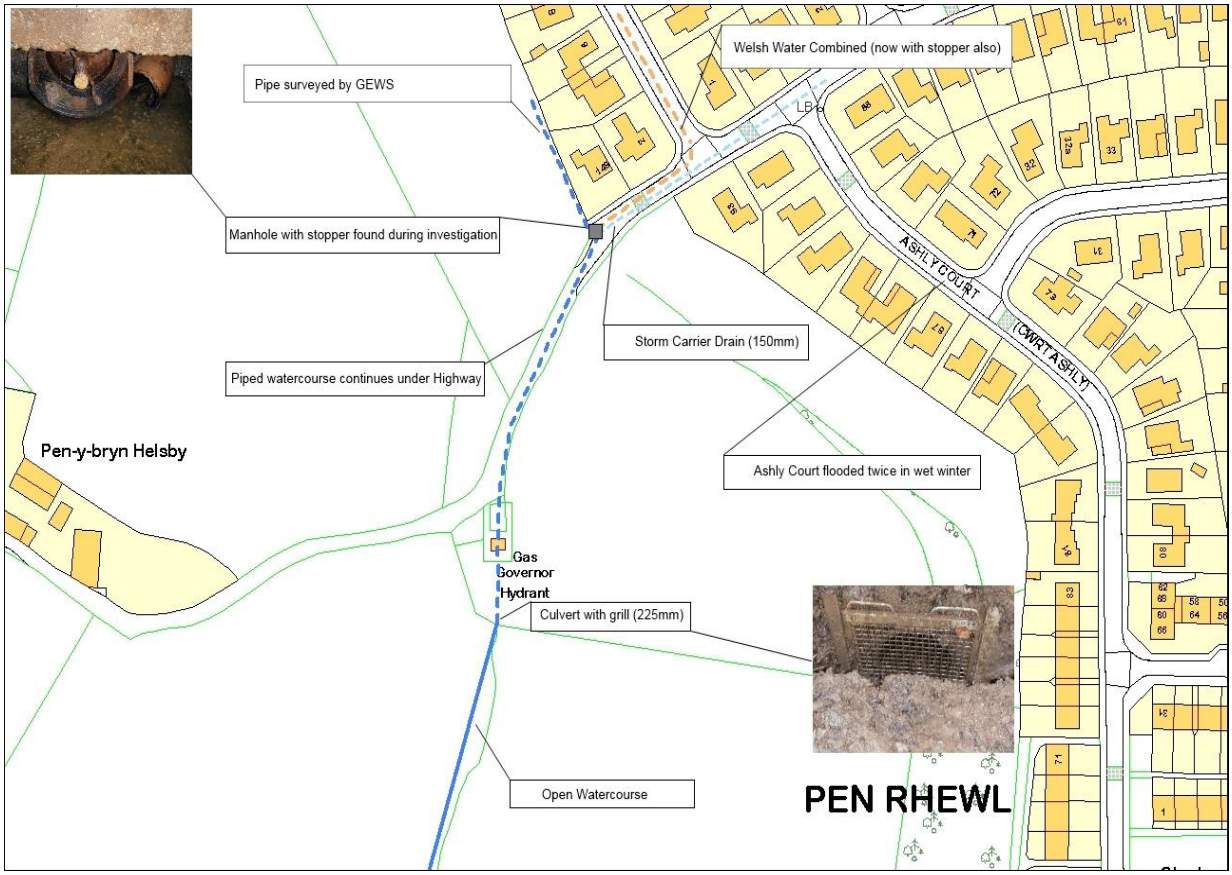

Figure 10: *Drainage systems for Hoel Esgob*

The highway drainage catchment for this drainage system is relatively small as shown by the lilac coloured area on figure 11 below.

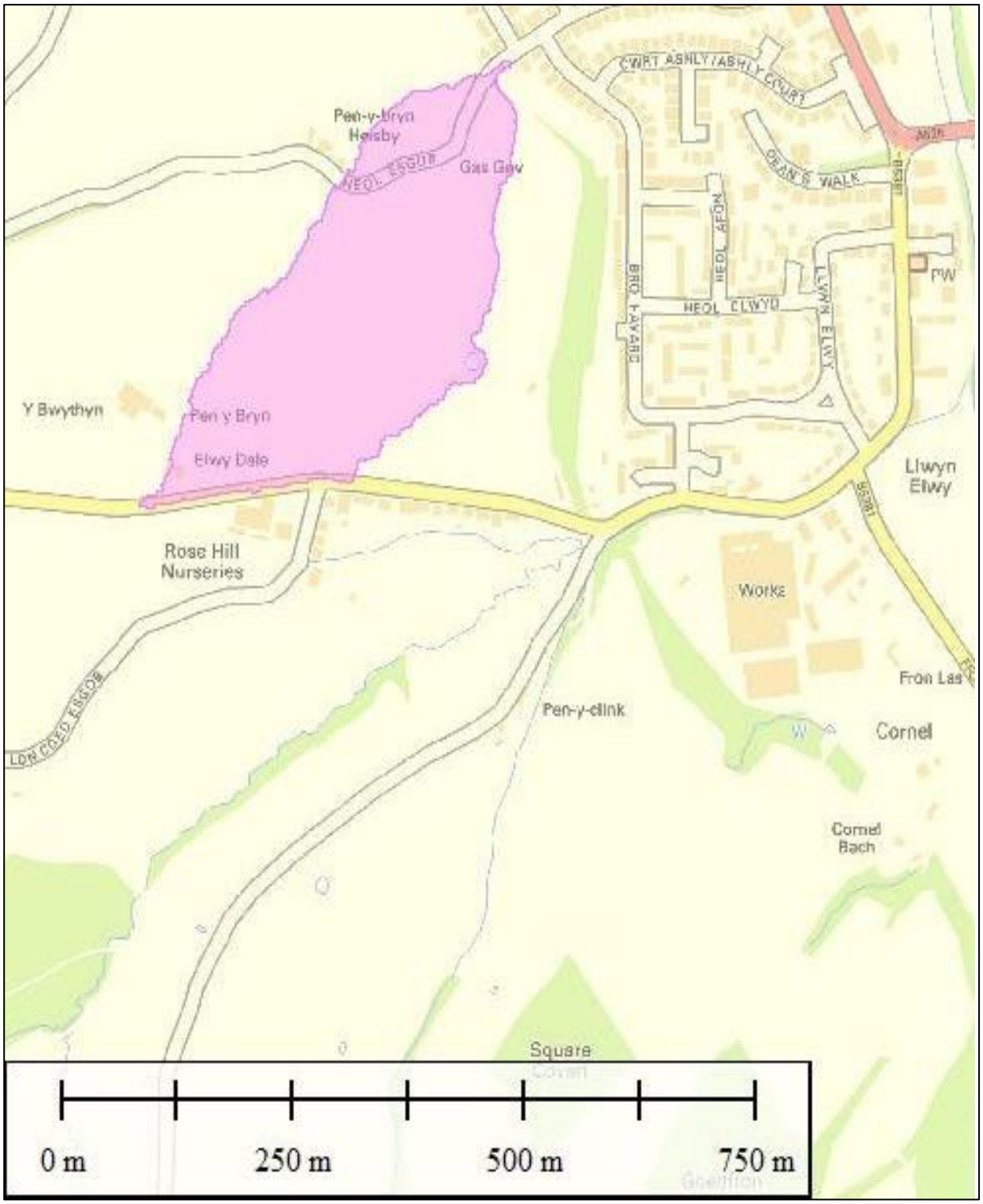

Figure 11: *Highway drainage catchment for Hoel Esgob*

4.4 Denbigh

The flooding investigation centres on Denbigh Green and Brookhouse. The former focuses on an ordinary watercourse and highway drainage, whereas the latter area lies adjacent to the Main River known as the Afon Ystrad.

4.4.1 Brookhouse

Main River

Figure 12 below shows the catchment for the Ystrad, with a blue pin marking the location of the confirmed flooded properties at Brookhouse.

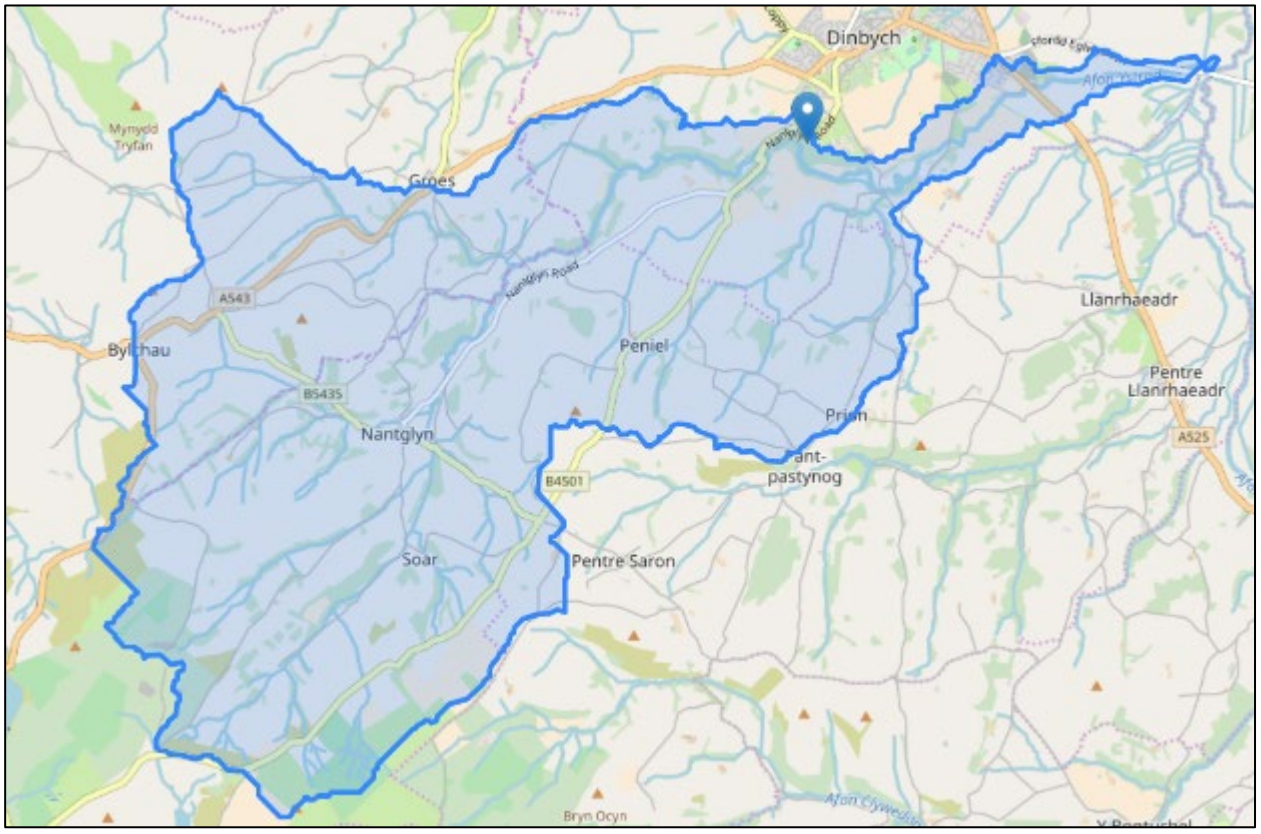

Figure 12: *River Catchment for the Afon Ystrad*[3]

4.4.2 Denbigh Green

Ordinary Watercourses

Within the investigation area for Denbigh Green, there are a number of watercourses which run from the fields behind the affected properties. One of the watercourses is culverted at the point where it leaves agricultural land, whereby it runs underneath the A525 to an open channel, parallel to a farm track.

The watercourses contribute to the Henllan Brook catchment as shown in figure 13, which also falls within the overall Clwyd Catchment. Figure 14 shows in more detail the location of the culverted section.

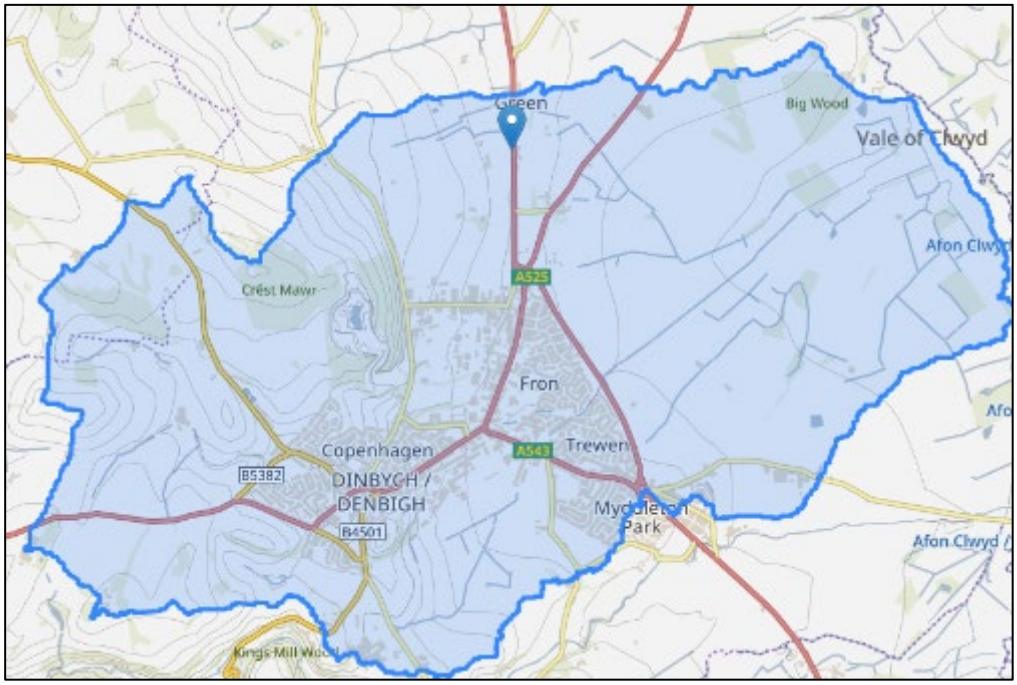

***Figure 13**: Catchment for the Henllan Brook[3]*

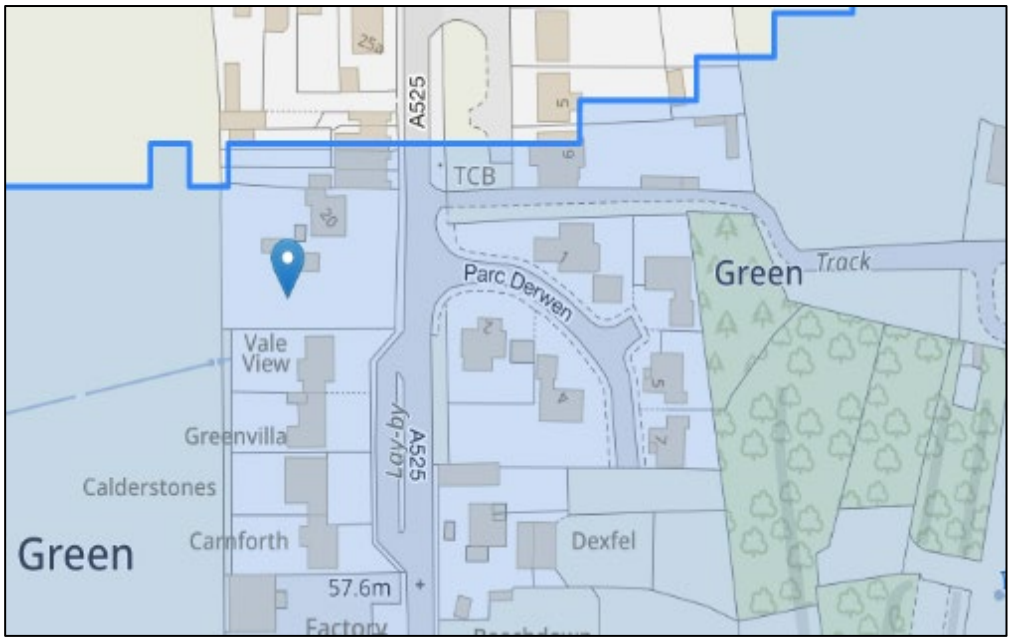

***Figure 14**: Location of the culverted watercourse.*

Drainage systems

The A525 cuts through Denbigh Green, which has a number of highway gullies located along this section of road.

4.5 Llandyrnog/Aberwheeler

For Llandyrnog and Aberwheeler, internal flooding occurred to one property each, with the focus is on highway driange systems and also a private system

4.5.1 Llandyrnog

Drainage Systems

For the investigatory area within Llandyrnog, there is highway culvert system and ditch, as well as private system taking roof water discharging into the highway ditch.

4.5.2 Aberwheeler

Drainage Systems

For Aberwheeler, there are a series of highway culverts/road gullies, which serve part of the B5429, adjacent to the effected Property.

4.6 Llanarmon/Lloggerheads

The investigatory areas for Llanarmon and Loggerheads centres around one property for former, whereas for the latter, the focus is on the DCC owned County Park visitor Centre/Café

4.6.1 Main River

Both Investigatory areas are impacted by the Main River known as the Alyn. Figure 15 below shows the catchment for this River, with two blue pins marking the location of the investigatory areas.

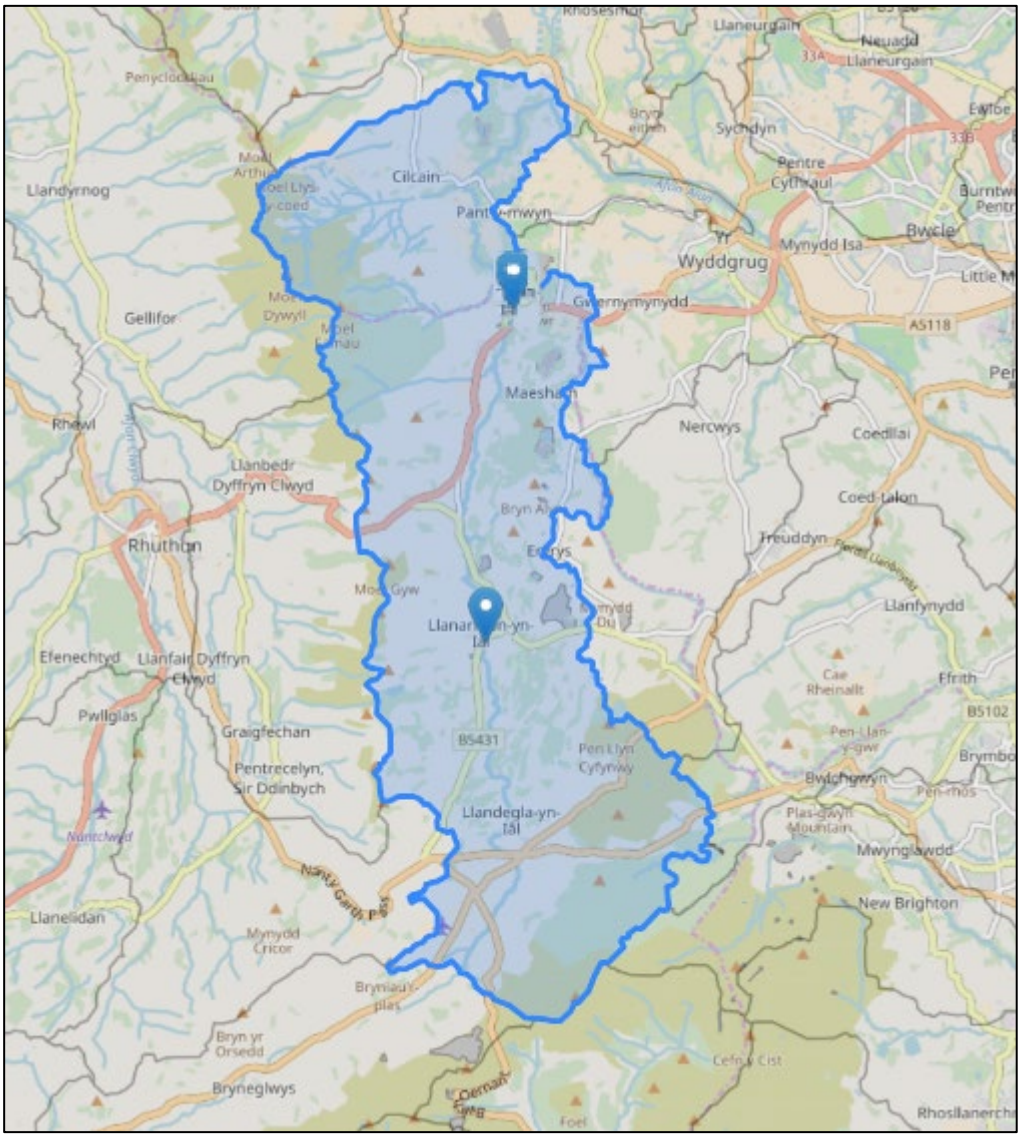

Figure 15: *River Catchment for the River Alyn – Upper River above Rhydymwyn*[3]

4.6.2 Drainage Systems

For the Property at Llanarmon Yn Ial, historically surface water highway drainage has caused issues, so much so that in 2007 DCC undertook work to install bespoke highway drains in front of the Property, as shown In photo 1.

Photo 1: *Bespoke highway drainage at Llanarmon Yn Ial flood investigation area*

4.7 Nantglyn

For the investigatory area of Nantglyn, one property was affected by the Afon Ystrad, which is Main River.

Historically, the Property suffered flooding from a surface water highway drainage system, but work was done in 2012 to a culvert inlet to alleviate this issue

4.7.1 Main River

Figure 16 below shows the catchment for the Ystrad, with a blue pin marking the location of the investigatory area.

Figure 16: *River Catchment for the River Ystrad*[3]

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1 https://datamap.gov.wales/layers/inspire-nrw:NRW_MAIN_RIVERS?lang=cy

2 https://corporate.dwrcymru.com/en/community/environment/combined-storm-overflows

3 https://datamap.gov.wales/maps/new?layer=geonode:nrw_wfd_cycle_3_classifications#/

4 https://riverlevels.uk/elwy-st-asaph-community-st-asaph

5.0 Information Gathering

5.1 Flood Risk

Historical flooding has occurred to most of the investigatory areas, notably Dyserth, Brookhouse, Rhyl & Prestatyn/ Meliden, Llys y Felin and Ashley Court. Hence, a long term flood risk exists

5.1.1 Long Term Flood risk for Denbighshire

Flooding from Main Rivers and Ordinary Watercourses

Historic flood data used in DCC's LFRMS shows that the majority of fluvial flood risk within Denbighshire is located along the Main Rivers of the River Clwyd, most notably in Ruthin; the River Elwy, at St Asaph; and the River Dee at Corwen. Historic data also shows the majority of fluvial flood risk is associated with numerous smaller, or Ordinary Watercourses, throughout the County. Figure 17 shows the extent of the main rivers and ordinary watercourses within DCC.

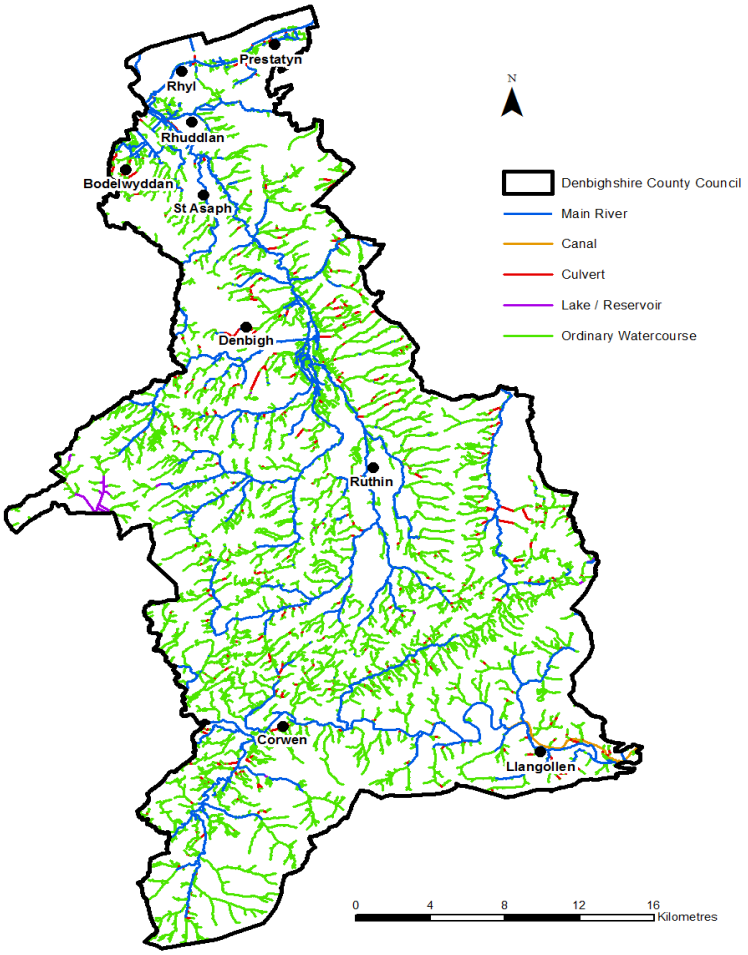

Figure 17: *Main Rivers and Ordinary Watrecourses within DCC*

Flooding from Surface Water

Surface water flooding, includes:

- Surface water runoff (also known as pluvial flooding), which can occur during an intense rainfall event; and
- Sewer flooding

There are certain locations, generally within urban areas, where the probability and consequence of pluvial and sewer flooding are more prominent due to the complex hydraulic interactions that exist in the urban environment. Urban watercourse connectivity, sewer capacity, and the location and condition of highway gullies all have a major role to play in surface water flood risk**.**

For DCC, it is estimated that 5,140 properties ae potentially risk from surface water flooding to a depth of 0.1 m and 1,579 properties were at risk from surface water flooding to a depth of 0.3 m⁴. Of these 1,579 properties, 89% were residential. This assessment was calculated in 2015 using NRW's second generation Flood Map for Surface Water (FMfSW). However, this data has now been replaced by NRW's New National Flood Hazard maps (2020), hence, the figures quoted could change. The Maps show flood depth, velocity (speed and direction), hazard and extent for High, Medium and Low risk scenarios without raised flood defences. They are based on the modelling of Surface Water Catchments

Flooding from the sewer network mainly occurs when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. Pinch points and failures within the drainage network may also restrict flows. Water then begins to back up through the sewers and surcharge through manholes, potentially flooding highways and properties. It must be noted that once water enters a drainage infrastructure, it is the sole concern of the relevant drainage undertaker, such as DCWW.

5.1.2 Flood History

Historic flood events help to build a picture of where flooding occurs most frequently. Table 2 below shows a summary of past flooding events in Denbighshire over the last 20 years.

Year of Flood	Areas Effected	Type of Flood	Consequence
2021	18 communities were effected by Storm Christophe	Ordinary Watercourse/Main River/surface water	Approximately 70 properties were flooded. Areas effected relevant to this investigation are **Grange Road** in Rhyl, **Dyserth**, **Llys y Felin and Ashley Court** in St.Asaph, **Denbigh Green, Brookhouse, Llanarmon Yn Ial and Nantglyn**
2020	St.Asaph, Denbigh(Brookhouse), Llanynys, Llandrillo & Bodelwyddan	Ordinary Watercourse/Main River/surface water	35 residential homes and 6 businesses were flooded internally Areas effected relevant to this report include **Asley Court/Hoel Esgob, Llys Y Felin & Denbigh Brookhouse**
2017	Prestatyn, Rhyl, Rhuddlan & St.Asaph	Surface water	70 residential properties flooded incld **Ffordd Derwen and Walford Avenue in Rhyl.**
2016	Dyserth, Rhyl	Surface water	Strom Angus caused internal flooding to the **New Inn Pub**.
2012	St.Asaph, Rhuddlan & Ruthin	Main River	550 residential properties flooded across the County
2008	Prestatyn	Surface water	**Winchester Drive** & **Ffordd Pennwhylfa** were among flooded properties in Prestatyn
2007	Prestatyn	Surface water	13 residential properties flooded by surface water, including **Winchester Drive & Ffordd Penwhylfa**
2000	Corwen,Dyserth, St,Asaph,Llanbedr, Ruthin,	Ordinary Watercourse/Main River	62 residential properties flooded and 6 Businesses flooded

Table 2: *Historic Flooding within DCC*

Main River & Oridinary Watercourse Fluvial Flooding

The major floods in November 2012 were due in part to prolonged rainfall on already saturated ground in the Clwyd and Elwy catchments which led to both the Clwyd and Elwy Main Rivers overtopping.

2020 & 2021 brought Storm Ciara and Storm Christophe to the County, consequently causing widespread flooding from main river and ordinary watercourses, notably Dyserth, Brookhouse, Nantglyn and Llanarmon Yn Ial.

Surface Water Pluvial flooding

In recent years there have been two pluvial flood events which led to locally significant and harmful consequences from surface water flooding:

In 2016, 6 residential properties along Ffordd Derwen and 5 business units in Alitts Industrial Park, Rhyl were flooded due to blockages on local drainage networks.

In 2017, 6 residential properties along Ffordd Derwen and 5 properties along Garford Road, Rhyl were flooded following intense rainfall. The same event also led to 28 business properties flooding at various points on Prestatyn High Street.

2007/08 also saw intense rainfall cause internal flooding to properties at Winchester Drive and Ffordd Penwhylfa in Prestatyn.

Sewer Flooding

Records of historic flooding from sewers exist within DCWW's DG5 Register. This register was supplied for the 2018 Strategic Flood Consequence Assessment update and is displayed in figure 18 below. The register includes records for hydraulic failure dating back to 1992 and show that there are 490 incidents within Denbighshire between 1992 and 2017. The records entailing other causes begin in June 2003 with 441 incidents recorded across the County. Overall, Prestatyn has had the highest number of sewer flooding incidents with around 240 incidents recorded, followed by Rhyl with approximately 149 incidents recorded. Other communities with a significant number of incidents recorded include Denbigh with 87, St Asaph with 77, Llangollen with 66 and Ruthin with 57 incidents.

It must be noted that for the surface water flooding incidents within Denbighshire, some of these can be attributed to sewer flooding, be it from combined or surface water systems

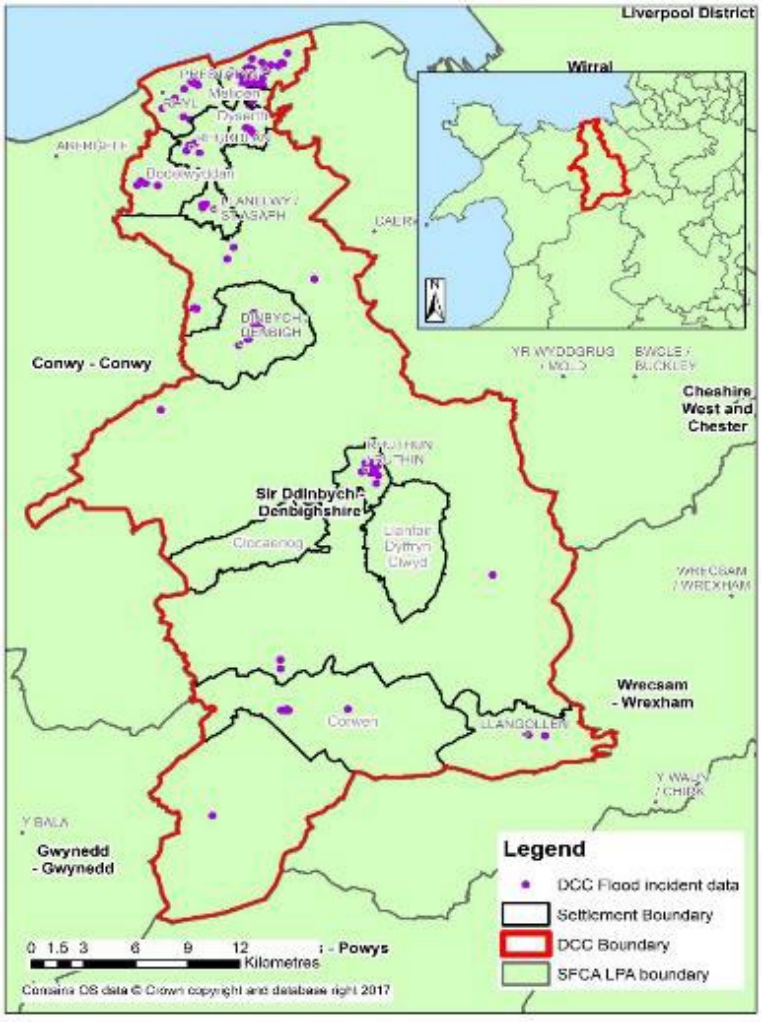

Figure 18: *DCWW's DG5 Register*

6.0 Hydrological analysis of the October 20th Event

Storm Babet brought heavy, persistent and widespread rain, which effected much of England, Wales and Northern Ireland from 18th to 20th October 2023, with 100mm falling fairly widely. This was the third-wettest independent 3-day period for England and Wales in a series from 1891 with 52.8mm of rain falling, 53% of the October whole-month 1991-2020 average, with the only wetter periods on record being 28 to 30 October 2000 and 23 to 25 September 2012[5]. The chart below (figure 19) shows the 10 wettest independent 3-day periods on record for England and Wales in the series

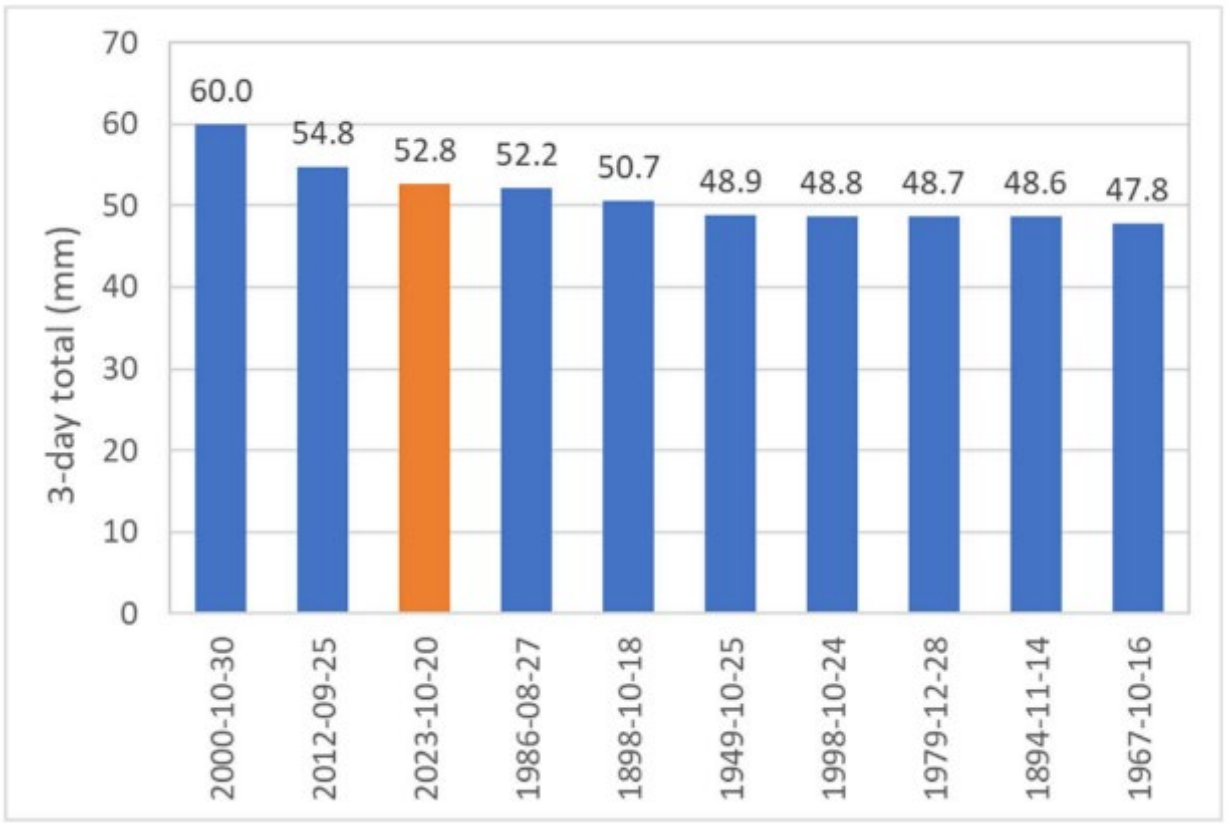

Figure 19: *10 wettest independent 3-day periods on record for England and Wales[5]*

Figure 20 below shows the accumulated daily rainfall for the 4-day period from the 18th to 21st October as actual totals in mm (left) and percentage of the October whole-month average (right). Large swathes of the UK received over 50mm of rain, with North Wales receiving 75 to 100mm, as shown in figure 21

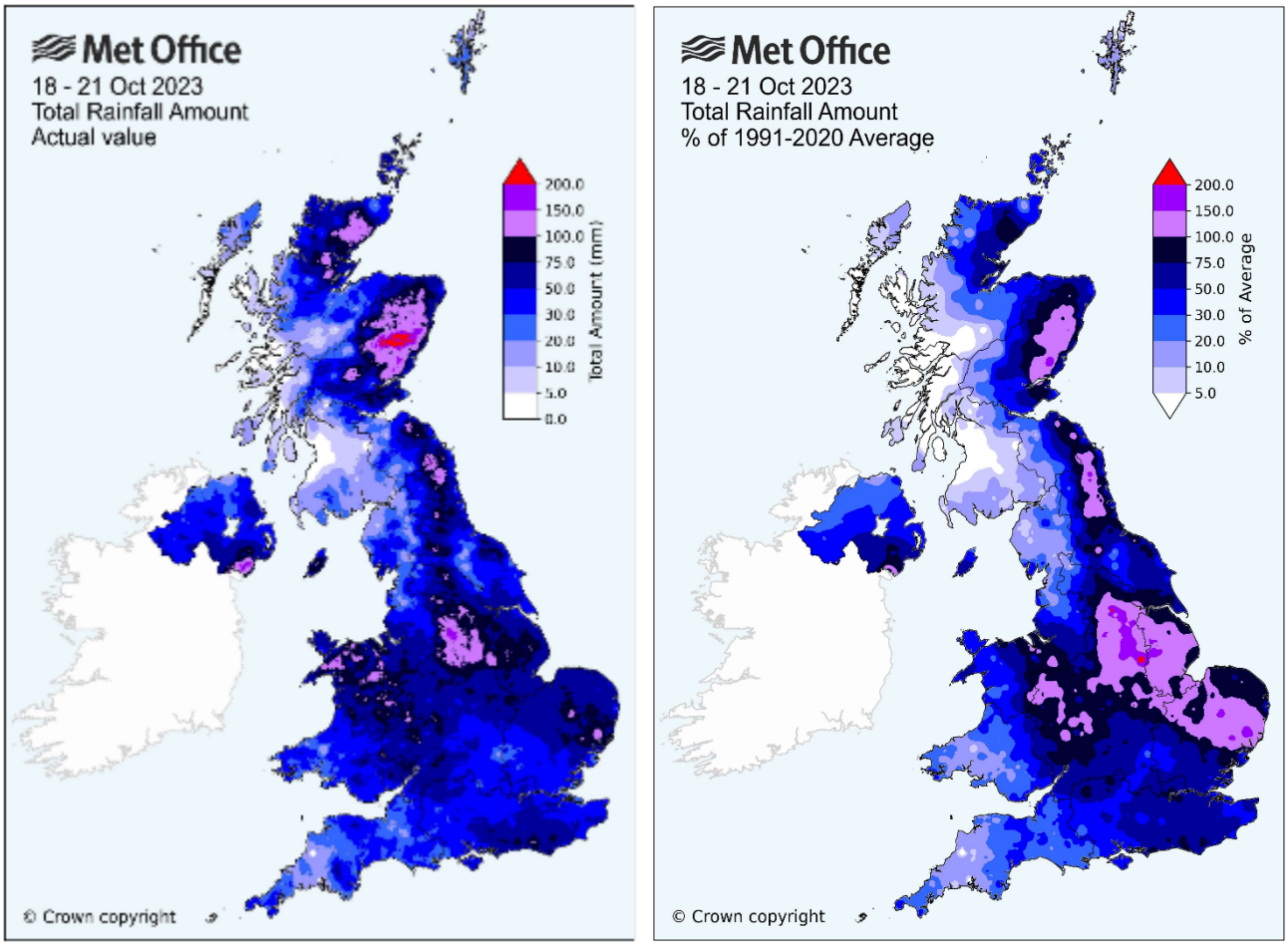

Figure 20 *18-21 Oct 2023 Total Rainfall Amount and Total Rainfall Amount as percentage of 1991-2020 Average*[5]

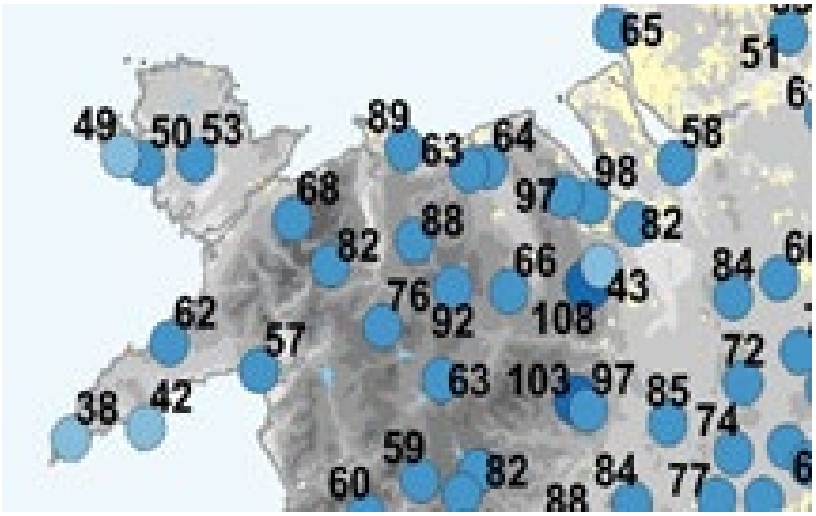

Figure 21: 4 day rain accumulation in mm from the 18th to 21st October for North Wales[5]

It is in this context that the flooding that affected communities in Denbighshire on 20th October must be viewed.

Furthermore, the rain came on top of very wet weather earlier in October. The maps within Figure 22 show daily rainfall totals for each day of October 2023 from 1st to 23rd. The rainfall from 18th to 21st October from storm Babet occurred a week after an area of low pressure brought another very wet period for England and Wales from 10th to 13th in which 40 or 50mm fell widely across Wales, the Midlands and East Anglia, with locally over 70mm

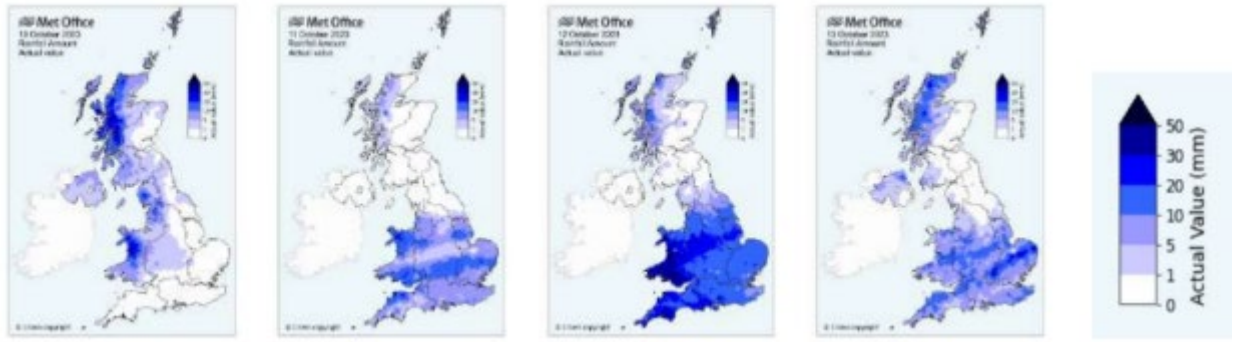

Figure 22: *Daily rainfall totals for October 10th to 13th 2023*[5]

Figure 23 below shows rainfall totals across Wales and central England for the first three weeks of October from 1st to 21st as anomalies relative to the 1991-2020 October long-term average.

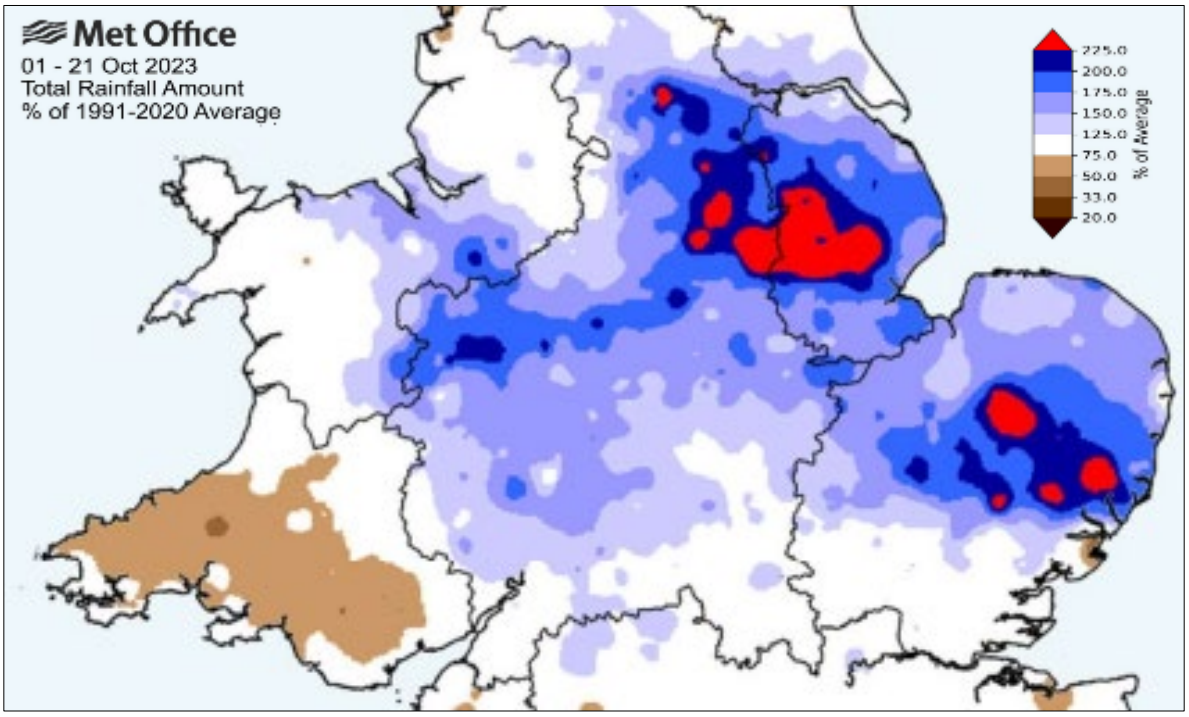

Figure 23: *01 – 21 Oct 2023 Total Rainfall Amount % of 1991-2020 Average*[5]

Specific to Denbighshire, figure 24 taken from NRWs St.Asaph rain gauge, shows approximately 130 mm of rain for October 2023 as opposed to the long term average total of approximately 75 mm. Figure 25 on the other hand, shows the cumulative actual up to the 20th October as being 138% higher than the monthly average.[6]

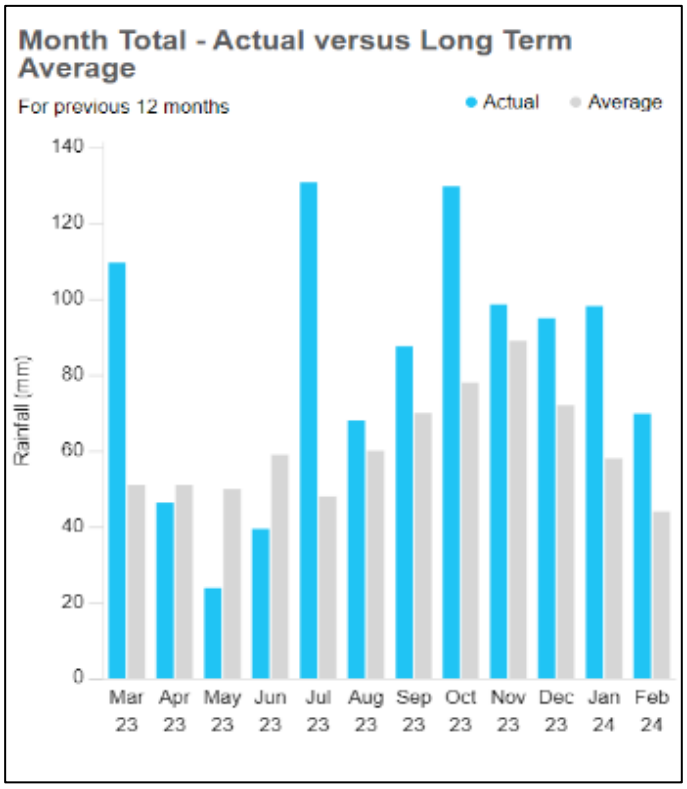

***Figure 24**: Monthly rainfall total for 2023 versus the long term average[6]*

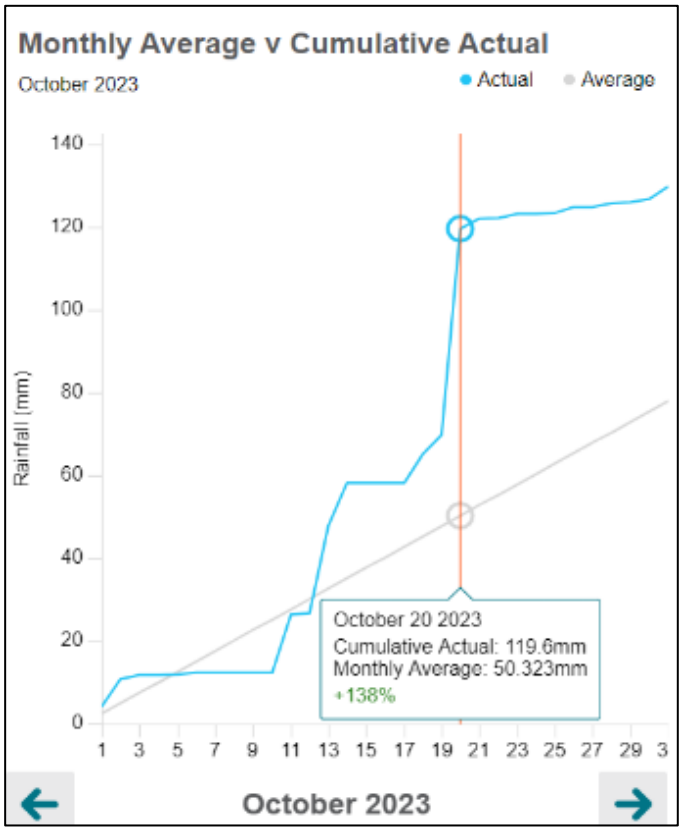

***Figure 25**: Cumulative Actual rainfall data up to the 20th October compared to the monthly average[6]*

The NRW rain gauge at Loggerheads had an accumulative actual rainfall up to the 20th October at 196.4mm, which was 267% above the average at 53.548mm[6]

In terms of a return period for Storm Babet, JBA Risk Management conducted Extreme Value Analysis on historic rainfall and streamflow data in order to estimate the return period of the Event.

A rainfall exceedance probability curve for Derby in the north Midlands and Mold in North Wales was produced from an observed 24-hour rainfall total of 41.4 mm in Derby, which suggests around a 1-in-40 year rainfall event and 39.6 mm of rainfall received in Mold, suggesting around a 1-in-30 year rainfall event.[7]

To put that into a more local context, the rainfall accumulation for St.Asaph over the 24 hour period for the 20th October accumulated to 49.8mm[6].

5.https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2023/2023_08_storm_babet.pdf
6.https://rivers-and-seas.naturalresources.wales/Station/1005?parameterType=2
7.https://www.jbarisk.com/products-services/event-response/storm-babet-october-2023/

7.0 The Flood Event of the 20th October

The hydrological analysis in the previous section shows a period of prolonged, widespread heavy rain, which will inevitably result in significant flood impacts, as experienced by the locations in table 1 on the 20th October.

These locations are now discussed in more detail below, with three key questions considered, that is, why did the flooding happen? How likely it is for that scale of flooding to happen again? What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

For the second question, that is, how likely is it to happen again, this will be supported where possible by the NRW flood and coastal erosion risk maps for rivers, surface water and small watercourses, which has the following definitions:

- High risk is 1 in 30 or greater in a year;
- Medium risk is between 1 in 30 and 1 in 100 year; and
- Low risk is between 1 in 100 year and 1 in 1,000 year Annual Exceedance Probability (AEP).

7.1 Rhyl

7.1.1 Ffordd Derwen

Why did the flooding happen?

Property Number 53 Ffordd Derwen was flooded as a result of surface water build up making its way from the School playing field directly behind the Property and ingressing into living space in the form of a converted garage.

It was observed from the door knocking exercise that the back of the Property is a lot lower than School field, thus creating a pathway for the surface water to flow. Damage to the living space was minimal.

Although it did not cause internal property flooding, it needs to be mentioned that vehicles travelling through the flooded public highway at the front of the properties along Ffordd Derwen caused countless near misses due to wave effects of pushing the water off the highway (which leans on a gradient towards the properties), through into the properties' front gardens and drives. No property protection was present at all along Ffordd Derwen.

It is also important to note that during the Storm, DCC organised tankers to clear the watercourse adjacent to the front of the properties to alleviate potential flooding.

How likely it is for that scale of flooding to happen again?

Sections of Ffordd Derwen have been susceptible to flooding in the past, with a number of properties experiencing internal flooding in 2017. A DCC highway drainage improvement scheme was carried following this event

The low elevation of the properties along Ffordd Derwen compared to the surrounding area also makes them more susceptible to flooding, exacerbated further from the wave effects generated by vehicles using the road when it is in flood.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- To Progress with the Welsh Government (WG) funded flood alleviation scheme at Ffordd Derwen, which is currently at the design stage.

- In the meantime, encourage property level protection (PLP) and consider applying to WG for flood barriers which will help control flood waters to the front of the Properties on Ffordd Derwen, in particular the wave effects caused by vehicles using the road, or, consider the option to close the road under emergency powers to prevent the potential flood effects caused by vehicles.

7.1.2 River Street

Why did the flooding happen?

Numbers 10 and 11 at the back of River Street were flooded internally by surface water as a result of a blocked drain (directly outside No.10), which takes rain water from the roof. Surface water therefore backed-up and ingressed into both properties via the front doors. It was observed during the initial door knocking that damage to one of the properties, No.10, was minimal and the tenant did not have to move out. No.11 could not be viewed as no one was at home at that time. It was also noted that there was an absence of property protection.

How likely it is for that scale of flooding to happen again?

Figure 26 from the NRW Flood and Coastal Erosion Risk Maps surface water and small watercourses flood map shows that the two properties have a low to medium risk of flooding from surface water and small watercourses.

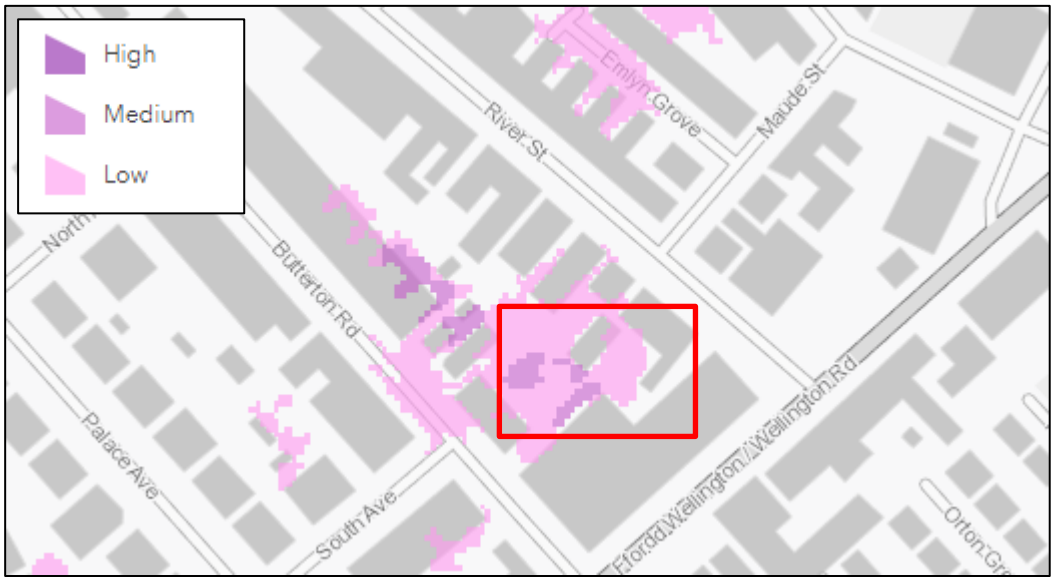

Figure 26: NRW Surface Flood and Coastal Risk Maps for surface water and small watercourses.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- The two properties are rented. Therefore, encourage the owner to invest in PLP for the front doors.
- Also, point out to the owner that it maybe worthwhile carrying out a CCtv drain survey to check for blockages to the roof water drain.

7.1.3 Maes Y Gog/Llys Gwennol/Lon Eglyn

Why did the flooding happen?

The main source of flooding for Maes Y Gog/Llys Gwennol came from the Maes Gwilym Drain, which as stated in section 4 is a Main River and is therefore maintained by NRW. Lon Eglyn on the other hand, not only suffered flooding to the rear of the properties as a result of the Drain over-topping, but also from the front due to possible hydraulic overload from DCWW combined systems, as reported by some of the effected residents of Lon Eglyn.

It is important to note that NRW manage the Drain, hence they carried out their post Storm visit to investigate the cause and extent of the flooding. Therefore, given that they are the key stakeholder here, this report also utilises their post storm flood findings.

For Maes Y Gog, the majority of flooding was classed as external, with the Maes Gwilym Drain over-topping and sending flood waters into the back of Nos 37 to 81. The flood water then made its way to the front of the properties whereby it was reported that several

members of the public were pumping and brushing the water from around their properties onto the road.

This action by some of the residents at Maes y Gog inevitably sent water down towards Llys Gwennol and merged with flood waters from the Maes Gwilym Drain, which according to residents had entered Llys Gwennol from the back of Nos 2 and 3, as shown in Photo 2 below, which has been supplied by NRW

Photo 2 showing the direction water came from the Maes Gwilym Drain into Llys Gwennol.

Nos 2 & 3 suffered no internal flooding, but unfortunately this flow, coupled with the brushed/pumped water from Maes Y Gog, caused internal flooding to Nos 7, 8, 9, 11,12, 13 at Llys y Gwennol and 83 Maes Y Gog, as shown in figure 27

From NRW's on site investigation, it was evident that the watercourse had come out of channel where there were two sharp almost 90 degree changes in direction of the channel. Figure 27 shows the location of these bends along with the flood flow direction. Water in the Maes Gwilym Drain is at maximum vclocity at these two bends and overtopping occurs.

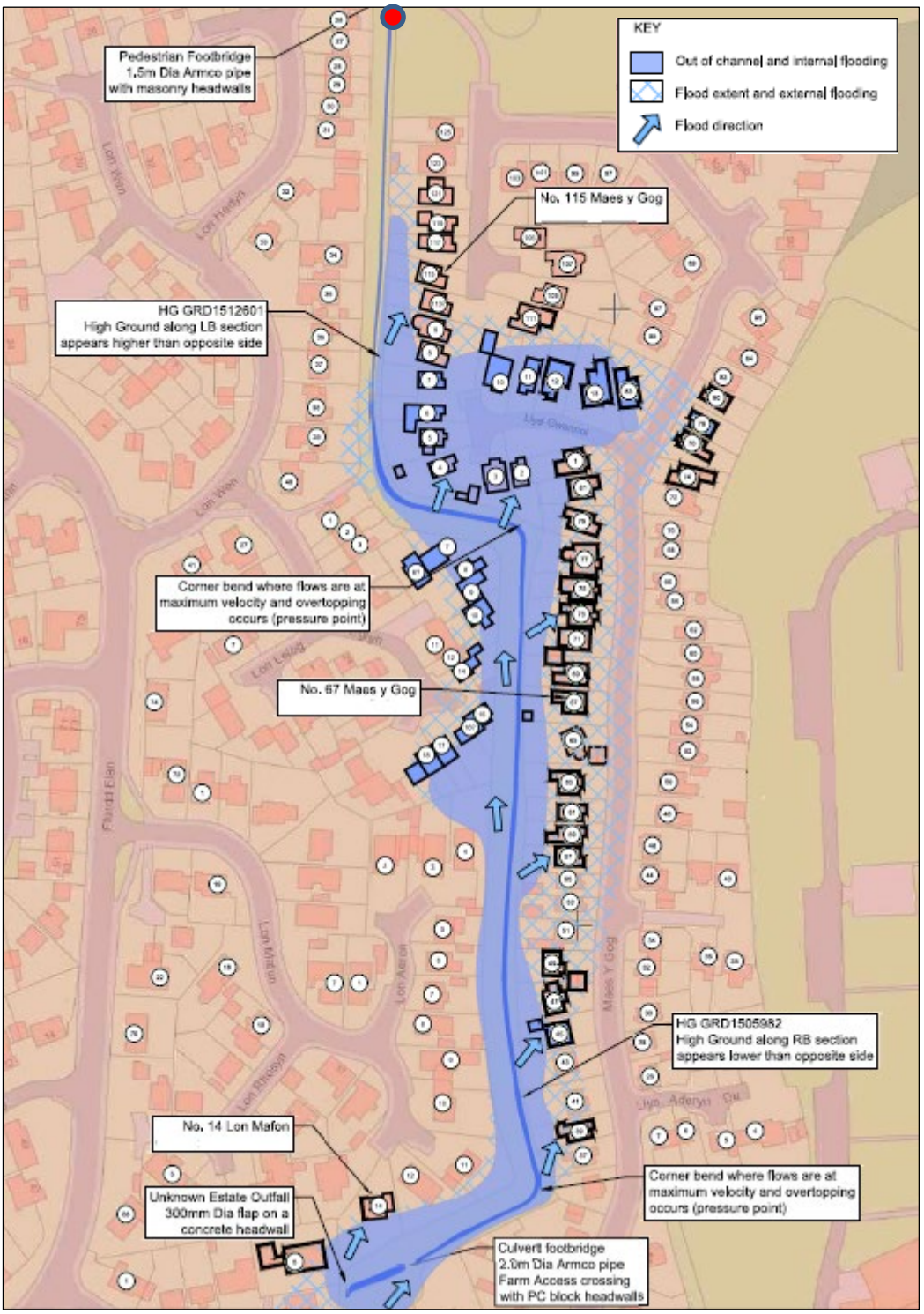

Figure 27: *Flood source map from the Maes Gwilym Drain, courtesy of NRW*

From the above Figure (27), the first bend is located behind No 39 Maes Y Gog and No 14 Lon Mafon. Here the water overtops and enters the back of properties at Maes Y Gog. Water also overtopped the left bank as witnessed by the resident of No 14 Lon Mafon who stated that the small culvert footbridge marked in the figure also restricted flows further and caused overtopping into the resident's back garden. The second bend is directly behind Nos 2 & 3 Llys Gwennol which would explain the anecdotal evidence from

residents at Llys y Gwennol that water came into the Estate from behind these two properties.

No other blockages were observed in the watercourse itself, although it might be that the footbridge culvert further down-stream of Llys y Gwennol (see red circle in figure 27 for location) may have restricted flows further, but there was no evidence of over-topping here. According to a resident of Maes Y Gog, there is also a possibility that the upstream culvert at the railway crossing and Lyons Holiday Park caused water to back-up to the Maes Gwilym Drain as both were aledgedly blocked with debris on the day of the flooding, Photo 3 and 4 show both culverts respectively, but were not taken on the day of the flooding.

Photo 3: Lyons Culvert

Photo 4: Railway Culvert

Referring back to figure 27, Lon Eglyn was also hit by the flood waters from the Drain, with up to 10 properties on the Estate experiencing internal flooding by the Drain, which ingressed in from the back gardens. It's worth pointing out that the ground is a lot higher on the left bank side of the channel compared to the Maes Y Gog side so the extent may have been on a slightly lesser scale.

During the door knocking exercise by DCC, some affected residents at Lon Eglyn reported surface water flooding from the front.

DCWW is responsible for the sewerage infrastructure serving Maes Y Gog/Llys Gwennol/Lon Eglyn, with figure 28 showing the sewerage network for this area as being combined, which drains to the main Rhyl Coast Road Pumping Station (see figure 4 for

location). This pumping station also has a storm overflow facility that discharges to the Rhyl Cut during storm conditions.

Some of the surface water for Lon Eglyn/Llys Y Gwennol/Maes Y Gog is collected and discharged into the local watercourse system.

The drains in the vicinity of the flooding at these locations may have surcharged during the event while the pumping station caught up, primarily due to the volume of flooding from other sources. DCWW deem this type of flooding to be coincidental where, flooding has occurred but the public sewer system is not at fault and has been inundated by an external source of water, in this case from the local watercourse system.

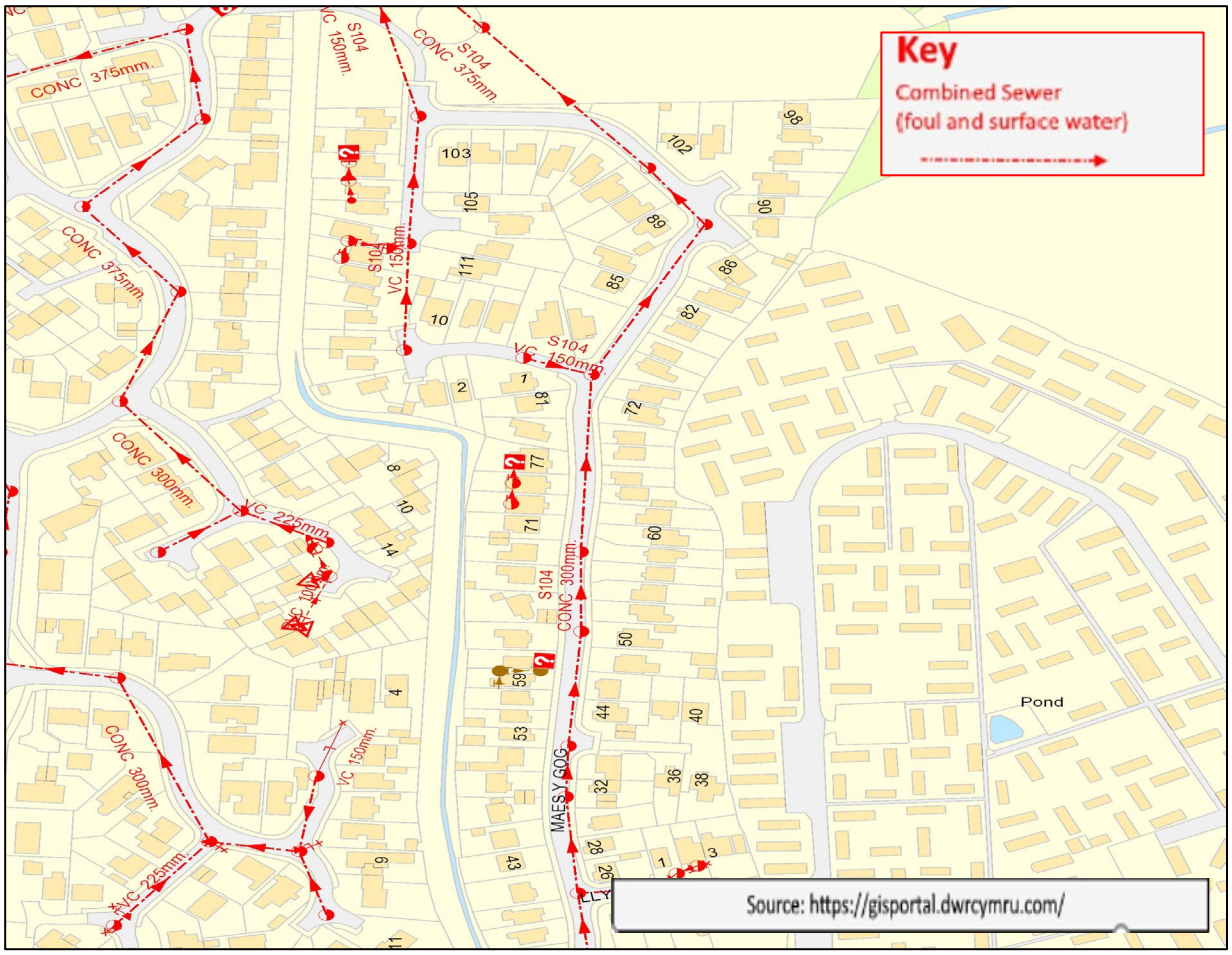

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Figure 28 : *DCWW apparatus at Maes y Gog/Llys Gwennol & Lon Eglyn*

How likely it is for that scale of flooding to happen again?

In terms of the likelihood of this type of flooding happening again, the NRW Flood and Coastal Erosion Risk Maps for Rivers shows in figure 29 parts of Llys Y Gwennol having a medium to high risk of being flooded by the Maes Gwilym Drain.

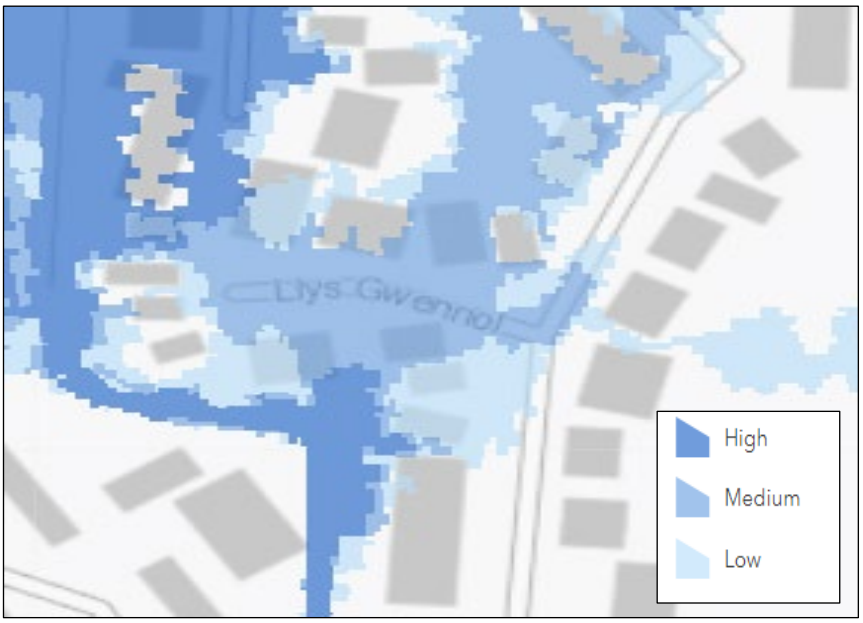


Figure 29: *The NRW Flood and Coastal Erosion Risk Maps for Rivers showing Llys y Gwennol*

For Lon Eglyn, figure 30 shows that the Risk Maps for rivers and surface water flooding does not currently have the effected houses as being at risk of flooding from these two flood sources. Hence, it is difficult to say how likely the scale of flooding from Storm Babet will happen again, but there is a potential contributing factor to flood risk through surface water, most notably the on-going housing development upstream of Maes Y Gog, which was granted planning permission prior to the statutory implementation of sustainable drainage (SuDS) for all new devlopements over 100 square metres.

Figure 30**:** *The NRW Flood and Coastal Erosion Risk Maps for Rivers and surface water showing Lon Eglyn*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Include Maes Y Gog, Llys Gwennol & Lon Eglyn in a WG funded scheme, which looks at ways to reduce and manage urban water catchments
- The low spots on the right bank wall of the Maes Gwilym Drain need to be addressed by NRW.
- Consider the merits of installing flood sensors at various points along the Maes Gwilym Drain to monitor river levels, although for this to have a benefit it would need to be managed by a Local Flood Action Group
- Encourage and assist with a potential Local flood Action Group.
- Carry out further engagement with relevant stakeholders to see what improvements can be made, for example, NRW will ensure that the Maes Gwilym Drain will still get the one annual weed cut although this will be brought this forward in the programme so that it is now in line with the section alongside the railway and into Rhyl Cut East. This change means that it will now get cut in September instead of November, which will be monitored as part of NRW's asset inspection and if a second cut is needed in early Winter, NRW will carry out the necessary work.
- NRW to carry out modelling work at Lon Eglyn at Maes y Gog to show the increased flood extent areas folloing Storm Babet.
- Look at funding avenues with Welsh Governemnt to investigate the potential for retrospective SuDS at the Aberkinsey devlopement, as well as nature based flood management solutions. It could lead to partnership working with the other relevant stakeholders such as DCWW and NRW

7.1.4 Walford Avenue – Plas Cyril/Inferno Dance Studio

Why did the flooding happen?

The DCC owned sheltered housing complex know as Plas Cyril suffered internal flooding to 5 ground floor flats. The Inferno Dance Studio also experienced internal flooding

From investigations carried out by the Council and Natural Resources Wales at these two locations, it was determined that for Plas Cyril, all 5 ground floor flats were flooded internally by surface water alone, predominately flowing off Walford Avenue. The surface water flow pooled outside the homes in the lowered gardens and entered the properties

via the front doors. The gardens in front of the properties are lower than the threshold of the properties.

Upon further investigation of the drainage here, no surface water connections were identified as connecting directly to the Rhyl Cut, which had high levels at the time of the flood. The entire area around Plas Cyril is in fact drained by the combined sewer network which was overwhelmed during the Storm Event.

The surface water which effected Plas Cyril also flowed towards the Dance studio with water entering from the rear and rapidly spreading throughout the ground floor area. The Owner of the Dance Studio told NRW during their post storm data gathering that flooding had been anticipated due to similar events in the past. All dance items were therefore boxed and moved upstairs where possible. Flooding continued throughout the day and only receded on the Saturday. Skips were organised to remove carpets and flooring materials

The sewage and drainage pipes had also reached capacity and raw sewage was present in a yard to the side of the Studio. Apparently DCWW had been in to jet and empty pipes and chambers within the vicinity and were due back at some point to continue cleaning the yard area located alongside the Dance Studio.

Figure 31 shows the flow route and flooding extent for the Plas Cyril and the Dance studio.

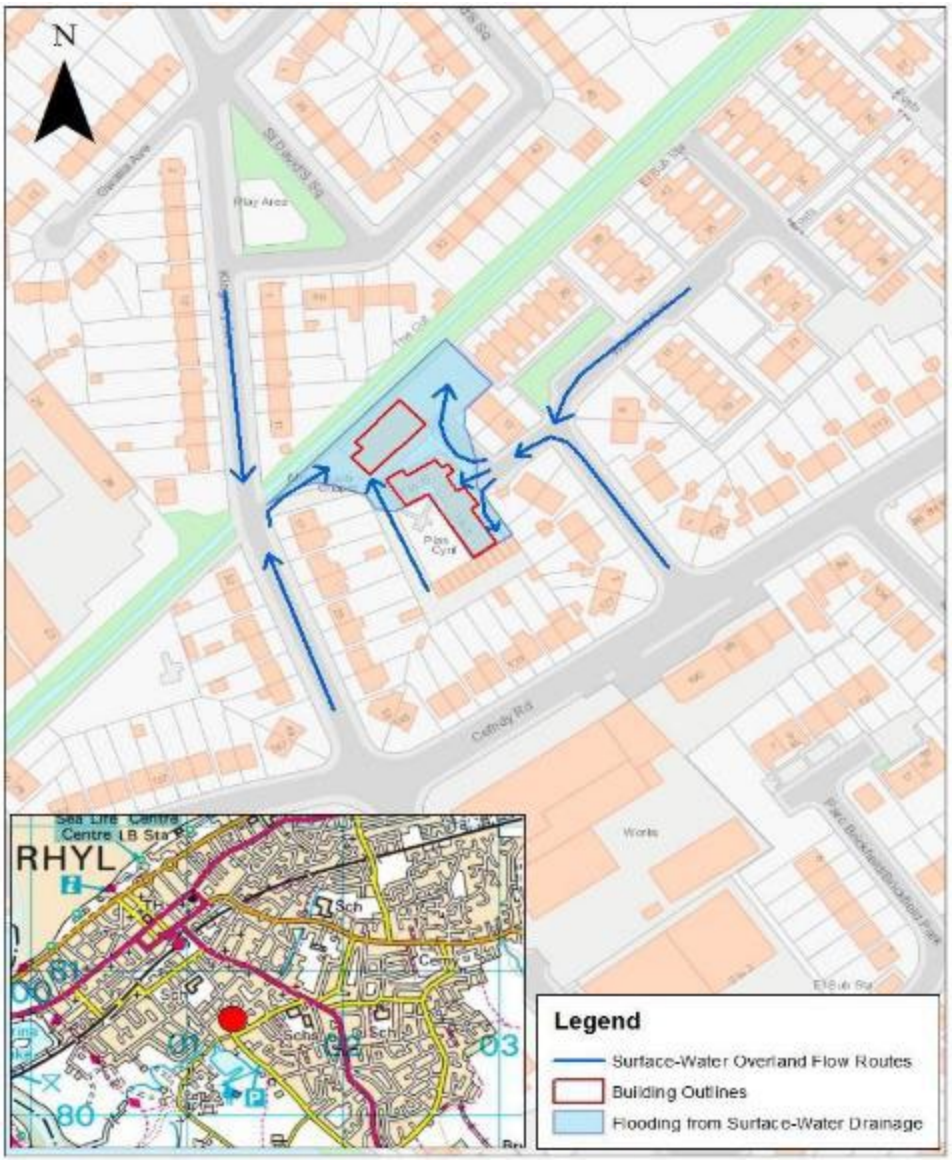


***Figure 31**: Flood outline and direction for Plas Cyril and the Dance Studio*

How likely it is for that scale of flooding to happen again?

For Plas Cyril and the Dance Studio, the chances of surface water flooding occurring again is at low to medium risk as shown in figure 32 below, which was taken from NRW's Flood and Coastal Risk Maps.

Both properties were flooded in 2017, with the Dance Studio in particular suffering further flooding in the past from the Rhyl Cut. Indeed, figure 33, from the Flood and Coastal Risk Maps for Rivers puts both properties at medium to high risk of flooding from rivers, that is, the Rhyl Cut.

Figure 32: *Surface Water Flood Map at Plas Cyril and the Dance Studio*

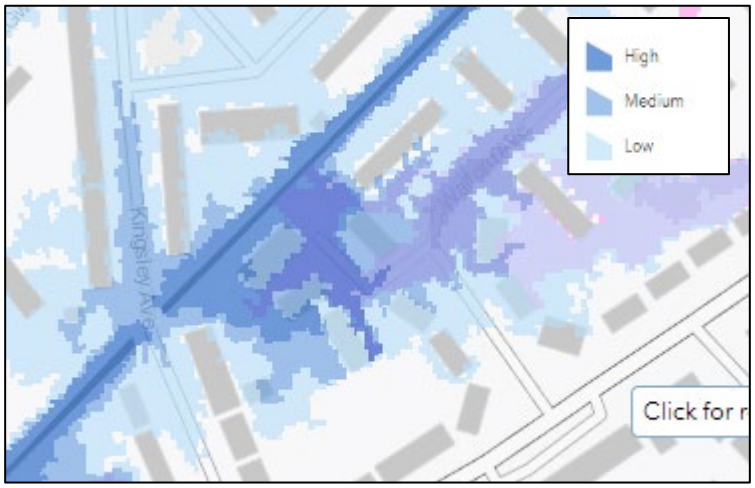


Figure 33: *NRW Flood and Coastal Risk Maps for Rivers at Plas Cyril and the Dance Studio*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Encourage the use of PLP for Plas Cyril and work with DCC Housing in the short term in relation to this.

- Work with relevant stakeholders to understand better the flood risk to the Dance Studio in terms of the maintenance of the Rhyl Cut and capacity issues of the sewer systems.

7.1.5 Locations in Rhyl that experienced near misses

Although these are classed as near misses, it is important to mention such loactions within this Report, especially given the impact on residents and DCC in trems of dealing with flooding issues.

In particular, the East of Rhyl experienced extreme highway flooding with countless near misses to dwellings at Lon Wen, Llys Y Twysog, Walnut Crescent, Fern Close, Aspen Walk, Sholing Drive, Eastville Avenue, Oakville Avenue, Edgbaston Road and Brynheddyd.Road, to name but a few. There were also some reports of sewage within the surface water, especailly at Edgbaston Road.

The Marine Caravan Park in the West of Rhyl also suffered serious flooding, with residents having to be evacuated. NRW are working with Marine Camp Holiday Park and undertaking CCTV works at Culvert Location. Work starts shortly.

A primary school also had to close after rain caused its toilets to "over flow".

A property on Grange Road suffered from water ingress under the floorboards, which also caused the electric to go off. This is a historic issue with the back garden of that Property experiencing flooding in the past from the playing field at Rhyl High School. Drianage work has been carried out by DCC, hence, further investigation is required as to why Storm Babet resulted in a reoccurance of the flooding.

7.2 Prestatyn/Meliden

7.2.1 Winchester Drive

Why did the flooding happen?

Based on the door knocking data gathering by DCC, Property Numbers 1 and 3 on Winchester Drive experienced internal flooding as a result of a hydraulic overload of the DCWW drainage systems.

Residents of Property number 1 were visited to discuss the flooding, which had caused severe internal damage to the Property. Photos 5 and 6 below show the extent of the flood at this Property.

Photo 5 – Flooding at No 1 Winchester Drive

Photo 6 – Flooding at No 1 Winchester Drive

At the time of the data collection, we were unable to speak to the owner of number 3, but the residents of No 1 confirmed that they had suffered the same fate.

NRW data collection at Winchester Drive also confirmed internal flooding to No 5, which stated that water entered the property from the rear and suggested that the source was the Prestatyn Gutter. Further flooding occurred via the property airbricks, with possible surface water flooding via the front door.

Welsh Water are responsible for the sewerage infrastructure at Winchester Drive. Figure 34 shows the the network at this location to area be combined, which drains to the main Marine Park Pumping Station (see figure 5 for the location). This pumping station also has a storm overflow facility that discharges to the Prestatyn Cut during storm conditions.

Some of the surface water for this area is collected and discharged into the Prestatyn Cut system. Local resident reports suggest the Gutter was high on the day of the Storm, hence surface water would have struggled to drain

The drains in the vicinity of the flooding may have surcharged during the event while our pumping station caught up, primarily due to the volume of flooding from other sources. We deem this type of flooding to be coincidental where, flooding has occurred but the public sewer system is not at fault and has been inundated by an external source of water, in this case from the local watercourse system both in the close proximity of the properties

but also the wider catchment area.

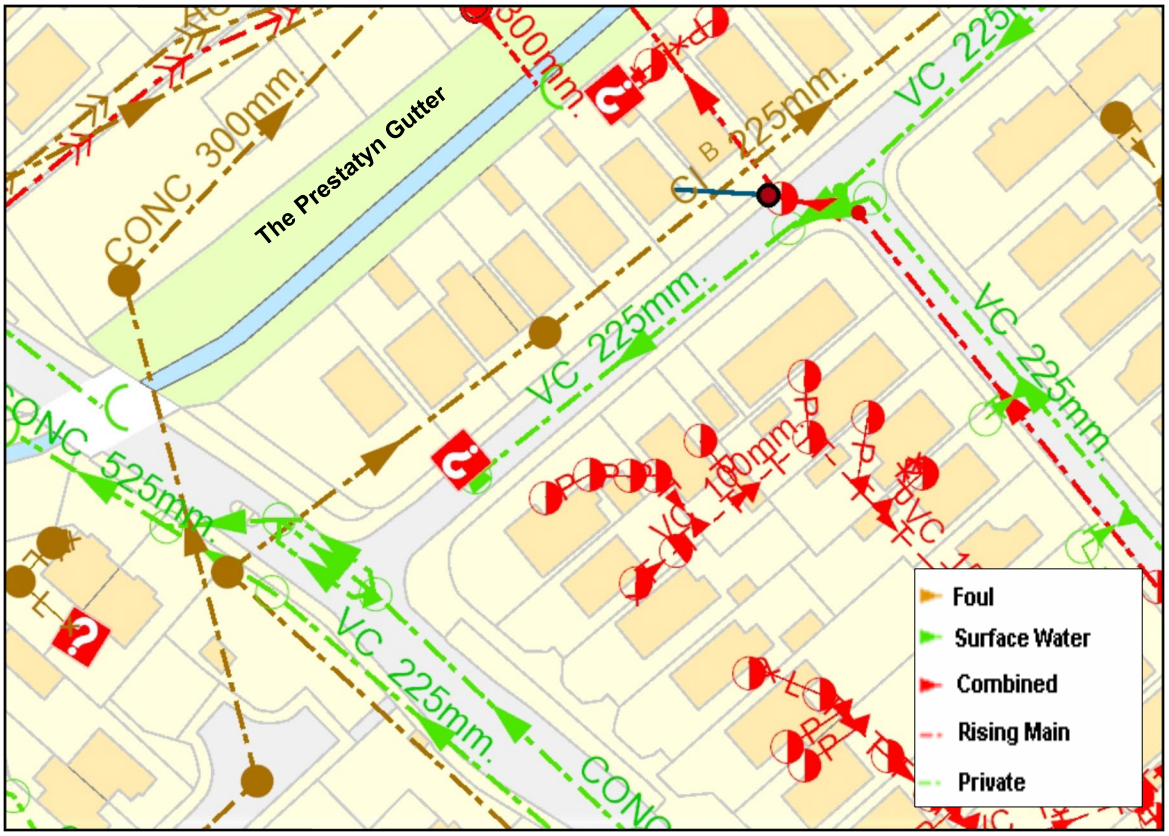


Figure 34: DCWW drainage apparatus map for Winchester Drive

How likely it is for that scale of flooding to happen again?

Historically sewer flooding has occurred at this location on Winchester Drive on a number of occasions, notably 2007 & 2008, with near misses as recently as 2017.

Figure 35 below taken from the NRW Flood and Coastal Erosion Risk Maps, shows Winchester Drive from numbers 1 to 17 having a high risk of being flooded from the Main River, that is the Prestatyn Gutter.

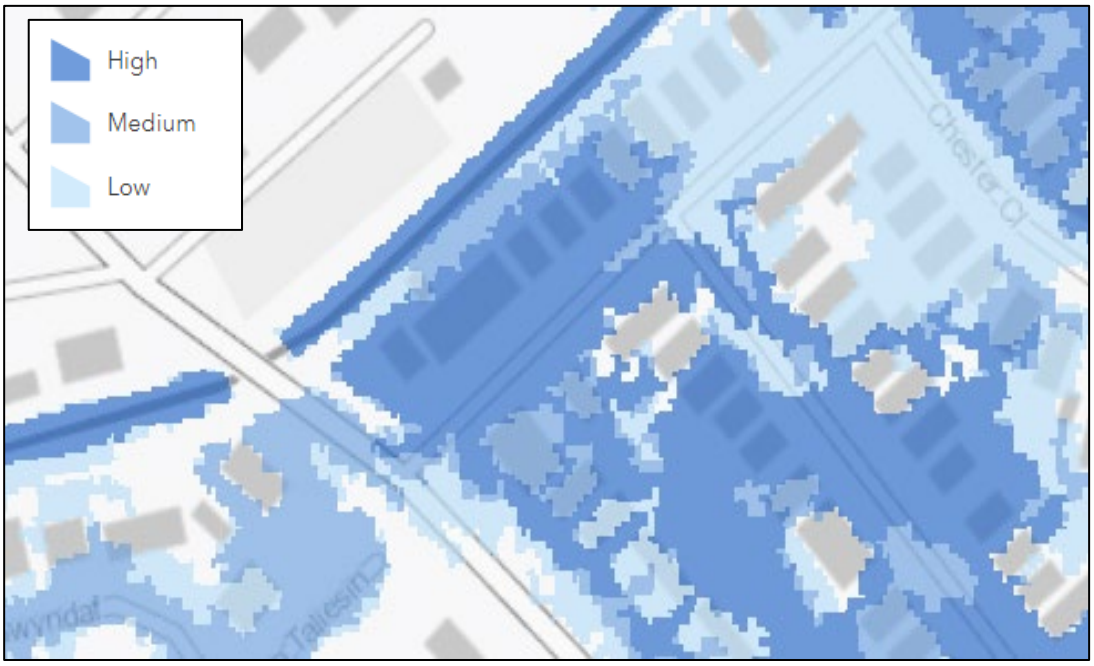


***Figure 35**: NRW Flood and Coastal Erosion Risk Maps for Rivers at Winchester Drive*

On the other hand, for surface water, the NRW Risk Maps in figure 36 show a low to medium risk of surface water flooding occurring for properties 1 to 7 on Winchester Drive.

***Figure 36:** : NRW Flood and Coastal erosion Risk Maps for Surface Water at Winchester Drive*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- To engage with all relevant stake-holders to understand how the drainage systems work and what can be done to improve the flood risk issue

- Affected properties should also consider PLP.

7.2.2 Ffordd Penwhylfa

Why did the flooding happen?

All the ground floor flats from No 88 to No 102 experienced internal flooding on the 20th October as a result of Storm Babet**.**

Highway gullies feed into the DCWW surface water system which discharges into the Prestatyn Gutter. It's Likely that due to high levels in the Gutter, water was unable to discharge effectively, hence water backed up and flooded the highway, which then made its way to the ground floor flats as shown by the blue arrows in figure 37 below.

Figure 37: **Flow direction of flood waters at Ffordd Penwhylfa**

Gravity made the situation worse since as photo 7 below shows, the flats are a lot lower than the adjacent road

Photo 7: *Photo showing the drop in gradient in front of the flooded ground floor flats at Ffordd Penwhylfa*

How likely it is for that scale of flooding to happen again?

Figure 38 from The NRW flood risk maps shows a low risk of surface water flooding for Ffordd Penwhylfa, although historically some these ground floor flats flooded in 2007 and 2008.

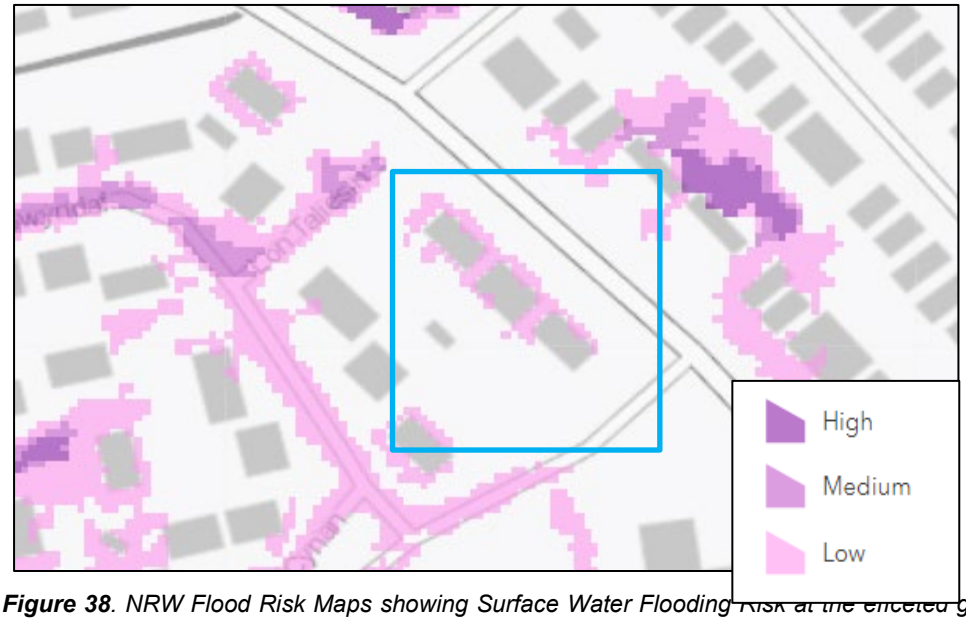


Figure 38*. NRW Flood Risk Maps showing Surface Water Flooding Risk at the elected ground floor flats on Ffordd Penwhylfa*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- To engage with all relevant stake-holders to understand how the drainage systems work and what can be done to improve the flood risk issue
- DCC strongly recommend residents investigate PLP

7.2.3 Meliden – Pwll y Bont

Why did the flooding happen?

Pwll y Bont is a street in the town of Meliden, Denbighshire. The Flood investigation area comprises a mixture of residential properties and greenfield land.

The Prestatyn Gutter flows north-east through the northern extent of the site and is culverted under Ffordd Penrhwylfa directly north-east of the site. The Gutter is also culverted beneath several property driveways leading off Pwll y Bont.

A total of five properties were flooded as a result of Storm Babet, with anecdotal evidence suggesting that the flood water came from upland area behind Pwll y Bont and flowed overland towards the Gutter, flooding 3 properties along the way, before entering the Gutter, which then over-top and flooded two further properties.

Figure 39 below shows the ground elevations for the investigation area, which confirms the higher ground behind.

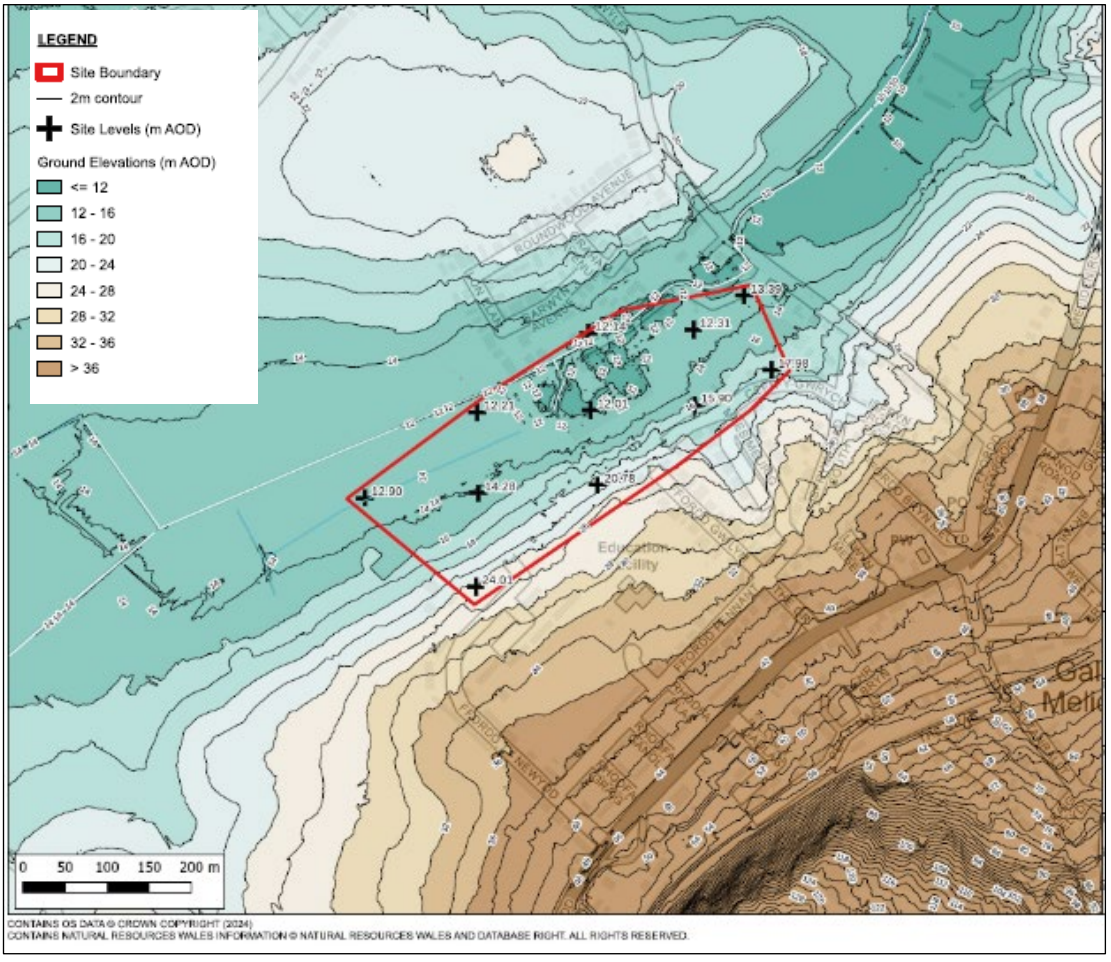


Figure 39: *Ground elevations in relation to the flood investigation area at Pwll y Bont*

Hence, it is likely that surface water inflow upstream of the site from ditches (minor watercourses) and runoff from the upland area flowing towards Prestatyn Gutter caused and contributed to the internal flooding of 5 properties at Pwll y Bont.

How likely it is for that scale of flooding to happen again?

3 properties were flooded at Pwll Y Bont as a result of Storm Christophe 2021. Residents commented at post Christophe that the Prestatyn Gutter was blocked, causing a restriction to flow. The depth of water outside “The Mallows” flooded to a depth of almost 2 foot and remained in place for about three hours.

Figure 40 below shows the Fluvial flood extent at Pwll Y Bont taken from the NRW Flood Risk Maps for Rivers.

***Figure 40**: NRW Flood Risk from Rivers at the Pwll y Bont Investigation area*

Approximately 9 properties along Pwll y Bont are within the fluvial flood extent

With regard to the flood risk extent from surface water at Pwll Y Bont, there is a low to medium risk of such flooding occurring for 4 of the properties within the investigation area, as shown in figure 41 below.

***Figure 41**: Flood risk from surface water at Pwll Y Bont, taken from the NRW flood risk Maps*

Furthermore, a Flood Risk and Drainage Review at Mindale Farm, which is south-west of the investigation site at Pwll y Bont was undertaken by flood consultants in 2017. The report detailed that the Farm received surface water from the upstream urban drainage catchment. The report also mentions previous issues surrounding groundwater flooding.

Anecdotal evidence provided by residents also suggest that flooding incidents have become more frequent since new developments along Meliden Road and at Llwyn Mesen have taken place,

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Further investigation is required to ascertain how the surface water drainage connections from the new housing developments nearby were made to the Prestatyn Gutter and if they are contributing to the flooding at Pwll y Bont.

- To include Pwll y Bont In the WG funded scheme, which looks at ways to reduce and manage urban water catchments for Prestatyn/Meliden

7.3 Dyserth

7.3.1 The section of Waterfall Road running parallel with the Afon Ffyddion

Why did the flooding happen?

The upstream catchment (see section 4.2.1) for the Afon Ffyddion during storm events such as Babet brings a high volume of water to the lower reaches of the Watercourse where it passes through the Village of Dyserth. Given this volume, the main cause of

flooding is lack of capacity within the channel to cope, as well as crossings/culverts along this section restricting flows further. Therefore, on the 20th October, this scenario played out, which caused the Afon Ffyddion to over-top onto Waterfall Road and consequently cause internal flooding to 3 properties and 1 business.

Photo 8 below shows the extent of the flooding on Waterfall Road, which also shows one of the crossing points causing restriction issue within the Channel.

***Photo 8**: Flooding from the Afon Ffyddion onto Waterfall Road*

How likely it is for that scale of flooding to happen again?

There is a long history of flooding at Dyserth. Old photographs reveal that significant flooding has occurred during most decades since the 1930's. The most recent major flood event occurred in 2000, when more than 30 properties were affected, although there have been several incidents since, most recently in 2021 following Strom Christophe.

Figure 42 below from the NRW Flood Risk Maps for Rivers shows the investigation area to have a high risk of fluvial flooding

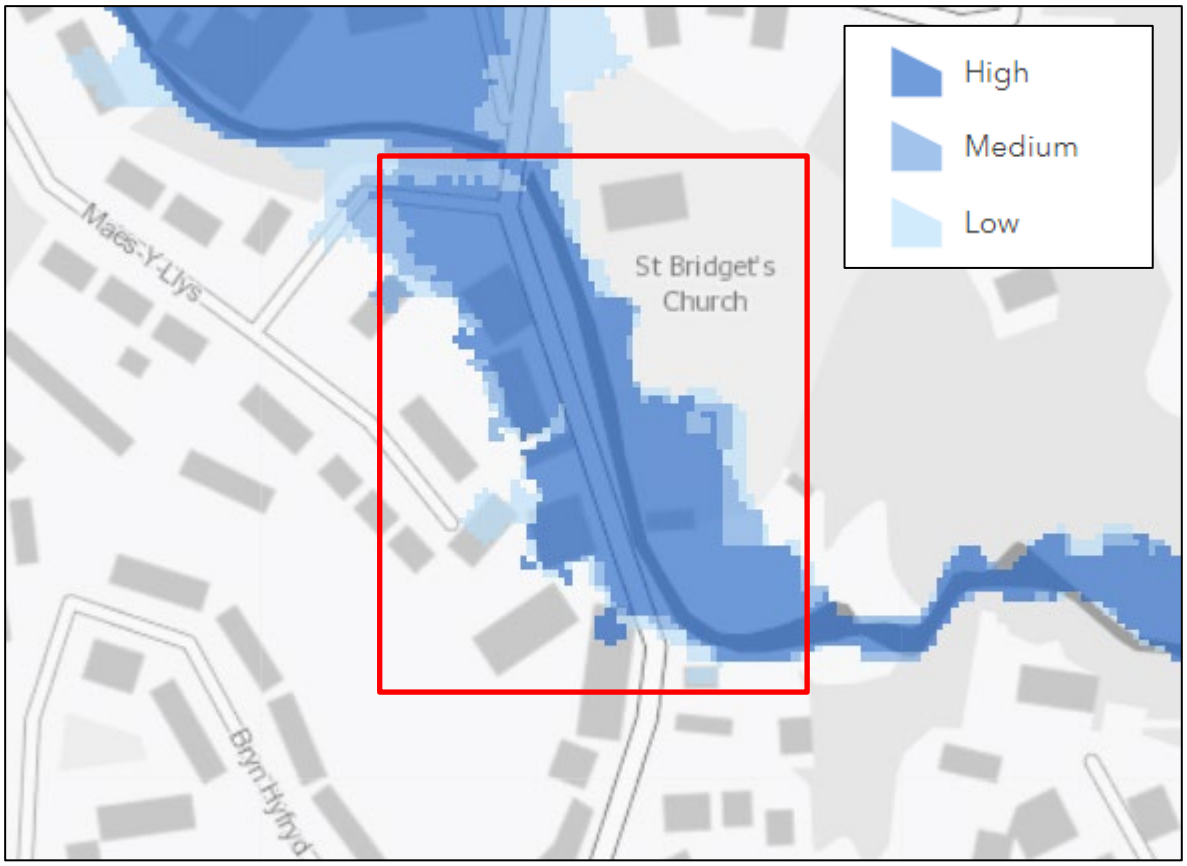


Figure 42: *NRW Flood Risk Maps for Rivers for the investigation area at Waterfall Road*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Progress with the detailed design element of a flood alleviation scheme for Dyserth. This includes work to both the upper and lower catchments, with a view to construction of the Scheme commencing in 2025/26, subject to viable funding and agreements.

- Smaller elements of the Scheme to be brought forward for construction if the full detailed design has to be shelved.

- Work with the local flood action group and provide assistance where possible.

- DCC has secured WG funding for PLP for those at risk in the lower catchment reaches of the Afon Ffyddion. Therefore, the aim is for DCC to purchase suitable flood barrier protection in the 2024/25 financial year and to arrange for the Local Flood Action Group to manage the installation of the barriers when required.

7.3.2 Lower Waterfall Road opposite Lyndholme

Why did the flooding happen?

The highway drainage system within this section of the Road couldn't cope with the excess water as a result of Storm Babet and therefore water surcharged from the man-hole opposite the property known as Lyndholme and caused internal flooding.

How likely it is for that scale of flooding to happen again?

This is the second time Lyndholme as experienced internal flooding, the first being as a result of Storm Christophe in 2021.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Post Storm Babet, the effected drainage systems have been cleaned out

- Another man-hole has also been installed.

- Further investigation required in terms of line of culvert, with the possibility of a feasibility study to divert the line of the culvert.

7.3.3 Pandy Lane – Glan y Afon Cottage

Why did the flooding happen?

Glan y Afon Cottage on Pandy lane suffered internal flooding due to the Afon Ffyddion overtopping as a result of the storm conditions, as shown in photo 9

Photo 9: *Flooding from the Afon Ffyddion at Glan y Afon Cottage*

The floodwater flowed out of the river bank and made its way around Glan y Afon Cottage before being impounded by the garden wall, which may have caused the flood water to back-up and increase the depth of flooding. This however will need further investigation via modelling to confirm the flood outlines.

There was also debris build up at the highway bridge adjacent to the Cottage, caused mainly by fallen trees which had washed down from the heavily wooded catchment as a result of the Storm. DCC operatives cleared debris build-up during the morning of the Storm.

How likely it is for that scale of flooding to happen again?

Glan Y Afon was flooded in 2021 as a result of Storm Christophe. The NRW Flood and Coastal Risk Maps for Rivers has it classed as high risk as shown in figure 43 below.

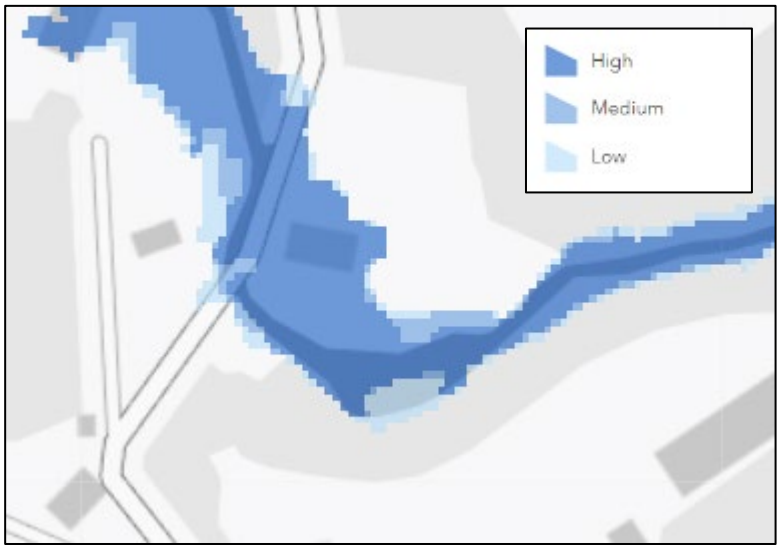


Figure 43: *NRW Flood and Coastal Risk Maps for Rivers at Glan y Afon*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- The owner of Glan Y Afon Cottage is hoping to construct a bund in the garden to protect the Property, but this would require modelling prior to construction in order to determine what level of protection is required. Consideration of flows should also be taken into account to ensure any works do not increase flood risk elsewhere.

- DCC to therefore provide possible assistance, through revisiting the hydraulic model for the Dyserth Flood Risk Management Scheme so as to advise what level of work to the river can be carried out by the owner of Glan Y Afon.

- Keep the owner of Glan Y Afon updated on the Dyserth Flood Risk Management Scheme

- Provide the owner with details of companies who install PLP.

7.4 St.Asaph

7.4.1 Llys y Felin

Why did the flooding happen?

The Intense rainfall experienced during Storm Babet, caused spilling from the DCWW tank (CSO) into the system which outfalls into the Elwy via a non return flapvalve. However, the River Elwy was high, that is, showing a maximum level of 4.44 metres[2],

which consequently caused water to back-up in the system and eventually surcharge out through a man-hole. The floodwater then flowed in a northerly direction towards the DCC owned flats at Llys y Felin and caused internal flooding to 6 flats.

Following flood modelling done by flood consultants, minimal input is shown into the gullies along St.Asaph High Street and therefore, it is the incapacity of the DCWW sewer system and tank (CSO) which caused the flooding.

Figure 44 below, taken from the modelling shows the flow extent and maximum flood depth during Storm Babet.

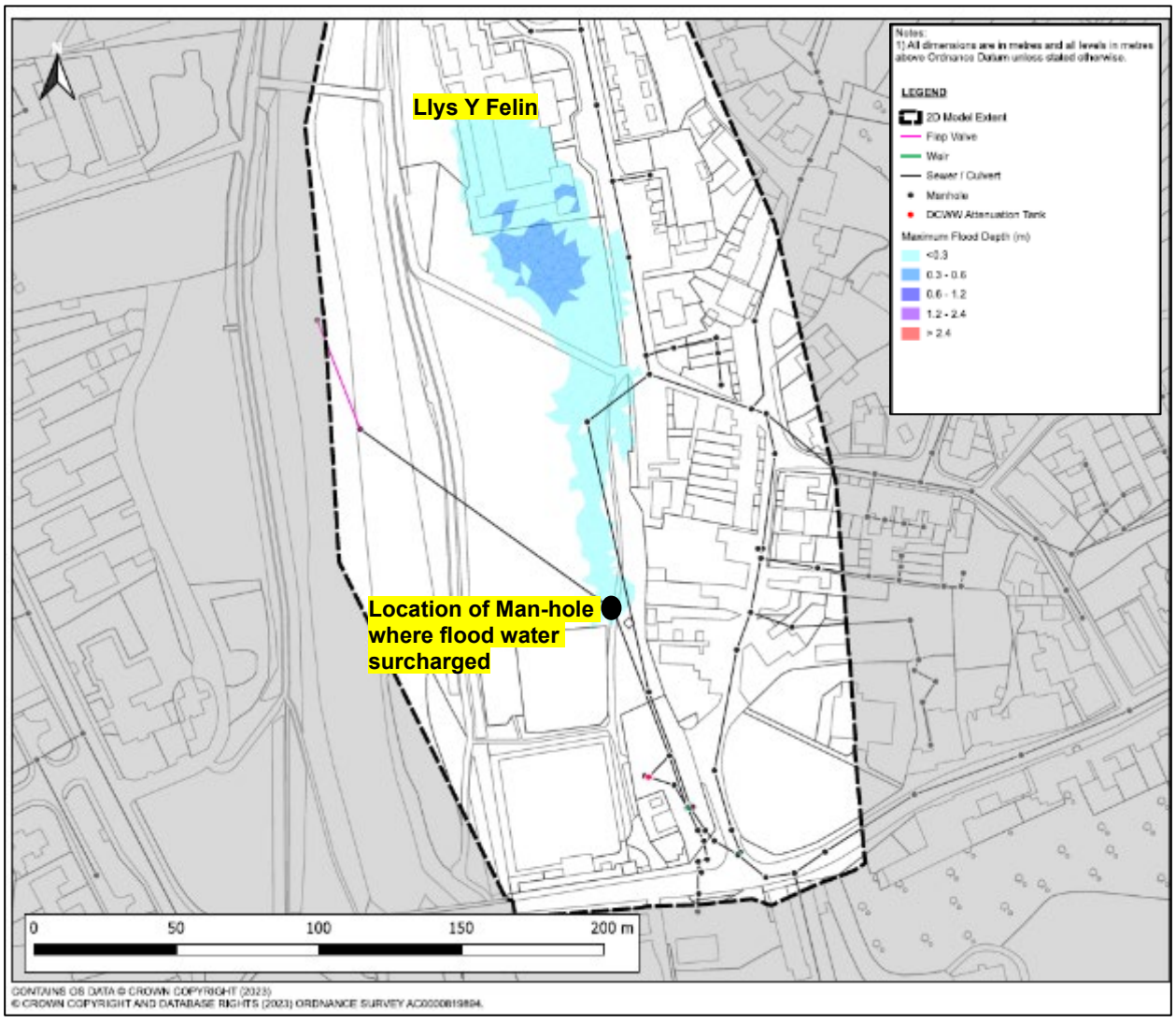


Figure 44. *Maximum Flood Depth during Storm Babet at Llys y Felin*

How likely it is for that scale of flooding to happen again?

Flooding to Llys y Felin also occurred in 2021 following Storm Christophe. Figures 45 and 46 from The NRW Flood and Coastal Risk Maps show that for Llys y Felin it has a high

risk of flooding from surface water and small watercourses, whereas for for flooding from rivers, it is low risk.

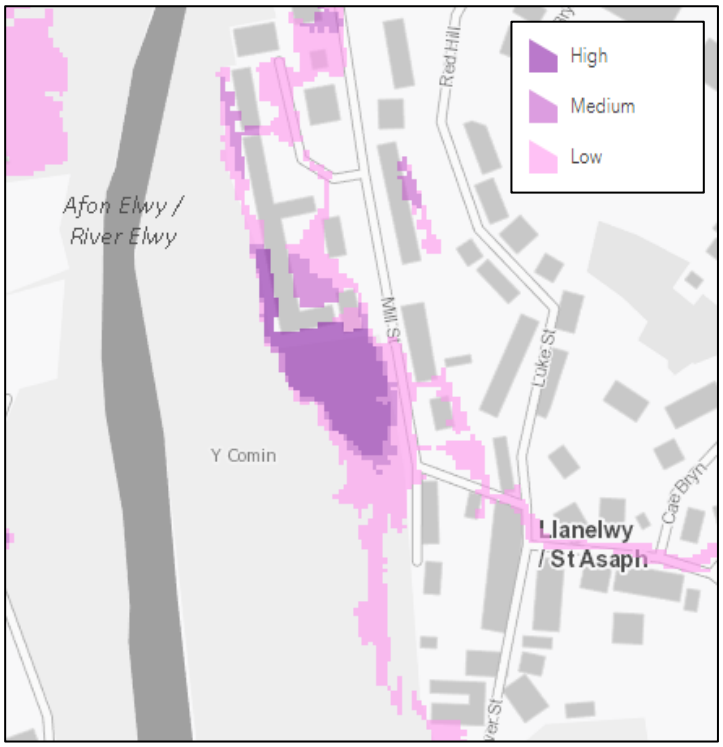


Figure 45: *NRW Flood and Coastal Risk Maps for Llys y Felin showing risk of flooding from surface water and small watercourses.*

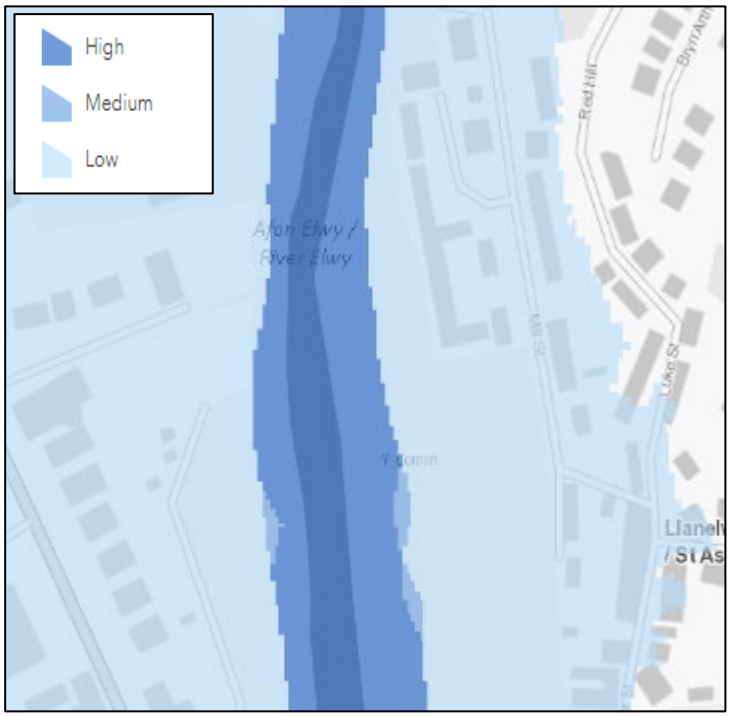


Figure 46: *NRW Flood and Coastal Risk Maps for Llys y Felin showing risk of flooding from rivers*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Flood consultants have been employed by DCC to come up with feasible options for mitigating the flooding. Continue this arrangement and also work with DCWW to come up with suitable options.

- DCC housing who manage the Llys y Felin are considering property level protection until a more sustainable solution can be determined

7.4.2. Hoel Esgob/Ashley Court

Why did the flooding happen?

As discussed in Section 4.3.2, the highway surface water connection to the DCWW combined system has been stoppered off. Consequently, this is now contributing to a more frequent localised flooding issue in and around Hoel Esgob/Ashley Court, as experienced during Storm Babet.

One property on Ashely Court suffered internal flooding, but there were also numerous near misses as a result of flooding to gardens and roads.

How likely it is for that scale of flooding to happen again?

Localised flooding occurs on a frequent level at Hoel Esgob, but usually it is to the roads and gardens in this area.

Figure 47 from the NRW Flood and Coastal Risk Maps has Hoel Esgob and Ashley Court as high to low risk from surface water and small watercourse flooding.

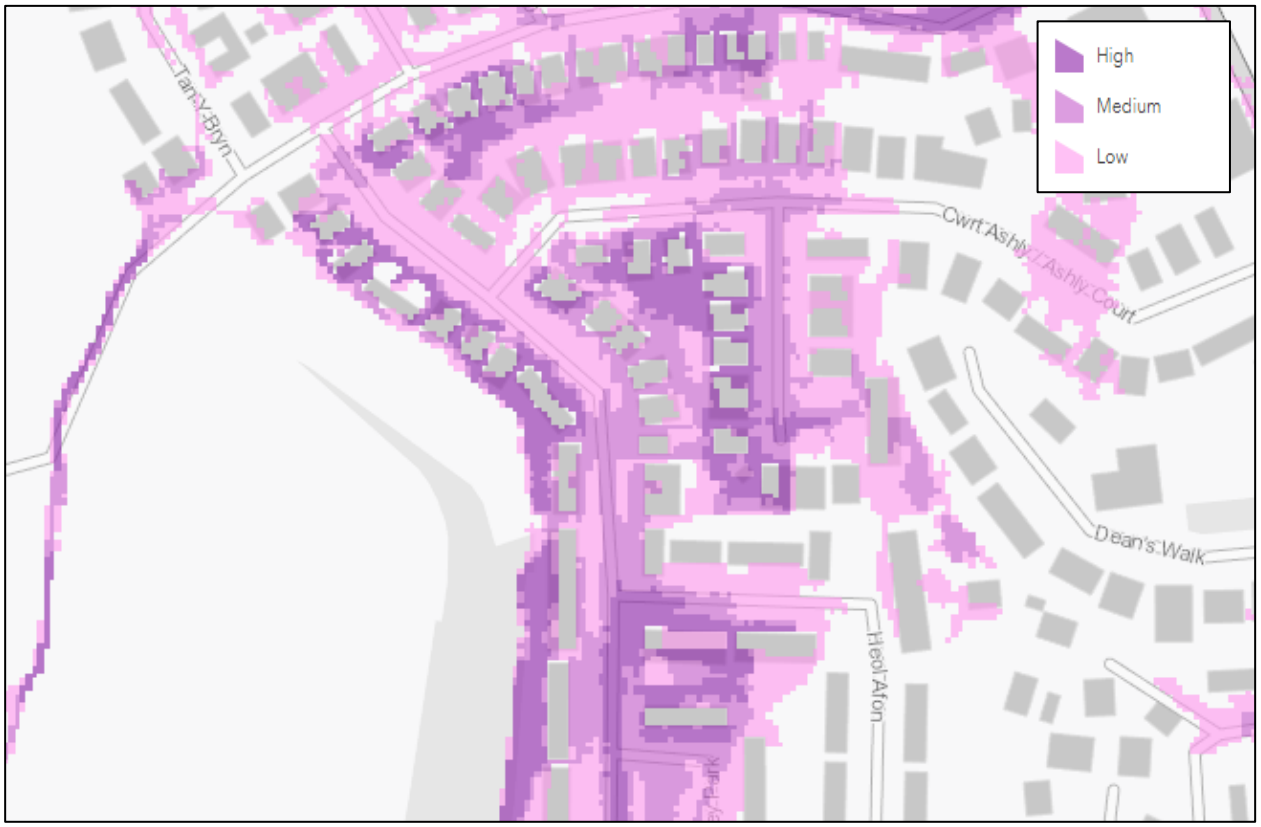


Figure 47: *NRW Flood and Coastal Risk Maps showing flood risk from surface water and small watercourses at Hoel Esgob/Ashley Court*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- To encourage properties at Ashley Court and Hoel Esgob to consider PLP
- Re-visit the 2016 DCC commissioned Study Report by flood consultants to come up with a long term option to reduce flood risk at Hoel Esgob/Ashely Court.
- A possible solution could be to explore Natural Flood Management (NFM) within the catchment, as in potential storage, an option discussed in the 2016 Report.
- Apply to WG for funding in the 2025/26 application window to carry out a design for potential (NFM).

7.5 Denbigh

7.5.1 Denbigh Green

Why did the flooding happen?

Flooding occurred to multiple properties along the A525 in the Denbigh Green Area, with the flood water entering properties from the rear via numerous watercourses/ditches, which flow from the West to the East. DCC's current understanding of the causes of this flooding relates to issues with culverts under private landownership, notably the one within described in section 4.4.2. Either blockage or capacity led to the flooding, with culverts unable to cope with the large volumes of water.

Residents were observed pumping water out of their properties through their front doors and the fire service attended to one property.

How likely it is for that scale of flooding to happen again?

In 2021, Storm Christophe caused a number of near misses to properties within the Green area.

Figure 48 below from the NRW Risk Maps has the effected properties in close proximity to being at high risk from surface water and small watercourse flooding.

Figure 48: *NRW Flood Risk Maps showing flood risk from surface water and small watercourses at Denbigh Green*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- to work with landowners and assess what improvements can be made to these culverts, which may include reconstruction of headwalls or complete replacements of the culverts.

7.5.2 Denbigh – Brookhouse

Why did the flooding happen?

According to NRW post Storm Babet data collection, one property was confirmed to have suffered internal flooding.

The Property known as Glan Llyn experienced flood water from the Main River, that is, the Afon Ystrad. Flood water entered the Property from the rear, through a private river flood defence wall, which then spread throughout the ground floor and out through the front door.

It could be that the flooding was not directly as a result of the rain experienced on the 20th October since the already heavily saturated conditions within the Ystrad catchment as a result of the weeks leading up to the 20th may have contributed to the flooding experienced at Glan Llyn.

How likely it is for that scale of flooding to happen again?

It is the third time In the last four years that the Brookhouse area has experienced issues with flooding.

The NRW Flood and Coastal Risk Maps confirms that Brookhouse is at high risk of flooding from rivers, that is, the River Ystrad, as shown in figure 49

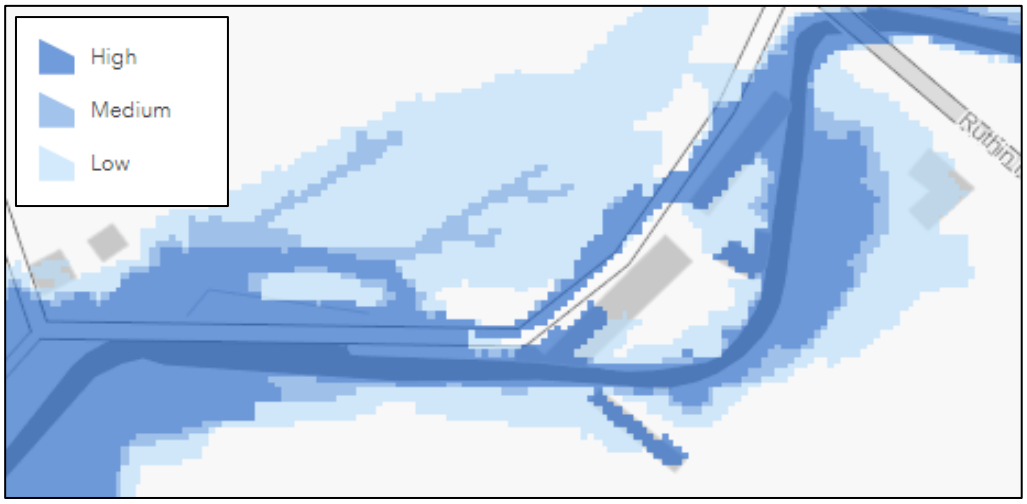


Figure 49: *NRW Flood and Coastal Risk Maps for Rivers at Brookhouse*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Liaise with NRW who manage the River Ystrad to see whether proposals laid out by them following the 2020 Flooding event at Brookhouse have been acted upon. That is:

- Consideration of the ability to provide improved warning and informing to residents, allowing additional time to prepare for flooding, could provide significant betterment at this location.

- Whilst including up to date hydrological and topographical datasets will increase confidence in the understanding of risk to the community of Brookhouse, this will most likely confirm the existing understanding and mechanisms of flooding. Consideration of improved warning and informing services to the community may result in more timely provision of service improvements at this location.

- Given the high risk of flooding associated with Brookhouse, It is likely that properties at Brookhouse will flood again from the Main River unless NRW undertake a flood alleviation scheme at this location.

7.6 Nantglyn – Segrwyd Mill

Why did the flooding happen?

The River Ystrad broke its banks behind the Property known as Sergwyd Mill and made its way into the Property via the back and front door. Photo 10 below shows the extent of the flooding from the back of the house

Photo 10: *Flooding from the Afon Ystrad at Segrwyd Mill, Nantglyn*

As with the Brookhouse, it is likely that the heavily saturated conditions within the Ystrad catchment contributed to the flooding experienced at Sergwyd Mill.

How likely it is for that scale of flooding to happen again?

Sergwyd Mill was flooded in 2020 on the back of Storm Ciara, but not to same extent as the flooding experienced from Storm Babet.

The NRW Flood and Coastal Risk Maps puts the Mill at high risk from river flooding, as shown in figure 50 below.

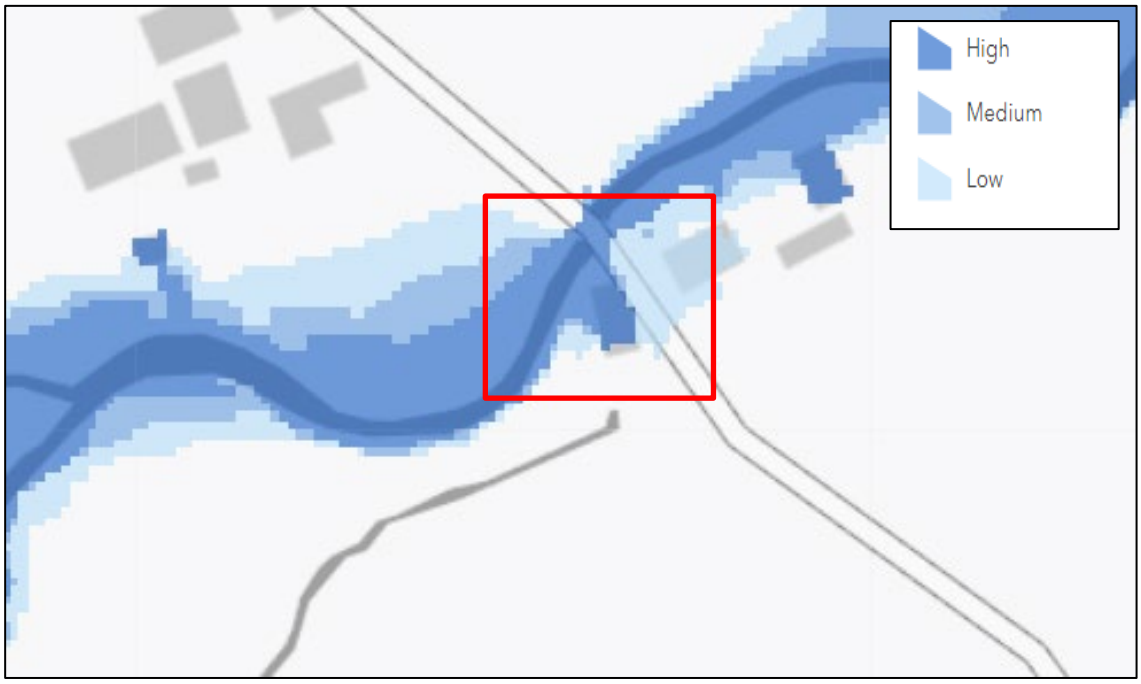


Figure 50: *NRW Flood and Coastal Risk Maps for Rivers at Sergwyd Mill*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- The owner of Sergwyd Mill is intending to invest in PLP for the front and back of the Property.
- NRW to carry out further investigation on this flood event

7.7 Llanarmon Yn Ial – Plas Isaf

Why did the flooding happen?

Flooding occurred as a consequence of both high flow levels in the River Alyn (Main River) and significant surface water flows coming off the highway being conveyed to an individual property known as Plas Isaf via its access track. Measures previously constructed by DCC (see photo 1 in section 4.6.2) to help reduce the risk of the water coming off the highway were overwhelmed, but predominately, the main source of flooding was the River flowing around a private wall structure.

Flood water entered the Property from the front via a low sitting floor, as shown in photo 11 below

Photo 11 *showing flood waters at the front door of Plas Isaf*

How likely it is for that scale of flooding to happen again?

This is the second time the Property has been flooded, the first being from Storm Christophe 2021

The NRW Risk Maps for rivers, as shown in figure 51, has the effected Property at high risk from flooding.

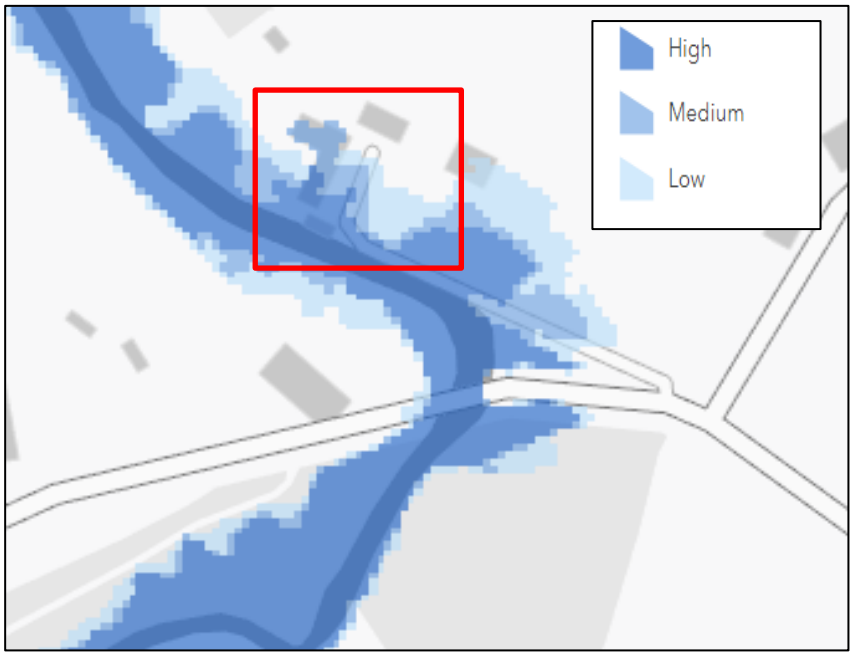


Figure 51: *NRW Flood and Coastal Risk Maps for Rivers at Plas Isaf*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Advice and guidance to be provided to the property owner and minor improvements to be made on the highway drainage.
- Encourage the uptake of individual PLP, in the form of flood barriers.
- Recommend imporovements or maintenance to be carried out to the private wall structure, which runs adjacent to the the River Alyn.
- NRW to carry out further investigation to get a better understanding of flooding from the River Alyn.

7.8 Llanferres – Loggerheads Country Park Café/Visitor Centre

Why did the flooding happen?

Flooding occurred due to the River Alyn overtopping its banks following the heavy rain of the 19th/20th, plus the already saturated catchment from the weeks leading up to Storm Babet[6].

How likely it is for that scale of flooding to happen again?

The Café/Visitor centre was also flooded in 2021 as a result of Storm Christophe.

The NRW Flood and Coastal Risk Maps for rivers as shown in figure 52 below puts the investigatory area in the high risk bracket for flooding

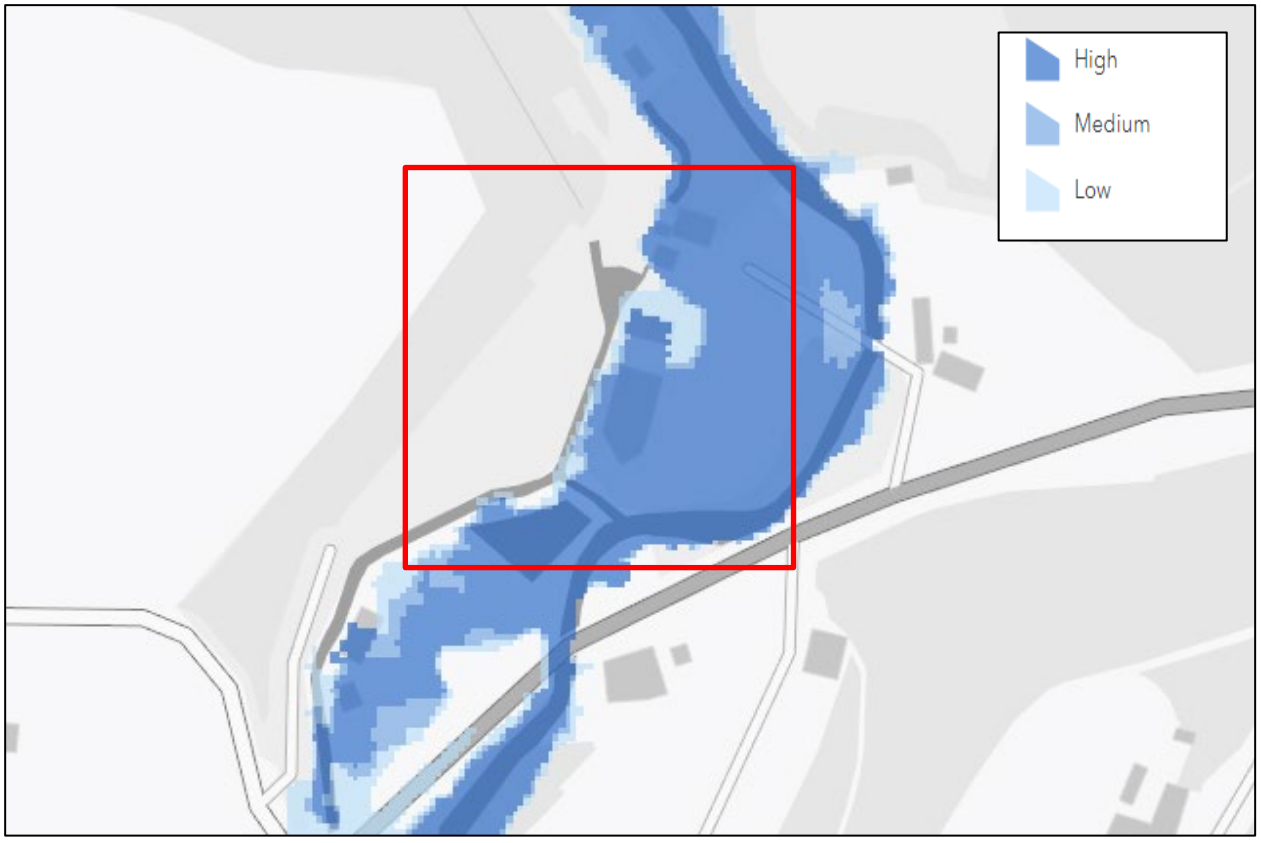


Figure 52: *NRW Flood and Coastal Risk Maps for Rivers at Lloggerheads Country Park*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- DCC's Countryside Service have employed Flood Consultants to look at measures to reduce flood risk
- Since the River Alyn is Main River, Natural Resources Wales should work with DCC's Countryside Service section in terms of suitable flood alleviation options to take forward.
- NRW to liaise with DCC Countryside Services and consider options and proposals going forward.

7.9 Llandyrnog – Glan Y Wern

Why did the flooding happen?

There was a blockage of a highway culvert, which became overwhelmed with flood water, which was conveyed towards multiple properties via the highway. Consequently, one property known as Glan Y Wern flooded as water accumulated in a private yard against the properties low sitting floor to ceiling windows. The private surface water drainage system serving this property also failed due to it discharging into a blocked highway ditch.

How likely it is for that scale of flooding to happen again?

The NRW Flood Risk Maps for surface water and small watercourses does not have the flooded Property at risk of flooding.

The flooding occurred primarily because of the over-reliance of the private system to be able to discharge into the highway ditch. Therefore, regular inspection/maintenance of the dict should prevent further flooding.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Reconstruction and realignment of the highway culvert headwall to improve capacity, reduce the risk of it surcharging and to improve access for future maintenance.

- NRW to look into adding the Property to the NRW Flood Risk Mapping for Surface Water and small watercourses.

7.10 Aberwheeler – Geinas

Why did the flooding happen?

Blocked highway culverts in the proximity of Aberwheeler Village , caused floodwater to flow along the highway network to the Property know as Pen Y Bont, which then ingressed into the House via the front door. The owner, an elderly gentleman had to leave the Property and stay at his daughters for a few days.

How likely it is for that scale of flooding to happen again?

The NRW Flood and Risk Maps for surface water and small watercourses do not have the Property down as a flood risk.

Furthermore, there is also a degree of exceptionality with Storm Babet due to the amount of sediment/scour washed into structures, not only at Aberwheeler, but Countywide.

Lack of maintenance to highway drainage structures in Aberwheeler Village area also contributed, but through careful monitoring, surface water flood risk to Geinas can be reduced in the future.

There is however a high risk that the Property could be flooded by the Main River known as the Afon Wheeler, which is located close by, as shown by figure 53 below

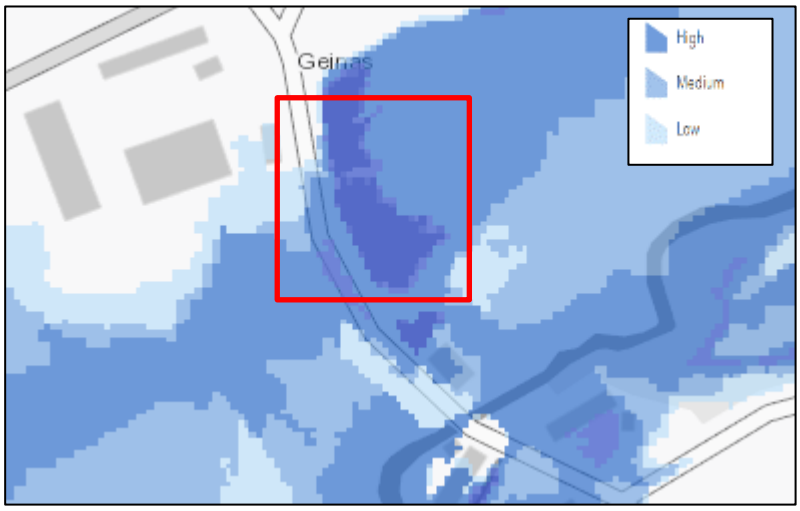


Figure 53: *NRW Flood and Coastal Risk Maps for Rivers at Geinas, Aberwheeler*

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

- Culvert since unblocked
- location to be monitored
- NRW to look into adding the Property to the NRW Flood Risk Mapping for Surface Water and small watercourses

7.11 Significant near miss locations

Corwen

A crew had to continually clear out the flood alleviation culvert below Pen y Pigyn for a number of hours on the morning of Storm Babet. Without this level of maintenance, a large proportion of Corwen Town would have been flooded by water over-toppping the culvert. Photo 12 below shows the intensity of the water almost over-topping the flood alleviation culvert.

Photo 12: *Flood Alleviation Culvert below Pen y Pigyn at Corwen during Storm Babet*

Nantglyn

There was extensive damage to highway infrastructure in and around the Village of Nantglyn as a result of the Storm, which in some instances caused near misses to residential properties.

The highway culvert within the Village, which historically overtops during storm events, flooding properties in the process, had just been replaced prior to Storm Babet. Its replacement came on the back of a recommendation in the Section 19 report for Storm Christophe in 2021, which caused flooding to a couple of properties within the Village. The new structure coped well during Storm Babet despite the torrential amount of water entering the inlet, as shown by photo 13 below.

Photo 13: *New culvert structure at Nantglyn Village during Storm Babet*

Gwyddelwern

The flood alleviation culvert at Gwyddelwern Village was continually blocking up with debris on the morning of the 20th October and consequently was in danger of over-topping and flooding parts of the Village. Hence, a team had to be deployed to continually un-block the culvert

8.0 Summary of Improvements required to ensure flood risk in the County is appropriately managed in future

Storm Babet was the third major storm to cause internal property flooding in the County of Denbighshire over the last 4 years. Hence, it is likely that a similar storm will hit the County again in the future.

Therefore, it is vital that the recommended improvements in the previous section should be acted to not only mitigate the impacts of future storm events, but to also understand better the flood risk at certain locations within this report, which in turn can lead to more effective solutions to alleviate the risk.

Below is a summary of the recommended flood risk improvements for each location in the Report.

8.1 Rhyl

8.1.1 Ffordd Derwen

- To Progress with the Welsh Government (WG) funded flood alleviation scheme at Ffordd Derwen, which is currently at the design stage.

- In the meantime, encourage property level protection (PLP) and consider applying to WG for flood barriers which will help control flood waters to the front of the Properties on Ffordd Derwen, in particular the wave effects caused by vehicles using the road, or, consider the option to close the road under emergency powers to prevent the potential flood effects caused by vehicles.

8.1.2 River Street

- Encourage the owner of the flooded rented properties to invest in PLP for the front doors.

- Also, point out to the owner that it maybe worthwhile carrying out a CCtv drain survey to check for blockages to the roof water drain.

8.1.3 Maes Y Gog/Llys Gwennol/Lon Eglyn

- Include Maes Y Gog, Llys Gwennol & Lon Eglyn in a WG funded scheme, which looks at ways to reduce and manage urban water catchments
- The low spots on the right bank wall of the Maes Gwilym Drain need to be addressed by NRW.
- Consider the merits of installing flood sensors at various points along the Maes Gwilym Drain to monitor river levels, although for this to have a benefit it would need to be managed by a Local Flood Action Group
- Encourage and assist with a potential Local flood Action Group.
- Carry out further engagement with relevant stakeholders to see what improvements can be made, for example, NRW will ensure that the Maes Gwilym Drain will still get the one annual weed cut although this will be brought this forward in the programme so that it is now in line with the section alongside the railway and into Rhyl Cut East. This change means that it will now get cut in September instead of November, which will be monitored as part of NRW's asset inspection and if a second cut is needed in early Winter, NRW will carry out the necessary work.
- NRW to carry out modelling work at Lon Eglyn at Maes y Gog to show the increased flood extent areas folloing Storm Babet.
- Look at funding avenues with Welsh Governemnt to investigate the potential for retrospective SuDS at the Aberkinsey devlopement, as well as nature based flood management solutions. It could lead to partnership working with the other relevant stakeholders such as DCWW and NRW

8.1.4 Walford Avenue – Plas Cyril/ Inferno Dance Studio

- Encourage the use of PLP for Plas Cyril and work with DCC Housing in the short term in relation to this.
- Consider applying to WG for funding to explore possible long term solutions at Plas Cyril
- Work with relevant stakeholders to understand better the flood risk to the Dance Studio in terms of the maintenance of the Rhyl Cut and capacity issues of the sewer systems

8.2 Prestatyn/Meliden

8.2.1 Winchester Drive

- To engage with all relevant stake-holders to understand how the drainage systems work and what can be done to improve the flood risk issue
- Affected properties should also consider PLP.

8.2.2 Ffordd Penwhylfa

- To engage with all relevant stake-holders to understand how the drainage systems work and what can be done to improve the flood risk issue
- Affected properties should also consider PLP

8.2.3 Meliden – Pwll y Bont

- Further investigation is required to ascertain how the surface water drainage from the new housing developments nearby connect to the Prestatyn Gutter were made and if they are contributing to the flooding at Pwll y Bont.
- To include Pwll y Bont In the WG funded scheme, which looks at ways to reduce and manage urban water catchments for Prestatyn/Meliden

8.3 Dyserth

8.3.1 The section of Waterfall Road running parallel with the Afon Ffyddion

- Progress with the detailed design element of a flood alleviation scheme for Dyserth. This includes work to both the upper and lower catchments, with a view to construction of the Scheme commencing in 2025/26, subject to viable funding and agreements.
- Smaller elements of the Scheme to be brought forward for construction if the full detailed design has to be shelved.
- Work with the local flood action group and provide assistance where possible.
- DCC has secured WG funding for PLP for those at risk in the lower catchment reaches of the Afon Ffyddion. Therefore, the aim is for DCC to purchase suitable

flood barrier protection in the 2024/25 financial year and to arrange for the Local Flood Action Group to manage the installation of the barriers when required.

8.3.2 Lower Waterfall Road opposite Lyndholme

- Post Storm Babet, the effected drainage systems have been cleaned out
- Another man-hole has also been installed.
- Further investigation required in terms of line of culvert, with the possibility of a feasibility study to divert the line of the culvert.

8.3.3 Pandy Lane – Glan y Afon Cottage

- The owner of Glan Y Afon Cottage is considering constructing a bund in the garden to protect the Property, but this would require modelling prior to construction to determine what level of protection is required. Consideration of flows should also be taken into account to ensure any works do not increase flood risk elsewhere.
- DCC to therefore provide possible assistance, through revisiting the hydraulic model for the Dyserth Flood Risk Management Scheme so as to advise what level of work to the river can be carried out by the owner of Glan Y Afon.
- Keep the owner of Glan Y Afon updated on the Dyserth Flood Risk Management Scheme
- Provide the owner with details of companies who install PLP

8.4 St.Asaph

8.4.1 Llys y Felin

- Flood consultants have been employed by DCC to come up with feasible options for mitigating the flooding. Continue this arrangement and also work with DCWW to come up with suitable options.
- DCC housing who manage the Llys y Felin are considering PLP until a more sustainable solution can be determined.

8.4.2 Hoel Esgob/Ashley Court

- To encourage properties at Ashley Court and Hoel Esgob to consider property level protection.

- Re-visit the 2016 DCC commissioned Study Report by flood consultants to come up with a long term option to reduce flood risk at Hoel Esgob/Ashely Court.

- A possible solution could be to explore Natural Flood Management (NFM) up the catchment, as in potential storage, an option discussed in the 2016 Report.

- Apply to WG for funding in the 2025/26 application window to carry out a design for potential (NFM).

8.5 Denbigh

8.5.1 Denbigh Green

- to work with landowners and assess what improvements can be made to these culverts, which may include reconstruction of headwalls or complete replacements of the culverts.

8.5.2 Brookhouse

- Consideration of the ability to provide improved warning and informing to residents, allowing additional time to prepare for flooding, could provide significant betterment at this location.

- Whilst including up to date hydrological and topographical datasets will increase confidence in the understanding of risk to the community of Brookhouse, this will most likely confirm the existing understanding and mechanisms of flooding. Consideration of improved warning and informing services to the community may result in more timely provision of service improvements at this location.

8.6 Nantglyn – Sergwyd Mill

- The owner of Sergwyd Mill is intending to invest in PLP for the front and back of the Property

- NRW to carry out further investigation on this flood event

8.7 Llanarmon Yn Ial – Plas Isaf

- Advice and guidance to be provided to the property owner and minor improvements to be made on the highway drainage.
- Encourage the uptake of individual PLP, in the form of flood barriers.
- Recommend imporovements or maintenance to be carried out to the private wall structure, which runs adjacent to the the River Alyn.
- NRW to carry out further investigation to get a better understanding of flooding from the River Alyn.

8.8 Llanferres – Lloggerheads Country Park Café/Visitor Centre

- DCC's Countryside Service have employed Flood Consultants to look at measures to reduce flood risk
- Since the River Alyn is Main River, Natural Resources Wales should work with DCC's Countryside Service section in terms of suitable flood alleviation options to take forward.
- NRW to liaise with DCC Countryside Services and consider options and proposals going forward.

8.9 Llandyrnog – Glan Y Wern

- Reconstruction and realignment of the highway culvert headwall to improve capacity, reduce the risk of it surcharging and to improve access for future maintenance.
- NRW to look into adding the Property to the NRW Flood Risk Mapping for Surface Water and small watercourses.

8.10 Aberwheeler – Pen y Bont

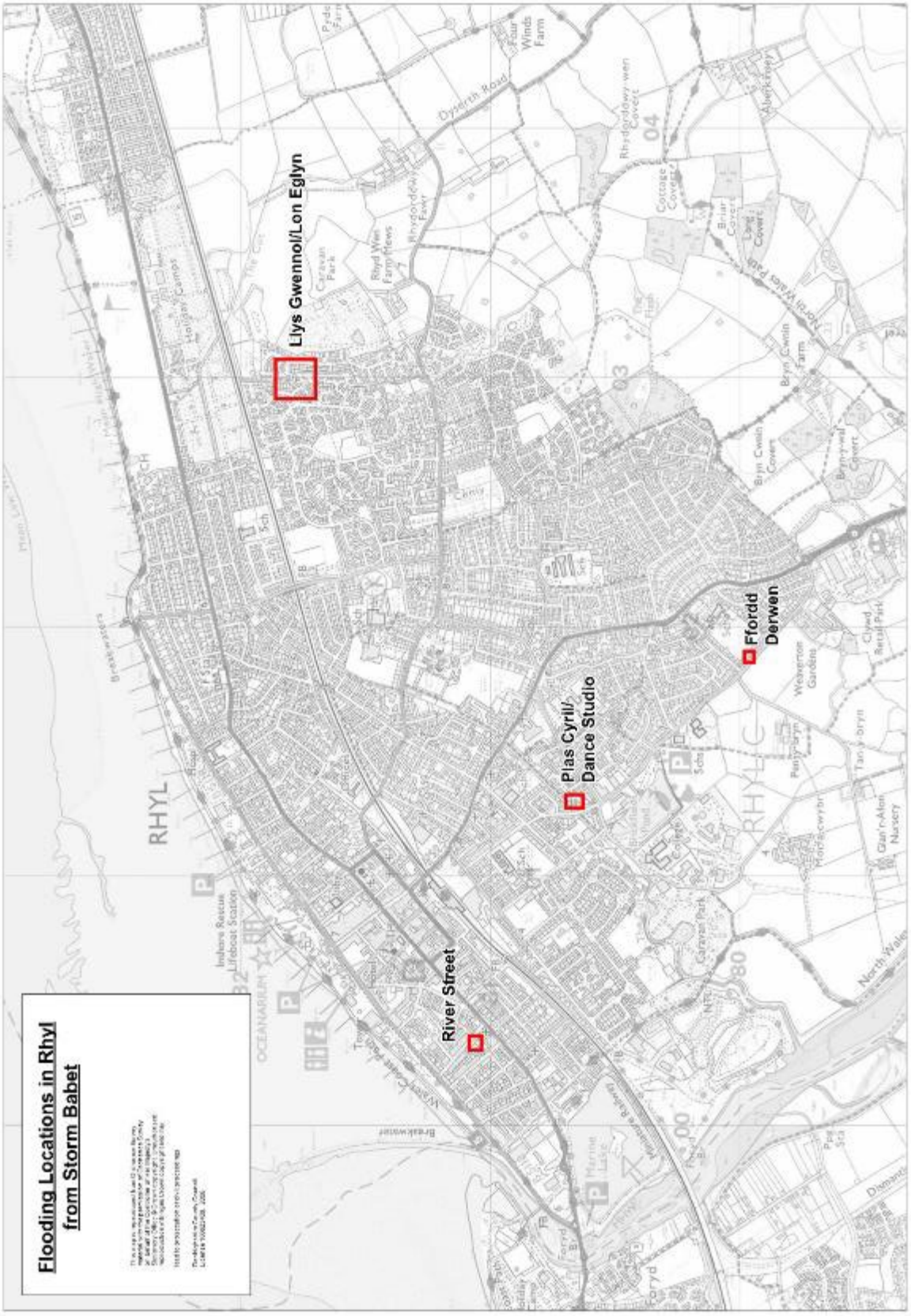
- Culvert since unblocked
- location to be monitored
- NRW to look into adding the Property to the NRW Flood Risk Mapping for Surface Water and small watercourses

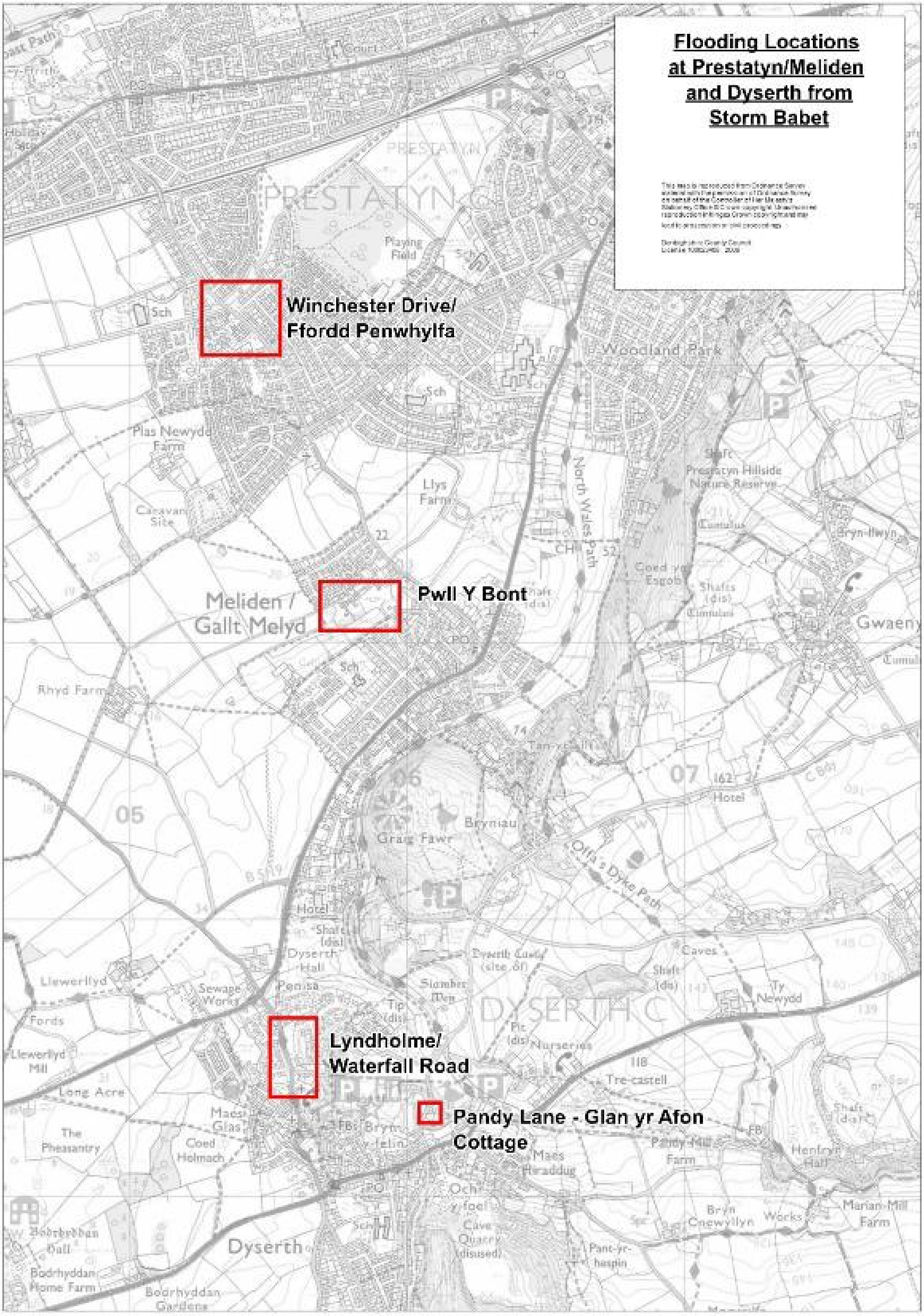
9.0 Conclusion

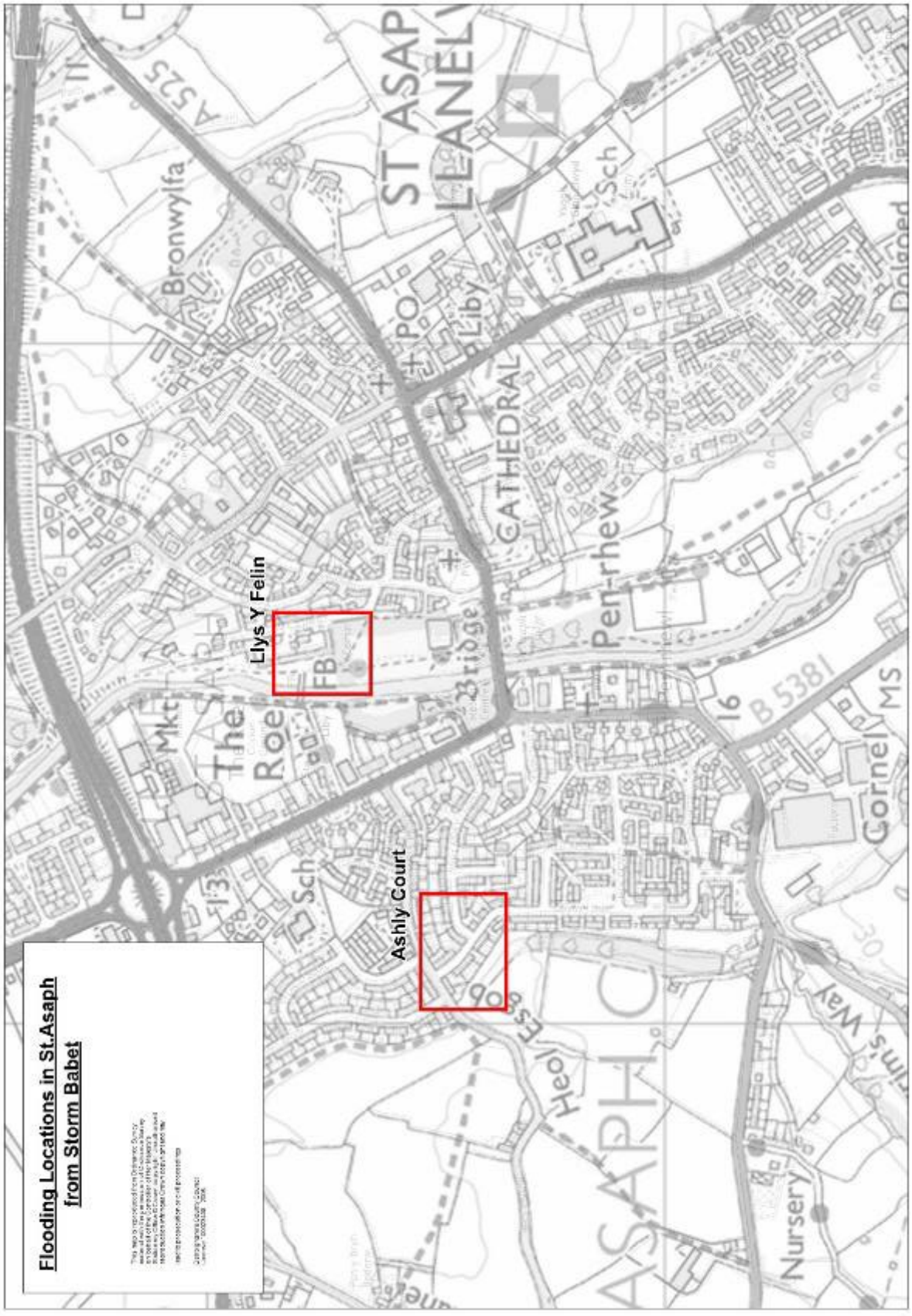
The flooding that affected Denbighshire on 20th October 2023 was the result of a significant rainfall event, with a possible higher than 1 in 40 likelihood of occurring in any one year. Whilst this was a statistically a rare event, its impacts covered a wide area and around 60 plus properties were flooded internally as a consequence.

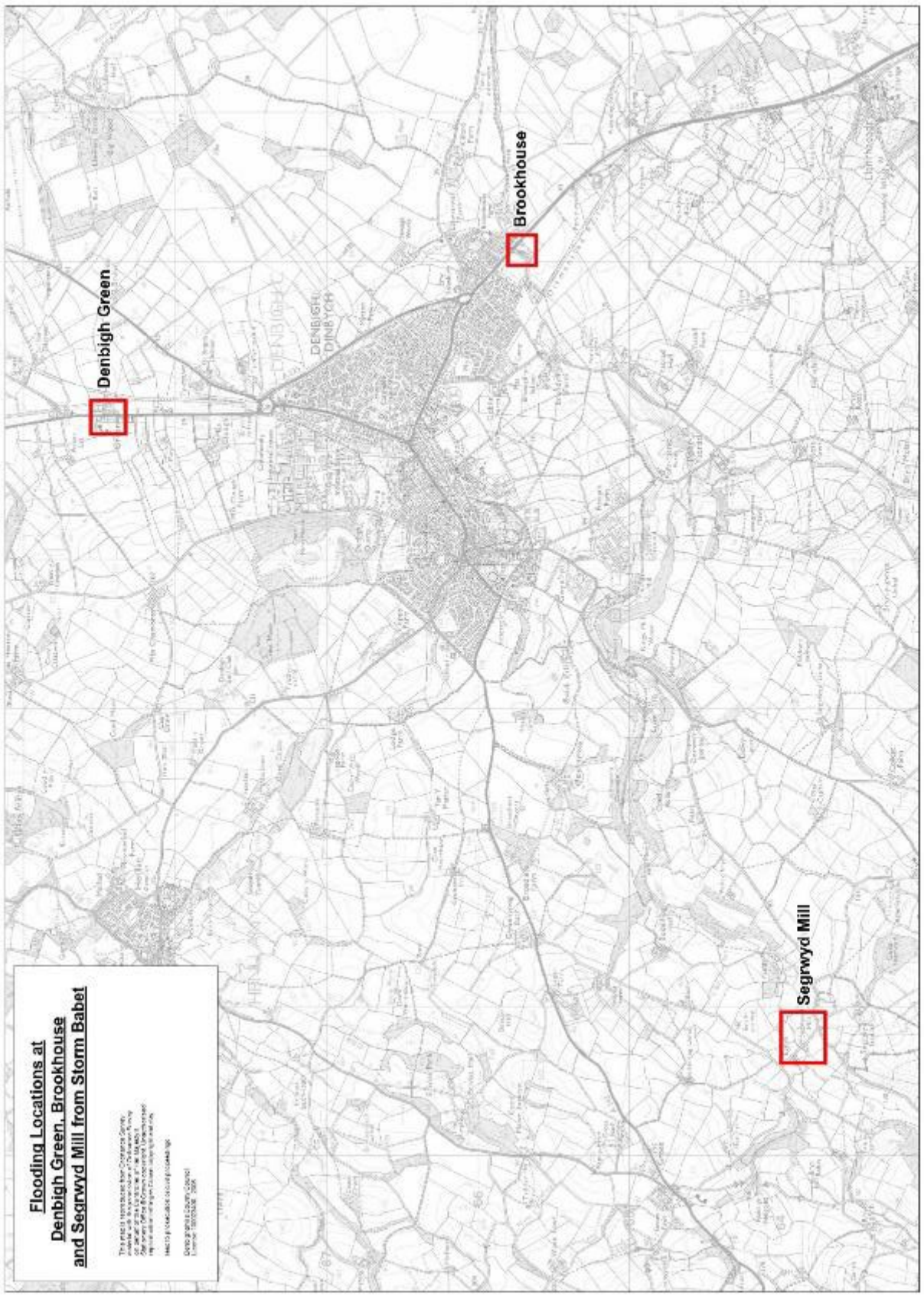
This report provides an overview of the Council's current understanding of what caused the flooding and how likely it is for flooding to occur again at the effected locations. Most importantly though, the Investigation Report outlines recommendations and actions that various organisations and authorities can do to minimise future flood risk, although It is important to note that a Section 19 report is not an in-depth analysis of flooding risks or mechanisms.

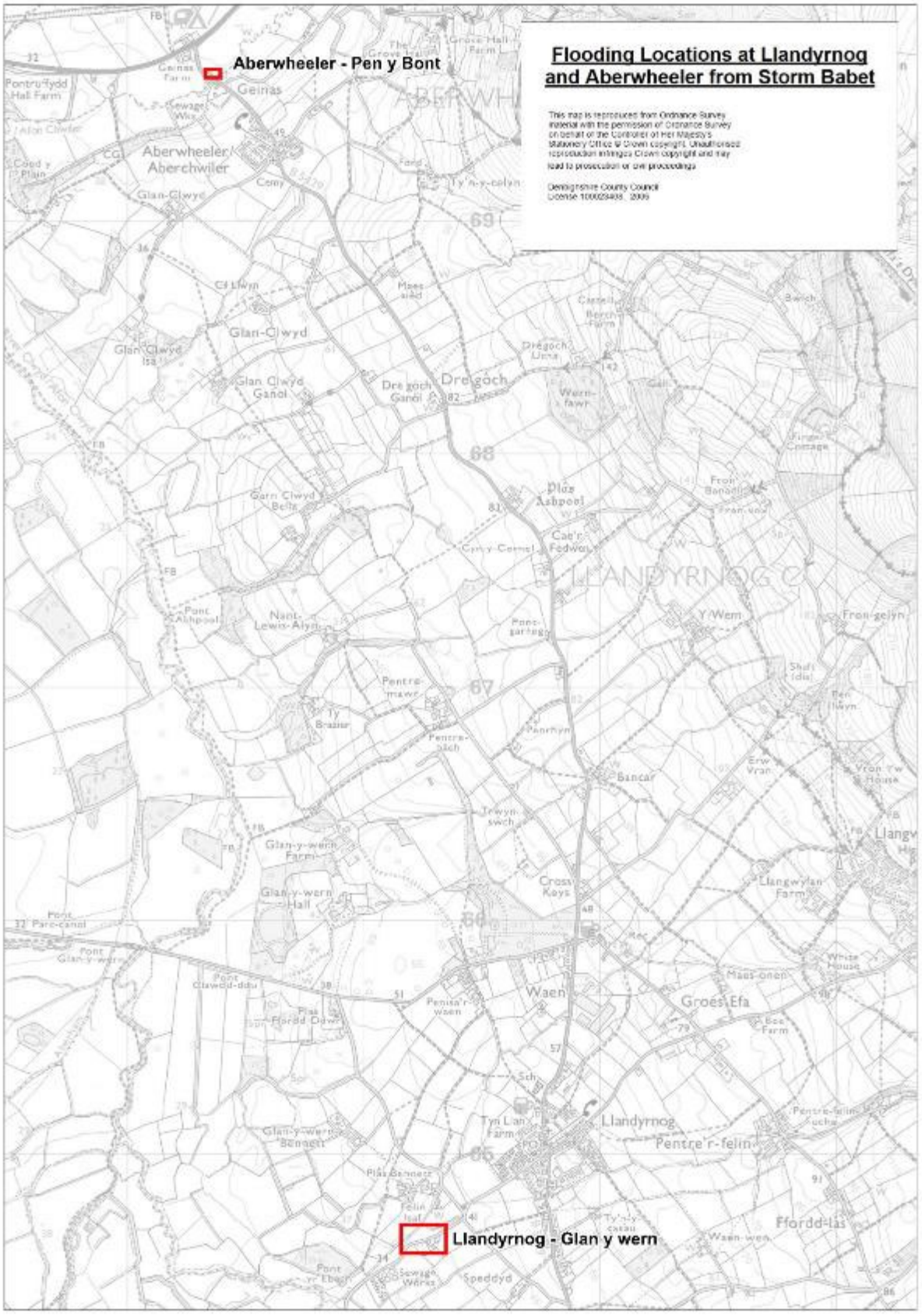
APPENDIX 1 – FLOODING LOCATIONS FROM STORM BABET


Flooding Locations in Rhyl from Storm Babet
Llys Gwennol/Lon Eglyn
Plas Cyril/ Dance Studio
Ffordd Derwen
River Street
RHYL


Flooding Locations at Prestatyn/Meliden and Dyserth from Storm Babet
Winchester Drive/ Ffordd Penwhylfa
Pwll Y Bont
Lyndholme/ Waterfall Road
Pandy Lane - Glan yr Afon Cottage
Meliden / Gallt Melyd
Dyserth
Woodland Park
Prestatyn Hillside Nature Reserve
Gwaeny
Offa's Dyke Path
North Wales Path


Flooding Locations in St.Asaph
from Storm Babet
Llys Y Felin
Ashly Court
ST ASAPH
LLANELW
CATHEDRAL
Bronwylfa
Pen-rhew
The Roe
Mkt
Sch
FB
Bridge
PO
Liby
Sch
A525
B5381
Cornel MS
Nursery
Heol Esgob
Williams Way
ASAPH CP


Flooding Locations at
Denbigh Green, Brookhouse
and Segrwyd Mill from Storm Babet
Denbigh Green
Brookhouse
Segrwyd Mill
DENBIGH
DINBYCH


Flooding Locations at Llandyrnog and Aberwheeler from Storm Babet
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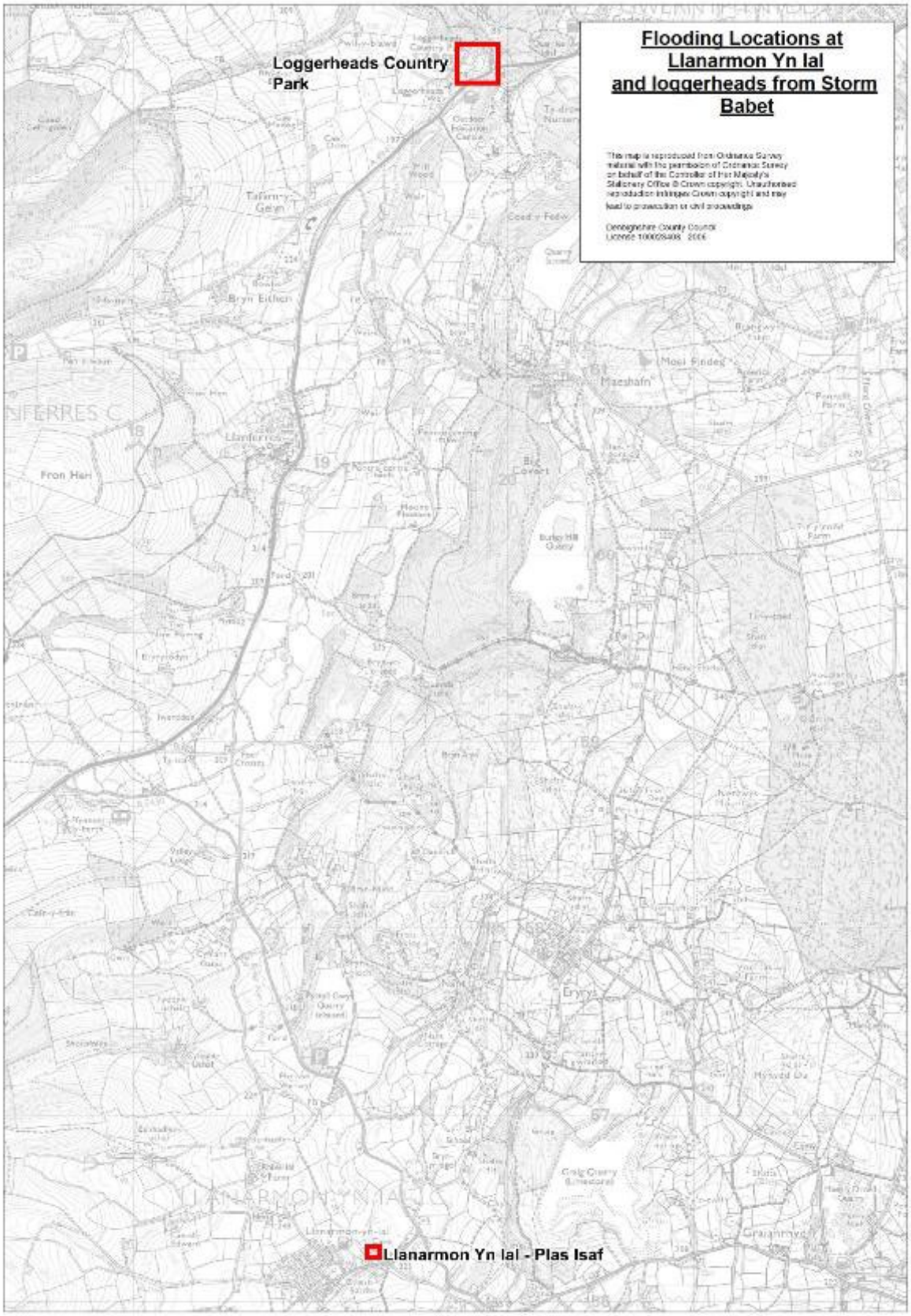
Denbighshire County Council
License 100023408. 2009
Aberwheeler - Pen y Bont
Llandyrnog - Glan y wern
Aberwheeler
Aberchwiler
Glan-Clwyd
Dreigoch
Llandyrnog
Pentre'r-felin
Waen
Groes Efa
Ffordd-las
Bancar
Cross Keys


Flooding Locations at Llanarmon Yn Ial and loggerheads from Storm Babet
Loggerheads Country Park
Llanarmon Yn Ial - Plas Isaf

APPENDIX 2 – NRW MAINTENANCE REGIME FOR RHYL CUT AND PRESTATYN GUTTER

Cyfoeth Naturiol Cymru
Natural Resources Wales

Maintenance at Rhyl Cut and Prestatyn Gutter

Overview

version 1.2 | 17 October 2022

digital version with links recommended

We have produced this document to help the public and other parties understand what we maintain and why.

We have taken an evidence-based approach using detailed hydraulic modelling. Flooding in Rhyl and Prestatyn is complex and can be from many sources. While river maintenance generally reduces flood risk, there are places where channel maintenance in one area could make flooding worse in another area.

Rhyl Cut and Prestatyn Gutter are split into reaches and each reach has a separate maintenance summary sheet. Public safety measures on NRW structures will be inspected annually and maintained or improved as necessary.

maintenance responsibilities

incident reporting and flood risk info

riverbed level management

Reach	Location
R1	Prestatyn Gutter confluence to Ffordd Penrhwylfa
R2	Ffordd Penrhwylfa to Maes Gwilym
R3	Rhyl Pumping Station leg
R4	Railway culvert to Tynewedd Road
R5	Tynewydd Road to Grange Road
R6	Grange Road to Vale Road
R7	Vale Road to Ffordd Las
R8	Ffordd Las to Rhyl outfall sluice
R9	Rhyl outfall sluice to River Clwyd
P1	Rhyd Farm to Pwll-Y-Bont
P2	Pwll-Y-Bont to Fforddisa
P3	Fforddisa to Rhyl Cut confluence
P4	Rhyl Cut to Sandy Lane railway culvert
P5	Sandy Lane railway culvert to Bastion Road
P6	Bastion Road to Barkby Avenue
P7	Barkby Avenue to Gronant Pumping Station
P8	Gronant Pumping Station to coast

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Maintenance at Rhyl Cut and Prestatyn Gutter

Maintenance Responsibilities

Natural Resources Wales is the risk management authority for 'main rivers'. Main rivers are usually larger streams and rivers, but some of them are small watercourses of significance (main river map). All other watercourses are classed as 'ordinary watercourses'. The Local Authority has a similar role for 'ordinary watercourses'.

If you own property alongside a watercourse, the likelihood is you are a 'riparian owner'. Responsibilities of riparian owners include: maintaining riverbeds and banks, allowing the flow of water to pass without obstruction, and controlling invasive species such as Japanese knotweed.
A guide to your rights and responsibilities of riverside ownership in Wales

NRW can utilise Permissive Powers under the Water Resources (1991) Act to carry out maintenance, improvement, or construction work for the purpose of managing flood risk. The decision to utilise permissive powers depends on a number of factors, including: property numbers at risk, mechanisms of flooding (frequency, depth, speed of inundation etc.), environmental impact, and local and national strategy & guidance. NRW will often remove large blockages from main river channels, and we request that the public report major blockages. NRW will also manage invasive non-native species (INNS) where there is an impact on flood risk maintenance. All necessary licences and permits will be obtained.

The responsibility for a selection of other maintenance activities and incidents that we do not deal with are highlighted below.

Maintenance Activity	Responsibility
Clearance of drains/ditches	Riparian landowner
River erosion	Riparian landowner
Litter picking	Landowner or Denbighshire County Council
Dog mess	Landowner or Denbighshire County Council
Amenity vegetation management	Landowner or Denbighshire County Council
Other outfall maintenance	Asset owner (Dŵr Cymru Welsh Water, Denbighshire County Council, private)

Incidents We Do Not Deal With

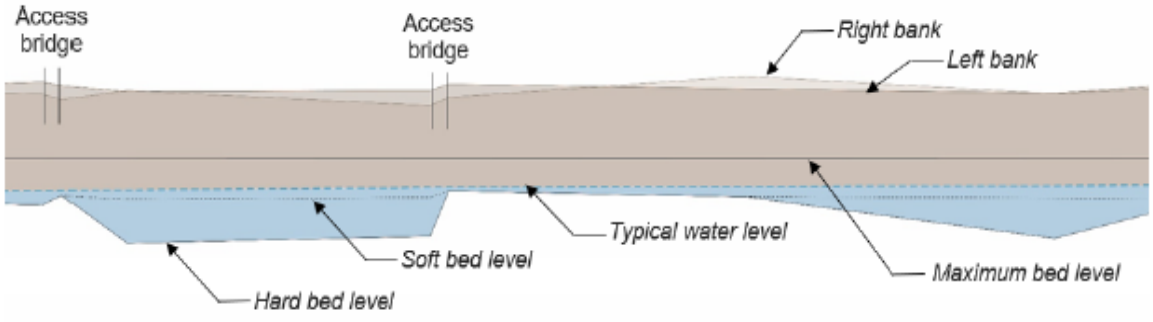
- road and highway drainage maintenance
- blocked domestic drains and sewers
- burst water mains
- discolouration or other drinking water problems
- fly-tipping of household rubbish
- vermin and infestations
- dead animals (unless potentially leading to flooding)
- domestic noise nuisance
- odours from domestic or small commercial premises
- burning of domestic or garden waste
- smoke emissions from vehicles

Maintenance at Rhyl Cut and Prestatyn Gutter

Riverbed Level Management

We have completed modelling of a range of riverbed levels from the lowest to the highest levels recorded since the 1960s. Property flooding is sensitive to riverbed levels in some places, while in other areas bed levels have no significant impact on main river flooding and raised bed levels can even reduce flood risk downstream.

A long section is provided on the maintenance summary sheet for each reach (except R3 and P8 where not available). See example long section below with key features. The right and left bank are as viewed when looking downstream.



Current soft riverbed levels (top level of soft silt/sand) and hard riverbed levels (top level of hard gravels/rock) are generally based on the most recent topographical survey undertaken in 2018, with older data used to infill gaps. The long sections may therefore not be fully up to date, but a selection of spot checks was undertaken at key locations in 2021.

The maximum bed level is the highest level that the surface of the soft bed can reach before there is a significant impact on flooding of properties. We will monitor riverbed levels and will plan removal of riverbed material when the maximum bed level is reached.

In many places drainage into the watercourses could be affected by silt levels. In these locations, the maximum bed level is often set by the invert level of outfalls. The main outfalls into the watercourses are shown on the long sections but not all outfalls have been surveyed.

For information about dredging and deshoaling click here.

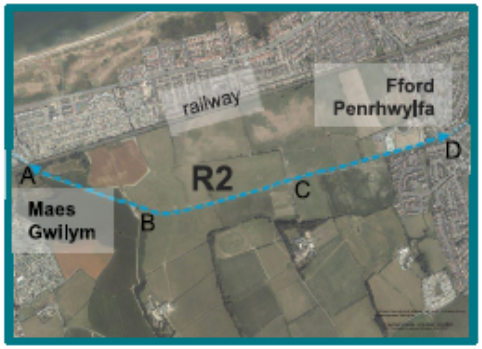
Cyfoeth Naturiol Cymru Natural Resources Wales

Maintenance at Rhyl Cut and Prestatyn Gutter

Rhyl Cut R2

Ffordd Penrhwylfa to Maes Gwilym

Main River Flood Risk Summary	There is no significant flood risk to properties from Rhyl Cut but there is flooding of farmland, in particular to the south of the cut. Properties around Maes-Y-Gog and Lon Hedyn are at risk of flooding from Maes Gwilym (MG) drain.
Current River Condition	Rhyl Cut is currently in good (if unnatural) condition with channel clearance undertaken relatively frequently. There can be substantial invasive weed growth. There could be significant benefits if the river was restored to a more natural state. Maes Gwilym drain is currently in reasonably good condition, except for a culvert under the railway which is partially collapsed (see impact below).
Maintenance Impacts	Maintaining the Rhyl Cut in this reach has no significant impact on property flooding from the main river. Reducing maintenance will lead to some additional flooding of farmland to the south and north of the cut. Drainage could be affected by silt levels. Maes Gwilym drain channel vegetation and raised bed levels increase flood risk. Maes Gwilym drain railway culvert increases flood risk downstream and will therefore not be maintained.



NRW Maintenance Activity	Main Constraints	Frequency
channel vegetation and weed clearance	bird nesting, water vole habitat	Rhyl Cut: partial clearance 5 yearly or as required for silt clearance Maes Gwilym drain: partial clearance annually (Sep/Oct)
bankside tree and hedge management	bird nesting, bats	Rhyl Cut: 5 yearly or as required for silt clearance Maes Gwilym drain: annually (Jan/Feb)
channel blockage removal	biosecurity, hazardous waste	Rhyl Cut: not required (riparian responsibility) Maes Gwilym drain: reactively before heavy rain
riverbed level management	fish spawning, water vole habitat	annual monitoring (both watercourses)

No long section available for Maes Gwilym drain. Max bed level to minimise reduction in capacity of culverts and other crossings.

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Maintenance at Rhyl Cut and Prestatyn Gutter

Rhyl Cut R3

Rhyl Pumping Station leg	
Main River Flood Risk Summary	There is no significant risk of flooding from Rhyl Cut in this reach but high water levels could affect properties in reach R4. A few caravans are at risk of flooding during infrequent floods (above approximately 1 in 30 annual chance).
Current River Condition	The river is currently in good condition with channel clearance undertaken relatively frequently. The left hand bore of the Ash Grove culvert upstream is partially blocked but the culvert has spare capacity.
Maintenance Impacts	Rhyl Pumping Station will continue to be operated and maintained (subject to pumping station review and impact of set-back sea defences), as it reduces flood risk to a large area and lots of properties. Maintaining the river channel in this reach has minimal impact on main river flooding but some clearance is required for Rhyl pumping station to operate effectively. Drainage could also be affected by silt levels.

NRW Maintenance Activity	Main Constraints	Frequency
channel vegetation and weed clearance	bird nesting, water vole habitat	partial clearance annually (Sep/Oct)
channel blockage removal	biosecurity, hazardous waste	reactively before heavy rain
Rhyl Pumping Station debris screen clearance	biosecurity, hazardous waste	weekly and before heavy rain
riverbed level management	fish spawning, water vole habitat	annual monitoring

No long section available for Rhyl Pumping Station leg. Max bed level of 2.13m AOD at pumping station culvert inlet (50mm above pumping station debris screen lip); max bed level of 2.32m AOD in at least one pipe of the Ash Grove culvert (200mm above invert).

Maintenance at Rhyl Cut and Prestatyn Gutter

Rhyl Cut R4

Maes Gwilym to Tynewedd Road	
Main River Flood Risk Summary	The highest point of Rhyl Cut is near Brynhedydd Road and can therefore flow in both directions along this reach. Properties near Brynhedydd Road and Edgbaston Road and some caravans are at risk of flooding during infrequent floods (above approximately 1 in 30 annual chance) from both Rhyl Cut and Fron Hall drain.
Current River Condition	This reach of Rhyl Cut and Fron Hall drain are in fair condition but there has been siltation between Tynewydd Road and Brynhedydd Road which requires clearance. Maintenance is difficult due to poor access in some locations along both watercourses.
Maintenance Impacts	Maintaining conveyance along this reach of Rhyl Cut slightly reduces the extent of flooding and reduces peak water levels, which may benefit incoming drainage; drainage could also be affected by silt levels. Channel vegetation and raised bed levels along Fron Hall drain increases flood risk.

NRW Maintenance Activity	Main Constraints	Frequency
channel vegetation and weed clearance	access, bird nesting, water vole habitat	Railway Culvert to Fron Hall drain: partial clearance annually (Sep/Oct) Fron Hall drain to Tynewydd Road: twice annually (Jun/Jul and Sep/Oct)
bankside tree and hedge management	access, bird nesting, bats	Rhyl Cut and Fron Hall drain: annually (Jan/Feb)
channel blockage removal	access, biosecurity, hazardous waste	Rhyl Cut and Fron Hall drain: reactively before heavy rain
riverbed level management	access, fish spawning, water vole habitat	Rhyl Cut and Fron Hall drain: annual monitoring (clearance currently required)

No long section available for Fron Hall drain. Max bed level to minimise reduction in capacity of culverts and other crossings.