



57 BRYN GLAS, RHOSLLANERCHRUGOG

HYDRAULIC MODELLING STUDY

Final Report v1.1

July 2019

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Hydraulic Modelling Study
Final Report v1.1

Client: Dave Cottle Civil Engineering Ltd

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by Dave Cottle Civil Engineering Ltd to undertake a hydraulic modelling study of an unnamed watercourse in order to identify and assess the level of flood risk from this source in association with the proposed redevelopment of site at 57 Bryn Glas, Rhosllanerchrugog.

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

- Section 1** Introduction and report structure
- Section 2** Provides background information relating to the development site and the watercourse
- Section 3** Describes the derivation of flows for the watercourse
- Section 4** Describes the hydraulic model development process
- Section 5** Describes the hydraulic modelling runs and results
- Section 6** Describes the hydraulic model calibration and sensitivity assessment that has been undertaken
- Section 7** Presents a summary of key findings

2 SITE LOCATION AND WATERCOURSE DETAILS

2.1 SITE LOCATION AND DESCRIPTION

The site is located at the end of Bryn Glas, Rhosllanerchrugog at Ordnance Survey National Grid Reference SJ 289 459, as shown in **Figure 1**. The site is approximately 0.1 hectares (ha) in area.

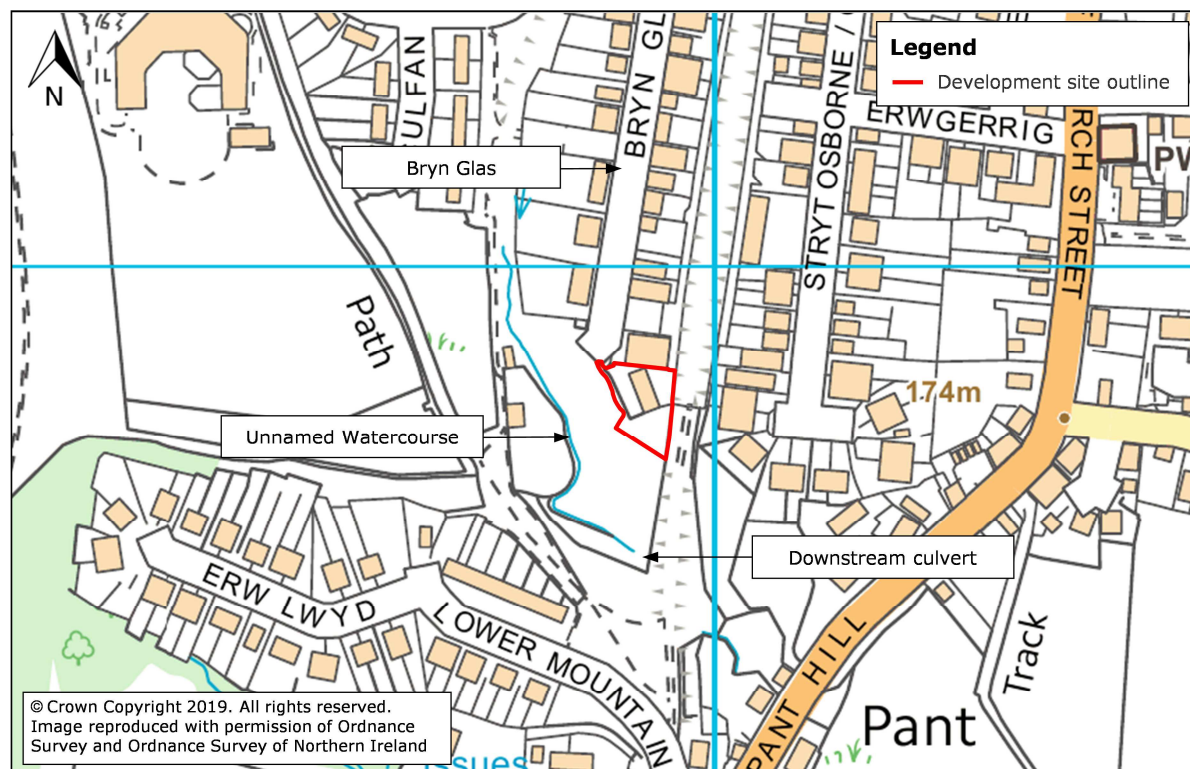


Figure 1: Site Location

2.2 WATERBODIES IN THE VICINITY OF THE SITE

There is an unnamed watercourse located approximately 20 m west of the site; this flows in a predominantly southerly direction and is classified as an 'ordinary watercourse'.

The watercourse flows in open channel when parallel to the site, prior to entering a culvert approximately 40 m south of the site. The watercourse is also culverted upstream of the site, through the residential areas to the north.

AS channel survey has been undertaken by Malcolm Hughes Land Surveyors and is provided in **Annex A**.



(Photo looking upstream)

Figure 2: Photograph of unnamed Watercourse

2.3 FLOOD ZONE DESIGNATION

Flood zones refer to the probability of river and sea flooding. TAN15 defines flood zones as follows:

- Zone A: Considered to be at little or no risk of fluvial or tidal/coastal flooding.
- Zone B: Areas known to have been flooded in the past evidenced by sedimentary deposits.
- Zone C: Based on [the Natural Resources Wales] flood outline, equal to or greater than 0.1% (river, tidal or coastal). Zone C is subdivided into the following two zones:
 - Zone C1: Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
 - Zone C2: Areas of the floodplain without significant flood defence infrastructure.

The flood zones are shown on the Development Advice Map. The zones do not account for possible future changes in flooding due to the impact of climate change or the presence of flood defences (although areas benefitting from flood defences may be indicated).

2.3.1 Development Advice Map

According to the Development Advice Map (**Figure 3**) the site is located in Zone A.

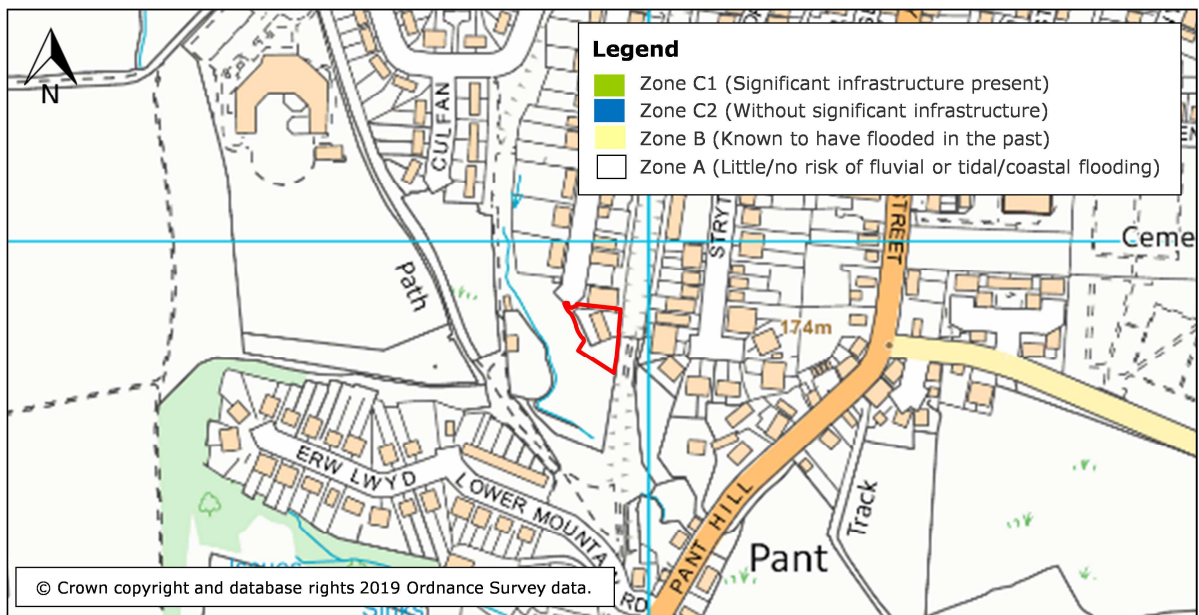


Figure 3: Development Advice Map
(Source: NRW website)

2.3.2 Natural Resources Wales Flood Risk Map

According to the Flood Risk Map (**Figure 4**) the site is located outside of the 1:1,000 annual probability flood outline, thereby supporting the sites Zone A designation.

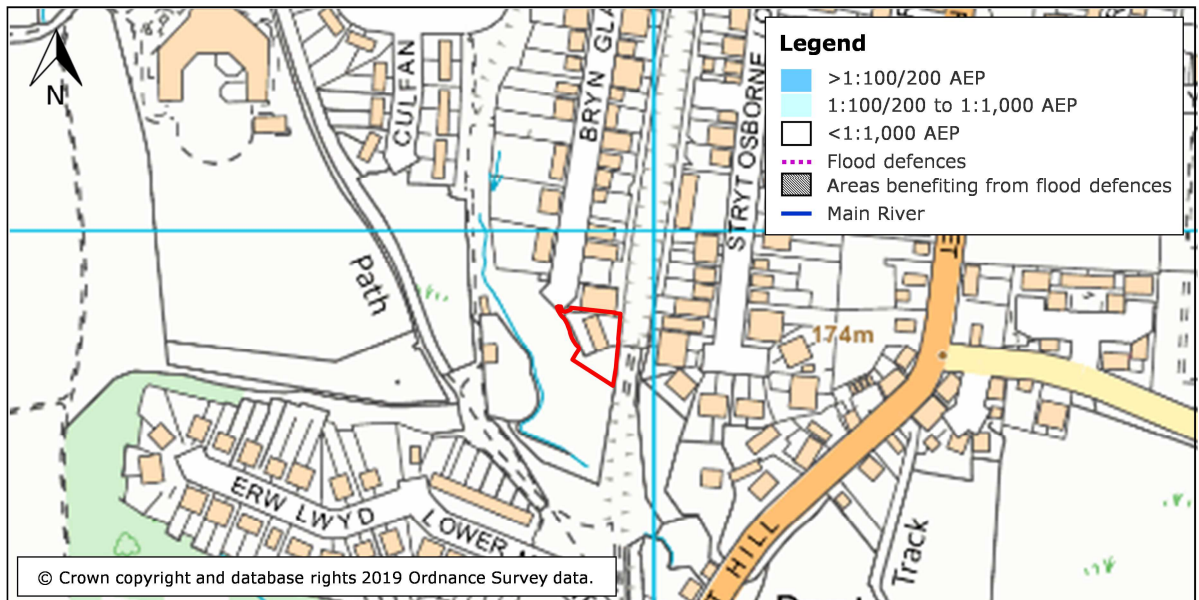


Figure 4: Flood Risk Map (Rivers and Sea)
(Source: NRW website)

2.4 FLUVIAL FLOOD RISK – UNNAMED WATERCOURSE

As discussed in **Section 2.2**, the unnamed watercourse is located 20 m to the west of the site.

The flood risk posed by the unnamed watercourse is not accurately represented by the NRW Flood Risk Map or on the Development Advice Map. The watercourse is not expected to have been considered due to the small size of the catchment.

In order to more accurately identify and assess the level of flood risk from the watercourses at the site, a 1D-2D ESTRY-TUFLOW hydraulic model has been developed by Weetwood.

3 HYDROLOGY

3.1 CATCHMENT EXTENTS

The extent of the unnamed watercourse catchment has been derived using the Flood Estimation Handbook (FEH) Web Service (**Figure 5**) and was validated using Ordnance Survey (OS) mapping and LiDAR data. The catchment descriptors for the unnamed watercourse are presented by **Table 1**.

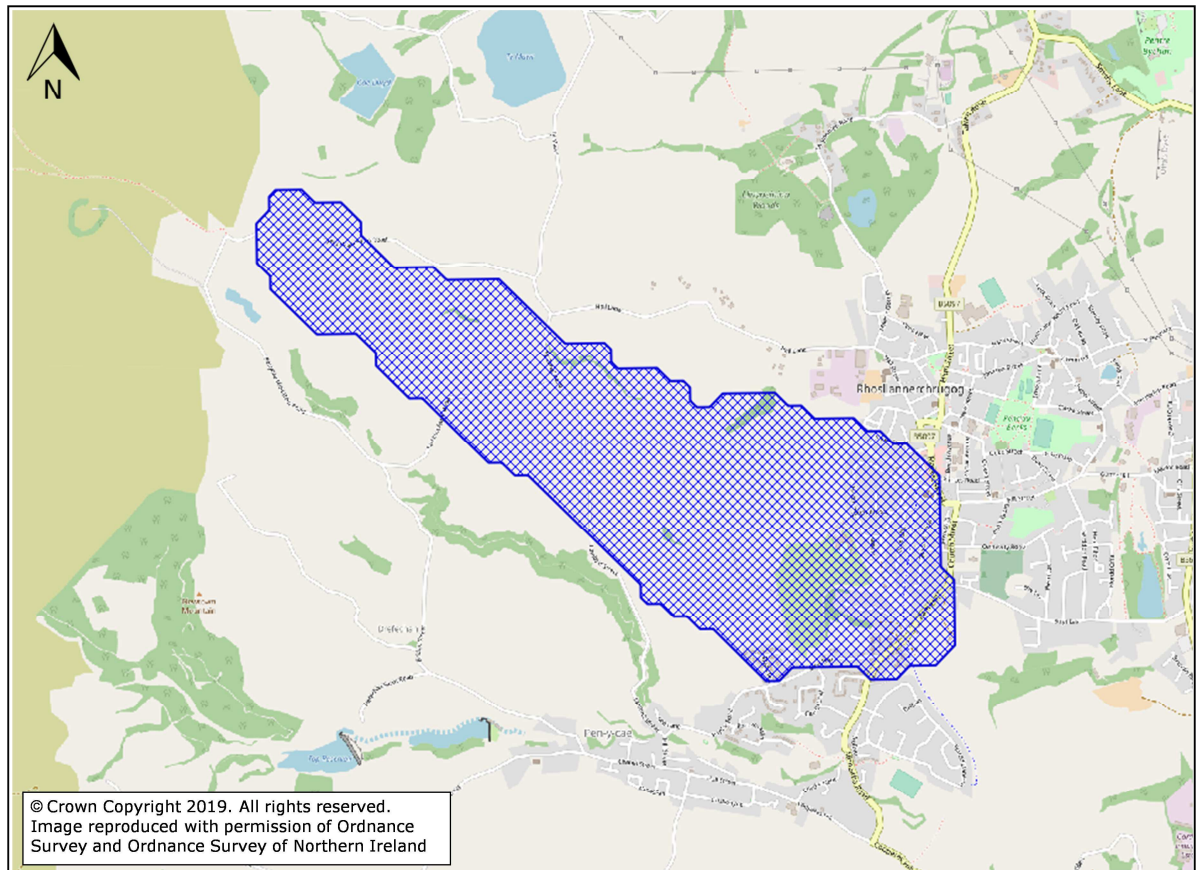


Figure 5: FEH Catchment Extents

Table 1: FEH Catchment Descriptors

Descriptor	Value	Descriptor	Value
OS NGR	329050 345650	LDP	3.87
AREA	1.92	RMED-1H	9.9
FARL	1	RMED-1D	35.9
PROPWET	0.51	RMED-2D	44.9
ALTBAR	215	SAAR	927
ASPBAR	108	SAAR4170	932
ASPVAR	0.71	SPRHOST	40.89
BFIHOST	0.403	URBCONC	0.77
DPLBAR	1.72	URBEXT	0.07
DPSBAR	57.3	URBLOC	0.37

3.2 APPROACH TO HYDROLOGICAL ANALYSIS

The FEH Statistical Method and Revitalised Flood Hydrograph Model v2.2 (ReFH2)¹ have been used to derive peak flows for the catchment.

3.2.1 FEH Statistical Method

The FEH Statistical Method for calculating peak flows uses gauged flow data from hydrologically similar catchments in the UK gauging station network. Flows calculated by the FEH Statistical Method may be considered more robust where a suitably homogeneous 'pooling group' of gauging stations similar to the study site can be identified.

The approach to calculating peak flows for given return periods using the FEH Statistical Method can be divided into two components:

- Estimating the index flood (QMED²)
- Estimating the flood growth curve (pooled analysis)

QMED is the median sized flood for a given catchment. The FEH recommends that data transfer from nearby gauged donor catchments should be used to calculate QMED wherever possible. QMED can be derived for ungauged catchments from catchment descriptors alone, or by adjusting the QMED value using a gauged 'donor' catchment to take into account differences between the donor catchment and the study catchment.

Most gauging stations record lengths are too short to allow for reliable estimation of long return-period floods. WINFAP-FEH allows for a pooled analysis, which draws together records from a group of hydrologically similar catchments into a pooling group.

The FEH Handbook recommends that 500 station years should be used, if possible, as this gives the best balance between a robust pooling group and enough data years to allow the determination of peak flows for extreme events.

The pooling group was generated in WINFAP-FEH v6.0, and catchment descriptors were used to assess whether the pooling group was acceptably homogenous and representative of the subject site.

A sufficiently representative pooling group could not be found due to the relatively high SAAR values (refer to **Annex B** for pooling group information). Nevertheless, peak flows estimated using the Generalised Logistic growth curve fitting are presented in **Table 2**.

3.2.2 ReFH2 Method

The ReFH2 method provides good definition of runoff contributions from small catchments and involves using 'catchment descriptors' to define:

- a) The duration of the critical rain storm for the catchment³.
- b) The rainfall for the critical storm duration with the required return period.
- c) The profile of the critical storm to apportion storm rainfall total.
- d) The shape of the unit hydrograph.

¹ Revitalised Flood Hydrograph Model ReFH2: Technical Guidance, Wallingford HydroSolutions Ltd, 2015

² To derive Qmed, a list of the maximum flow recorded in each year is drawn up. This is referred to as the Annual Maxima, or AMAX, series. Qmed is the median value in the AMAX series. As there is a 50% chance each year of the maximum flood being greater than Qmed, then Qmed is also analogous to the 1:2 annual probability flood.

³ In small, steep and urbanised catchments the duration will be shorter than in large, flat and undeveloped catchments

From these, the unit hydrograph and the profile storm are combined to produce the time against flow storm hydrograph from which a peak runoff rate can be determined.

The duration of the critical storm for the catchment was calculated using the catchment descriptors as approximately 4.45 hours. This duration was used with the catchment descriptors to calculate the design flood flows along the channel which are provided in **Table 2**.

Table 2: Peak Flow Estimates – Whole Catchment

Annual Probability	Peak Flow (m^3s^{-1})	
	FEH Statistical	ReFH2
QMED	1.24	1.28
1:100	3.33	4.29
1:1,000	-	6.95

The ReFH2 Method is shown to provide a more conservative estimate of peak flow rates and it was not possible to define a suitable representative pooling group using the FEH Statistical Method. As such, the ReFH2 Method flows will be used for the purpose of the hydraulic modelling study.

4 HYDRAULIC MODEL DEVELOPMENT

4.1 MODELLING APPROACH

In order to more accurately define the level of fluvial flood risk to the site posed by the unnamed watercourse, Weetwood has developed an ESTRY-TUFLOW hydraulic model.

The channels have been represented in 1D using ESTRY with the floodplain modelled in 2D using TUFLOW. The 1D and 2D model domains have been dynamically linked.

4.2 MODEL EXTENT

The upstream extent of the 1D domain is located approximately 595 m north-west of the development site at model node Rhos_1275. The downstream extent of the 1D domain is located approximately 375 m south-east of the development site at model node Rhos_0008.

The 2D domain extends across both the left and right floodplain of the unnamed watercourse as illustrated by **Figure 6**.

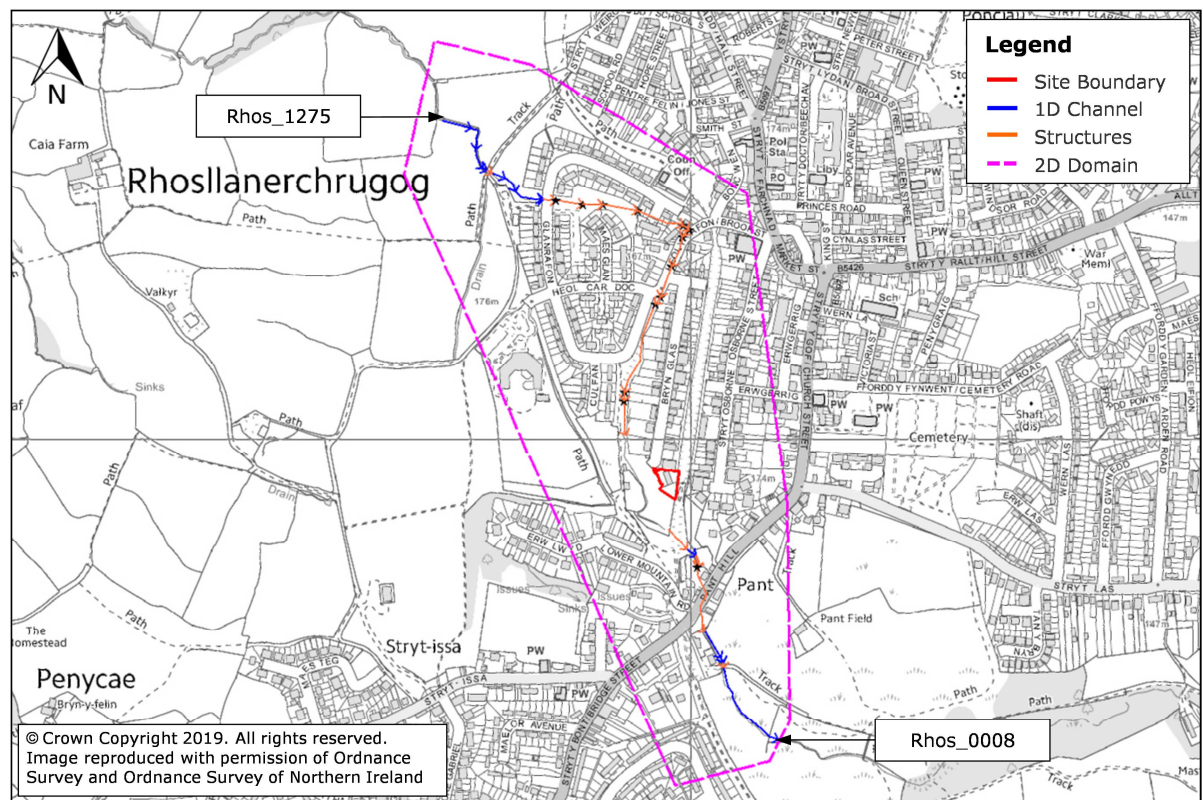


Figure 6: Model Extent

4.3 TOPOGRAPHIC DEVELOPMENT

In the 1D domain the channel topography is defined by cross-sections along the majority of the modelled reach. The data collected during the topographic survey (**Annex A**) has been used to define these channel cross-sections. The cross-sections are spaced at regular intervals with more detailed information collected around the structures (refer to **Section 4.3.1**).

The channel is located within a steep sided valley directly upstream and parallel to the site. It was determined that the channel should be represented within the 2D domain in this location to stabilise the model and to ensure that flood extents could be properly defined.

The 2D domain topography is based upon filtered LiDAR data, where this information is available, as shown in **Figure 7**. The OS Terrain50 dataset, supplemented by topographic survey, has been used to define the topography in areas where LiDAR data is unavailable.

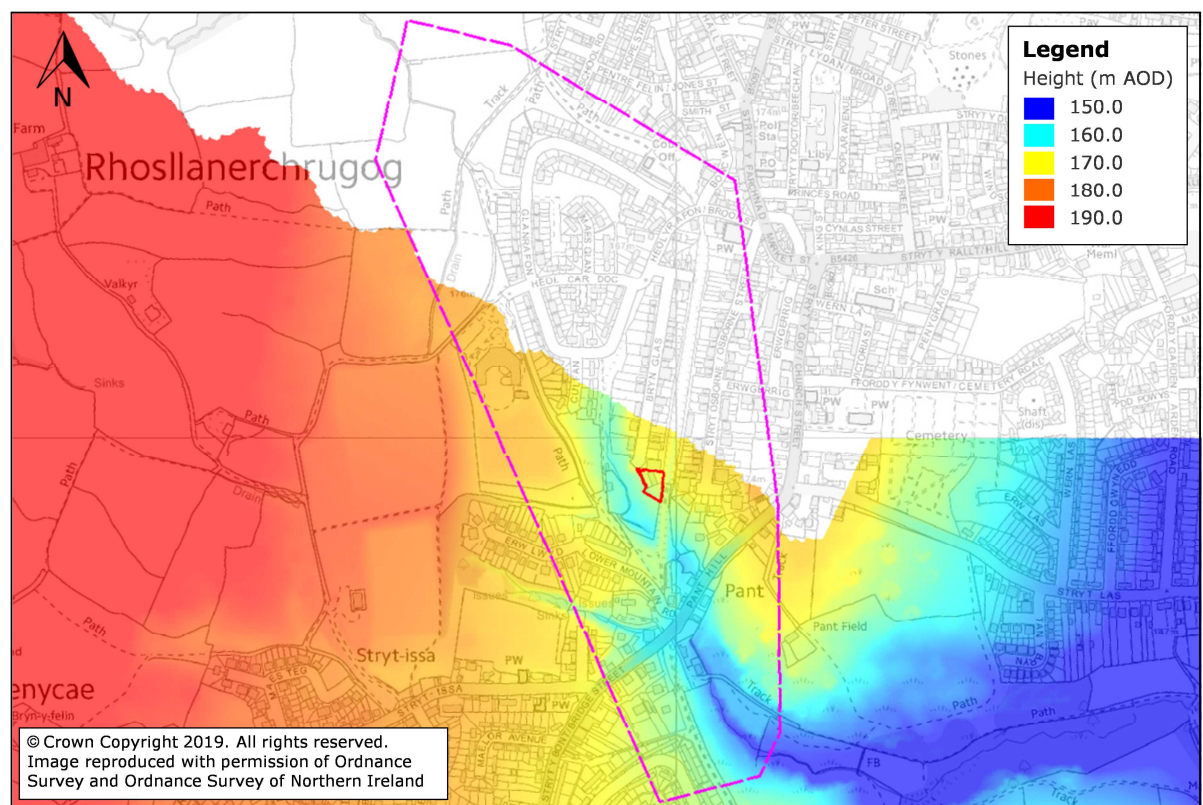


Figure 7: LiDAR

The above LiDAR data is the latest available composite digital terrain model (DTM) on the Lle Welsh Government website. It has a grid resolution of 1 m and is considered fit for purpose as it has been validated against the survey data.

The grid size used for the 2D domain was chosen as 2 m, thus enabling any flow paths between buildings/along roads to be modelled.

4.3.1 Structures - Channel

The structures along the watercourse are represented within the 1D domain. The location of these structures is shown in **Figure 8** with photographs of each structure and the ESTRY unit type provided in **Figure 9**.

It should be noted that structures 1, 2 and 4 have been represented using multiple conduits, with manhole losses automatically applied between conduits.

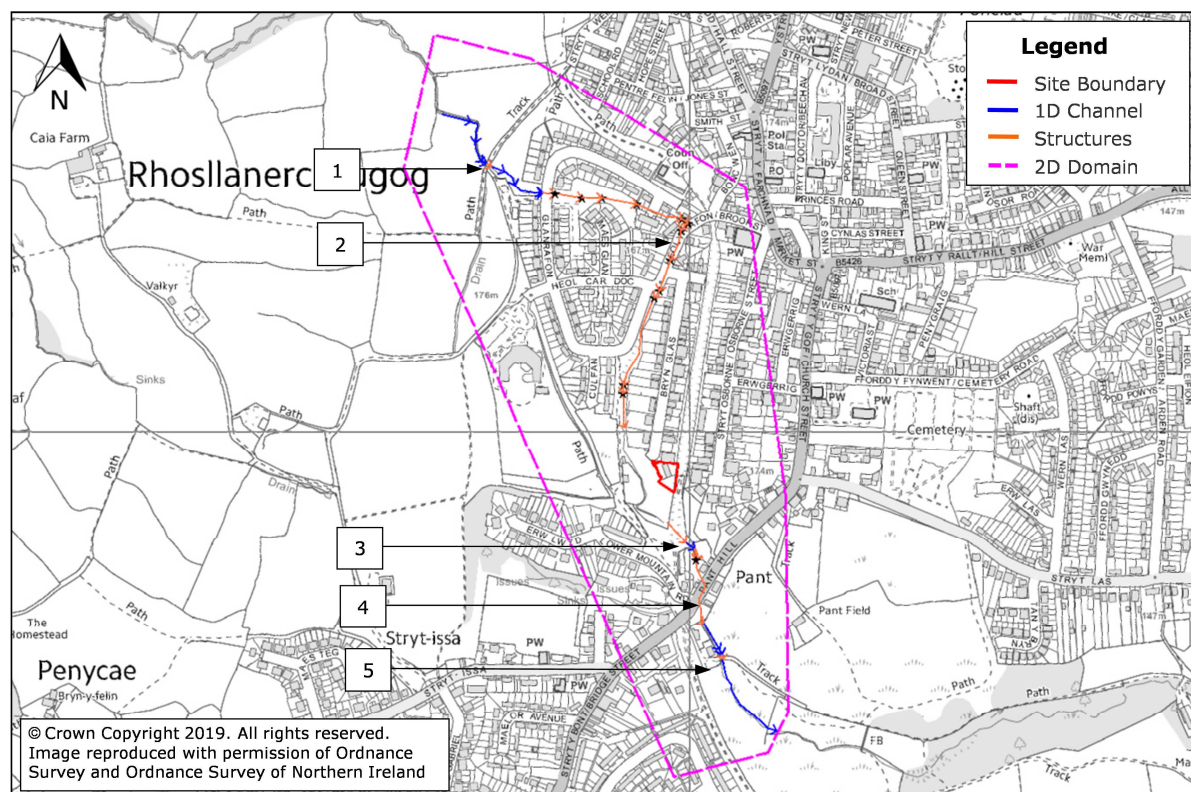
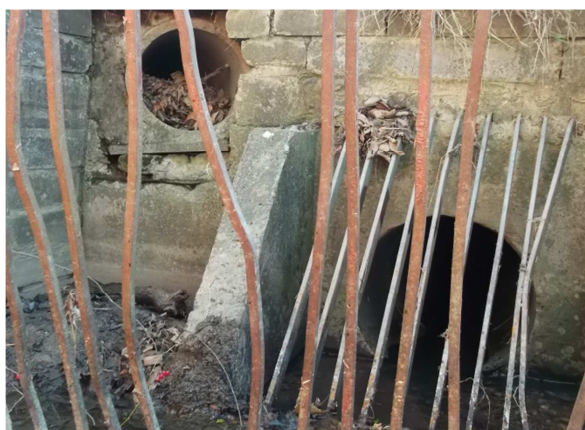


Figure 8: Location of Channel Structures in Modelled Reach



1. Double Culvert Inlet – Rhos_1158
ESTRY Unit: Circular Culverts



2. Culvert Inlet – Rhos_1059
ESTRY Unit: Circular Culvert



3. Culvert Inlet – Rhos_0362
ESTRY Unit: Circular Culvert



4. Triple Culvert Inlet – Rhos_0307
ESTRY Unit: Circular Culverts

Photo Unavailable

5. Bridge – Rhos_0144
ESTRY Unit: Bridge (B)

Figure 9: Photographs of Channel Structures in Modelled Reach

4.4 1D/2D LINKING

The 1D channel has been dynamically linked to the 2D domain. This has been carried out using 'HX' lines and 'CN' connectors within the '2d_bc_hx' layer in TUFLOW. Linking the two domains allows water to pass from the 1D domain to the 2D domain if water levels in the channel are higher than the floodplain. Conversely it allows water to pass into the 1D domain when water levels in the channel drop below floodplain levels.

4.5 MODEL COEFFICIENTS

4.5.1 Mannings n

The Mannings n values represent the 'roughness', or resistance to water flow due to friction, in both the river channel and the floodplain. Mapping data, aerial photography and several site visits were used to define the channel and land use types, which were then assigned Mannings n values.

The Mannings n values used in the model are shown in **Table 3**

Table 3: Mannings n Values

Land Use		Mannings n Value
Channel	Clean, straight channel with stones and weeds	0.035

Structures	Brick with Cement Mortar	0.015
	Corrugated Steel	0.025
	Float Finished Concrete	0.013 – 0.017
Floodplain	Long Grass	0.040
	Dense Trees and Shrubs	0.075
	Shrubs	0.050
	Gardens in built up areas	0.1
	Roads	0.025
	Buildings	0.500

4.6 BOUNDARY CONDITIONS

4.6.1 Input Boundaries

The input flow hydrographs are those outlined within **Section 3**. These have been input into the 1D model using a 'QT' boundary at model node 'Rhos_1275' (refer to **Figure 6**).

4.6.2 Downstream Boundaries

At the downstream extent of the 1D model, a 'HT' link is applied to node 'Rhos_0008' (refer to **Figure 6**). The downstream boundary is located significantly below site levels and will therefore not impact the assessment of flood risk at the site.

4.7 MODEL VERSION AND SIMULATION INFORMATION

The model was developed using TUFLOW build 2018-03-AB-iDP-w64.

Simulations for all design events were run with a 0.5 second timestep in both the 1D ESTRY domain and the 2D TUFLOW domain. Information on timestep and other variables can be seen in the '*.tcf' files for each run, and is recorded in the modelling logbook spreadsheet ('3494 Modelling Logbook.xls') accompanying this report (see **Annex C**).

5 MODEL RUNS AND RESULTS

5.1 MODEL RUNS

Table 4 details the model runs that have been undertaken in order to assess the flood risk at the existing site under the baseline scenario.

Full details are provided in the '3494 Modelling Logbook.xls' included within **Annex C** of this report.

Table 4: Model Runs - Baseline

Run Name	Flood Event (AEP)
3494_005_Q0100	1:100
3494_005_Q0100cc20	1:100+CC (20%)
3494_005_Q0100cc45	1:100+CC (45%)
3494_005_Q1000	1:1,000

5.2 MODEL RESULTS

Model output plots illustrating the maximum flood extents for all modelled events are provided in **Annex D**.

The baseline results indicate some flooding of the site would be expected to occur during the 1:1,000 annual probability event.

Table 5 summarises the maximum flood level, depth and velocity of floodwaters expected on site during the 1:1,000 annual probability event.

Table 5: Modelled Flood Level, Depth & Velocity - Baseline

Annual Probability Event	Level (m AOD)	Depth (m)	Velocity (m/s)
1:1,000	165.73	0.32	0.02

6 MODEL CALIBRATION AND SENSITIVITY

6.1 MODEL CALIBRATION

6.1.1 Known Historical Flood Events

The catchment is ungauged and there are no known historic flood events that have impacted the site and therefore it is not possible to calibrate the hydraulic model using historic data.

6.2 MODEL SENSITIVITY

6.2.1 Manning's n

Sensitivity testing has been carried out for the 1:100 +20CC annual probability event on the Manning's n coefficients by varying them by +/- 20%.

The results indicate that despite expected changes in velocity as a result of increasing Manning's n , peak water levels were generally not altered beyond + 30 mm. Reducing the roughness coefficients was not possible due to stability issues.

The model is therefore not considered to be sensitive to changes in roughness coefficients.

6.2.2 Downstream Boundary

Given that the downstream boundary of the model is located in an area where the channel invert is more than 10 m below the lowest channel invert level within the site, sensitivity testing on the downstream boundary should not be required as this is not likely to have any impact on flood risk at the site.

6.2.3 Structure Blockage

Sensitivity testing has been carried out for the 1:100+CC (20%) and 1:1,000 annual probability event for a 100% blockage of the culvert located 40 m to the south of the site.

The model plots are available in **Annex E** illustrating the maximum flood extents for the above scenario.

The model results indicate that a blockage of the aforementioned culvert would result in a significant increase in water levels due to the presence of the raised embankment along the site's eastern boundary. Water levels within the site boundary are shown to reach 166.54 m AOD and 166.59 m AOD in the 1:100+CC (20%) and 1:1,000 annual probability events respectively.

7 SUMMARY

Weetwood Services Ltd ('Weetwood') has been instructed by Dave Cottle Civil Engineering Ltd to undertake a hydraulic modelling study of an unnamed watercourse in order to identify and assess the level of flood risk from this source in association with the proposed redevelopment of a site at 57 Bryn Glas, Rhosllanerchrugog.

According to the Development Advice Map, the proposed development site is located in Flood Zone A. However, the risk of flooding from the unnamed watercourse is not expected to have been assessed owing to the small size of the catchment.

In order to more accurately identify and assess the level of flood risk from unnamed watercourse in the vicinity of the site a 1D-2D ESTRY-TUFLOW hydraulic model has been developed.

The baseline results indicate during the 1:1,000 annual probability event flooding would be expected at the site.

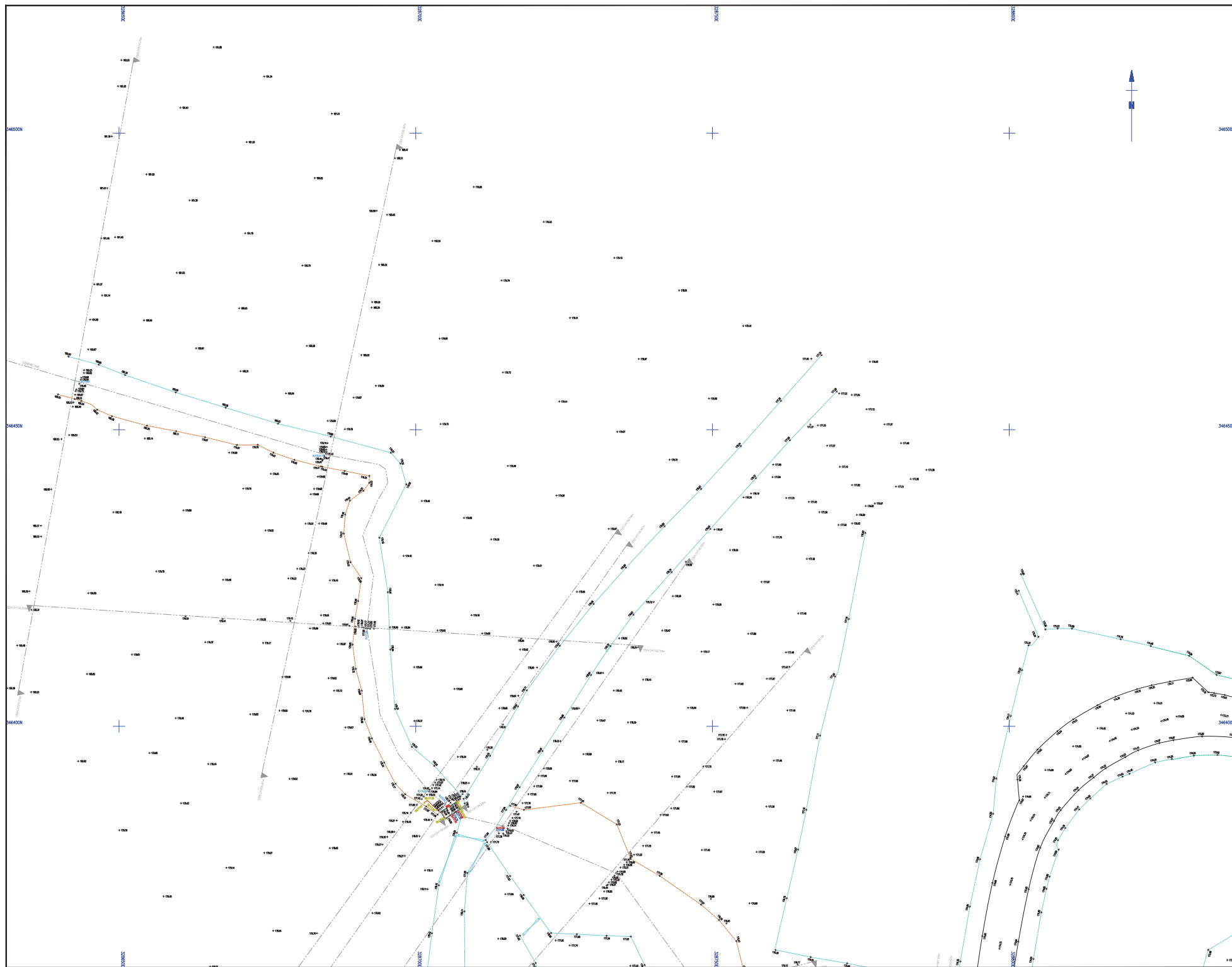
There are no recorded flood incidents at or within the vicinity of the site, the catchment is also ungauged. As such, it is not possible to calibrate the model in this instance.

The model sensitivity to Manning's n was tested by increasing the coefficient by + 20%. The results indicate that despite expected changes in velocity as a result of increasing Manning's n , peak water levels were generally not altered beyond + 30 mm. Reducing the roughness coefficients was not possible due to stability issues.

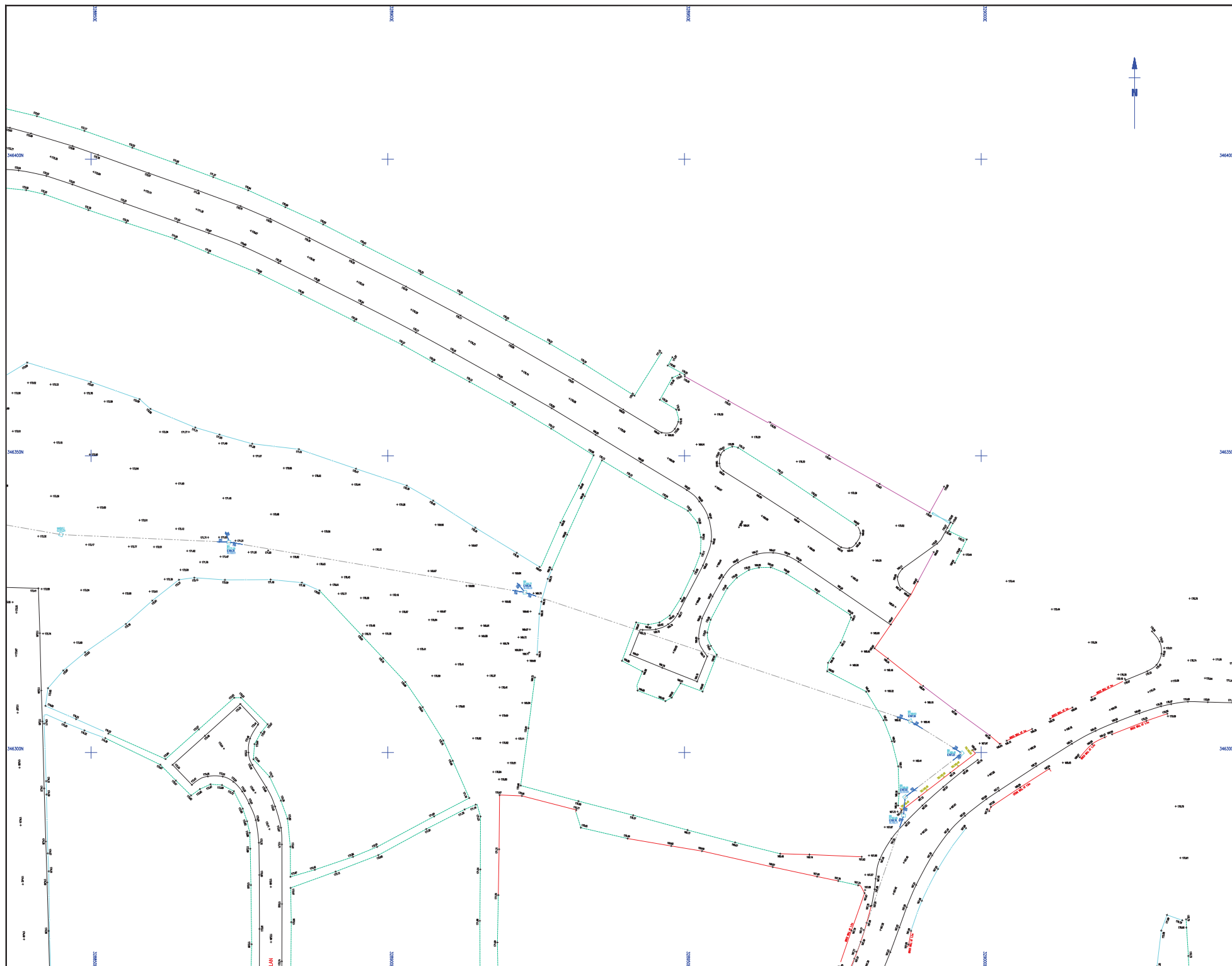
Sensitivity testing was also carried out for the 1:100+CC (20%) and 1:1,000 annual probability event for a 100% blockage of the culvert located 40 m to the south of the site. The model results indicate that a blockage of the culvert would result in a significant increase in water levels due to the presence of the raised embankment along the site's eastern boundary. Water levels within the site boundary are shown to reach 166.54 m AOD and 166.59 m AOD in the 1:100+CC (20%) and 1:1,000 annual probability events respectively.

Annex A:

Topographic Survey

[illegible][illegible]

MALCOLM HUGHES LAND SURVEYORS Chartered Land Surveyors 65 Cowes Road, Gos. Hortham NE2 7HF, Tel: 01435 506 1265 www.mhsls.co.uk survey@mhsls.co.uk	
Accredited by:    	
Client: WEETWOOD SUITE 1, PARK HOUSE BRONCROD BUSINESS PARK, WREXHAM RD, MOLD LL14, 2DL	
Project: BRYN GLAS RHOSLLANERCHUGOG LL14, 2DL	
Drawing Title: TOPOGRAPHIC SURVEY	
Issued At: 12/09/17 Checked By: 12/09/17	Date: December 2016 Scale: 1: 200 (AO Files)
Date: 18/09/17	



Survey Details

Location:

Scale:

Map Sheet:

Map Scale:

Map Date:

Map Author:

Map Title:

Map Project:

Map Status:

Map Version:

Map Date:

Map Author:

Map Title:

Map Project:

Map Status:

Map Version:

Legend

Topographical Survey Legend

General

Water

Vegetation

Buildings

Infrastructure

Topography

Other

Notes

[illegible]

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85 Cross Street, Sale, Manchester
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www.malcolmhughes.co.uk
survey@mhsl.co.uk



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SUITE 1, PARK HOUSE
BRONCOED BUSINESS PARK, WREXHAM RD, MOLD

Project

BRYN GLAS
RHOSLLANERCHRUGOG
LL14, 2DL

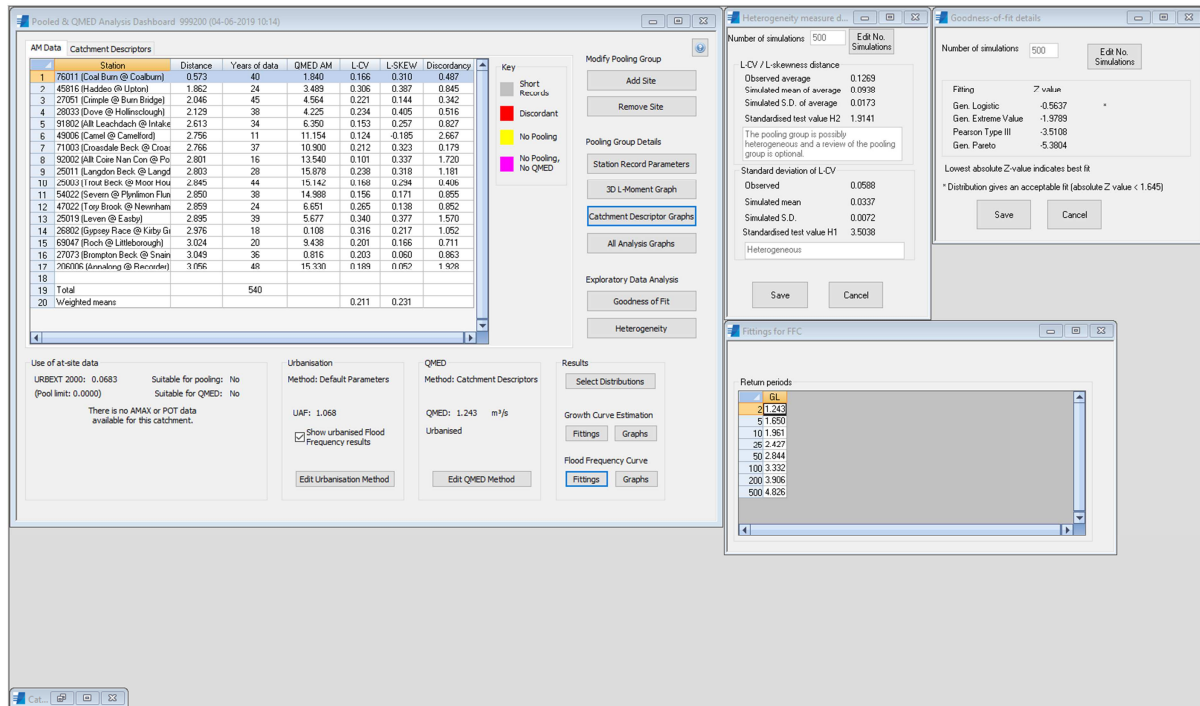
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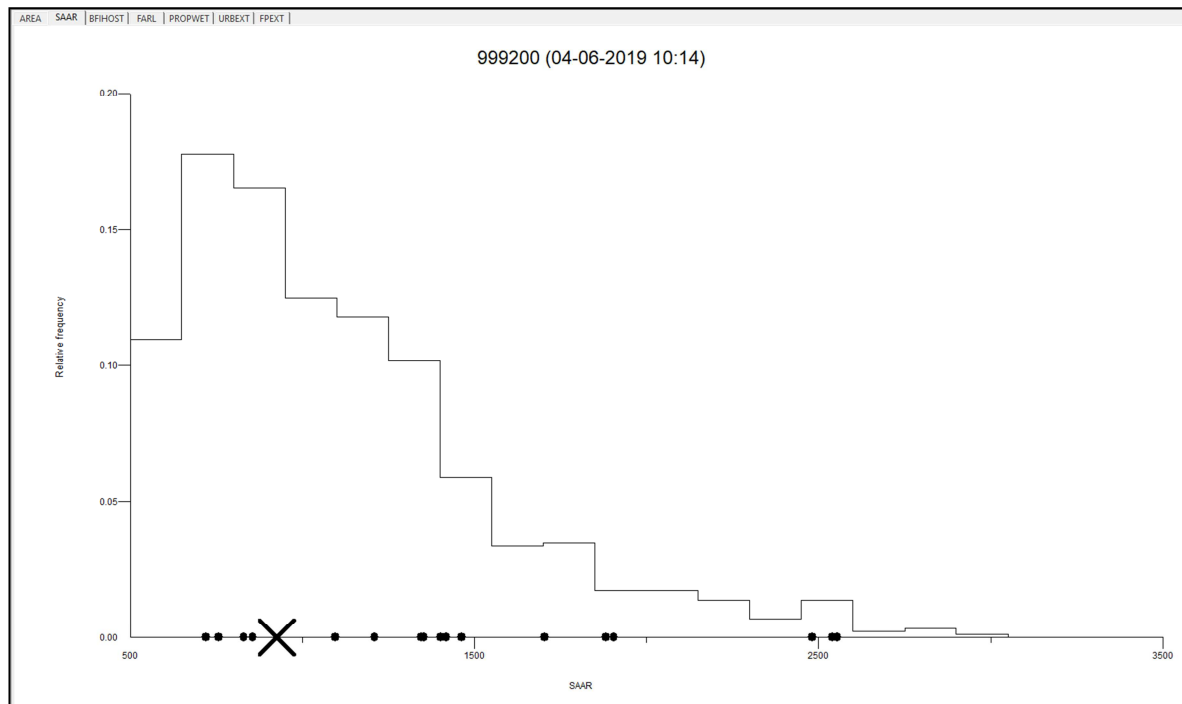


Annex B:

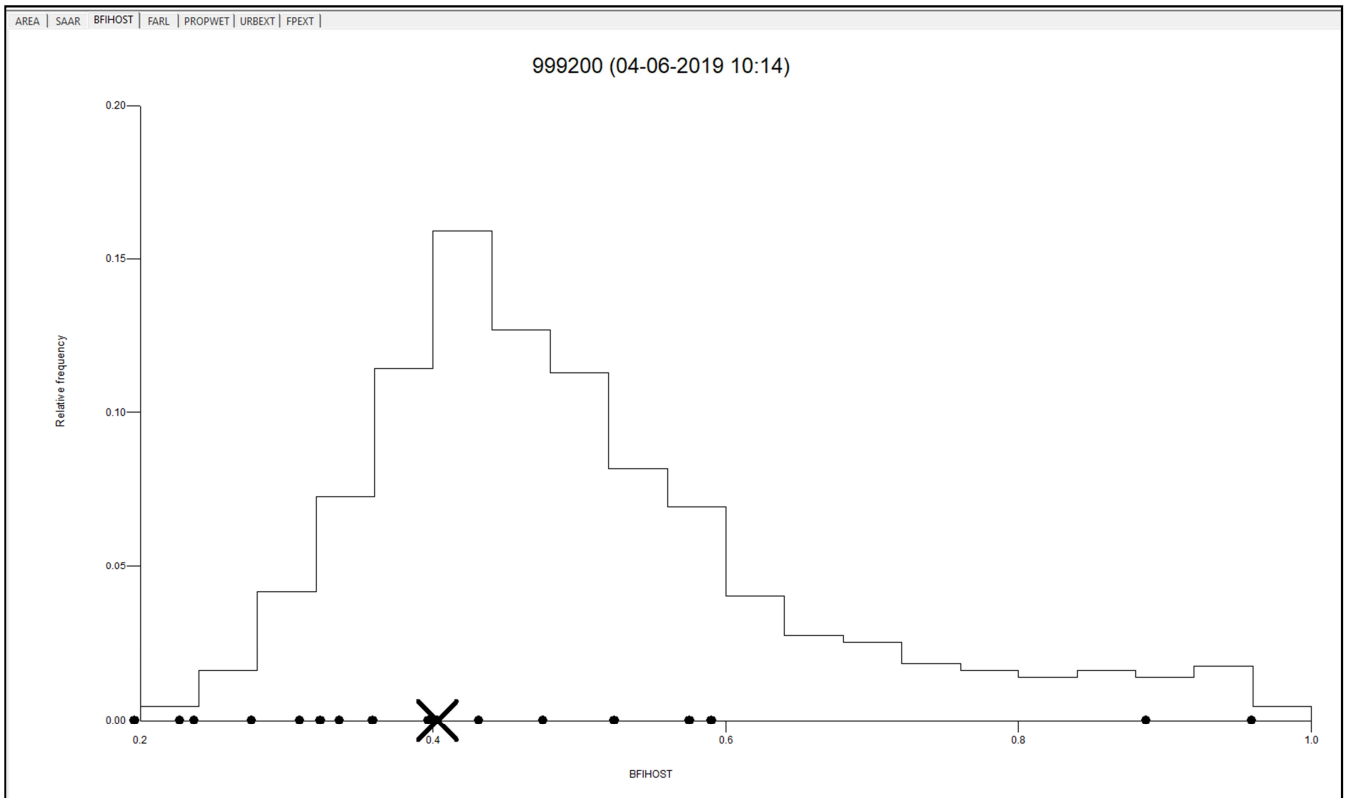
FEH Statistical Method - Pooling Group Details



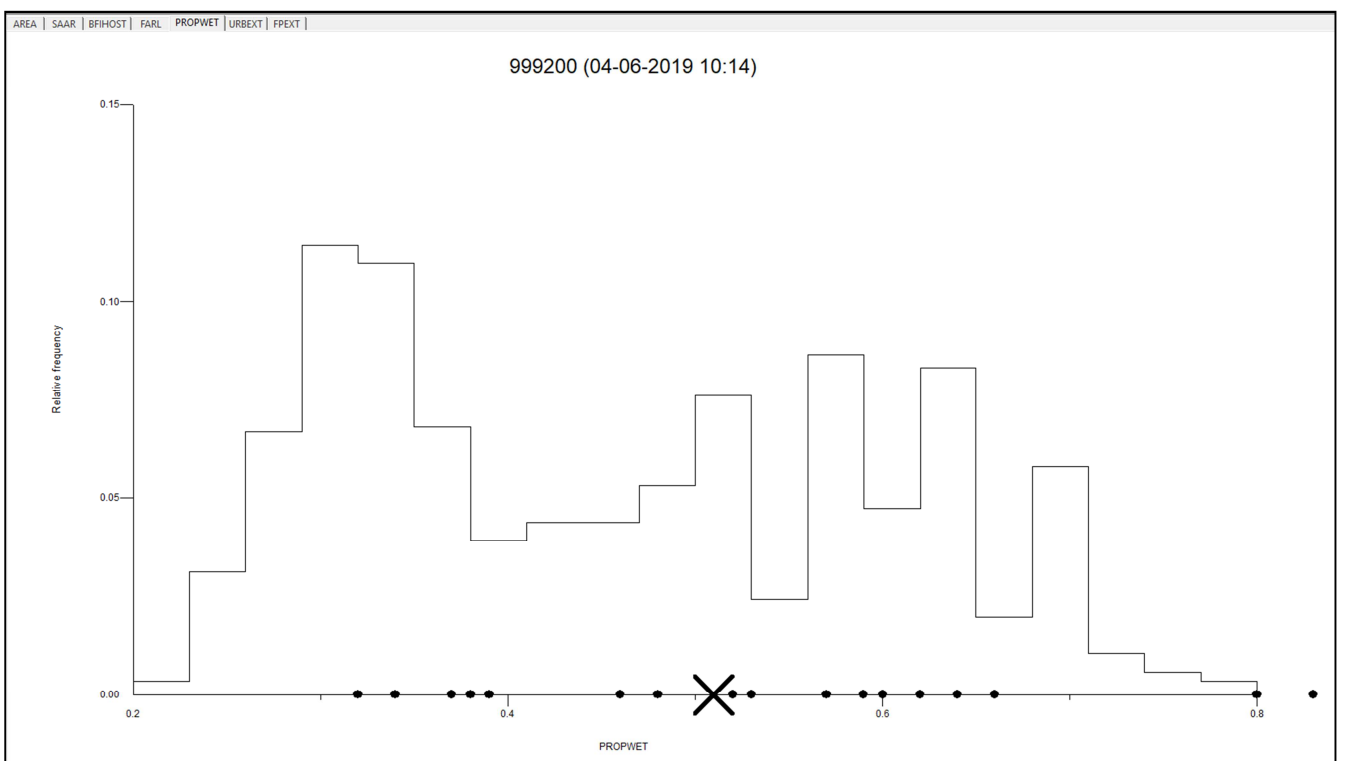
Pooling Group with Heterogeneity measures, Goodness of fit details and Fittings for Flood Frequency Curve



Catchment Descriptor Graph - SAAR



Catchment Descriptor Graph - BFIHOST



Catchment Descriptor Graph - PROPWET

Annex C:

Digital Model Files

Available upon request

Annex D:

Model Results - Baseline

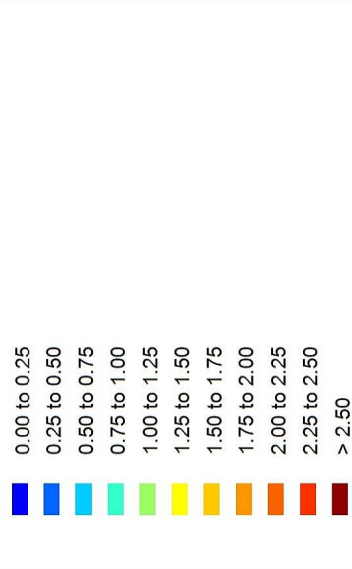
Notes:

1. Do not scale from this drawing.
2. Map backdrop reproduced from Ordnance Survey digital map data. Crown Copyright under licence.

KEY:

— Site Location

Depth (metres)



Weetwood

Development • Planning • Environment

70 Cowcross Street
London
EC1M 6EJ

Tel: 0203 757 5444
Email: info@weetwood.net

Client:

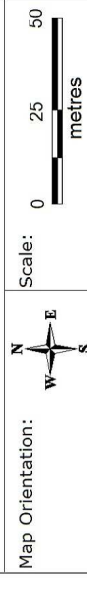
Dave Cottle Civil Engineering Ltd

Project Title:

57 Bryn Glas, Rhosllanerchrugog

Drawing Title:

**Baseline Scenario
1:100 AEP**



Drawn:	Checked:	Date:
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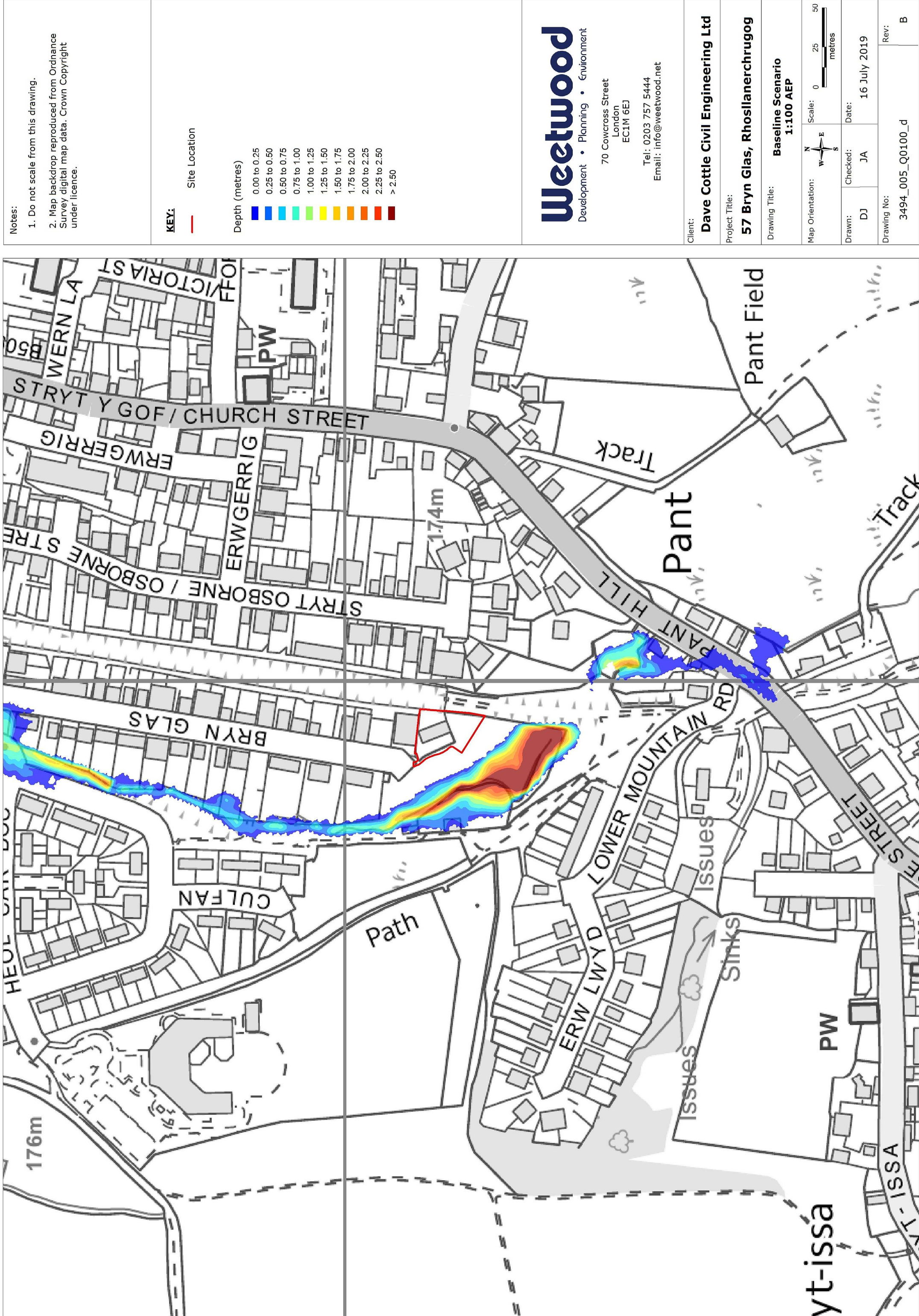
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Rev:



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KEY:

Site Location

Depth (metres)

0.00 to 0.25

0.25 to 0.50

0.50 to 0.75

0.75 to 1.00

1.00 to 1.25

1.25 to 1.50

1.50 to 1.75

1.75 to 2.00

2.00 to 2.25

2.25 to 2.50

> 2.50

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Project Title:

57 Bryn Glas, Rhosllanerchrugog

Drawing Title:

Baseline Scenario
1:100+CC (20%) AEP

Map Orientation:

N

W

E

S

Scale: 0 25 50 metres

Drawn:

DJ

Checked:

JA

Date:

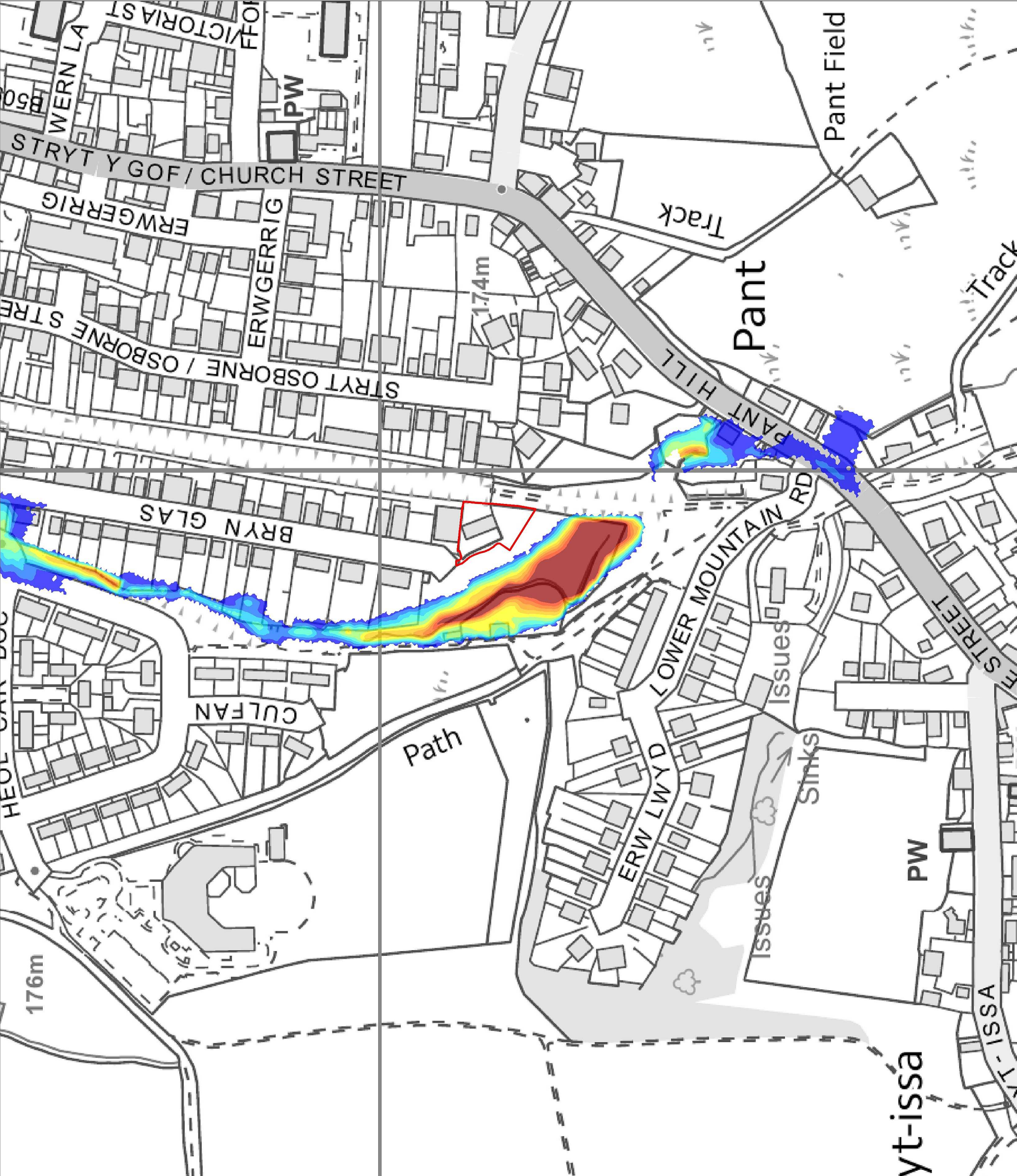
16 July 2019

Drawing No:

3494_005_Q0100cc20_d

Rev:

B



Notes:

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KEY:

Site Location

Depth (metres)

0.00 to 0.25

0.25 to 0.50

0.50 to 0.75

0.75 to 1.00

1.00 to 1.25

1.25 to 1.50

1.50 to 1.75

1.75 to 2.00

2.00 to 2.25

2.25 to 2.50

> 2.50

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Client:

Dave Cottle Civil Engineering Ltd

Project Title:

57 Bryn Glas, Rhosllanerchrugog

Drawing Title:

Baseline Scenario
1:100+CC (45%) AEP

Map Orientation:

N

W

E

S

Scale: 0 25 50 metres

Drawn:

DJ

Checked:

JA

Date:

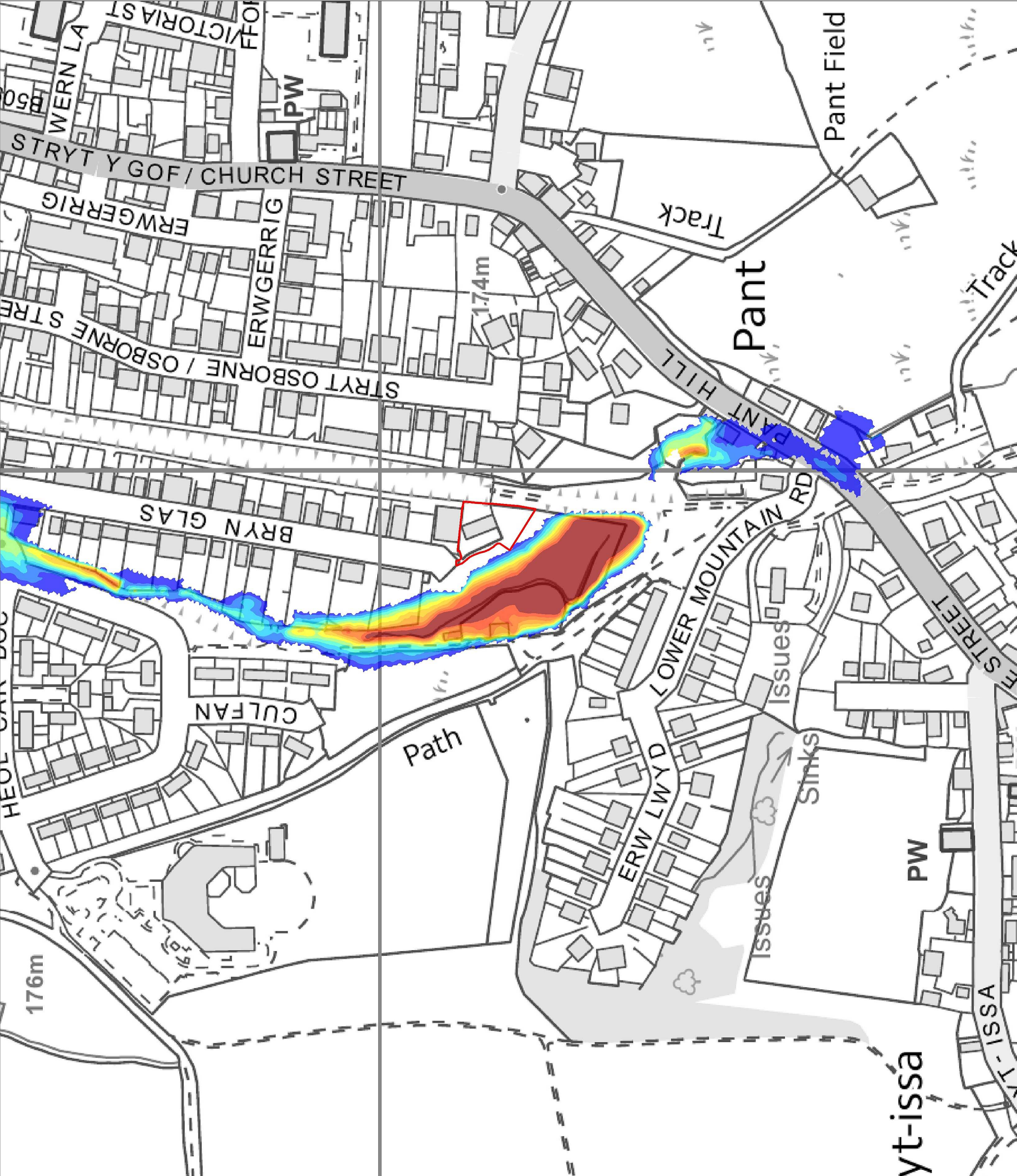
16 July 2019

Drawing No:

3494_005_Q0100cc45_d

Rev:

B



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KEY:

Site Location

Depth (metres)

0.00 to 0.25

0.25 to 0.50

0.50 to 0.75

0.75 to 1.00

1.00 to 1.25

1.25 to 1.50

1.50 to 1.75

1.75 to 2.00

2.00 to 2.25

2.25 to 2.50

> 2.50

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Client:

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Project Title:

57 Bryn Glas, Rhosllanerchrugog

Drawing Title:

Baseline Scenario
1:1,000 AEP

Map Orientation:

Scale: 0 25 50 metres

Drawn:

Checked:

Date:

16 July 2019

Drawing No:

3494_005_Q1000_d

Rev:

B

This figure is a flood map of the Bryn Glas area, showing depth contours and the location of the site. The map includes the following features:

- Streets:** WERN LA, STRYT Y GOF / CHURCH STREET, ERWGERRIG, STRYT OSBORNE / OSBORNE STREET, BRYN GLAS, CULFAN, LOWER MOUNTAIN RD, ERW LWYD, ISSUES, SINKS, PW, YTT-ISSA.
- Contours:** 176m, 174m.
- Site Location:** Indicated by a red outline on the map.
- Depth Legend:** 0.00 to 0.25, 0.25 to 0.50, 0.50 to 0.75, 0.75 to 1.00, 1.00 to 1.25, 1.25 to 1.50, 1.50 to 1.75, 1.75 to 2.00, 2.00 to 2.25, 2.25 to 2.50, > 2.50.
- Other Features:** Path, Track, Pant Hill, Pant Field, Issues, Sinks, PW.

Annex E:

Model Results - Sensitivity

Notes:

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KEY:

Site Location

Depth (metres)

0.00 to 0.25

0.25 to 0.50

0.50 to 0.75

0.75 to 1.00

1.00 to 1.25

1.25 to 1.50

1.50 to 1.75

1.75 to 2.00

2.00 to 2.25

2.25 to 2.50

> 2.50

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Client:

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Project Title:

57 Bryn Glas, Rhosllanerchrugog

Drawing Title:

Baseline Scenario - Blockage(100%)
1:100+CC (20%) AEP

Map Orientation:

Scale: 0 25 50 metres

Drawn:

Checked:

Date:

Drawing No:

Rev:

The figure is a flood map overlaid on a street map of a residential area. The map shows various streets including Church Street, Bryn Glas, Pant Hill, and Pant Field. A red outline highlights a specific area of interest, which is surrounded by flood contours. The flood contours are color-coded according to depth, with blue representing 0.00 to 0.25 metres and red representing depths greater than 2.50 metres. The map also shows a path, a track, and a sink. The area of interest is located near the intersection of Church Street and Bryn Glas. The map includes a key for the depth contours and a site location marker. The map is titled 'Baseline Scenario - Blockage(100%) 1:100+CC (20%) AEP'.

Notes:

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KEY:

Site Location

Depth (metres)

0.00 to 0.25

0.25 to 0.50

0.50 to 0.75

0.75 to 1.00

1.00 to 1.25

1.25 to 1.50

1.50 to 1.75

1.75 to 2.00

2.00 to 2.25

2.25 to 2.50

> 2.50

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Client:

Dave Cottle Civil Engineering Ltd

Project Title:

57 Bryn Glas, Rhosllanerchrugog

Drawing Title:

Baseline Scenario - Blockage(100%)
1:1,000 AEP

Map Orientation:

Scale: 0 25 50 metres

Drawn:

Checked:

Date:

16 July 2019

Drawing No:

3494_008_Q1000_d

Rev:

B

This figure is a flood map overlaid on a street map of a residential area. The map shows various streets including Wern La, Victoria St, Church Street, Erwgerrig, Stryt Osborne / Osborne Street, Bryn Glas, Culfan, Lower Mountain Road, Erw Lwyd, Pant Hill, Pant Field, and Pant. A red outline indicates the 'Site Location'. The flood depth is represented by a color gradient from blue (0.00 to 0.25m) to dark red (> 2.50m). A large area of deep flooding (red/orange) is visible along the Bryn Glas and Culfan streets. Other areas of shallower flooding (blue/cyan) are scattered throughout the map. The map also includes labels for 'Track', 'Path', 'Issues', 'Sinks', and 'PW'. A dashed line labeled '176m' is shown in the bottom left corner. A scale bar and north arrow are located in the top right corner.



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