LAND BETWEEN BEDWELL PARK AND F LLOYD PENLEY LTD
WREXHAM INDUSTRIAL ESTATE, BEDWELL ROAD, WREXHAM

FLOOD CONSEQUENCES ASSESSMENT

Final Report v1.0
May 2026

Weetwood Services Ltd
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Report Title	**Land Between Bedwell Park and F Lloyd Pendley Ltd** **Wrexham Industrial Estate, Bedwell Road, Wrexham** Flood Consequences Assessment Final Report v1.0
Client	FI Real Estate Management
Date of issue	14 May 2026

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List of Abbreviations

AEP	Annual Exceedance Probability	km	Kilometres
AOD	Above Ordnance Datum	LFRMS	Local Flood Risk Management Strategy
ASGWF	Areas Susceptible to Groundwater Flooding	LiDAR	Light Detection and Ranging
bgl	Below Ground Level	LLFA	Lead Local Flood Authority
BGS	British Geological Survey	LPA	Local Planning Authority
BRE	Building Research Establishment	l/s	Litres per Second
BSI	British Standards Institute	m	Metres
CC	Climate Change	m^2	Square Metres
CCMA	Coastal Change Management Area	m^3	Cubic Metres
CFMP	Catchment Flood Management Plan	NFM	Natural Flood Management
CIRIA	Construction Industry Research and Information Association	NGR	National Grid Reference
		NRW	Natural Resources Wales
CRT	Canal and River Trust	NVZ	Nitrate Vulnerable Zone
DCWW	Dŵr Cymru Welsh Water	OS	Ordnance Survey
DEFRA	Department for Environment, Food and Rural Affairs	PFRA	Preliminary Flood Risk Assessment
		PPW	Planning Policy Wales
DS	Drainage Statement	QBAR	Mean Annual Maximum Flow Rate
EA	Environment Agency	QMED	Median Annual Maximum Flow Rate
FCA	Flood Consequences Assessment	RBD	River Basin District
FCADS	Flood Consequences Assessment and Drainage Statement	RBMP	River Basin Management Plan
		RFI	Request for Information (to NRW)
FCERM	Flood and Coastal Erosion Risk Management	RMA	Risk Management Authority
		RoFSW	Risk of Flooding from Surface Water
FEH	Flood Estimation Handbook	SAC	Special Area of Conservation
FFL	Finished Floor Level	SFCA	Strategic Flood Consequences Assessment
FMfP	Flood Map for Planning		
FMP	Flood Management Plan	SMP	Shoreline Management Plan
FRMP	Flood Risk Management Plan	SoP	Standard of Protection
FWA	Flood Warning Area	SSSI	Site of Special Scientific Interest
FWEP	Flood Warning and Evacuation Plan	SAB	SuDS Approving Body
FWMA	Flood and Water Management Act	SuDS	Sustainable Drainage System
FWS	Flood Warning System	SWMP	Surface Water Management Plan
GSPZ	Groundwater Source Protection Zone	TAN15	Technical Advice Note 15
ha	Hectare	WFD	Water Framework Directive
IDD	Internal Drainage Districts		

1 INTRODUCTION

1.1 Purpose of Report

Weetwood Services Ltd ('Weetwood') has been instructed by FI Real Estate Management to prepare a FCA report to accompany a retrospective planning application (Ref. P/2025/0886) for the construction of a bridge over the River Clywedog, between at Bedwell Park and F Lloyd Penley, Bedwell Road, Wrexham ("the site").

The assessment has been undertaken in accordance with the requirements of TAN15.

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
Section 3 Presents national and local flood risk planning policy
Section 4 Assesses the potential risk of flooding to the development site
Section 5 Presents a summary of key findings and the recommendations

1.3 Relevant Documents and Planning Policy

The assessment has been informed by the following documents, policy and information:

- Flood Consequences Assessments: Climate Change Allowances, Welsh Government, March 2026, https://www.gov.wales/sites/default/files/publications/2026-03/climate-change-allowances-and-flood-consequence-assessments.pdf;
- Technical Advice Note 15: Development, Flooding and Coastal Erosion, Welsh Government, March 2025;
- Planning Policy Wales, Welsh Government, February 2024;
- Wrexham Local Development Plan 2013 - 2028, Wrexham County Borough Council, December 2023;
- Future Wales - the National Plan 2040, Welsh Government, February 2021;
- The National Strategy for Flood and Coastal Erosion Risk Management in Wales, Welsh Government, October 2020;
- Dee Preliminary Flood Risk Assessment, Natural Resources Wales, December 2018;
- Preliminary Flood Risk Assessment Addendum, Wrexham County Borough Council, November 2017;
- Flood Risk Management Plan 2016 - 2021, Wrexham County Borough Council, July 2016;
- Local Flood Risk Management Strategy, Wrexham County Borough Council, April 2013;
- Soilscapes, Soil and AgriFood Institute, Cranfield University, www.landis.org.uk/soilscapes;
- National Geoscience Data Centre's Single Onshore Borehole Index, https://www.bgs.ac.uk/products/onshore/SOBI.html; and
- BGS Mapping of Surface Geology, https://www.bgs.ac.uk/map-viewers/geoindex-onshore/.

1.4 Third Party Surveys, Drawings and Assessments

The assessment has been informed by the following third party surveys, drawings and assessments:

- Site Layout as Proposed, Domus Architecture, Ref. 2153 A1-03 Rev. B, December 2025 (**Appendix A**);
- Proposed Bridge Elevations, Domus Architecture, Ref. 2153 A4-01, November 2025 (**Appendix A**);
- Topographic Surveys (Annex B of **Appendix B**), including:
    - Land at Bedwell Park, Survey Operations, January 2026;
    - Cross Sectional Survey, Survey Operations, January 2026;
    - River Clywedog, Met GeoEnvironmental, June 2025; and
    - Land at F Lloyd Wrexham Industrial Estate, Survey Operations, February 2023.

1.5 Explanatory Note on Flood Probability

This report refers to the likelihood of a flood event occurring in terms of an AEP expressed as a percentage. This terminology is consistent with the definition of the FMfP flood zones presented in Figure 1 of TAN15 (refer to **Section 4.2** of this report).

The AEP is the reciprocal of the return period which describes the rarity of an event in terms of its statistical reoccurrence interval in years. For example, a '1 in 30 year flood' has a 1/30 = 0.033 (3.3%) probability of occurring in any one year, whilst a '1 in 100 year flood' has a 1/100 = 0.010 (1.0%) probability of occurring in any one year.

AEP	AEP (expressed as a %)	Return Period (years)	Alternative Expression
1.000	100.0%	1	1 in 1
0.500	50.0%	2	1 in 2
0.100	10.0%	10	1 in 10
0.050	5.0%	20	1 in 20
0.033	3.3%	30	1 in 30
0.020	2.0%	50	1 in 50
0.010	1.0%	100	1 in 100
0.005	0.5%	200	1 in 200
0.001	0.1%	1,000	1 in 1,000

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 Site Location

The approximately 0.15 ha site is located to the east of Bedwell Road at OS NGR SJ 375 484, as shown in **Figure 1**.

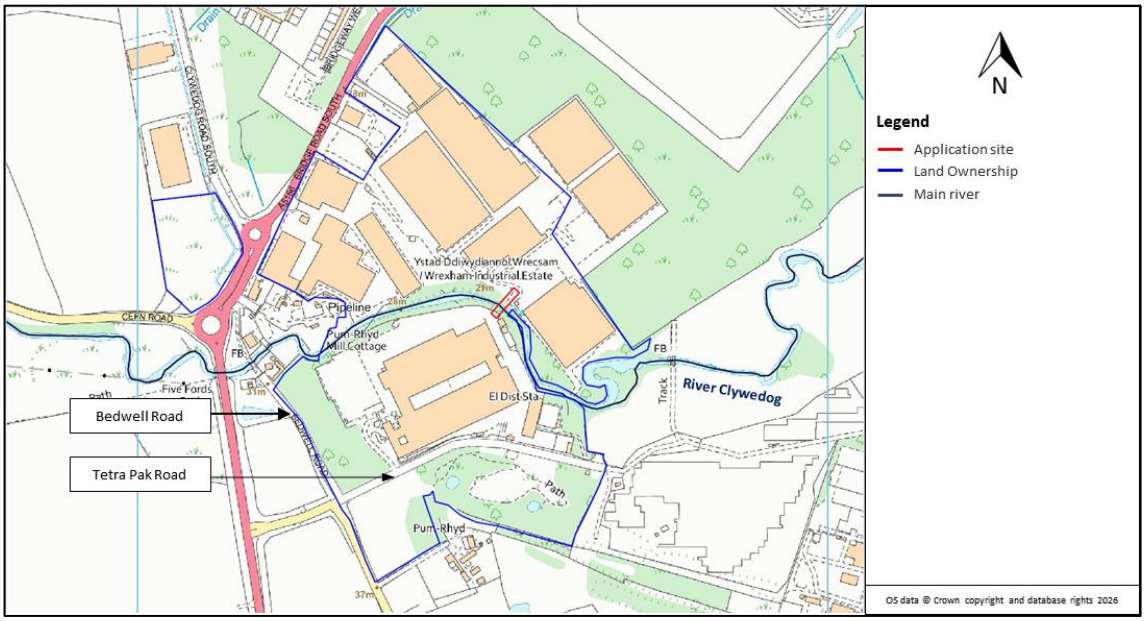


Figure 1: Site Location and Location of Surface Waterbodies

2.2 Proposed Development

The proposals comprise the construction of a bridge to facilitate a link between the industrial warehouses located on land to the north and south of the River Clywedog for which significant benefits will be provided, primarily by improving logistics, streamlining operations and reducing costs.

The bridge has been constructed and comprises a clear span steel bridge supported on each bank by concrete abutments, with railings.

The proposed site layout and bridge elevations are provided in **Appendix A**.

TAN15 does not specifically classify the vulnerability of access roads/bridges; however, given that this will provide access between existing industrial uses, it may be classed as Less Vulnerable to flood risk.

2.3 Surface Waterbodies in the Vicinity of the Site

The River Clywedog flows east/south-east through the site.

2.4 Topographic Levels

A topographic survey of the pre-developed site has been undertaken by Survey Operations (Annex A of **Appendix B**) and LiDAR data has been used to develop a digital terrain model of the site and surrounding area as illustrated in **Figure 2**.

Site levels are indicated to be in the region of 30.0 - 30.3 m AOD to the south of the River Clywedog, and 30.0 - 32.6 m AOD to the north, with levels falling towards the watercourse.

The as-built bridge was surveyed by Survey Operations in January 2026, and the cross-sectional profile is provided in Annex B of **Appendix B** (Ref. CS 17 and CS 16, representing the upstream and downstream extents respectively). This indicates that the soffit level of the bridge is 30.51 - 31.13 m AOD, with a deck level of

30.94 - 31.56 m AOD. The deck ties in with the concrete abutments on either bank before subsequently tying in with existing ground levels.

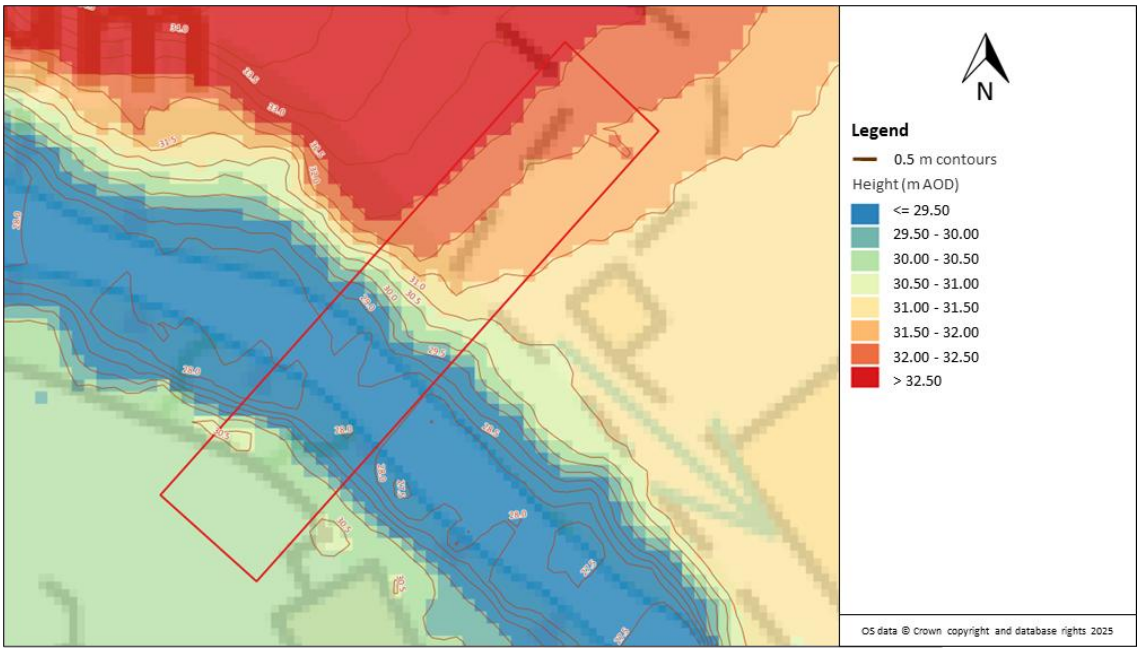


Figure 2: Digital Terrain Model from LiDAR Data

2.5 Ground Conditions

According to the Soilscapes soils dataset produced by the Cranfield Soil and AgriFood Institute, soil conditions at the site are described as loamy and clayey floodplain soils with naturally high groundwater.

BGS mapping of surface geology indicates the underlying bedrock formation comprises mudstone, sandstone and conglomerates (Salop Formation), overlain by clay, silt, sand and gravel (Alluvium) superficial deposits.

According to the BGS and NRW aquifer designation dataset the superficial deposits and underlying bedrock at the site are classified as a Secondary A aquifer. The site is not shown to be located within a designated GSPZ.

3 PLANNING POLICY AND GUIDANCE

3.1 National Planning Policy and Policy Guidance

Future Wales - the National Plan 2040 sets out the national development framework for Wales with a strategy for addressing key national priorities through the planning system, including sustaining and developing a vibrant economy, achieving decarbonisation and climate-resilience, developing strong ecosystems and improving the health and well-being of our communities.

Policy 8 - Flooding states that *"flood risk management that enables and supports sustainable strategic growth and regeneration in National and Regional Growth Areas will be supported. The Welsh Government will work with Flood Risk Management Authorities and developers to plan and invest in new and improved infrastructure, promoting nature-based solutions as a priority. Opportunities for multiple social, economic and environmental benefits must be maximised when investing in flood risk management infrastructure. It must be ensured that projects do not have adverse impacts on international and national statutory designated sites for nature conservation and the features for which they have been designated"*.

PPW sets out government's planning policies for Wales and how these are expected to be applied. TAN15 provides technical guidance which supplements the policies set out in PPW and Future Wales in relation to flooding and coastal erosion. The approach set out in TAN15 ensures flooding is accorded appropriate consideration in plan making and development management decisions. TAN15 subsequently provides a framework within which the flood risks arising from rivers, the sea and surface water can be assessed. It also provides advice on the consequences of the risks and adapting to and living with flood risk.

3.2 Local Planning Policy

The Wrexham Local Development Plan 2013 - 2028 was adopted by Wrexham County Borough Council in December 2023. The following policies are relevant in respect of flood risk:

Policy SP18 - Climate Change

To mitigate against the effects of climate change and adapt to its impacts, development proposals will need to demonstrate that they have considered the following:

vi. Avoiding areas susceptible to flood risk in the first instance in accordance with the sequential approach set out in national guidance. Highly vulnerable development, as defined in TAN15: Development and Flood Risk, should not be located within zone C2;
vii. Preventing development that increases flood risk and;
viii. Assesses the potential effects of climate change when preparing a Flood Consequence Assessment for the site

Policy DM1 Development Management Considerations

Development proposals, where relevant, must:

vii. Not increase the risk of flooding but makes adequate provision for sustainably dealing with foul and surface water drainage and not result in an unacceptable impact upon the water environment.

3.3 Water Framework Directive

The WFD provides a legal framework for the protection, improvement and sustainable use of inland surface waters, groundwater, transitional waters, and coastal waters across Wales, and seeks to:

- Prevent deterioration in the status of surface water and groundwater bodies;
- Protect, enhance and restore surface water and groundwater bodies (except artificial or heavily modified water bodies) with the aim of achieving good ecological, chemical and groundwater quantitative status by December 2021;
- Protect and enhance artificial and heavily modified water bodies with the aim of achieving good ecological potential and good chemical status by December 2021; and

- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment and progressively reduce pollution of groundwater.

The WFD applies to any proposed development which has the potential to impact on a waterbody. Where this is the case, NRW may require evidence demonstrating that the proposed development does not compromise the aims of the WFD.

3.4 Environmental Permitting

Under the Environmental Permitting (England and Wales) Regulations 2016 an Environmental Permit for Flood Risk Activities[1] is required from NRW for any permanent or temporary works, including works:

- In, over or under a designated main river; and / or
- Within 8 m of the top of bank of a designated main river or of the landward toe of a flood defence (16 m if it is a tidal main river or a sea defence).

In addition, any permanent or temporary works within the floodplain of a designated main river may also require an Environmental Permit for Flood Risk Activities. A permit is separate to and in addition to any planning permission granted.

1 https://naturalresources.wales/permits-and-permissions/environmental-permits/?lang=en

4 REVIEW OF FLOOD RISK

4.1 Historical Records of Flooding

The FMfP (Recorded Flood Extents) dataset[2] indicates that there are no records of flooding at or within the immediate vicinity of the site.

4.2 Flood Risk from Rivers (Fluvial)

The FMfP (Rivers and Sea) dataset (**Figure 3**) indicates the part of the site to the south and within the immediate vicinity of the River Clywedog to be located in flood zone 3 (rivers), with the land to the north in flood zone 1 (rivers and sea).

The flood zones are defined as follows and include the effects of climate change:

- Flood zone 1 (Rivers and Sea): Less than a 0.1% chance of flooding from rivers and the sea in a given year;
- Flood Zone 2 (Rivers): Areas with a 0.1% to 1.0% chance of flooding from rivers in a given year;
- Flood Zone 3 (Rivers): Areas with more than a 1.0% chance of flooding from rivers in a given year;
- Flood Zone 2 (Sea): Areas with a 0.1% to 0.5% chance of flooding from the sea in a given year;
- Flood Zone 3 (Sea): Areas with more than a 0.5% chance of flooding from the sea in a given year; and
- TAN15 Defended Zones: Areas that benefit from RMA flood defences with a present day 1.0% AEP and 0.5% AEP SoP for rivers and the sea respectively

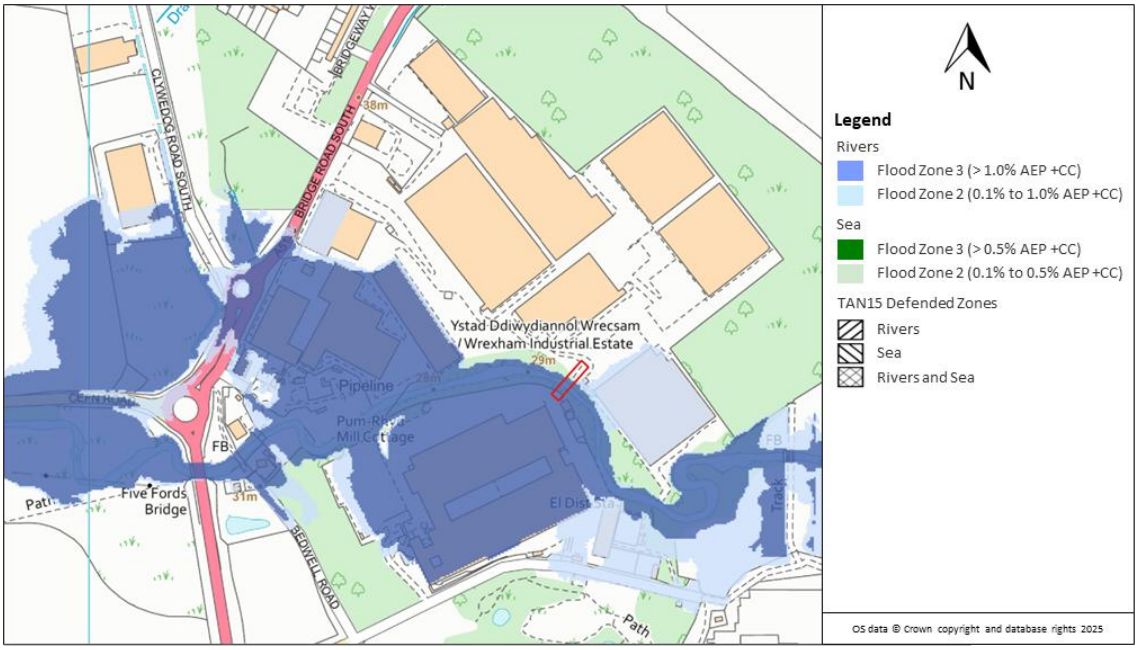


Figure 3: Flood Map for Planning (Rivers and Sea)
Source: NRW website; Accessed: April 2026

A 1D-2D ESTRY-TUFLOW hydraulic model of the River Clywedog has been developed by Weetwood to more accurately assess the risk of flooding from this source. Details regarding this are presented in the Hydraulic Modelling Study report in **Appendix B**.

The hydraulic model assesses the risk of flooding for the 1.0% and 0.1% AEP events and the 1.0% and 0.1% AEP events +25% and +50% climate change.

The pre-development (baseline) modelled outputs are provided in Annex E of the Hydraulic Modelling Study report (see **Appendix B**) and indicate that flows are contained within the channel of the River Clywedog in up

[2] https://datamap.gov.wales/layers/inspire-nrw:NRW_HISTORIC_FLOODMAP

to a 0.1% AEP event. Flooding of the site to the south and within the immediate vicinity of the River Clywedog is subsequently expected in the 0.1% AEP event when allowing for climate change.

The maximum flood level expected in the floodplain at the site during the 0.1% AEP +25% and 50% climate change events are 30.48 and 30.62 m AOD respectively. The in-channel water levels expected at the proposed bridge are discussed in **Section 4.6** in **Table 1**.

4.3 Flood Risk from Surface Water (Pluvial) and Small Watercourses

The FMfP (Surface Water and Small Watercourses) dataset (**Figure 4**) indicates that no flooding of the site is expected in up to a 0.1% AEP event including an allowance for climate change.



Figure 4: Flood Map for Planning (Surface Water and Small Watercourses)
Source: NRW website; Accessed: April 2026

4.4 Flood Risk from Reservoirs, Canals and Other Water Impounding Structures

The FMfP (Flood Risk from Reservoirs) dataset (**Figure 5**) indicates that part of the site is at risk of flooding from Marchweil reservoir, which is located approximately 2.8 km to the west. However, all large reservoirs are regularly inspected by reservoir panel engineers with essential safety work carried out as required. As such, reservoir flooding is extremely unlikely to occur.

There are no canals or other impounded waterbodies located within the immediate vicinity of the site.



Figure 5: Flood Map for Planning (Flood Risk from Reservoirs)
Source: NRW website; Accessed: April 2026

4.5 Flood Risk from Groundwater

The JBA Groundwater Flood Risk Indicator map (**Figure 6**) indicates that the site is at a Negligible risk during a 1.0% AEP groundwater flood event.



Figure 6: JBA Groundwater Flood Risk Indicator Map
Source: Blue Sky Maps; Accessed: January 2026

4.6 Flood Risk Mitigation

The proposed bridge layout and elevations are presented in **Appendix A**. As detailed in **Section 2.4**, the as-built bridge was surveyed by Survey Operations in January 2026, and the cross-sectional profile is provided in Annex B of the Hydraulic Modelling Study report (see **Appendix B**). This indicates that the soffit level of the bridge is 30.51 - 31.13 m AOD, with a deck level of 30.94 - 31.56 m AOD. The deck ties in with the concrete abutments on either bank before subsequently tying in with existing ground levels.

The as-built bridge has been incorporated within the Weetwood hydraulic model of River Clywedog and simulated for the 3.3%, 1.0% and 0.1% AEP events, and the 1.0% and 0.1% AEP events +25% and +50% climate change.

The post-development (proposed) scenario modelled outputs are provided in **Appendix C** and indicate that the deck would remain dry during the 1.0 % AEP and 0.1% AEP plus 25% climate change events.

The 1D in-channel water levels for the proposed scenario at the proposed bridge have been assessed, and the flood levels expected are as presented in **Table 1**.

Table 1: In-channel Flood Levels at Site (Proposed)

AEP Event	Max Level (m AOD)
3.3%	28.49
1.0%	28.75
1.0% + 25% Climate Change	29.27
1.0% + 50% Climate Change	29.47
0.1%	29.42
0.1% + 25% Climate Change	29.65
0.1% + 50% Climate Change	29.84

Given that the soffit level of the proposed bridge is 1.23 and 0.86 m higher (at its lowest point on the soffit) than the peak water levels expected during the 1.0% AEP event +25% climate change and 0.1% AEP event +25% climate change respectively, the proposed bridge is considered to have been designed with sufficient freeboard to minimise the risk of blockage.

This would also afford dry access and egress in up to a 0.1% AEP event +25% climate change in accordance with Figure 6 of TAN15.

It is also noteworthy that a sensitivity assessment of flows was undertaken in Section 6.2.3 of **Appendix B**, indicating that even when accounting for higher flows derived by ReFH2, a freeboard of 0.82 m would be provided above the 1.0% AEP event +25% climate change flood level.

4.7 Flood Risk Elsewhere

In accordance with Figure 2 and para. 11.4 of TAN15 developers must ensure that there is no increase in flooding elsewhere for floods up to the severity of the 0.1% AEP event including an allowance for climate change and should consider blockage where necessary.

Modelled outputs comparing the baseline and proposed scenario for the 1.0% and 0.1% AEP events +25% climate change are provided in **Appendix E**. These indicate that any small increases in flood risk are contained within the wider ownership boundary, with no third party impacted as a result. Following a review of 1D water levels both upstream and downstream of the wider site boundary for the both events, there is a negligible difference between the baseline and post-development scenarios as shown in **Table 2**.

Table 2: Comparison of In-channel Flood Levels at Site

AEP Event	Max Level (m AOD)			
	Upstream of Bridge (node ref: CLYW01_01845)		Downstream of Bridge (node ref: C:LYW01_01747)	
				Proposed
3.3%	29.44	29.44	28.16	28.16
1.0%	29.65	29.65	28.40	28.40
1.0% + 25% Climate Change	30.09	30.09	29.14	29.14
0.1%	29.90	29.90	29.03	29.03
0.1% + 25% Climate Change	30.41	30.41	29.27	29.27

A blockage of the newly constructed bridge was not included in this assessment with respect to increasing flood risk elsewhere because the soffit level of the bridge has been appropriately elevated to minimise the likelihood of debris becoming trapped. In addition, there are a number of structures located a short distance upstream of the site, which would likely prevent large floating debris reaching the new bridge.

5 SUMMARY AND RECOMMENDATIONS

This report has been prepared on behalf of FI Real Estate Management and relates to the retrospective planning application for the construction of a bridge over the River Clywedog, between at Bedwell Park and F Lloyd Penley, Bedwell Road, Wrexham.

The FMfP indicates the part of the site to the south and within the immediate vicinity of the River Clywedog to be located in flood zone 3 (rivers), with the land to the north in flood zone 1 (rivers and sea).

An assessment of flood risk from all identified potential sources of flooding has been undertaken using best available information. The risk of flooding to the site is assessed to be negligible/low with the exception of flooding from the River Clywedog.

The as-built bridge was surveyed by Survey Operations in January 2026 and has been incorporated within the hydraulic model of River Clywedog and simulated for the 3.3%, 1.0% and 0.1% AEP events, and the 1.0% and 0.1% AEP events +25% and +50% climate change.

The proposed scenario modelled outputs indicate that the deck would remain dry during the 1.0 % AEP and 0.1% AEP plus 25% climate change events and that the soffit level of the bridge is 1.23 and 0.86 m higher higher (at its lowest point on the soffit) than the peak water levels expected during the 1.0% AEP event +25% climate change and 0.1% AEP event +25% climate change.

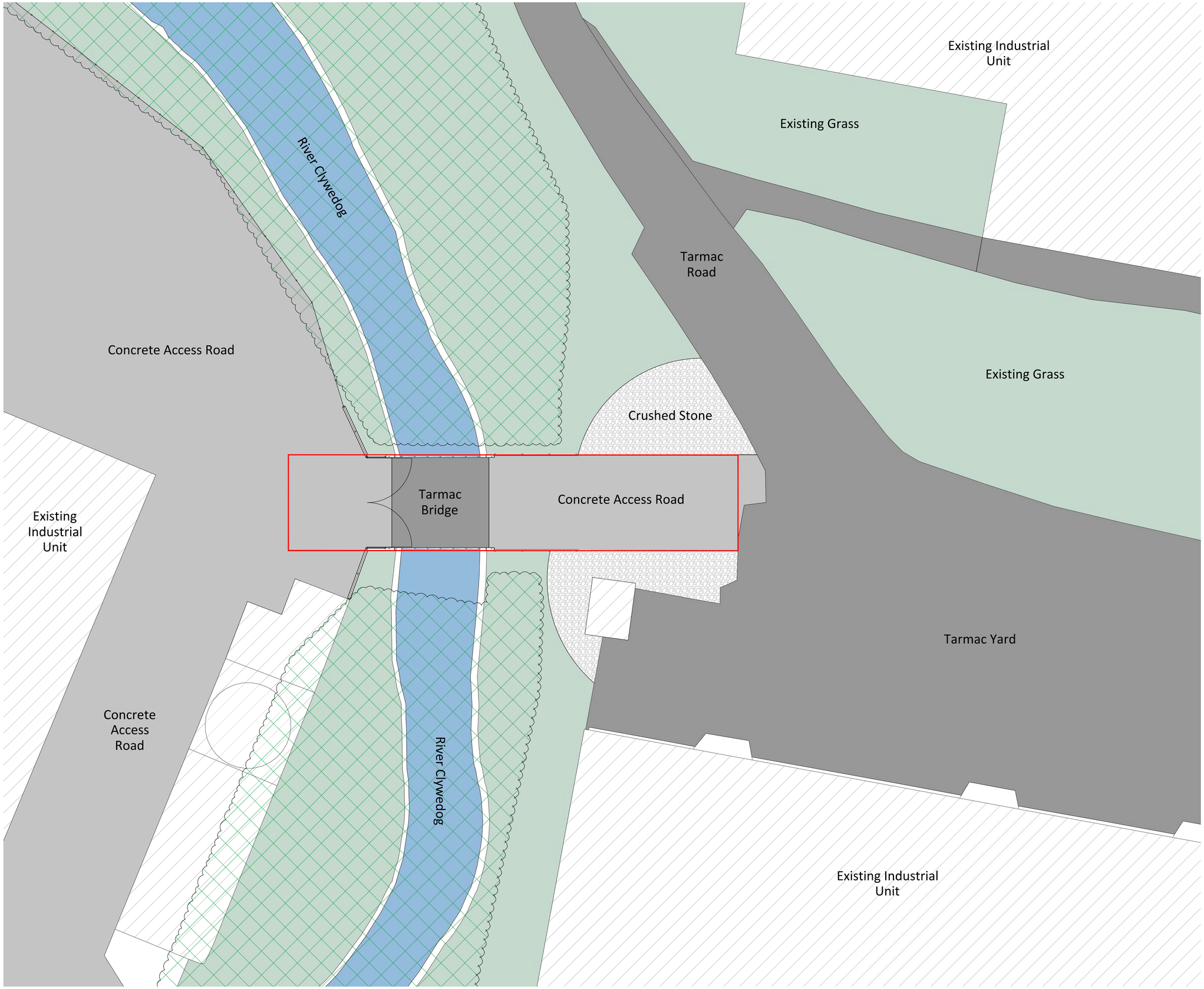
The bridge would afford dry access and egress past the 0.1% AEP event +25% climate change in accordance with Figure 6 of TAN15.

The proposals would not be expected to have an adverse impact on flood risk elsewhere.

In conclusion, this report demonstrates that the as-built bridge satisfies the requirements of planning policy.

APPENDIX A

Proposed Site Layout and Bridge Elevations



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Scale Bar:

0 2 5 10 20

1:200

North Point:

N

Revision	Date	Description	Checked
A	05/11/25	Red line boundary updated.	JT
B	05/12/25	Red line boundary updated as requested by local planning authority.	JT

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Retrospective Application for Bridge

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Client:
FI Real Estate Management Ltd

Title:
Site Layout As Proposed

Date:	Scale:	Checked:
October 2025	1:200 @ A1	JT
Project: 2153	Dwg No: A1-03	Revision: B

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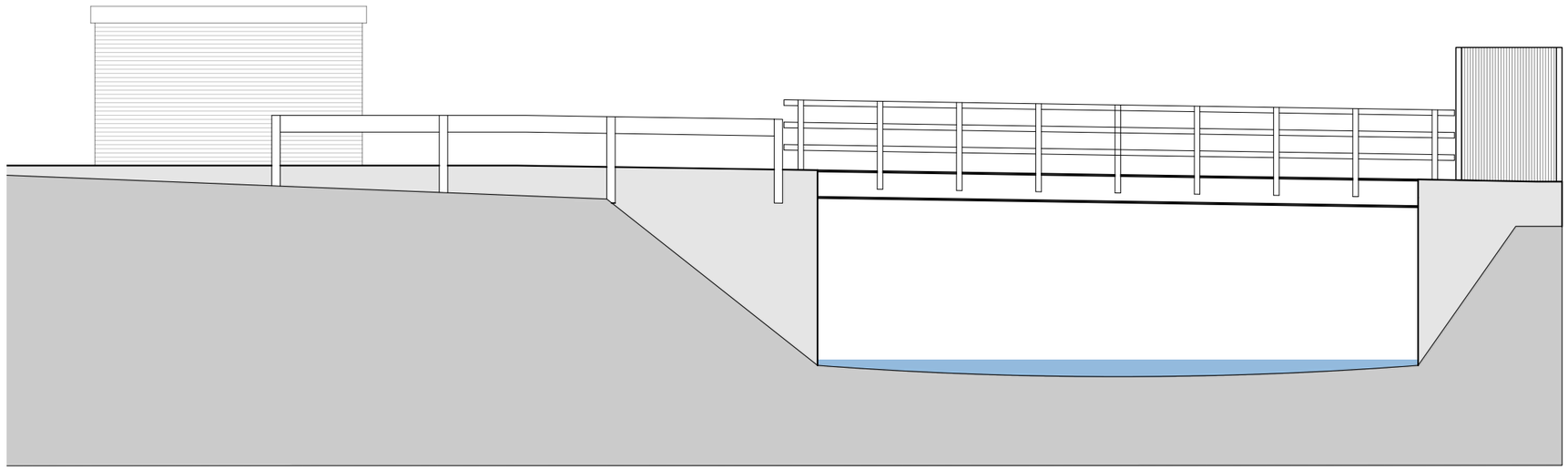
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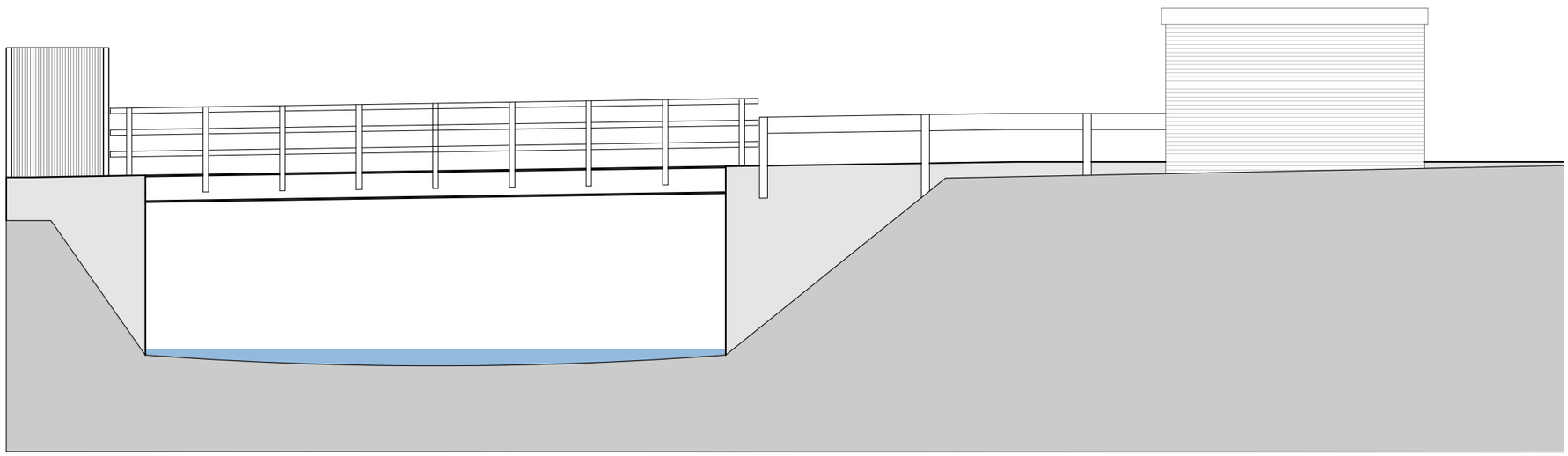
North Point:

N

Revision	Date	Description	Checked



Proposed Elevation Facing South West



Proposed Elevation Facing North East

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Project:
Retrospective Application for Bridge

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Wrexham LL13 9SQ

Client:
FI Real Estate Management Ltd

Title:
Proposed Bridge Elevations

Date:	Scale:	Checked:
November 2025	1:1250 @ A3	JT
Project:	**Dwg No:**	**Revision:**
2153	A4-01	-

APPENDIX B

River Clywedog Hydraulic Modelling Study, Weetwood, April 2026

LAND BETWEEN BEDWELL PARK AND F LLOYD PENLEY LTD
WREXHAM INDUSTRIAL ESTATE, BEDWELL ROAD, WREXHAM

RIVER CLYWEDOG HYDRAULIC MODELLING STUDY

Final Report v1.0
May 2026

Weetwood Services Ltd
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Report Title	**6577 – Bedwell Park, Wrexham** River Clywedog Hydraulic Modelling Study Final Report v1.0
Client	FI Real Estate Management
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1 INTRODUCTION

1.1 Purpose of Report

Weetwood Services Ltd ('Weetwood') has been instructed by FI Real Estate Management to undertake a hydraulic modelling study of the River Clywedog, to accompany a retrospective planning application (Ref. P/2025/0886) for the construction of a bridge over the River Clywedog, between at Bedwell Park and F Lloyd Penley, Bedwell Road, Wrexham ("the site").

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 model runs and results
Section 6 Describes the hydraulic model calibration and sensitivity assessment
Section 7 Presents a summary of key findings

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 Site Location and Description

The application site is located within an existing industrial site that is approximately 33.9 hectares (ha) and located within the Wrexham Industrial Estate at OS NGR SJ 374 485 as shown in **Figure 1**.

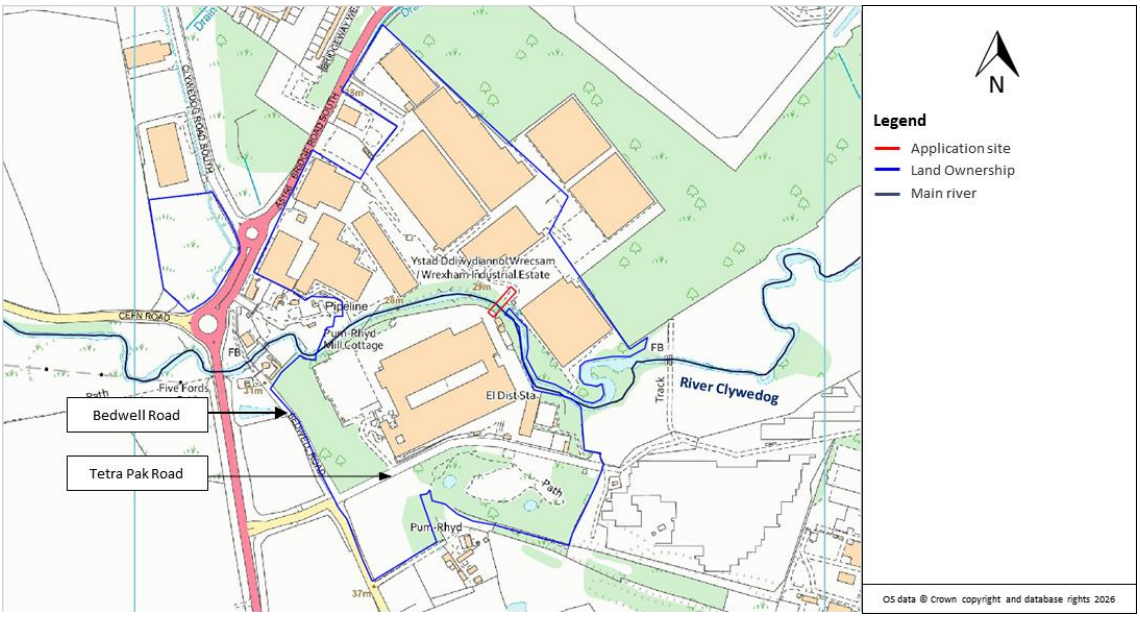


Figure 1: Site Location

A topographic survey of the site has been undertaken by Survey Operations and is provided in **Annex A**. Ground levels within the application site are indicated to be in the region of 30.0 - 30.3 m AOD to the south of the River Clywedog, and 30.0 - 32.6 m AOD to the north, with levels falling towards the watercourse.

The as-built bridge was surveyed by Survey Operations in January 2026, and the cross-sectional profile is provided in **Annex B** (Ref. CS 17 and CS 16, representing the upstream and downstream extents respectively). This indicates that the soffit level of the bridge is 30.51 - 31.13 m AOD, with a deck level of 30.94 - 31.56 m AOD. The deck ties in with the concrete abutments on either bank before subsequently tying in with existing ground levels.

2.2 Waterbodies in the Vicinity of the Site

The waterbodies located in the vicinity of the site are illustrated in **Figure 1**.

The River Clywedog is classified as a main river and flows in an easterly direction through the centre of the Bedwell Park site.

An unnamed watercourse (hereafter referred to as 'Drain A') is classified as an ordinary watercourse and it flows to the west of Clywedog Road South in a southerly direction before outfalling into the River Clywedog.

A channel survey of the River Clywedog was carried out in July 2020 by RJP Surveying Consultants, and additional channel survey data was obtained from Survey Operations in 2026, which are both provided in **Annex B**.

2.3 Flood Zone Designation

Flood zones refer to the probability of river and sea flooding. Figure 1 of Technical Advice Note 15 (TAN15) defines flood zones as follows[1]:

- Flood zone 1: Low Probability. Land having a less than 1 in 1,000 annual probability of river or sea flooding
- Flood zone 2: Medium Probability. Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding
- Flood zone 3: High Probability. Land having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of sea flooding
- TAN15 Defended Zones: Areas that benefit from RMA flood defences with a present day 1.0% AEP and 0.5% AEP SoP for rivers and the sea respectively.

The flood zones are shown on the Natural Resources Wales (NRW) Flood Map for Planning (Rivers and Sea)[2].

The flood zones shown on the flood map are defined by the predicted extent of flooding during the present day 1 in 100 (non-tidal rivers), 1 in 200 (tidal rivers and sea) and 1 in 1,000 (rivers and sea) annual exceedance probability (AEP) events. The zones account for the possible impacts of climate change and consequent changes in the future probability of flooding.

Where an area benefits from formal flood defences providing a minimum standard of protection, the defended area may be indicated as an area benefiting from flood defences. However, not all areas are shown as such, and unless specifically indicated, the Flood Map for Planning conservatively shows land at risk of flooding in the absence of flood defences.

The Flood Map for Planning (**Figure 2**) indicates the northern extent of the site to be located in flood zone 1, and the southern extent of the site is located in flood zone 2 and flood zone 3 (rivers).

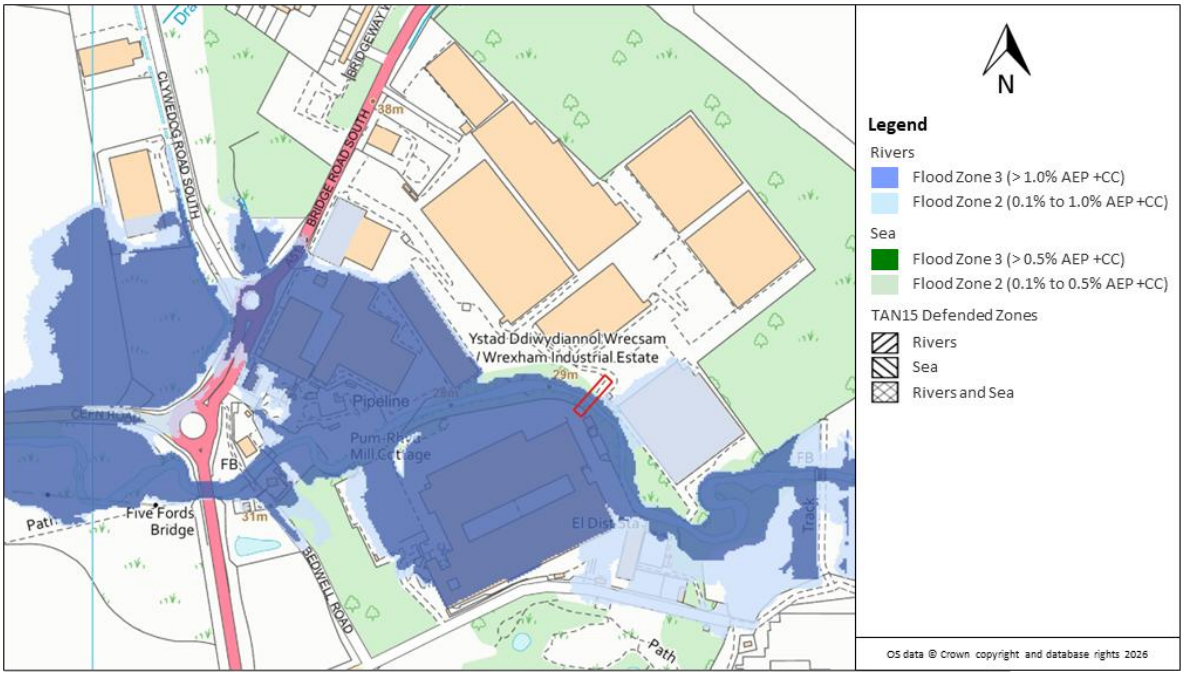


Figure 2: Flood Map for Planning
Source: gov.uk website; Accessed: April 2026

[1] https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-zone-and-flood-risk-tables
[2] https://naturalresources.wales/flooding/flood-map-for-planning/?lang=en

3 HYDROLOGY

3.1 Requirement for Flood Estimation

Design flows are required for the 3.3%, 1.0& and 0.1% AEP events and the 1.0% and 0.1% AEP event including +25% and +50% increases in flow to allow for future climate change in accordance with the national guidance updated 20 March 2026[3].

3.2 Methodology

The catchment delineation is shown in **Figure 3** with key catchment descriptors for the River Clywedog are shown in **Table 1**. The methodology is detailed within the Flood Estimation Report presented in **Annex C.**

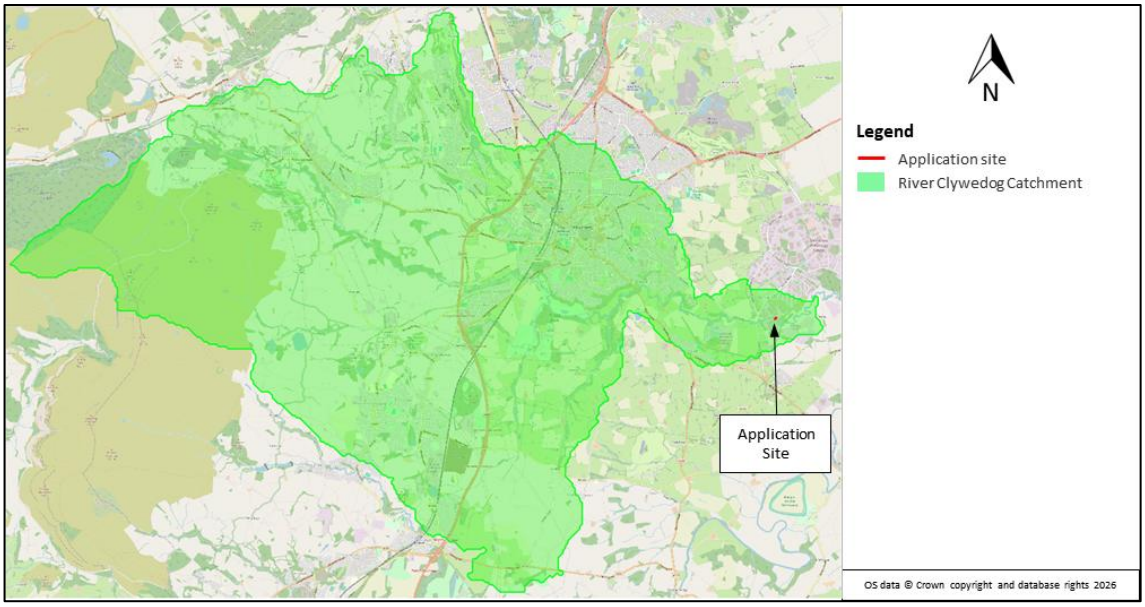


Figure 3: Catchment Delineation

Table 1: FEH Catchment

Site code	AREA (km^2)	$SAAR_{9120}$	PROPWET	$BFIHOST_{19}$	$BFIHOST_{19}$ Scaled	DPLBAR	DPSBAR	$URBEXT_{2015}$	$URBEXT_{2000}$	FPEXT	$FARL_{2015}$
CW_01	86.01	917	0.51	0.519	0.518	13.74	68.4	0.127	0.099	0.062	0.993

3.3 Final Choice of Method

The peak flows derived using the FEH Statistical Method have been taken forward for use in the hydraulic modelling study because it is NRW's preferred approach for deriving peak flows and the donor stations and pooling group were considered to be suitably representative of the subject catchment. However, it should be noted that the 0.1% AEP peak flow has been derived using the ratio method.

[3] https://www.gov.wales/sites/default/files/publications/2026-03/climate-change-allowances-and-flood-consequence-assessments.pdf

3.4 Flows Applied to Hydraulic Model

The hydrographs have been input into the model as point inflows at the upstream end of the 1D model of the River Clywedog.

The 1.0% AEP hydrograph used within the model for the catchment of the River Clywedog are shown in **Figure 4** and peak flow estimates for the catchment are shown in **Table 2**.

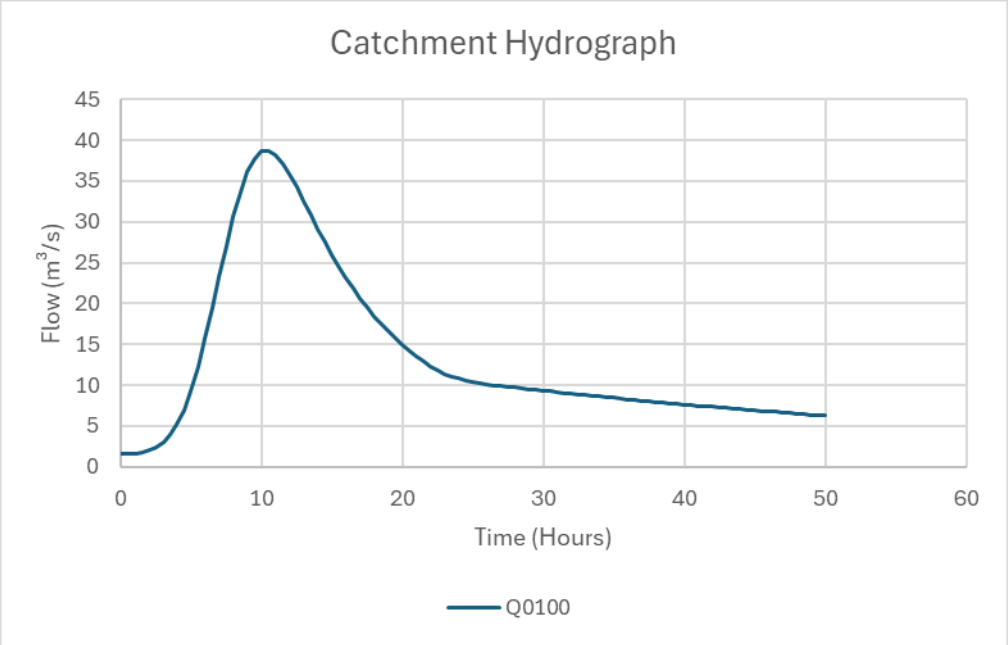


Figure 4: Flood Hydrographs

Table 2: Peak Flow Estimates

Site code	Peak flow (m^3/s) for the following AEP events							
	50.0%	**3.3%**	**1.0%**	**1.0% +CC25%**	**1.0% +CC50%**	**0.1%**	**0.1% +CC25%**	**0.1% +CC50%**
CW_01	13.85	30.77	38.67	48.34	58.01	55.63	72.36	83.44

4 HYDRAULIC MODEL DEVELOPMENT

4.1 Existing Models

There are no existing models held by NRW for the River Clywedog in the vicinity of the site. As such, a new hydraulic model has been developed by Weetwood.

4.2 Modelling Approach

In order to more accurately define the level of fluvial flood risk to the site from the River Clywedog, Weetwood has developed an ESTRY-TUFLOW hydraulic model utilising site specific channel survey data (**Annex B**).

The River Clywedog and associated structures have been represented using a 1D ESTRY model. The floodplain has been modelled in 2D using TUFLOW. This has been dynamically linked to the 1D fluvial model.

4.3 Model Extent

The upstream extent of the 1D domain of the River Clywedog is located approximately 1.3 km upstream of the site, on an open section of the River Clywedog approximately 155 m south of old Llwyn Onn Farm. The downstream extent of the 1D domain is located approximately 570 m downstream of the site.

The 2D domain extends across both the left and right floodplain between the entire modelled reach. The lateral extents of the 2D domain have been derived with reference to the topography and site location. The upstream and downstream extent of the 2D domain has been based on topography in order to have minimal influence on the assessed flood risk at the site.

Figure 5 illustrates the model extent.

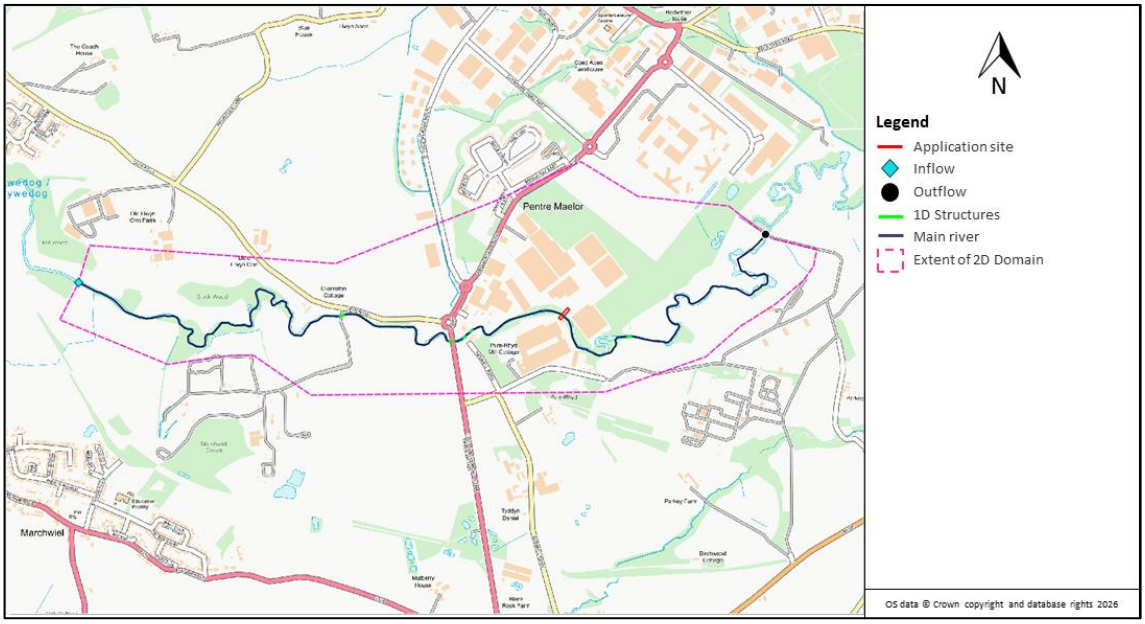


Figure 5: Model Extent

4.4 Topographic Development

In the 1D domain the channel topography is defined by cross-sections. The data collected during the channel survey (**Annex B**) 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 (**Section 4.4.1**).

The 2D domain topography is based upon filtered LiDAR data as shown in **Figure 6**.

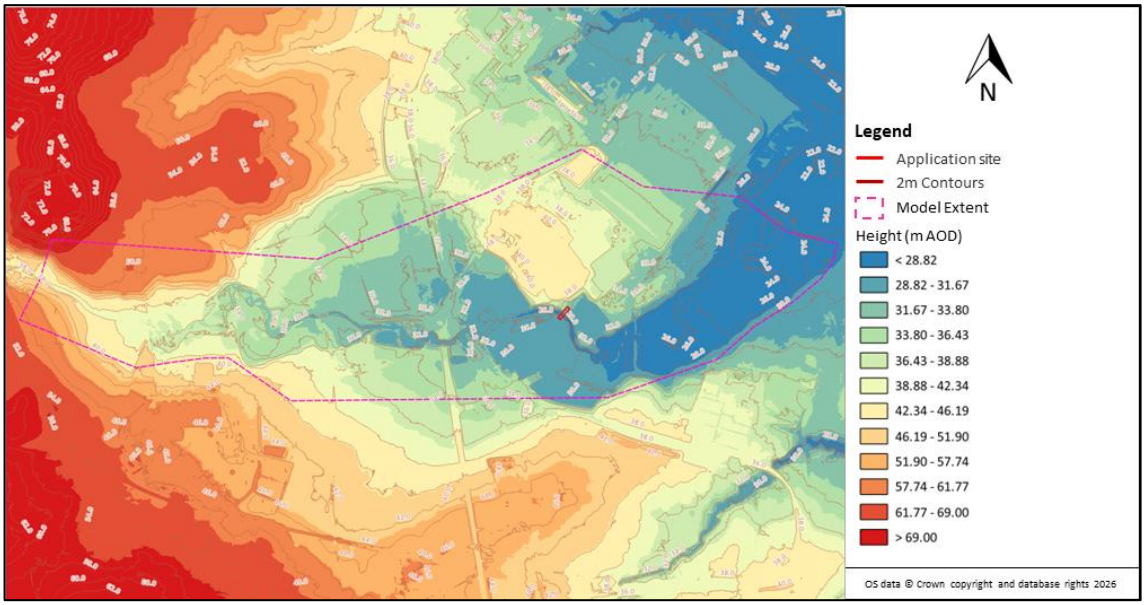


Figure 6: LiDAR

The LiDAR data was flown between 2021 and 2022 and is considered to be the most recent available data with a grid resolution of 1 m. The LiDAR data was validated against the topographic survey data (**Annex A**) and is considered fit for purpose.

A number of buildings are present on the Bedwell Park site, and the finished floor levels of these have been represented within 2d_zsh files based on the average surveyed finished floor levels from **Annex A**.

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 whilst still permitting reasonable model run times.

4.4.1 Structures - Channel

The structures that cross the channel are represented within the 1D domain. The location of these structures along the River Clywedog are shown in **Figure 7** with photographs of each structure and the ESTRY unit type provided **Figure 8**.

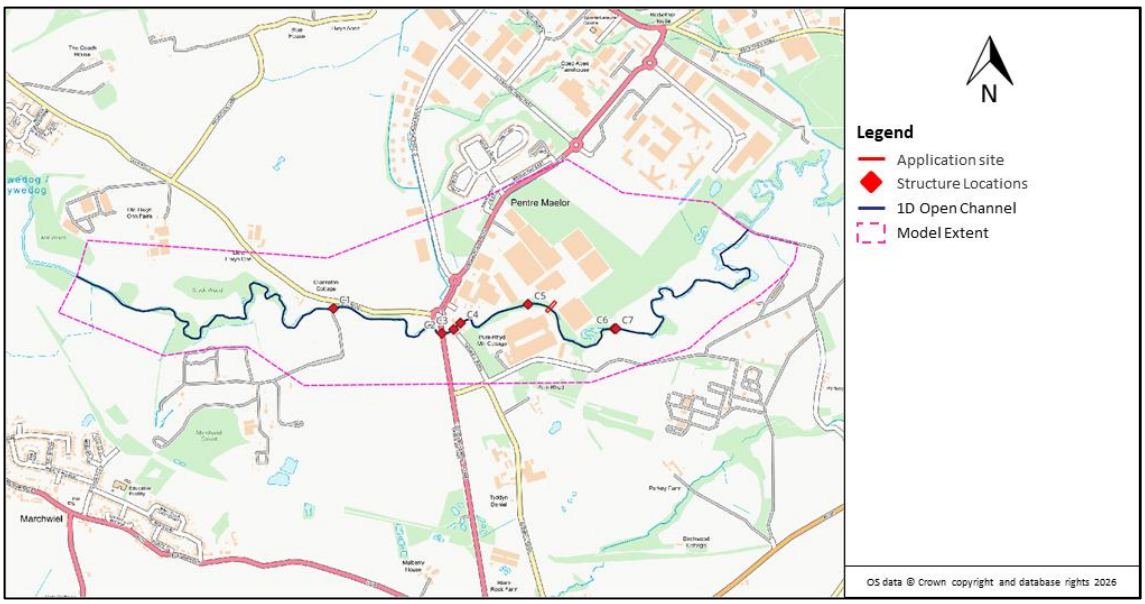


Figure 7: Location of Channel Structures in Modelled Reach

	
C1. ELEVATION_8	C2. ELEVATION_9
ESTRY Unit: BB Bridge	*ESTRY Unit: BB Bridge*
	
C3. CLYW01_02078_I	C4. ELEVATION_11
ESTRY Unit: Irregular Culvert	*ESTRY Unit: BB Bridge*
	
C5. CLYW01_01748_W	C6. ELEVATION_12
ESTRY Unit: WB (Broad-crested Weir)	*ESTRY Unit: BB Bridge Unit*



C7. ELEVATION_13

ESTRY Unit: BB Bridge Unit

Figure 8: Photographs of Channel Structures in Modelled Reach

4.4.2 Structures - Floodplain

Significant structures that are present on the floodplain are represented within the 2D domain. The location of these structures is shown in **Figure 7** with photographs of each structure provided **in Figure 8**.

Bridge decks that are not well represented by the LiDAR data, have represented in the 2D domain by reinforcing the bridge decks using a "2d_zsh" based on the channel survey.

4.5 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.

4.6 Model Coefficients

4.6.1 Manning's n

The Manning's *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 site visits were used to define the channel and land use types, which were then assigned Manning's *n* values.

The Manning's *n* values used in the model are shown in **Table 3**.

Table 3: Manning's *n* Values

Land Use		Manning's n Value
Channel (1D)	Clean, straight channel with stones and weeds	0.035
	Clean, winding channel with stones and weeds	0.040
	Concrete, float finish	0.010
	Clean, winding channel with heavy stones and weeds	0.045
	Medium to dense brush, in winter	0.060

Structures	Concrete	0.010
Floodplain (2D)	Short Grass	0.035
	Dense Shrubs	0.060
	Roads / Paths	0.025
	Gardens	0.100
	Hardstanding Areas	0.035
	Buildings	0.500
	Light Brush	0.050
	Water Bodies	0.025
	Channels	0.035
	Woodland	0.100
	Railway	0.060

4.7 Boundary Conditions

4.7.1 Input Boundaries

The input flow hydrographs are those outlined within **Section 3**. These have been input into the upstream extent of the 1D model at the location shown in **Figure 5** as a Flow-Time (QT) boundary point inflow in the '1d_bc_inflow' file.

4.7.2 Downstream Boundaries

At the downstream extent of the 1D model a Head-Time (HT) boundary is applied to the final cross-section.

The downstream boundary of the 1D domain was initially represented using an (Head-Flow) HQ boundary condition (normal/critical depth). During model development, persistent numerical instability was encountered at the downstream extent despite sensitivity testing of model parameters, including timestep and boundary location.

Review of the hydraulic behaviour indicated that the instability was associated with the low-gradient nature of the downstream floodplain and the highly sinuous channel alignment in this area. Out-of-bank flow occurred relatively early during simulation events, resulting in complex bidirectional exchange of flow between the 1D channel and adjacent 2D floodplain domains. Under these conditions, the HQ boundary was found to provide insufficient hydraulic control at the downstream extent, leading to oscillatory water level behaviour and instability where shallow floodplain flow interacted with the downstream 1D boundary.

To improve numerical stability the HT boundary was implemented, and the initial water level of this was fixed at the surveyed water level of 22.9 m AOD for the first hour of the simulation to establish stable initial conditions, before increasing to 25.0 m AOD for the remainder of the simulation. This approach maintained permanent inundation within the downstream floodplain area adjacent to the boundary, preventing repeated wetting and drying immediately upstream of the model limit.

The revised boundary condition removed the numerical instability while maintaining stable hydraulic behaviour throughout the model domain, particularly during peak-stage. Sensitivity checks confirmed that the adopted boundary condition did not materially influence model results within the principal study area, with impacts confined to the immediate downstream extent of the model.

4.8 Model Version and Simulation Information

The model was developed using TUFLOW release 2025.1.2 (HPC) single precision solver.

Simulations for all design events were run with a 0.125 second timestep in the 1D ESTRY domain. Information on timestep and other variables can be seen in the *'*.tcf/ecf'* files for each run and is recorded in the modelling logbook spreadsheet (*'6577 Modelling Logbook.xls'*) accompanying this report (see **Annex D**).

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 '*6577 Modelling Logbook*' included within **Annex D** of this report.

Table 4: Model Runs

Scenario		Run Name	AEP Flood Event
Baseline		6577_044_~e1~	3.3%
			1.0%
			1.0 +25% CC
			1.0 +50% CC
			0.1%
			0.1 +25% CC
			0.1 +50% CC
Sensitivity	Manning's *n* +20%	6577_044_~e1~_plus20	1.0 +25% CC
	Manning's *n* -20%	6577_044_~e1~_minus20	1.0 +25% CC
	Downstream Boundary	6577_044_~e1~_ds_sens	1.0 +25% CC
	Flows (ReFH2)	6577_044_~e1~REFH2_sens	1.0 +25% CC

5.2 Model stability

Once the model has fully initialised, it is stable in both the 1D and 2D domains. The final cumulative Mass Error (ME) is between 0.06% and 1.12% for all baseline scenarios.

The model stability is considered to be acceptable. The HPC 'Not a Number' (NaN) value is 0 for all modelled runs, indicating that no instabilities have occurred. There is a HPC 'High Control Number' (HCN) value of 4 for all model simulations. Once the model has initialised the dt value remains smooth and the timestep values are reasonable.

There are no 1D negative depths through all baseline simulations, aside from the present day 3.3%, 1.0% and 0.1% AEP events, which range between 848 to 856; however, these occur at around 4.75 hours into the simulations, which is well before the peak meaning that the max-stage results are unaffected.

There are also no negative depths throughout the sensitivity simulations, with the exception of the minus 20% manning's sensitivity assessment, which experienced 129 1D negative depths; however, these are all within the first hour of the simulation and the results are unaffected.

There are 38 warning messages prior to the simulations. These have been checked and are not considered to impact the suitability of the model. There are 3 warnings during the simulation that occur within the 2D domain, that are located on the floodplain just before the downstream boundary. Gradients within this area of the model are extremely low and the introduction of the 1d_HT boundary introduces a large volume of water after 1 hour of the simulation. This is therefor, not considered to have an impact on the suitability of the model.

5.3 Model Results

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

6 MODEL CALIBRATION AND SENSITIVITY

6.1 Model Calibration

6.1.1 Known Historical Events

The catchment is ungauged and according to the NRW historic flood outlines there are no recorded flood incidents at or within the vicinity of the site. No other such information has been made available. As such, it has not been possible to calibrate the hydraulic model using historic flow data.

6.2 Model Sensitivity

6.2.1 Manning's n

Sensitivity testing has been carried out for the 1.0% AEP plus climate change (25%) event on the Manning's *n* coefficients by varying them by +/-20%.

Model output plots are provided in **Annex F**. The results indicate that despite expected changes in velocity as a result of increasing and decreasing Manning's *n*, peak flood levels at the proposed bridge location were increased by 0.17 m AOD and decreased by 0.14m respectively when compared to the baseline scenario.

The model is therefore, the model is only considered sensitive to a reduction in manning's *n* coefficients. .

6.2.2 Downstream Boundary

Sensitivity testing has been carried out for the 1.0% AEP plus climate change (25%) event on the Head-Time (HT) downstream boundary condition at the outlet of the model. The water level was increased by an additional 1.0 m to 26.0 m AOD after the first hour of the model simulation, which is the approximate water level that would be expected before water could weir across the downstream bridge structure. This resulted in no change in flood level, depths or velocity at the proposed bridge location. Therefore, the model is not considered to be sensitive in changes in the downstream boundary's maximum flood level.

6.2.3 ReFH2 Inflows

Sensitivity testing has been carried out for the 1.0% AEP plus climate change (25%) event on the inflow hydrograph for the River Clywedog. Despite the FEH statistical method being the preferred method when producing inflow hydrographs for the River Clywedog, it is noted that the ReFH2 assessment produced the most conservative flows for the catchment (see **Annex C**). Therefore, ReFH2-derveid flows for the 1.0% AEP plus climate change (25%) event have been applied to the model. The use of ReFH2 flows resulted in flooding out of bank in the vicinity of the site and the water level at the proposed bridge location increased to 29.69 m AOD.

6.3 Model Limitations and Assumptions

Study specific model limitations and assumptions include:

- The model represents existing situation at the time of the channel surveys being undertaken.
- Model calibration has not been undertaken due to the limited data available.
- The model utilises peak flows derived from the FEH Statistical method. Whilst these are considered to be less conservative than ReFH2 derived flows, the FEH Statistical method is considered the preferred approach for modelling large catchments within Wales.
- This model has been produced specifically to assess in-channel water levels at a proposed bridge location. As such, conservative approaches have been taken which may result in elevated water levels in-channel. Conversely, this could result in less out-of-bank flow and the model would need to be re-assessed if being used in the future to assess flood risk to specific area in the floodplain.

7 SUMMARY

This report has been prepared on behalf of FI Real Estate Management to undertake a hydraulic modelling study of River Clywedog and Drain A, to accompany a retrospective planning application (Ref. P/2025/0886) for the construction of a bridge over the River Clywedog, between at Bedwell Park and F Lloyd Penley, Bedwell Road, Wrexham.

According to the Flood Map for Planning the proposed development site is located within the 1.0% AEP flood outline and is therefore defined by TAN15 as being situated within flood zone 3.

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

The modelled outputs indicate that all flow is contained within the channel of the River Clwyedog in the vicinity of the proposed bridge in up to a 0.1% AEP event. Some flooding on the southern side of the site is shown in the 0.1% AEP events when accounting for +25% and +50% climate change. Flood levels at the proposed bridge location have been established.

The model is not considered to be sensitive to increases in Manning's n coefficients or to changes to the downstream boundary.

ANNEX A

Topographic Survey

SW STORM WATER SEWERS
FW FOUL WATER SEWERS
WM WATER MAIN
GM GAS MAIN
EL ELECTRIC CABLES
DUCT CABLE DUCTING
BT BT (UNDERGROUND)
CABLE TV
CCTV CLOSED CIRCUIT TV
UF UNIDENTIFIED FEATURE
UP UNIDENTIFIED PIPE
UC UNIDENTIFIED CABLE
UNFR UNPROVEN FEATURE
END OF TRACE
LATERAL CONNECTIONS
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD. (SURVEYED ~~~~)
CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
COVER POSITION FROM CCTV REPORT - NOT SURVEYED ON TOPOGRAPHICAL SURVEY
0.6d APPROXIMATE DEPTH OF BURIED SERVICE

UNDENTIFIED - A buried feature or utility that has been located, but we are unable to state what it is.

UNPROVEN - The assumed location of a reported feature or utility, usually taken from records, but not found during the utility trace (due to various conditions).

CAUTION - Electric pot ended cables, even when they are live, are unable to be detected or traced.

UNDERGROUND UTILITIES SERVICES DISCLAIMER

We have endeavoured to locate existing services using records provided by Statutory Authorities as a guide. Some apparatus were untraceable and details have therefore been taken from Utility Record Drawings, which may be of poor quality. Consequently we cannot guarantee accuracy of information taken from such records.

Where indicated, no allowance has been made for sub-surface entry into manholes, other chambers or confined spaces below ground level. Therefore any details relating to depths, sizes etc, are taken from the surface and as such will be approximate.

We have endeavoured to supply you with the most accurate data possible by using methods and equipment that are at the forefront of our industry. We have taken great care in the detection of pipework and buried features, but as with all methods of detecting underground or buried utilities the information provided is based on results obtained from electromagnetic techniques, and as such may be liable to distortion or errors beyond the reasonable control of the operator or his instruments.

It is the responsibility of the user under Health & Safety (HSG47) Guidelines to satisfy himself of the suspected location of any services prior to excavation of the services shown.

NOTE 1

This utility survey has been undertaken using:
A: Radiodetection RD4000 + RD4000 TID
B: Tola Geoscience Ground Probing Radar

NOTE 2

Power carrying features shown on this drawing are shown as an individual service line. This does not necessarily represent the number of cables actually present and it is possible that there could be multi numbers of cables including HV, LV and communications transmission cables following the same trace line. These could be at different depths, the trace signal from the deeper cables being masked by signal emitted from the shallower service above. Cable runs could also be present running parallel to the single line shown.

UNPROVEN ELEC
UNPROVEN BT
UNPROVEN GAS
UNPROVEN WATER
UNPROVEN SURFACE
UNPROVEN FOUL

All unproven lines without additional notes on drawing show the approximate location of a reported utility or feature as indicated on stat records undertaken and supplied at time of survey.

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N

Note:
The survey is plotted on a plane local Grid. Orientation to National Grid.
All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

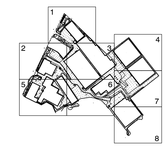
Drainage information must be verified with local authority records before use

Survey Operations Dwg 21GOS5 added to Survey Operations Dwg 21EO17.

SURVEY STATIONS			
Name	Easting	Northing	Height
CA1	337303.16	348805.77	38.23
CA2	337262.53	348723.31	37.92
CA3	337213.52	348620.81	31.66
CA4	337311.52	348547.97	31.62
CA5	337311.63	348542.31	31.57
CA6	337384.01	348473.79	30.77
LB1	337615.81	348508.83	31.28
LB2	337520.85	348495.68	34.45
SO1	337351.04	348760.72	38.81
SO2	337414.26	348728.22	39.35
SO3	337511.71	348683.02	39.23
SO4	337572.61	348640.50	38.23
SO5	337622.85	348538.98	36.63
SO6	337445.88	348515.84	37.55

STANDARD REFERENCE & ABBREVIATIONS

ABD.....Assumed Route
AB.....Air Brick
AV.....Air Valve
B/W.....Barbed Wire
BAR.....Barrier
BB.....Bellcha Beacon
BH.....Borehole
BL.....Bed Level
BOL.....Bollard
BS.....Bus Stop
BT Box.....British Telecom Box
BT.....British Telecom (C
BWTR.....Brick Retaining Wall
BW.....Brick Wall
C/B.....Close Boarded
C/I.....Corrugated Iron
C/P.....Chestnut Paling
CB.....Control Box
CBB.....Concrete Block Wall
CCTV.....Closed Circuit TV
CD.....Cable Duct
CEL.....Ceiler Light
CH/.....Chain Link
CHM.....Chimney
CL.....Cover Level
CM.....Cable Marker
COL.....Column
CONC.....Concrete
CP.....Catch Pit
CRTN.....Concrete Retaining Wall
CTV.....Cable Television
CUL.....Culvert
DW.....Concrete Block Wall
DC.....Drainage Channel
DPC.....Damp Proof Course
D.....Invert Level
DP.....Inlet Pipe
MH.....Access Hole
EOP.....Electricity Cable Pit
EUI.....Electricity Inspection Cover
EJ.....Expansion Joint
EJB.....Electricity Junction Box
EL SUB STN..Electricity Sub Station
EL.....Eaves Level
ELB.....Electricity Box
EP.....Electricity Pole
ER.....Earth Rod
ETL.....Electricity Transmission Line
FB.....Flower Bed
FH.....Fire Hydrant
FL.....Floor Level
FP.....Flagpole
GT.....Girth (of tree)
G.....Gulley
GAB.....Gabion
GIP.....Gas Inlet Pipe
GMRK.....Gas Marker
GBT.....Gas Stop Tap (Domestic)
GSV.....Gas Stop Valve (Mains)
HSE.....Housing
HT.....Height
HV.....High Voltage
I/R.....Iron Railing
IC.....Inspection Cover
IL.....Invert Level
IP.....Inlet Pipe
KO.....Kerb Outlet
LB.....Letter Box
LP.....Lamp Post
MB.....Multi-Girth
MH.....Manhole
MKR.....Marker
MP.....Mooring Point
NP.....Street Name Plate
O/H.....Overhead
O/P.....Open Paling
OE.....Overhead Electric Wire
OP.....Outfall Pipe
OSBM.....Ordnance Survey Bench Mark
OT.....Overhead Telecom Wire
P/C.....Post & Chain
P/R.....Post & Rail
P/W.....Post & Wire
PAV.....Paving
PB.....Pillar Box
PC.....Pedestrian Crossing
PY.....Petrol Pump
PT.....Post or Pillar
RE.....Rodding Eye
RS.....Road Sign
RTW.....Retaining Wall
RWP.....Rain Water Pipe
SAP.....Sailing
SL.....Sump Level
SL.....Soffit Level
SP.....Sign Post
SPL.....Springing Level
SRTN.....Stone Retaining Wall
SV.....Stop Valve (unspecified)
TBM.....Temporary Bench Mark
TCB.....Telephone Call Box
TFP.....Taken From Records
TIP.....Anchor Point (Masts/Poles)
TL.....Traffic Light
TLB.....Traffic Light Control Box
TR.....Ticket Machine
TWC.....Tarmac
TP.....Telecommunications Pole
TPIT.....Trial Pit
TS.....Trash Screen
U/C.....Under Construction
U/G.....Underground
UTL.....Unable to LiPT (BM,IC etc)
UTS.....Unable to Survey
VDP.....Vehicle Detector Pad
VP.....Vent Pipe
W/H.....Wire Mesh
WL.....Water Level
WM.....Water Meter
WO.....Wash Out
WP.....Waste Pipe
WST.....Water Stop Tap (Domestic)
WSV.....Water Stop Valve (Mains)



Sheet Layout

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Tel: 01695 725662 Fax: 01695 51816
Email: mail@survops.co.uk ~ www.survops.co.uk

Client
FI Real Estate Management

Drawing Title
Utility Survey of Land at:
Wrexham Industrial Estate
Wrexham
Sheet 1 of 8

Scale(s)	1:200	Surveyor	SC
Date	AUG 21	Drawn	MP
Job Number	21G055	Checked	SO

Sheet Size & Drg Number & Revision
A0 21G055/001

SW STORM WATER SEWERS
FW FOUL WATER SEWERS
WM WATER MAIN
GM GAS MAIN
EL ELECTRIC CABLES
DUCT CABLE DUCTING
BT BT (UNDERGROUND)
CCTV CABLE TV
CCTV CLOSED CIRCUIT TV
UI UNIDENTIFIED FEATURE
UP UNIDENTIFIED PIPE
UC UNIDENTIFIED CABLE
UNPR UNPROVEN FEATURE
SW END OF TRACE
LATERAL CONNECTIONS
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD. (SURVEYED ***-****)
FW CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
SW
COVER POSITION FROM CCTV REPORT NOT SURVEYED ON TOPOGRAPHICAL SURVEY
0.6d APPROXIMATE DEPTH OF BURIED SERVICE

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NOTE 1

This utility survey has been undertaken using;
A: Radiodetection RD4000 + RD4000 TX2
B: Mala Geoscience Ground Probing Radar

NOTE 2

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MH089 OUSTANDING

MH090 OUSTANDING

MH091 OUSTANDING

MH092 OUSTANDING

MH079 OUSTANDING

MH069 OUTSTANDING

MH086 OUSTANDING

UNPROVEN ELEC
UNPROVEN BT
UNPROVEN GAS
UNPROVEN WATER
UNPROVEN SURFACE
UNPROVEN FOUL

All unproven lines without specific notes on drawing show the approximate location of reported utility or feature as indicated on stat records undertaken and supplied at time of survey.

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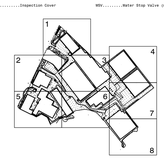
Survey Operations Dwg 21GOS5 added to Survey Operations Dwg 21EO17.

SURVEY STATIONS

Name	Easting	Northing	Height
CA1	337303.16	348805.77	38.23
CA2	337262.53	348723.31	37.92
CA3	337213.52	348620.81	31.66
CA4	337311.63	348543.37	31.02
CA5	337371.83	348642.97	31.57
CA6	337384.01	348673.79	30.77
LB1	337615.81	348508.83	31.28
LB2	337520.85	348495.68	34.45
SO1	337351.04	348760.72	38.81
SO2	337414.26	348728.22	39.35
SO3	337512.71	348680.50	39.23
SO4	337572.61	348640.92	38.23
SO5	337622.85	348538.98	36.63
SO6	337445.88	348515.84	37.55

STANDARD REFERENCE & ABBREVIATIONS

(AB).....Assumed Route
AB.....Air Brick
AV.....Air Valve
B/W.....Barbed Wire
BAR.....Barrier
BB.....Bellaire Beacon
BH.....Borehole
BL.....Bed Level
BOL.....Bollard
BS.....Bus Stop
BT BOX.....British Telecom Box
BT.....British Telecom (C
BWTH.....Brick Retaining Wall
BW.....Brick Wall
C/B.....Close Boarded
C/I.....Corrugated Iron
C/P.....Chestnut Paling
CB.....Control Box
CBR.....Concrete Block Wall
CCTV.....Closed Circuit TV
CD.....Cable Duct
CEL.....Cellar Light
CH/L.....Chain Link
CHY.....Chimney
CL.....Cover Level
CM.....Cable Marker
COL.....Column
CONC.....Concrete
CP.....Catch Pit
CRTN.....Concrete Retaining Wall
CTV.....Cable Television
CUL.....Culvert
CW.....Concrete Block Wall
DC.....Drainage Channel
DPC.....Damp Proof Course
DR.....Drain
DRW.....Dry Stone Wall
ECP.....Electricity Cable Pit
EJB.....Electricity Junction Box
EL SUB STN.....Electricity Sub Station
EL.....Excess Level
ELB.....Electricity Box
EP.....Electricity Pole
ER.....Earth Rod
ETL.....Electricity Transmission Line
FB.....Flower Bed
FH.....Fire Hydrant
FL.....Floor Level
FP.....Flagpole
G*.....Gully (if tree)
G.....Gulley
GMB.....Gabion
GIP.....Gas Inlet Pipe
GMK.....Gas Marker
GBT.....Gas Stop Tap (Domestic)
GSV.....Gas Stop Valve (Mains)
HSG.....Housing
HT.....Height
HV.....High Voltage
I/R.....Iron Railing
IC.....Inspection Cover
IL.....Invert Level
IP.....Inlet Pipe
KO.....Kerb Outlet
LB.....Letter Box
LP.....Lamp Post
MB.....Multi-Gulvin
MH.....Manhole
MRK.....Marker
MP.....Mooring Point
NP.....Street Name Plate
O/H.....Overhead
O/P.....Open Paling
OE.....Overhead Electric Wire
OF.....Outfall Pipe
OSBM.....Ordnance Survey Bench Mark
OT.....Overhead Telecom Wire
P/C.....Post & Chain
P/R.....Post & Rail
P/W.....Post & Wire
PAV.....Paving
PB.....Pillar Box
PC.....Pedestrian Crossing
PP.....Petrol Pump
PT.....Post or Pillar
RE.....Rodding Eye
RS.....Road Sign
RTN.....Retaining Wall
RWP.....Rain Water Pipe
RP.....Railing
SL.....Sump Level
SO.....Soffit Level
SP.....Sign Post
SPL.....Springing Level
SRTN.....Stone Retaining Wall
SV.....Stop Valve (unspecified)
SVP.....Soil Vent Pipe
SW.....Stone Wall
TBC.....Tactile Paving
TB.....Traffic Bollard
TBM.....Temporary Bench Mark
TCB.....Telephone Call Box
TFR.....Taken From Records
TSP.....Hunter Point (Masts/Poles)
TL.....Traffic Light
TLB.....Traffic Light Control Box
TM.....Ticket Machine
TWC.....Tarmac
TX.....Telecommunications Pole
TP/T.....Trial Pit
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U/C.....Under Construction
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UTL.....Unable to Lift (MH,IC etc)
UTS.....Unable to Survey
VDP.....Vehicle Detector Pad
VP.....Vent Pipe
WLW.....Wire Mesh
WL.....Water Level
WM.....Water Meter
WO.....Wash Out
WP.....Waste Pipe
WST.....Water Stop Tap (domestic)
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Sheet Layout

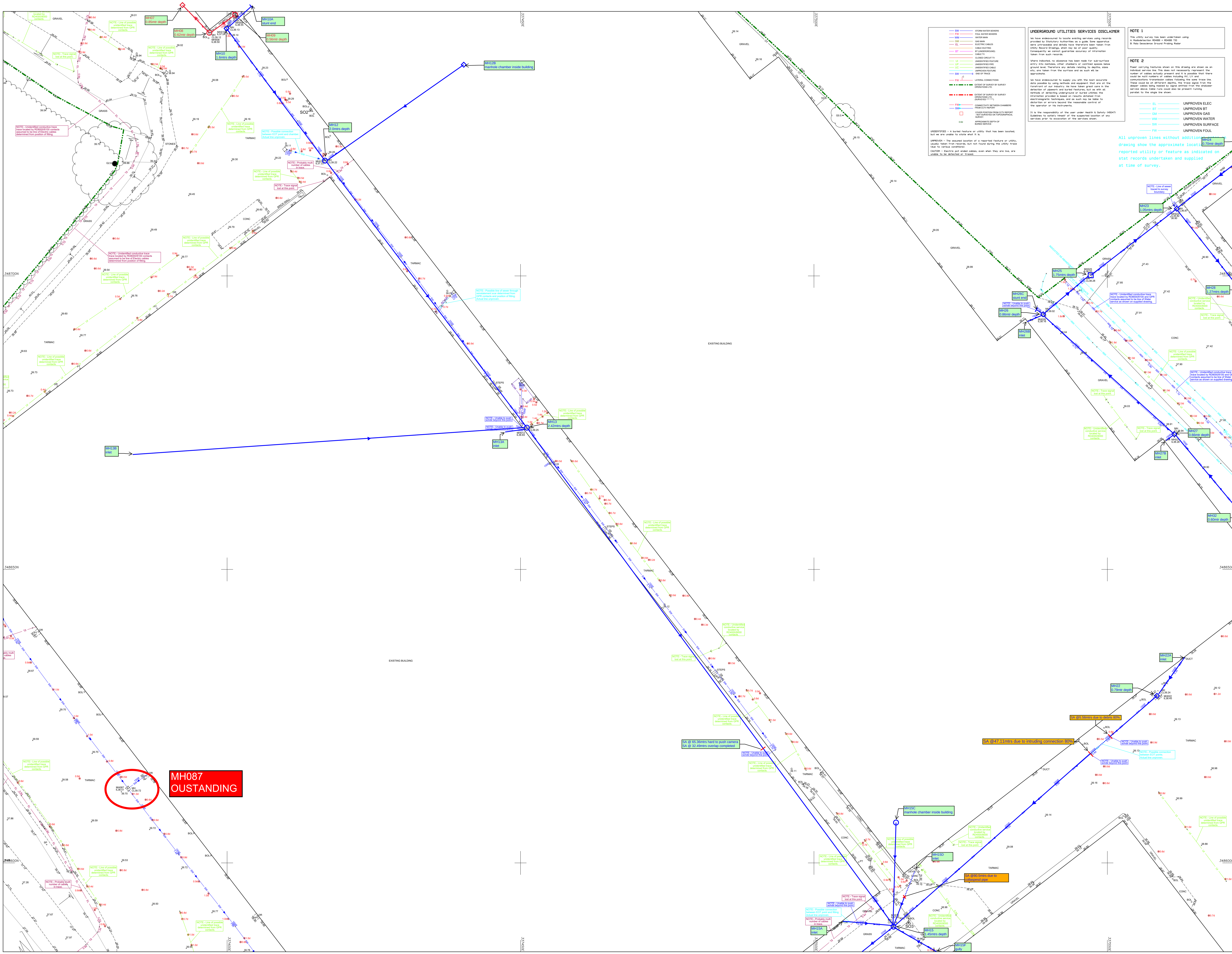
SurveY OPERATIONS
Smith Street, Skelmersdale, Lancs. WN8 8LN
Tel: 01695 725662 Fax: 01695 51816
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Client
FI Real Estate Management

Drawing Title
Utility Survey of Land at:
Wrexham Industrial Estate
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Sheet 2 of 8

Scale(s)	1:200	Surveyor	SC
Date	AUG 21	Drawn	MP
Job Number	21G055	Checked	SO

Sheet Size & Drg Number & Revision
A0 21G055/002



SW	STORM WATER SEWERS
FW	FOUL WATER SEWERS
WM	WATER MAIN
GM	GAS MAIN
EL	ELECTRIC CABLES
	CABLE DUCTING
BT	BT (UNDERGROUND)
	CABLE TV
	CLOSED CIRCUIT TV
UI	UNIDENTIFIED FEATURE
UP	UNIDENTIFIED PIPE
UC	UNIDENTIFIED CABLE
	UNPROVEN FEATURE
SW	END OF TRACE
FW	LATERAL CONNECTIONS
	EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
	EXTENT OF SURVEY BY SURVEY OPERATIONS LTD. (SURVEYED **** ****)
FW / SW	CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
	COVER POSITION FROM CCTV REPORT - NOT SURVEYED ON TOPOGRAPHICAL SURVEY.
0.6d	APPROXIMATE DEPTH OF BURIED SERVICE

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EL	UNPROVEN ELEC
BT	UNPROVEN BT
GM	UNPROVEN GAS
WM	UNPROVEN WATER
SW	UNPROVEN SURFACE
FW	UNPROVEN FOUL

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Note:
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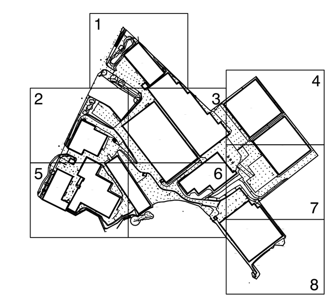
Survey Operations Dwg 21G055 added to Survey Operations Dwg 21E017.

SURVEY STATIONS

Name	Easting	Northing	Height
CA1	337303.16	348805.77	38.23
CA2	337262.53	348723.31	37.92
CA3	337213.52	348620.81	31.66
CA4	337273.29	348597.67	31.92
CA5	337311.63	348582.31	31.07
CA6	337384.01	348473.79	30.77
LB1	337615.82	348508.83	31.28
LB2	337520.85	348495.68	34.45
SO1	337351.04	348760.72	38.81
SO2	337414.26	348728.22	39.35
SO3	337516.13	348589.83	38.95
SO4	337572.61	348640.50	39.23
SO5	337622.85	348538.98	36.63
SO6	337445.88	348515.84	37.55

STANDARD REFERENCE & ABBREVIATIONS

(AR)........Assumed Route
AB.........Air Brick
AV.........Air Valve
B/W........Barbed Wire
BAR........Barrier
BB.........Belisha Beacon
BH.........Borehole
BL.........Bed Level
BOL........Bollard
BS.........Bus Stop
BT Box......British Telecom Box
BT.........British Telecom IC
BRTW.......Brick Retaining Wall
BW.........Brick Wall
C/B........Close Boarded
C/I........Corrugated Iron
C/P........Chestnut Paling
CB.........Control Box
CBW........Concrete Block Wall
CCTV.......Closed Circuit TV
CD.........Cable Duct
CEL........Cellar Light
CH/L.......Chain Link
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CM.........Cable Marker
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CTV........Cable Television
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CW.........Concrete Block Wall
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DR.........Drain
DSW........Dry Stone Wall
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EJ.........Expansion Joint
EJB........Electricity Junction Box
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GST........Gas Stop Tap (Domestic)
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LB.........Letter Box
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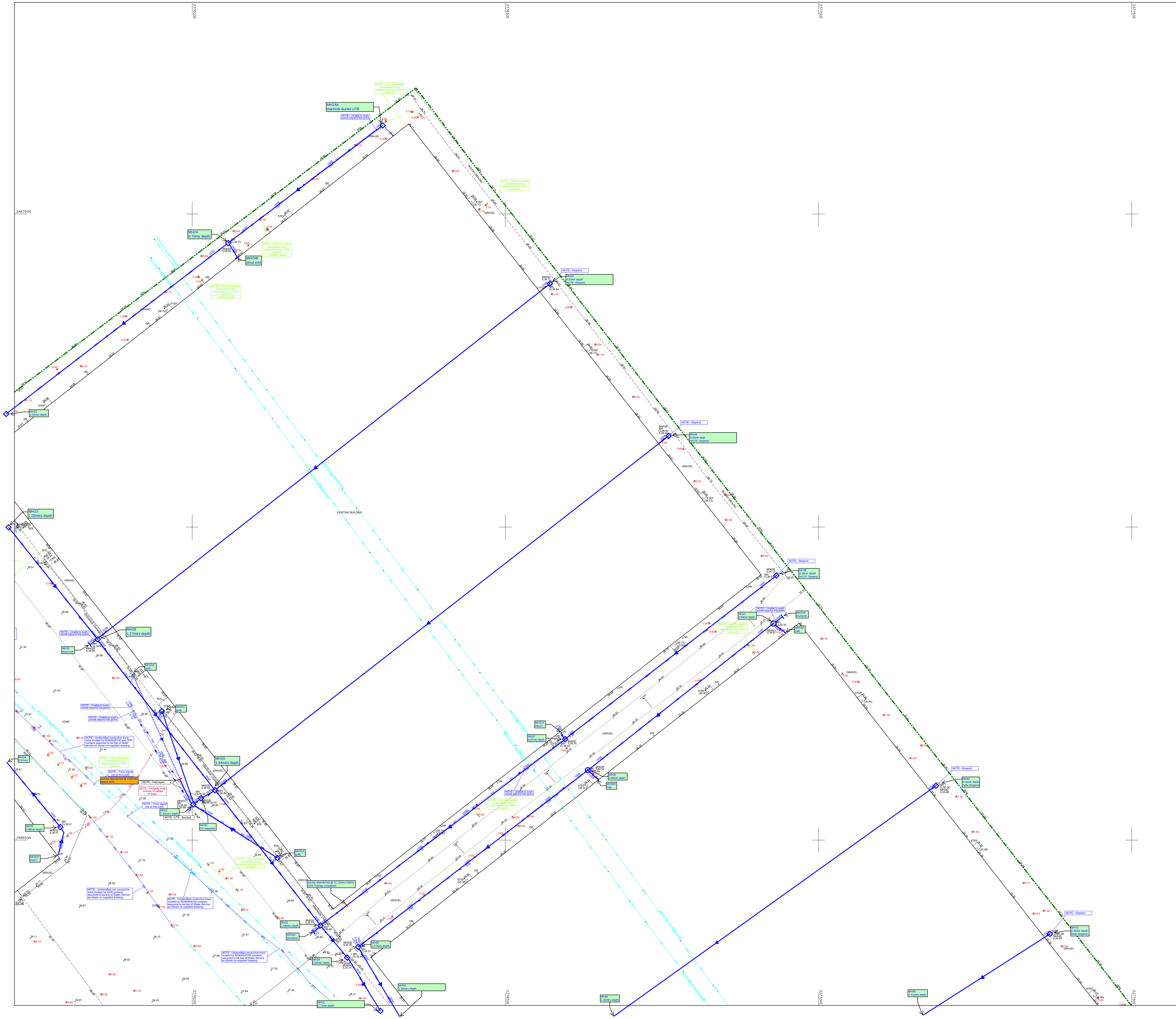
Survey Operations
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Sheet 3 of 8

Scale(s)	1:200	Surveyor	SC
Date	AUG 21	Drawn	MP
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Sheet Size & Drg Number & Revision
A0 21G055/003



- SW — STORM WATER SEWERS
- FW — FOUL WATER SEWERS
- WM — WATER MAIN
- GM — GAS MAIN
- EL — ELECTRIC CABLES
- DUCT — CABLE DUCTING
- BT — BT (UNDERGROUND)
- CABLE TV
- CCTV — CLOSED CIRCUIT TV
- UI — UNIDENTIFIED FEATURE
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- UNPR — UNPROVEN FEATURE
- SW — END OF TRACE
- FW — LATERAL CONNECTIONS
- EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
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- 0.6d — APPROXIMATE DEPTH OF BURIED SERVICE

UNPROVEN ELEC
UNPROVEN BT
UNPROVEN GAS
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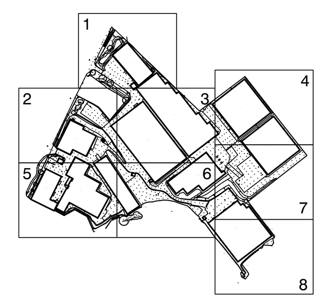
Survey Operations Dwg 21G055 added to Survey Operations Dwg 21E017.

SURVEY STATIONS

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LB1	337615.82	348508.83	31.28
LB2	337520.85	348495.68	34.45
SO1	337351.04	348760.72	38.81
SO2	337414.26	348728.22	39.35
SO3	337516.13	348589.83	38.95
SO4	337572.61	348640.50	39.23
SO5	337622.85	348538.98	36.63
SO6	337445.88	348515.84	37.55

STANDARD REFERENCE & ABBREVIATIONS

(AR)........Assumed Route	IL..........Invert Level
AB..........Air Brick	IP..........Inlet Pipe
AV..........Air Valve	KO..........Kerb Outlet
B/W.........Barbed Wire	LB..........Letter Box
BAR.........Barrier	LP..........Lamp Post
BB..........Belisha Beacon	MG..........Multi-Girth
BH..........Borehole	MH..........Manhole
BL..........Bed Level	MKR.........Marker
BOL.........Bollard	MP..........Mooring Point
BS..........Bus Stop	NP..........Street Name Plate
BT Box......British Telecom Box	O/H.........Overhead
BT..........British Telecom IC	O/P.........Open Paling
BRTW........Brick Retaining Wall	OE..........Overhead Electric Wire
BW..........Brick Wall	OP..........Outfall Pipe
C/B.........Close Boarded	OSBM........Ordnance Survey Bench Mark
C/I.........Corrugated Iron	OT..........Overhead Telecom Wire
C/P.........Chestnut Paling	P/C.........Post & Chain
CB..........Control Box	P/R.........Post & Rail
CBW.........Concrete Block Wall	P/W.........Post & Wire
CCTV........Closed Circuit TV	PAV.........Paving
CD..........Cable Duct	PB..........Pillar Box
CEL.........Cellar Light	PC..........Pedestrian Crossing
CH/L........Chain Link	PP..........Petrol Pump
CHY.........Chimney	PT..........Post or Pillar
CL..........Cover Level	RE..........Rodding Eye
CM..........Cable Marker	RS..........Road Sign
COL.........Column	RTW.........Retaining Wall
CONC........Concrete	RWP.........Rain Water Pipe
CP..........Catch Pit	SAP.........Sapling
CRTW........Concrete Retaining Wall	SL..........Sump Level
CTV.........Cable Television	SoL.........Soffit Level
CUL.........Culvert	SP..........Sign Post
CW..........Concrete Block Wall	SPL.........Springing Level
DC..........Drainage Channel	SRTW........Stone Retaining Wall
DPC.........Damp Proof Course	SV..........Stop Valve (unspecified)
DR..........Drain	SVP.........Soil Vent Pipe
DSW.........Dry Stone Wall	SW..........Stone Wall
ECP.........Electricity Cable Pit	TAC.........Tactile Paving
EIC.........Electricity Inspection Cover	TB..........Traffic Bollard
EJ..........Expansion Joint	TBM.........Temporary Bench Mark
EJB.........Electricity Junction Box	TCB.........Telephone Call Box
EL SUB STN..Electricity Sub Station	TFR.........Taken From Records
EL..........Eaves Level	TIE.........Anchor Point (Masts/Poles)
ELB.........Electricity Box	TL..........Traffic Light
EP..........Electricity Pole	TLB.........Traffic Light Control Box
ER..........Earth Rod	TM..........Ticket Machine
ETL.........Electricity Transmission Line	TMC.........Tarmac
FB..........Flower Bed	TP..........Telecommunications Pole
FH..........Fire Hydrant	TPIT........Trial Pit
FL..........Floor Level	TS..........Trash Screen
FP..........Flagpole	U/C.........Under Construction
G*.*........Girth (of tree)	U/G.........Underground
G...........Gulley	UTL.........Unable to Lift (MH,IC etc)
GAB.........Gabion	UTS.........Unable to Survey
GIP.........Gas Inlet Pipe	VDP.........Vehicle Detector Pad
GMKR........Gas Marker	VP..........Vent Pipe
GST.........Gas Stop Tap (Domestic)	W/M.........Wire Mesh
GSV.........Gas Stop Valve (Mains)	WL..........Water Level
HSE.........Housing	WM..........Water Meter
Ht..........Height	WO..........Wash Out
HV..........High Voltage	WP..........Waste Pipe
I/R.........Iron Railing	WST.........Water Stop Tap (domestic)
IC..........Inspection Cover	WSV.........Water Stop Valve (mains)



Sheet Layout

Survey Operations
Smith Street, Skelmersdale, Lancs. WN8 8LN
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Email: mail@survops.co.uk — www.survops.co.uk

Client	FI Real Estate Management
Drawing Title	Utility Survey of Land at: Wrexham Industrial Estate Wrexham Sheet 4 of 8
Scale(s)	1:200
Surveyor	SC
Date	AUG 21
Drawn	MP
Job Number	21G055
Checked	SO
Sheet Size & Drg Number & Revision	A0 21G055/004

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Survey Operations Dwg 21GOS5 added to Survey Operations Dwg 21E017.

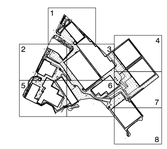
EL UNIPROVEN ELEC
BT UNIPROVEN BT
GA UNIPROVEN GAS
WM UNIPROVEN WATER
SW UNIPROVEN SURFACE
FW UNIPROVEN FOUL

All unproven lines without additional notes on drawing show the approximate location of a reported utility or feature as indicated on stat records undertaken and supplied at time of survey.

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CA5	337371.83	348547.37	31.07
CA6	337384.01	348473.79	30.77
LB1	337615.81	348508.83	31.28
LB2	337520.85	348495.68	34.45
SO1	337351.04	348760.72	38.81
SO2	337414.26	348728.22	39.35
SO3	337511.71	348680.02	39.23
SO4	337572.61	348640.92	38.23
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BB.....Bellcha Beacon
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BL.....Bed Level
BOL.....Bollard
BS.....Bus Stop
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BT.....British Telecom (C
BWTR.....Brick Retaining Wall
BW.....Brick Wall
C/B.....Close Boarded
C/I.....Corrugated Iron
C/P.....Chestnut Paling
CB.....Control Box
CBR.....Concrete Block Wall
CCTV.....Closed Circuit TV
CD.....Cable Duct
CEL.....Cellar Light
CH.....Chain Link
CHP.....Chimney
CL.....Cover Level
CM.....Cable Marker
COL.....Column
CONC.....Concrete
CP.....Catch Pit
CRTN.....Concrete Retaining Wall
CTV.....Cable Television
CUL.....Culvert
DB.....Concrete Block Wall
DC.....Drainage Channel
DPC.....Damp Proof Course
DR.....Drain
DRN.....Dry Stone Wall
ECP.....Electricity Cable Pit
EIC.....Electricity Inspection Cover
EJ.....Expansion Joint
EJB.....Electricity Junction Box
EL SUB STN.....Electricity Sub Station
EL.....Exces Level
ELB.....Electricity Box
EP.....Electricity Pole
ER.....Earth Rod
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FB.....Flower Bed
FH.....Fire Hydrant
FL.....Floor Level
FP.....Flagpole
H*.....Girth (of tree)
G.....Gulley
GAB.....Gabion
GIP.....Gas Inlet Pipe
GMK.....Gas Marker
GOT.....Gas Stop Tap (Domestic)
GSV.....Gas Stop Valve (Mains)
HSE.....Housing
HT.....Height
HV.....High Voltage
I/R.....Iron Railing
IC.....Inspection Cover
IL.....Invert Level
IP.....Inlet Pipe
KO.....Kerb Outlet
LB.....Letter Box
LP.....Lamp Post
MB.....Multi-Girth
MH.....Manhole
MKR.....Marker
MP.....Mooring Point
NP.....Street Name Plate
O/H.....Overhead
O/P.....Open Paling
OE.....Overhead Electric Wire
OP.....Outfall Pipe
OSBM.....Ordnance Survey Bench Mark
OT.....Overhead Telecom Wire
P/C.....Post & Chain
P/R.....Post & Rail
P/W.....Post & Wire
PAV.....Paving
PB.....Pillar Box
PC.....Pedestrian Crossing
PP.....Petrol Pump
PT.....Post or Pillar
RE.....Rodding Eye
RS.....Road Sign
RTW.....Retaining Wall
RWP.....Rain Water Pipe
SAP.....Sapling
SL.....Sump Level
SOL.....Soffit Level
SP.....Sign Post
SPL.....Springing Level
SRTN.....Stone Retaining Wall
SV.....Stop Valve (unspecified)
SVP.....Soil Vent Pipe
SW.....Stone Wall
TAC.....Tactile Paving
TB.....Traffic Bollard
TBM.....Temporary Bench Mark
TCB.....Telephone Call Box
TFP.....Taken From Records
TSS.....Anchor Point (Guys/Poles)
TL.....Traffic Light
TLB.....Traffic Light Control Box
TM.....Ticket Machine
TWC.....Tarmac
TP.....Telecommunications Pole
TPIT.....Trial Pit
TS.....Trash Screen
U/C.....Under Construction
U/G.....Underground
UTL.....Unable to Lift (BM,IC etc)
UTS.....Unable to Survey
VDP.....Vehicle Detector Pad
VP.....Vent Pipe
WCM.....Wire Mesh
WL.....Water Level
WM.....Water Meter
WO.....Wash Out
WP.....Waste Pipe
WSP.....Water Stop Tap (Domestic)
WSV.....Water Stop Valve (Mains)



Sheet Layout

SW STORM WATER SEWERS
FW FOUL WATER SEWERS
WM WATER MAIN
GM GAS MAIN
EL ELECTRIC CABLES
DUCT CABLE DUCTING
BT BT (UNDERGROUND)
CCTV CABLE TV
CLOSED CIRCUIT TV
UI UNIDENTIFIED FEATURE
UP UNIDENTIFIED PIPE
UC UNIDENTIFIED CABLE
UNPFE UNPROVEN FEATURE
SW END OF TRACE
C
FW LATERAL CONNECTIONS
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD. (SURVEYED ***** ****)
FW CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
SW
COVER POSITION FROM CCTV REPORT PLOTTED ON TOPOGRAPHICAL SURVEY
0.6d APPROXIMATE DEPTH OF BURIED SERVICE

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NOTE 1

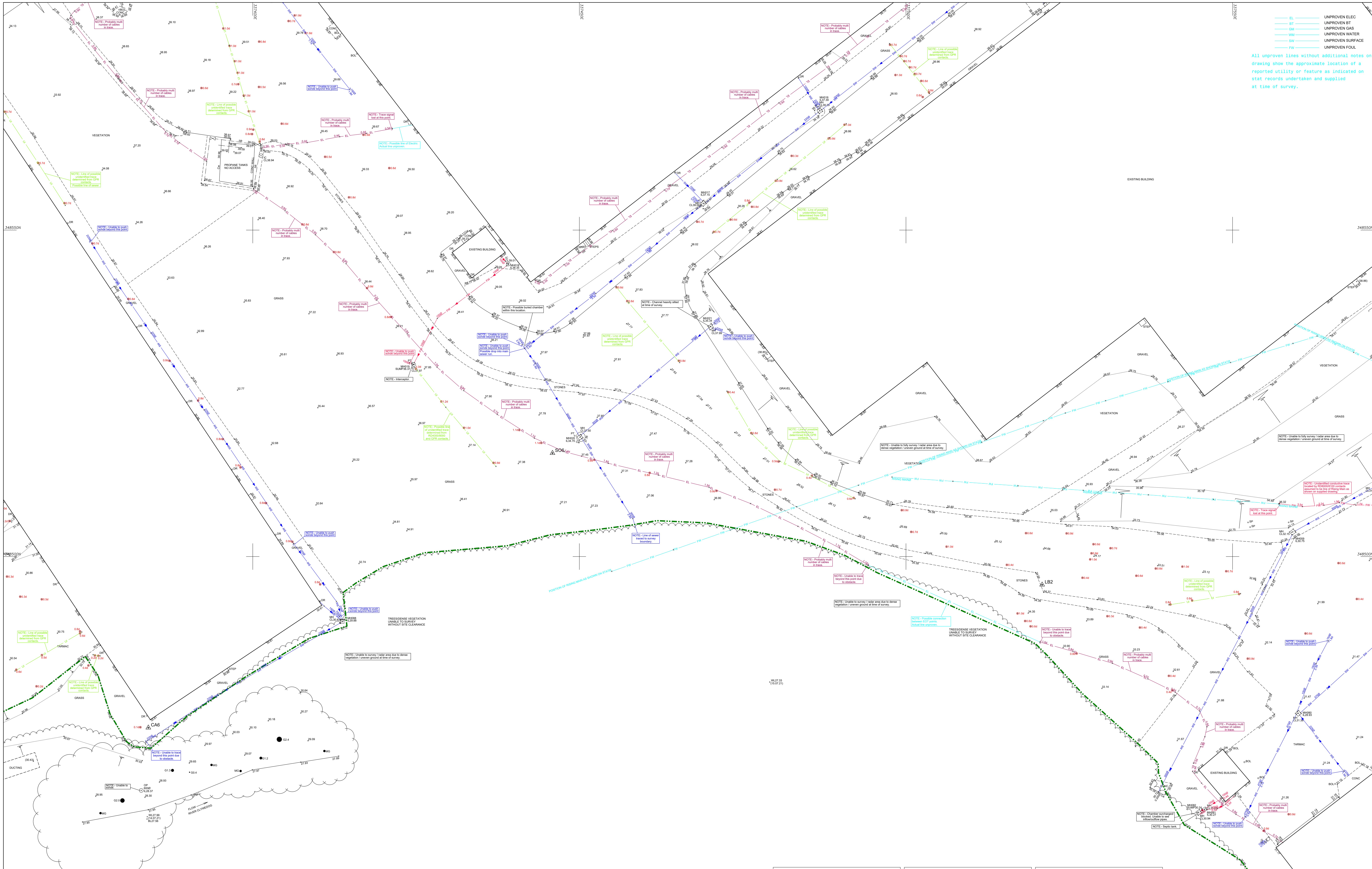
This utility survey has been undertaken using:
A: Radiodetection RD4000 + RD4000 TX2
B: Mala Geoscience Ground Probing Radar

NOTE 2

Power carrying features shown on this drawing are shown as an individual service line. This does not necessarily represent the number of cables actually present and it is possible that there could be multi numbers of cables including HV, LV and communications transmission cables following the same trace line. Where cables lay at different depths, the trace signals from the deeper cables are masked by signals emitted from the shallower service above. Cable runs could also be present running parallel to the single line shown.

Smith Street, Skelmersdale, Lancs. WN8 8LN
Tel: 01695 725662 Fax: 01695 51816
Email: mail@survops.co.uk — www.survops.co.uk

Client	FI Real Estate Management
Drawing Title	Utility Survey of Land at: Wrexham Industrial Estate Wrexham Sheet 5 of 8
Scale(s) 1:200	Surveyor SC
Date AUG 21	Drawn MP
Job Number 21G055	Checked SO
Sheet Size & Drg Number & Revision	A0 21G055/005



SW	STORM WATER SEWERS
FW	FOUL WATER SEWERS
WM	WATER MAIN
GM	GAS MAIN
EL	ELECTRIC CABLES
DUCT	CABLE DUCTING
BT	BT (UNDERGROUND)
	CABLE TV
CCTV	CLOSED CIRCUIT TV
UI	UNIDENTIFIED FEATURE
UP	UNIDENTIFIED PIPE
UC	UNIDENTIFIED CABLE
UNPR	UNPROVEN FEATURE
SW	END OF TRACE
FW C	LATERAL CONNECTIONS
	EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
	EXTENT OF SURVEY BY SURVEY OPERATIONS LTD. (SURVEYED **** ****)
FW / SW	CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
	COVER POSITION FROM CCTV REPORT - NOT SURVEYED ON TOPOGRAPHICAL SURVEY.
0.6d	APPROXIMATE DEPTH OF BURIED SERVICE

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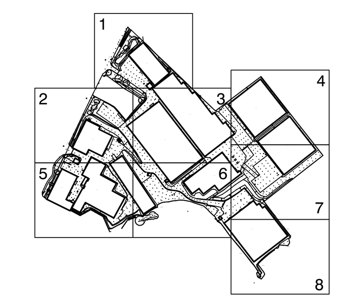
Survey Operations Dwg 21G055 added to Survey Operations Dwg 21E017.

SURVEY STATIONS

Name	Easting	Northing	Height
CA1	337303.16	348805.77	38.23
CA2	337262.53	348723.31	37.92
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LB2	337520.85	348495.68	34.45
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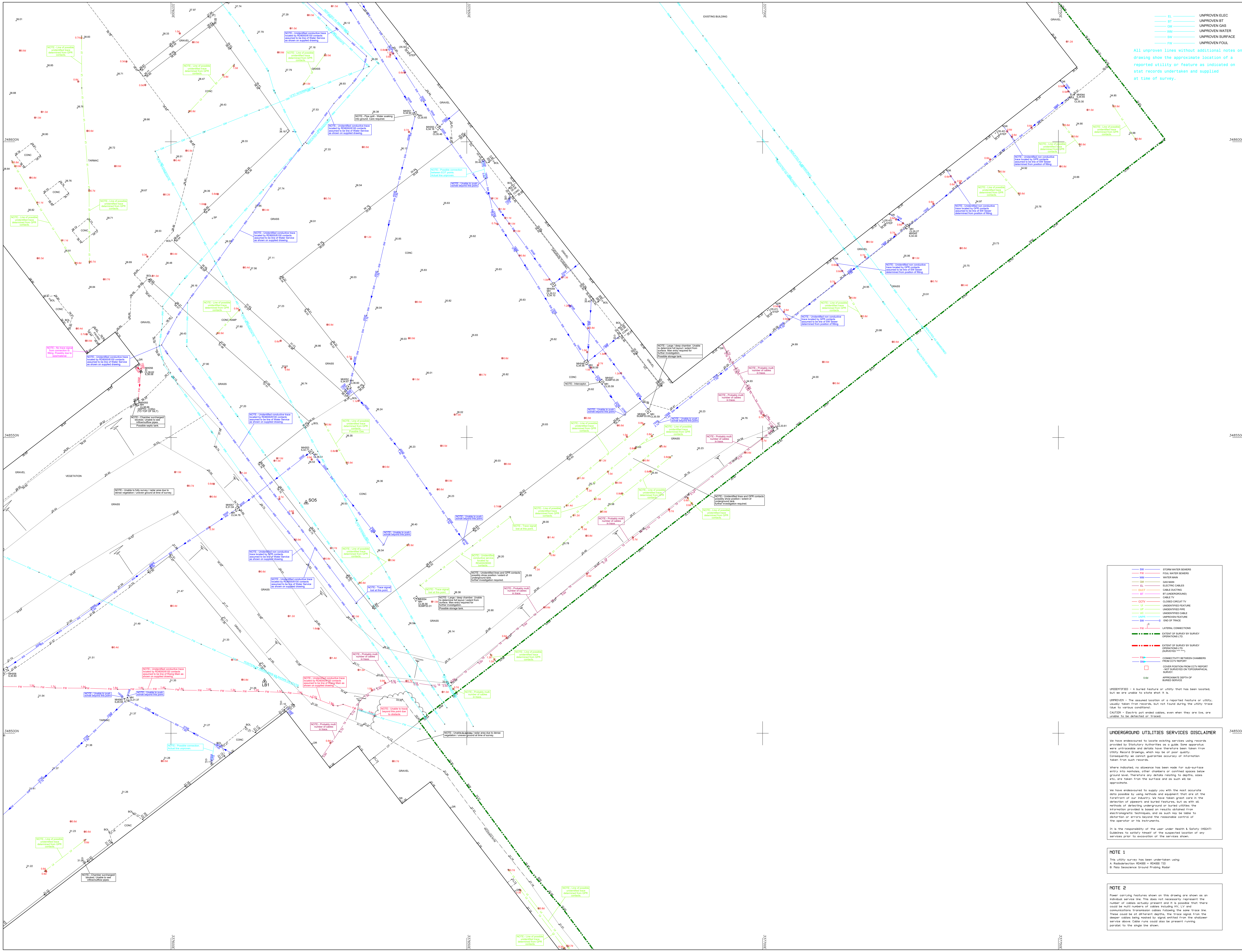
Survey Operations
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Client
FI Real Estate Management

Drawing Title
Utility Survey of Land at:
Wrexham Industrial Estate
Wrexham
Sheet 6 of 8

Scale(s)	1:200	Surveyor	SC
Date	AUG 21	Drawn	MP
Job Number	21G055	Checked	SO

Sheet Size & Drg Number & Revision
A0 21G055/006



EL	UNPROVEN ELEC
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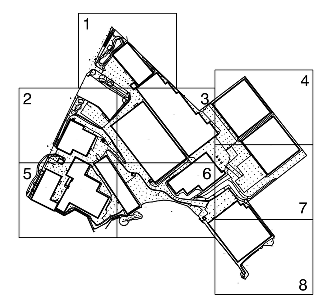
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B/W	Barbed Wire	LB	Letter Box
BAR	Barrier	LP	Lamp Post
BB	Belisha Beacon	MG	Multi-Girth
BH	Borehole	MH	Manhole
BL	Bed Level	MKR	Marker
BOL	Bollard	MP	Mooring Point
BS	Bus Stop	NP	Street Name Plate
BT Box	British Telecom Box	O/H	Overhead
BT	British Telecom IC	O/P	Open Paling
BRTW	Brick Retaining Wall	OE	Overhead Electric Wire
BW	Brick Wall	OP	Outfall Pipe
C/B	Close Boarded	OSBM	Ordnance Survey Bench Mark
C/I	Corrugated Iron	OT	Overhead Telecom Wire
C/P	Chestnut Paling	P/C	Post & Chain
CB	Control Box	P/R	Post & Rail
CBW	Concrete Block Wall	P/W	Post & Wire
CCTV	Closed Circuit TV	PAV	Paving
CD	Cable Duct	PB	Pillar Box
CEL	Cellar Light	PC	Pedestrian Crossing
CH/L	Chain Link	PP	Petrol Pump
CHY	Chimney	PT	Post or Pillar
CL	Cover Level	RE	Rodding Eye
CM	Cable Marker	RS	Road Sign
COL	Column	RTW	Retaining Wall
CONC	Concrete	RWP	Rain Water Pipe
CP	Catch Pit	SAP	Sapling
CRTW	Concrete Retaining Wall	SL	Sump Level
CTV	Cable Television	SoL	Soffit Level
CUL	Culvert	SP	Sign Post
CW	Concrete Block Wall	SPL	Springing Level
DC	Drainage Channel	SRTW	Stone Retaining Wall
DPC	Damp Proof Course	SV	Stop Valve (unspecified)
DR	Drain	SVP	Soil Vent Pipe
DSW	Dry Stone Wall	SW	Stone Wall
ECP	Electricity Cable Pit	TAC	Tactile Paving
EIC	Electricity Inspection Cover	TB	Traffic Bollard
EJ	Expansion Joint	TBM	Temporary Bench Mark
EJB	Electricity Junction Box	TCB	Telephone Call Box
EL SUB STN.	Electricity Sub Station	TFR	Taken From Records
EL	Eaves Level	TIE	Anchor Point (Masts/Poles)
ELB	Electricity Box	TL	Traffic Light
EP	Electricity Pole	TLB	Traffic Light Control Box
ER	Earth Rod	TM	Ticket Machine
ETL	Electricity Transmission Line	TMC	Tarmac
FB	Flower Bed	TP	Telecommunications Pole
FH	Fire Hydrant	TPIT	Trial Pit
FL	Floor Level	TS	Trash Screen
FP	Flagpole	U/C	Under Construction
G*.*	Girth (of tree)	U/G	Underground
G	Gulley	UTL	Unable to Lift (MH,IC etc)
GAB	Gabion	UTS	Unable to Survey
GIP	Gas Inlet Pipe	VDP	Vehicle Detector Pad
GMKR	Gas Marker	VP	Vent Pipe
GST	Gas Stop Tap (Domestic)	W/M	Wire Mesh
GSV	Gas Stop Valve (Mains)	WL	Water Level
HSE	Housing	WM	Water Meter
Ht	Height	WO	Wash Out
HV	High Voltage	WP	Waste Pipe
I/R	Iron Railing	WST	Water Stop Tap (domestic)
IC	Inspection Cover	WSV	Water Stop Valve (mains)



Sheet Layout

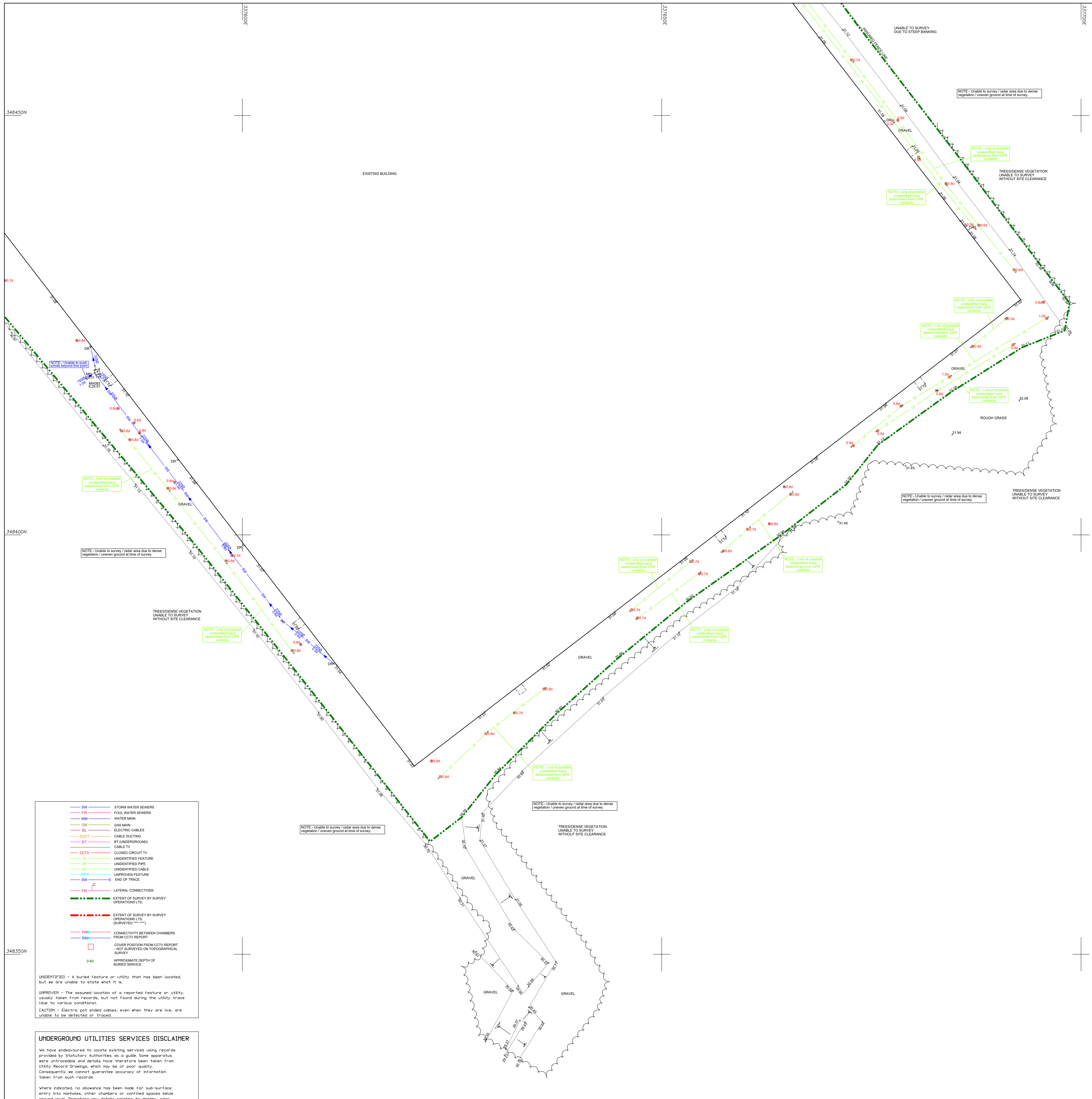
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Email: mail@survops.co.uk — www.survops.co.uk

Client
FI Real Estate Management

Drawing Title
Utility Survey of Land at:
Wrexham Industrial Estate
Wrexham
Sheet 7 of 8

Scale(s)	1:200	Surveyor	SC
Date	AUG 21	Drawn	MP
Job Number	21G055	Checked	SO

Sheet Size & Drg Number & Revision
A0 21G055/007



EL — UNPROVEN ELEC
BT — UNPROVEN BT
GM — UNPROVEN GAS
WM — UNPROVEN WATER
SW — UNPROVEN SURFACE
FW — UNPROVEN FOUL

All unproven lines without additional notes on drawing show the approximate location of a reported utility or feature as indicated on stat records undertaken and supplied at time of survey.

SW — STORM WATER SEWERS
FW — FOUL WATER SEWERS
WM — WATER MAIN
GM — GAS MAIN
EL — ELECTRIC CABLES
DUCT — CABLE DUCTING
BT — BT (UNDERGROUND)
CABLE TV
CCTV — CLOSED CIRCUIT TV
UI — UNIDENTIFIED FEATURE
UP — UNIDENTIFIED PIPE
UC — UNIDENTIFIED CABLE
UNPR — UNPROVEN FEATURE
SW — END OF TRACE
FW C — LATERAL CONNECTIONS
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD.
EXTENT OF SURVEY BY SURVEY OPERATIONS LTD. (SURVEYED **** ****)
FW / SW — CONNECTIVITY BETWEEN CHAMBERS FROM CCTV REPORT
COVER POSITION FROM CCTV REPORT - NOT SURVEYED ON TOPOGRAPHICAL SURVEY.
0.6d — APPROXIMATE DEPTH OF BURIED SERVICE

UNIDENTIFIED - A buried feature or utility that has been located, but we are unable to state what it is.

UNPROVEN - The assumed location of a reported feature or utility, usually taken from records, but not found during the utility trace (due to various conditions).

CAUTION - Electric pot ended cables, even when they are live, are unable to be detected or traced.

UNDERGROUND UTILITIES SERVICES DISCLAIMER

We have endeavoured to locate existing services using records provided by Statutory Authorities as a guide. Some apparatus were untraceable and details have therefore been taken from Utility Record Drawings, which may be of poor quality. Consequently we cannot guarantee accuracy of information taken from such records.

Where indicated, no allowance has been made for sub-surface entry into manholes, other chambers or confined spaces below ground level. Therefore any details relating to depths, sizes etc, are taken from the surface and as such will be approximate.

We have endeavoured to supply you with the most accurate data possible by using methods and equipment that are at the forefront of our industry. We have taken great care in the detection of pipework and buried features, but as with all methods of detecting underground or buried utilities the information provided is based on results obtained from electromagnetic techniques, and as such may be liable to distortion or errors beyond the reasonable control of the operator or his instruments.

It is the responsibility of the user under Health & Safety (HSG47) Guidelines to satisfy himself of the suspected location of any services prior to excavation of the services shown.

NOTE 1

This utility survey has been undertaken using:
A: Radiodetection RD4000 + RD4000 TIO
B: Mala Geoscience Ground Probing Radar

NOTE 2

Power carrying features shown on this drawing are shown as an individual service line. This does not necessarily represent the number of cables actually present and it is possible that there could be multi numbers of cables including HV, LV and communications transmission cables following the same trace line. These could be at different depths, the trace signal from the deeper cables being masked by signal emitted from the shallower service above. Cable runs could also be present running parallel to the single line shown.

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N

Note:
The survey is plotted on a plane local Grid. Orientation to National Grid. All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

Drainage information must be verified with local authority records before use

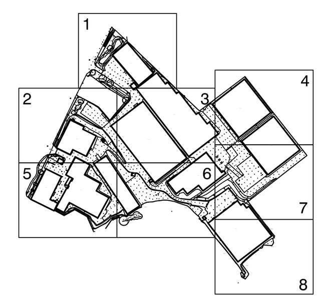
Survey Operations Dwg 21G055 added to Survey Operations Dwg 21E017.

SURVEY STATIONS

Name	Easting	Northing	Height
CA1	337303.16	348805.77	38.23
CA2	337262.53	348723.31	37.92
CA3	337213.52	348620.81	31.66
CA4	337273.29	348597.67	31.92
CA5	337311.63	348582.31	31.07
CA6	337384.01	348473.79	30.77
LB1	337615.82	348508.83	31.28
LB2	337520.85	348495.68	34.45
SO1	337351.04	348760.72	38.81
SO2	337414.26	348728.22	39.35
SO3	337516.13	348589.83	38.95
SO4	337572.61	348640.50	39.23
SO5	337622.85	348538.98	36.63
SO6	337445.88	348515.84	37.55

STANDARD REFERENCE & ABBREVIATIONS

(AR)........Assumed Route	IL..........Invert Level
AB..........Air Brick	IP..........Inlet Pipe
AV..........Air Valve	KO..........Kerb Outlet
B/W.........Barbed Wire	LB..........Letter Box
BAR.........Barrier	LP..........Lamp Post
BB..........Belisha Beacon	MG..........Multi-Girth
BH..........Borehole	MH..........Manhole
BL..........Bed Level	MKR.........Marker
BOL.........Bollard	MP..........Mooring Point
BS..........Bus Stop	NP..........Street Name Plate
BT Box......British Telecom Box	O/H.........Overhead
BT..........British Telecom IC	O/P.........Open Paling
BRTW........Brick Retaining Wall	OE..........Overhead Electric Wire
BW..........Brick Wall	OP..........Outfall Pipe
C/B.........Close Boarded	OSBM........Ordnance Survey Bench Mark
C/I.........Corrugated Iron	OT..........Overhead Telecom Wire
C/P.........Chestnut Paling	P/C.........Post & Chain
CB..........Control Box	P/R.........Post & Rail
CBW.........Concrete Block Wall	P/W.........Post & Wire
CCTV........Closed Circuit TV	PAV.........Paving
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CEL.........Cellar Light	PC..........Pedestrian Crossing
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CHY.........Chimney	PT..........Post or Pillar
CL..........Cover Level	RE..........Rodding Eye
CM..........Cable Marker	RS..........Road Sign
COL.........Column	RTW.........Retaining Wall
CONC........Concrete	RWP.........Rain Water Pipe
CP..........Catch Pit	SAP.........Sapling
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EL SUB STN..Electricity Sub Station	TFR.........Taken From Records
EL..........Eaves Level	TIE.........Anchor Point (Masts/Poles)
ELB.........Electricity Box	TL..........Traffic Light
EP..........Electricity Pole	TLB.........Traffic Light Control Box
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FB..........Flower Bed	TP..........Telecommunications Pole
FH..........Fire Hydrant	TPIT........Trial Pit
FL..........Floor Level	TS..........Trash Screen
FP..........Flagpole	U/C.........Under Construction
G*.*........Girth (of tree)	U/G.........Underground
G...........Gulley	UTL.........Unable to Lift (MH,IC etc)
GAB.........Gabion	UTS.........Unable to Survey
GIP.........Gas Inlet Pipe	VDP.........Vehicle Detector Pad
GMKR........Gas Marker	VP..........Vent Pipe
GST.........Gas Stop Tap (Domestic)	W/M.........Wire Mesh
GSV.........Gas Stop Valve (Mains)	WL..........Water Level
HSE.........Housing	WM..........Water Meter
Ht..........Height	WO..........Wash Out
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I/R.........Iron Railing	WST.........Water Stop Tap (domestic)
IC..........Inspection Cover	WSV.........Water Stop Valve (mains)



Sheet Layout

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FI Real Estate Management

Drawing Title
Utility Survey of Land at:
Wrexham Industrial Estate
Wrexham
Sheet 8 of 8

Scale(s)	1:200	Surveyor	SC
Date	AUG 21	Drawn	MP
Job Number	21G055	Checked	SO

Sheet Size & Drg Number & Revision
A0 21G055/008

ANNEX B

Channel Survey



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Note:

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Client
Weetwood Environmental Engineering

Drawing Title
Cross Sectional Survey at:
Bedwell Park
Wrexham
Sheet 1 of 7

Scale(s)	1:1250	Surveyor	MF/SB/SI
Date	JAN 26	Drawn	JR
Job Number	25H226	Checked	SO

Sheet Size & Drg Number & Revision
A0 25H226/001

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Note:

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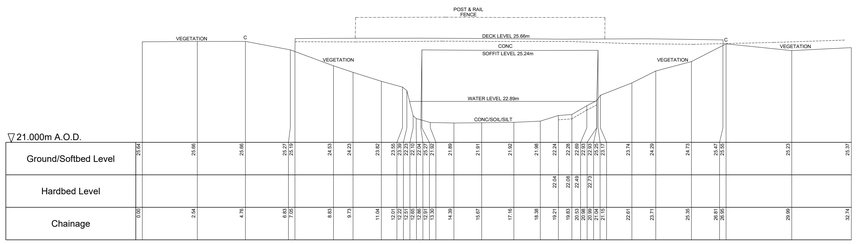
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Client
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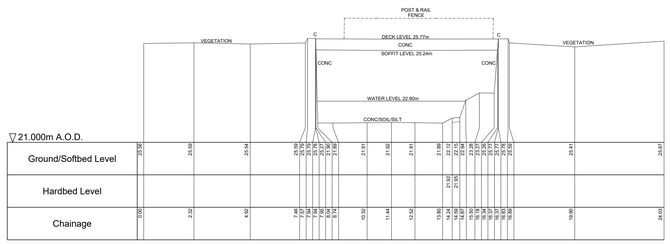
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Cross Sectional Survey at:
Bedwell Park
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Sheet 2 of 7

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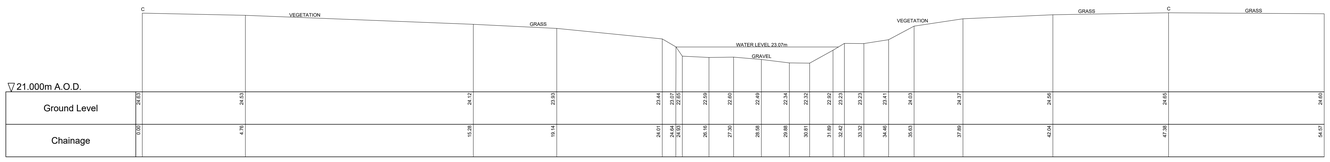
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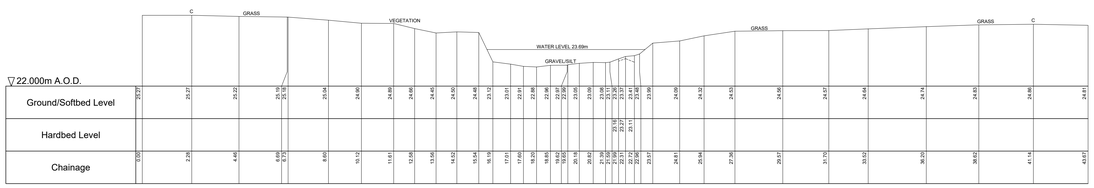
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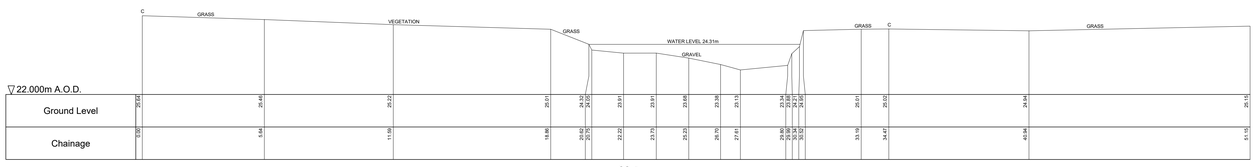
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03/12/25

NOTE: ALL CROSS SECTIONS VIEWED LOOKING DOWNSTREAM.
NOTE: CROSS SECTION DATUM VALUES VARY.

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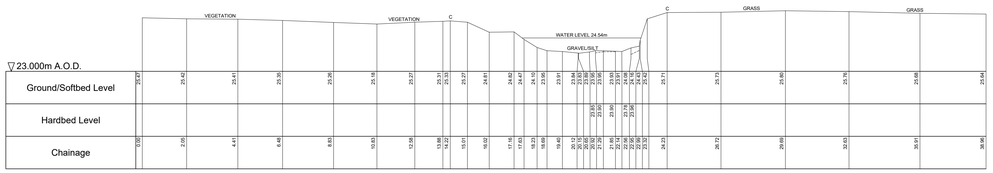
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Client: Weetwood Environmental Engineering

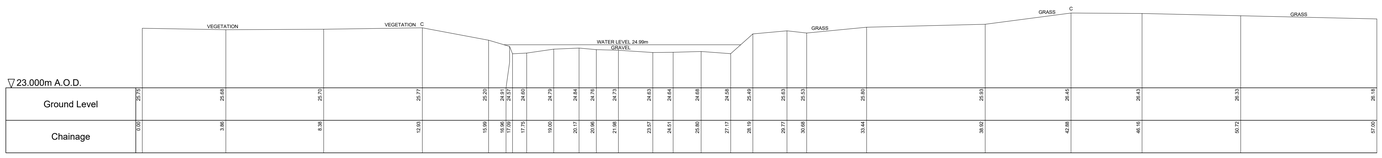
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Wrexham
Sheet 3 of 8

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Job Number	25H226	Checked	SO

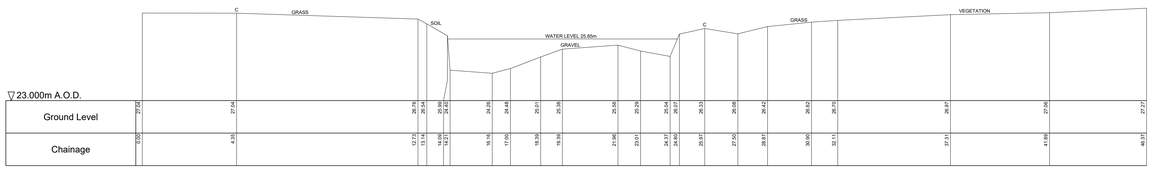
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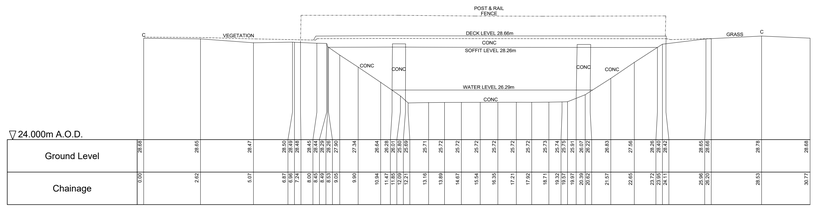
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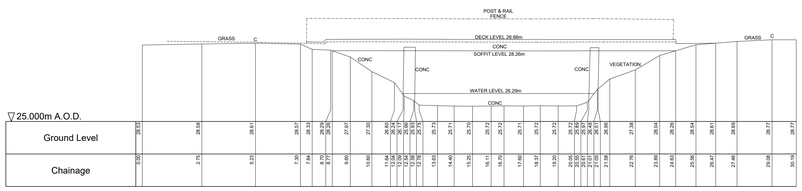
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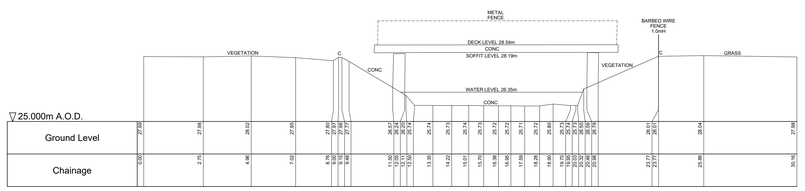
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03/12/25



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03/12/25



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02/12/25

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Client
Weetwood Environmental Engineering

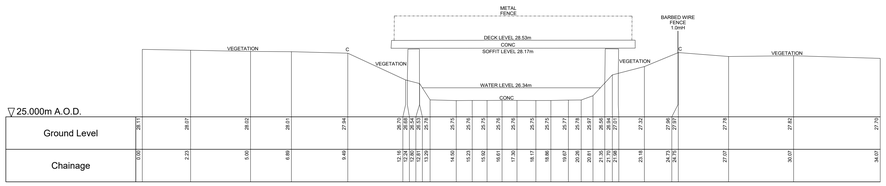
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Bedwell Park
Wrexham
Sheet 4 of 8

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Job Number	25H226	Checked	SO

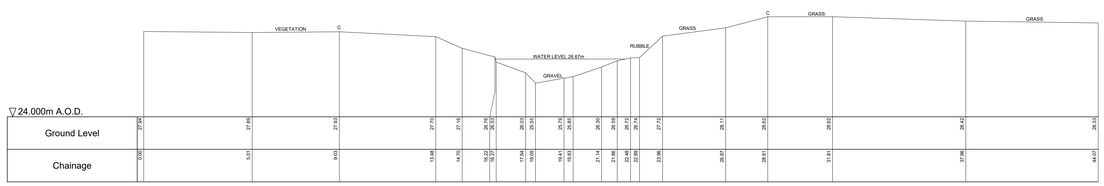
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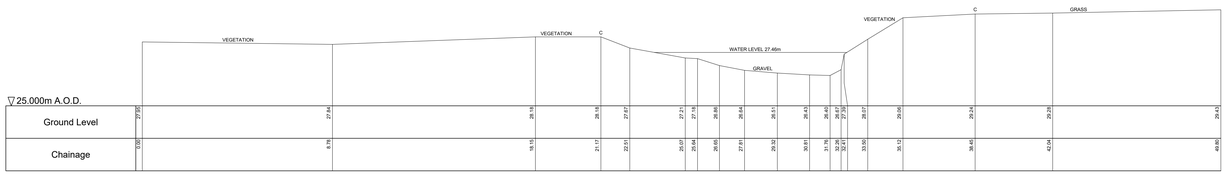
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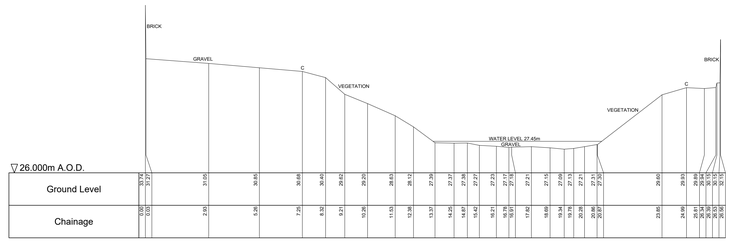
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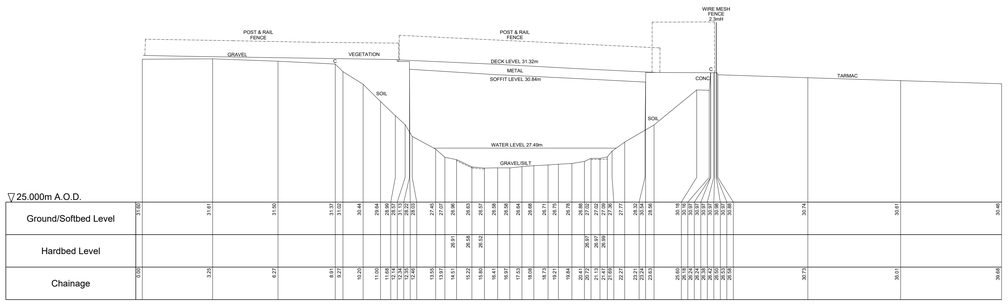
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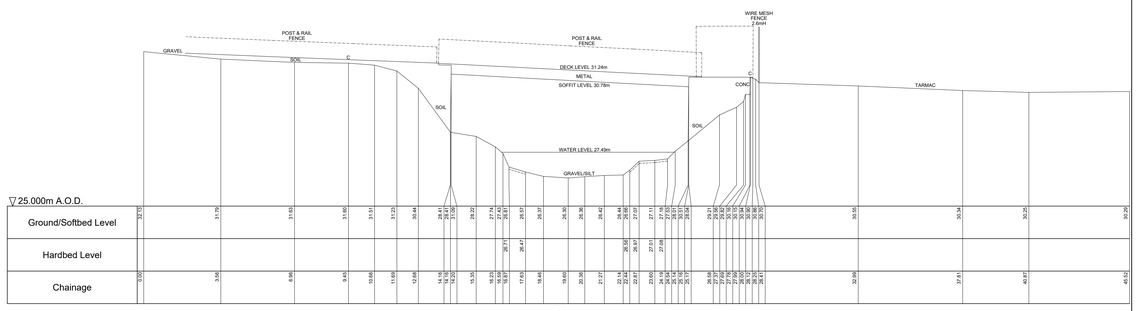
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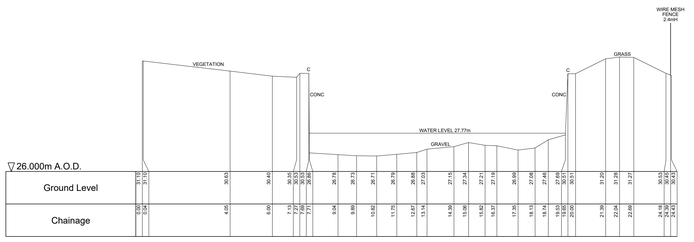
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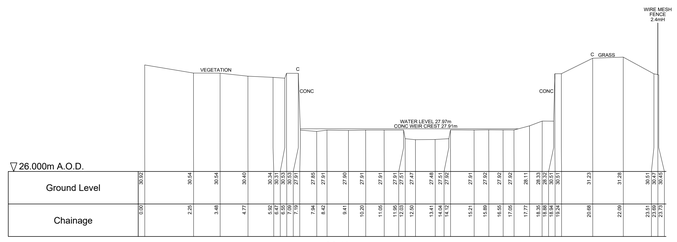
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28/11/25



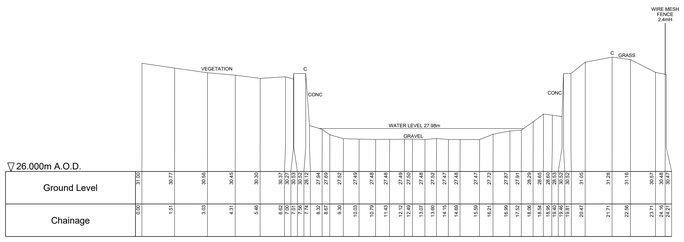
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28/11/25



CS 20
CLYW01_01749
28/11/25

NOTE: ALL CROSS SECTIONS VIEWED LOOKING DOWNSTREAM.
NOTE: CROSS SECTION DATUM VALUES VARY.

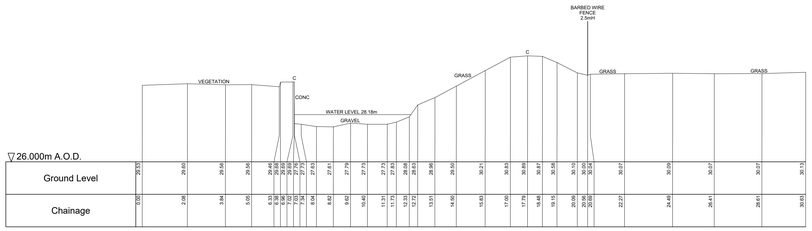
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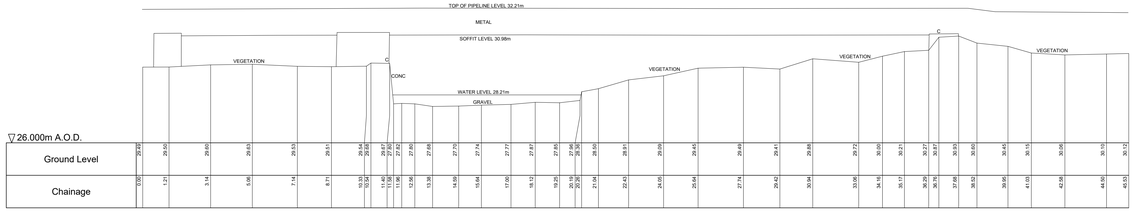
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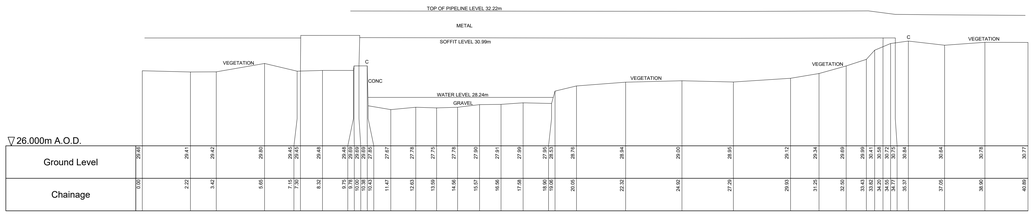
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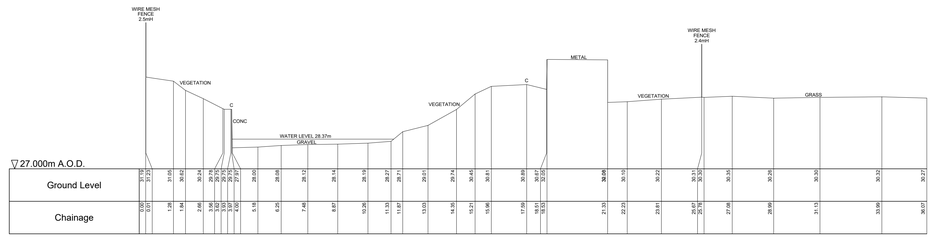
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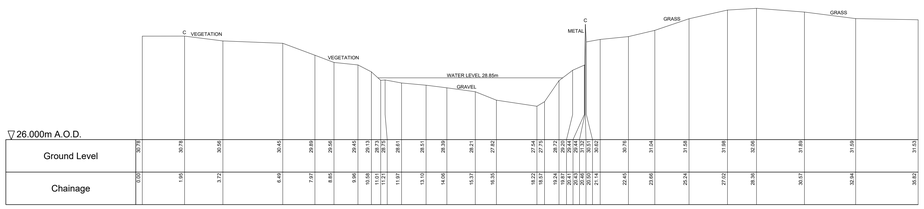
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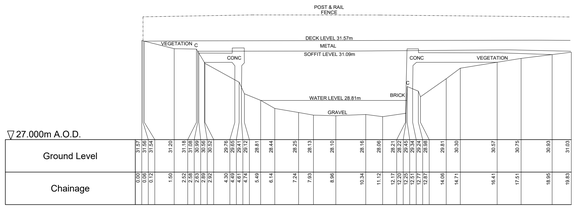
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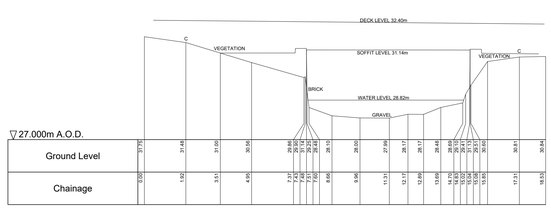
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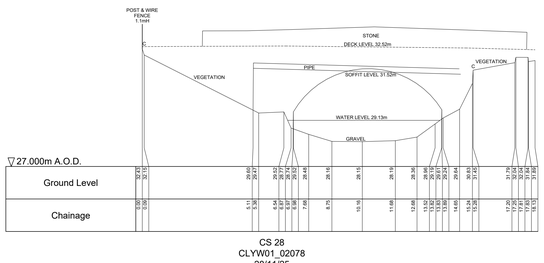
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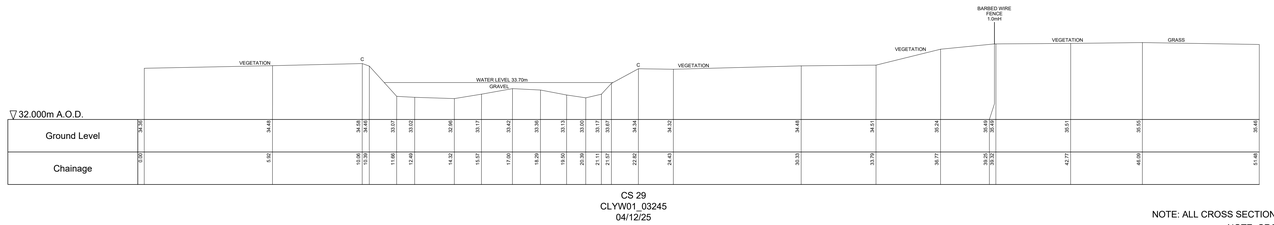
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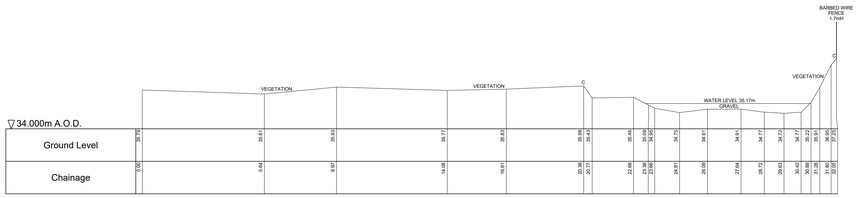
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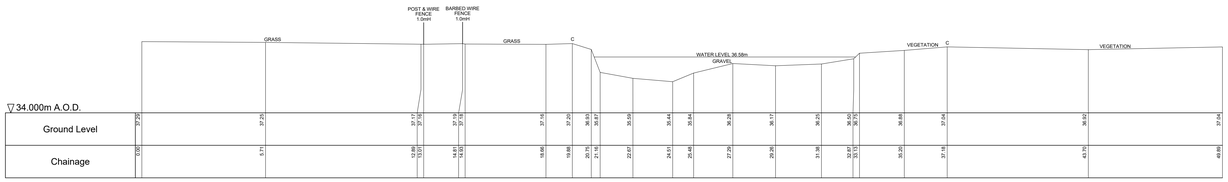
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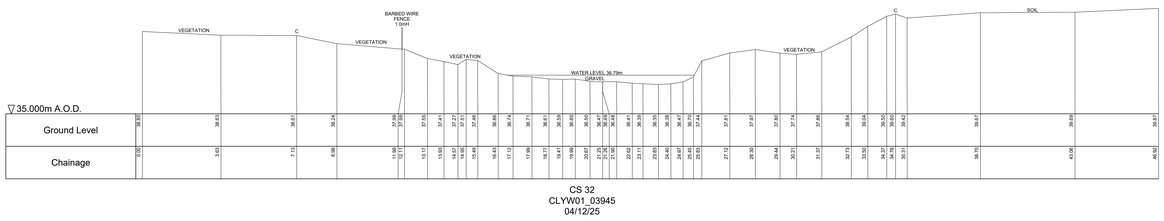
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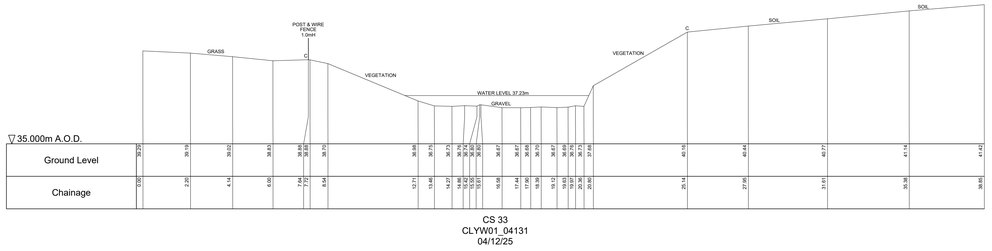
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Sheet 7 of 8

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ANNEX C

Weetwood Hydrological Assessment

BEDWELL PARK HYDRAULIC MODELLING STUDY

FLOOD ESTIMATION REPORT

Final Report v1.0
May 2026

Weetwood Services Ltd
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Report Title	**Bedwell Park Hydraulic Modelling Study** Flood Estimation Report Final Report v1.0
Client	FI Real Estate Management
Date of issue	14 May 2026

Prepared by	Arran Bright BSc (Hons) MSc *Flood Risk Consultant*
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Approved by	Adam Edgerley BSc (Hons) *Managing Director*

This document has been prepared solely as a Flood Estimation Report for FI Real Estate Management. This report is confidential to FI Real Estate Management and Weetwood Services Ltd accepts no responsibility or liability for any use that is made of this document other than by FI Real Estate Management for the purposes for which it was originally commissioned and prepared.

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List of Abbreviations

AEP	Annual Exceedance Probability	POT	Peaks Over Threshold
AM	Annual Maximum	RBD	River Basin District
AOD	Above Ordnance Datum	ReFH	Revitalised Flood Hydrograph Model
AREA	Catchment Area (km^2)	RFI	Request for Information (to the EA)
ARF	Areal Reduction Factor	SAAR	Standard Average Annual Rainfall (mm)
BFIHOST	Base Flow Index Derived Using HOST Class	SFRA	Strategic Flood Risk Assessment
BGS	British Geological Survey	SPR	Standard Percentage Runoff
BL	Baseflow Lag	SPRHOST	Standard Percentage Runoff Derived Using HOST Class
BR	Baseflow Recharge		
CC	Climate Change	SoP	Standard of Protection
CD	Catchment Descriptor	TN	Technical Note
CDA	Critical Drainage Area	Tp	Time to Peak of the Instantaneous Unit Hydrograph (hours)
C_{max}	Maximum Soil Moisture Capacity (mm)	UAF	Urban Adjustment Factor
DEFRA	Department for Environment, Food and Rural Affairs	URBAN	FSR Index of Fractional Urban Extent
		URBEXT	FEH Index of Fractional Urban Extent
DPLBAR	Index Describing Average Drainage Path Length (km)	WHS	Wallingford Hydro Solutions
		WINFAP	Frequency Analysis Package for the FEH Statistical Method
DPSBAR	Index Describing Catchment Steepness (m/km)		
DT	Data Transfer		
EA	Environment Agency		
FARL	Index of Flood Attenuation Due to Reservoirs and Lakes		
FEH	Flood Estimation Handbook		
FER	Flood Estimation Report		
FPEXT	Index Describing Floodplain Extent		
FSR	Flood Studies Report		
ha	Hectare		
HMS	Hydraulic Modelling Study		
HOST	Hydrology of Soil Types		
IDB	Internal Drainage Board		
IF	Impervious Factor		
km	Kilometres		
LiDAR	Light Detection and Ranging		
LLFA	Lead Local Flood Authority		
l/s	Litres per Second		
mm	Millimetres		
m	Metres		
m^3/s	Cubic Metres per Second		
NGR	National Grid Reference		
NRFA	National River Flow Archive		
OS	Ordnance Survey		
PROPWET	Index of Proportion of Time That Soils Are Wet		
QMED	Median Annual Maximum Flow Rate		

1 INTRODUCTION

1.1 Purpose of Report

Weetwood Services Ltd ('Weetwood') has been instructed by FI Real Estate Management to prepare a FER report in association with the construction of bridge over the River Clywedog at Bedwell Industrial Park.

1.2 Structure of the Report

The report is structured as follows:

Section 1 Introduction and report structure
Section 2 Presents a summary of the assessment
Section 3 Presents the method statement for the hydrological analysis
Section 4 Details the locations of the required peak flow estimates
Section 5 Presents the FEH Statistical Method calculations
Section 6 Presents the ReFH2 calculations
Section 7 Presents discussion and summary of the results

1.3 Explanatory Note on Flood Probability

This report refers to the likelihood of a flood event occurring in terms of an AEP expressed as a percentage.

The AEP is the reciprocal of the return period which describes the rarity of an event in terms of its statistical reoccurrence interval in years. For example, a '1 in 30 year flood' has a 1/30 = 0.033 (3.3%) probability of occurring in any one year, whilst a '1 in 100 year flood' has a 1/100 = 0.010 (1.0%) probability of occurring in any one year.

AEP	AEP (expressed as a %)	Return Period (years)	Alternative Expression
1.000	100.0%	1	1 in 1
0.500	50.0%	2	1 in 2
0.100	10.0%	10	1 in 10
0.050	5.0%	20	1 in 20
0.033	3.3%	30	1 in 30
0.020	2.0%	50	1 in 50
0.010	1.0%	100	1 in 100
0.005	0.5%	200	1 in 200
0.001	0.1%	1,000	1 in 1,000

2 SUMMARY OF ASSESSMENT

2.1 Site Location

The approximately 33.8 ha site is located east of Bedwell Road and Bridge South Road, at Wrexham Industrial Estate, as shown in **Figure 1**.

The River Clywedog flows in an easterly direction through the centre of the industrial estate.

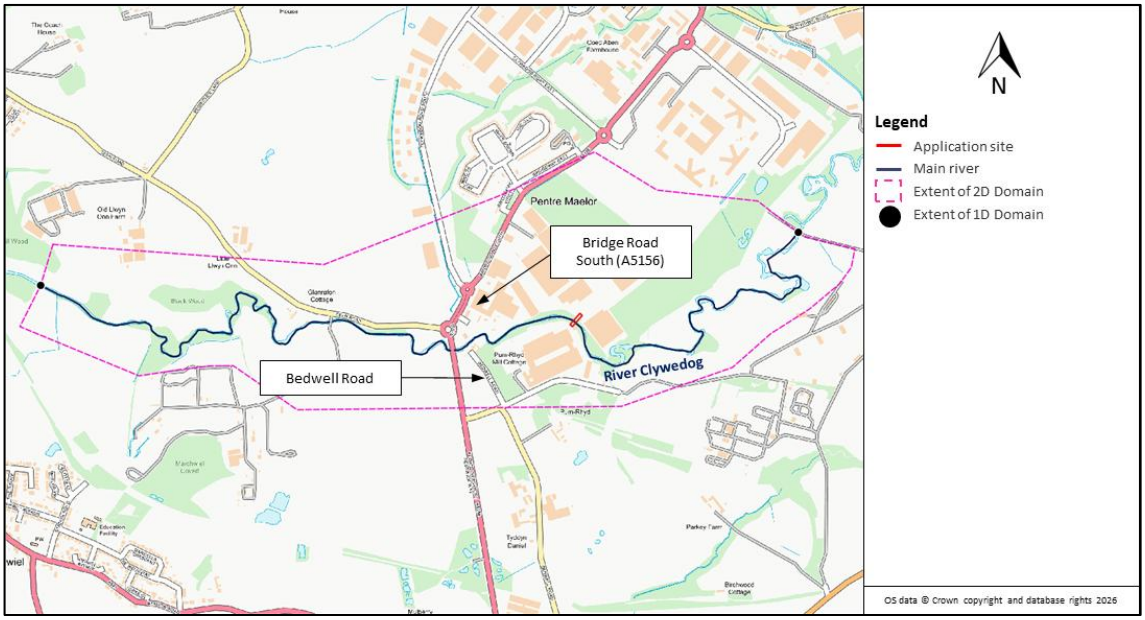


Figure 1: Site Location and Location of Surface Waterbodies

2.2 Purpose of Study

The purpose of the study is to obtain peak flows and hydrographs for the 3.3%, 1.0% and 0.1% AEP events for the River Clywedog. These will be utilised within an ESTRY-TUFLOW (1D-2D) hydraulic model to inform a site-specific assessment of fluvial flood risk.

2.3 Key Catchment Features

The River Clywedog catchment is large and moderately urbanised, with a significant proportion of the urban extent concentrated around Wrexham, which is 1.7 km upstream of the site. Much of the rural extent of the catchment is concentrated to the west of Wrexham.

2.4 Flooding Mechanisms

The risk of fluvial flooding at the site is expected to relate to the capacity of the River Clywedog channel being exceeded and/or the blockage of in-channel structures.

2.5 Final Choice of Method

The peak flows derived using the FEH Statistical Method have been taken forward for use in the hydraulic modelling study.

3 METHOD STATEMENT

3.1 Project Scope

The scope of work includes a simple review of flood history, review of gauging station data (if available) and derivation of peak flows and hydrographs to be used within the hydraulic model.

3.2 The Catchment

The approximately 86 km^2 River Clywedog catchment extends east from Esclusham Mountain to Wrexham, as shown in **Figure 2**.

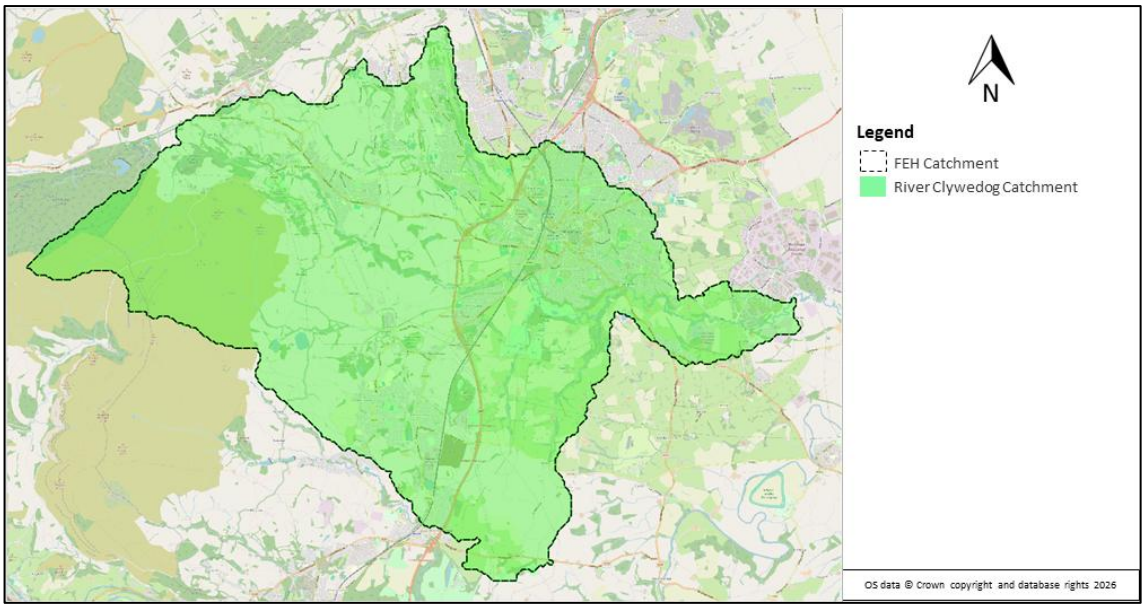


Figure 2: Catchment Location

3.3 Source of Peak Flood Data

The NRFA peak flow dataset (Version 14) has been used within WINFAP and the FEH22 rainfall dataset has been used within ReFH2.

3.4 Gauging Stations

The Clywedog at Bowling Bank gauging station (NRFA ref: 67025) is located approximately 2.8 km downstream of the subject catchment. However, the gauging station is not considered to be suitable for QMED estimation of for pooling.

3.5 Hydrological Understanding of Catchment

The River Clywedog flows in a predominantly easterly direction through the study area. The river is a designated main river and outfalls to the River Dee approximately 3.61 km south-east of the site.

The catchment immediately upstream of Bedwell Park is predominantly urban with the city of Wrexham falling within the catchment boundary, whereas the rest of the catchment is more rural with smaller urbanised areas.

Natural Soils Research Institute Mapping[1] classifies soil conditions within the catchment as mainly slowly permeable, seasonally wet loamy and clayey soils, with the exception of areas within Wrexham classified as freely draining, sandy soils.

[1] https://www.landis.org.uk/soilscapes/

British Geological Survey (BGS) Surface Geology Mapping[2] indicates that the underlying bedrock through the catchment ranges from mudstone (Pennine Lower Coal Measures, Salop and Etruria formations) and sandstone (Kinnerton Sandstone Formation) deposits. The superficial deposits range from mainly Glaciofluvial sand and gravel to Devensian till deposits throughout the catchment.

Finally, the urban areas associated with Wrexham and the surrounding villages are expected to be positively drainage by the public combined and surface water sewer network.

3.6 Other Data Available

Type of data	Data relevant to this study?	Data available?	Details
Check flow gauging's	Yes	No	n/a
Historical flood data	Yes	Yes	The Recorded Flood Extents layer presented by the NRW Flood and Coastal Erosion Risk Maps indicates that there are recorded flood events at and in the vicinity of the site.
Rainfall data for events	No	No	n/a
Potential evaporation data	No	No	n/a
Results from previous studies	Yes	No	n/a
Other data or information	No	No	n/a

3.7 Initial Choice of Approach

Initial choice of method(s) and reasons	The initial choice of method is the FEH Statistical Method as it is the preferred option in Wales.
How will hydrograph shapes be derived?	ReFH2 will be used to derive the hydrograph shapes.
Will catchment be split into sub-catchments?	No.
Software to be used	FEH Web Service / WINFAP v5.3 / ReFH2 v3

[2] https://www.bgs.ac.uk/map-viewers/geoindex-onshore/

4 LOCATIONS WHERE FLOOD ESTIMATES REQUIRED

4.1 Summary of Subject Sites

Site code	Type of estimate L: lumped S: sub-catchment	Watercourse	Description of catchment	Easting	Northing	AREA (km^2)
CW_01	L	River Clywedog	River Clywedog upstream of confluence with Redwither Brook	338350	348900	86.01

4.2 Important Catchment Descriptors (Incorporating Changes Made)

Site code	AREA (km^2)	$SAAR_{9120}$	PROPWET	$BFIHOST_{19}$	$BFIHOST_{19}$ Scaled	DPLBAR	DPSBAR	$URBEXT_{2015}$	$URBEXT_{2000}$	FPEXT	$FARL_{2015}$
CW_01	86.01	917	0.51	0.519	0.518	13.74	68.4	0.127	0.099	0.062	0.993

4.3 Catchment Descriptor Checks

Record how catchment boundary was checked and describe any changes	The River Clywedog catchment extent was validated using LiDAR data and was considered to be appropriate.
Record how other catchment descriptors were check and describe any changes	BGS mapping suggests that the BFIHOST descriptor is appropriate.
Source of URBEXT	$URBEXT_{2000}$ and $URBEXT_{2015}$.
Method for updating URBEXT	The Urban Extent 2015 layer has been validated against OS mapping and aerial imagery and is considered to be suitably representative of the existing catchment and also defines urban areas more accurately than the OS Built Up Areas dataset and the Urban Extent 2000 layer. As such, $URBEXT_{2015}$ has been used within WINFAP and ReFH2.

5 STATISTICAL METHOD

5.1 Overview of QMED Estimation

Site code	QMED (rural) from CDs (m^3/s)	Method	Data transfer			UAF	Final QMED (m^3/s)
			NRFA no.	Distance (km)	Moderated QMED adjustment factor (A/B)[a]		
CW_01	17.84	DT	67008	12.10	0.63	1.23	13.87
			67009	13.93			
			67005	18.02			
			66005	20.30			
			54020	21.59			
			66001	23.70			
			68020	26.23			
			66004	26.79			
Are QMED values spatially consistent?					n/a		
Urban adjustment parameters					$URBEXT_{2015}$		

5.2 Donor Sites and QMED Adjustment Factors

NRFA no.	Method	QMED (deurbanised) from flow data (A)	QMED (rural) from CDs (B)	Adjustment ratio (A/B)
67008	AM	20.265	40.150	0.505
67009		8.685	19.605	0.443
67005		30.842	59.320	0.520
66005		16.430	28.433	0.578
54020		10.042	17.762	0.565
66001		49.502	68.959	0.718
68020		14.589	17.221	0.847
66004		3.638	9.036	0.403

Donor adjustment was undertaken using the eight closest stations as recommended by the WINFAP Technical Guide.

No. of donor stations	NRFA no.	QMED adjustment ratio (A/B)[a]
1	67008	0.80
2	67008, 67009	0.73
3	67008, 67009, 67005	0.68
4	67008, 67009, 67005, 66005	0.67
5	67008, 67009, 67005, 66005, 54020	0.64
6	67008, 67009, 67005, 66005, 54020, 66001	0.64
7	67008, 67009, 67005, 66005, 54020, 66001, 68020	0.65
8	67008, 67009, 67005, 66005, 54020, 66001, 68020, 66004	0.63

The donor stations were reviewed and the suitability of the stations for providing QMED estimates for donor transfer presented by the NRFA are summarised as follows:

67008 – Gauged above QMED. QMED in bank and there are multiple gaugings available above it. However, it is noted that water may be lost from the upper reaches of the catchment due to mine drainage tunnels.
67009 – Gauged above QMED. QMED within bank and well gauged.
67005 – Gauged above QMED. QMED in bank and weir remains modular.
66005 – Well gauged to, and beyond QMED.

54020 – Gauged above QMED. All flows well contained and theoretical rating expected to perform well. However, it is noted that there is some marshland with complex artificial drainage.
66001 – Gauged above QMED.
68020 –Early gaugings extended to around QMED. QMED is less reliable from summer 1999, but is similar to earlier period. Ratings fit to corresponding gaugings reasonable.
66004 – Gauged close to QMED. Rating is good fit to gaugings.

The donor adjusted factorial standard error reduced from 1.403 to 1.377 from a single donor station to the eight selected donor stations. The maximum percentage of non-flood years is 6.7% (NFRA no. 68020) and there is typically no trend present within the AMAX series, with a maximum Mann Kendall Z statistic of 1.8 (NRFA no. 66005).

5.3 Derivation of Pooling Group

<table>
<tr><th>Site code</th><th>Subject site treated as gauged?</th><th>Changed made to default pooling group and reason</th><th>Weighted average L-moments (rural)</th></tr>
<tr><td>CW_01</td><td>No</td><td>Initial standardised test value H2 = 2.626.

Stations removed from the pooling group:

206001 (Clanrye @Mountmill Bridge) – The stations SAAR9120 value differs significantly from the subject catchment.

Stations added to the pooling group:

53023 (Sherston Avon @Fosseway)

Final Pooling group includes:
<table>
<tr><th>NRFA no.</th><th>Station</th></tr>
<tr><td>7010</td><td>Muckle Burn @ Brodie</td></tr>
<tr><td>69012</td><td>Bolin @ Wilmslow</td></tr>
<tr><td>52004</td><td>Isle @ Ashford Mill</td></tr>
<tr><td>52010</td><td>Brue @ Lovington</td></tr>
<tr><td>51001</td><td>Doniford Stream @ Swill Bridge</td></tr>
<tr><td>20005</td><td>Birns Water @ Saltoun Hall</td></tr>
<tr><td>67009</td><td>Alyn @ Rhydymwyn</td></tr>
<tr><td>53013</td><td>Marden @ Stanley</td></tr>
<tr><td>20007</td><td>Gifford Water @ Lennoxlove</td></tr>
<tr><td>21016</td><td>Eye Water @ Eyemouth Mill</td></tr>
<tr><td>205020</td><td>Enler @ Comber</td></tr>
<tr><td>39025</td><td>Enborne @ Brimpton</td></tr>
<tr><td>53017</td><td>Boyd @ Bitton</td></tr>
<tr><td>27059</td><td>Laver @ Ripon Laver Weir</td></tr>
<tr><td>41022</td><td>Lod @ Halfway Bridge</td></tr>
<tr><td>53023</td><td>Sherston Avon @ Foddeway</td></tr>
</table>
Final standardised test value H2 = 2.946 (2.715 with non-flood years adjustment).</td><td>L-CV = 0.260
L-Skew = 0.216</td></tr>
</table>

5.4 Suitable Growth Curve Distributions

Site code	Distribution	Goodness of fit (z value)	Parameters of distribution
CW_01	Generalised Extreme Value	0.541	Location: 0.868 Scale: 0.354 Shape: -0.070
	Pearson Type III	-1.603	Location: 0.346 Scale: 0.322 Shape: 2.356
	Generalised Logistic Non-Flood Years*	4.478	Location: 1.000 Scale: 0.223 Shape: -0.249

*Distribution does not provide an acceptable fit, but 1 site has >15% non-flood years so non-flood year adjustment has been assessed

5.5 Peak Flow Estimates for Growth Curve Distributions

Site code	AEP Event	Peak flow (m^3/s) for the following distributions		
		Generalised Extreme Value	Pearson Type III	Generalised Logistic Non-Flood Years
CW_01	50.0%	13.849	13.849	13.849
	3.3%	30.773	30.735	30.151
	1.0%	38.669	37.271	40.423
	0.1%	55.631	49.221	70.767

5.6 Choice of Growth Curve Distribution

Site code	Method	Distribution and reason for choice	Weighted average L-moments	Growth factor for 1.0% AEP event
CW_01	P	Generalised extreme value used because it provides the best fit	L-CV: 0.239 L-Skew: 0.216	2.792

5.7 Peak Flow Estimates

Site code	Peak flow (m^3/s) for the following AEP events			
	50.0%	3.3%	1.0%	0.1%
CW_01	13.85	30.77	38.67	55.63

The WINFAP report is provided in **Appendix A**.

6 REVITALISED FLOOD HYDROGRAPH MODEL (REFH2)

6.1 Parameters for ReFH2

Site code	Method	Tp	Tp urban scaling factor	C_{max}	SPR_{imp}	BL	BR
CW_01	CD	4.84	0.75	393.98	0.7	50.25	2.15-2.77

6.2 Design Events for ReFH2

Site code	Urban or rural	Season of design event	Storm duration (hours)	ARF
CW_01	Urban	Winter	9.5	0.92

6.3 Peak Flow Estimates

Site code	Peak flow (m^3/s) for the following AEP events			
	50.0%	3.3%	1.0%	0.1%
CW_01	20.04	41.30	52.87	79.15

The ReFH2 reports are provided in **Appendix B**.

7 DISCUSSION AND SUMMARY OF RESULTS

7.1 Comparison of Results from Different Methods

Site code	Ratio of ReFH2 peak flow to FEH Statistical Method peak flow	
	50% AEP Event	1% AEP Event
CW_01	1.45	1.37

7.2 Final Choice of Method

Choice of method and reasons	The peak flows derived using the FEH Statistical Method have been taken forward for use in the hydraulic modelling study because it is NRW's preferred approach for deriving peak flows and the donor stations and pooling group were considered to be suitably representative of the subject catchment. However, sensitivity testing will be undertaken using the 1.0% AEP +CC flow derived using ReFH2 given the significant differences between the hydrological methods. It should also be noted that the 0.1% AEP peak flow has been derived using the ratio method, i.e. the ratio between the 1.0% and 0.1% AEP peak flows output from ReFH2 has been used to scale the 1.0% AEP flow derived using the FEH Statistical Method.
How will hydrograph shapes be derived?	The hydrograph shapes will be derived using ReFH2.

7.3 Assumptions, Limitations and Uncertainty

List the main assumptions made	The FEH Web Service CDs accurately reflect the subject catchment. There is no net import/export of water from the catchment associated with the sewers serving the urbanised areas within the catchment. ReFH2 is representative of the hydrological regimes within the subject catchment. The donor stations and pooling group are representative of the hydrological regime within the subject catchment.
Discuss any particular limitations	The subject catchment is ungauged and there is therefore more uncertainty associated with the peak flow estimates.
Provide information on the uncertainty in the design peak flow estimates and the methodology	The donor adjusted factorial standard error for the QMED estimate is 1.38. The factorial standard errors reported in the WHS ReFH2 Science Report – Calibration and Evaluation of the ReFH2.3-FEH22 Design Event Model for the 1.0% and 0.1% AEP events are 1.45 and 1.51 respectively.
Comment on the suitability of the results for future studies	The hydrological assessment has been undertaken to inform a hydraulic modelling study of the bridge that has been constructed over the River Clywedog and may not be suitable for assessing flood risk in other parts of the catchment.

7.4 Checks

Are the results consistent, for example at confluences?	n/a
What do the results imply regarding the frequency of flooding during the period of record?	n/a
What is the range of 1.0% AEP growth factors?	Statistical Method = 2.79 ReFH2 = 2.64
If 0.1% AEP flows have been derived, what is the range of ratios to the 1.0% AEP flows?	Statistical Method = 1.44 ReFH2 = 1.50
How do the results compare with those of other studies?	n/a
Are the results compatible with the flood history?	n/a

7.5 Climate Change Allowances

The current Welsh Government guidance on climate change allowances (March 2026) advises that the River Clywedog catchment is located within the Dee River Basin District. The Central and Upper peak river flow allowances for the Dee River Basin District are +25% and +50% (2080s) respectively.

7.6 Final Results

Site code	Peak flow (m^3/s) for the following AEP events							
	50.0%	**3.3%**	**1.0%**	**1.0% +CC25%**	**1.0% +CC50%**	**0.1%**	**0.1% +CC25%**	**0.1% +CC50%**
CW_01	13.85	30.77	38.67	48.34	58.01	55.63	69.53	83.44

APPENDIX A

WINFAP Report

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Date of creation:	12-05-2026 10:14:08
Software:	WINFAP Version: 5.3.9575 (10310)
Peak Flow dataset:	Peak Flow Dataset 14.0.1
Method:	2025
Supplementary data used:	No

Site details

Site number:	3279039446
Site name:	FEH_Catchment_Descriptors_338350_348900_v5_1_0
Site location:	SJ 38350 48900
Easting:	338350
Northing:	348900
Catchment area:	86.01 km²
SAAR9120:	917 mm
BFIHOST19scaled:	0.518
FPEXT:	0.062
FARL2015:	0.993
URBEXT2015:	0.1270

Site data

At-site data

At-site data present: No

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Analysis settings

Urbanisation settings

User defined: No
URBEXT: 0.12700
UAF: 1.23316

Growth curve settings

Pooling group URBEXT Threshold: 0.300
Deurbanise Pooling Group L-moments: Yes

QMED settings

Use at-site data: No
Method: Donor Station(s)

Growth curve data and results

Pooling group AM data

Station	Distance	Years of data	QMED AM	L-CV Observed	L-CV Deurbanised	L-SKEW Observed	L-SKEW Deurbanised
7010 (Muckle Burn @ Brodie)	0.400	19	17.674	0.219	**0.219**	0.153	**0.153**
69012 (Bollin @ Wilmslow)	0.544	57	17.458	0.227	**0.250**	0.260	**0.260**
52004 (Isle @ Ashford Mill)	0.574	59	35.806	0.206	**0.210**	0.035	**0.035**
52010 (Brue @ Lovington)	0.584	60	37.574	0.278	**0.281**	0.338	**0.338**
51001 (Doniford Stream @ Swill Bridge)	0.586	56	13.094	0.311	**0.314**	0.352	**0.352**
20005 (Birns Water @ Saltoun Hall)	0.618	44	18.215	0.303	**0.304**	0.222	**0.222**
67009 (Alyn @ Rhydymwyn)	0.633	68	8.780	0.290	**0.291**	0.359	**0.359**
53013 (Marden @ Stanley)	0.652	52	13.908	0.251	**0.257**	0.243	**0.243**
20007 (Gifford Water @ Lennoxlove)	0.656	51	17.280	0.304	**0.305**	0.175	**0.175**
21016 (Eye Water @ Eyemouth Mill)	0.677	57	40.306	0.304	**0.306**	0.202	**0.202**
205020 (Enler @ Comber)	0.683	41	19.459	0.187	**0.194**	0.232	**0.232**
39025 (Enborne @ Brimpton)	0.707	57	16.600	0.201	**0.205**	0.178	**0.178**
53017 (Boyd @ Bitton)	0.714	51	13.946	0.235	**0.239**	0.084	**0.084**
27059 (Laver @ Ripon Laver Weir)	0.740	47	22.169	0.222	**0.224**	0.286	**0.286**
41022 (Lod @ Halfway Bridge)	0.770	54	16.755	0.290	**0.292**	0.157	**0.157**
53023 (Sherston Avon @ Fosseway)	0.783	48	7.396	0.231	**0.232**	0.133	**0.133**
Total		**821**					

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Pooling group AM data - Non-flood Years

Station	Distance	Years of data	L-CV Observed NFY	L-CV Deurbanised NFY	L-SKEW Observed NFY	L-SKEW Deurbanised NFY
7010 (Muckle Burn @ Brodie)	0.400	18	0.198	**0.198**	0.238	**0.238**
69012 (Bollin @ Wilmslow)	0.544	56	0.223	**0.246**	0.271	**0.271**
52004 (Isle @ Ashford Mill)	0.574	57	0.199	**0.203**	0.049	**0.049**
52010 (Brue @ Lovington)	0.584	58	0.275	**0.277**	0.344	**0.344**
51001 (Doniford Stream @ Swill Bridge)	0.586	51	0.290	**0.293**	0.403	**0.403**
20005 (Birns Water @ Saltoun Hall)	0.618	39	0.275	**0.276**	0.276	**0.276**
67009 (Alyn @ Rhydymwyn)	0.633	64	0.278	**0.280**	0.389	**0.389**
53013 (Marden @ Stanley)	0.652	51	0.243	**0.249**	0.271	**0.271**
20007 (Gifford Water @ Lennoxlove)	0.656	44	0.280	**0.281**	0.203	**0.203**
21016 (Eye Water @ Eyemouth Mill)	0.677	48	0.259	**0.261**	0.297	**0.297**
205020 (Enler @ Comber)	0.683	40	0.179	**0.186**	0.270	**0.270**
39025 (Enborne @ Brimpton)	0.707	57	0.201	**0.205**	0.178	**0.178**
53017 (Boyd @ Bitton)	0.714	44	0.207	**0.211**	0.131	**0.131**
27059 (Laver @ Ripon Laver Weir)	0.740	47	0.222	**0.224**	0.286	**0.286**
41022 (Lod @ Halfway Bridge)	0.770	50	0.276	**0.278**	0.174	**0.174**
53023 (Sherston Avon @ Fosseway)	0.783	43	0.209	**0.210**	0.182	**0.182**
Total		**767**				

Pooling group suitability

Station	Suitability for QMED	Suitability for pooling	Years	Non-flood years	Percentage non-flood years	Mann Kendall (MK)	MK significance (%)	Discordancy	Comments
7010 (Muckle Burn @ Brodie)	Yes	Yes	19	1	5.26			0.311	
69012 (Bollin @ Wilmslow)	Yes	Yes	57	1	1.75	1.95	10	0.545	
52004 (Isle @ Ashford Mill)	Yes	Yes	59	2	3.39	0.58	None	1.368	
52010 (Brue @ Lovington)	Yes	Yes	60	2	3.33	1.14	None	0.856	
51001 (Doniford Stream @ Swill Bridge)	Yes	Yes	56	5	8.93	0.59	None	1.483	
20005 (Birns Water @ Saltoun Hall)	Yes	Yes	44	5	11.36	0.49	None	0.531	
67009 (Alyn @ Rhydymwyn)	Yes	Yes	68	4	5.88	1.29	None	1.072	
53013 (Marden @ Stanley)	Yes	Yes	52	1	1.92	1.63	None	0.092	
20007 (Gifford Water @ Lennoxlove)	Yes	Yes	51	7	13.73	1.86	10	1.021	
21016 (Eye Water @ Eyemouth Mill)	Yes	Yes	57	9	15.79	2.57	5	1.074	
205020 (Enler @ Comber)	Yes	Yes	41	1	2.44	2.76	5	1.798	
39025 (Enborne @ Brimpton)	Yes	Yes	57	0	0.00	-1.20	None	1.281	
53017 (Boyd @ Bitton)	Yes	Yes	51	7	13.73	0.80	None	1.067	
27059 (Laver @ Ripon Laver Weir)	Yes	Yes	47	0	0.00	1.27	None	0.984	
41022 (Lod @ Halfway Bridge)	Yes	Yes	54	4	7.41	1.13	None	1.951	
53023 (Sherston Avon @ Fosseway)	Yes	Yes	48	5	10.42	0.20	None	0.566	

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Pooling group catchment descriptors

Station	Area	SAAR9120	FPEXT	FARL2015	URBEXT2015	BFIHOST19scaled
7010 (Muckle Burn @ Brodie)	80.675	881	0.065	0.986	0.001	0.597
69012 (Bollin @ Wilmslow)	68.382	988	0.079	0.965	0.153	0.529
52004 (Isle @ Ashford Mill)	87.412	970	0.084	0.983	0.034	0.455
52010 (Brue @ Lovington)	137.865	915	0.082	0.997	0.012	0.508
51001 (Doniford Stream @ Swill Bridge)	74.228	1009	0.038	0.990	0.015	0.559
20005 (Birns Water @ Saltoun Hall)	92.600	858	0.030	0.995	0.005	0.542
67009 (Alyn @ Rhydymwyn)	81.595	1020	0.033	0.987	0.006	0.527
53013 (Marden @ Stanley)	99.460	810	0.073	0.983	0.036	0.584
20007 (Gifford Water @ Lennoxlove)	67.780	867	0.029	0.977	0.006	0.516
21016 (Eye Water @ Eyemouth Mill)	118.865	837	0.036	1.000	0.009	0.544
205020 (Enler @ Comber)	61.395	983	0.064	1.000	0.060	0.432
39025 (Enborne @ Brimpton)	142.010	835	0.075	0.986	0.032	0.562
53017 (Boyd @ Bitton)	47.580	898	0.050	0.960	0.023	0.503
27059 (Laver @ Ripon Laver Weir)	78.438	975	0.045	0.984	0.013	0.418
41022 (Lod @ Halfway Bridge)	52.438	935	0.061	0.978	0.013	0.427
53023 (Sherston Avon @ Fosseway)	77.728	897	0.070	1.000	0.010	0.725

Pooling Group Rejected Stations

Station	Distance	Years of data	QMED AM	L-CV Observed	L-CV Deurbanised	L-SKEW Observed	L-SKEW Deurbanised	Comments
206001 (Clanrye @ Mountmill Bridge)	0.780	49	19.990	0.213	0.215	0.254	0.254	

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Growth curve L-moments

Rural L-CV:	0.260	Urban L-CV:	0.239
Rural L-Skewness:	0.216	Urban L-Skewness:	0.216
Rural L-CV NFY:	0.245	Urban L-CV NFY:	0.226
Rural L-Skewness NFY:	0.249	Urban L-Skewness NFY:	0.249

Rural fitted parameters

Distribution	Location	Scale	Shape	H	Bound
GEV	0.856	0.388	-0.070		-4.682
P3	0.284	0.352	2.356		0.284
GL NFY	1.000	0.244	-0.249		0.019

Urban fitted parameters

Distribution	Location	Scale	Shape	H	Bound
GEV	0.868	0.354	-0.070		-4.194
P3	0.346	0.322	2.356		0.346
GL NFY	1.000	0.223	-0.249		0.103

Goodness of fit

GL:	2.9033
GEV:	0.5407 *
P3:	-1.6028 *
GP:	-5.0051
KAP3:	2.0737
GL NFY:	4.4783

** Distribution gives an acceptable fit (absolute Z value < 1.645)*

Heterogeneity

Standardised test value H2: 2.9456

The pooling group is heterogeneous and a review of the pooling group is desirable.

Heterogeneity NFY

Standardised test value H2: 2.7154

The pooling group is heterogeneous and a review of the pooling group is desirable.

Standardised growth curves

Rural

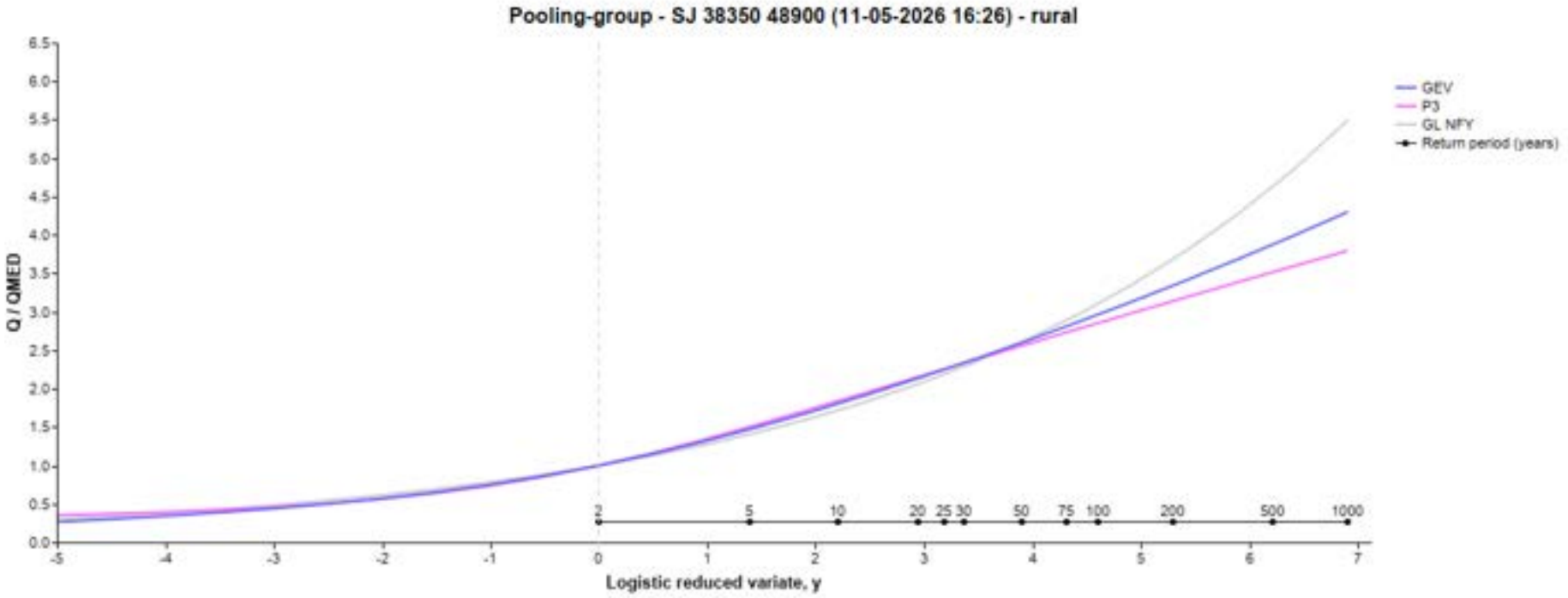
Return period	GEV	P3	GL NFY
2	1.000	1.000	1.000
5	1.469	1.503	1.404
10	1.801	1.838	1.714
20	2.136	2.155	2.061
25	2.246	2.254	2.183
30	2.337	2.334	2.288
50	2.596	2.556	2.604
75	2.807	2.729	2.884
100	2.961	2.851	3.099
200	3.342	3.140	3.684
500	3.875	3.515	4.627
1000	4.301	3.795	5.496

Urban

Return period	GEV	P3	GL NFY
2	1.000	1.000	1.000
5	1.429	1.459	1.370
10	1.732	1.766	1.653
20	2.039	2.055	1.970
25	2.139	2.146	2.082
30	2.222	2.219	2.177
50	2.459	2.422	2.467
75	2.652	2.580	2.722
100	2.792	2.691	2.919
200	3.141	2.955	3.453
500	3.628	3.298	4.315
1000	4.017	3.554	5.110

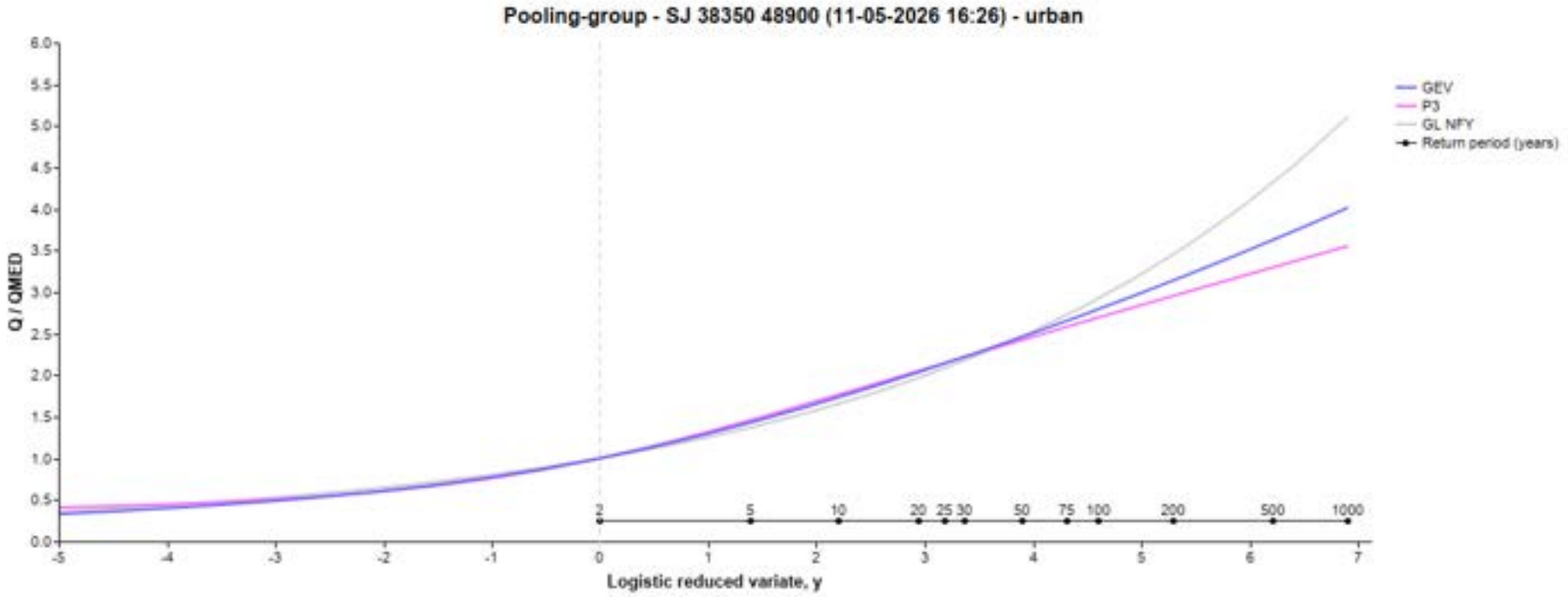
UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method



UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method



UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

QMED data and results

Donor selection criteria

Only sites suitable for QMED:	Yes
URBEXT2015:	<0.300
Donor adjusted FSE:	1.377
No. of donors:	8

Donor stations

Station	Distance	Use QMED obs deurbanised	QMED obs	QMED deurbanised	QMED CDs urban	QMED CDs rural	QMED ratio
67008 (Alyn @ Pont-y-Capel)	12.10	Yes	21.740	**20.265**	43.072	40.150	0.505
67009 (Alyn @ Rhydymwyn)	13.93	Yes	8.780	**8.685**	19.605	19.605	0.443
67005 (Ceiriog @ Brynkinalt Weir)	18.02	Yes	31.010	**30.842**	59.320	59.320	0.520
66005 (Clwyd @ Ruthin Weir)	20.30	Yes	16.629	**16.430**	28.433	28.433	0.578
54020 (Perry @ Yeaton)	21.59	Yes	10.653	**10.042**	17.762	17.762	0.565
66001 (Clwyd @ Pont-y-Cambwll)	23.70	Yes	50.626	**49.502**	68.959	68.959	0.718
68020 (Gowy @ Bridge Trafford)	26.23	Yes	15.374	**14.589**	17.221	17.221	0.847
66004 (Wheeler @ Bodfari)	26.79	Yes	3.739	**3.638**	9.036	9.036	0.403

Donor suitability

Station	Suitability for QMED	Suitability for pooling	Years	Non-flood years	Percentage non-flood years	Mann Kendall (MKZ)	MKZ significance (%)	Comments
67008 (Alyn @ Pont-y-Capel)	Yes	Yes	58	0	0.00	-0.58	None	
67009 (Alyn @ Rhydymwyn)	Yes	Yes	68	4	5.88	1.29	None	
67005 (Ceiriog @ Brynkinalt Weir)	Yes	No	27	0	0.00	0.65	None	
66005 (Clwyd @ Ruthin Weir)	Yes	No	48	1	2.08	1.80	10	
54020 (Perry @ Yeaton)	Yes	Yes	61	2	3.28	-0.56	None	
66001 (Clwyd @ Pont-y-Cambwll)	Yes	No	48	1	2.08	0.67	None	
68020 (Gowy @ Bridge Trafford)	Yes	No	45	3	6.67	-0.48	None	
66004 (Wheeler @ Bodfari)	Yes	No	47	2	4.26	1.35	None	

Donor catchment descriptors

Station	Area	Centroid X	Centroid Y	SAAR9120	FPEXT	FARL2015	URBEXT2015	BFIHOST19Scaled
FEH_Catchment_Descriptors_338350_348900_v5_1_0 @ SJ 38350 48900)	86.010	329940	349142	917	0.062	0.993	0.127	0.518
67008 (Alyn @ Pont-y-Capel)	225.653	323013	359066	958	0.048	0.992	0.040	0.541
67009 (Alyn @ Rhydymwyn)	81.595	319020	357784	1020	0.033	0.987	0.006	0.527
67005 (Ceiriog @ Brynkinalt Weir)	111.718	317500	336107	1338	0.023	1.000	0.004	0.402
66005 (Clwyd @ Ruthin Weir)	96.392	309817	351811	1027	0.037	0.996	0.008	0.471
54020 (Perry @ Yeaton)	188.077	337383	328872	789	0.190	0.986	0.028	0.606
66001 (Clwyd @ Pont-y-Cambwll)	404.558	309230	360665	973	0.057	0.995	0.013	0.539
68020 (Gowy @ Bridge Trafford)	148.657	351376	364257	748	0.146	0.998	0.029	0.542
66004 (Wheeler @ Bodfari)	62.905	315144	371478	911	0.028	0.983	0.013	0.613

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Unused Donor stations

Station	Distance	URBEXT2015	Use QMED obs deurbanised	QMED obs	QMED deurbanised	QMED CDs urban	QMED CDs rural	QMED ratio	Centroid X	Centroid Y	Area	SAAR9120	BFIHOST19Scaled	FARL2015	Years of data	Comments
54038 (Tanat @ Llanyblodwel)	27.90	0.003	Yes	79.323	**78.988**	109.461	109.461	0.722	312720	327196	241.125	1386	0.427	0.995	51	
67015 (Dee @ Manley Hall)	28.35	0.007	Yes	227.000	**225.135**	376.139	376.139	0.599	303097	340024	1008.740	1513	0.386	0.932	55	

QMED

Rural: 11.230 m³/s

Urban: 13.849 m³/s

UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

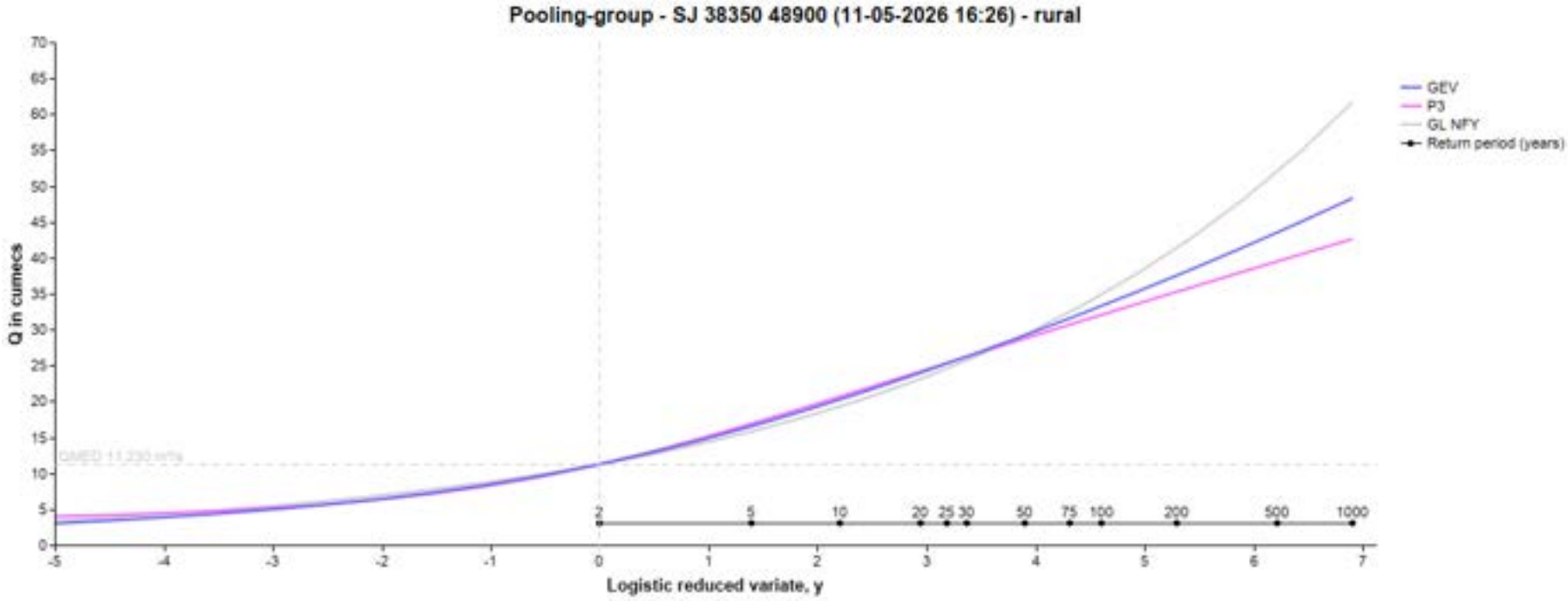
Flood Frequency Curve

Rural Flood Frequency Curve

Return period	GEV (m³/s)	P3 (m³/s)	GL NFY (m³/s)
2	11.230	11.230	11.230
5	16.501	16.875	15.772
10	20.228	20.640	19.253
20	23.992	24.199	23.146
25	25.226	25.315	24.519
30	26.244	26.217	25.692
50	29.154	28.708	29.246
75	31.527	30.653	32.385
100	33.249	32.018	34.803
200	37.533	35.264	41.371
500	43.514	39.480	51.958
1000	48.297	42.624	61.721

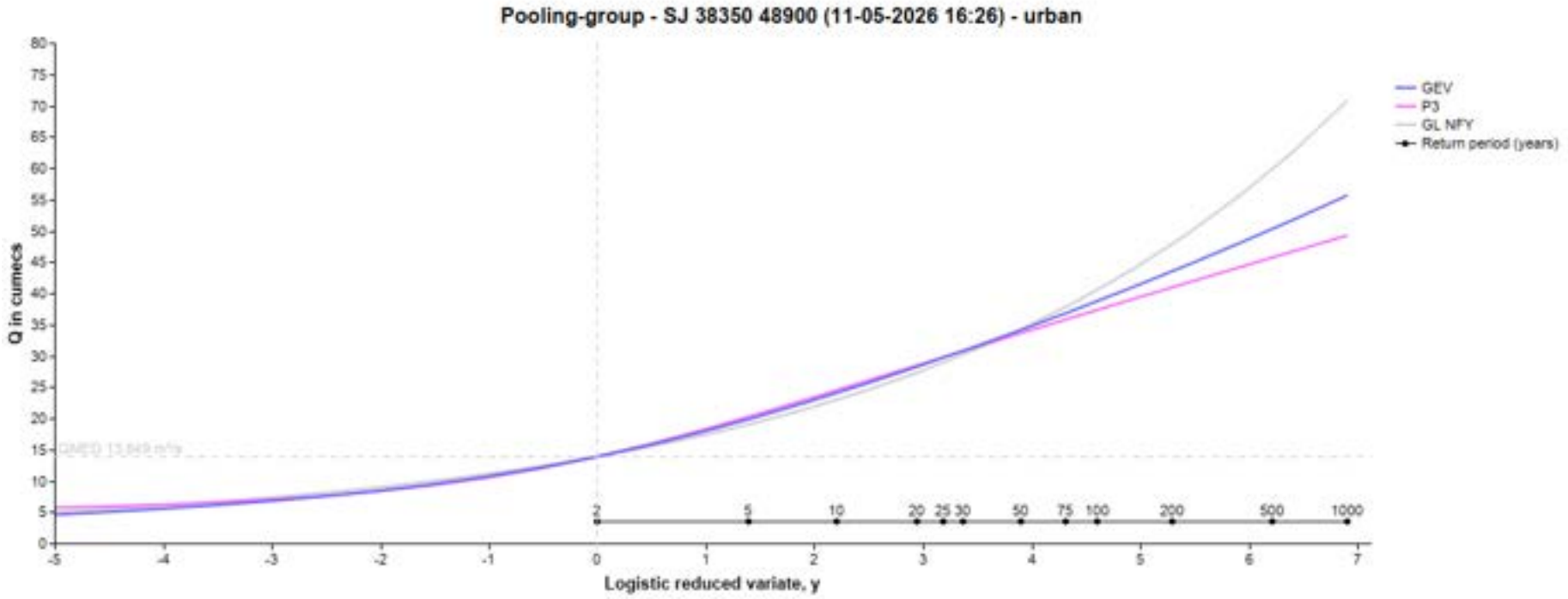
Urban Flood Frequency Curve

Return period	GEV (m³/s)	P3 (m³/s)	GL NFY (m³/s)
2	13.849	13.849	13.849
5	19.790	20.209	18.968
10	23.991	24.452	22.892
20	28.234	28.462	27.281
25	29.625	29.718	28.829
30	30.773	30.735	30.151
50	34.053	33.542	34.159
75	36.728	35.733	37.697
100	38.669	37.271	40.423
200	43.498	40.929	47.826
500	50.240	45.679	59.761
1000	55.631	49.221	70.767



UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

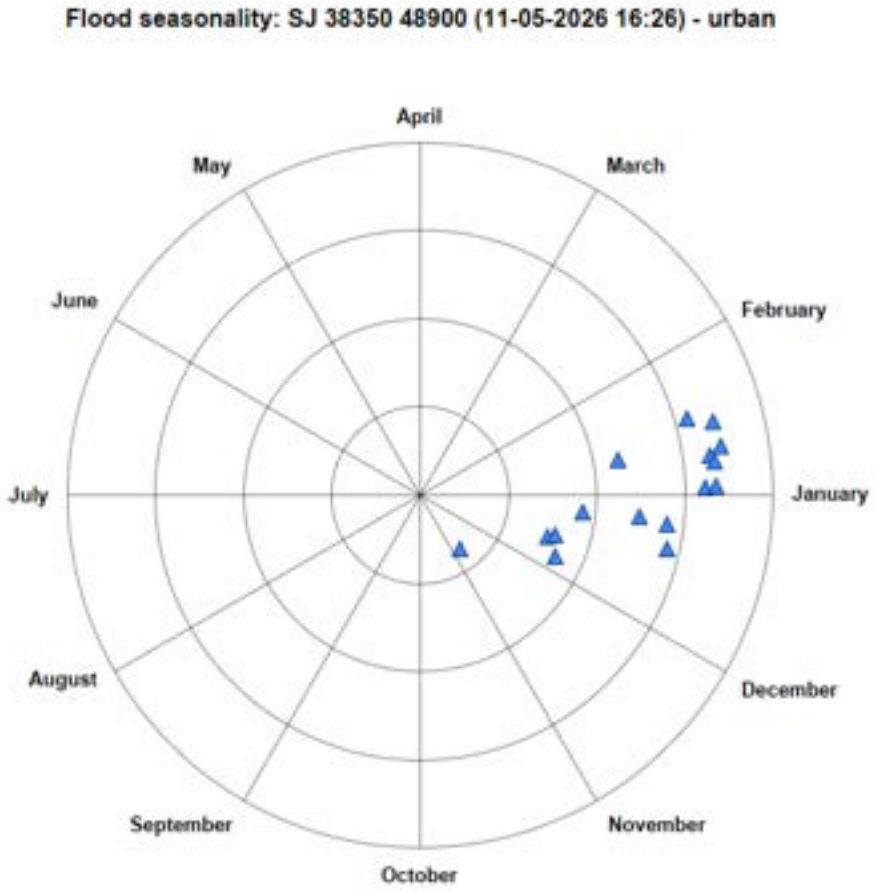


UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

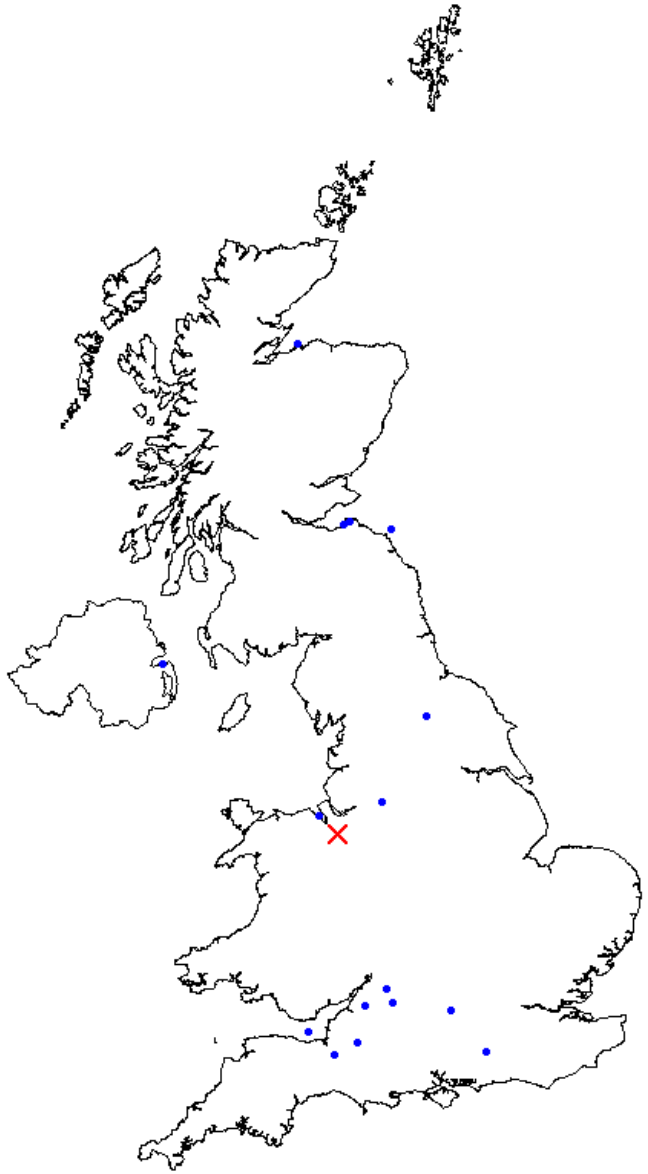
Appendix

Station record parameters



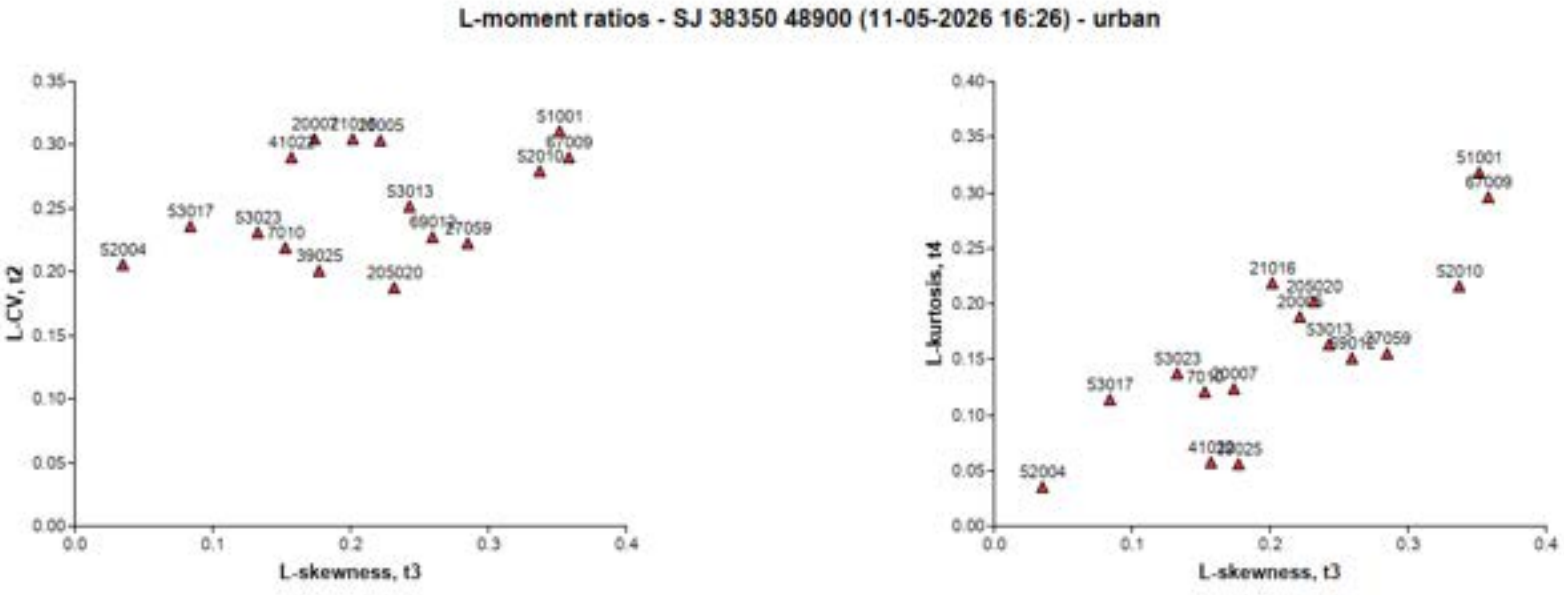
UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method



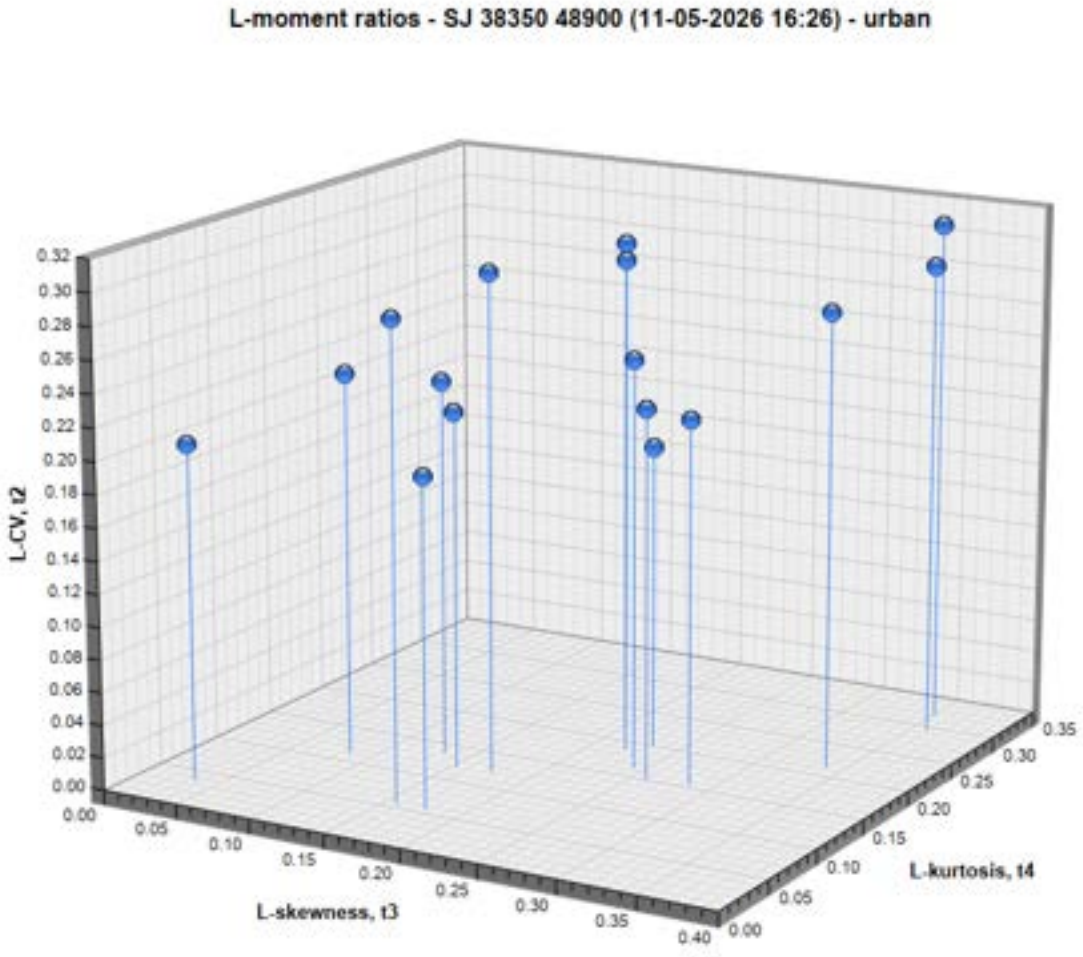
UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method



UK Design Flood Estimation

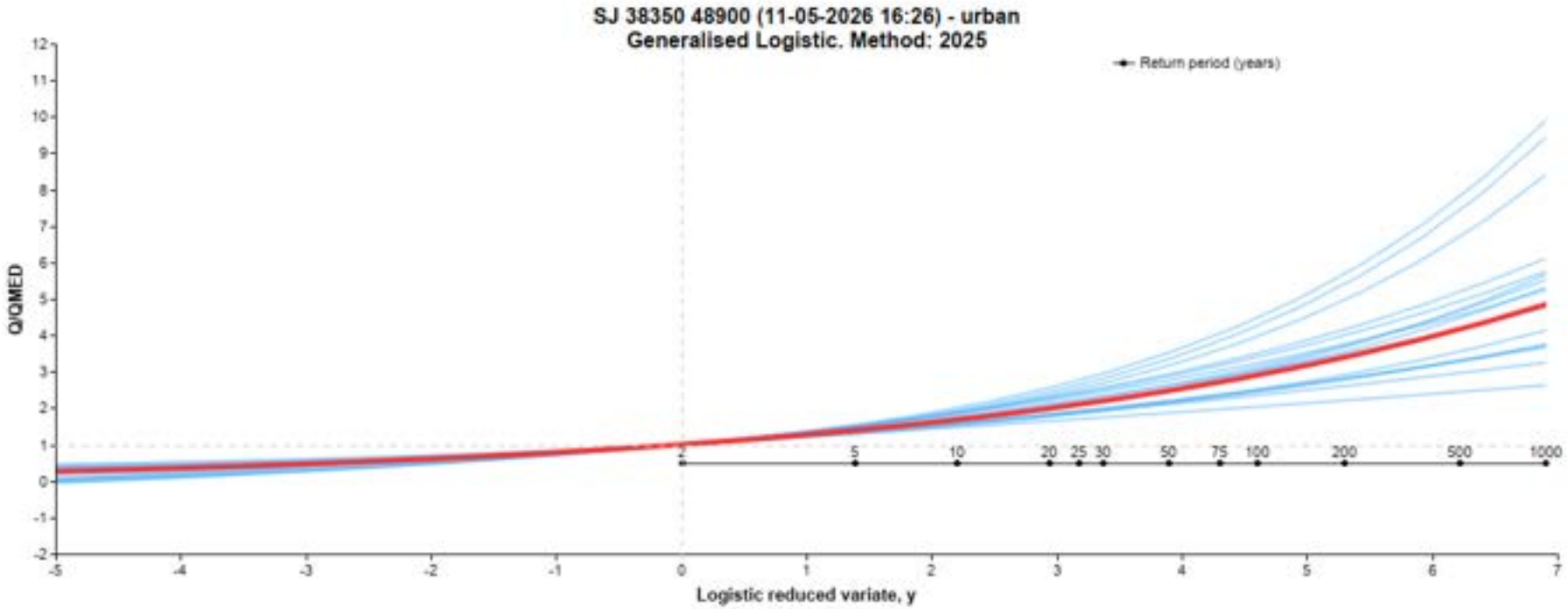
Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method



UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

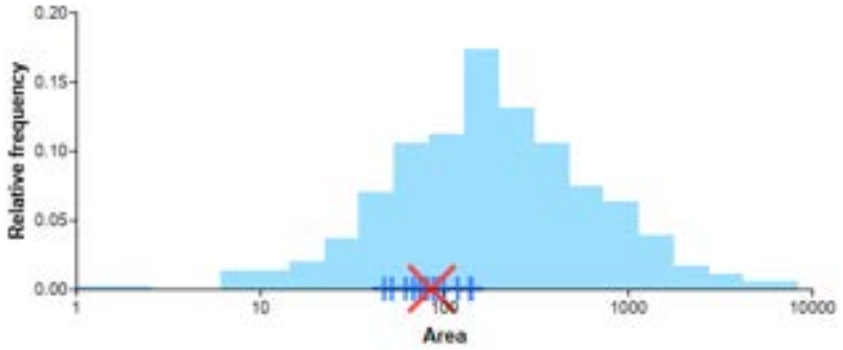
Pooling group growth curves

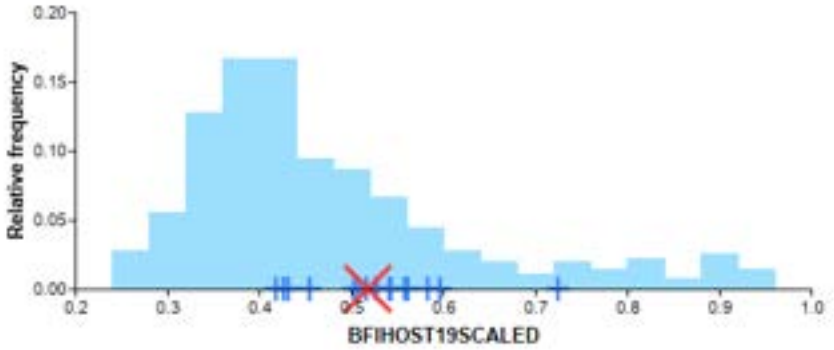


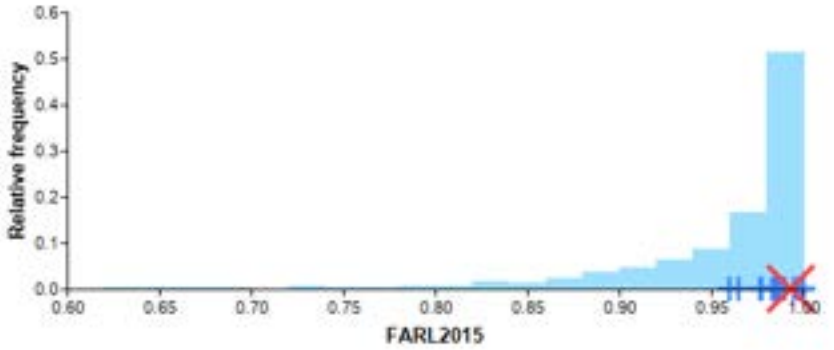
UK Design Flood Estimation

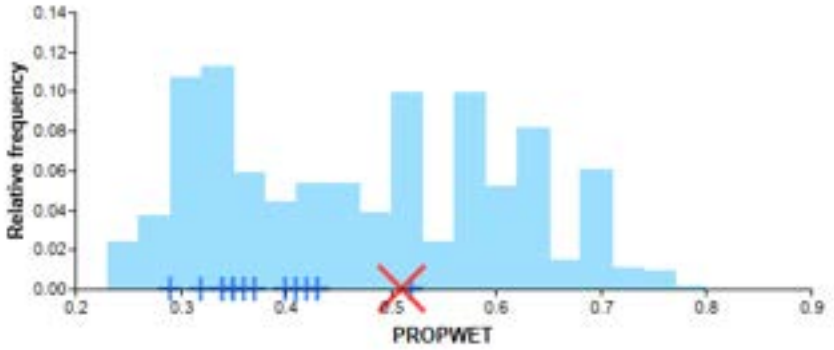
Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Catchment descriptors



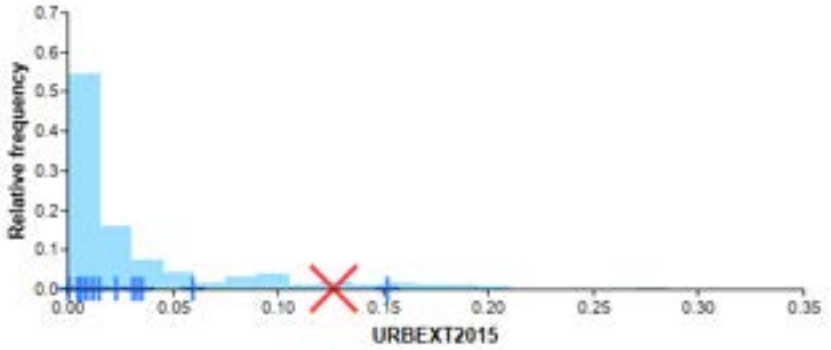


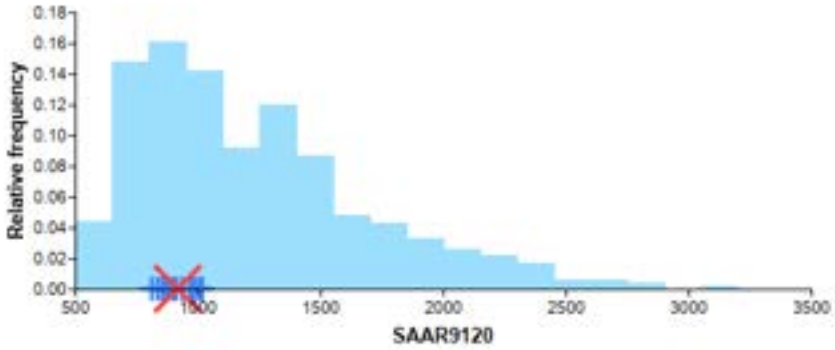


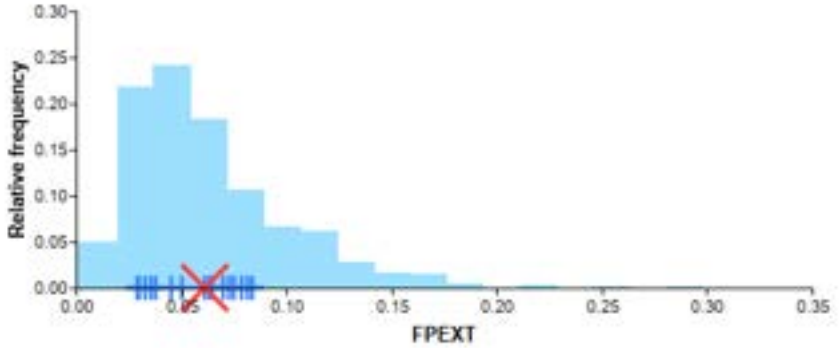


UK Design Flood Estimation

Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method







APPENDIX B

ReFH2 Reports – 1.0% AEP event

UK Design Flood Estimation

Generated on Tuesday, May 12, 2026 11:23:57 AM by ModellingMold
Printed from the ReFH2 Flood Modelling software package, version 4.0.8560.23190

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: 098D-99E1

Site name: FEH_Catchment_Descriptors_338350_348900_v5_1_0 - URBEXT2015

Easting: 338350

Northing: 348900

Country: England, Wales or Northern Ireland

Catchment Area (km²): 86.01

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH22 (mm):	75.96	Total runoff (ML):	1502.77
Total Rainfall (mm):	53.15	Total flow (ML):	4494.09
		Peak flow (m³/s):	52.87
Peak Rainfall (mm):	7.25		

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH22)

Name	Value	User-defined?
Duration (hh:mm:ss)	09:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.76	No
ARF (Areal reduction factor)	0.92	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	87.35	No
Cmax (mm)	393.98	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	4.84	No
Up	0.65	No

Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	2.36	No
BL (hr)	50.25	No
BR	2.4	No

Urbanisation parameters

Name	Value	User-defined?
Sewer capacity (m^3/s)	0	No
Exporting drained area (km^2)	0	No
Urban area (km^2)	17.12	No
Urbext 2000	0.13	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.601	0.000	0.157	0.000	2.171	2.171
00:30:00	0.812	0.000	0.217	0.033	2.149	2.182
01:00:00	1.094	0.000	0.295	0.143	2.129	2.272
01:30:00	1.472	0.000	0.402	0.360	2.112	2.472
02:00:00	1.976	0.000	0.547	0.721	2.099	2.821
02:30:00	2.647	0.000	0.748	1.280	2.094	3.374
03:00:00	3.531	0.000	1.024	2.107	2.098	4.206
03:30:00	4.684	0.000	1.404	3.301	2.118	5.419
04:00:00	6.135	0.000	1.919	4.981	2.160	7.141
04:30:00	7.247	0.000	2.383	7.294	2.233	9.526
05:00:00	6.135	0.000	2.116	10.410	2.348	12.758
05:30:00	4.684	0.000	1.676	14.299	2.520	16.819
06:00:00	3.531	0.000	1.298	18.751	2.759	21.510
06:30:00	2.647	0.000	0.993	23.525	3.074	26.599
07:00:00	1.976	0.000	0.752	28.382	3.469	31.851
07:30:00	1.472	0.000	0.566	33.078	3.946	37.024
08:00:00	1.094	0.000	0.424	37.350	4.503	41.854
08:30:00	0.812	0.000	0.317	40.912	5.135	46.047
09:00:00	0.601	0.000	0.236	43.523	5.832	49.355
09:30:00	0.000	0.000	0.000	45.063	6.579	51.642
10:00:00	0.000	0.000	0.000	45.429	7.356	52.785
10:30:00	0.000	0.000	0.000	44.728	8.141	52.869
11:00:00	0.000	0.000	0.000	43.203	8.913	52.116
11:30:00	0.000	0.000	0.000	41.085	9.656	50.742
12:00:00	0.000	0.000	0.000	38.574	10.360	48.933
12:30:00	0.000	0.000	0.000	35.829	11.014	46.843
13:00:00	0.000	0.000	0.000	32.954	11.615	44.569
13:30:00	0.000	0.000	0.000	30.038	12.158	42.196
14:00:00	0.000	0.000	0.000	27.183	12.643	39.826
14:30:00	0.000	0.000	0.000	24.451	13.071	37.521
15:00:00	0.000	0.000	0.000	21.930	13.445	35.375
15:30:00	0.000	0.000	0.000	19.619	13.770	33.390
16:00:00	0.000	0.000	0.000	17.488	14.051	31.539
16:30:00	0.000	0.000	0.000	15.512	14.292	29.804
17:00:00	0.000	0.000	0.000	13.679	14.494	28.173
17:30:00	0.000	0.000	0.000	11.981	14.661	26.641
18:00:00	0.000	0.000	0.000	10.428	14.794	25.222
18:30:00	0.000	0.000	0.000	9.021	14.894	23.916
19:00:00	0.000	0.000	0.000	7.740	14.964	22.704
19:30:00	0.000	0.000	0.000	6.560	15.005	21.565
20:00:00	0.000	0.000	0.000	5.462	15.017	20.480
20:30:00	0.000	0.000	0.000	4.443	15.003	19.445
21:00:00	0.000	0.000	0.000	3.507	14.963	18.470
21:30:00	0.000	0.000	0.000	2.671	14.900	17.571

22:00:00	0.000	0.000	0.000	1.956	14.817	16.772
22:30:00	0.000	0.000	0.000	1.387	14.717	16.104
23:00:00	0.000	0.000	0.000	0.959	14.604	15.563
23:30:00	0.000	0.000	0.000	0.642	14.482	15.124
24:00:00	0.000	0.000	0.000	0.413	14.353	14.766
24:30:00	0.000	0.000	0.000	0.251	14.220	14.471
25:00:00	0.000	0.000	0.000	0.140	14.085	14.225
25:30:00	0.000	0.000	0.000	0.068	13.948	14.017
26:00:00	0.000	0.000	0.000	0.025	13.812	13.837
26:30:00	0.000	0.000	0.000	0.005	13.675	13.680
27:00:00	0.000	0.000	0.000	0.000	13.540	13.540
27:30:00	0.000	0.000	0.000	0.000	13.406	13.406
28:00:00	0.000	0.000	0.000	0.000	13.273	13.273
28:30:00	0.000	0.000	0.000	0.000	13.142	13.142
29:00:00	0.000	0.000	0.000	0.000	13.012	13.012
29:30:00	0.000	0.000	0.000	0.000	12.883	12.883
30:00:00	0.000	0.000	0.000	0.000	12.755	12.755
30:30:00	0.000	0.000	0.000	0.000	12.629	12.629
31:00:00	0.000	0.000	0.000	0.000	12.504	12.504
31:30:00	0.000	0.000	0.000	0.000	12.380	12.380
32:00:00	0.000	0.000	0.000	0.000	12.258	12.258
32:30:00	0.000	0.000	0.000	0.000	12.136	12.136
33:00:00	0.000	0.000	0.000	0.000	12.016	12.016
33:30:00	0.000	0.000	0.000	0.000	11.897	11.897
34:00:00	0.000	0.000	0.000	0.000	11.779	11.779
34:30:00	0.000	0.000	0.000	0.000	11.663	11.663
35:00:00	0.000	0.000	0.000	0.000	11.547	11.547
35:30:00	0.000	0.000	0.000	0.000	11.433	11.433
36:00:00	0.000	0.000	0.000	0.000	11.320	11.320
36:30:00	0.000	0.000	0.000	0.000	11.208	11.208
37:00:00	0.000	0.000	0.000	0.000	11.097	11.097
37:30:00	0.000	0.000	0.000	0.000	10.987	10.987
38:00:00	0.000	0.000	0.000	0.000	10.878	10.878
38:30:00	0.000	0.000	0.000	0.000	10.771	10.771
39:00:00	0.000	0.000	0.000	0.000	10.664	10.664
39:30:00	0.000	0.000	0.000	0.000	10.558	10.558
40:00:00	0.000	0.000	0.000	0.000	10.454	10.454
40:30:00	0.000	0.000	0.000	0.000	10.350	10.350
41:00:00	0.000	0.000	0.000	0.000	10.248	10.248
41:30:00	0.000	0.000	0.000	0.000	10.146	10.146
42:00:00	0.000	0.000	0.000	0.000	10.046	10.046
42:30:00	0.000	0.000	0.000	0.000	9.946	9.946
43:00:00	0.000	0.000	0.000	0.000	9.848	9.848
43:30:00	0.000	0.000	0.000	0.000	9.750	9.750
44:00:00	0.000	0.000	0.000	0.000	9.654	9.654
44:30:00	0.000	0.000	0.000	0.000	9.558	9.558
45:00:00	0.000	0.000	0.000	0.000	9.464	9.464

45:30:00	0.000	0.000	0.000	0.000	9.370	9.370
46:00:00	0.000	0.000	0.000	0.000	9.277	9.277
46:30:00	0.000	0.000	0.000	0.000	9.185	9.185
47:00:00	0.000	0.000	0.000	0.000	9.095	9.095
47:30:00	0.000	0.000	0.000	0.000	9.004	9.004
48:00:00	0.000	0.000	0.000	0.000	8.915	8.915
48:30:00	0.000	0.000	0.000	0.000	8.827	8.827
49:00:00	0.000	0.000	0.000	0.000	8.740	8.740
49:30:00	0.000	0.000	0.000	0.000	8.653	8.653
50:00:00	0.000	0.000	0.000	0.000	8.567	8.567
50:30:00	0.000	0.000	0.000	0.000	8.483	8.483
51:00:00	0.000	0.000	0.000	0.000	8.399	8.399
51:30:00	0.000	0.000	0.000	0.000	8.316	8.316
52:00:00	0.000	0.000	0.000	0.000	8.233	8.233
52:30:00	0.000	0.000	0.000	0.000	8.152	8.152
53:00:00	0.000	0.000	0.000	0.000	8.071	8.071
53:30:00	0.000	0.000	0.000	0.000	7.991	7.991
54:00:00	0.000	0.000	0.000	0.000	7.912	7.912
54:30:00	0.000	0.000	0.000	0.000	7.834	7.834
55:00:00	0.000	0.000	0.000	0.000	7.756	7.756
55:30:00	0.000	0.000	0.000	0.000	7.679	7.679
56:00:00	0.000	0.000	0.000	0.000	7.603	7.603
56:30:00	0.000	0.000	0.000	0.000	7.528	7.528
57:00:00	0.000	0.000	0.000	0.000	7.453	7.453
57:30:00	0.000	0.000	0.000	0.000	7.380	7.380
58:00:00	0.000	0.000	0.000	0.000	7.307	7.307
58:30:00	0.000	0.000	0.000	0.000	7.234	7.234
59:00:00	0.000	0.000	0.000	0.000	7.163	7.163
59:30:00	0.000	0.000	0.000	0.000	7.092	7.092
60:00:00	0.000	0.000	0.000	0.000	7.022	7.022
60:30:00	0.000	0.000	0.000	0.000	6.952	6.952
61:00:00	0.000	0.000	0.000	0.000	6.883	6.883
61:30:00	0.000	0.000	0.000	0.000	6.815	6.815
62:00:00	0.000	0.000	0.000	0.000	6.748	6.748
62:30:00	0.000	0.000	0.000	0.000	6.681	6.681
63:00:00	0.000	0.000	0.000	0.000	6.615	6.615
63:30:00	0.000	0.000	0.000	0.000	6.549	6.549
64:00:00	0.000	0.000	0.000	0.000	6.484	6.484
64:30:00	0.000	0.000	0.000	0.000	6.420	6.420
65:00:00	0.000	0.000	0.000	0.000	6.357	6.357
65:30:00	0.000	0.000	0.000	0.000	6.294	6.294
66:00:00	0.000	0.000	0.000	0.000	6.231	6.231
66:30:00	0.000	0.000	0.000	0.000	6.170	6.170
67:00:00	0.000	0.000	0.000	0.000	6.109	6.109
67:30:00	0.000	0.000	0.000	0.000	6.048	6.048
68:00:00	0.000	0.000	0.000	0.000	5.988	5.988
68:30:00	0.000	0.000	0.000	0.000	5.929	5.929

69:00:00	0.000	0.000	0.000	0.000	5.870	5.870
69:30:00	0.000	0.000	0.000	0.000	5.812	5.812
70:00:00	0.000	0.000	0.000	0.000	5.755	5.755
70:30:00	0.000	0.000	0.000	0.000	5.698	5.698
71:00:00	0.000	0.000	0.000	0.000	5.641	5.641
71:30:00	0.000	0.000	0.000	0.000	5.585	5.585
72:00:00	0.000	0.000	0.000	0.000	5.530	5.530
72:30:00	0.000	0.000	0.000	0.000	5.475	5.475
73:00:00	0.000	0.000	0.000	0.000	5.421	5.421
73:30:00	0.000	0.000	0.000	0.000	5.367	5.367
74:00:00	0.000	0.000	0.000	0.000	5.314	5.314
74:30:00	0.000	0.000	0.000	0.000	5.262	5.262
75:00:00	0.000	0.000	0.000	0.000	5.210	5.210
75:30:00	0.000	0.000	0.000	0.000	5.158	5.158
76:00:00	0.000	0.000	0.000	0.000	5.107	5.107
76:30:00	0.000	0.000	0.000	0.000	5.056	5.056
77:00:00	0.000	0.000	0.000	0.000	5.006	5.006
77:30:00	0.000	0.000	0.000	0.000	4.957	4.957
78:00:00	0.000	0.000	0.000	0.000	4.908	4.908
78:30:00	0.000	0.000	0.000	0.000	4.859	4.859
79:00:00	0.000	0.000	0.000	0.000	4.811	4.811
79:30:00	0.000	0.000	0.000	0.000	4.763	4.763
80:00:00	0.000	0.000	0.000	0.000	4.716	4.716
80:30:00	0.000	0.000	0.000	0.000	4.670	4.670
81:00:00	0.000	0.000	0.000	0.000	4.623	4.623
81:30:00	0.000	0.000	0.000	0.000	4.578	4.578
82:00:00	0.000	0.000	0.000	0.000	4.532	4.532
82:30:00	0.000	0.000	0.000	0.000	4.487	4.487
83:00:00	0.000	0.000	0.000	0.000	4.443	4.443
83:30:00	0.000	0.000	0.000	0.000	4.399	4.399
84:00:00	0.000	0.000	0.000	0.000	4.355	4.355
84:30:00	0.000	0.000	0.000	0.000	4.312	4.312
85:00:00	0.000	0.000	0.000	0.000	4.270	4.270
85:30:00	0.000	0.000	0.000	0.000	4.227	4.227
86:00:00	0.000	0.000	0.000	0.000	4.185	4.185
86:30:00	0.000	0.000	0.000	0.000	4.144	4.144
87:00:00	0.000	0.000	0.000	0.000	4.103	4.103
87:30:00	0.000	0.000	0.000	0.000	4.062	4.062
88:00:00	0.000	0.000	0.000	0.000	4.022	4.022
88:30:00	0.000	0.000	0.000	0.000	3.982	3.982
89:00:00	0.000	0.000	0.000	0.000	3.943	3.943
89:30:00	0.000	0.000	0.000	0.000	3.904	3.904
90:00:00	0.000	0.000	0.000	0.000	3.865	3.865
90:30:00	0.000	0.000	0.000	0.000	3.827	3.827
91:00:00	0.000	0.000	0.000	0.000	3.789	3.789
91:30:00	0.000	0.000	0.000	0.000	3.752	3.752
92:00:00	0.000	0.000	0.000	0.000	3.714	3.714

92:30:00	0.000	0.000	0.000	0.000	3.678	3.678
93:00:00	0.000	0.000	0.000	0.000	3.641	3.641
93:30:00	0.000	0.000	0.000	0.000	3.605	3.605
94:00:00	0.000	0.000	0.000	0.000	3.569	3.569
94:30:00	0.000	0.000	0.000	0.000	3.534	3.534
95:00:00	0.000	0.000	0.000	0.000	3.499	3.499
95:30:00	0.000	0.000	0.000	0.000	3.464	3.464
96:00:00	0.000	0.000	0.000	0.000	3.430	3.430
96:30:00	0.000	0.000	0.000	0.000	3.396	3.396
97:00:00	0.000	0.000	0.000	0.000	3.363	3.363
97:30:00	0.000	0.000	0.000	0.000	3.329	3.329
98:00:00	0.000	0.000	0.000	0.000	3.296	3.296
98:30:00	0.000	0.000	0.000	0.000	3.264	3.264
99:00:00	0.000	0.000	0.000	0.000	3.231	3.231
99:30:00	0.000	0.000	0.000	0.000	3.199	3.199
100:00:00	0.000	0.000	0.000	0.000	3.168	3.168
100:30:00	0.000	0.000	0.000	0.000	3.136	3.136
101:00:00	0.000	0.000	0.000	0.000	3.105	3.105
101:30:00	0.000	0.000	0.000	0.000	3.075	3.075
102:00:00	0.000	0.000	0.000	0.000	3.044	3.044
102:30:00	0.000	0.000	0.000	0.000	3.014	3.014
103:00:00	0.000	0.000	0.000	0.000	2.984	2.984
103:30:00	0.000	0.000	0.000	0.000	2.955	2.955
104:00:00	0.000	0.000	0.000	0.000	2.925	2.925
104:30:00	0.000	0.000	0.000	0.000	2.896	2.896
105:00:00	0.000	0.000	0.000	0.000	2.868	2.868
105:30:00	0.000	0.000	0.000	0.000	2.839	2.839
106:00:00	0.000	0.000	0.000	0.000	2.811	2.811
106:30:00	0.000	0.000	0.000	0.000	2.783	2.783
107:00:00	0.000	0.000	0.000	0.000	2.756	2.756
107:30:00	0.000	0.000	0.000	0.000	2.729	2.729
108:00:00	0.000	0.000	0.000	0.000	2.702	2.702
108:30:00	0.000	0.000	0.000	0.000	2.675	2.675
109:00:00	0.000	0.000	0.000	0.000	2.648	2.648
109:30:00	0.000	0.000	0.000	0.000	2.622	2.622
110:00:00	0.000	0.000	0.000	0.000	2.596	2.596
110:30:00	0.000	0.000	0.000	0.000	2.570	2.570
111:00:00	0.000	0.000	0.000	0.000	2.545	2.545
111:30:00	0.000	0.000	0.000	0.000	2.520	2.520
112:00:00	0.000	0.000	0.000	0.000	2.495	2.495
112:30:00	0.000	0.000	0.000	0.000	2.470	2.470
113:00:00	0.000	0.000	0.000	0.000	2.446	2.446
113:30:00	0.000	0.000	0.000	0.000	2.421	2.421
114:00:00	0.000	0.000	0.000	0.000	2.398	2.398
114:30:00	0.000	0.000	0.000	0.000	2.374	2.374
115:00:00	0.000	0.000	0.000	0.000	2.350	2.350
115:30:00	0.000	0.000	0.000	0.000	2.327	2.327

116:00:00	0.000	0.000	0.000	0.000	2.304	2.304
116:30:00	0.000	0.000	0.000	0.000	2.281	2.281
117:00:00	0.000	0.000	0.000	0.000	2.259	2.259
117:30:00	0.000	0.000	0.000	0.000	2.236	2.236
118:00:00	0.000	0.000	0.000	0.000	2.214	2.214
118:30:00	0.000	0.000	0.000	0.000	2.192	2.192

Appendix

Catchment descriptors

Name	Value
Area (km^2)	86.01
ALTBAR	186
ASPBAR	93
ASPVAR	0.46
BFIHOST	0.53
BFIHOST19	0.52
DPLBAR (km)	13.74
DPSBAR (mkm^{-1})	68.4
FARL	0.99
LDP	24.94
PROPWET	0.51
RMED1H	10
RMED1D	34.7
RMED2D	43.4
SAAR (mm)	880
SAAR4170 (mm)	886
SPRHOST	36.02
Urbext2015	0.13
Urbext1990	0.07
URBCONC	0.85
URBLOC	0.83
DDF parameter C	-0.03
DDF parameter D1	0.37
DDF parameter D2	0.41
DDF parameter D3	0.32
DDF parameter E	0.29
DDF parameter F	2.41
DDF parameter C (1km grid value)	-0.03
DDF parameter D1 (1km grid value)	0.32
DDF parameter D2 (1km grid value)	0.41
DDF parameter D3 (1km grid value)	0.31
DDF parameter E (1km grid value)	0.29
DDF parameter F (1km grid value)	2.38

User-defined value used?
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No
No

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ANNEX D

Digital Model Files

Digital model files are available on request

ANNEX E

Model Results - Baseline



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Legend

Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Baseline Scenario - Maximum Flood Depths - 3.3% AEP event**

Map Orientation:

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Site boundary

Depth (m)

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- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Baseline Scenario - Maximum Flood Depths - 1.0% AEP event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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Site boundary

Depth (m)

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- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Drawing Title: **Baseline Scenario - Maximum Flood Depths - 0.1% AEP event**

Map Orientation:

Scale: 0 6 12 18 24

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- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Map Orientation:

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- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Drawing Title: **Baseline Scenario - Maximum Flood Depths - 1.0% AEP + 50% Climate Change event**

Map Orientation:

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Site boundary

Depth (m)

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- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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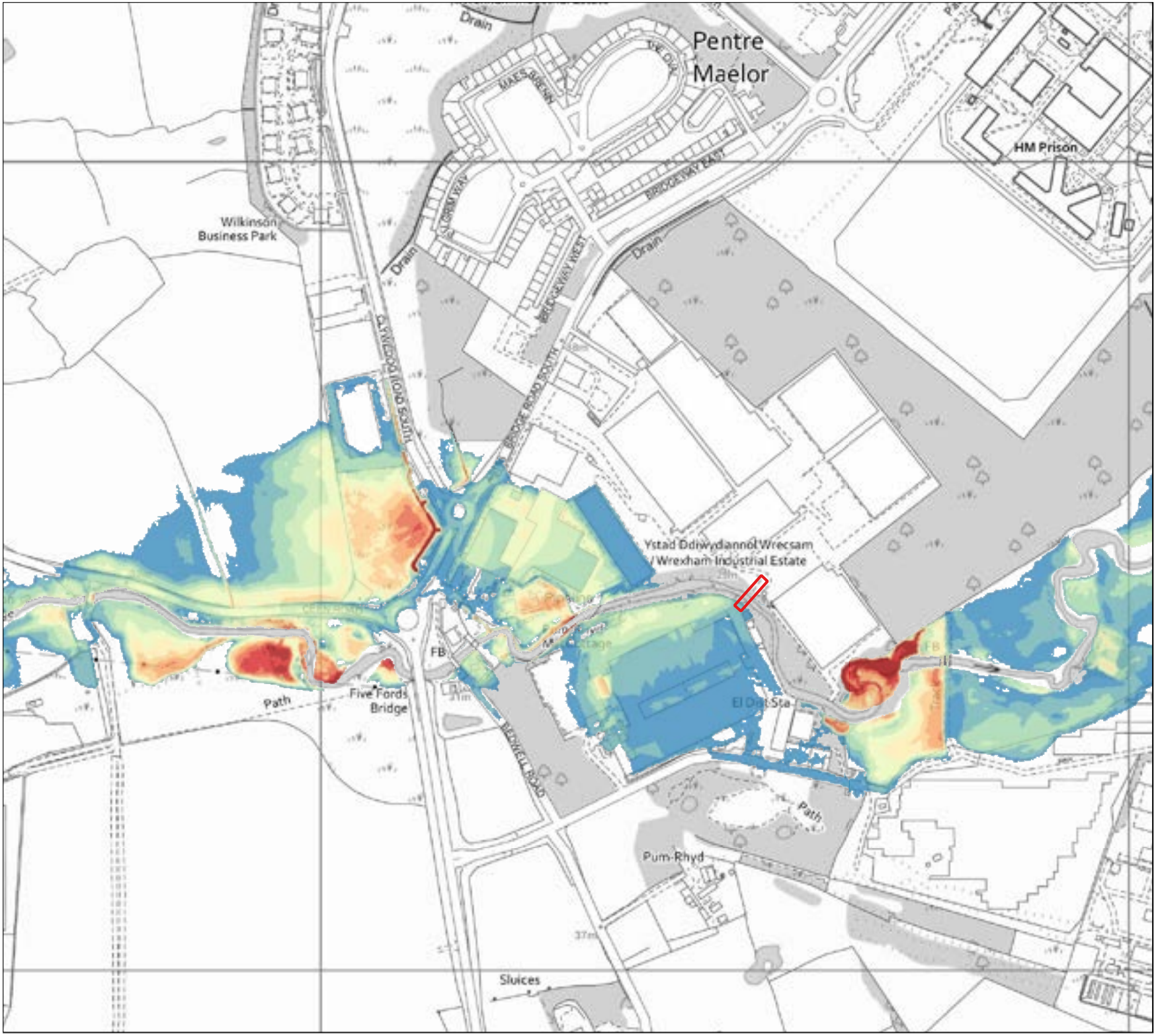
Drawing Title: **Baseline Scenario - Maximum Flood Depths - 0.1% AEP + 25% Climate Change event**

Map Orientation:

Scale: 0 6 12 18 24

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- Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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ANNEX F

Model Results - Sensitivity



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Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Sensitivity Analysis (+20% Manning's) - Maximum Flood Depths - 1.0% AEP + 25% Climate Change event**

Map Orientation:	Scale: 0 6 12 18 24	
Drawn: AB	Checked: AE	Date: 14 May 2026
Project No: 6577	Drawing No: 6577_044_Q0100CC25_plus20_d	Rev: A



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Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Sensitivity Analysis (-20% Manning's) - Maximum Flood Depths - 1.0% AEP + 25% Climate Change event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

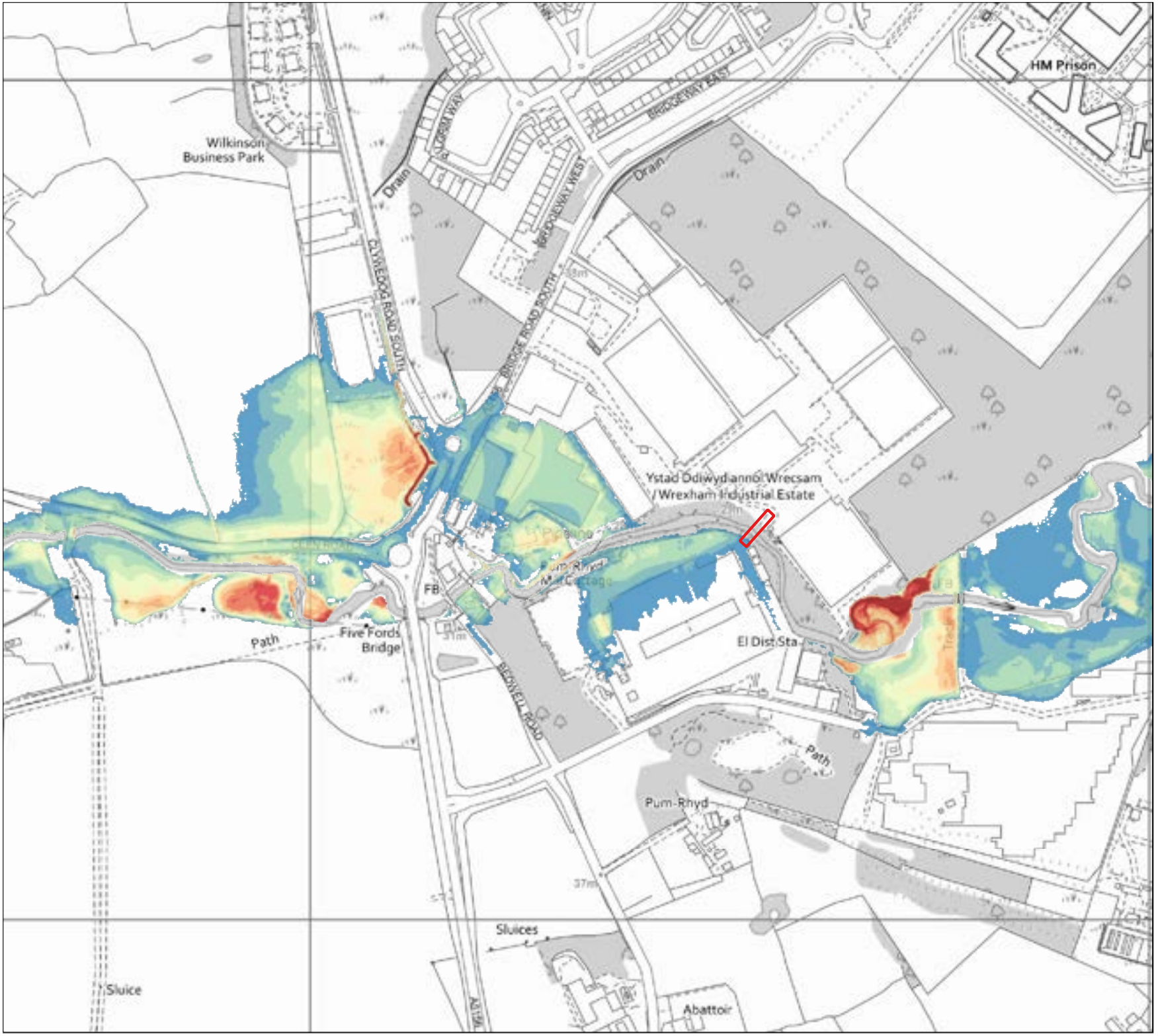
Drawing Title: **Sensitivity Analysis (Downstream Boundary) - Maximum Flood Depths - 1.0% AEP + 25% Climate Change event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
AB	AE	14 May 2026

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- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Drawing Title:
Sensitivity Analysis (ReFH2 Flows) - Maximum Flood Depths - 1.0% AEP + 25% Climate Change event

Map Orientation:	Scale: 0 6 12 18 24		
Drawn: AB	Checked: AE	Date: 14 May 2026	
Project No: 6577	Drawing No: 6577_044_Q0100CC25_REFH2_sens_d	Rev: A	

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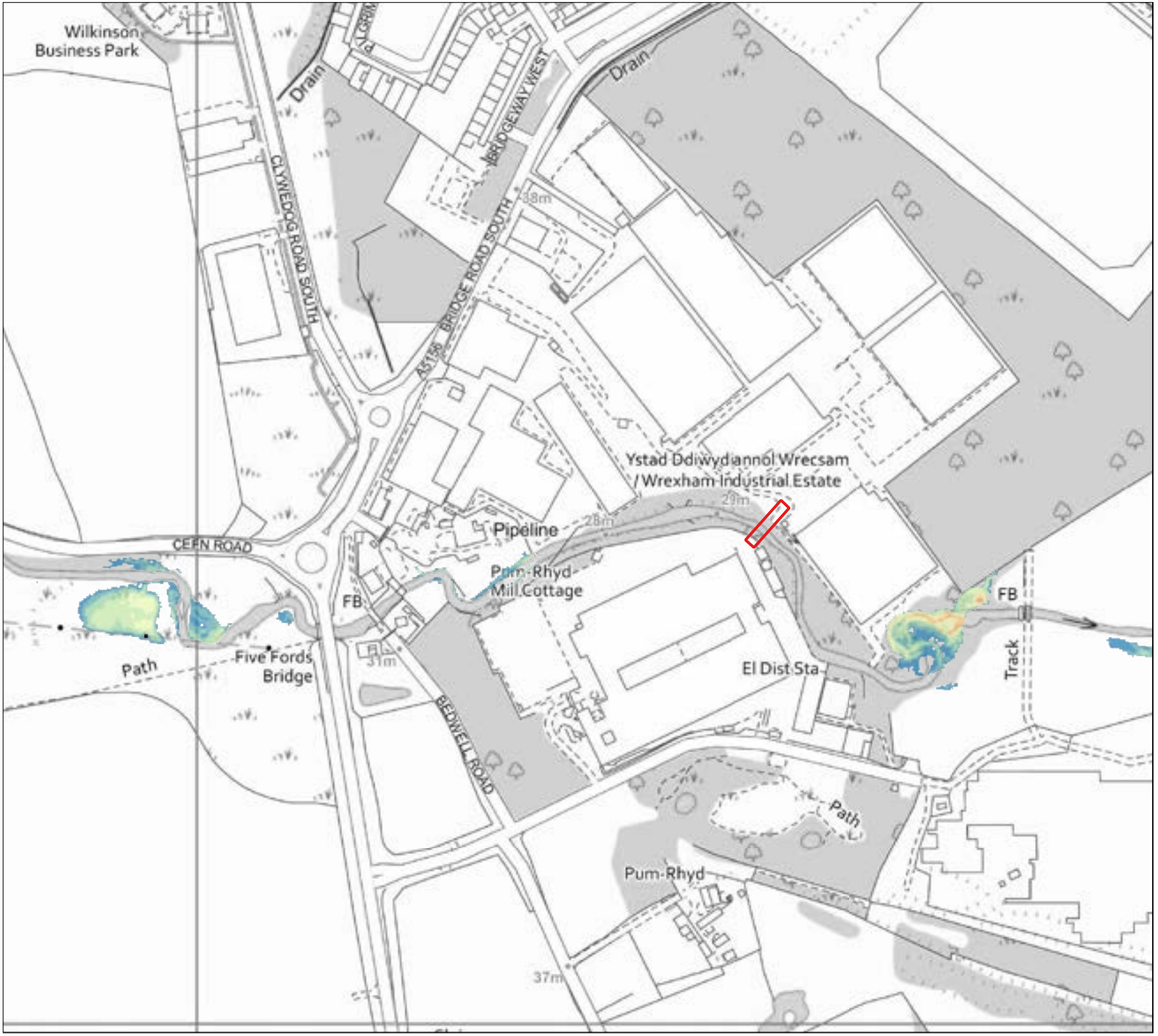
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APPENDIX C

Modelled Outputs - Post-Development (Proposed) Scenario



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Site boundary

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- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Proposed Scenario - Maximum Flood Depths - 3.3% AEP event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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Project No:	Drawing No:	Rev:
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Legend

- Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

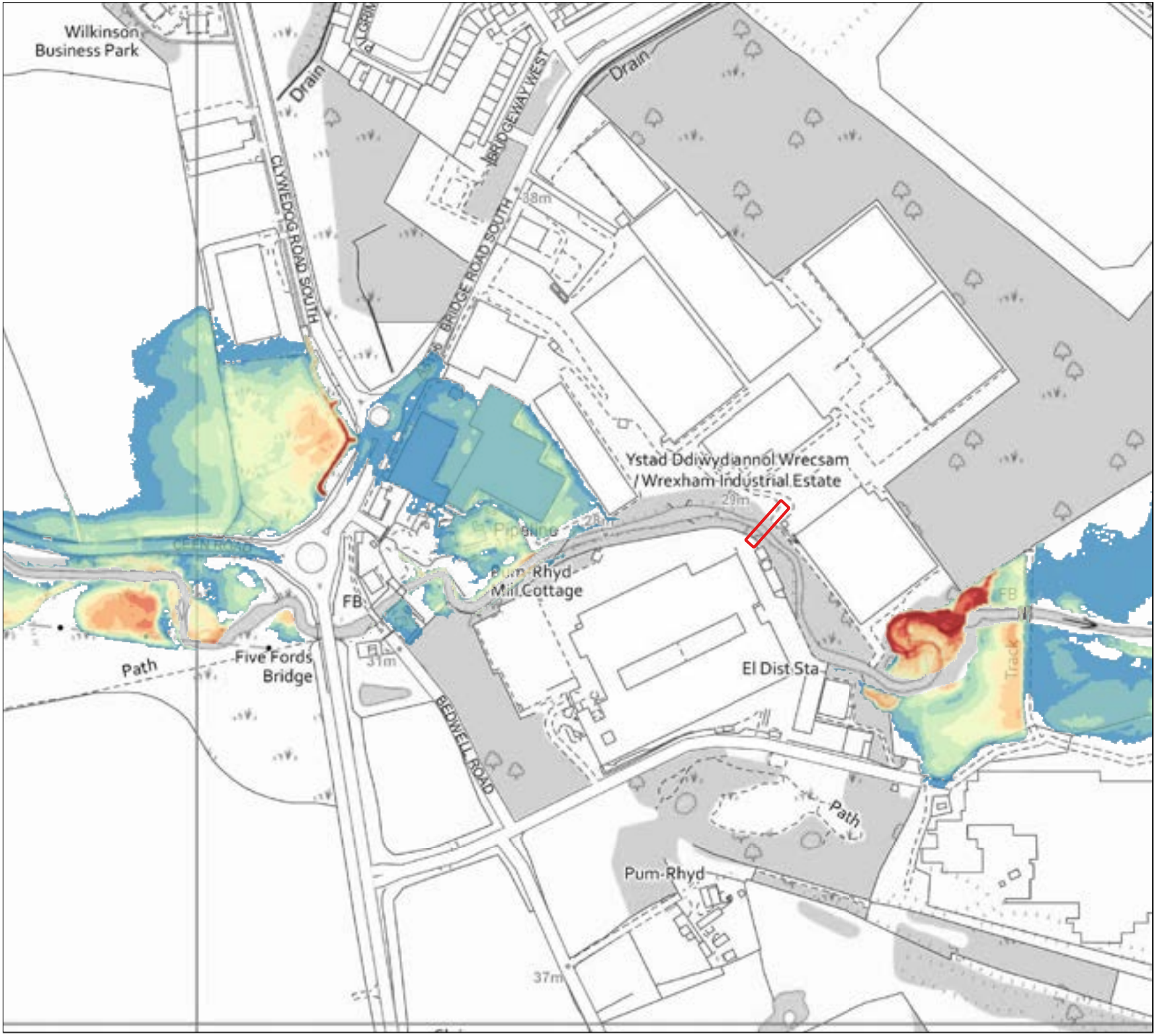
Drawing Title: **Proposed Scenario - Maximum Flood Depths - 1.0% AEP event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
AB	AE	14 May 2026

Project No:	Drawing No:	Rev:
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Legend

Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

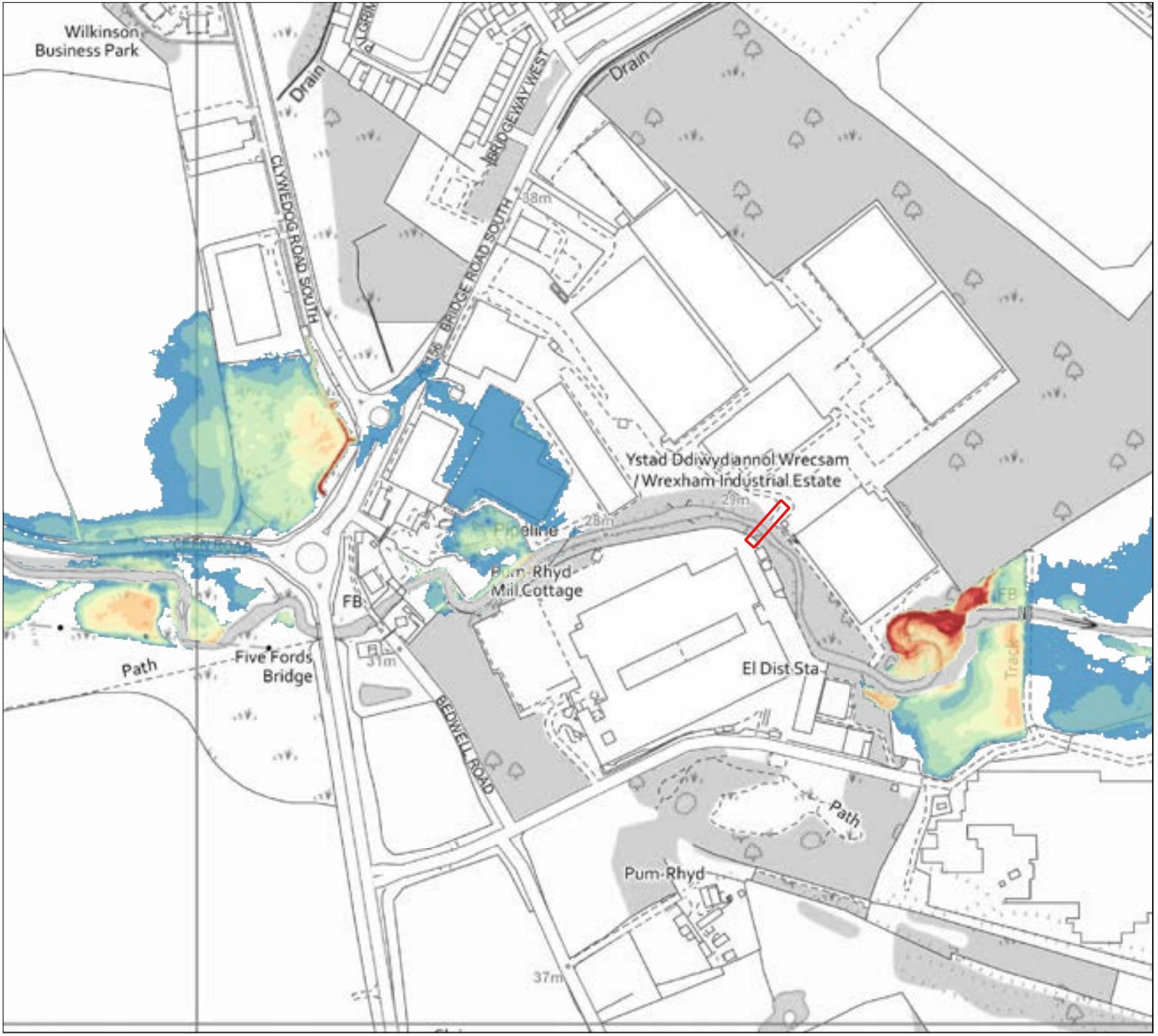
Drawing Title: **Proposed Scenario - Maximum Flood Depths - 0.1% AEP event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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Project No:	Drawing No:	Rev:
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Legend

Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title:
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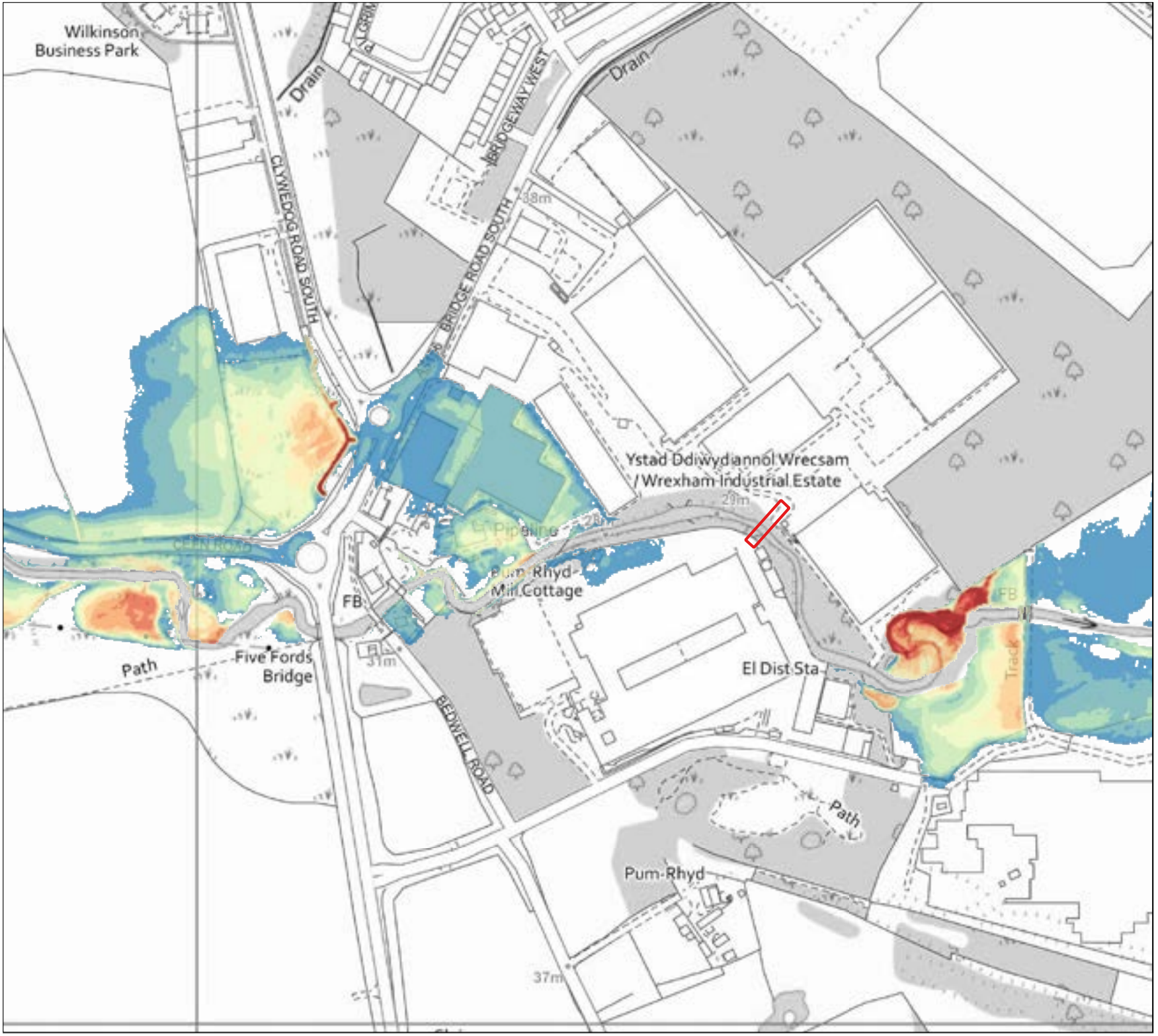
Drawing Title:
Proposed Scenario - Maximum Flood Depths - 1.0% AEP + 25% Climate Change event

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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Project No:	Drawing No:	Rev:
6577	6577_PD_045_Q0100CC25_d	A



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Legend

- Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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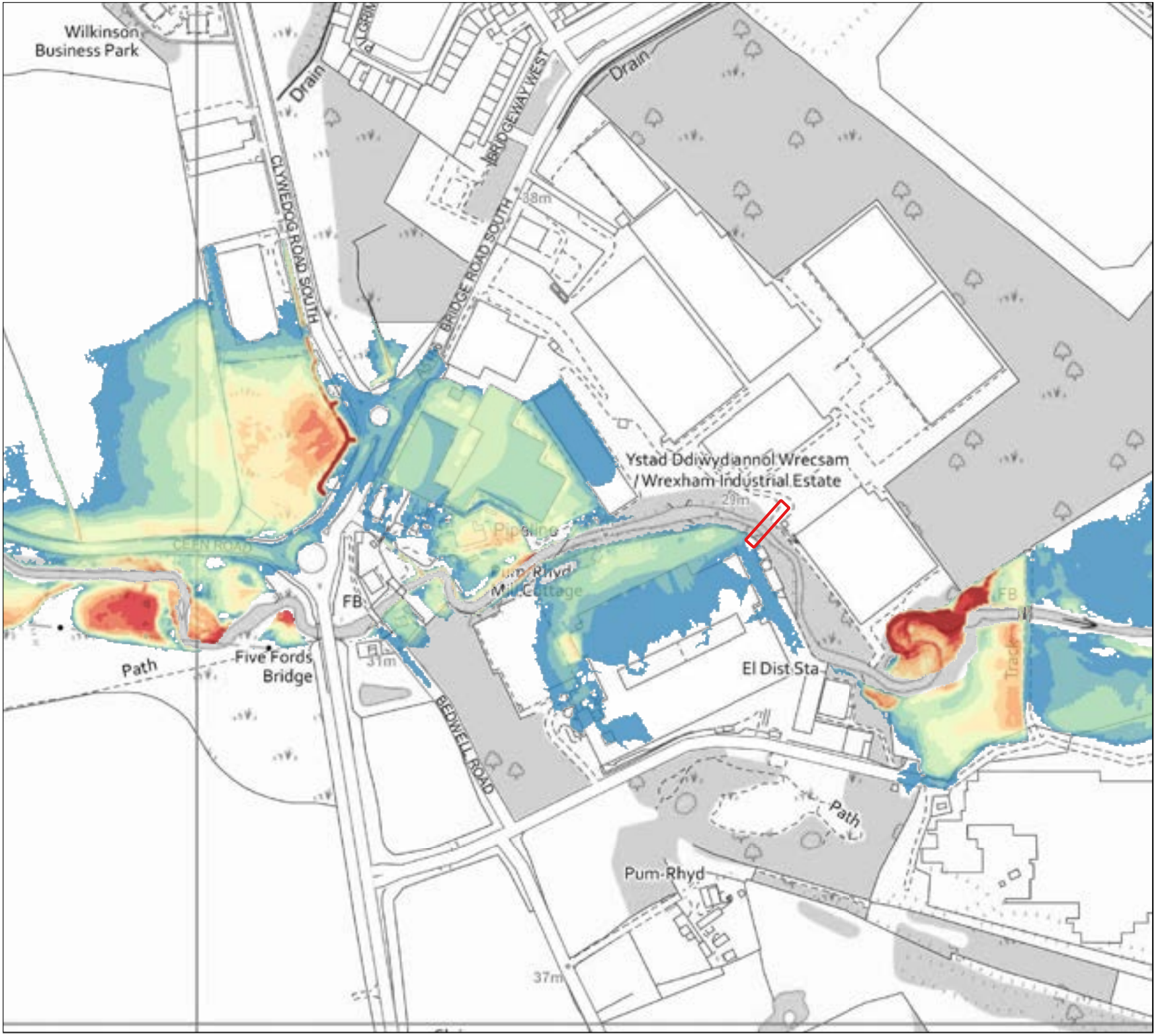
Drawing Title: **Proposed Scenario - Maximum Flood Depths - 1.0% AEP + 50% Climate Change event**

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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Legend

Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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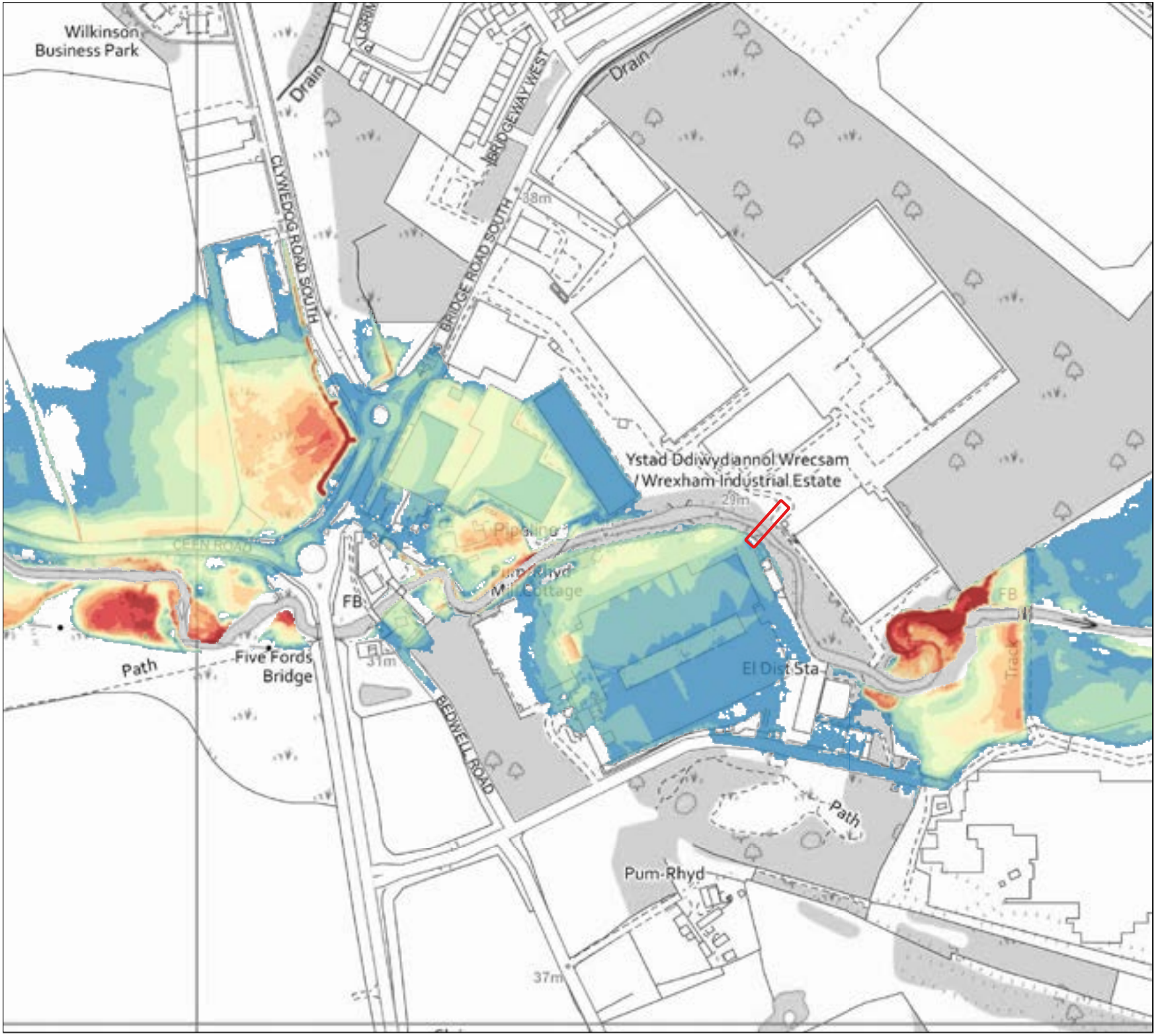
Drawing Title: **Proposed Scenario - Maximum Flood Depths - 0.1% AEP + 25% Climate Change event**

Map Orientation:

Scale: 0 6 12 18 24

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Site boundary

Depth (m)

- < 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.2
- 1.2 - 1.4
- 1.4 - 1.6
- 1.6 - 1.8
- 1.8 - 2.0
- > 2.0

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Proposed Scenario - Maximum Flood Depths - 0.1% AEP + 50% Climate Change event**

Map Orientation:

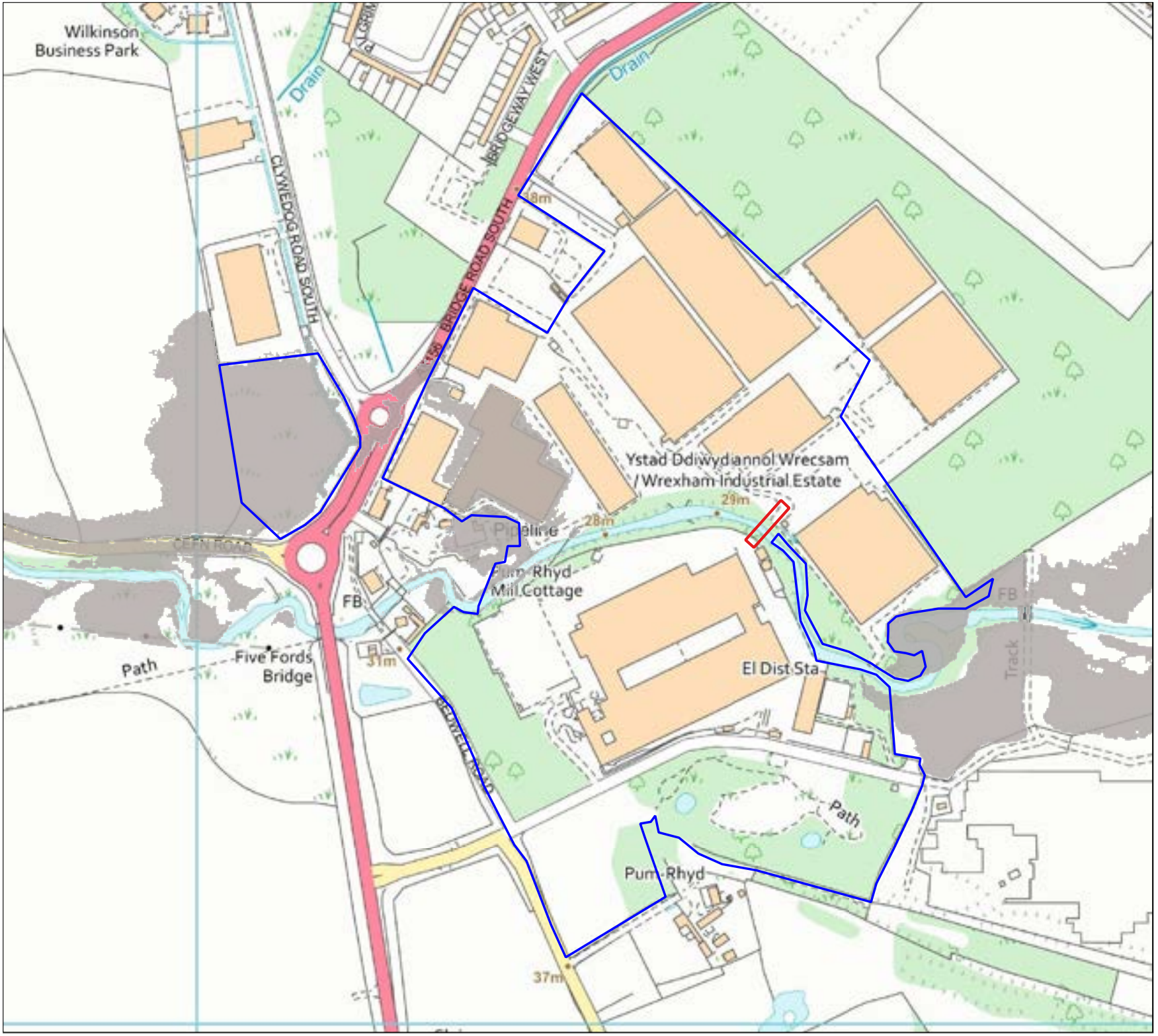
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APPENDIX D

Modelled Outputs - Pre-Development (Baseline) and Proposed Scenario Comparison



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Legend

- Site boundary
- Land Ownership

Change in Depth (m)

- Reduction < 0.3
- Reduction 0.3 to 0.1
- Reduction 0.1 to 0.03
- Reduction 0.03 to 0.01
- No Change
- Increase 0.01 to 0.03
- Increase 0.03 to 0.1
- Increase 0.1 to 0.3
- Increase > 0.3

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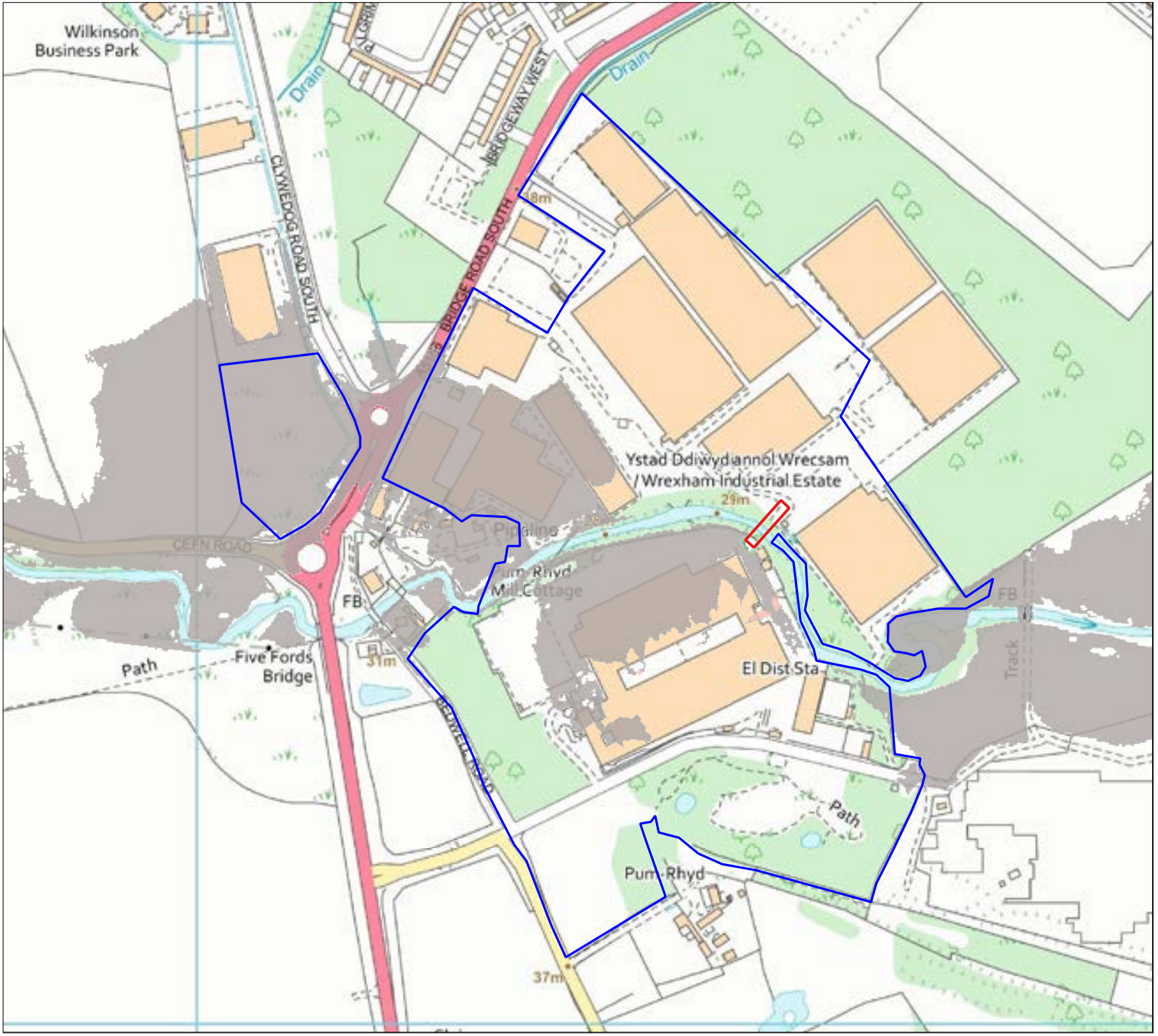
Drawing Title:
Proposed Scenario - Comparison Plot - 1.0% AEP + 25% Climate Change event

Map Orientation:

Scale: 0 6 12 18 24

Drawn:	Checked:	Date:
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Legend

- Site boundary
- Land Ownership

Change in Depth (m)

- Reduction < 0.3
- Reduction 0.3 to 0.1
- Reduction 0.1 to 0.03
- Reduction 0.03 to 0.01
- No Change
- Increase 0.01 to 0.03
- Increase 0.03 to 0.1
- Increase 0.1 to 0.3
- Increase > 0.3

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Project Title: **Bedwell Park, Wrexham**

Drawing Title: **Proposed Scenario - Comparison Plot - 0.1% AEP + 25% Climate Change event**

Map Orientation:

Scale: 0 6 12 18 24

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