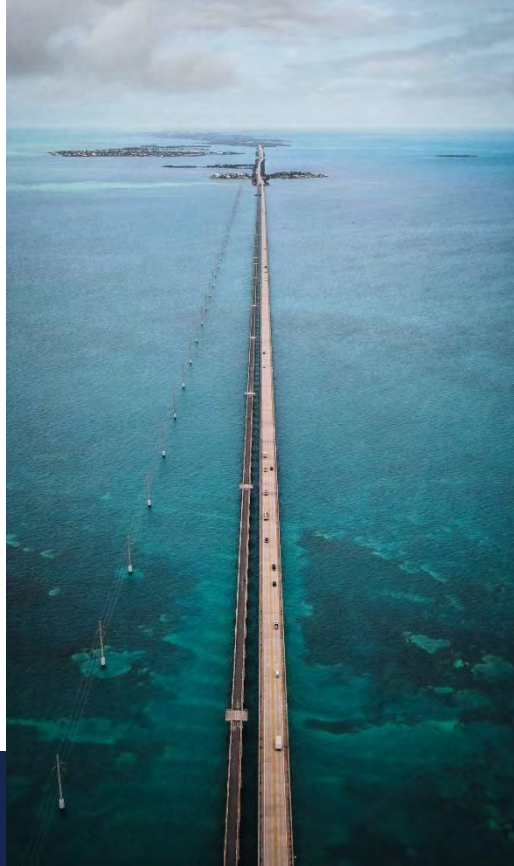




Fluvial Hydraulic Model Report

AEG8623_PO10_Emsworth_Fluvial_Model_Report

Site Address:
Land East of North Street
Emsworth
Hampshire
PO10 7PN

UK Experts in Flood Modelling, Flood Risk Assessments,
and Surface Water Drainage Strategies

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1. Introduction

- 1.1. Aegaea have been commissioned by PNH Properties to undertake a hydraulic modelling exercise of the study area at Land East of North Street, Emsworth, Hampshire, PO10 7PN, hereby referred to as the 'Site'.
- 1.2. This hydraulic modelling exercise focuses solely on the fluvial (flood from rivers) component of flood risk, to support the emerging masterplan and planning application.
- 1.3. The hydraulic model has been developed to quantify Baseline fluvial flood risk for the Site by modelling watercourse capacity and exceedance flow paths with a lumped inflow methodology derived from the upstream catchment. The findings will inform Site design and demonstrate flood risk constraints to the Environment Agency (EA) and Local Planning Authority (LPA) as part of the planning process.
- 1.4. This report outlines the hydrological assessment and hydraulic modelling methodology, presents the Baseline simulation results, and details key assumptions and limitations of the model.
- 1.5. This report uses varied map layout extents to present geospatial information. These are denoted in figure captions as Layout 1 (L1), Layout 2 (L2), and Layout 3 (L3).

Site Overview

- 1.6. The Site is located immediately south of the A27 and north of the West Coast Railway Line, near Emsworth. The River Ems is located approximately 100m east of the Site, and West Brook is located approximately 120m west of the Site. A standing water body identified as Peter Pond is located 500m downstream of the Site on the River Ems. The Site is currently greenfield land and the location is shown in Figure 1 and Figure 2.

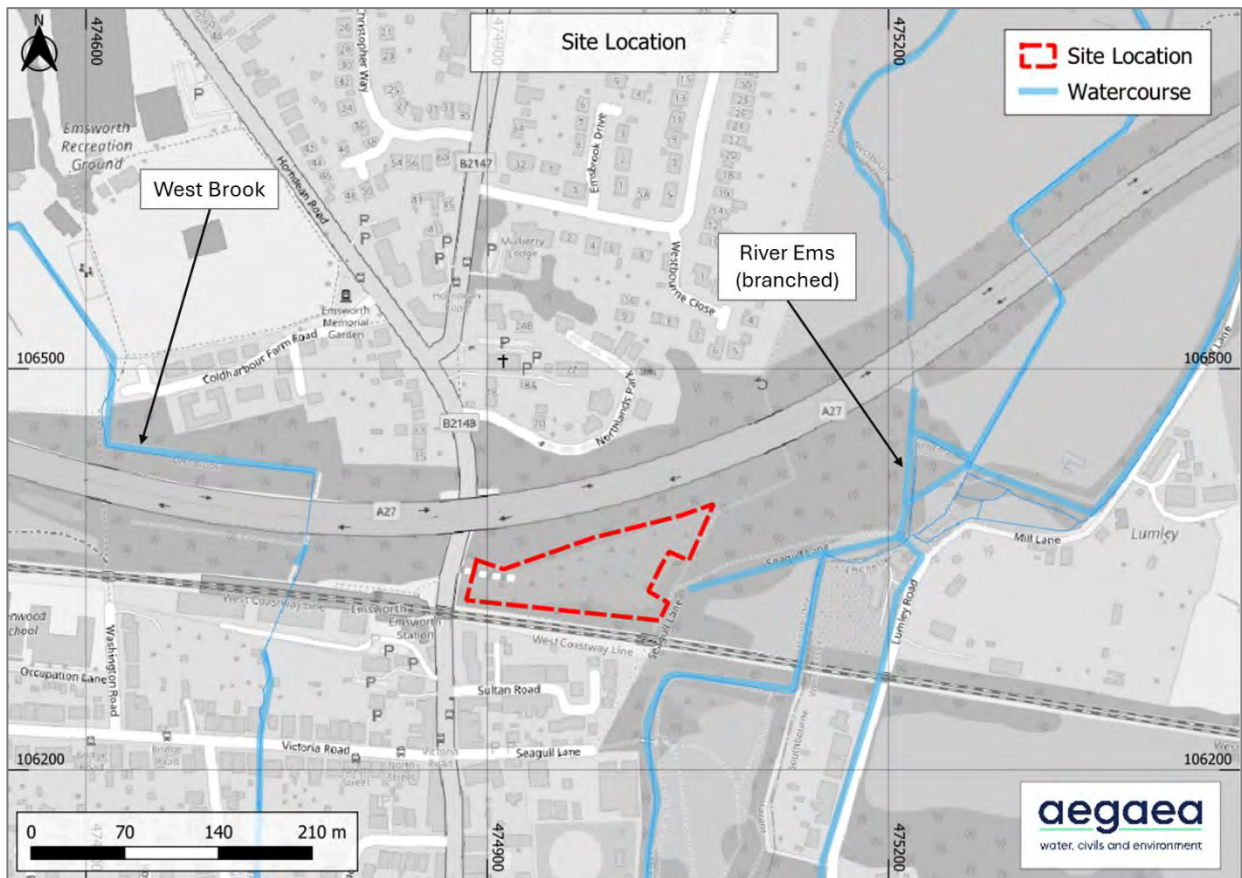


Figure 1: Area of Interest | L2 (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © <https://www.openstreetmap.org> and contributors).

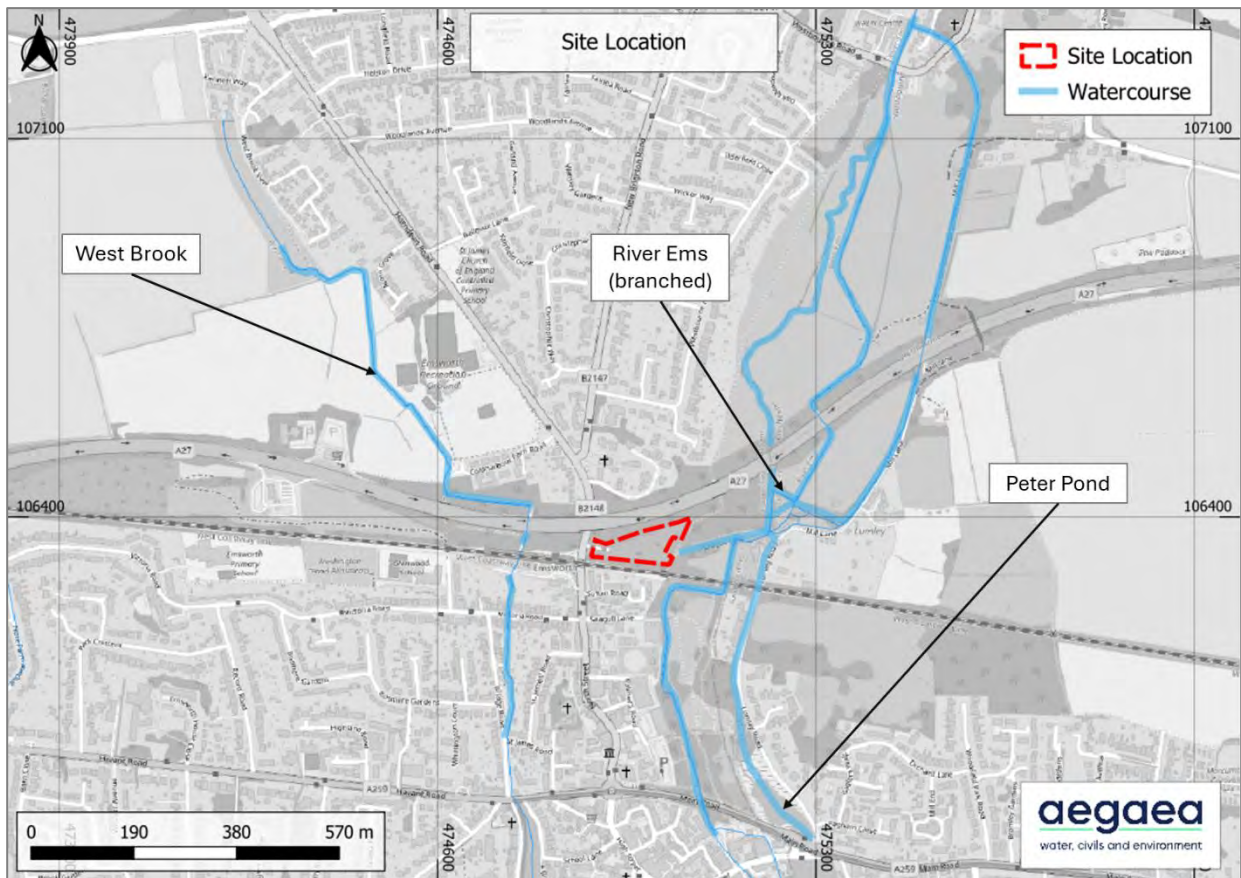


Figure 2: Area of Interest | L1 (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © <https://www.openstreetmap.org> and contributors).

Aims and Objectives

- 1.7. The aim of this exercise is to establish a good hydraulic representation of the fluvial flooding mechanisms and magnitude within the study area.
- 1.8. To achieve this aim, the following objectives have been identified:
 - Construct a 2D model representing the River Ems and West Brook watercourse and floodplain with embedded 1D structures in the vicinity of the Site using ESTRY-TUFLOW.
 - Undertake a hydrological assessment of the catchment, in line with EA Flood Estimation Guidance¹ using both FEH Statistical² and ReFH2.3 methods³ to establish design inflows for key return periods.

¹ EA Flood Estimation Guidelines: <https://www.gov.uk/government/publications/flood-estimation-guidelines>

² Flood Estimation Handbook (FEH Web Service): <https://fehweb.ceh.ac.uk/>

³ ReFH2.3 Method Technical Guidance (Wallingford HydroSolutions): https://www.hydrosolutions.co.uk/wp-content/uploads/2022/09/ReFH2.3_technical_guidance.pdf

- Simulate fluvial events to establish a set of Baseline conditions, including climate change allowances.
- Simulate sensitivity tests within the model to test key physical parameters and assumptions.

- 2.4. While the FMfP provides a useful strategic overview, due to the lack of detailed modelling it uses a coarse representation of watercourse and ground conditions without incorporating site-specific data. Given the complex flow pathways and the presence of major culverts upstream and downstream of the Site, a more detailed site-specific hydraulic modelling study is required to refine the understanding of fluvial flood risk and inform the development layout.

Terrain Data

- 2.5. High-resolution topographic data for the local area is available through the EA's National Light Detection and Ranging (LiDAR) Programme. A 1m horizontal resolution Digital Terrain Model (DTM), published in 2022, was used to inform the hydraulic model build.
- 2.6. A hillshade representation of the LiDAR dataset is presented in Figure 4 showing the variation of ground levels across the Site and upstream catchment. Figure 5 shows the elevations in the vicinity of the Site.
- 2.7. Elevations within the Site range from 9m AOD near the western boundary to 5m AOD at the southeastern boundary of the Site. Some key topographic features that influence the conveyance of flood water in the vicinity of the Site are identified below and referenced on Figure 5:
- A. A27 Highway Embankment
 - B. West Coastway Train Line Embankment

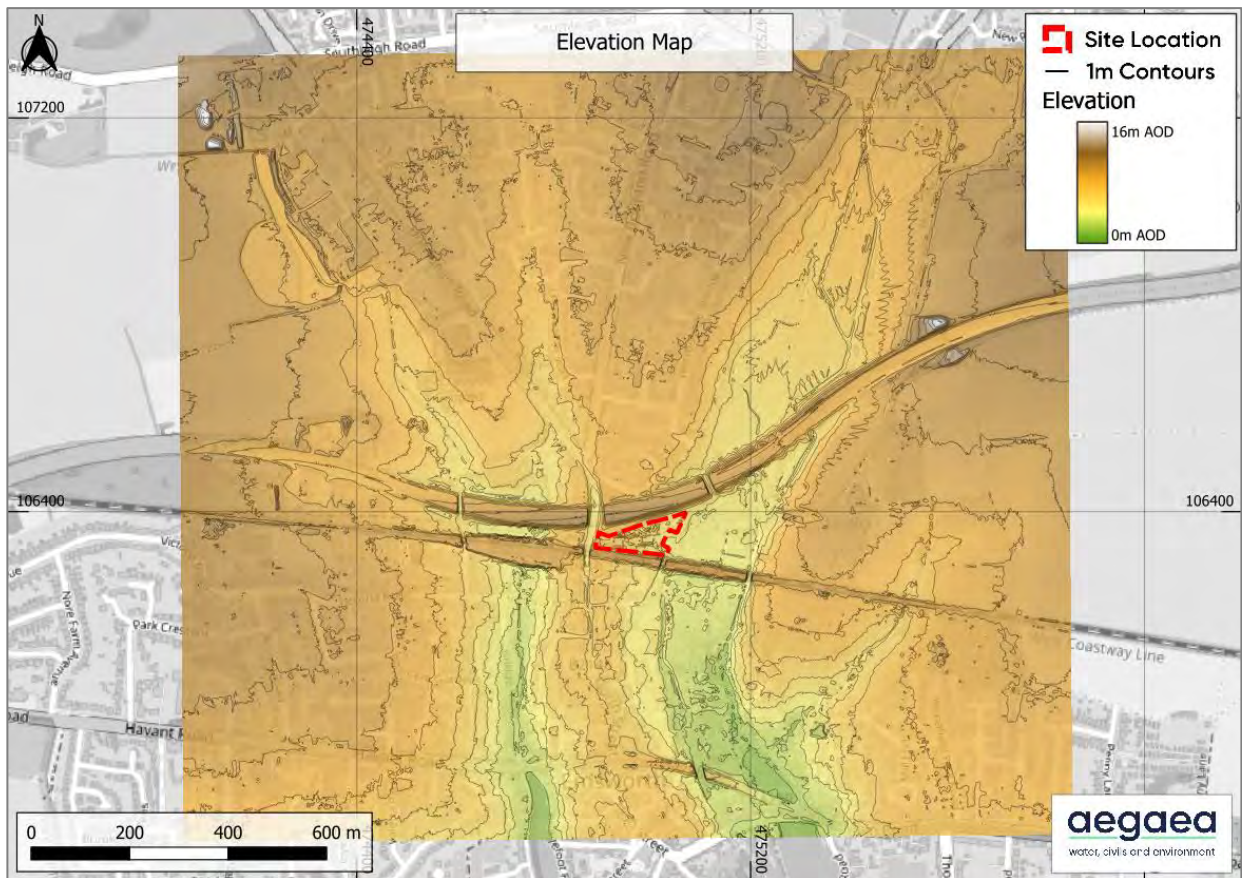


Figure 4: EA 1m LiDAR with hillshade. | L1 (Data Source: Environment Agency National LiDAR Programme, Environment Agency © Crown Copyright and database rights 2022. All rights reserved.)

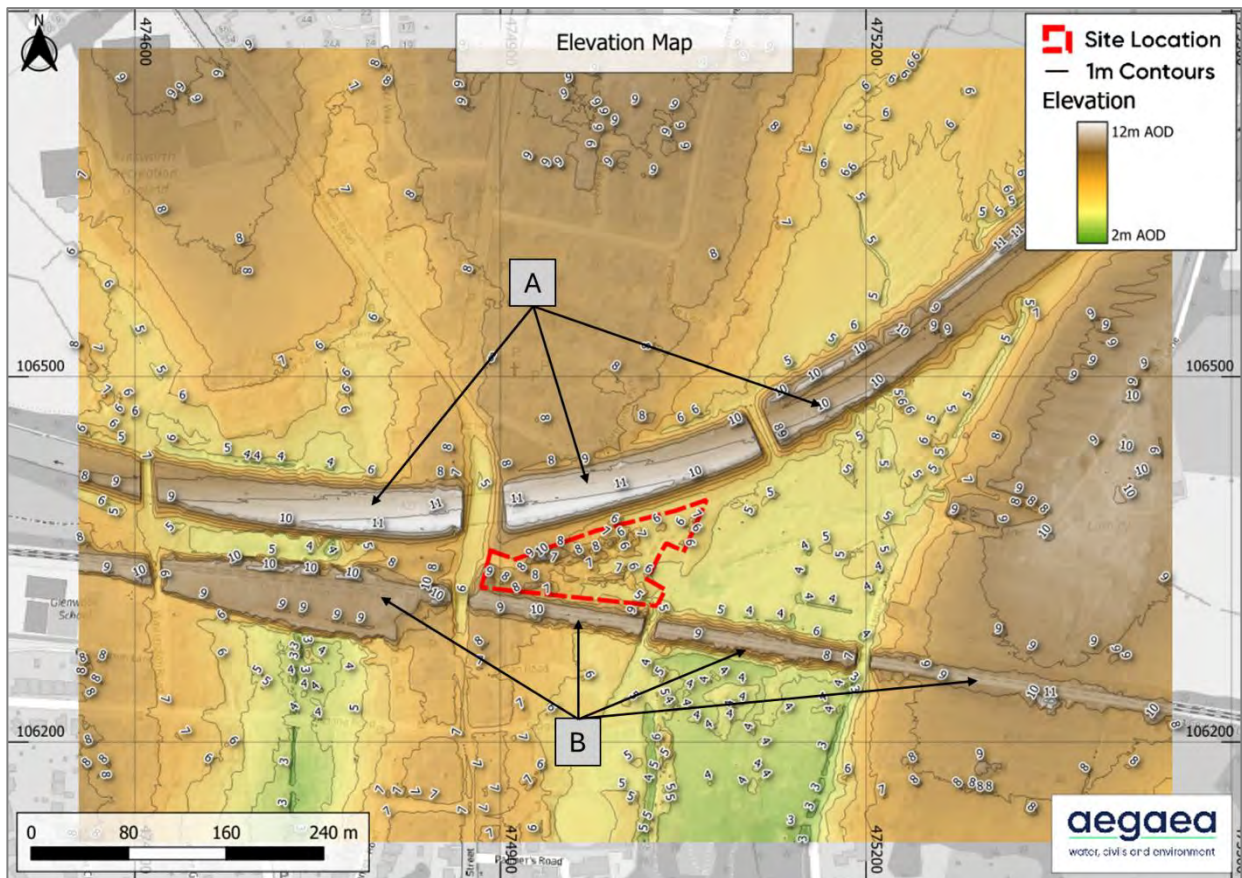


Figure 5: EA 1m LiDAR with hillshade at Site with key topographic features labelled. | L2 (Data Source: Environment Agency National LiDAR Programme, Environment Agency © Crown Copyright and database rights 2022. All rights reserved.)

Watercourse Survey Data

- 2.8. Storm Geomatics were contracted to undertake a channel and structure survey of the River Ems and West Brook in the vicinity of the Site. The survey was undertaken in December 2025.
- 2.9. Storm Geomatics noted extensive access issues with landowners refusing or revoking permission within the vicinity of the Site, limiting the amount of data obtained. The area unable to be surveyed is highlighted on Figure 6.
- 2.10. The locations of the surveyed cross-sections are shown in Figure 6. The channel survey data is presented in Appendix A.

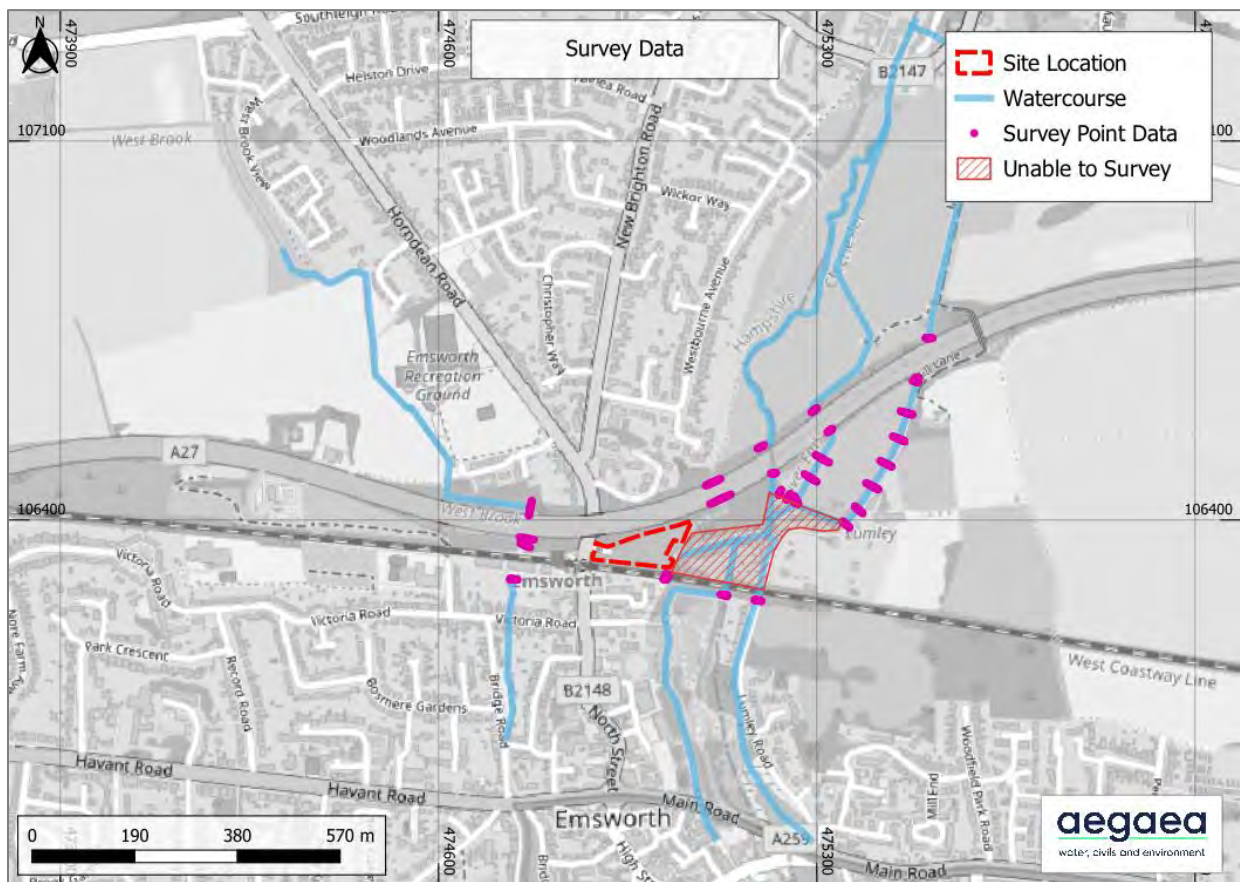


Figure 6: Surveyed cross sections | L1. (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

- 2.11. Crucially, despite extensive access limitations, Storm Geomatics were able to obtain survey data for all identified critical structures through the A27 highway embankment and the West Coastway Railway Line embankment. At least one upstream or downstream face was surveyed for the key structures expected to restrict flow through the embankment features.

Roughness Data

- 2.12. The roughness values have been spatially varied in the hydraulic model using OS open data, which has been used to infer the land use. Chow (1959) was utilised as a method by which to assign values. A list of Manning's roughness coefficients is presented in Table 1. The roughness values were checked against aerial imagery and survey photographs were found to be suitable; therefore, no change has been made to the default values.

Table 1: Manning's roughness coefficient

Land use description		Manning's roughness (<i>n</i>)
1D – Structures		
Brick		0.020
Concrete		0.015
2D – Floodplain		
Natural surface – general greenfield land		0.040
Roads		0.020
Private Road / Tracks		0.035
Dense trees and woodlands		0.090
Buildings		0.100

3. Hydrological Assessment

Overview

- 3.1. A hydrological assessment has been undertaken, following the latest EA Flood Estimation Guidance, to establish peak fluvial flood flows at key return periods. This section summarises the methodology and approach undertaken to derive fluvial inflows for the hydraulic model.
- 3.2. Two Hydraulic Estimation Points (HEPs) were used to define inflow locations for the model. These are: EMS01 (River Ems) and WBR01 (West Brook). Catchment descriptors were obtained from the FEH webservice and catchments checked against LiDAR data and aerial imagery, with updates applied as necessary. Figure 7 shows the FEP locations.

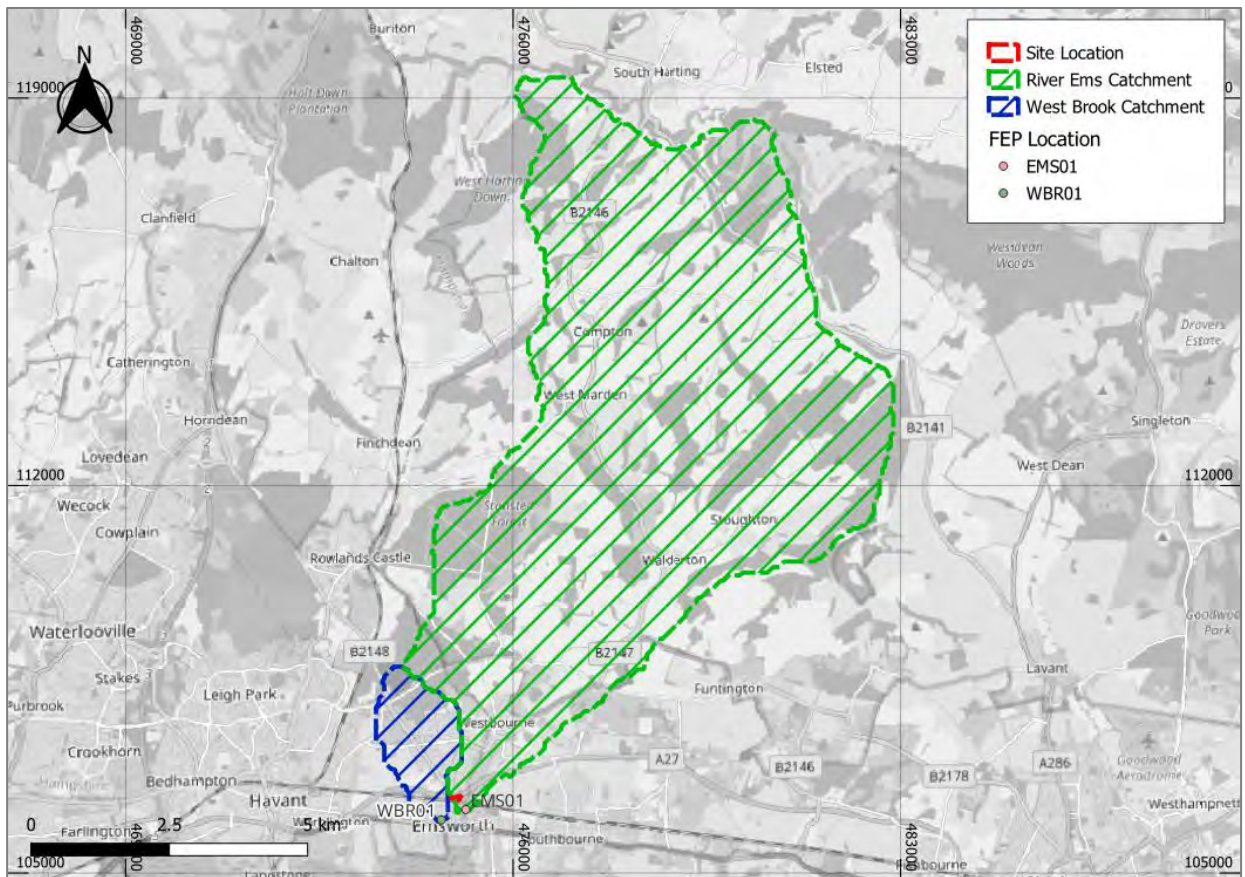


Figure 7: FEP Locations (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

- 3.3. A Hydrological Assessment Methodology note describes the methods in detail and is included in Appendix B.
- 3.4. Catchment descriptors were derived from FEH webservice and reviewed against LiDAR catchment delineation, CEH landcover data and aerial imagery. The final catchment descriptors used in the study are included in Table 2 below.

3.5. URBEXT was checked using aerial imagery and the CEH Land Cover mapping⁴. For the Ems catchment, a manual calculation yielded comparable but slightly higher URBEXT value (0.0168) than the FEH URBEXT 2015 value (0.0128). Therefore, manual recalculation value was taken forwards as a precautionary approach. No changes were made to the West Brook FEH URBEXT 2015 value as it was found to be appropriate.

Table 2: Final Catchment Descriptors

Site Code	FARL	PROPWET	BFIHOST 19	DPLBAR (km)	SAAR (mm)	URBEXT 2015	FPEXT	Area (km ²)
EMS01	1	0.26	0.872	8.78	594	0.0168	0.1557	60.1
WBR01	1	0.34	0.521	1.91	760	0.2041	0.1504	2.77

River Ems - Peak Flow Estimation

3.6. Hydrological inflow boundaries were derived using:

- FEH Statistical (WINFAP-FEH v5.2, NRFA Peak Flow Dataset 14.0.1): Applied to derive peak flows up to the 0.1% AEP based on catchment descriptors and gauged donor station adjustments.
- ReFH2.3 Rainfall-Runoff Method: Applied to derive peak flows up to the 0.1% AEP based on catchment descriptors. ReFH2 hydrographs were also used for the temporal distribution of inflows across all events.

3.7. Urbanised parameters were used to derive flow in both WINFAP and REFH2.3.

3.8. In REFH2.3, the storm duration was optimised for peak flow and the 25hr storm duration was taken forward as it derived the highest peak flow values.

3.9. Peak flows derived from REFH2.3 and WINFAP are provided in

⁴ Centre for Ecology and Hydrology, 2023. Land Cover Mapping

- 3.10. Table 3 for EMS01. The final peak flow estimates for each inflow boundary were selected from the FEH Statistical method as the more conservative estimate. For the 0.1% AEP event, the hybrid method was adopted, scaling the FEH statistical 1% AEP peak value by the ratio of the ReFH2 0.1% AEP flow to the ReFH2 1% AEP flow.

Table 3: Peak Flow Estimates – EMS01

EMS01 Catchment Peak Flows (m³/s)				
Method	50% AEP (Qmed)	3.3% AEP	1% AEP	0.1% AEP
Rainfall Runoff (REFH2.3)	3.99	5.97	7.86	14.50
FEH Statistical (WINFAP)	2.60	6.34	8.67	15.43

3.11. In REFH2.3, hydrographs were derived using the winter storm seasonality profile in line with the EA Flood Estimation Guidelines (FEG) which state:

You should use winter storm rainfall depths, Cini and initial baseflow values and storm profiles in for all catchments, unless:

- *URBEXT2000 greater than or equal to 0.30; or*
- *URBEXT2000 greater than or equal to 0.15 **and** BFIHOST19 greater than or equal to 0.65 **and** SAAR is less than 800 mm.*

West Brook – Peak Flow Estimation

- 3.12. Hydrological inflow boundaries were derived using:
- FEH Statistical (WINFAP-FEH v5.2 NRFA Peak Flow Dataset 14.0.1): Applied to derive peak flows up to the 0.1% AEP based on catchment descriptors and donor station adjustments.
 - ReFH2.3 Rainfall-Runoff Method: Applied to derive peak flows up to the 0.1% AEP based on catchment descriptors. ReFH2 hydrographs were also used for the temporal distribution of inflows across all events.
- 3.13. Urbanised parameters were used to derive flow in both WINFAP and REFH2.3.
- 3.14. In REFH2.3, the storm duration was optimised for peak flow and the 7.5hr storm duration was taken forward as it derived the highest peak flow values.
- 3.15. Peak flows derived from REFH2.3 and WINFAP are provided in and below for WBR01. The final peak flow estimates for each inflow boundary were selected from the FEH Statistical method, as the more conservative estimate. For the 0.1% AEP event, the hybrid method was adopted, scaling the FEH statistical 1% AEP peak value by the ratio of the ReFH2 0.1% AEP flow to the ReFH2 1% AEP flow.

Table 4: Peak Flow Estimates – WBR01

WBR Catchment Peak Flows (m³/s)				
Method	50% AEP (Qmed)	3.3% AEP	1% AEP	0.1% AEP
Rainfall Runoff (REFH2.3)	0.81	1.54	1.95	3.25
FEH Statistical (WINFAP)	1.21	2.67	3.51	5.68

- 3.16. In REFH2.3, hydrographs were derived using the winter storm seasonality profile in line with the EA Flood Estimation Guidelines (FEG). It is unrealistic to observe a discrepancy in storm seasonality between adjacent catchments in a hydraulic modelling study. As the EMS01 inflow is the larger of the two, the winter profile has been retained for this inflow and also applied to the WBR01 inflow. The 7.5hr storm duration hydrograph was taken forward, scaled to the WINFAP derived peak flow values.

Climate Change (CC)

- 3.17. It is essential that climate change is accounted for during planning applications where there is potential flood risk posed from fluvial sources.
- 3.18. The Site lies within the Arun and Western Streams Management Catchment. In line with EA guidance, the climate change uplift for the central and higher central allowance for the 2080's epoch was assessed for this study. The central allowance is appropriate as the proposed development is classified as 'less

vulnerable'. The central and higher central allowances of 25% and 36% increase in peak river flows respectively was applied to the 1% AEP design flow to assess the future climate scenarios.

Design Events

- 3.19. The model was simulated against the key design flood events shown in Table 5 below.

Table 5: Design Events

Annual Exceedance Probability (AEP)	Return Period
3.3%	30 year
1%	100 year
1% +CC25%	100 year plus 25% climate change uplift
1% +CC36%	100 year plus 36% climate change uplift
0.1%	1000 year

Final Inflows

- 3.20. Final peak inflows applied to the River Ems and West Brook are presented in Table 6 below.

Table 6: Final Peak Inflows

Site Code	2 50%	30 3.3%	100 1%	100 1% + 25% CC	100 1% + 36% CC	1000 0.1%
EMS01	2.60	6.34	8.67	10.83	11.78	14.50
WBR01	1.21	2.67	3.51	4.38	4.77	5.86

4. Fluvial Baseline Hydraulic Modelling

Model Build

- 4.1. A dynamically linked one-dimensional (1D) and two-dimensional (2D) modelling approach was adopted using ESTRY-TUFLOW Heavily Parallelised Compute (HPC) (version 2025.2.2-ISP-w64). A 2D TUFLOW domain represents the open channel, floodplain and wider catchment. Where sufficient survey information was available structures have been embedded into the 2D domain as 1D ESTRY units.
- 4.2. A 2D model methodology was adopted for all areas of floodplain and open channel within the model extent. Only the surveyed structures were represented in the 1D domain using an 'embedded' approach. Whilst some open channel cross-sections were obtained, these were only used to reinforce a 2D bed level. To construct a full hydrodynamically linked 1D-2D model of open channel and floodplain in the vicinity of the Site, third-party access would need to be granted to surveyors, which has previously been refused. Alternatively, new open channel sections in the vicinity of the Site could be assumed based on upstream and downstream geometry and slope. However, given the scale of estimation that would be required a 2D only channel represented has been preferred as the more representative option.
- 4.3. Conservative channel width and bed level reinforcement has been applied to better represent channel capacity in the 2D domain. Where surveyed bed levels are available these have been taken forward as the reinforcement elevation. Elsewhere EA LiDAR elevations have been sampled at open channel locations and decreased by 0.3m to compensate for inability of LiDAR to penetrate the water surface. The reinforcement value of 0.3m is within the range of discrepancies identified between survey and LiDAR where spot check comparisons are possible.

1D Domain - Structures

- 4.4. The 1D ESTRY network is entirely comprised of 9 structures, which are embedded into the 2D domain. Figure 8 and Figure 9 show the schematisation of the 1D domain features for the Baseline scenario.

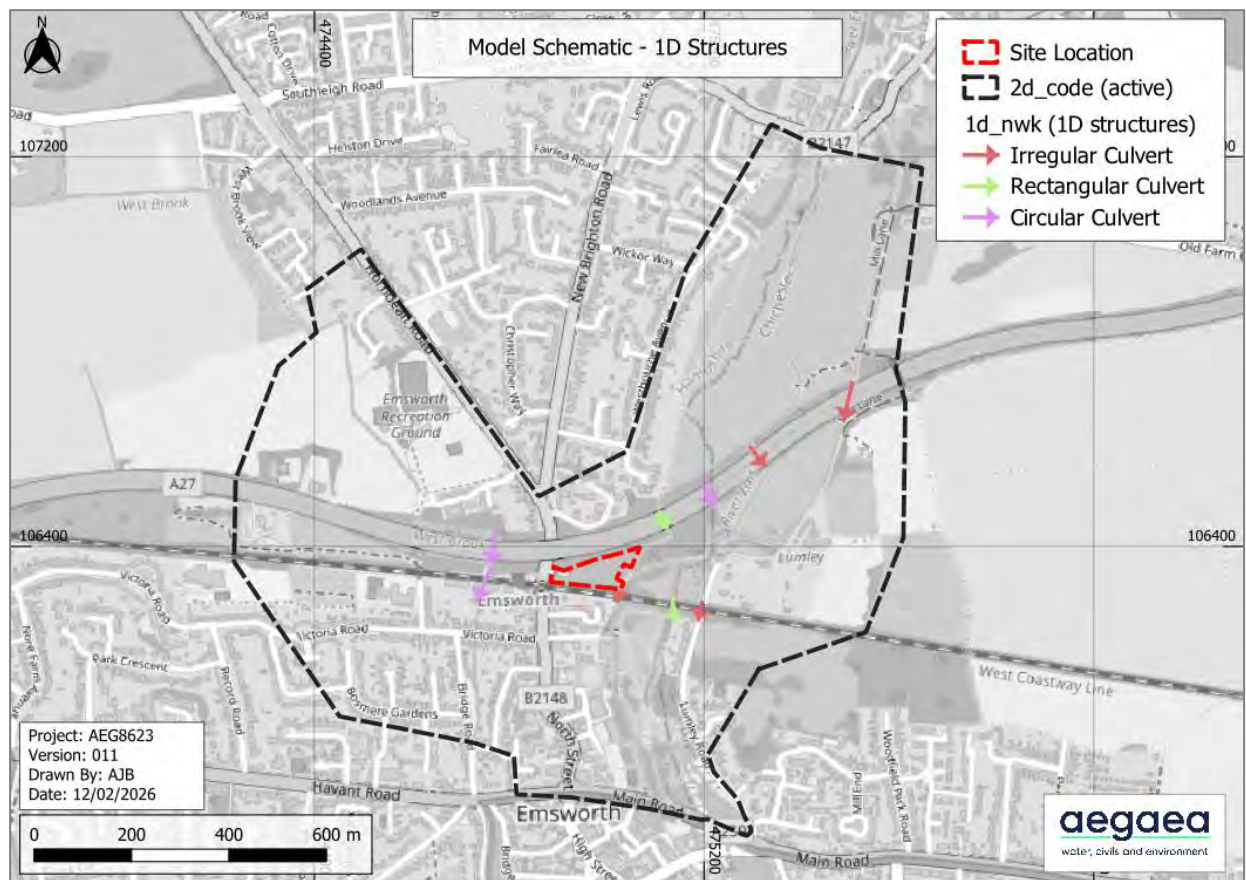


Figure 8: Baseline Fluvial Model Schematic – 1D Structures | L4 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

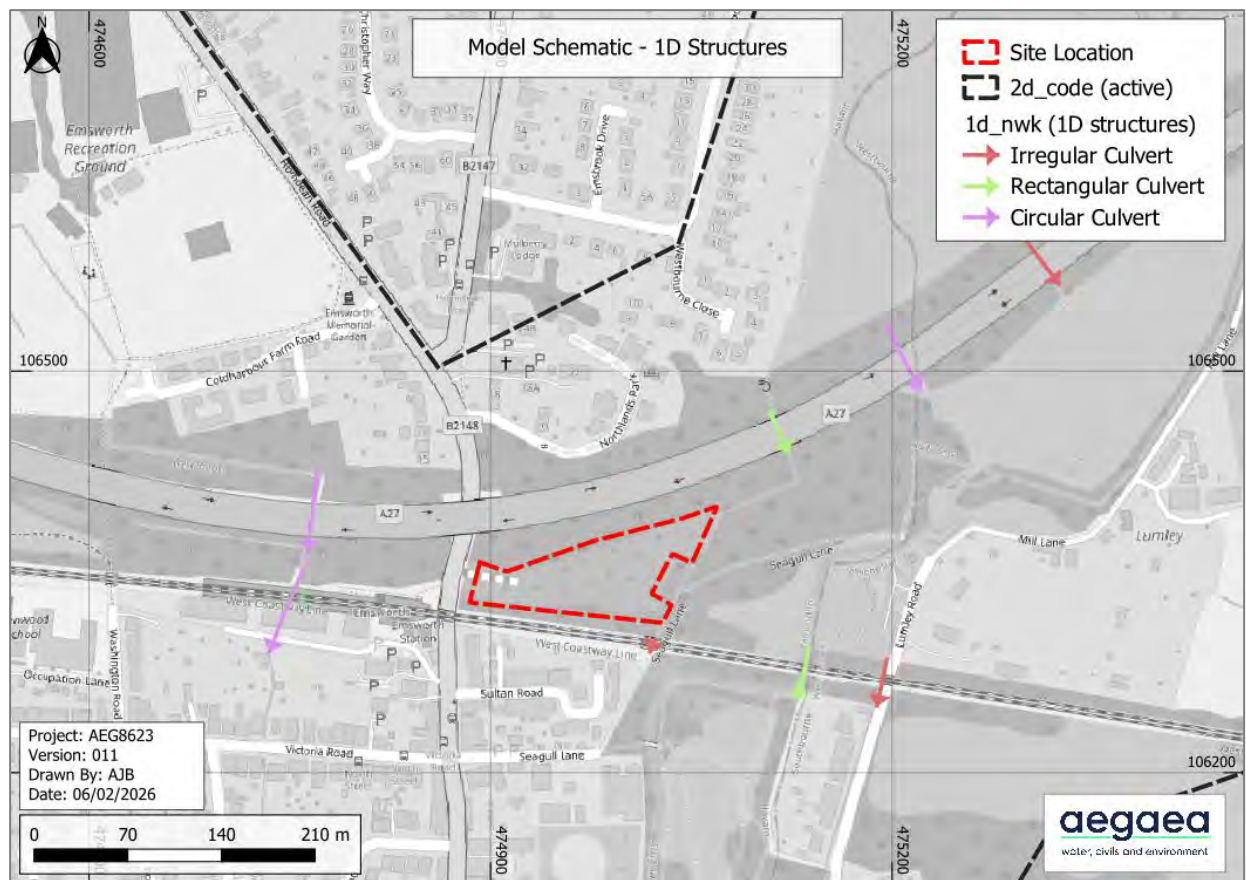
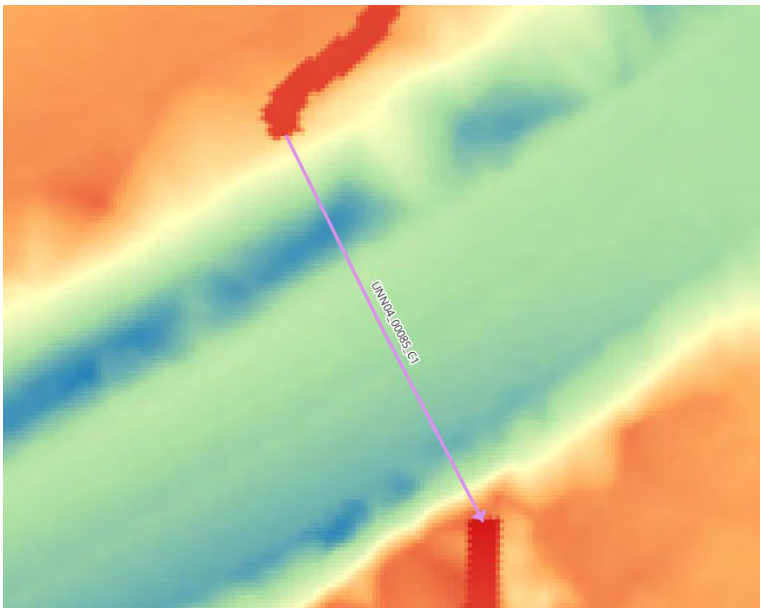


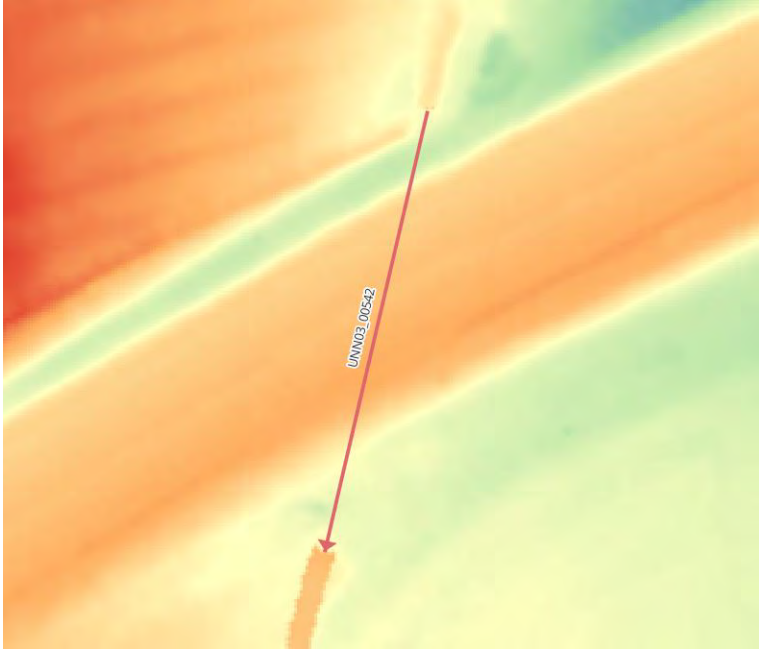
Figure 9: Baseline Fluvial Model Schematic – 1D Structures | L2 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

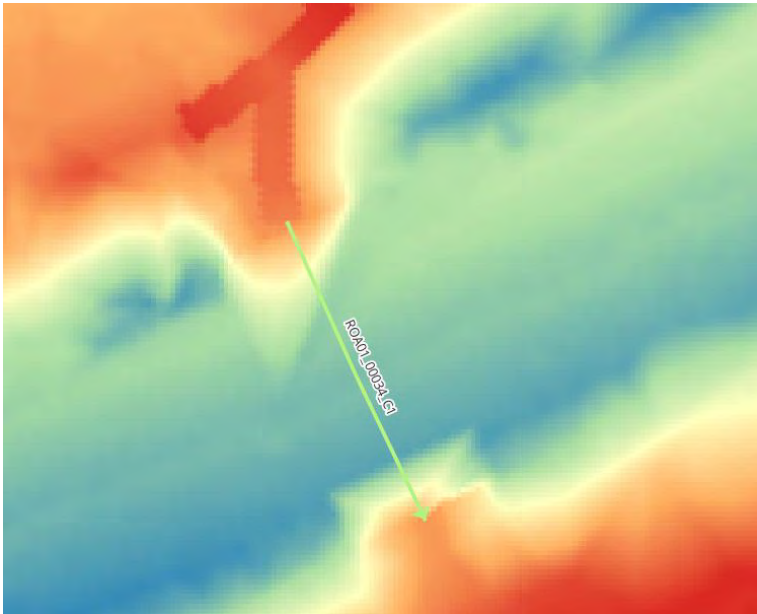
- 4.5. Structures were represented as 1d_nwk features. Details of the modelled structures are presented in Table 7. Spills were represented in the 2D domain to represent flow over the structures within the hydraulic model. Structure geometry and elevations were retained from the survey information provided by Storm Geomatics.
- 4.6. Structure roughness values were applied to the model and were informed by photographs provided with the topographic survey. The methodology outlined by Chow (1959) was used to assign these values. Manning's 'n' roughness coefficients ranging between 0.0130 and 0.020 were applied for structure conditions. Sensitivity testing for in-channel and floodplain roughness has been conducted and is described in Section 6 of this report.

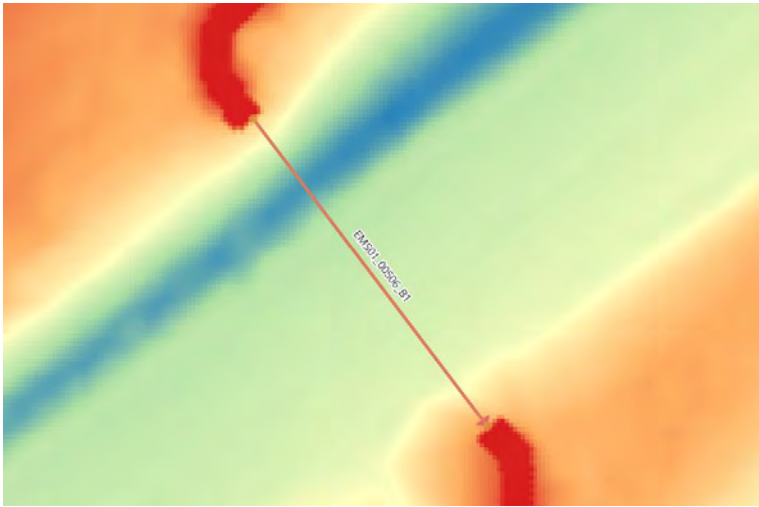
Table 7: Modelled 1D Structures

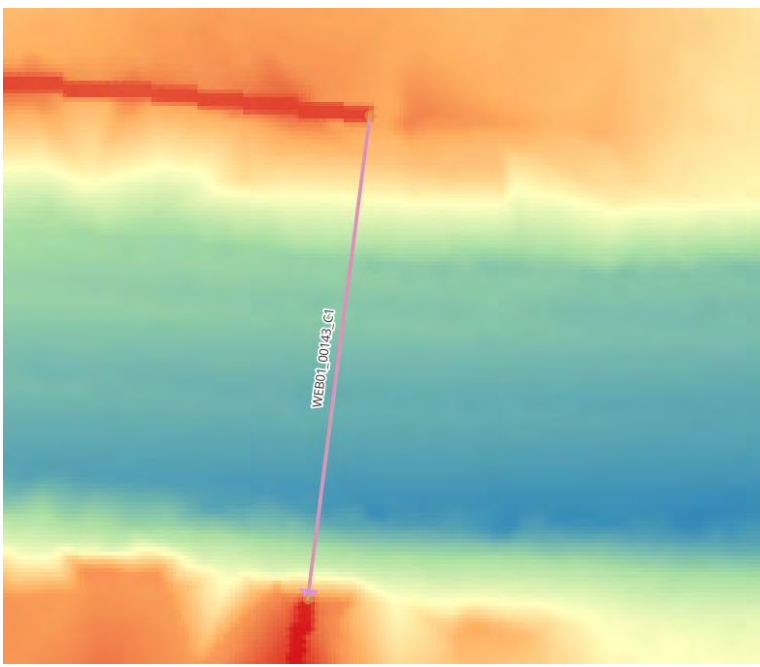
UNN04_00085_C1	
Cross Section Label	UNN04_00085_C1
Unit Type	Circular Culvert
Upstream Invert (m AOD)	4.30
Downstream Invert (m AOD)	3.78
Dimensions (m)	1.00 (diameter)
Structure length (m)	Approx. 54
Spill Type	2D embankment – well defined in LiDAR ground levels.
Comments	River Ems culvert structure through A27 highway embankment upstream of Site.
Photograph	

Schematisation (DEM_Z shown)	
UNN03_00542	
Cross Section Label	UNN03_00542
Unit Type	Irregular Culvert
Upstream Invert (m AOD)	8.50
Downstream Invert (m AOD)	8.25
Dimensions (m)	Approx. 1.00 (W) x 0.70 (H)
Structure length (m)	Approx. 76
Spill Type	2D – good representation of LiDAR ground levels.
Comments	River Ems Eastern branch channel structure through A27 highway embankment upstream of Site. Geometry taken from downstream face as conservative approach. Trash screen not represented due to narrow bars not significantly impacting flow mechanisms.

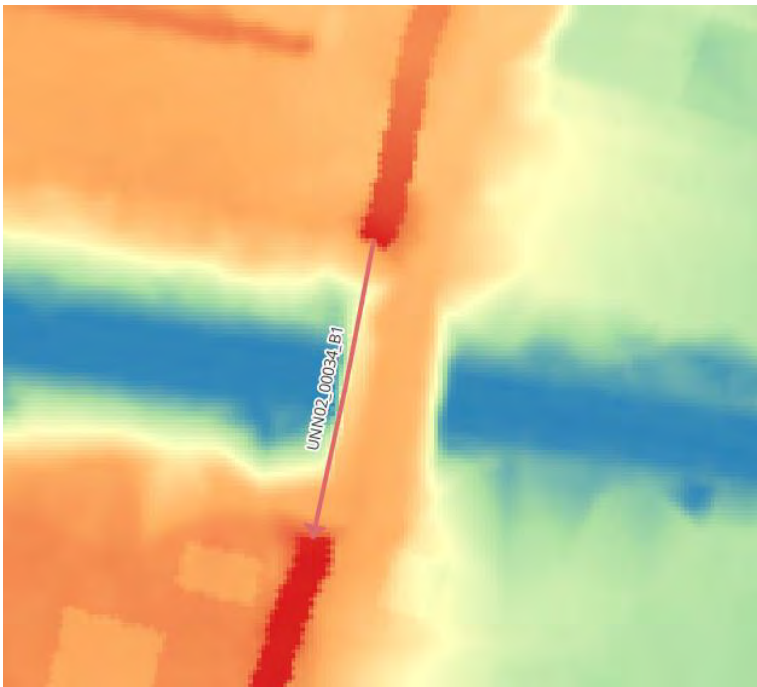
Photograph	
Schematisation (DEM_Z shown)	
ROA01_00034_C1	
Cross Section Label	ROA01_00034_C1
Unit Type	Rectangular Culvert
Upstream Invert (m AOD)	5.74
Downstream Invert (m AOD)	6.05
Dimensions (m)	Approx. 3.60 (W) x 2.70 (H)
Structure length (m)	Approx. 34

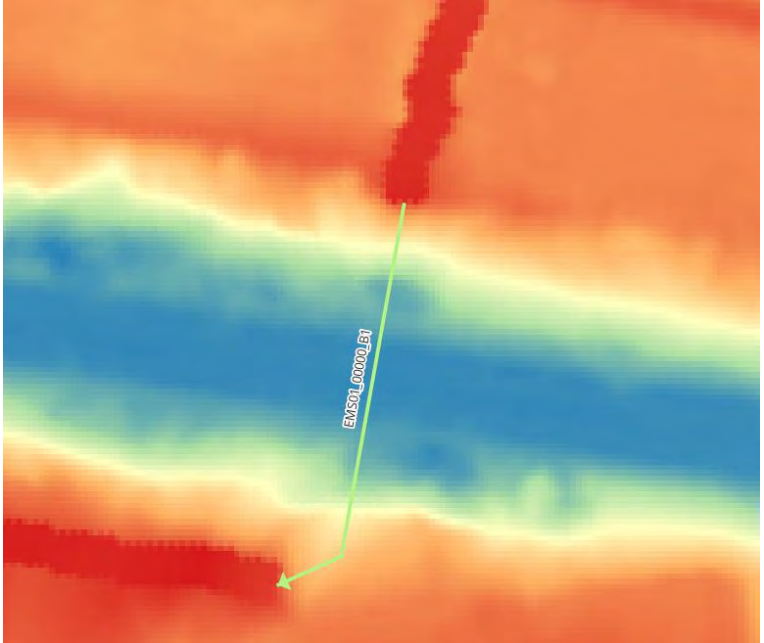
Spill Type	2D –Embankment/deck levels have been reinforced as DTM had been burned through.
Comments	A27 pedestrian underpass structure upstream of Site.
Photograph	
Schematisation (DEM_Z shown)	
EMS01_00506_B1	
Cross Section Label	EMS01_00506_B1
Unit Type	Irregular Culvert
Upstream Invert (m AOD)	4.52
Downstream Invert (m AOD)	4.51

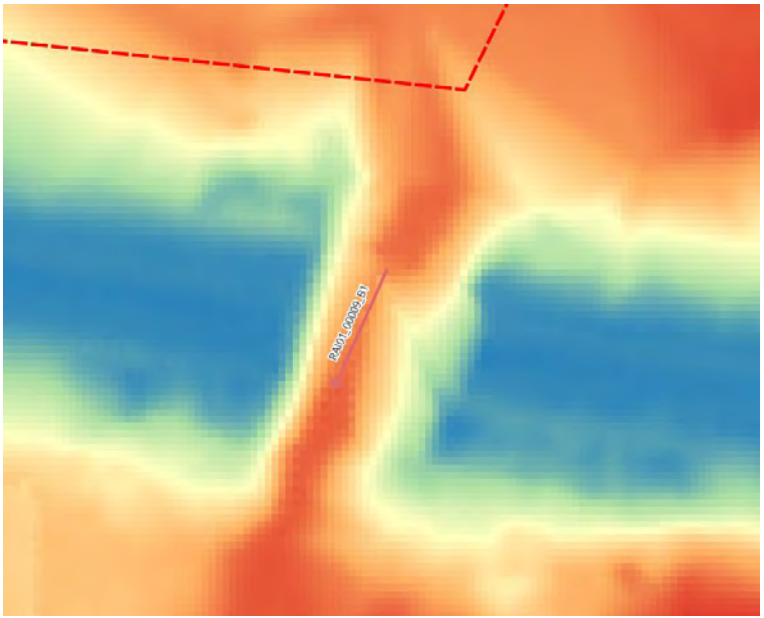
Dimensions (m)	Approx. 3.60 (W) x 1.40 (H)
Structure length (m)	Approx. 47.5
Spill Type	2D – good representation of LiDAR ground levels.
Comments	River Ems main branch culvert structure upstream of Site.
Photograph	
Schematisation (DEM_Z shown)	
WEB01_00143_C1	
Cross Section Label	WEB01_00143_C1
Unit Type	C
Upstream Invert (m AOD)	3.37
Downstream Invert (m AOD)	2.97

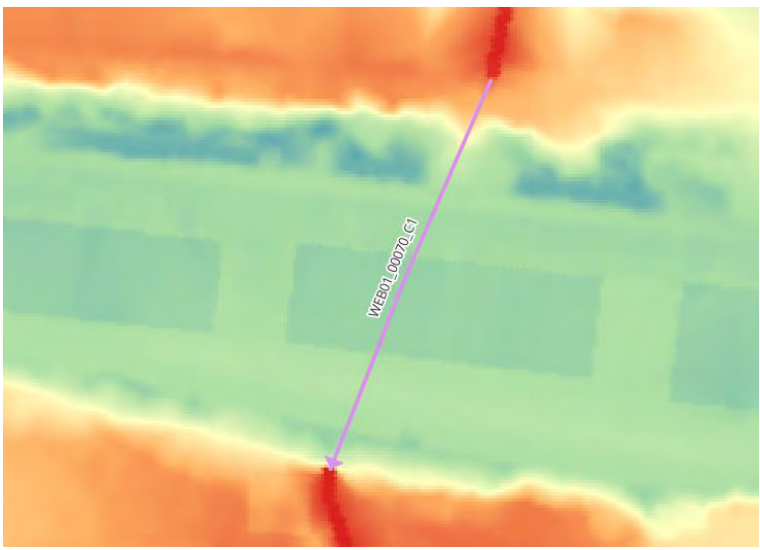
Dimensions (m)	1.05 (diameter)
Structure length (m)	58.1
Spill Type	2D – good representation of LiDAR ground levels.
Comments	West Brook culvert structure through A27 highway embankment. Upstream of Site.
Photograph	
Schematisation (DEM_Z shown)	
UNN02_00034_B1	
Cross Section Label	UNN02_00034_B1
Unit Type	Irregular Culvert

Upstream Invert (m AOD)	2.69 (unsurveyed - assumed flat based on downstream)
Downstream Invert (m AOD)	2.69
Dimensions (m)	1.85 (W) x 1.75 (H) (only downstream face surveyed)
Structure length (m)	34.8
Spill Type	2D – railway deck burned through. Good representation of adjacent road ground levels.
Comments	River Ems eastern branch culvert adjacent to Lumley Road, beneath West Coastway Railway Line embankment, downstream of Site.
Photograph	

Schematisation (DEM_Z shown)	
EMS01_00000_B1	
Cross Section Label	EMS01_00000_B1
Unit Type	Rectangular Culvert
Upstream Invert (m AOD)	3.33 (unsurveyed - assumed flat based on downstream)
Downstream Invert (m AOD)	3.33
Dimensions (m)	3.10 (W) X 1.42 (H) Upstream face unsurveyed. Dimensions based on the full width and half height of the downstream face, due to a photograph through the structure showing obstruction at the upstream face.
Structure length (m)	39.30
Spill Type	2D – good representation of LiDAR ground levels.
Comments	River Ems main branch culvert structure through the West Coastway Railway Line embankment downstream of Site. Blockage sensitivity test undertaken and described in 6 of this Report.

Photograph	
Schematisation (DEM_Z shown)	
RAI01_00009_B1	
Cross Section Label	RAI01_00009_B1
Unit Type	Irregular Culvert
Upstream Invert (m AOD)	3.33
Downstream Invert (m AOD)	4.57
Dimensions (m)	3.80 (W) X 4.40 (H)
Structure length (m)	9.20
Spill Type	2D – railway deck burned through.

Comments	Underpass through West Coastway Railway Line embankment. Downstream of Site.
Photograph	
Schematisation (DEM_Z shown)	
WEB01_00070_C1	
Cross Section Label	WEB01_00070_C1
Unit Type	C
Upstream Invert (m AOD)	2.83
Downstream Invert (m AOD)	2.65

Dimensions (m)	1.50 (diameter)
Structure length (m)	66.50
Spill Type	2D – good representation of LiDAR ground levels.
Comments	West Brook culvert structure through West Coastway Railway Line embankment. Downstream of Site.
Photograph	
Schematisation (DEM_Z shown)	

2D Domain

- 4.7. The 2D domain was constructed using a high-resolution 1m base grid size throughout the model extent. This grid size matches the resolution of the LiDAR input data. Model simulation times could be improved

by increasing grid size. However, given the open channel representation in the 2D domain, the higher resolution was preferred over reduced simulation times.

- 4.8. TUFLOW sub-grid sampling (SGS) was enabled, allowing intra-grid cell lidar elevations to be captured and represented within the model.
- 4.9. Terrain data for the 2D domain was derived from the EA's 1m resolution LiDAR Digital Terrain Model (2022). This provides sufficient accuracy for capturing overland flow paths, depressions, and kerb-level features in the rural and urban environment.
- 4.10. The grid orientation angle for the model was defined using the 2d_loc line. This was chosen to align the grid with the predominant direction of the River Ems watercourse in the study area.
- 4.11. Channel capacity of the River Ems and West Brook watercourse features were reinforced in the 2D domain using '2d_zsh' line and point features. Channel width was reinforced between 2m and 4m based on aerial imagery, LiDAR data and survey data where available. The '2d_zsh' option 'NO MERGE' was specified as the channels are predominantly engineered, with unfirm channel shape. Channel elevations were applied using the limited available cross section data. Where section data was not available, elevations were sampled from LiDAR data and decreased by 0.3m to approximate the observed disparity between surveyed elevations where available elsewhere. Sensitivity testing has been undertaken to test the impact of the decrease in elevations and is described in Section 6 of this report. Typically, with SGS enabled the MIN option would not be required as existing low points within grid cells would be sampled. However, the '2d_zsh' reinforcement lines require the MIN option as the underlying elevations are being 'burned' through, rather than representing the existing underlying elevations. This
- 4.12. Buildings were modelled using a 0.3m threshold, known as the 'stubby buildings' approach, through the application of 2d_zsh layers to route flows around the buildings where depths are below floor levels.
- 4.13. The LiDAR elevations in the upstream catchment were reviewed and any key structures located on main flow paths were reinforced using a simple cut-through approach. This represents a conservative approach in light of the fact that survey data cannot be obtained for every structure in the surface water catchment.
- 4.14. Ordnance Survey Open Data was used to assign a Manning's roughness coefficient for the 2D floodplain area based on the feature code attribute (land classes). A TUFLOW Materials File (.tmf) is used to associate these feature codes with the Manning's roughness values for each surface type based on aerial imagery, street view and survey photographs, with reference to Chow's roughness guide as provided in Table 1. A general Manning's 'n' roughness of 0.04 was applied to the 2D domain based on aerial imagery. Dense vegetation is present at the Site and its immediate surroundings to the River Ems. A high roughness value of 0.09 has been applied to dense vegetation and trees. Roughness sensitivity tests have been undertaken and are described in Section 6 of this report.
- 4.15. No losses to the ground were represented directly within the model. Losses have been accounted for in the hydrological assessment to derive inflows as per fluvial modelling guidance (EA Hydraulic modelling: best practice).
- 4.16. Figure 10 and Figure 11 show the schematisation of the 2D domain geometry for the Baseline scenario.

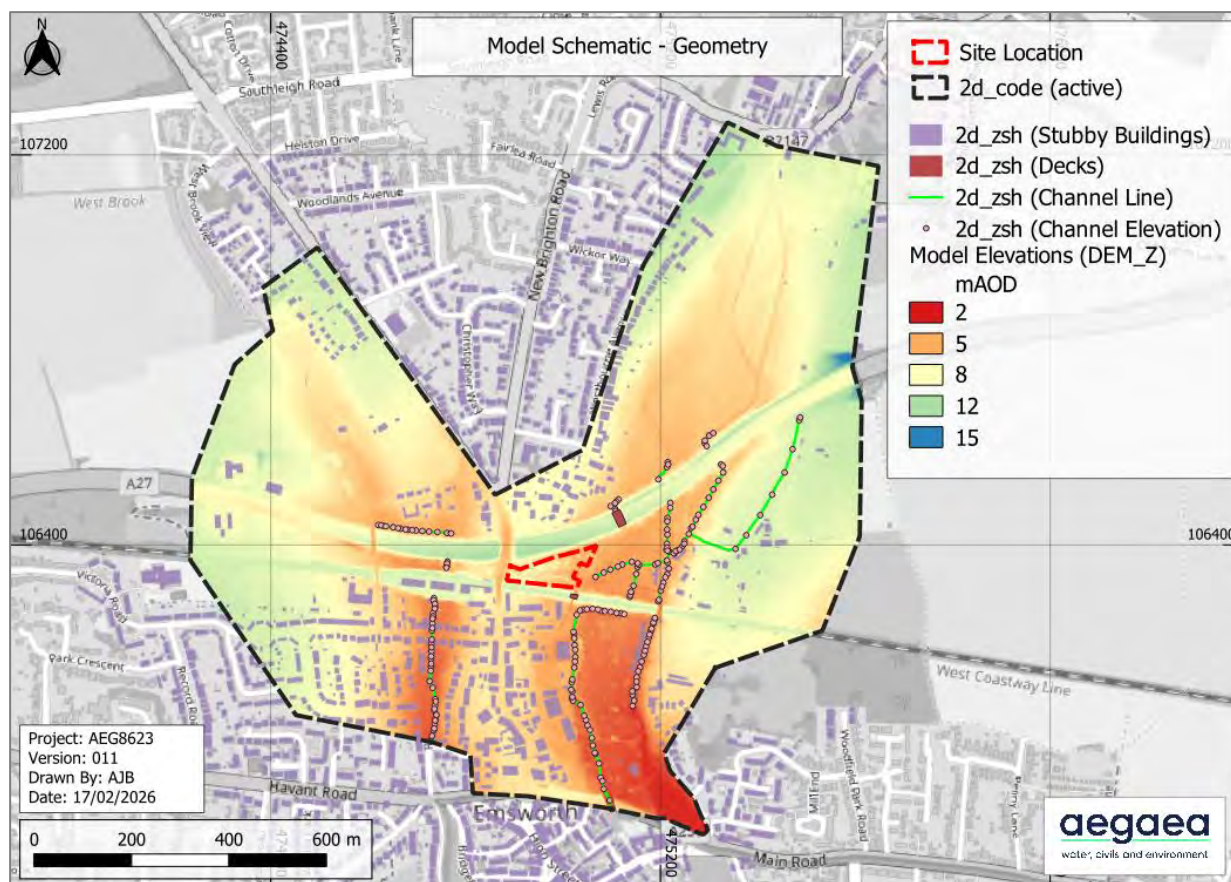


Figure 10: Baseline Fluvial Model Schematic – 2D Geometry | L4 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

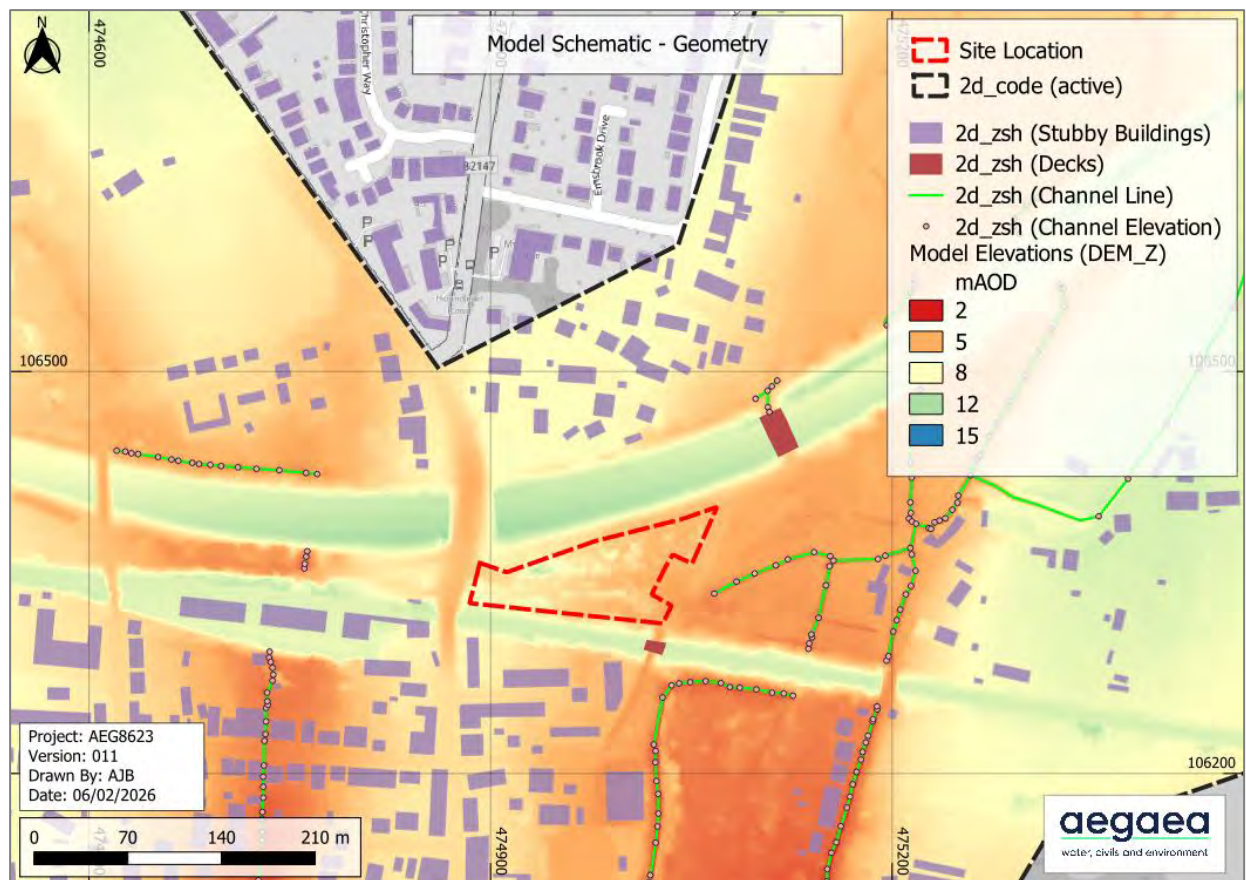


Figure 11: Baseline Fluvial Model Schematic – 2D Geometry | L2 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

Linking 1D and 2D Domains

- 4.17. The 1D structures were linked to the 2D domain using CN (connection) lines digitised at each 1D node. The CN lines were connected to SX boundaries, allowing the transfer of water to and from selected 2D cells.
- 4.18. To preserve accurate hydraulic representation of the structures and ensure the inlets were not buried, the 'Z' flag was applied to the SX connections to ensure 2D cell elevations are no greater than the connecting 1D invert level.

Boundary Conditions

Inflow Boundary

- 4.19. The derived inflow hydrograph for each HEP (EMS01 and WBR01) was applied as type QT boundary conditions to the model in the 2D domain.
- 4.20. The '2d_bc' type QT lines were digitised within the 2D bank elevations perpendicular to the flow direction. Additionally, the active model code extent was snapped to the inflow boundaries to ensure no recirculation could occur upstream of the boundary condition.

- 4.21. A 5-hour warm-up time was applied to the model, with initial baseflow values applied to wet the 2D domain channel to provide initial conditions and ensure the channel is not dry at the onset of the storm event. 5-hours is sufficient time for water to propagate to the downstream extent of the model.

Downstream Boundary

- 4.22. Three separate downstream boundary conditions have been applied to the 2D domain:
- '2d_bc' type HT applied at the standing water body / lake feature downstream of the River Ems eastern branch. A constant water level boundary of 2m has been applied in the Baseline scenario, approximating the fixed water level of the lake feature based on LiDAR elevations. Sensitivity testing undertaken with varied water levels described in Section 6.
 - '2d_bc' type HQ applied at the downstream of the River Ems main branch. Slope measured to be 0.002 based on a 100m upstream profile of LiDAR levels.
 - '2d_bc' type HQ applied at the downstream of the West Brook main branch. Slope measured to be 0.001 based on a 100m upstream profile of LiDAR levels.
- 4.23. No tidal conditions have been represented at the downstream boundary. Whilst the River Ems and West Brook ultimately outfall to a tidal water body, desktop investigations show engineered hydraulic controls such as Peter Pond that are expected restrict any tidal influence upstream. The Site itself sits an elevation of between 9m AOD and 5m AOD and so is not expected to be at risk of flooding from tidal sources. This study focused on the fluvial component of flood risk and a separate study would be required to assess the flood risk from tidal sources.
- 4.24. Figure 12 shows the schematisation of boundary conditions for the Baseline scenario.

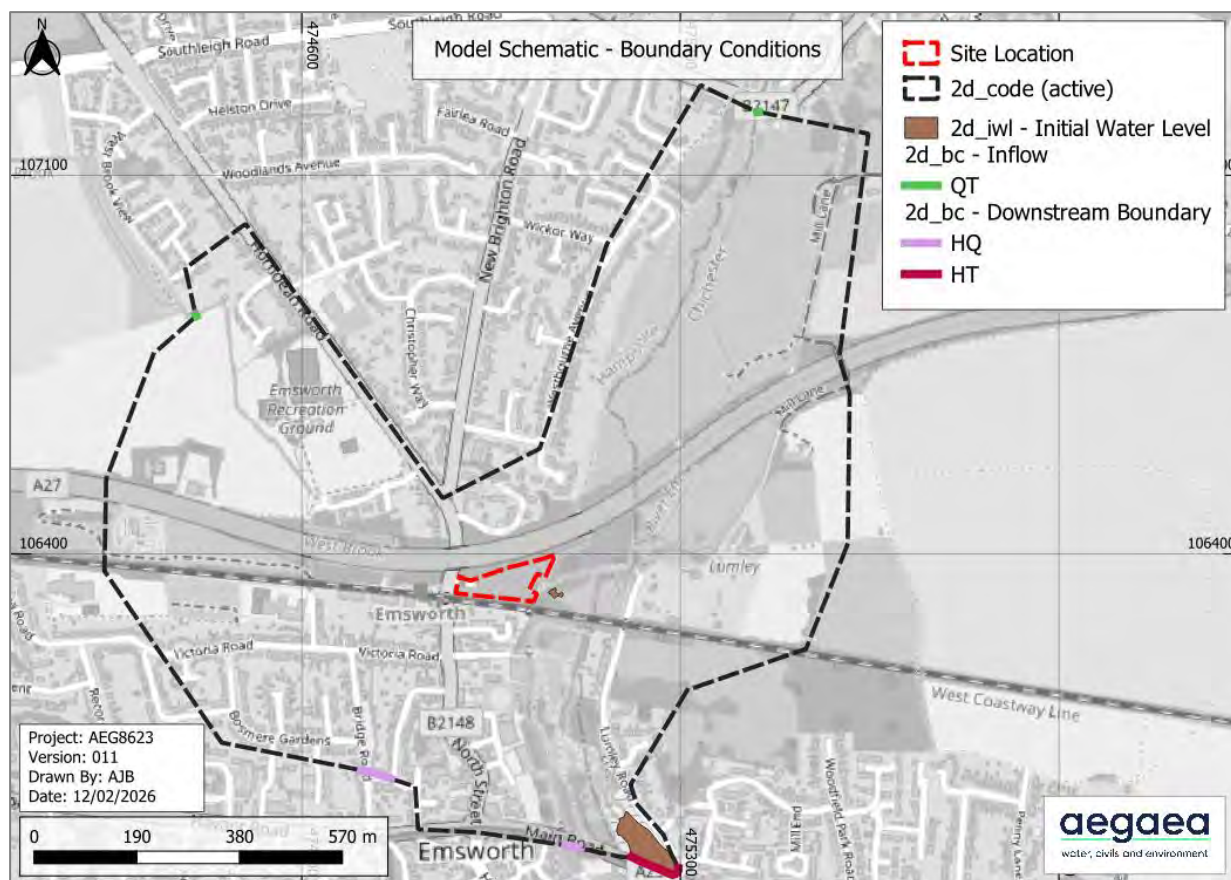


Figure 12: Baseline Fluvial Model Schematic – Boundary Conditions (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

5. Fluvial Model Results

Flood Extents

- 5.1. The Baseline maximum modelled flood extents within the model are shown in Figure 13 and Figure 14 below. The figure shows the model outputs for all events simulated. The hydraulic model outputs indicate that the Site remains largely outside the extent of all simulated events. Minor encroachments to the Site boundary are noted for the 1% AEP + 25%, 1% AEP + 36% and 0.1% AEP events, however, the flooding is confined to the lowest ground elevations on Site in the southeast corner.

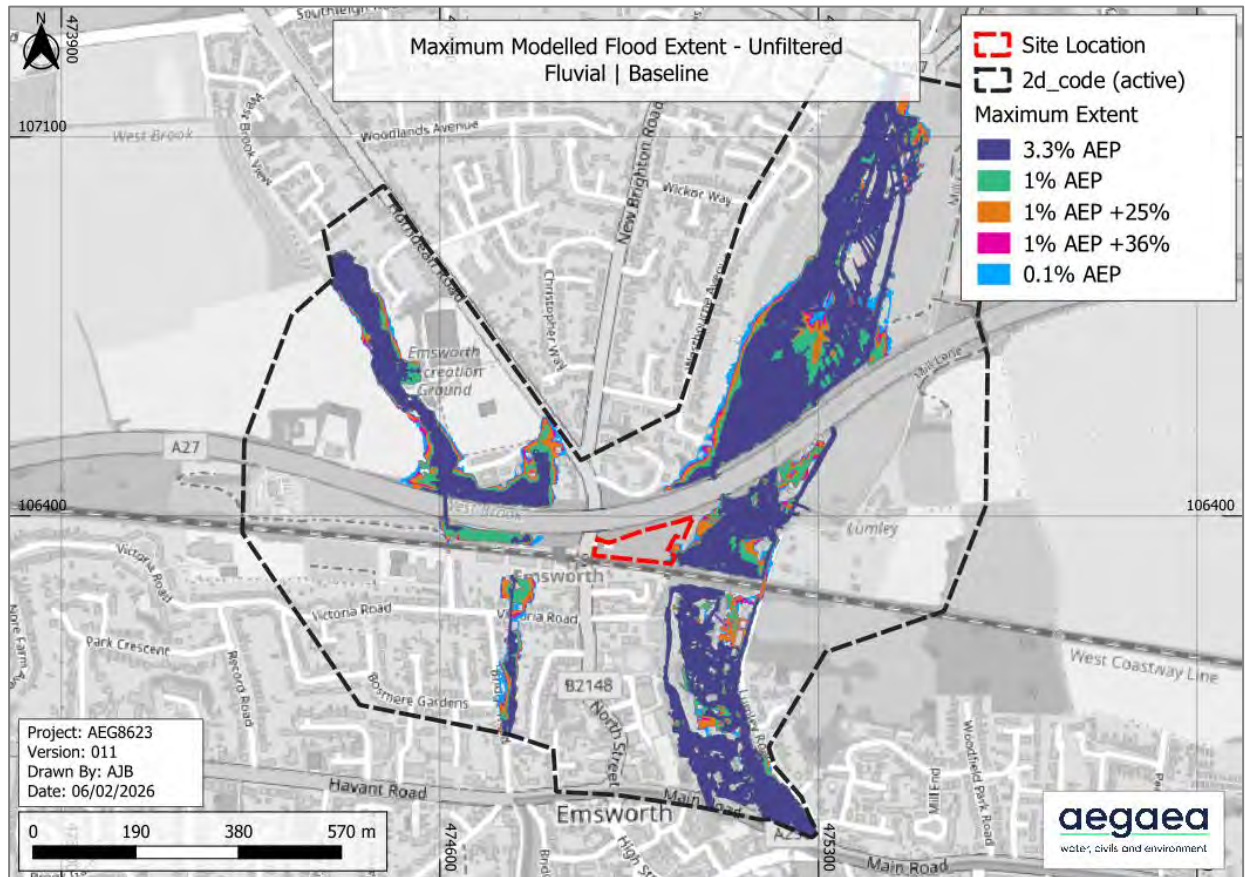


Figure 13: Baseline maximum modelled flood extents | L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

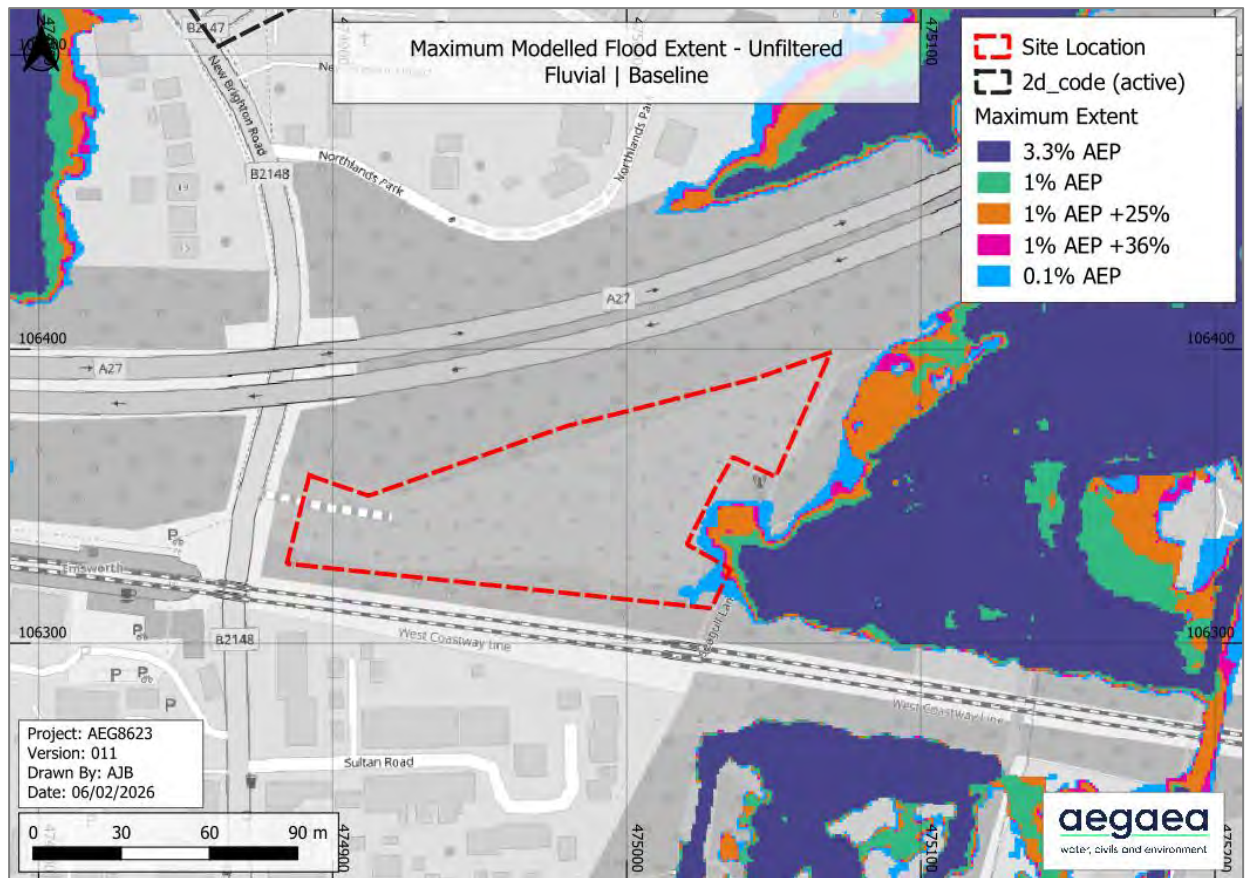


Figure 14: Baseline maximum modelled flood extents | L3 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

- 5.2. Flows were found to exceed channel capacity for all simulated events from the West Brook and River Ems. Large extents of floodplain inundation are observed, with severe backing up of water upstream of the A27 highway embankment and the West Coastway Railway Line. Hydraulic structures and underpass features through these topographic features restrict conveyance downstream and are the dominant control on flood mechanisms in the vicinity of the Site. The Site occupies higher ground relative to the River Ems and West Brook and largely remains outside the modelled flood extents.
- 5.3. The Site is identified as being outside the 1% AEP maximum flood extent which is analogous to Flood Zone 3 in lieu of historic or tidal flood extents.
- 5.4. Flow pathways within close proximity to the Site are depicted on Figure 15. Flooding from the West Brook is shown not to impact the Site.

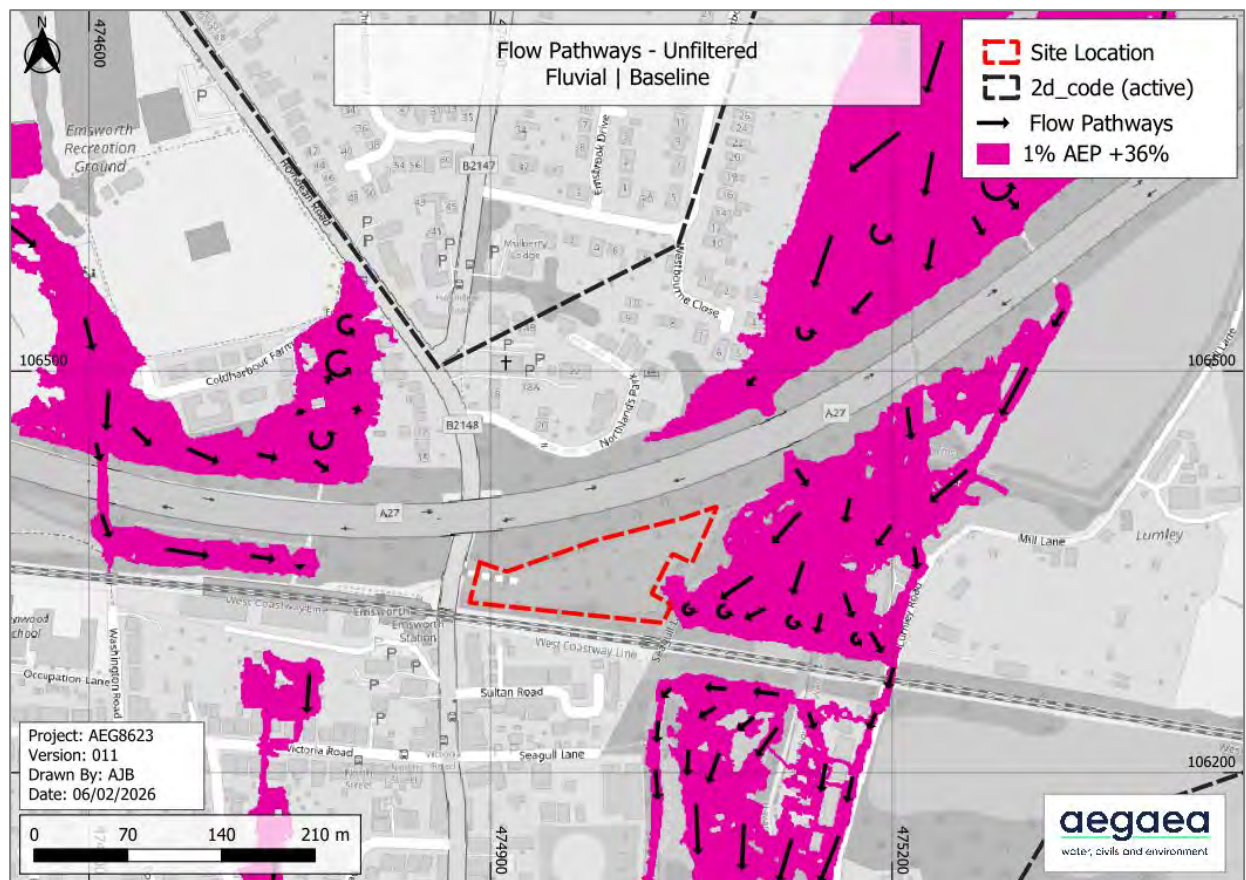


Figure 15: Baseline flow pathways within Site vicinity | L2 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

Maximum Modelled Depths

- 5.5. Baseline maximum modelled flood depth maps for all simulated storm events between the 3.3% and 0.1% AEP event are shown in Figure 16 to Figure 20. The deepest flooding observed onsite in the 2D domain is located within a localised depression to the southeast of the Site. Sampled maximum depths within the Site boundary have been extracted and are presented in Table 8. Maximum depths of up to 0.21m are observed during the 0.1% AEP event within the Site boundary.

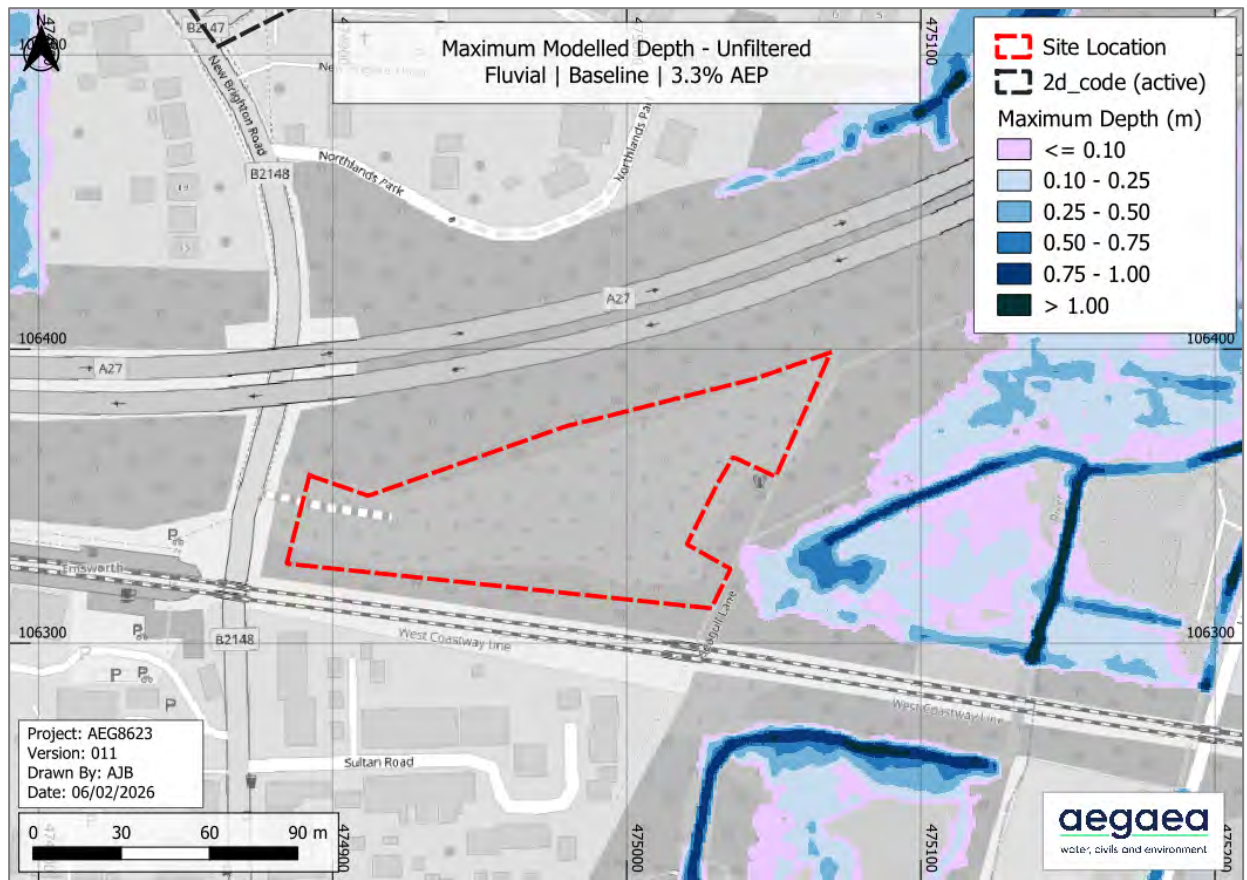


Figure 16: Baseline maximum modelled unfiltered depths for the 3.3% AEP event. | L3 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

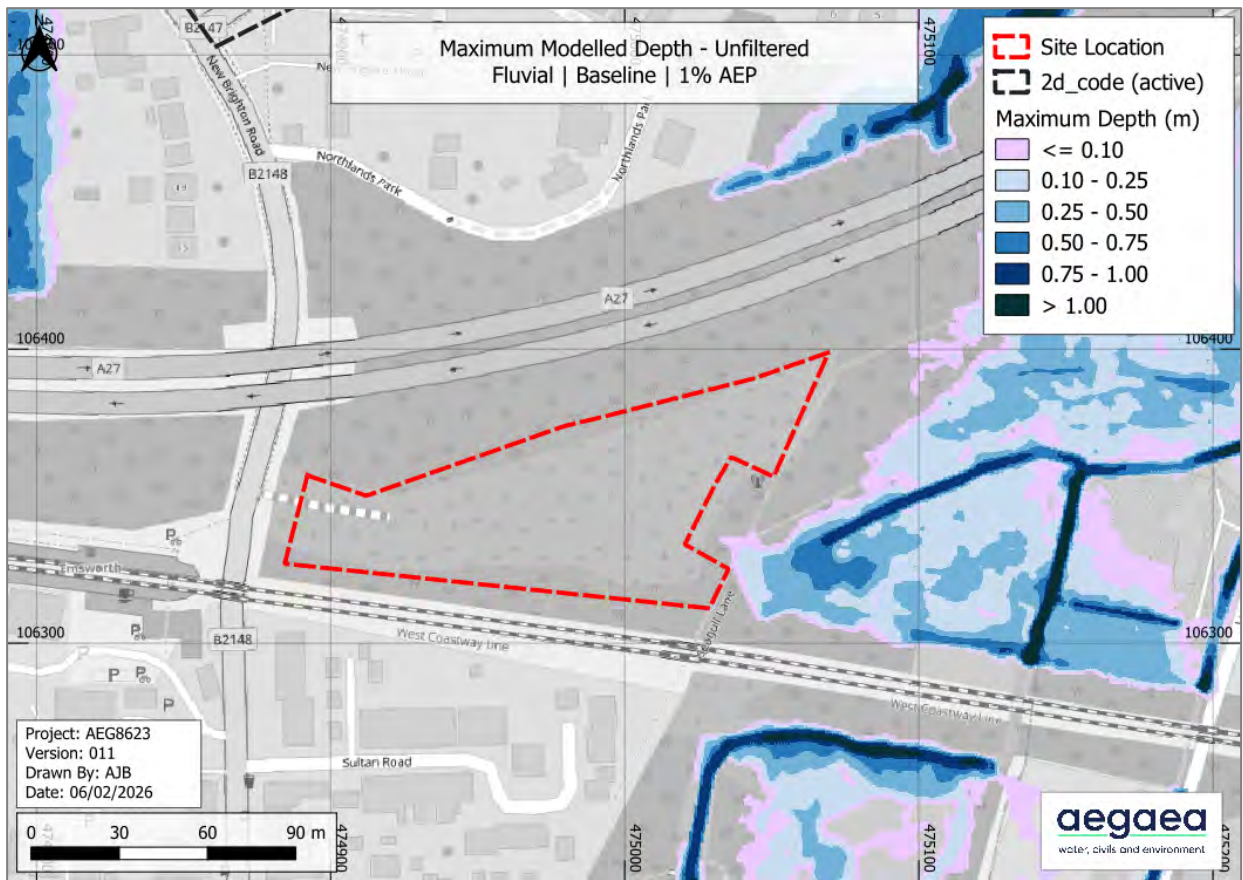


Figure 17: Baseline maximum modelled unfiltered depths for the 1% AEP event | L3 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

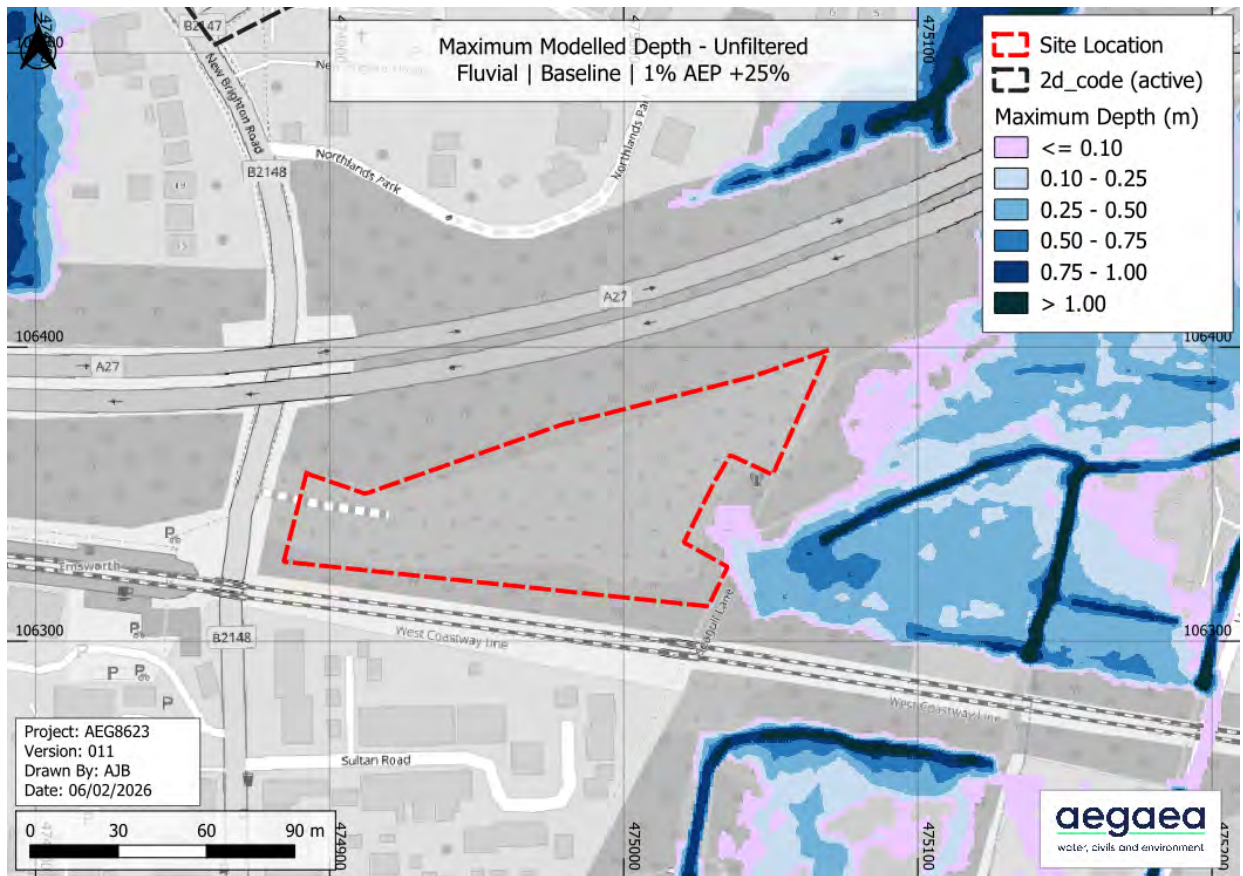


Figure 18: Baseline maximum modelled unfiltered depths for the 1% AEP plus 25% climate change event | L3 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

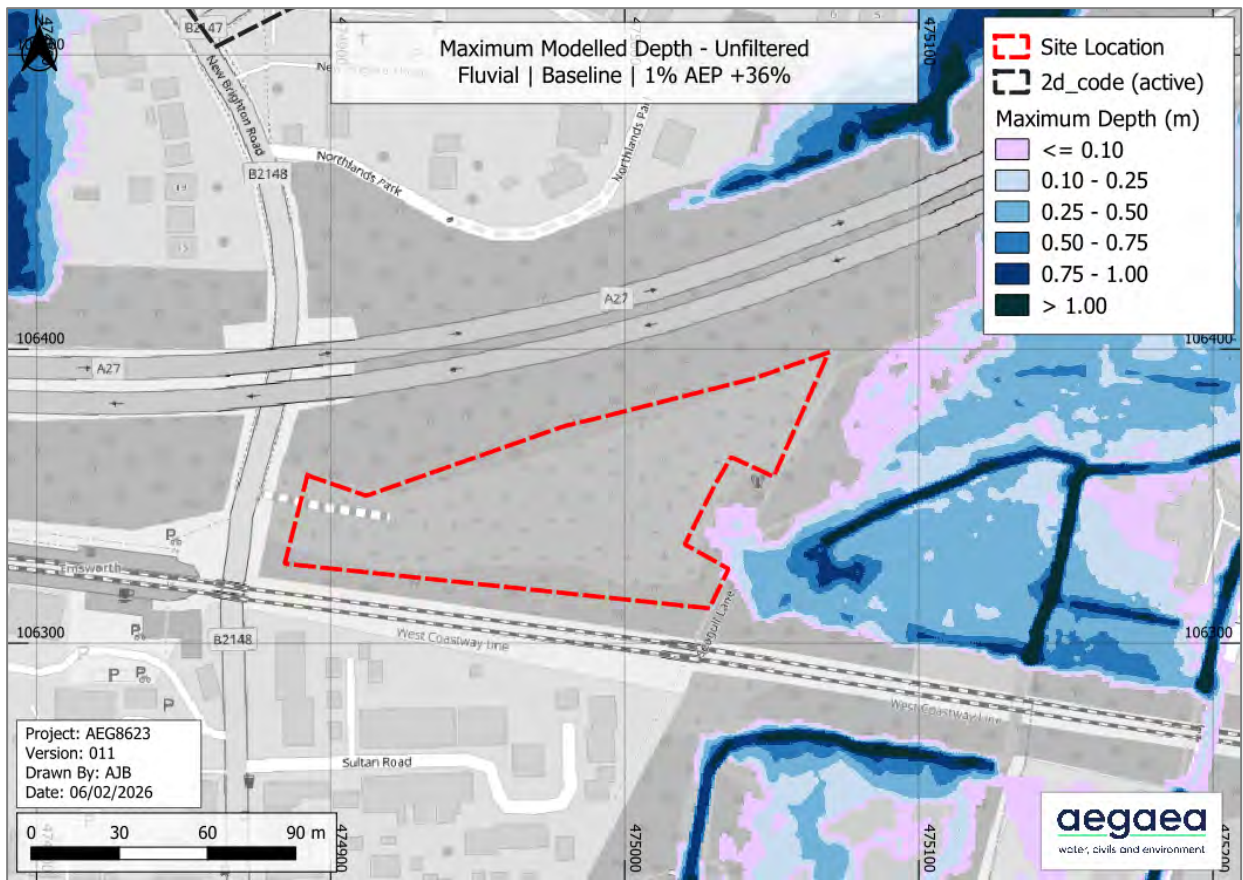


Figure 19: Baseline maximum modelled unfiltered depths for the 1% AEP plus 36% climate change event | L3 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

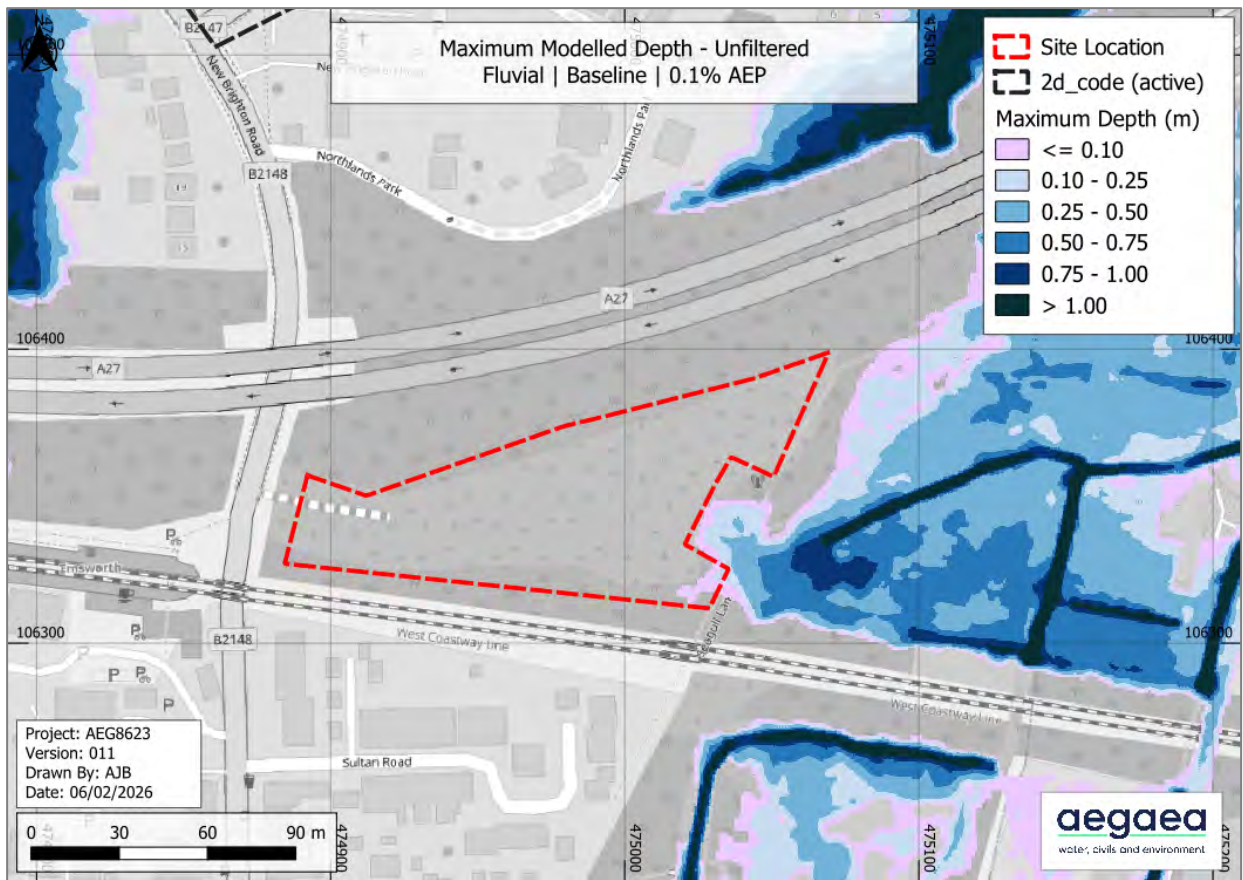


Figure 20: Baseline maximum modelled unfiltered depths for the 0.1% AEP event | L3 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

5.6. Baseline maximum flood depths have been extracted from within the Site boundary for each AEP event are summarised in Table 8. The maximum depth and water level within the Site boundary occurs in the southwest corner.

Table 8: Baseline maximum modelled flood depth within the Site boundary

Storm Event (AEP)	Maximum Modelled Depth (m)	Maximum Modelled Level (m AOD)
3.3%	n/a	n/a
1%	n/a	n/a
1% + 25%	0.03	4.82
1% + 36%	0.06	4.85
0.1%	0.21	5.00

FMfP Flood Zones Results Comparison

- 5.7. A comparison between the Baseline modelled extents and the EA FMfP Flood Zone data (NaFRA2 release) for the 1% and 0.1% AEP events are shown in Figure 21 and Figure 22.
- 5.8. The Baseline modelled flood extents for both events were found to follow similar overland flow paths, and a good correspondence is observed with the EA mapping. However, the Site is identified as being outside the 1% AEP maximum flood extent which is analogous to Flood Zone 3 in lieu of historic or tidal flood extents. A reduced extent of flooding is observed upstream of the Site during simulated 0.1% AEP event.
- 5.9. It is important to note that the TUFLOW modelled extents incorporate a higher-resolution DTM and a higher horizontal-resolution grid. Additionally, the site-specific modelling study incorporates key structure survey data, better representing conveyance through the upstream A27 and downstream Railway Line embankments. Consequently, the site-specific modelling results are considered more reliable and should take precedence over the national-scale approach.

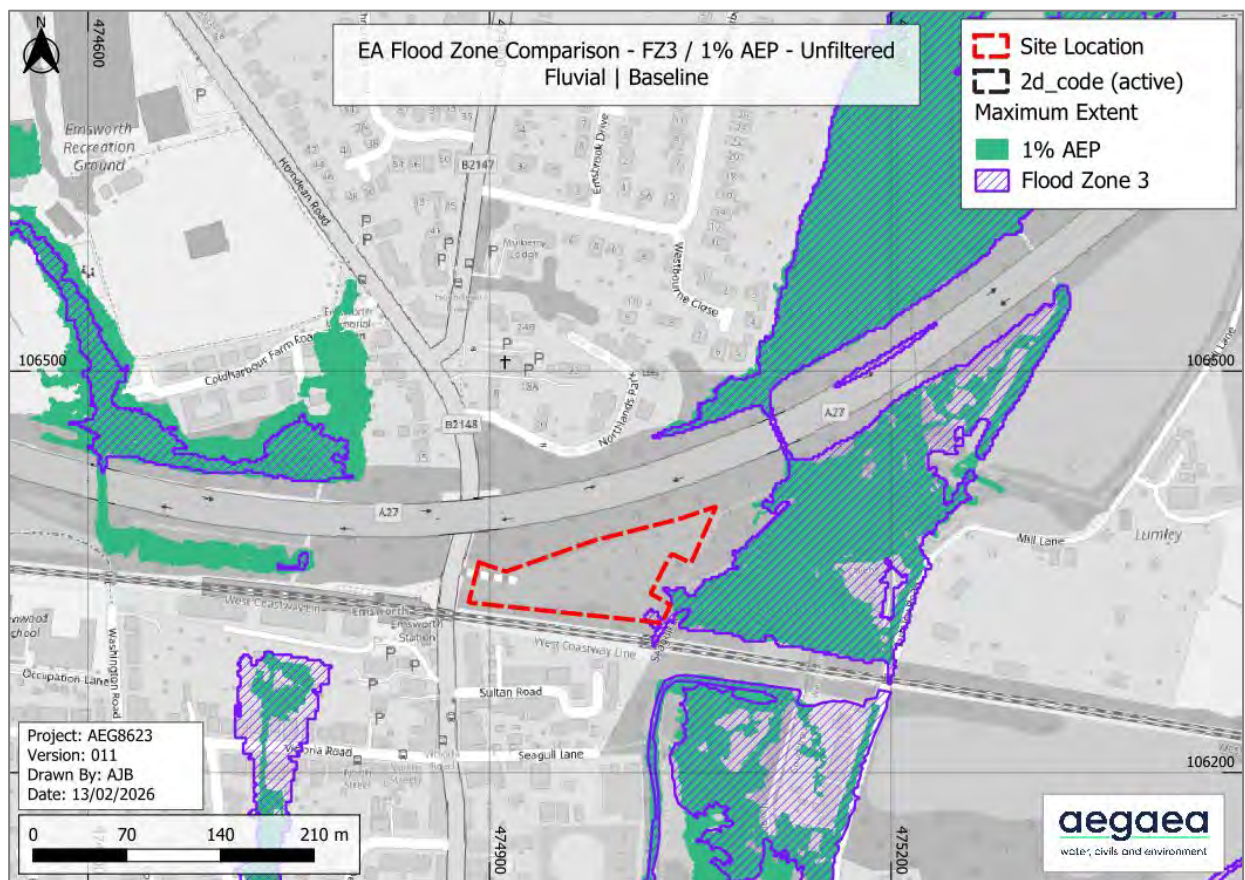


Figure 21: Comparison between the Baseline modelled 1% AEP maximum modelled flood extents and EA's FMfP (2025) medium risk band mapping | L2 (FMfP Data: EA ©. Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

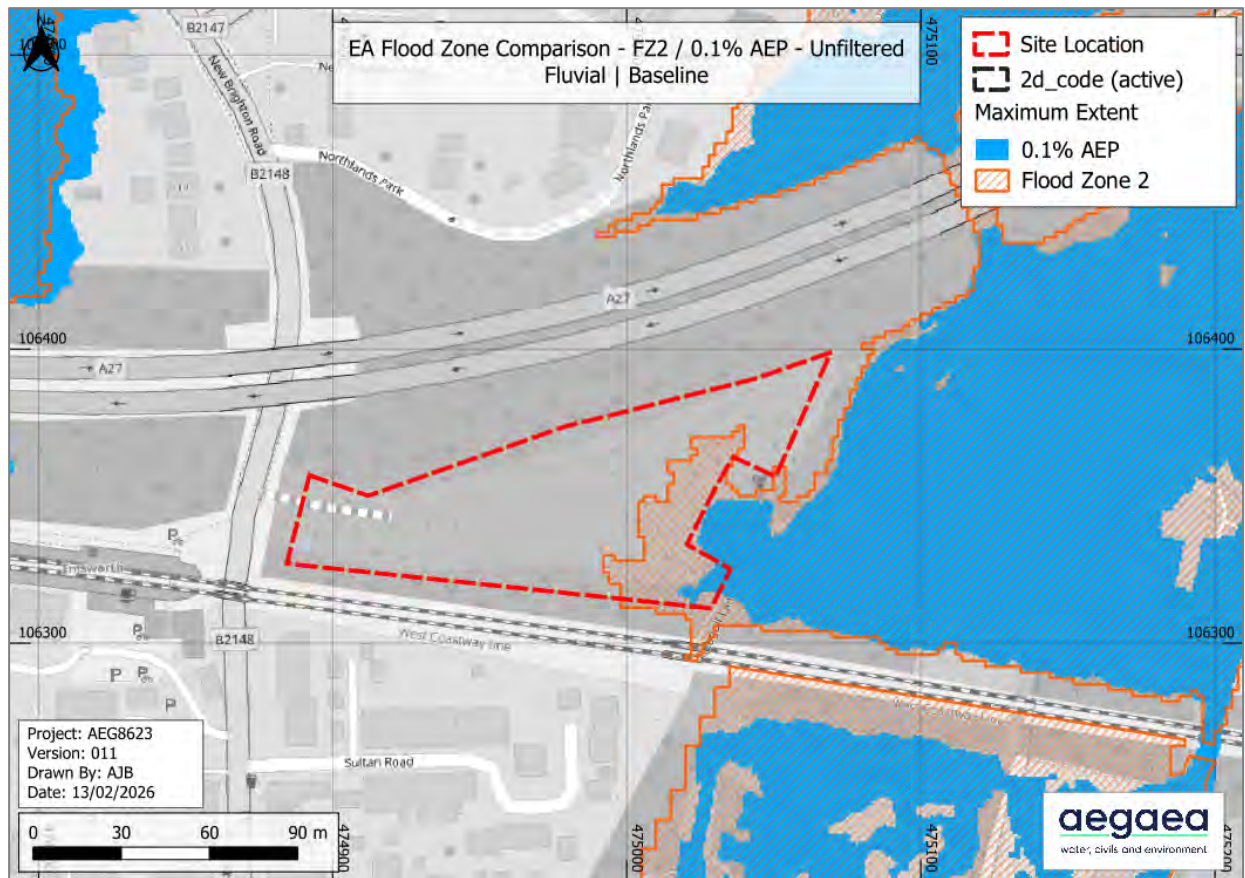


Figure 22: Comparison between the Baseline modelled 0.1% AEP maximum modelled flood extents and EA's FMfP (2025) low risk band mapping | L2 (FMfP Data: EA ©. Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

Summary

- 5.10. The hydraulic model outputs indicate that the Site remains largely outside the extent of all simulated events. The Site is identified as being outside the 1% AEP maximum flood extent which is analogous to Flood Zone 3 in lieu of historic or tidal flood extents. Minor encroachments to the Site boundary are noted for the 1% AEP + 25% climate change, 1% AEP + 36% climate change and 0.1% AEP events, however, the flooding is confined to the lowest ground elevations on Site in the southeast corner.
- 5.11. Large extents of floodplain inundation are observed outside the Site boundary, with severe backing up of water upstream of the A27 highway embankment and the West Coastway Railway Line. Hydraulic Structures and underpass features through these topographic features restrict conveyance downstream and are the dominant control on flood mechanisms in the vicinity of the Site. The Site occupies higher ground relative to the River Ems and West Brook and largely remains outside the modelled flood extents.
- 5.12. The deepest flooding observed onsite in the 2D domain is located within a localised depression to the southeast of the Site. Sampled maximum depths within the Site boundary have been extracted and are presented in Table 8. Maximum depths of up to 0.21m are observed during the 0.1% AEP event within the Site boundary.

6. Model Sensitivity

- 6.1. A series of sensitivity tests were undertaken on the model using the 1% AEP + 36% climate change event.

Downstream Structure Blockage

- 6.2. To assess the influence of a potential blockage of the downstream structure EMS01_00000_B1, the model was simulated with a significant 50% blockage at this structure. The blockage was enforced using the 'pblockage' attribute in the 1d_nwk feature. The EMS01_00000_B1 structure is large and is not expected to be particularly vulnerable to blockage events. Therefore, the application of a 50% blockage event is considered to be a conservative scenario sensitivity test (SEN_BLA).
- 6.3. All other boundary conditions and inflow parameters remained unchanged. The scenario was used to test the robustness of the estimated structure geometry, where the upstream face survey data was not available and to understand the potential impact of a downstream blockage event on flood extents in the vicinity of the Site.
- 6.4. The results demonstrate that the blockage event has a major impact on flood depths upstream of the West Coast Railway Line embankment, however, the impacts on extent are more limited. Within the Site boundary, the impact is slight with increased flood extent in the southeast corner.
- 6.5. The model performed as expected, therefore no changes were applied to the hydraulic model methodology in light of this sensitivity test.

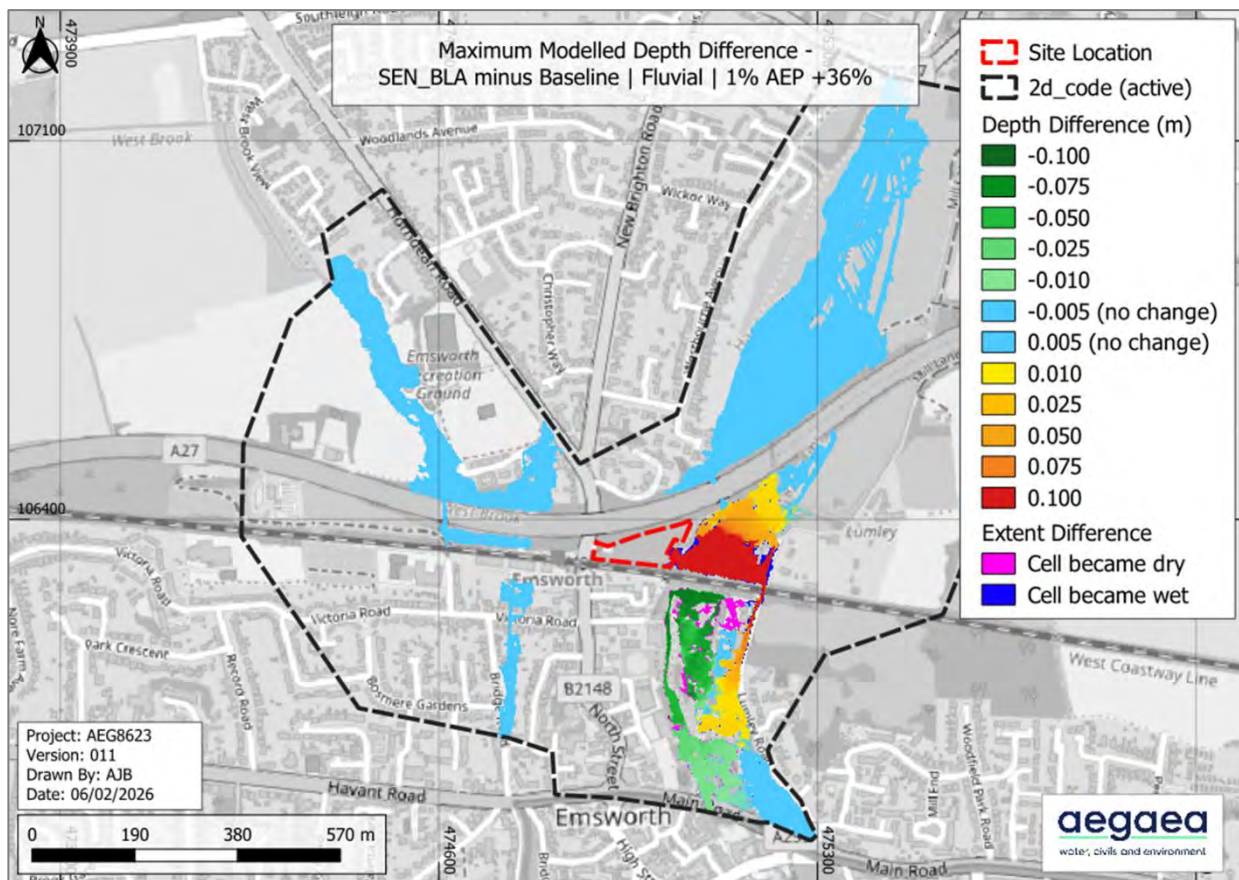


Figure 23: Depth difference map showing the impact of a 50% blockage of EMS01_00000_B1 compared to the Baseline scenario for the 1% AEP +36% event. | L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

Channel Reinforcement Method

- 6.6. To assess the influence of the channel reinforcement applied, based on survey data where available and LiDAR elevations decreased by 0.3m elsewhere, a sensitivity test was undertaken without the 0.3m reinforcement. During the SEN_LIDAR_ELEVS scenario, channel reinforcement levels were based on survey data where available and directly sampled LiDAR elevations. In effect, channel bed levels were 0.3m higher during this sensitivity test.
- 6.7. All other boundary conditions and inflow parameters remained unchanged.
- 6.8. Figure 24 demonstrates that removing the 0.3m reinforcement to channel elevations has a moderate impact on maximum modelled flood depths in the vicinity of the Site. Within the Site boundary, the impact is slight with increased flood extent in the southeast corner. Channel depths are decreased by up to 0.30m whilst floodplain depths increase by up to 0.05m in the vicinity of the Site. In the wider model domain, depth increases of up to 0.12m are observed.
- 6.9. The model performed as expected, therefore no changes were applied to the hydraulic model methodology considering this sensitivity test. LiDAR does not penetrate water surface elevations, so it is considered appropriate to apply some amount of reinforcement. Within the channel where limited survey was available, 0.3m was found to be within the range of observed discrepancies. Baseflow has

been represented within the hydrograph curve to ensure normal flow conditions are not omitted from the inflows.

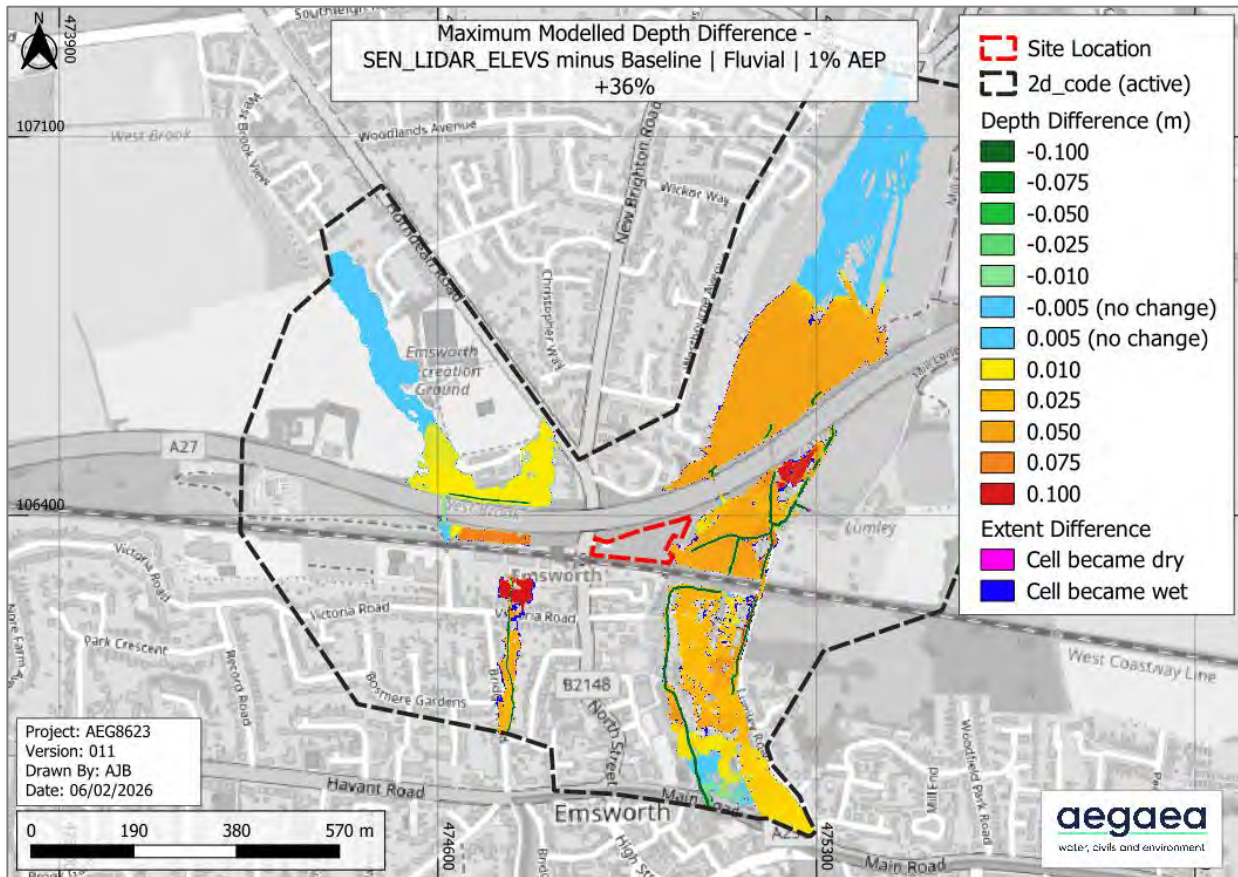


Figure 24: Depth difference map showing the impact of removing the 0.3m decrease in elevations to LiDAR sampled bed level reinforcement levels conditions compared to the Baseline scenario for the 1% AEP +36% event | L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

Downstream Boundary

- 6.10. To assess the influence of the downstream boundary conditions, sensitivity testing was undertaken with an increased HQ slope and HT value, and separately a decreased HQ slope and HT value. The slope was varied by +/- 20% and the water level was varied by +/- 0.5m representing changes in water level at Peter Pond.
- 6.11. All other boundary conditions and inflow parameters remained unchanged.
- 6.12. The results demonstrate that whilst the impacts are noted at the downstream boundary, the effects of a change in slope and water level value do not propagate upstream to the Site location. The model performed as expected and therefore, no changes were applied to the hydraulic model methodology in light of this sensitivity test.

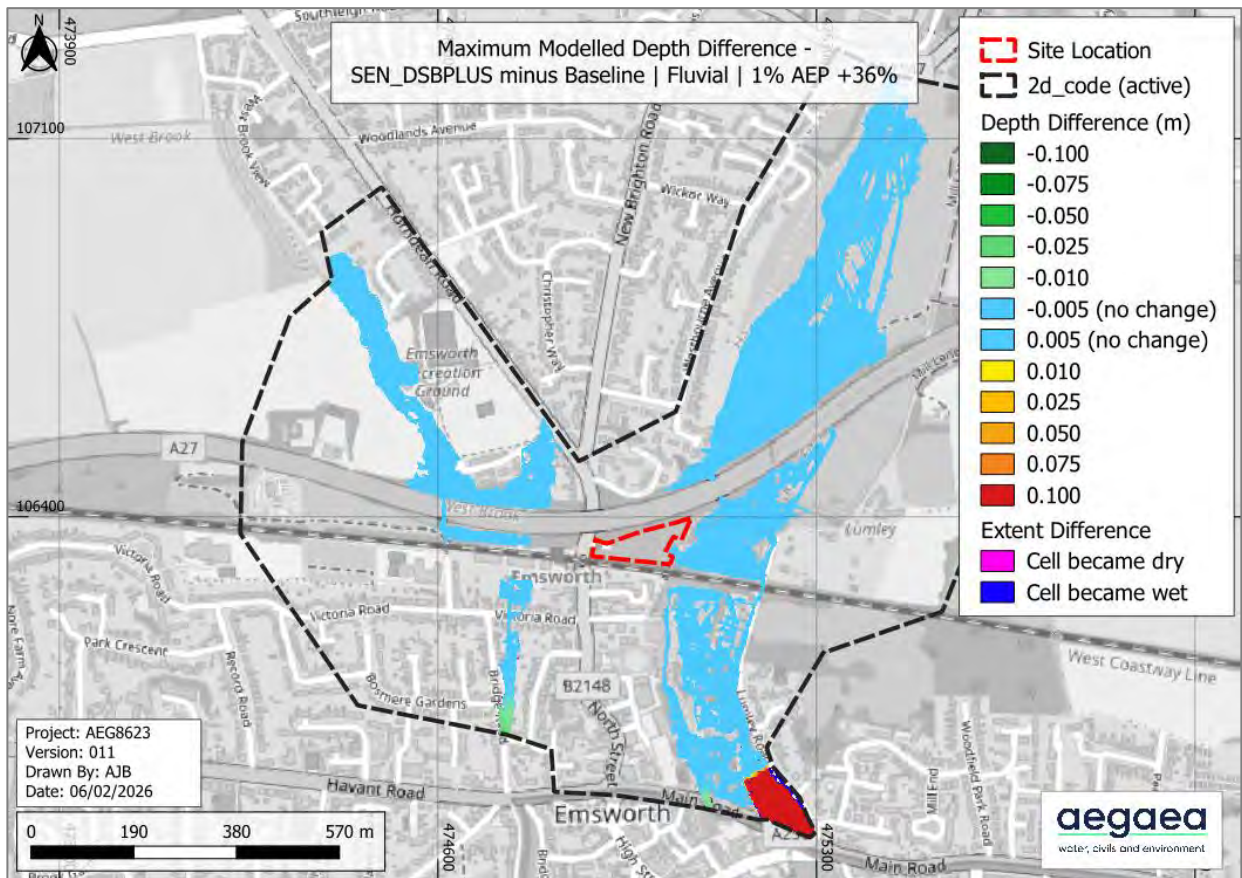


Figure 25: Depth difference map showing the impact of increased slope and water level downstream boundary conditions compared to the Baseline scenario for the 1% AEP +36% event. | L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence

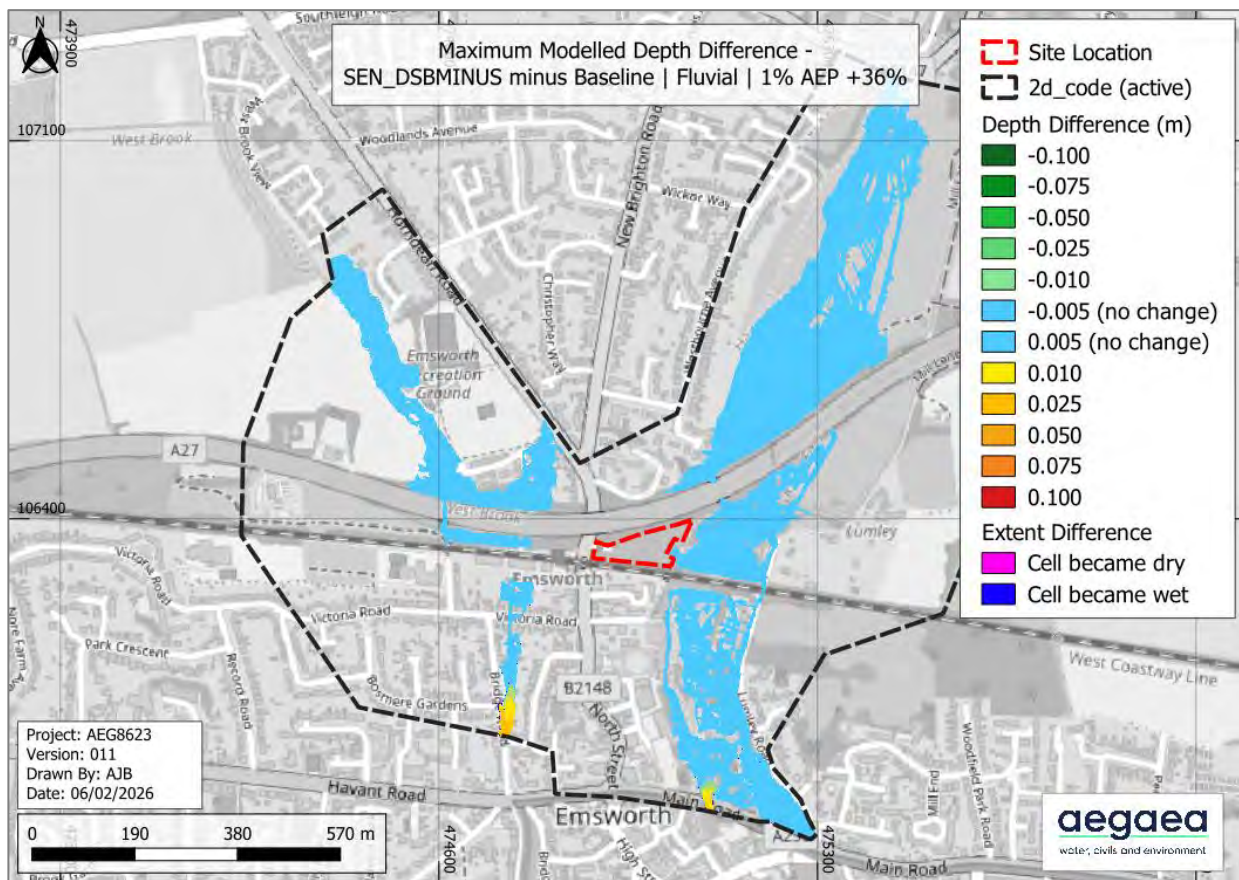


Figure 26: Depth difference map showing the impact of decreased slope and water level downstream boundary conditions compared to the Baseline scenario for the 1% AEP +36% event. | L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence

Roughness

- 6.13. To account for the seasonal variations in vegetation, sensitivity tests were conducted against the Baseline conditions in model roughness parameters. The following sensitivity tests were conducted:
- 20% increase in catchment floodplain and channel roughness
 - 20% decrease in catchment floodplain and channel roughness
- 6.14. Figure 27 presents the depth difference results for the 20% increase in roughness. Generally, this scenario results in moderate changes to flood depths and minor changes to extents in the vicinity of the Site. There are significantly increased depths throughout the model domain. On-site changes in flood depth are limited to a maximum of 0.03m.
- 6.15. Figure 28 presents the depth difference results for the 20% decrease in roughness. Generally, this scenario results in moderate change to flood depths and minor changes to extents in the vicinity of the Site. There are significantly decreased depths throughout the model domain. On Site changes in flood depth are limited to a maximum of -0.04m.
- 6.16. The model exhibits moderate sensitivity to changes in floodplain roughness throughout the model domain. While site-specific calibration data was not available, the Baseline floodplain Manning's n values

were selected based on Ordnance Survey Open Data and satellite imagery and are considered appropriate for the observed land cover and model resolution. The results confirm that the model performs reliably within a reasonable range of expected roughness values, and that the parameterisation is suitable for use in the context of a site-specific hydraulic modelling study.

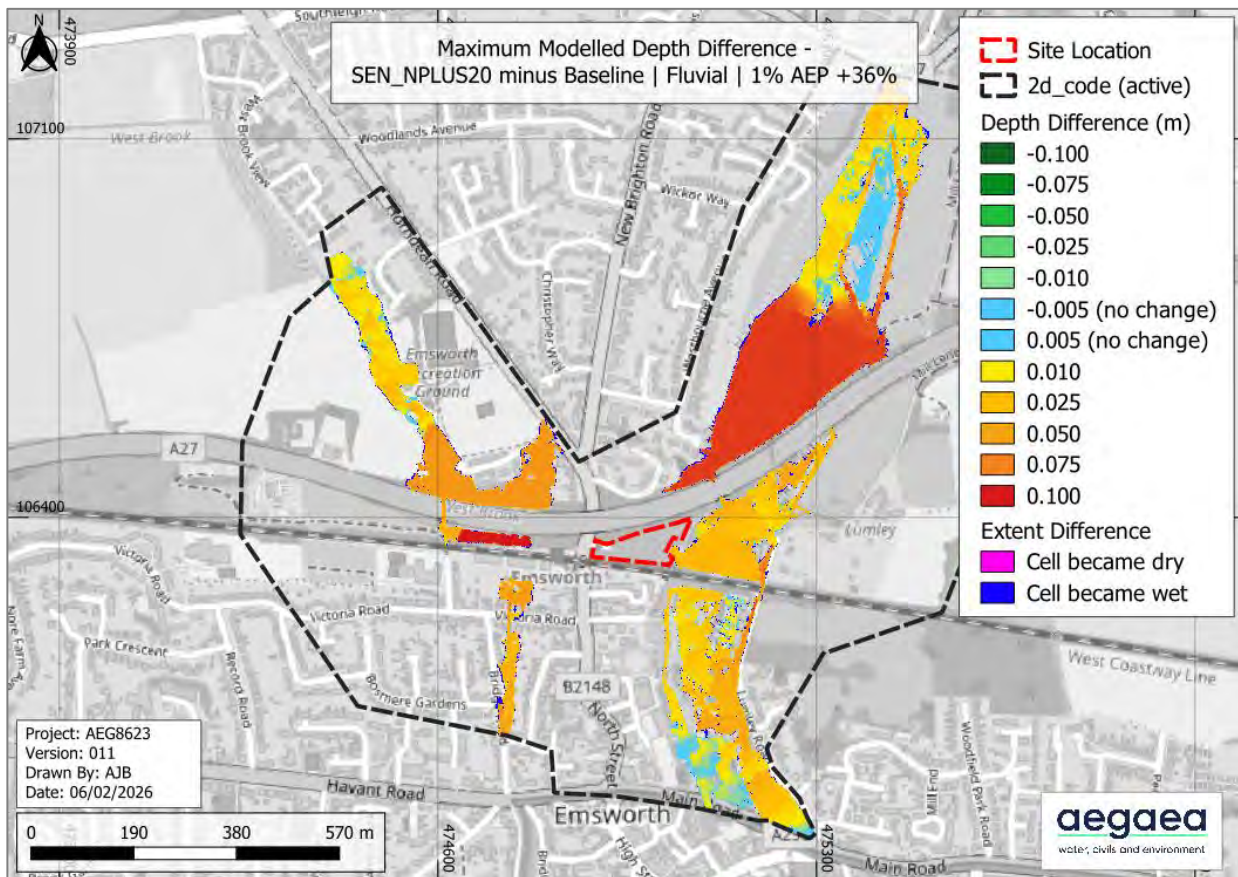


Figure 27: Depth difference comparison between the 20% increase in roughness and the Baseline for the 1% AEP +36% event | L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

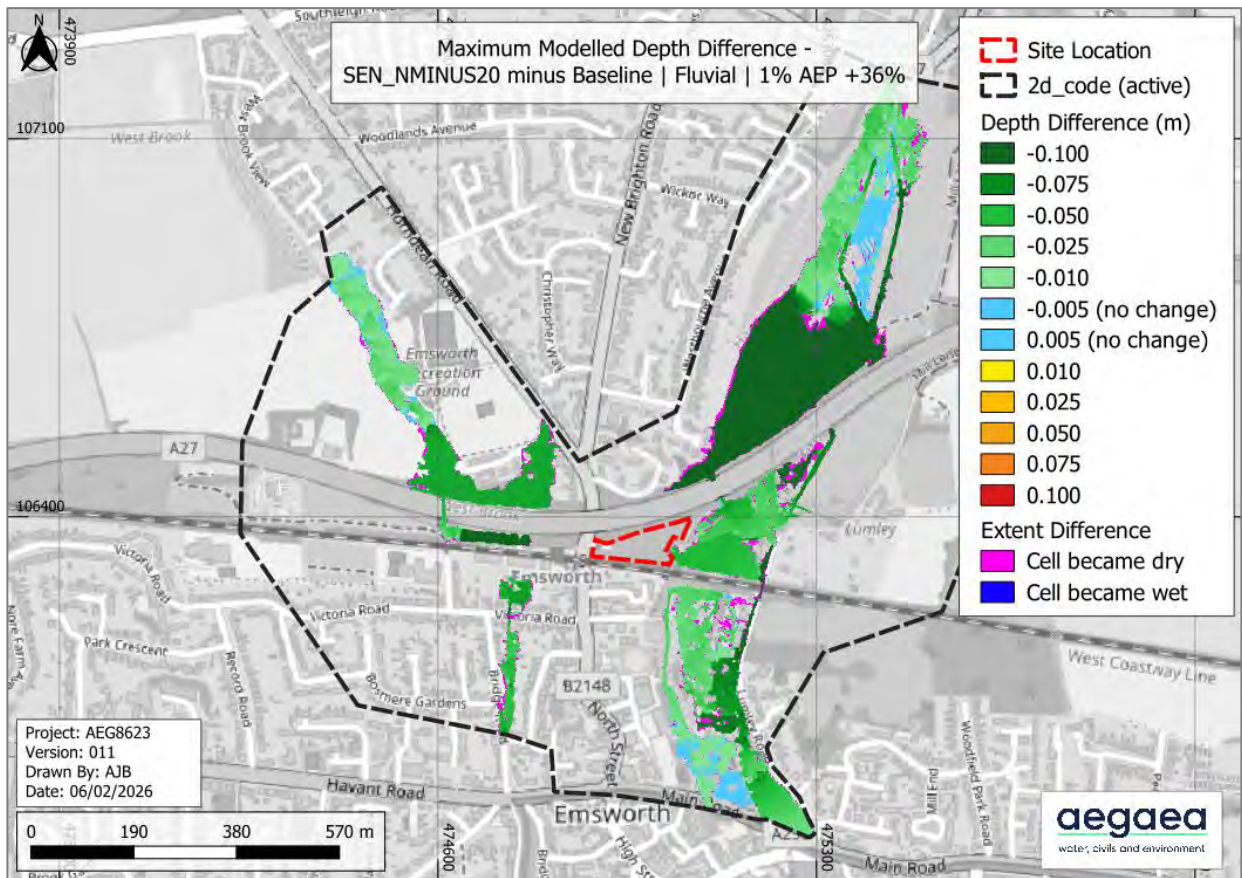


Figure 28: Depth difference comparison between the 20% decrease in roughness and the Baseline for the 1% AEP +36% event| L1 (Base map: OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence number 100024198).

7. Model Stability & Limitations

Simulation Parameters

- 7.1. TUFLOW version 2025.2.2-iSP-w64 Heavily Parallelised Compute (HPC) was used for all simulations and was the most recent release at the time of final simulation.
- 7.2. All parameters were retained as default.
- 7.3. The model adopts adaptive timestepping to optimise computational efficiency and ensure numerical stability.

Model Stability

- 7.4. No negative depths were reported in the 1D or 2D domain for the Baseline simulations.
- 7.5. No repeated timesteps were reported in the HPC (2D) domain for the fluvial Baseline, which is a good indicator of model stability. The final cumulative mass error for all Baseline simulations was between +0.01% and -0.01%. This is within the acceptable tolerance for healthy model performance ($\pm 1.0\%$).
- 7.6. For a HPC model to be considered stable, three parameters should be maintained: Nu (Courant number relates to velocity relative to the cell size), Nc (Celerity Control number relates to water depth relative to cell size) and Nd (Diffusion control relates diffusion of momentum relating to the sub grid viscosity). Generally, for a stable model these values should be: $Nu < 1$, $Nc < 1$ and $Nd < 0.3$. Based on the values in Table 9, the model's Nu, Nc and Md max values do not exceed the limit for healthy performance, therefore the model is considered stable.
- 7.7. The N_c and N_d numbers could be reduced by increasing the model grid size, however, this would sacrifice model accuracy. Therefore, it was decided to retain the high-resolution model cell size and tolerate the high N_c and N_d number during more extreme storm events, where modelled water depths are highest. It's important to note that, despite the borderline N_c and N_d values, the model remains within acceptable tolerance for stability.

Table 9: HPC solver stability outputs

	Maximum allowance indicating a healthy model performance	Max Outputs - 1%AEP +CC36%	Average Outputs - 1%AEP +CC36%
Nu (Courant number)	1.00	0.66	0.36
Nc (Celerity Control number)	1.00	1.00	0.66
Nd (Diffusion control number)	0.30	0.30	0.29

- 7.8. Table 10 presents the warning and checks present within the TUFLOW messages output. None were considered to have an impact on the model results.

Table 10: TUFLOW Messages in Baseline 1%AEP +CC36% simulation

Message Code	Message Comment	Model Impact
216 x Warning 0646	Input geometry may be empty.	No impact on model results
62 x Check 3505	SGS TIN outside model domain.	ZSH modifications located outside domain. No impact on results.
16 x Check 3519	Using MIN or GULLY option in SGS model.	As intended. The '2d_zsh' reinforcement lines require the MIN option as the underlying elevations are being 'burned' through, rather than representing the existing underlying elevations.
20 x Check 2118	Lowered SX ZC Zpt by 0.13m to 1D node bed level.	Intended result of 'Z' flags on SX lines.
2 x Warning 2118	Lowered SX ZC Zpt by 0.13m to 1D node bed level.	Intended result of 'Z' flags on SX lines.

Limitations

- 7.9. Limitations of the hydraulic modelling have been presented below. The hydraulic modelling process, while based on the best available information, involved certain assumptions made during the model build, which are outlined below.
- 7.10. The hydrological inflow boundaries were derived using ReFH2.3 hydrographs scaled to FEH Statistical peak flows, which is an accepted industry-standard approach. While the method involves assumptions, it provides a robust foundation for inflow estimation within the study area catchment.

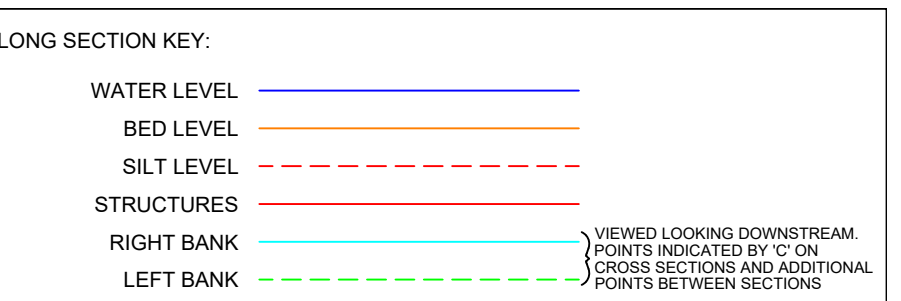
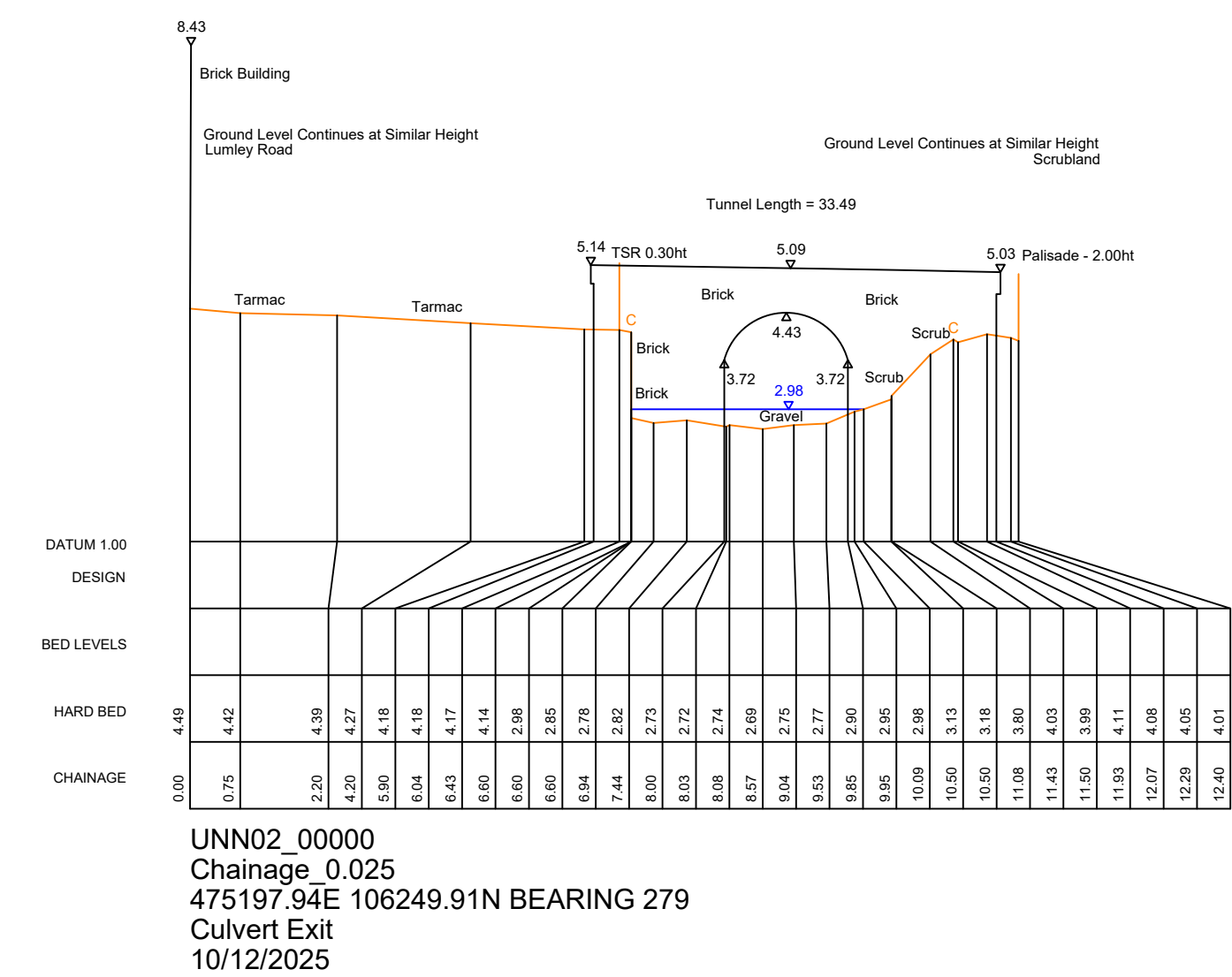
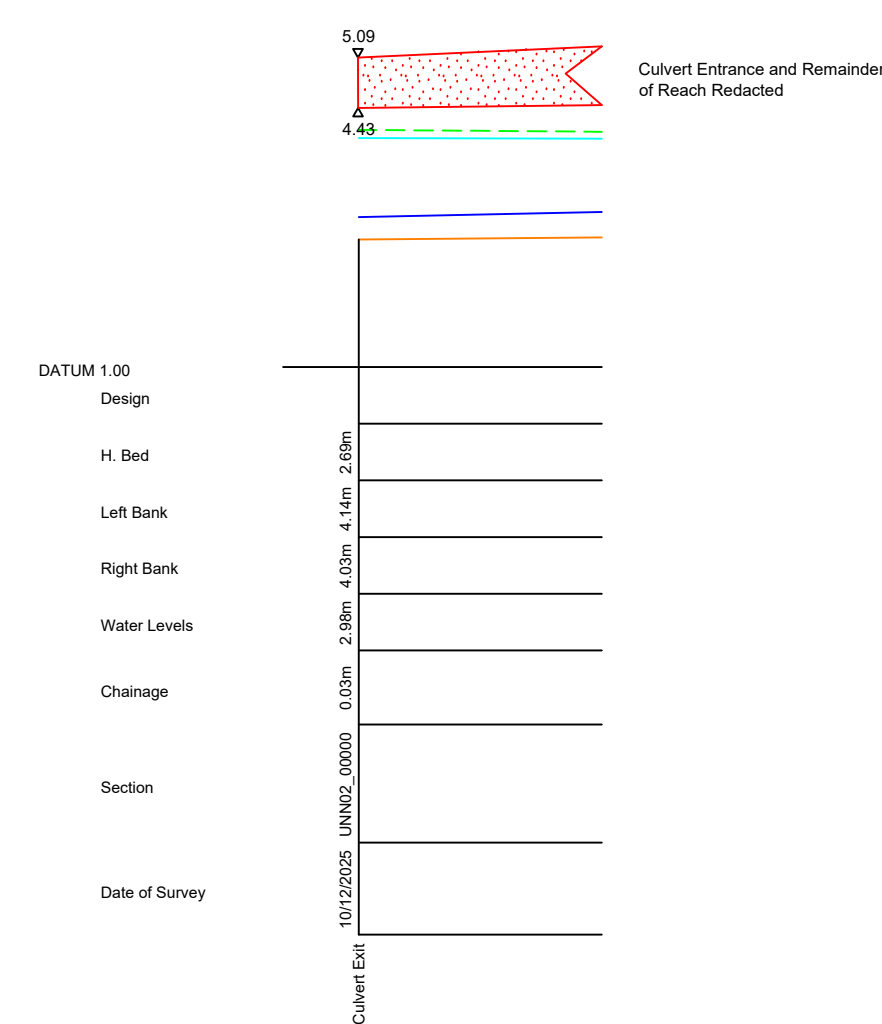
- 7.11. The model uses LiDAR DTM data, which has a vertical accuracy of +/- 0.15m. This level of accuracy is suitable for the purposes of the model but may introduce some limitations, especially in areas with dense vegetation where topographical features may be less accurately represented.
- 7.12. Storm Geomatics were unable to survey sections of the River Ems in the vicinity of the Site due to access refusals and revocations. Consequently, despite best efforts to obtain comprehensive survey data, the only 1D elements of the model build are embedded structures within the 2D domain. Open channel is represented with LiDAR elevations, reinforced with limited survey data and 'z shape' reinforcement to width and bed level. Crucially, Storm Geomatics were able to obtain survey data for all identified critical structures through the A27 highway embankment and the West Coastway Railway Line embankment. At least one upstream or downstream face was surveyed for the key hydraulic controls through upstream and downstream embankments.
- 7.13. Manning's n values were selected based on survey, aerial imagery, and LiDAR interpretation. While no calibration data was available, floodplain and channel roughness values were tested through sensitivity analysis ($\pm 20\%$) and the model showed only moderate sensitivity to these changes. As such, the Baseline values are deemed appropriate.
- 7.14. The downstream structure EMS01_00000_B1 was only surveyed at the downstream face. Dimensions are estimated based on the full width and half height of the downstream face due to a photograph through the structure showing obstruction at upstream face. Sensitivity testing of this structure showed only slight change in depth and extent within the site boundary as a result of a 50% blockage event.
- 7.15. This model was used to assess fluvial flood risk at the Site location and should not be used to assess flood risk in the wider catchment or from different sources without review and updates being applied by a suitably qualified hydraulic modeller.

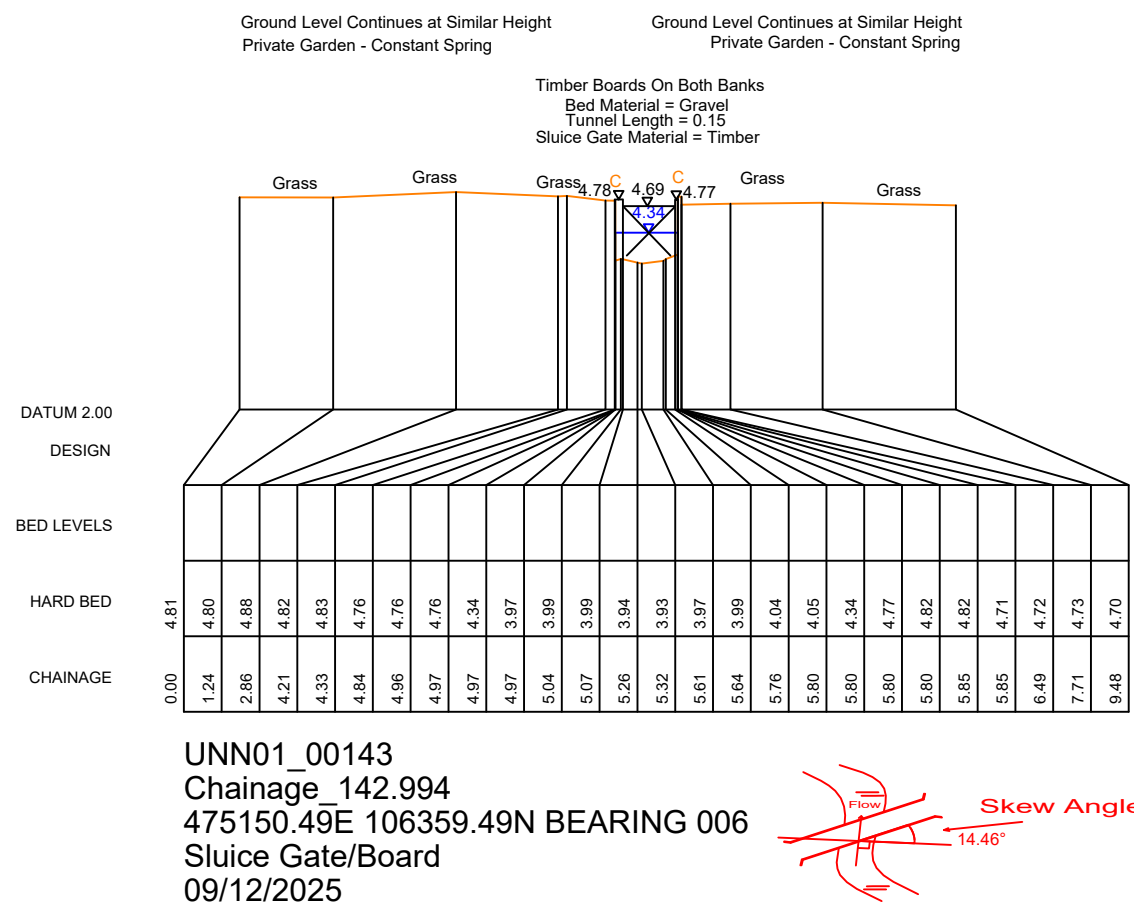
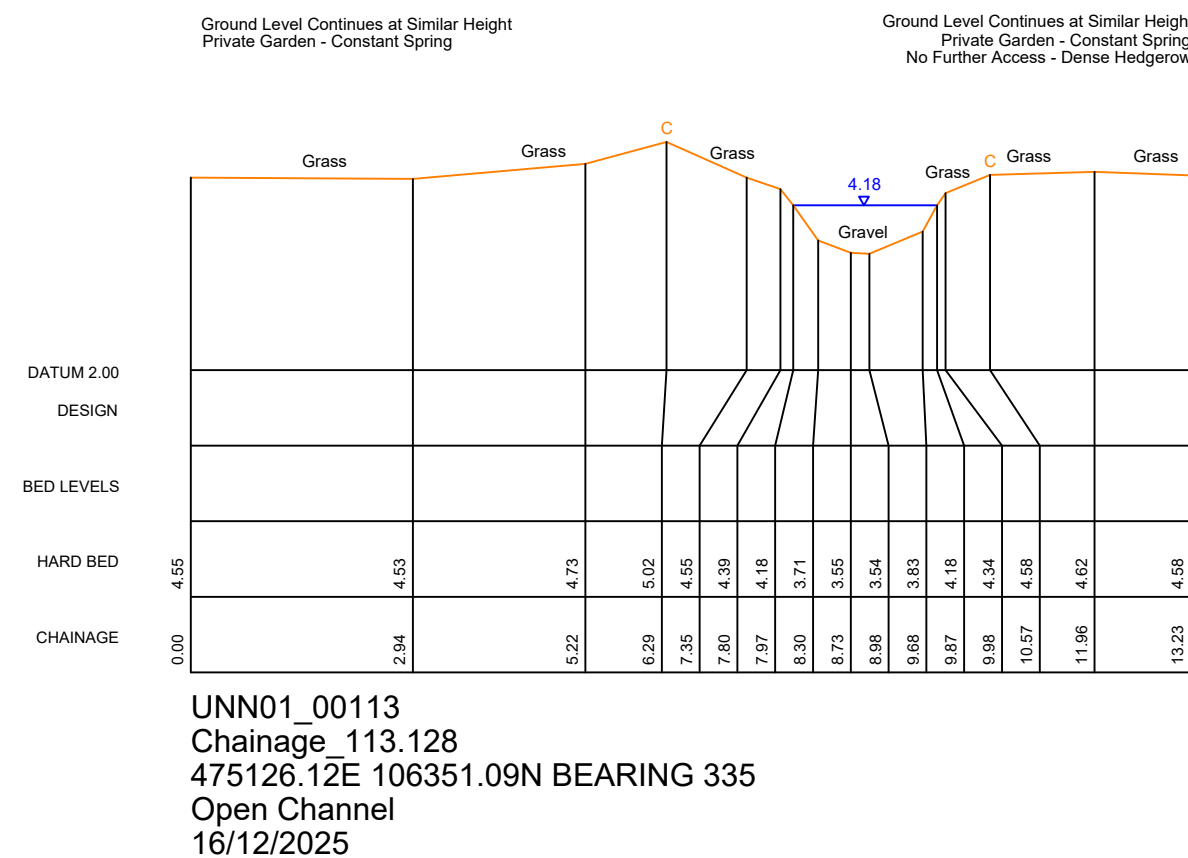
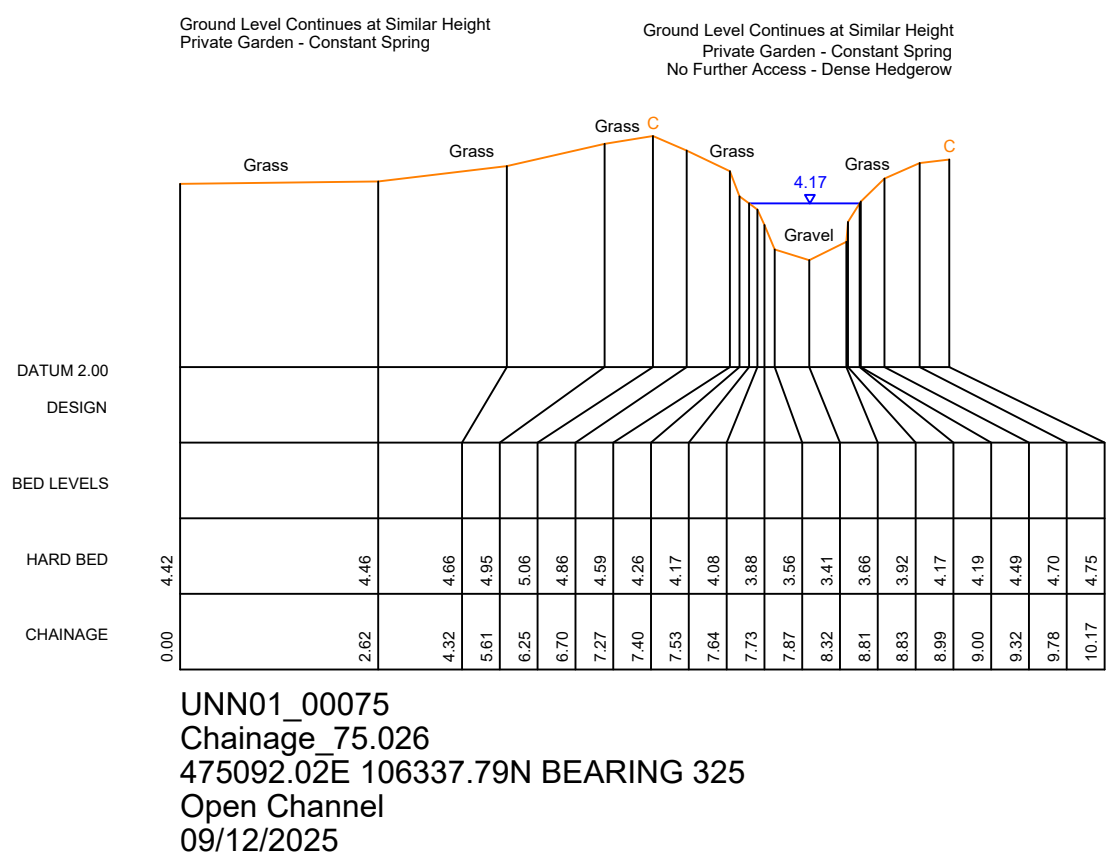
8. Conclusions

- 8.1. A detailed hydraulic model has been developed to assess fluvial flood risk at the Site, using a linked 1D–2D ESTRY–TUFLOW HPC modelling approach. Where sufficient survey information was available; the 1D ESTRY domain was constructed to represent hydraulic structures in the vicinity of the Site. A 2D TUFLOW domain represents the open channel, floodplain and wider catchment. The model incorporates high-resolution LiDAR terrain, site-specific survey data, and following best practice. The final model configuration demonstrates good numerical stability across all simulated scenarios.
- 8.2. The hydraulic model outputs indicate that the Site remains largely outside the extent of all simulated events. Minor encroachments to the Site boundary are noted for the 1% AEP + 25%, 1% AEP +36% and 0.1% AEP events, however, the flooding is confined to the lowest ground elevations on Site in the southeast corner. Large extents of floodplain inundation are observed outside the Site boundary, with severe backing up of water upstream of the A27 highway embankment and the West Coastway Railway Line. Hydraulic structures and underpass features through these topographic features restrict conveyance downstream and are the dominant control on flood mechanisms in the vicinity of the Site. The Site occupies higher ground relative to the River Ems and West Brook and largely remains outside the modelled flood extents. The deepest flooding observed onsite in the 2D domain is located within a localised depression to the southeast of the Site. Sampled maximum depths within the Site boundary have been extracted and are presented in Table 8. Maximum depths of up to 0.21m are observed during the 0.1% AEP event within the Site boundary.
- 8.3. The Site is identified as being outside the 1% AEP maximum flood extent which is analogous to Flood Zone 3 in lieu of historic or tidal flood extents.
- 8.4. The Baseline modelled extents for both events were found to follow similar overland flow paths, and a good correspondence is observed with the EA mapping. A reduced extent of flooding is observed upstream during simulated 0.1% AEP event.
- 8.5. It is important to note that the TUFLOW modelled extents incorporate a higher-resolution Digital Terrain Model and a higher horizontal-resolution grid. Additionally, the site-specific modelling study incorporates key structure survey data, better representing conveyance through the upstream A27 and downstream Railway Line embankments. Consequently, the site-specific modelling results are considered more reliable and should take precedence over the national-scale approach.
- 8.6. Sensitivity testing confirmed the model's robustness to key uncertainties. The model exhibits moderate sensitivity to changes in floodplain roughness and blockage. At the Site, changes in depth are limited to the southeast corner and are generally less than 0.05m. particularly in the southeast corner of the Site. The Site is not sensitive to downstream control conditions in the 1D domain including a severe blockage event. The model performed as expected to a range of sensitivity tests.
- 8.7. The model was shown to be numerically stable, with no negative depths, mass balance errors, or timestep instability. Solver performance (Nu, Nc, Nd) remained within acceptable thresholds. No repeated timesteps occurred in the 2D domain.

- 8.8. The modelling outputs presented in this report provide a reliable, site-specific representation of fluvial flood risk, based on available topographic and hydrological data. The model incorporates detailed survey of surveyed structures, accurately capturing key flow paths and flood mechanisms within the Site. Developed in accordance with best practice and EA guidance, and demonstrating strong numerical stability with low sensitivity to key parameters, the results are considered suitable to support planning decisions and water management strategies for the Site.
- 8.9. The model has been developed to assess fluvial flood risk specifically at the Site and should not be used for applications beyond its defined extent without review and updates from a suitable qualified hydraulic modeller.

Appendix A – Survey Data

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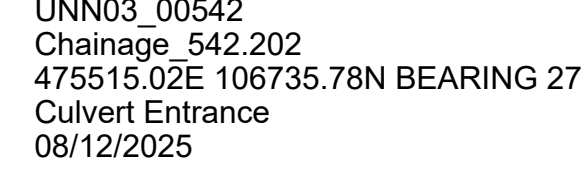
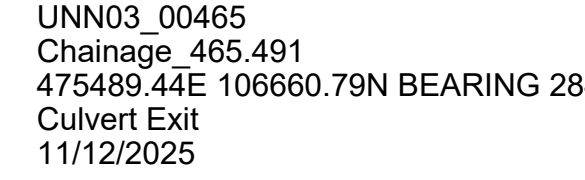
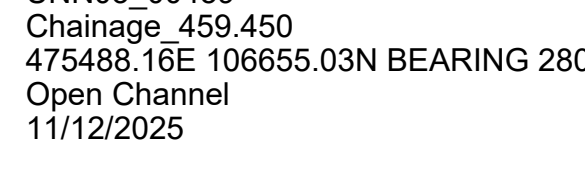
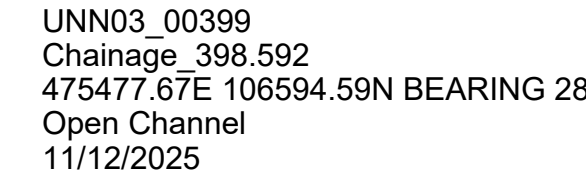
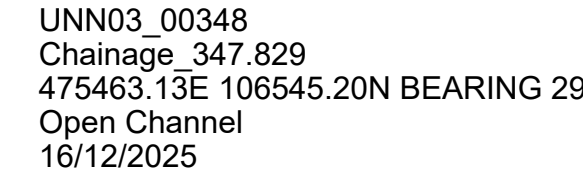
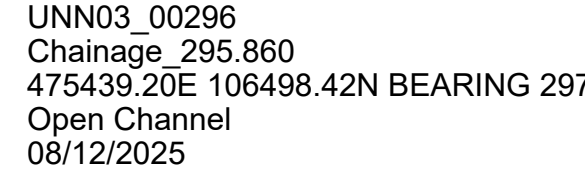
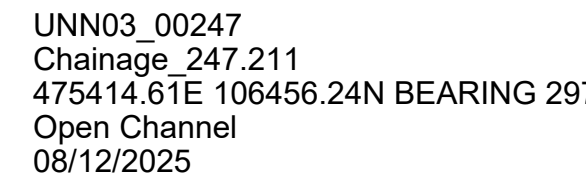
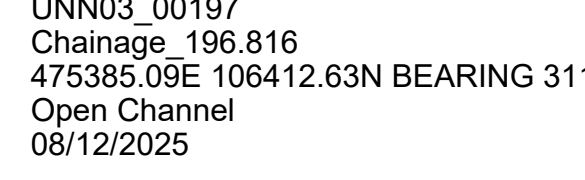
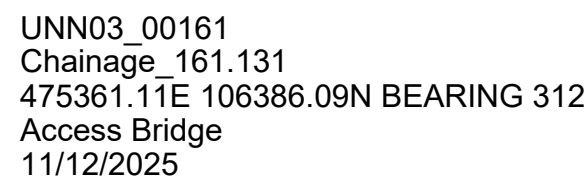
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WATER LEVEL
BED LEVEL
SILT LEVEL

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NOTES:
ALL CROSS SECTION SHOWN IN A DOWNSTREAM DIRECTION UNLESS OTHERWISE STATED
ALL CROSS SECTION SHOWN WITHIN A 100M RADIUS OF THE CROSS SECTION
ALL DIMENSIONS & COORDINATES ARE IN METERS UNLESS OTHERWISE STATED

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[illegible]

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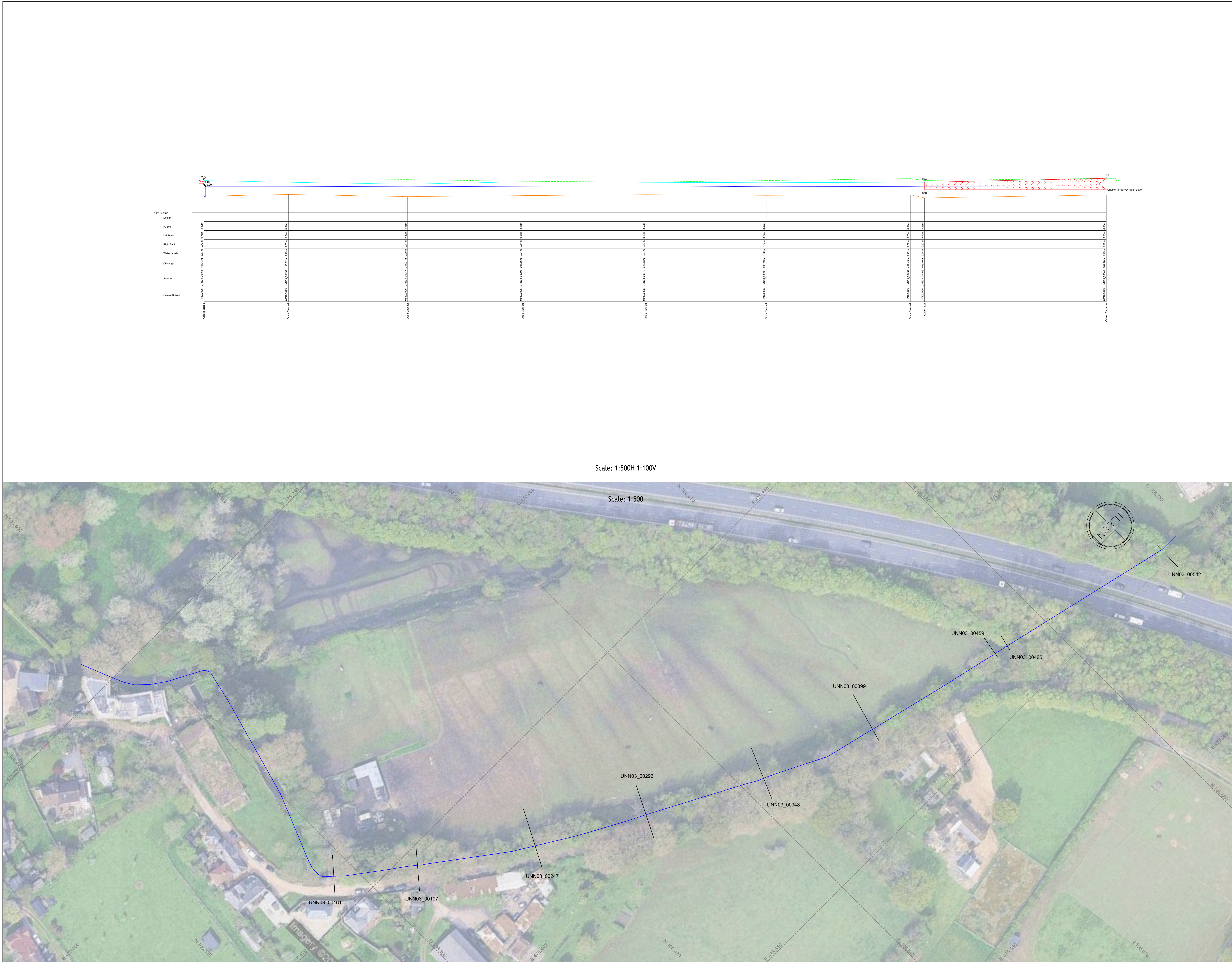
Tel: 01608 664910
mail@storm-geomatics.com
www.storm-geomatics.com

Aegaea

PROJECT Emsworth

Unnamed Reach 03
 Lumley Rd, Emsworth, PO10 8AQ
 UNN03_00161 to UNN03_00542
 Sheet 1 of 1

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Scale: 1:500H 1:100V

Scale: 1:500

LONG SECTION KEY:

WATER LEVEL

RED LEVEL

SILT LEVEL

STRUCTURES

RIGHT BANK

LEFT BANK

1 POINTS LOOKING DOWNSTREAM

POINTS INDICATED BY 'C' ON CATCHMENT

POINTS BETWEEN SECTIONS

POINTS BETWEEN SECTIONS

Sheet Layout (not to scale)

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NOTES:

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UNN03_00197

UNN03_00247

UNN03_00296

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UNN03_00465

UNN03_00542

CONTROL USED:

DAVID 06

Eastings

Northings

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STORM

GEOMATICS

Tel: 01608 664910

mail@storm-geomatics.com

www.storm-geomatics.com

CLIENT

Aegaea

PROJECT

Emsworth

SITE

Unnamed Reach 03

Lumley Rd, Emsworth, PO10 8AQ

Long Section & Location Plan

Sheet 1 of 1

SURVEYED BY: Storm Geomatics Ltd

Project Ref: 254C10012783

SURVEY DATE: December 2025

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CHKD: TI

DATUM: OS Newlyn (15)

DATE: 23/12/2025

DATE: 02/01/2026

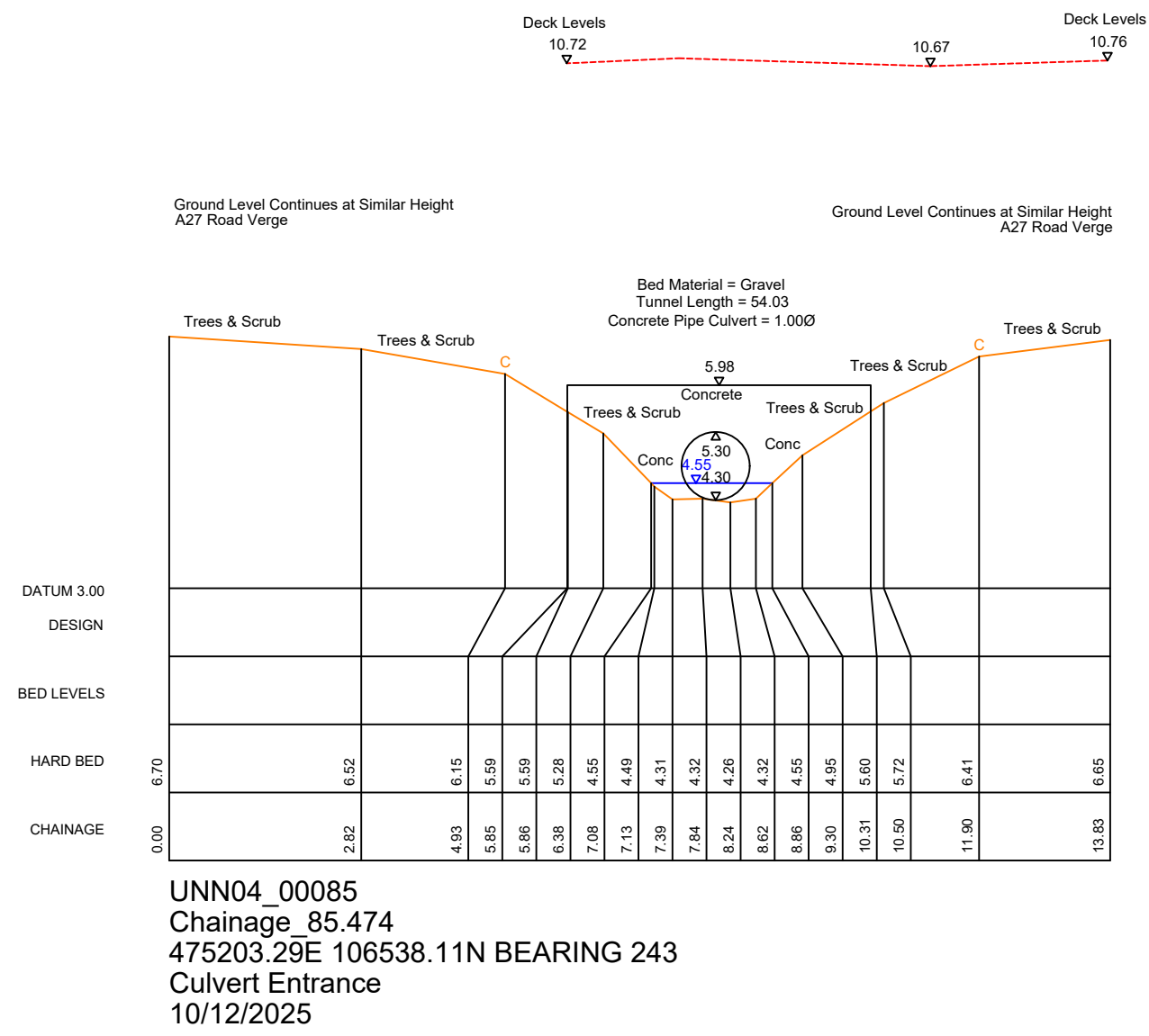
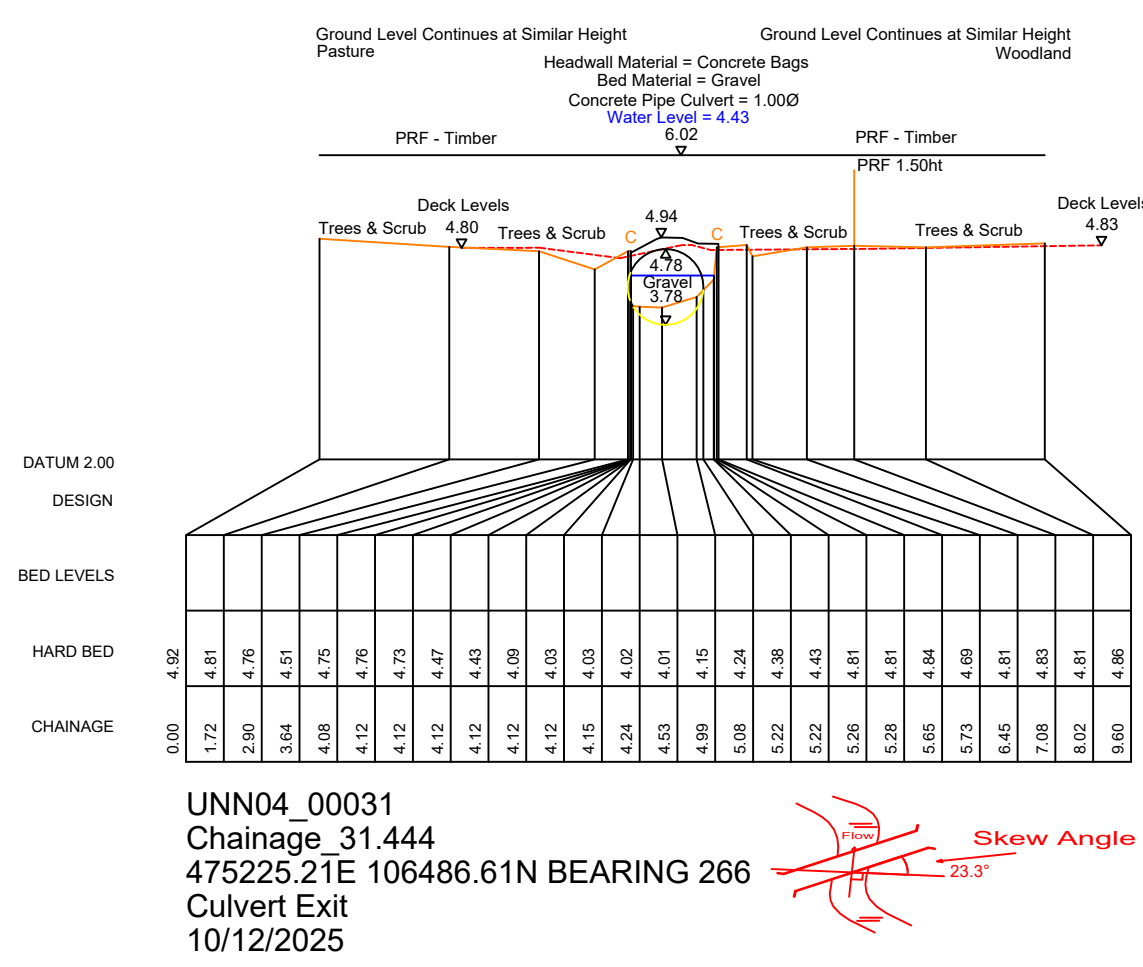
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CROSS SECTION KEY:

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BED LEVEL —————

SILT LEVEL - - - - -

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ALL CROSS SECTIONS VIEWED IN A DOWNSTREAM DIRECTION UNLESS OTHERWISE STATE.
ALL ELEVATIONS ARE METERS ABOVE CHINA'S DATUM UNLESS OTHERWISE STATED.

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PU	PAL	PL	PLATE
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QD	QAL	PL	PLATE
QE	QAL	PL	PLATE
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QI	QAL	PL	PLATE
QJ	QAL	PL	PLATE
QK	QAL	PL	PLATE
QL	QAL	PL	PLATE

REV.	AMENDMENT	DATE	CHD

ID	DESCRIPTION	Easting	Northing	Height
TRANS E6	PK Nail	475294.281	105808.300	2.946

STORM
GEOMATICS

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 **RICS**
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 **THE SURVEY ASSOCIATION**

 **ICES**
International Council of Engineers and Surveyors

 **Constructionline**
The UK's leading construction industry website

 **CARBON TRUST**
The UK's leading carbon reduction organization



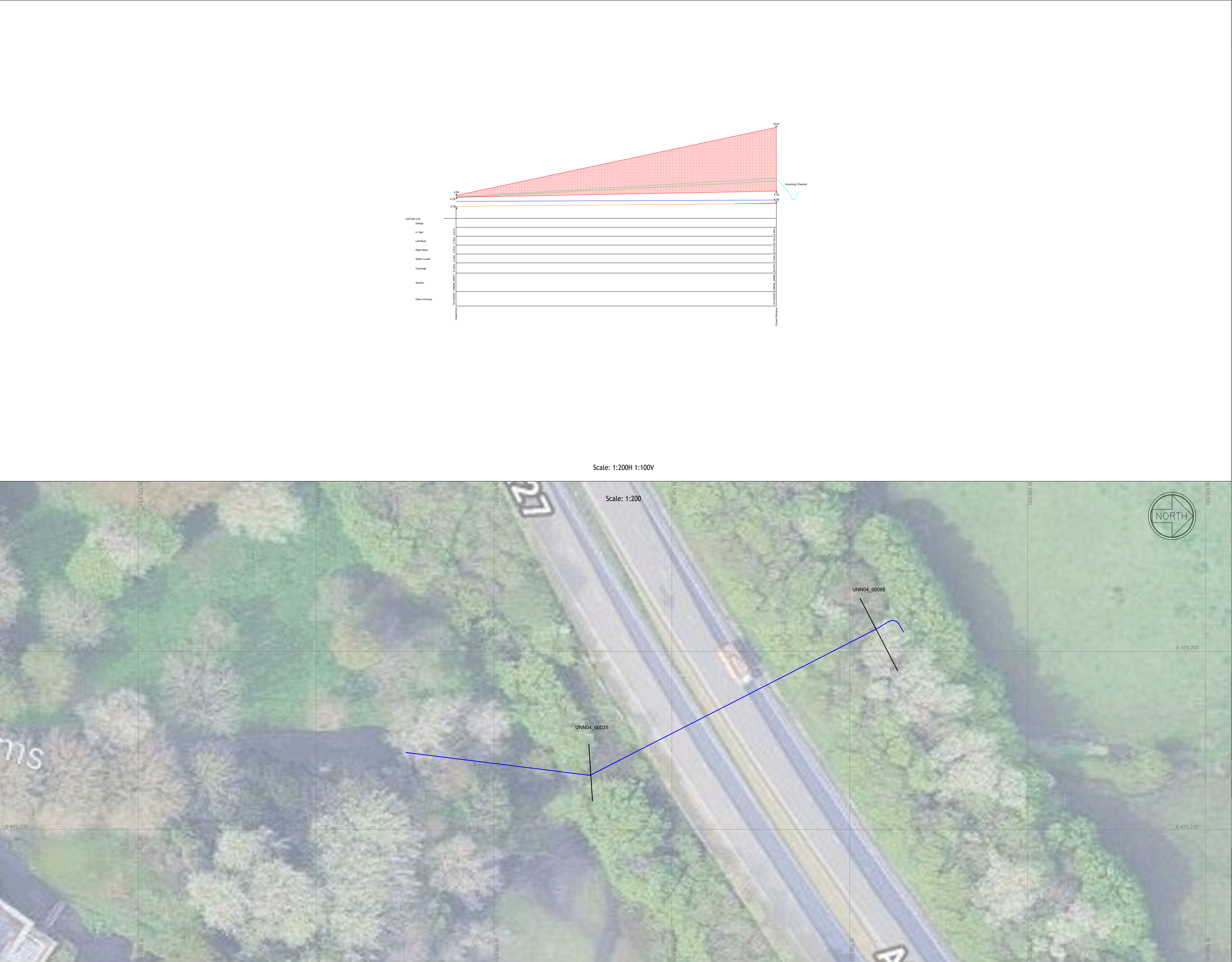
Aegaea

PROJECT Emsworth

Unnamed Reach 04
Lumley Rd, Emsworth, PO10 8AQ
UNN04_00031 to UNN04_00085
Sheet 1 of 1

SURVEYED BY: Storm Geomatics Ltd Project Ref: 25AEG01

SURVEY DATE: December		
SCALE: 1:100 (AO Sheet)	DRN: JM	CHKD: TI
LOCATION: OS Newlyn (15)	DATE: 23/12/2025	DATE: 02/01/26
GRID: OS Grid (15)	DRAWING NO.	
AD_FILENAME: AEG8623_DCS_UNN04_XS.dwg	AEG8623-10	



LONG SECTION KEY:

- WATER LEVEL
- BED LEVEL
- SILT LEVEL
- STRUCTURES
- RIGHT BANK
- LEFT BANK

1. Hatched Looking Downstream
2. Points Indicated by 'C' Only
3. Cross Section and Additional
4. Points Between Sections

Sheet Layout (not to scale)

NOTES:

ALL LINES AND OTHER MARKS SHOWN ON THIS DRAWING ARE TO BE USED AS A GUIDE ONLY. ALL DIMENSIONS & COORDINATES ARE IN METERS UNLESS OTHERWISE STATED.

REV.	AMENDMENT	DRN	CHKD	DATE

CONTROL USED:

NO.	DESCRIPTION	Eastings	Northings	Height
1	BM 100	47524.381	106480.300	2.546

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RICS
Construction

RECS
RECS

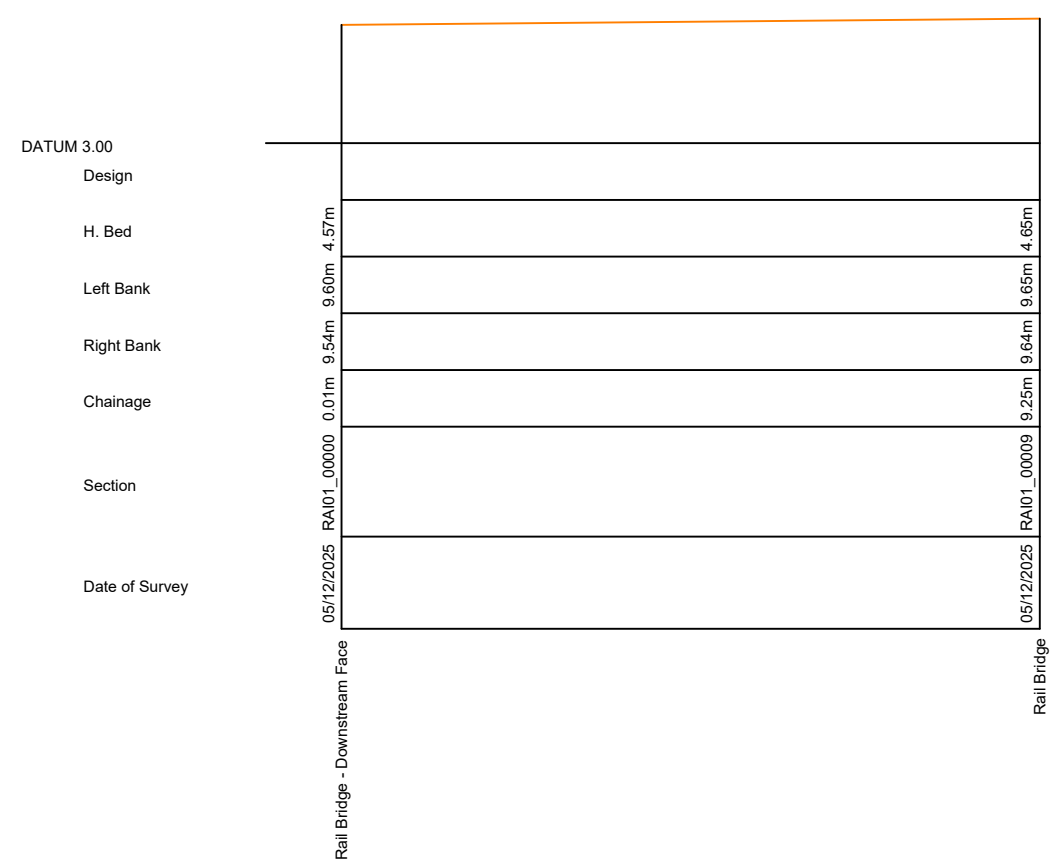
CARBON
RECS

CLIENT: Aegaea

PROJECT: Emsworth

SITE: Unnamed Reach 04
Lumley Rd, Emsworth, PO10 8AQ
Long Section & Location Plan
Sheet 1 of 1

SURVEYED BY: Storm Geomatics Ltd		Project Ref: 25461001283	
SURVEY DATE: December 2025			
SCALE: As Shown (A0 Sheet)		DRN: JM	CHKD: TI
DATUM: OS Newlyn (15)		DATE: 23/12/2025	DATE: 02/01/2026
GRID: OS Grid (15)		DRAWING NO:	REV:
CAD FILENAME: AEG8623_DPP_UNN04_L5147.dwg		AEG8623-11	



Scale: 1:100

[illegible]

REV.	AMENDMENT	DRN	CHRD	DATE

ID	DESCRIPTION	Easting	Northing	Height
DMS E6	PK Nail	475294.281	105808.300	2.946

STORM
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mail@storm-geomatics.com
www.storm-geomatics.com

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 **THE SURVEY**
ASSOCIATION
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 **RICS**
REGULATED
MEMBER

 **Constructionline**
MEMBER

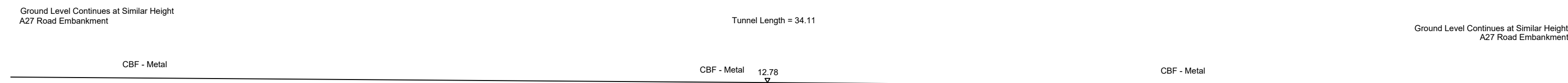
 **CARBON**
TRUST
MEMBER

 **GBC**
MEMBER

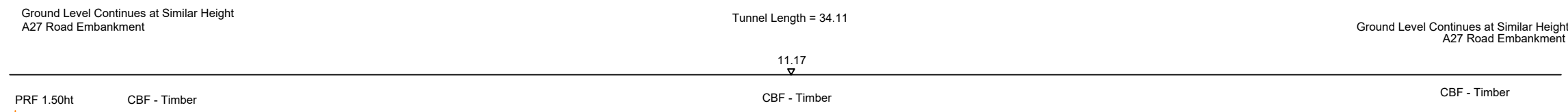
 **GBC**
MEMBER

 **GBC**
MEMBER

LIDT		Aegaea	
PROJECT		Emsworth	
SITE		Railway Bridge Lumley Rd, Emsworth, PO10 8AQ Long Section & Location Plan Sheet 1 of 1	
SURVEYED BY: Storm Geomatics Ltd		Project Ref: 25AC010783	
SURVEY DATE: December 2025			
SCALE: As Shown (A0 Sheet)		DRNG: JM	CHD1: TI
DATUM: OS Newlyn (15)		DATE: 23/12/2025	DATE: 05/01/2026
GRID: OS Grid (15)		DRAWING NO:	
DRAWING FILENAME: AEG0823_0001_A0_L15.dwg		AEG8623-13	
		REV.	



ROA01_00000
Chainage_0.311
475140.83E 106447.08N BEARING 245
Road Bridge - Downstream Face
05/12/2025



ROA01_00034
Chainage 34.416
475122.14E 106475.92N BEARING 245
Road Bridge
05/12/2025

CROSS SECTION KEY:

WATER LEVEL —————

BED LEVEL —————

SILT LEVEL - - - - -

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ALL CROSS SECTIONS VIEWED IN A DOWNSTREAM DIRECTION UNLESS OTHERWISE STATE.
ALL ELEVATIONS ARE METERS ABOVE CHINA'S DATUM UNLESS OTHERWISE STATED.

SPEAKER LEGEND			
ALBANY	71	FRANK AYER	REP
ALBANY	72	FRANK AYER	REP
ALBANY	73	FRANK AYER	REP
ALBANY	74	FRANK AYER	REP
ALBANY	75	FRANK AYER	REP
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REV.	AMENDMENT	DATE	CHD

CONTROL USED:				
ID	DESCRIPTION	Easting	Northing	Height
MS E6	PK Nail	475284.281	105838.300	2.946

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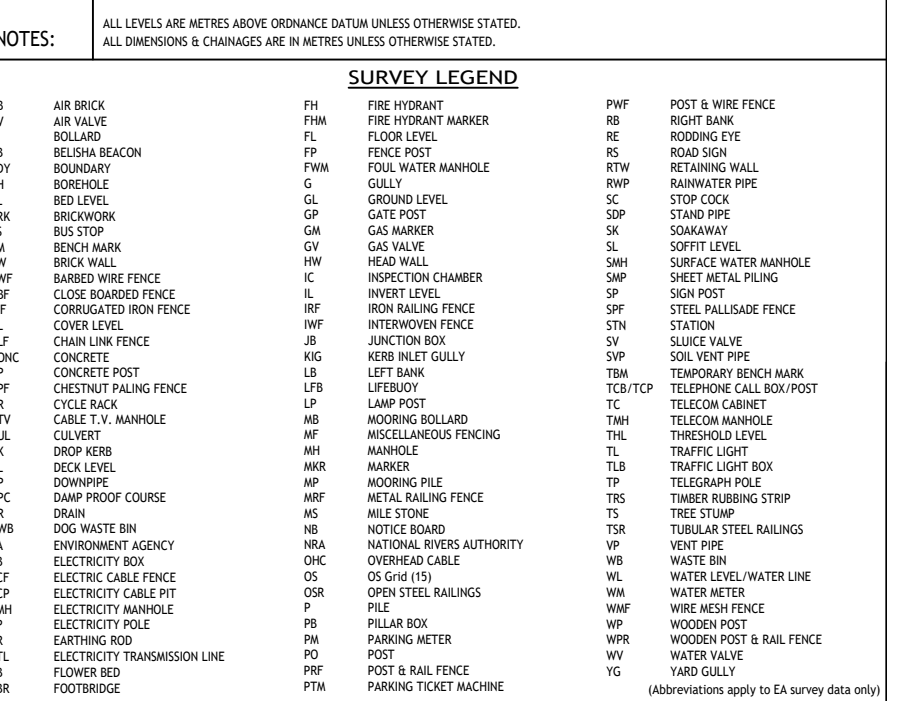
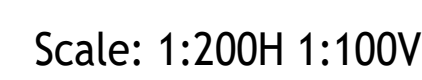
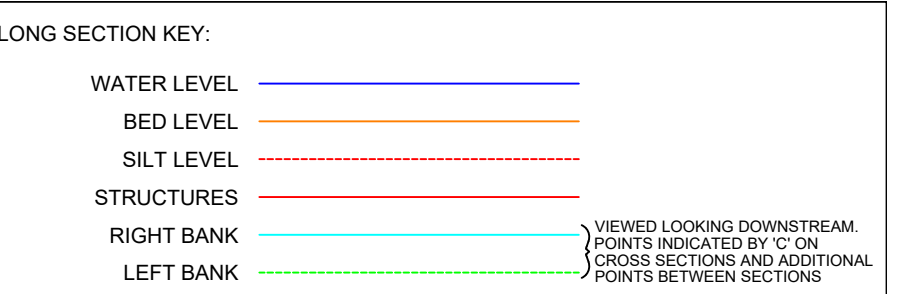
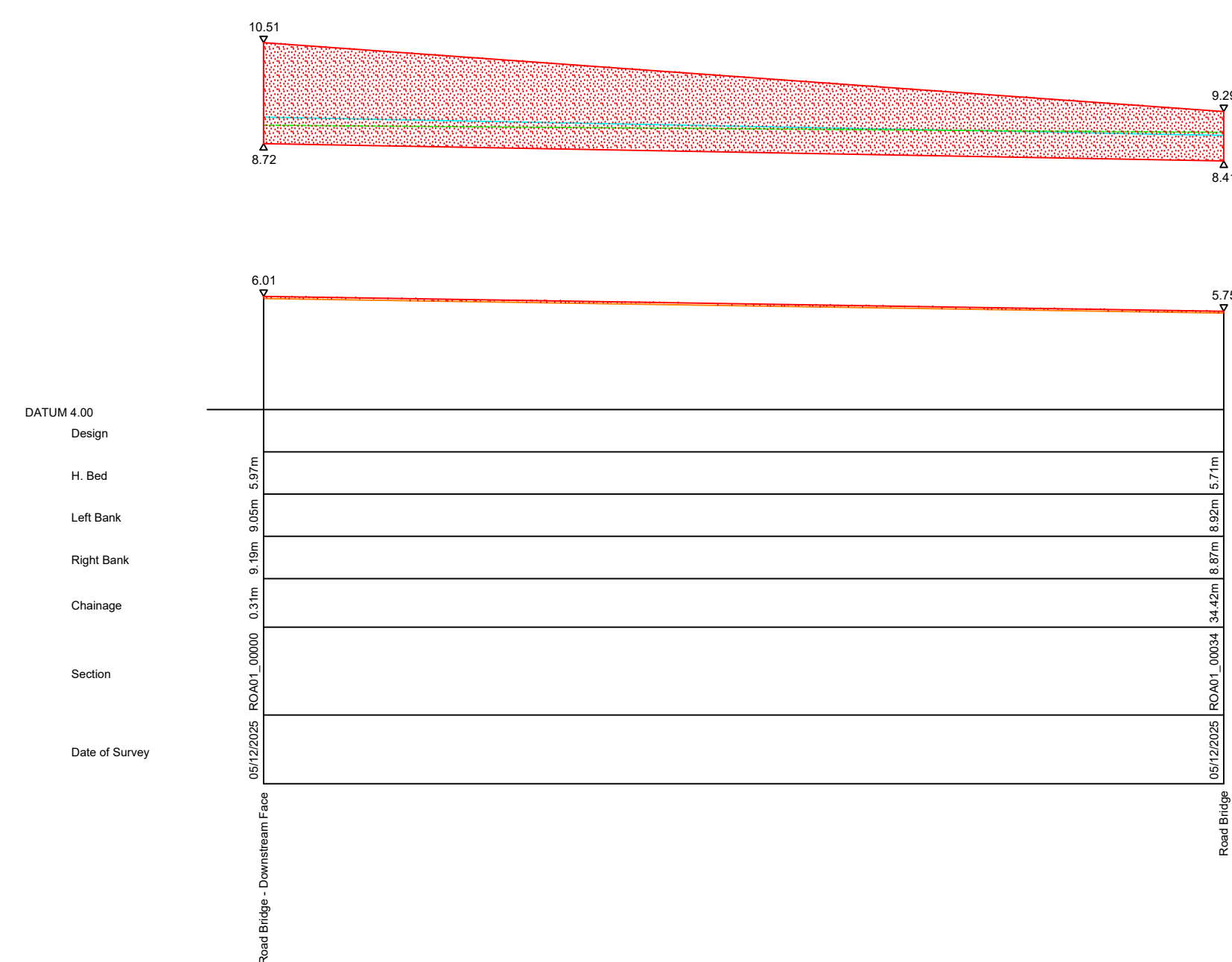
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PROJECT Emsworth

A27 Road Bridge
Lumley Rd, Emsworth, PO10 8AQ
ROA01_00000 to ROA01_00034
Sheet 1 of 1

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SURVEY DATE: December		
SCALE: 1:100 (A0 Sheet)	DRN: JM	CHKD: TI
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REV.	AMENDMENT	DEP.	CHG.	DATE

ID	DESCRIPTION	Easting	Northing	Height
DMS E6	PK Nail	475294.281	105808.300	2.946

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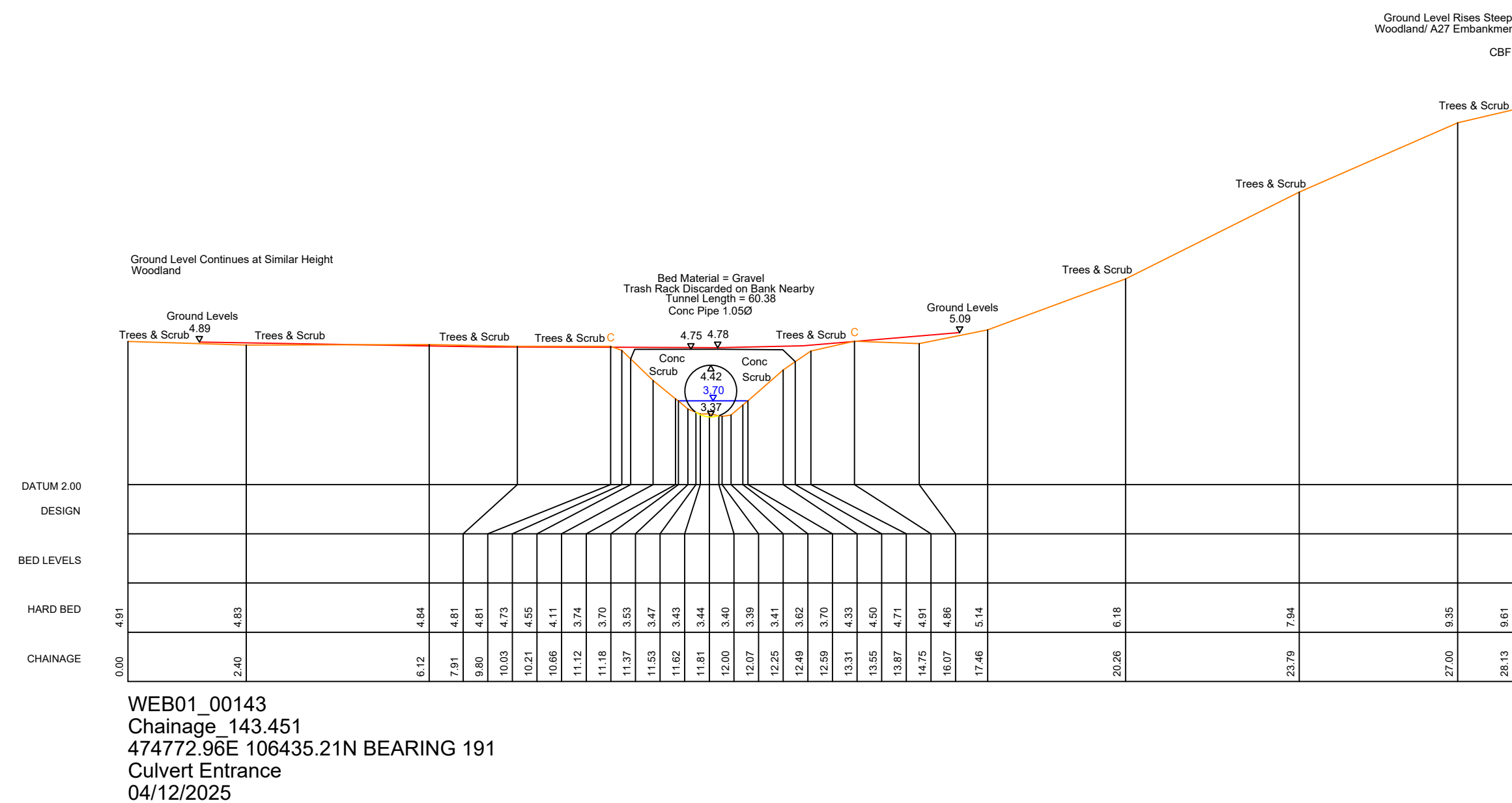
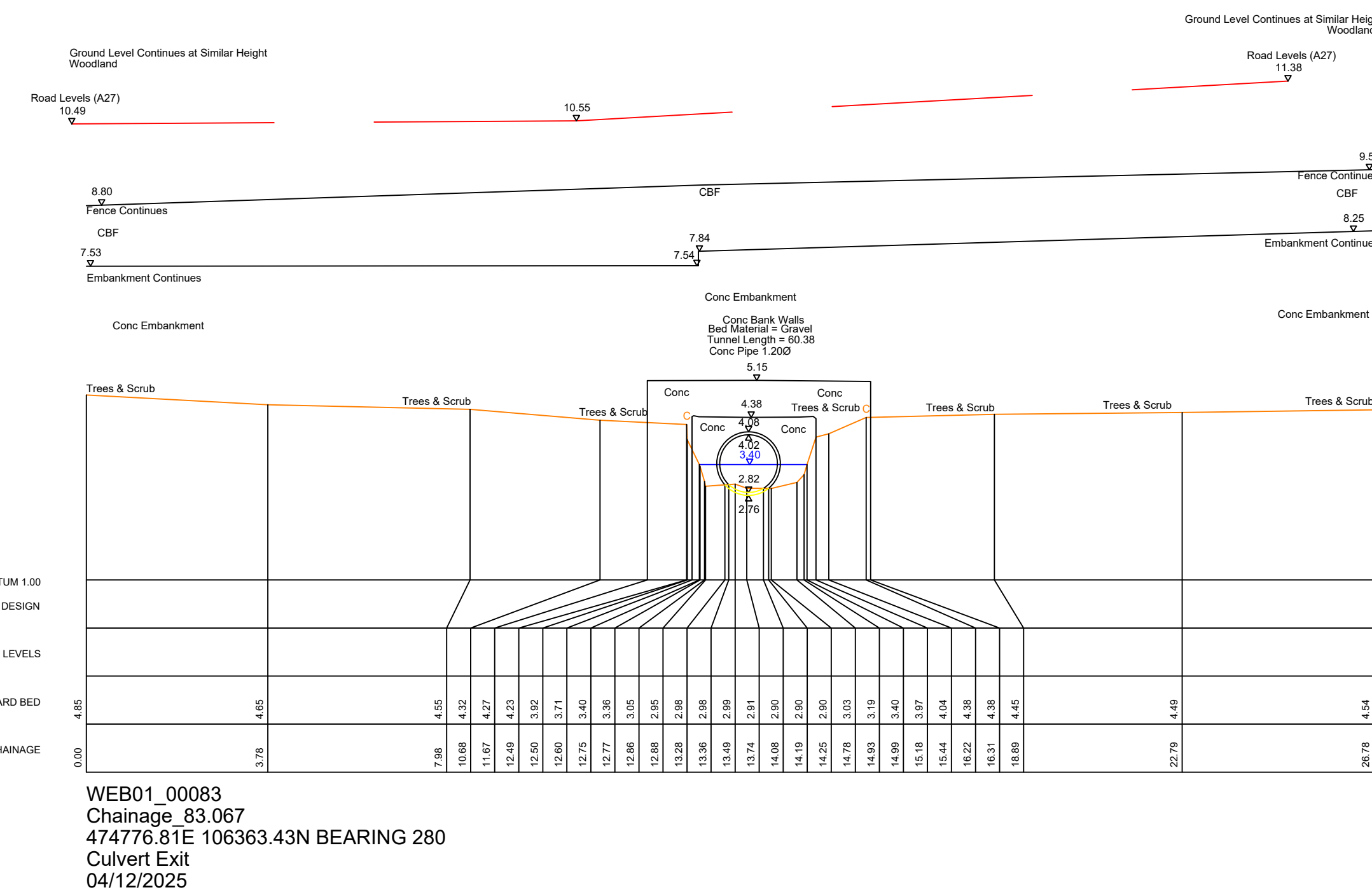
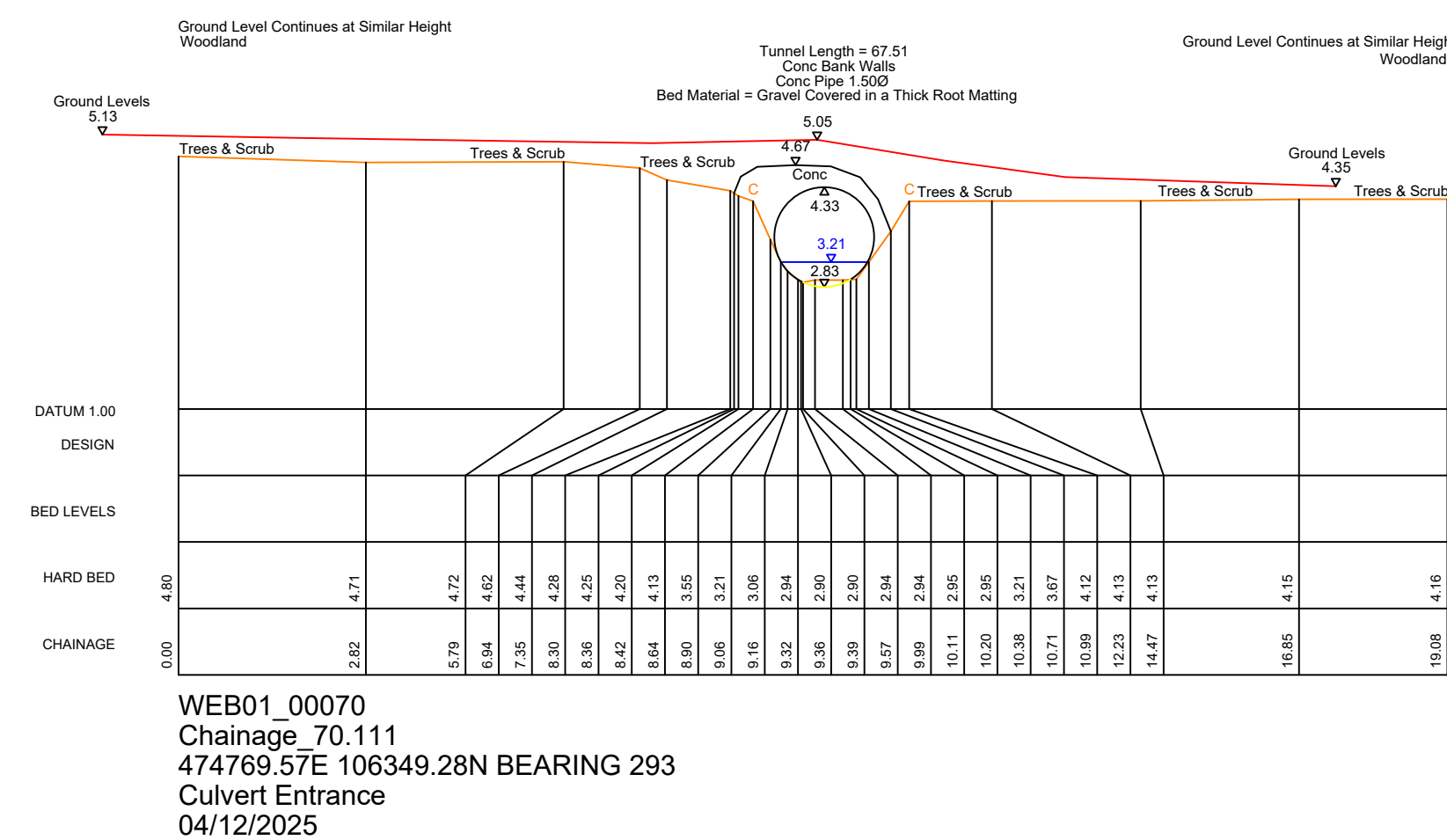
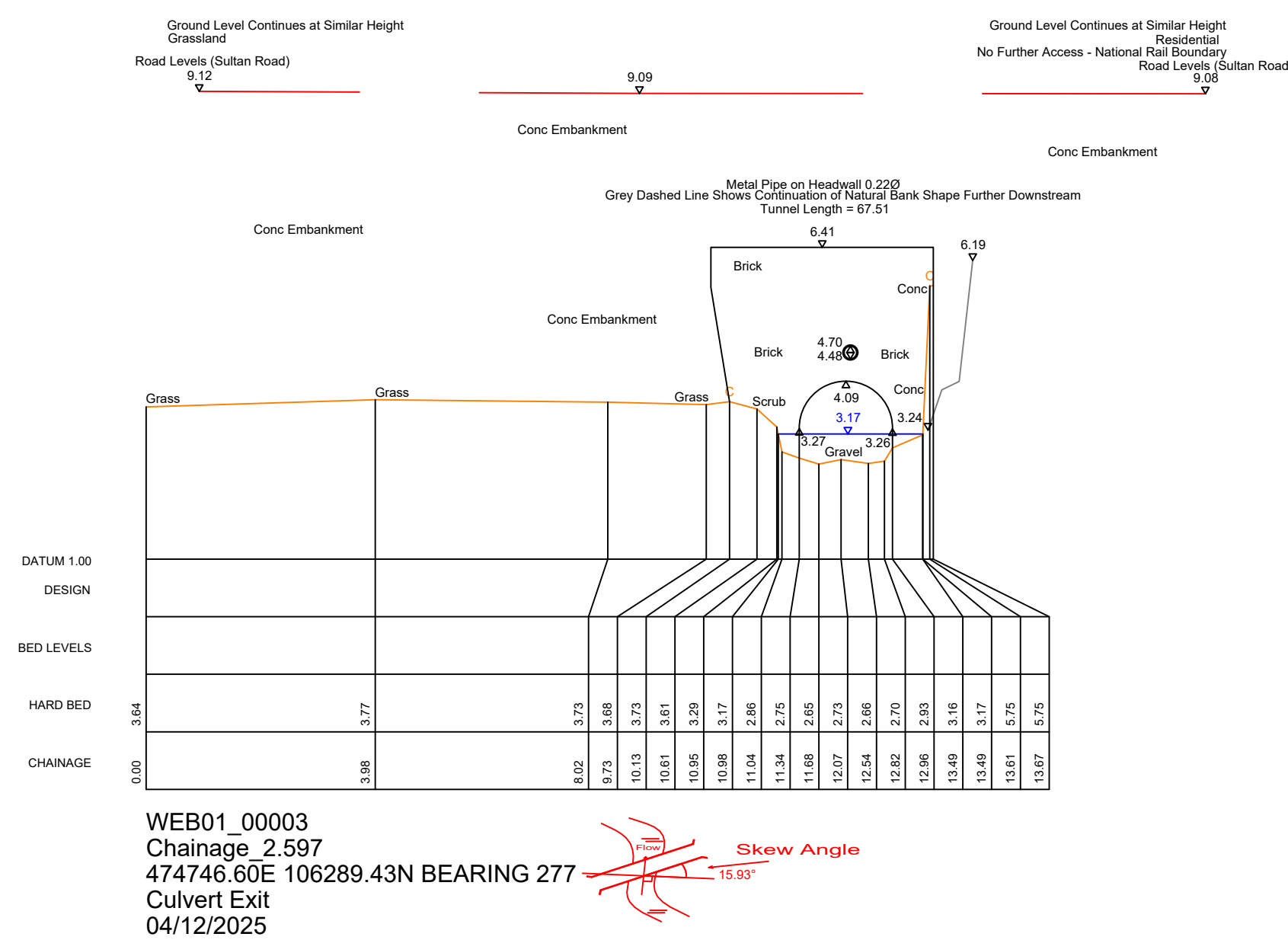
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PROJECT	Emsworth
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A27 Road Bridge
Lumley Rd, Emsworth, PO10 8AQ
Long Section & Location Plan
Sheet 1 of 1

SURVEYED BY: Storm Geomatics Ltd		Project Ref: 25AEG012783	
SURVEY DATE: December 2025			
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GRID: OS Grid (15)		DRAWING NO.	REV.
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CROSS SECTION KEY:

WATER LEVEL —————

BED LEVEL —————

SILT LEVEL —————

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REV.	AMENDMENT	DRN	CHRD	DATE

ID	DESCRIPTION	Easting	Northing	Height
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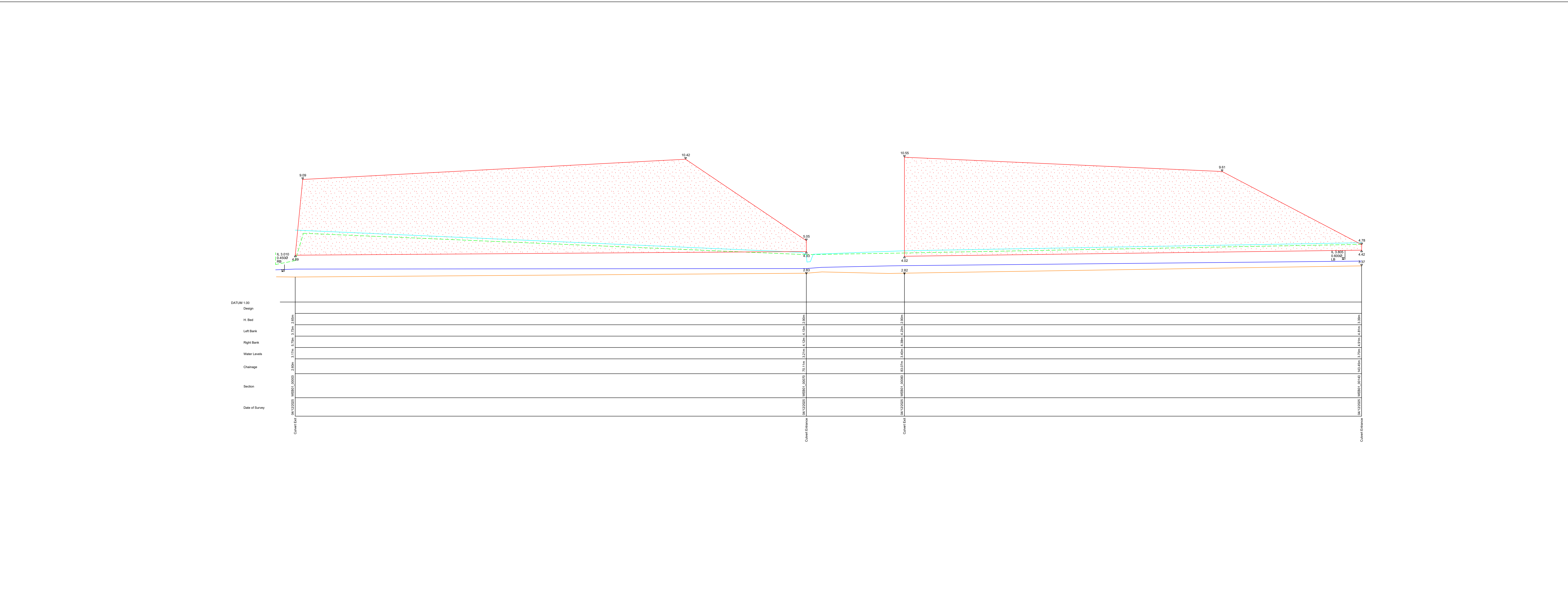
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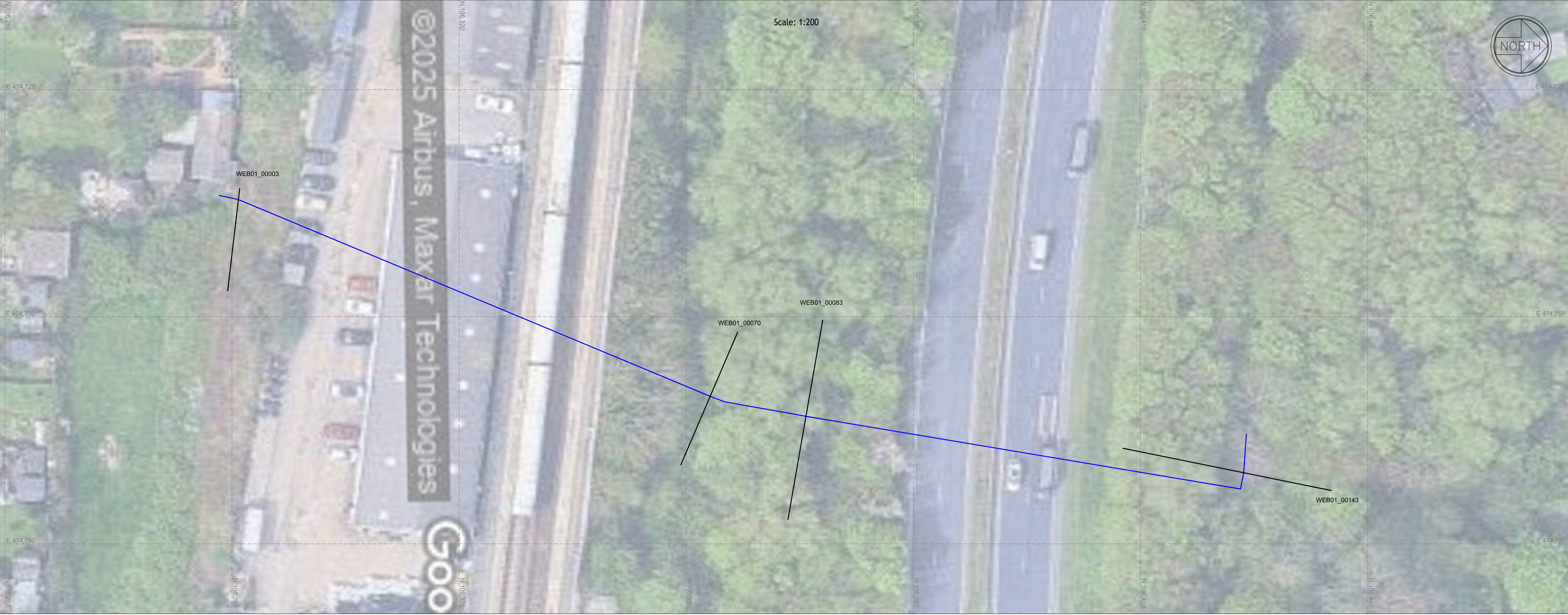
PROJECT Emsworth

West Brook
North St, Emsworth, PO10 7PW
WEB01_00003 to WEB01_00143
Sheet 1 of 1

SURVEYED BY: Storm Geomatics Ltd		Project Ref: 25AE0012783	
SURVEY DATE: December			
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DATUM: OS Newlyn (15)	DATE: 23/12/2025	DATE: 05/01/2026	
A0 FILENAME: AEG8623_DCS_NE001_KS.dwg	DRAWING NO.	REV.	
	AEG8623-16	-	



Scale: 1:200H 1:100V



LONG SECTION KEY:

- WATER LEVEL
- BED LEVEL
- SILT LEVEL
- STRUCTURES
- RIGHT BANK
- LEFT BANK

VERTICAL LOOKING DOWNSTREAM
POINTS INDICATED BY 'C' ON
CROSS SECTION AND ADDITIONAL
POINTS BETWEEN SECTIONS

Sheet Layout (not to scale)

NOTES:

ALL LEVELS ARE METRIC UNLESS OTHERWISE STATED UNLESS OTHERWISE STATED
ALL DIMENSIONS & COORDINATES ARE IN METRIC UNLESS OTHERWISE STATED

REV.	AMENDMENT	DRN	CHD	DATE

CONTROL USED:

NO	DESCRIPTION	Easting	Northing	Height
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CLIENT: Aegaea

PROJECT: Emsworth

SITE: West Brook
Lumley Rd, Emsworth, PO10 8AQ
Long Section & Location Plan
Sheet 1 of 1

SURVEYED BY:	Storm Geomatics Ltd	Project Ref:	254C10012783
SURVEY DATE:	December 2025		
SCALE:	As Shown (A0 Sheet)	DRN: JM	CHD: T1
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GRID:	OS Grid (15)	DRAWING NO:	REV:
CAD FILENAME:	AEGB623_DPP_WEB01_L54P.dwg	AEGB623-17	

Appendix B – Flood Estimation Report



Flood Estimation Report



AEG8623_PO10_Emsworth_01

Site Address:
Land East of North Street
Emsworth
Hampshire
PO10 7PN

UK Experts in Flood Modelling, Flood Risk
Assessments, and Surface Water Drainage Strategies

Document Issue Record

Project: AEG8623_PO10_Emsworth_01

Prepared for: PNHProperties Ltd

Reference: AEG8623_PO10_Emsworth_Flood_Estimation_Report_001

Site Location: Land East of North Street, Emsworth, Hampshire, PO10 7PN

Version	Date	Author	Check	Auth.	Comments
001	05/01/2026	AJB	CDH	RT	First Issue

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Abbreviations

Abbreviation	Definition
AEP	Annual Exceedance Probability
AMAX	Annual Maximum
AREA	Catchment area (km ²)
BFI	Baseflow Index
BFIHOST19	Baseflow index derived using the HOST soil classification, revised in 2019
FARL	FEH index of flood attenuation due to reservoirs and lakes
FEH	Flood Estimation Handbook
GEV	Generalised Extreme Value
GLO	Generalised Logistic
HOST	Hydrology of Soil Types
IF	Impervious Fraction
IRF	Impervious Runoff Factor
LF	Low flow statistics (flow duration curve)
NRFA	National River Flow Archive
POT	Peaks Over a Threshold
QMED	Median Annual Flood (with return period of 2 years)
ReFH	Revitalised Flood Hydrograph method
ReFH2	Revitalised Flood Hydrograph method version 2
SAAR	Standard Average Annual Rainfall (mm)
Tp	Time to peak of the instantaneous unit hydrograph

URBAN	Flood Studies Report index of fractional urban extent
URBEXT1990	FEH index of fractional urban extent
URBEXT2000	FEH index of fractional urban extent revised in 2000
WINFAP	Windows Frequency Analysis Package (software that is used to carry out the FEH statistical method)

1. Summary of Assessment

Summary

Catchment Location

The catchment is located on the River Ems, to the north of the town of Emsworth in England. The upper catchment extends across the largely rural areas of Compton, North Marden, Uppark Garden and Up Marden. The River Ems and West brook flow southwards, ultimately draining to the tidal water body of Emsworth Harbour within the town of Emsworth.

Purpose of Study and Complexity

Aegaea Limited have been commissioned by PNHProperties Ltd to undertake a hydrological assessment of the River Ems and West Brook. The purpose of this study is to derive peak inflows for the River Ems and West Brook to input into a hydraulic model assessing a proposed development, located near the town of Emsworth. The study is routine.

The following peak flows and hydrographs will be derived:

- 3.3% AEP / 1 in 30 year
- 1% AEP / 1 in 100 year
- 1% AEP + 21% CC / 1 in 100 year + 21% climate change
- 1% AEP + 32% CC / 1 in 100 year + 32% climate change
- 0.1% AEP / 1 in 1000 year

Key Catchment Features

River Ems

The River Ems is classified as a Main River. The River Ems flows in a general southerly direction through a largely rural catchment before passing through the town of Emsworth, south of the Site.

The catchment is considered essentially rural and highly permeable. There are no significant reservoirs upstream in the catchment or pumped watercourses, however there is a large railroad embankment immediately south of the Site that could provide flood storage. This will be accounted for explicitly in the hydraulic model. The high permeability of the catchment results in a baseflow dominated regime and a slow response to storms and thus long typical storm duration. There is significant net export of water from the catchment (groundwater abstractions) but low flows are augmented by compensation water (from borehole).

West Brook

The West Brook is identified as a Main River. The West Brook flows south through Emsworth, ultimately outfalling to the Chichester Harbour tidal water body.

The West Brook is a smaller watercourse than the River Ems, with a smaller upstream catchment area. Furthermore, it is more urbanised and less permeable than the Ems catchment. Key topographic features within the West Brook catchment include the A27 highway embankment and West Coastway Railway Line embankment.

Flooding Mechanisms

The Environment Agency (EA) Flood Map for Planning (FMfP) identifies parts of the Site as being located within Flood Zones 2 and 3, indicating a medium to high probability of flooding from rivers. These zones are associated with overtopping of the River Ems, which is located east of the Site. A series of interconnected channels are associated with the River Ems in the vicinity of the Site. The Channels are heavily engineered with a number of culverts and bridges present.

Gauged / ungauged

The Ems catchment is gauged with two flow gauges identified on the River Ems: Ems at Walderton (NRFA ID 41034) and Ems at Westbourne (NRFA ID 41015). The Ems at Walderton gauge station was decommissioned in 1984 and so is not relevant to this study. The Ems at Westbourne gauge station is summarised as an *“Asymmetrical compound Crump weir gauging a river with baseflow-dominated regime. Significant net export of water from catchment, but also some flow augmentation.”*

No gauges are present within the West Brook catchment.

Final Choice of Method

Ems

The final choice of method is the FEH Statistical method, with QMED derived from catchment descriptors and adjusted with single donor gauged data. Hydrograph shape was derived from REFH2 as the Ems at Westbourne gauge (41015) is limited with a peak flow data structure limit is 5.08m³/s and therefore not suitable for deriving hydrograph shape.

West Brook

The final choice of method is the FEH Statistical method, with QMED derived from catchment descriptors adjusted with a single donor catchment. Hydrograph shape was derived from REFH2.

Key Limitations / Uncertainties in Results

The main limitation for this study is the lack of NRFA gauging stations available for the West Brook catchment. Furthermore, the gauge data available on the River Ems is only suitable for QMED and not suitable for pooling.

Flood Frequencies

AEP (%)	50	20	10	5	3.33	2	1.33	1	0.5	0.1
AEP	0.5	0.2	0.1	0.05	0.033	0.02	0.013	0.01	0.005	0.001
Return Period (years)	2	5	10	20	30	50	75	100	200	1000

2. Method Statement

Requirements for Flood Estimates

Overview and Project Scope

The scope of this project is to derive peak fluvial flows at the FEP for use in a hydraulic modelling study. This project will also include the production of hydrograph shape derived from REFH2 at the River Ems and West Brook and the results will be used to support a planning application.

The study will provide peak flows for the following design events for the River Ems and West Brook:

- 3.3% AEP / 1 in 30 year
- 1% AEP / 1 in 100 year
- 1% AEP + 25% CC / 1 in 100 year + 25% climate change
- 1% AEP + 36% CC / 1 in 100 year + 36% climate change
- 0.1% AEP / 1 in 1000 year

Hydrographs will also be produced for the above events. The climate change allowances are based on the latest Arun and Western Streams Management Catchment peak river flow allowances, applying both the Central and Higher Central allowances at the 2080s epoch.

The Catchment

Maps

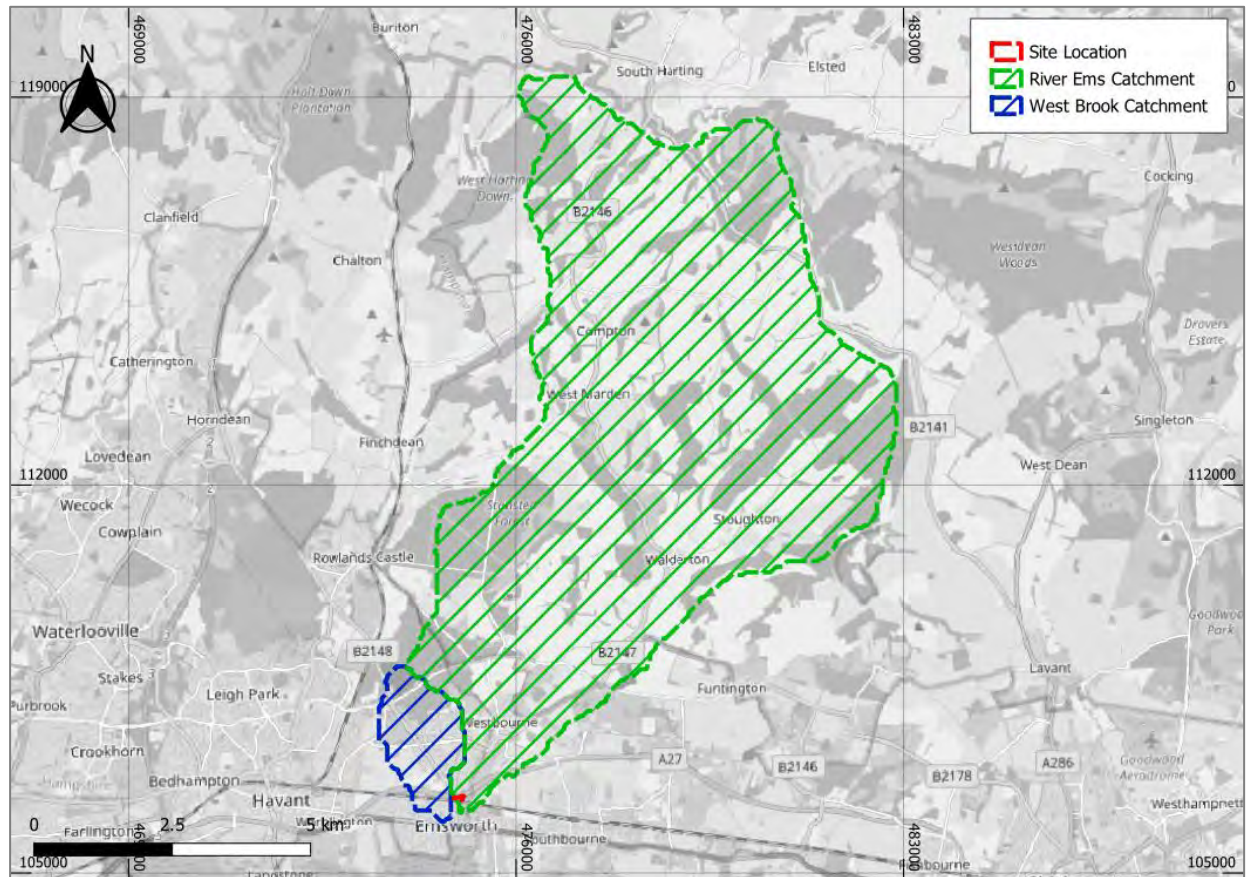


Figure 1: Site and Catchment Location Plan (OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence 100024198).

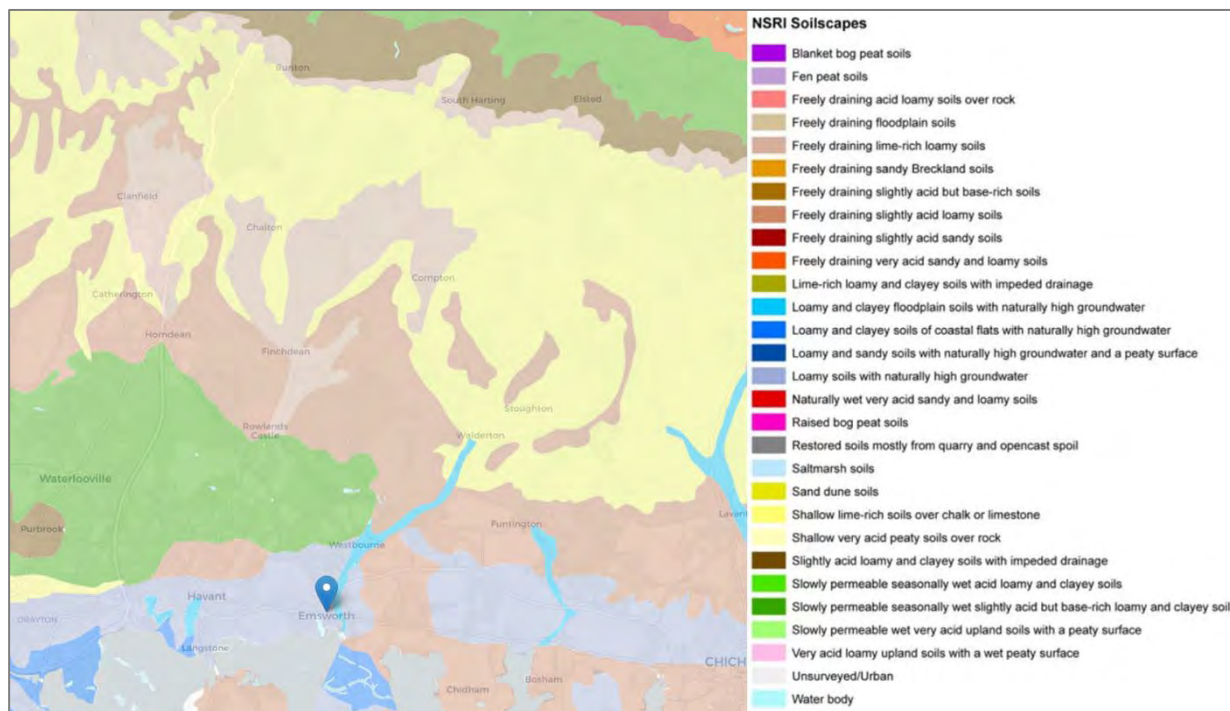


Figure 2: Catchment Soils (OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence 100024198, British Geological Survey © https://mapapps2.bgs.ac.uk/gsni_geindex/home.html).

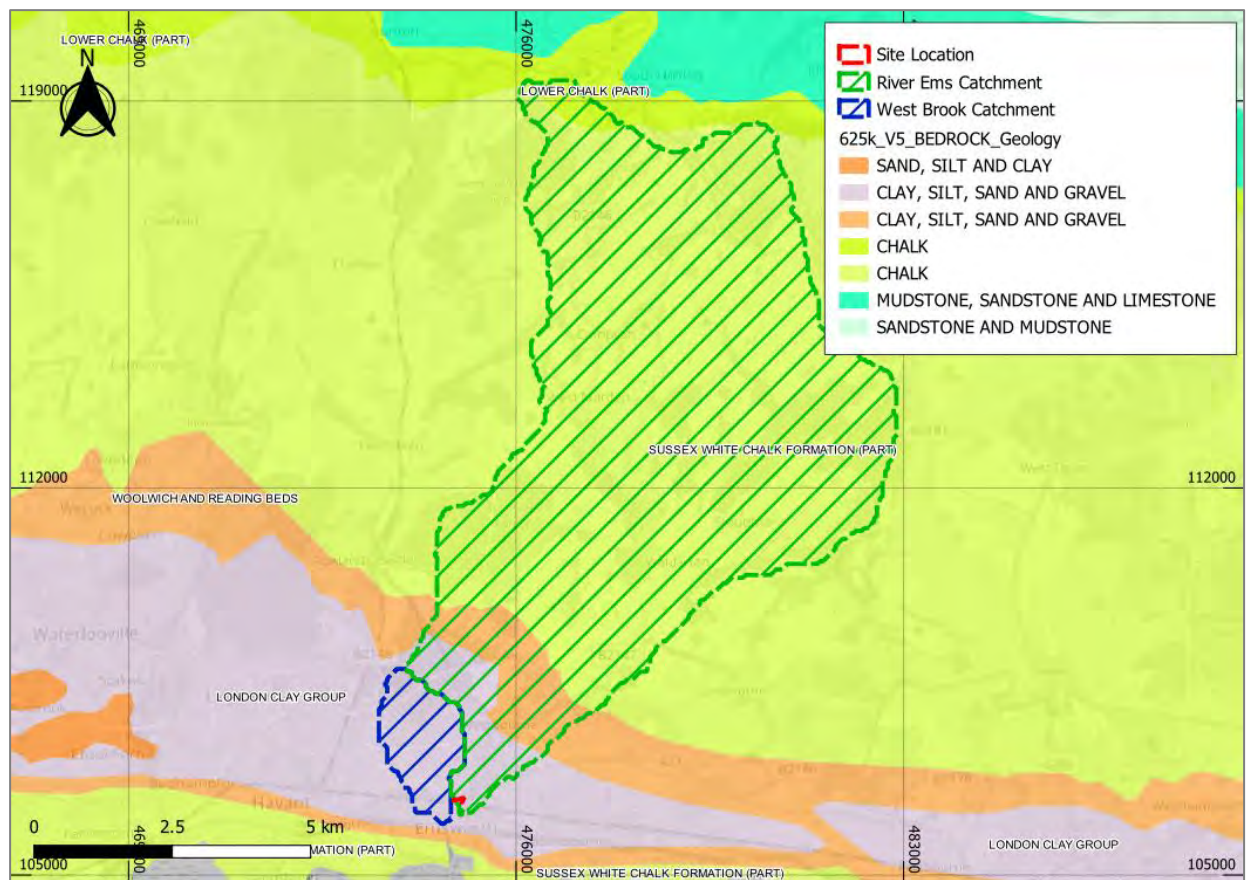


Figure 3: Bedrock Geology of the Catchment (OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence 100024198, British Geological Survey © https://mapapps2.bgs.ac.uk/qsni_geoindex/home.html).

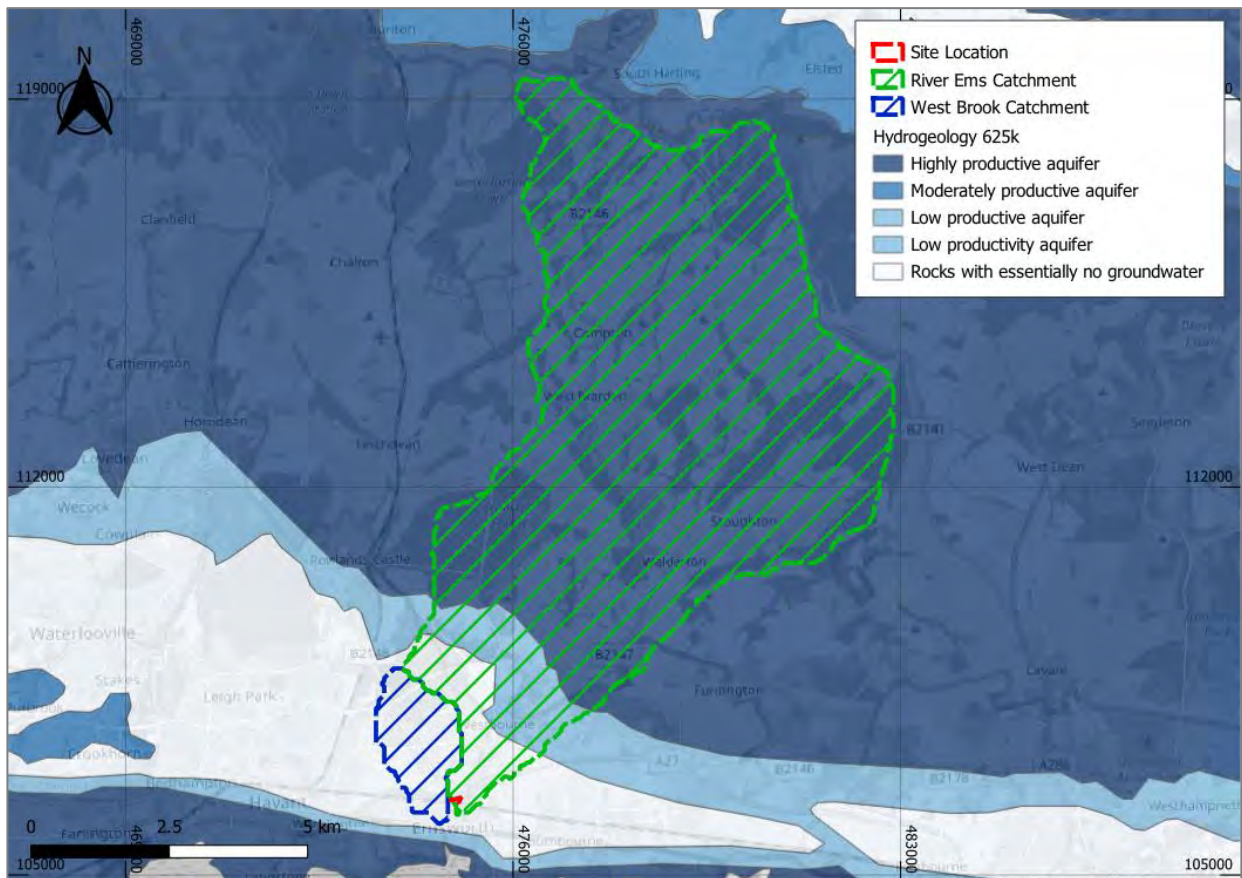


Figure 4: Hydrogeological characteristics of the catchment (OpenStreetMap © <https://www.openstreetmap.org> and contributors. Ordnance Survey licence 100024198, British Geological Survey © https://mapapps2.bgs.ac.uk/gsni_geindex/home.html).

Catchment Description

This study focuses on the River Ems and West Brook catchment to provide peak flows and hydrographs for use in a hydraulic modelling study.

River Ems

According to the FEH Web Service, the River Ems catchment has an area of 60.1km². The catchment is considered to be essentially rural with a URBEXT2015 value of 0.0128, and is very permeable, with a BFIHOST19 value of 0.894. The catchment slopes from north to south from approximately 241mAOD to 3mAOD at the outlet. The catchment terminates at the south coast, with the River Ems discharging to Emsworth Harbour.

The British Geological Survey (BGS) online GeoIndex mapping indicates that the catchment is underlain predominantly lime-rich soils over chalk.

West Brook

According to the FEH Web Service, the West Brook catchment has an area of 2.8km². The catchment considered to be heavily urbanised with a URBEXT2015 value of 0.204. The

BFIHOST19 value of 0.521 indicates a lower permeability catchment than the River Ems. The catchment slopes from north to south from approximately 64mAOD to 3mAOD at the outlet. The catchment terminates at the south coast discharging to Emsworth Millpond.

The British Geological Survey (BGS) online GeoIndex mapping indicates that the catchment is underlain predominantly by clay, silt, sand and gravel. The catchment is expected to be more responsive to rainfall events than the River Ems catchment.

Hydrometric Data

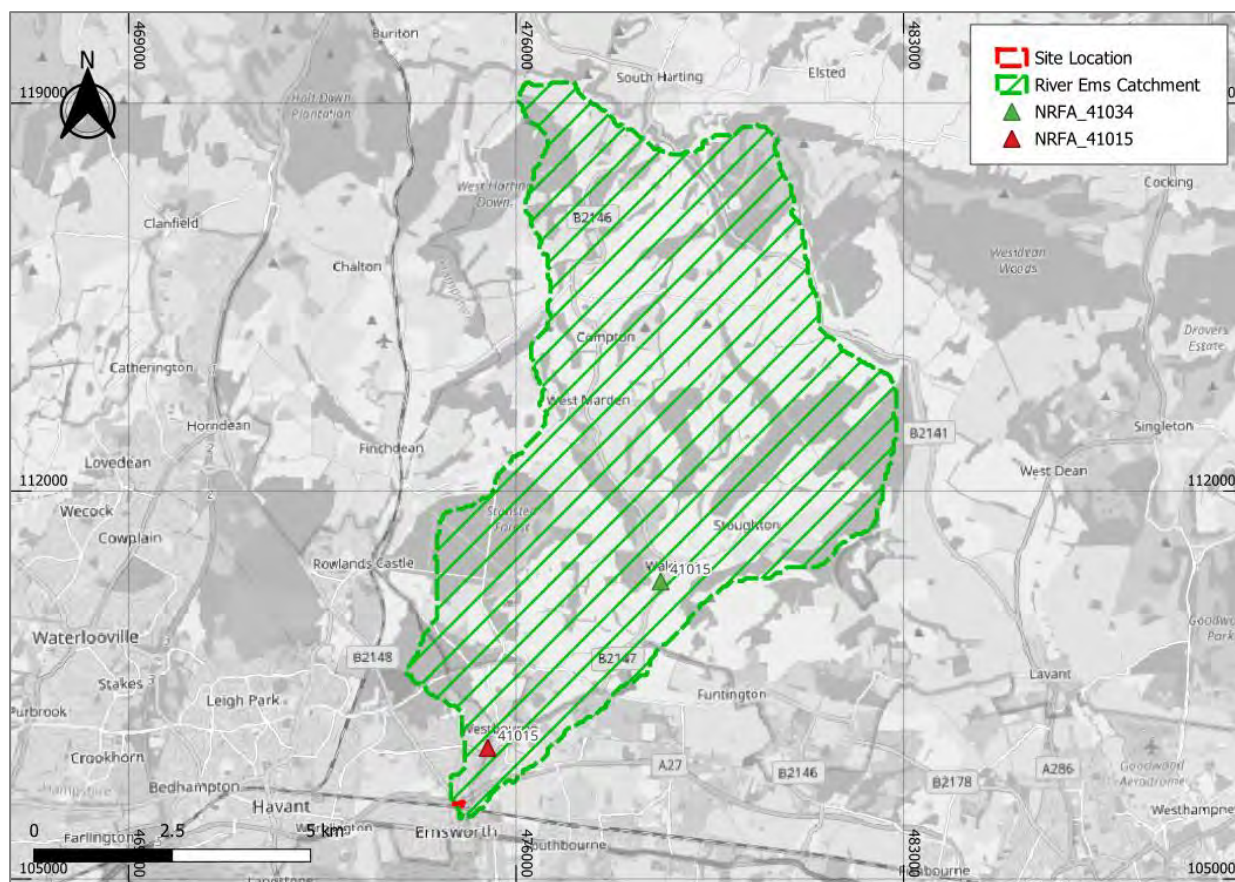
Source of Flood Peak Data

Flood peak data was obtained from the National River Flow Archive (NRFA) peak flows dataset version 14, which was released in August 2025.

Gauging Stations (Flow and Level)

A single operational gauge is located on the River Ems watercourse approximately 1.1km upstream of the site, at Westbourne. A decommissioned gauge is located further upstream at Walderton. The location of the gauges are shown in Figure 5 below. No gauges are present in the West Brook Catchment.

Watercourse	Station Name	Gauging Authority Number	NRFA Number	Catchment Area (km ²)	Type (rated/ ultrasonic/ level...)	Start and End of Record (if closed)
River Ems	Ems at Westbourne	Environment Agency - Solent and South Downs (255110010)	41015	58.3	Rated	1967 - present
River Ems	Ems at Walderton	Environment Agency - Solent and South Downs (N/A)	41034	41.5	Rated	1966 – 1984



Data Available at Each Flow Gauging Station

Watercourse	Station Name	Data Type	Start and End of Flood Peak Record	Update For This Study?	OK For QMED?	Data Quality Check Needed?	Station and Flow Data Quality Summary
River Ems	Ems at Westbourne	15-minute	1967 - present	No	Yes	Yes	Peak flow data structure limit is 5.08m ³ /s. Flows were above structure limit during 2000 event for long periods of time. One theoretical rating applied across period of record, but appears to overestimate flows. Suitable for QMED but unsuitable for pooling.

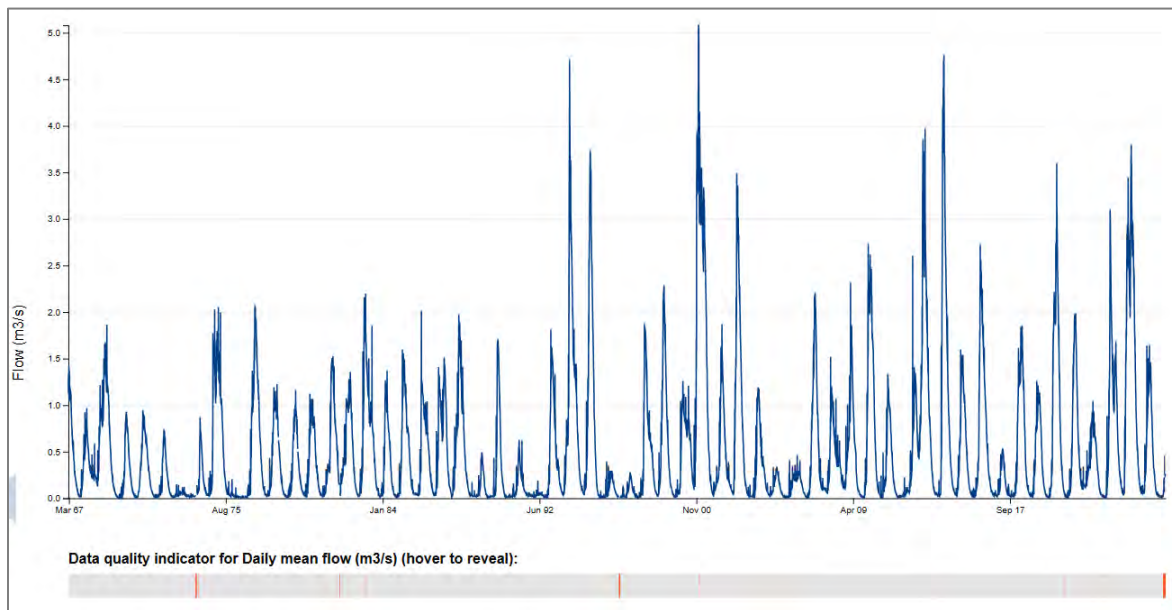


Figure 6: Ems at Westbourne Gauge Record (Hydrology Data Explorer, <https://environment.data.gov.uk/hydrology/explore>)

Updates or Revisions to Flood Peak Data

No updates or revisions were made to the flood peak data

Rating Equations

A rating equation was available for the Ems at Westbourne gauge station.

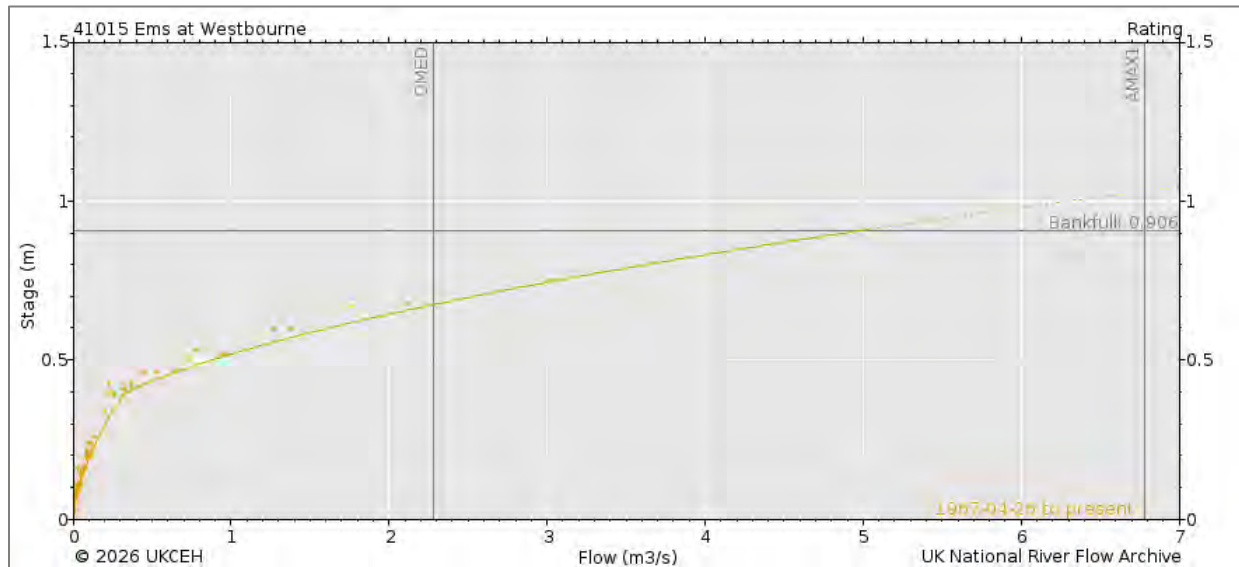


Figure 7: Ems at Westbourne Peak Flow Rating Curve (NRFA, <https://nrfa.ceh.ac.uk/data/station/peakflow/41015#rating>)

REF ↓	LIMB ↑	DETAILS ↑	EQUATION ↓	START DATE ↓	MAX STAGE (M) ↓	END DATE ↓
1	a	REPLACE LOST RATING	$Q = 1.434 * (h + 0.000) ^ 1.576$	26/04/1967	0.19	01/01/2100
1	b	REPLACE LOST RATING	$Q = 1.468 * (h + 0.1510) ^ 2.475$	26/04/1967	0.39	01/01/2100
1	c	REPLACE LOST RATING	$Q = 10.664 * (h - 0.2580) ^ 1.759$	26/04/1967	0.91	01/01/2100

Figure 8: Ems at Westbourne Peak Flow Rating Equation (NRFA, <https://nrfa.ceh.ac.uk/data/station/peakflow/41015#rating>)

Rating Reviews

The NRFA indicates that the Ems at Westbourne gauging station is suitable for QMED within FEH methods. It is not suitable for pooling as there are few high flow gaugings meaning the rating cannot be validated beyond QMED. The magnitude of deviation from gaugings is unknown.

Other Data Available and How it Has Been Obtained

Type of Data	Data Relevant to This Study	Data Available?	Source of Data	Details
Check Flow Gaugings	N/A			
Historical Flood Data	NA			

Flow or River Level Data for Events	N/A			
Rainfall Data for Events	N/A			
Potential Evaporation Data	N/A			
Results From Previous Studies				
Other Data or Information	N/A			

Conclusions of Hydrometric Data Review

Station Name	Rating Suitability	Suitability for Flood Estimation Calculations	Non-stationary Analysis Requirements
41015 Ems at Westbourne	Rating is suitable for Qmed. Not suitable for pooling	Event data to be used to inform Qmed only.	N/A

Hydrological Understanding of the Catchment

River Ems

AMAX and QMED Data

Figure 9 presents the Annual Maximum (AMAX) series flow data from 1967 to 2025 at Ems at Westbourne gauge. Based on the gauged information, the QMED flow is 2.28m³/s. The largest AMAX flow value is 6.8m³/s (extrapolated), occurring on the 9th December 2000.

As the structure limit for gauged flow is 5.08m³/s, any AMAX data above this represents extrapolated values.

The MKZ score for the Ems at Westbourne gauge is 2.78, with a significance of 5%. This indicates a positive trend of AMAX values since records began.

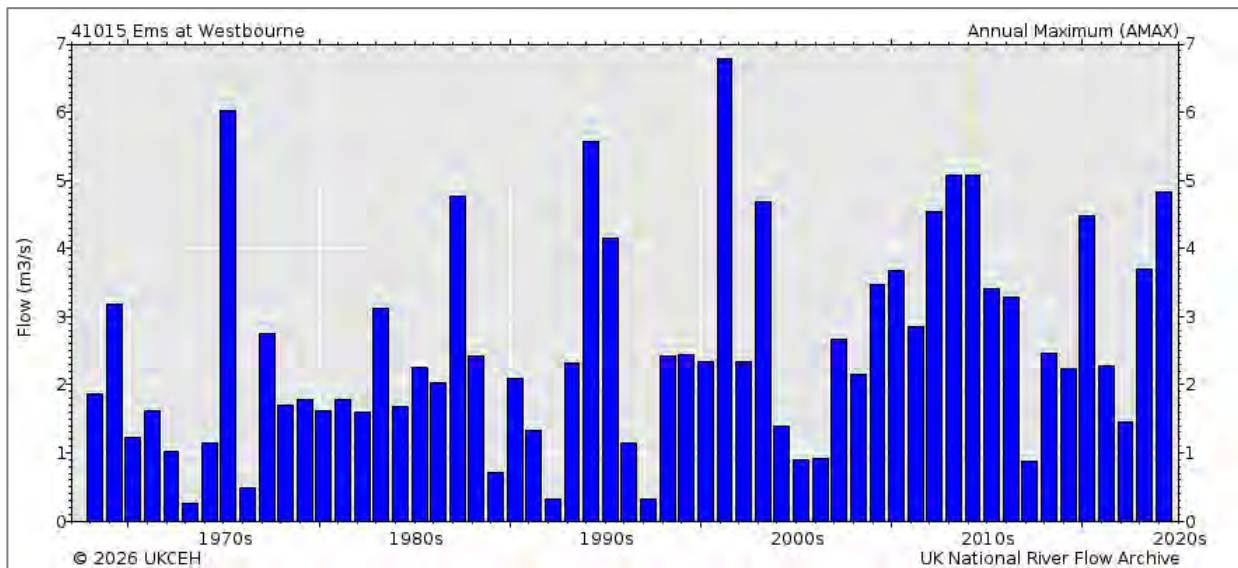


Figure 9: Ems at Westbourne Gauge – Annual Maximum (AMAX) Flow 1967-2024 (National River Flow Archive)

Flow Regime

The catchment is dominated by baseflow. Flood events are typically small, runoff normally approximately 1%. There is significant net export of water from the catchment (groundwater abstractions) but low flows are augmented by compensation water (from borehole).

Conceptual Model

The proposed development Site is located within a predominantly rural catchment, with some local urbanisation in the town of Emsworth. The Site is located between the A27 to the north and the West Coastway Railway Line to the south. It covers an area of approximately 7,500 m².

The likely main cause of flooding at this location is peak flows and volumes exceeding the capacity of the channel, causing flows to spill out of bank and travel overland. In the vicinity of the Site on the River Ems, several culverts and access bridges locally constrict flows within the channel, influencing upstream water levels and overland routing.

Unusual Catchment Features

The catchment is considered essentially rural and highly permeable. There are no significant reservoirs upstream in the catchment or pumped watercourses, however there is a large railroad embankment immediately south of the Site that could provide flood storage. This will be accounted for explicitly in the hydraulic model. The high permeability of the catchment results in a baseflow dominated regime and a slow response to storms and thus long typical storm duration. This has been accounted for by using the GL NFY fitting in the FEH statistical method which accounts for non-flood years.

West Brook

Flow Regime

The catchment is more responsive than the Ems catchment, being smaller, more urbanised and less permeable.

Unusual Catchment Features

As with the Ems catchment, a large railroad embankment immediately south of the Site that could provide flood storage. This will be accounted for explicitly in the hydraulic model.

Initial Choice of Approach

Are FEH Methods Appropriate?

FEH methods are considered appropriate as there are no significant factors that would affect flow regimes, or major influences that would warrant an alternative method. While potentially significant groundwater influences are noted in the summer, larger storms are predicted to occur in the winter in this catchment and thus FEH methods are still appropriate.

Initial Choice of Method(s) and Reasons

River Ems

The initial choice of method is to utilise the FEH Statistical method, with QMED derived from catchment descriptors and adjusted based on a single donor gauged station. FEH-Rainfall Runoff and REFH2 are not considered appropriate for deriving QMED due to the high permeability of the catchment and the low runoff response.

West Brook

The initial choice of method is to utilise the FEH Statistical method, with QMED derived from catchment descriptors with donor adjustment.

How Will Hydrograph Shapes be Derived If Needed

The Ems at Westbourne is not suitable for deriving hydrograph shape due to limits on peak flow at the gauge. Therefore, hydrograph shapes will be derived using REFH2.

Will the Catchment Be Split into Sub-catchments? If So, How?

The River Ems and West Brook do not confluence. Two separate lumped estimates will be calculated for the Ems and West Brook FEPs approximately 250m downstream of the Site at Emsworth.

Software to Be Used

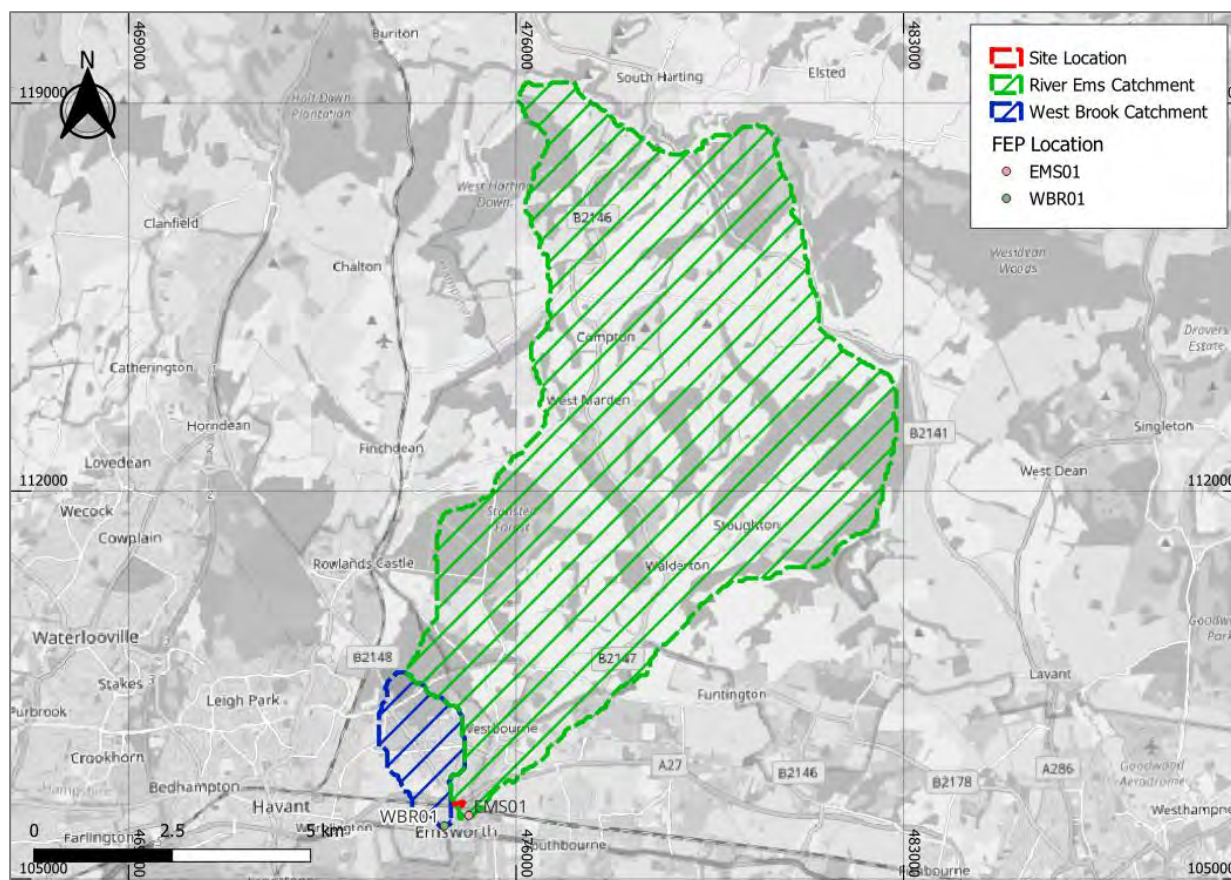
WINFAP 5 and ReFH2.3 will be used in this assessment.

3. Locations Where Flood Estimates Are Required

Summary of Subject Sites

Site Code	Type of Estimate: Lumped (L) or Sub-catchment (S)	Watercourse	Site Name / Description	Easting	Northing	AREA on FEH WEb Service (km ²)	Revised Area if altered) (km ²)
EMS01	L	River Ems	River Ems Downstream	475150	106150	60.1	-
WBR01	L	West Brook	West Brook Downstream	474700	105950	2.86	2.77

FEP locations are shown in Figure 10 below.



Catchment Descriptors

Final Catchment Descriptors at Each Catchment/Subject Site

Site Code	FARL	PROPWE T	BFIHOST 19	DPLBAR (km)	SAAR (mm)	URBEXT 2015	FPEXT
EMS01	1	0.26	0.872	8.78	594	0.0168	0.1557
WBR01	1	0.34	0.521	1.91	760	0.2041	0.1504

Catchment Boundary Checks and Revisions

Due to the age of the FEH catchment delineation and underlying topographic dataset, a review of the catchment boundaries was undertaken using SCALGOlive. It was found that the SCALGO catchment was based on unrealistic flowpaths due to the flat topography and

significant number of hydraulic structures present. From analysis of the LiDAR data the FEH catchment was found to be more appropriate, therefore, no changes were made to the AREA descriptor for the Ems catchment. Minor revisions were made to the West Brook Catchment where LiDAR delineation showed slight discrepancy to the FEH boundary

URBEXT Source and Method for Updating

URBEXT was checked using aerial imagery and the CEH Land Cover mapping¹. For the Ems catchment, a manual calculation yielded comparable but slightly higher URBEXT value (0.0168) than the FEH URBEXT 2015 value (0.0128). Therefore, manual recalculation value was taken forwards as a precautionary approach. No changes were made to the West Brook FEH URBEXT 2015 value as it was found to be appropriate.

BFIHOST Source, Checks and Updates

BFIHOST was checked against geological data published by BGS. Both catchments geology was found to be in line with the BFIHOST value, therefore, no updates were made.

Checks and Revisions to Other Catchment Descriptors

Other catchment descriptors such as DPLBAR and FARL were checked and found to be appropriate, therefore no changes were made to catchment descriptors.

¹ Centre for Ecology and Hydrology, 2023. Land Cover Mapping

4. Stationary Statistical Methods

Method Overview

What is the Purpose of Applying These Methods

The purpose of applying the Statistical Method is to calculate peak flows for the FEPs (EMS01 and WBR01) to inform inflows the hydraulic model, and to compare with the results calculated using the ReFH2 method.

What Methods Will Be Used to Estimate QMED and Growth Curves

Site Code	Methods Used for QMED	Methods Used for Growth Curves
EMS01	Single Donor Adjustment (gauged)	Pooling Group
WBR01	Single Donor Adjustment (nearest neighbour - gauged)	Pooling Group

Estimating QMED

QMED at Subject Sites

Site Code	Method (CD/ DT/ BCW)	Initial QMED (rural) from CDs (m ³ /s)	Donors Used (NRFA No.)	Donor Distances from Subject Centroids (km)	Combined and Weighted Donor Adjustment Factor	Urban Adjustment Factor	Final QMED (m ³ /s)
EMS01	DT	2.33	41015	0.24	0.993	1.121	2.60
WBR01	DT	0.87	41015	7.16	0.997	1.393	1.21

Methods: CD – Catchment descriptors alone; DT - Catchment descriptors with donor transfer; BCW - Catchment descriptors with bankful channel width.

Urban Adjustment of QMED

QMED was adjusted for urbanisation using the urban adjustment setting within WINFAP 5.

Search for Donor Sites

Owing to the presence of gauge 41015 at Ems at Westbourne (approximately 1.1km upstream of the site), station 41015 was chosen as the single donor catchment for calculation of QMED.

Donor Sites Chosen and QMED Adjustment Factors

NRFA No.	Method (AM/ POT/ LF)	Adjusted for Climactic Variation?	QMED from Flow Data (m ³ /s)	De-urbanised QMED from Flow Data (m ³ /s) (A)	QMED from Catchment Descriptors (m ³ /s) (B)	Adjustment Ratio (A/B)
41015	AM	No	2.28	2.18	2.20	0.993

Methods: AM – Annual Maxima; POT – Peaks over threshold; LF – Low flow (flow duration curve) statistics.

Estimating Growth Curves

The Enhanced Single Site analysis method is not appropriate in this instance as the single operational gauge within the catchment (41015 Ems at Westbourne) is not suitable for pooling.

Derivation of Growth Curves at Subject Sites

Site Code	Method (SS/ P, ESS, H)	If P or ESS, Name of Pooling Group	Distribution Used and Reason for Choice	Any Urban or Non-Flood Years Adjustments	Parameters of Distribution	Growth Factor for 1% AEP
EMS01	P	PG01	GL NFY – z value shows acceptable fit (1.3346) and accounts for non flood years which is suitable for permeable catchments.	Pooling group L-moments were deurbanised, and urban adjustment selected in line with guidance. GL NFY distribution selected to account for non-flood years.	Location: 1.000 Scale: 0.281 Shape: - 0.241	3.334
WBR01	P	PG01	Kappa 3 – z value shows best fit (0.3339).	Pooling group L-moments were deurbanised, and urban adjustment	Location: 0.937 Scale: 0.274	2.899

				selected in line with guidance. Catchment is below permeability threshold (catchment BFIHOST19 < 0.65) for non flood years adjustment so GL NFY not appropriate.	Shape: - 0.181 H: -0.400	
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Methods: SS – Single Site, P – Pooled; ESS – Enhanced Single Site; H – Historical.

Flood Frequency Curve Plots

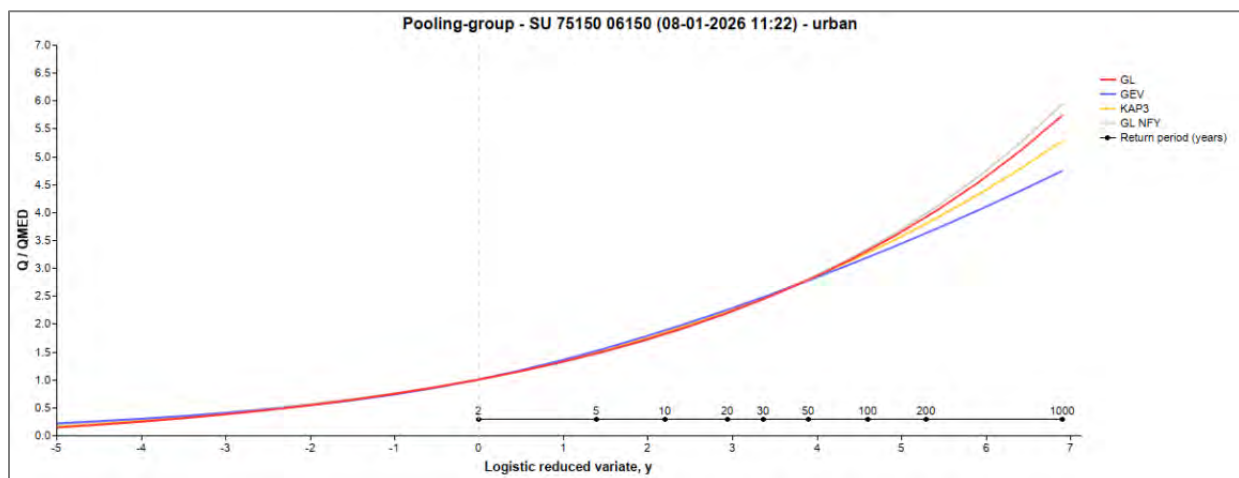


Figure 11: FEH Statistical Flood Frequency Curve EMS01

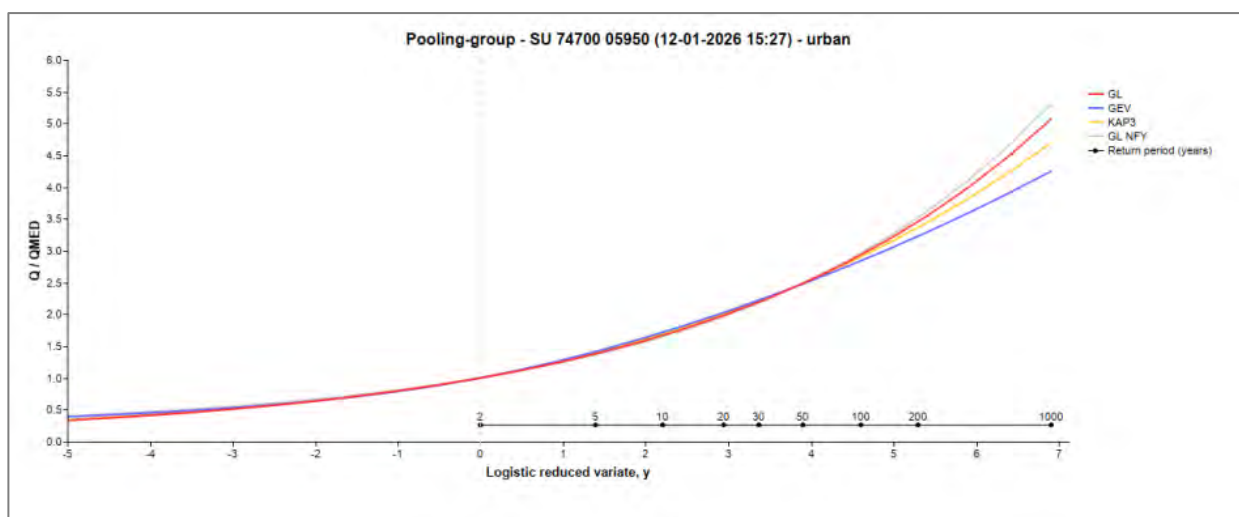


Figure 12: FEH Statistical Flood Frequency Curve WBR01

Derivation of Pooling Groups

Name of Group	Site Code Used to Derive Group	Subject Site Treated as Gauged? (ESS)	URBEXT2000 Threshold Applied to Group	L-moments Deurbanised	Small Catchments Pooling Procedure Applied?
PG01	EMS01	No	0.03	L-CV: 0.283 L-SKEW: 0.224	No
PG01	WBR01	No	0.25	L-CV: 0.252 L-SKEW: 0.241	Yes

Pooling Group Composition

Name of Group	Changes Made to Default Pooling Group and Reasons	Weighted Average L-moments
PG01 – EMS01	43012 (Wylle @ Norton Bavant) removed due to duplicate catchment (43029 Wylle @ Brixton Deverill included). 44003 (Asker @ Bridport) removed due to duplicate catchment (44011 Asker @ Bridport East Bridge included). 7010 (Muckle Burn @ Brodie) removed due to geographic distance and low permeability – catchment is located in far northeast of Scotland and is not considered representative of subject site. Added 39033 (Winterbourne Stream @ Bagnor) and 49002 (Hayle @ St Erith) to ensure total number of record years is above 800. 39033 is a rural highly permeable catchment with a large number of recorded data years. The pooling group is strongly heterogenous, however, a review of the pooling group determined	L-CV: 0.280 L-Skew: 0.224

	that the remaining stations were appropriate and should be retained.	
PG01 – WBR01	No changes made to default pooling group.	

Final Choice of QMED and Growth Curves

Method Choice and Reasons

Site Code	Final Choice of QMED and Reasons	Final Choice of Growth Curve Method and Reasons
EMS01	QMED was adjusted using a single donor site – 41015 Ems @ Westbourne	Pooled growth curve
WBR01	QMED was adjusted using a single donor site – 41015 Ems @ Westbourne	Pooled growth curve

Final Flood Estimates from Stationary Statistical Methods

Site Code	2 50%	5 20%	10 10%	30 3.3%	50 2%	100 1%	200 0.5%	1000 0.1%
EMS01	2.60	3.79	4.69	6.34	7.25	8.67	10.33	15.43
WBR01	1.21	1.68	2.04	2.67	3.01	3.51	4.07	5.68

5. Revitalised Flood Hydrograph 2 (ReFH2)

Method

Method Overview

What is the Purpose of Applying This Method

The purpose of applying the ReFH2 Method is to calculate peak flows for the FEPs (EMS01 and WBR01) to inform inflows the hydraulic model, and to compare with the results calculated using the Statistical method. Final hydrograph shape will also be derived from ReFH2 as the gauge data at 41015 Ems @ Westbourne is limited to a flow rate of 5.08 m³/s with higher flows being extrapolated.

Version of ReFH2 Applied

ReFH2 version 4 has been used.

Model Parameters

Summary of Model Parameters

Site Code	Method	Tp (hours) Rural	Cmax (mm)	BL (hours)	Area Modelled as Urban (km ²)	TP Urban Scaling Factor	IF	IRF	DS
EMS01	CD	6.28	1136.68	79.17	1.58	0.75	0.4	0.7	0.5
WBR01	CD	3.64	431.37	39.38	0.8	0.75	0.4	0.7	0.5

Methods: OPT – Optimisation from event analysis, BR – Baseflow recession fitting, LAG: TP from lag analysis, CD – Catchment descriptors, DT – Data transfer, CAL – Model calibration.

Analysis Undertaken to Derive Model Parameters

Parameter retained as default.

Model Inputs for Design Events

Design Events for Lumped Catchments

Site Code	Rainfall DDF Model	Urban or Rural	Highly Permeable?	Season of Design Event	Storm Duration (hrs)	Initial Soil Moisture (Cini)	Initial Baseflow (BFO)
EMS01	FEH22	Urban	Yes	Winter	25.25	50.32	0.28
WBR01	FEH22	Urban	No	Winter	7.50	94.82	0.07

Design Events for Subcatchments and Intervening Areas

Catchment treated as lumped.

Storm Duration Testing

Ems

Storm duration testing was undertaken to optimise for peak flow, as a precautionary approach particularly given the evidence of the catchment's slow response. Testing of a range of durations in 1-hour increments indicated that the critical storm duration for the catchment is 25 hours. The final peak flows from the ReFH2 method were defined based on this duration.

West Brook

Storm duration testing was undertaken to optimise for peak flow as a precautionary approach. Testing of a range of durations in 1-hour increments indicated that the critical storm duration for the catchment is 7.5 hours. The final peak flows from the ReFH2 method were defined based on this duration.

Final Choice of ReFH2 Flow Estimates

Method Choice and Reasons

Site Code	Final Choice of Design Inputs and Model Parameters
EMS01	Model parameters were taken from catchment descriptors and all parameters retained as default. Lumped catchment with a 25 hour storm duration.

WBR01	Model parameters were taken from catchment descriptors and all parameters retained as default. Lumped catchment with a 7.5 hour storm duration.
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Final Flood Estimates from ReFH2 Method

Site Code	2 50%	5 20%	10 10%	30 3.3%	50 2%	100 1%	200 0.5%	1000 0.1%
EMS01	3.038	3.99	4.71	5.97	6.69	7.86	9.39	14.50
WBR01	0.808	1.06	1.24	1.55	1.71	1.95	2.24	3.25

6. Discussion and Summary of Results

Comparison of Results from Different Methods

Site Code	Ratio of ReFH2 to Stationary Statistical Peak, 50% AEP	Ratio of ReFH2 to Stationary Statistical Peak, 1% AEP	Ratio of ReFH2 to Stationary Statistical Peak, 0.1% AEP
EMS01	1.06	0.91	0.94
WBR01	0.67	0.55	0.57

Ems

A comparison of the results from the two chosen methods shows that ReFH2 estimates are lower than the estimates derived using the Statistical Method for all events greater than 3.3% AEP event, being 0.91 times lesser than the Statistical Peak at the 1% AEP event. Based on the objectives of the hydraulic modelling, and the use of gauged data to derive Qmed, the FEH Statistical method was taken forwards for use as a precautionary approach.

West Brook

A comparison of the results from the two chosen methods shows that ReFH2 estimates are lower than the estimates derived using the Statistical Method for all events. being 0.55 times lesser than the Statistical Peak at the 1% AEP event. Based on the objectives of the hydraulic modelling, and the use of donor adjusted gauged data to derive Qmed, the FEH Statistical method was taken forwards for use as a precautionary approach.

Final Choice of Method

Choice of Method and Reasons

The FEH Statistical Method is the final choice for peak flows as a precautionary approach given its higher estimation of flows. Additionally, the use of gauged data in estimating Qmed gives greater confidence to the choice of the FEH statistical method. The hydrograph shape will be derived from ReFH2 as the gauge at Ems @ Westbourne is not suitable for pooling and has extrapolated flow values above 5.08m³/s.

How Will the 0.1% AEP Flows Be Estimated?

The hybrid method will be adopted, scaling the FEH statistical 1% AEP peak value by the ratio of the ReFH2 0.1% AEP flow to the ReFH2 1% AEP flow.

How Will the Flows Be Applied to a Hydraulic Model

It is assumed that flows will be applied to the model via a lumped inflow at the upstream boundary.

Final Results

Site Code	2 50%	5 20%	10 10%	30 3.3%	50 2%	100 1%	200 0.5%	1000 0.1%
EMS01	2.60	3.79	4.69	6.34	7.25	8.67	10.33	15.99
WBR01	1.21	1.68	2.04	2.67	3.01	3.51	4.07	5.86

Climate Change Allowances

The climate change allowances have been applied based on the latest Arun and Western Streams Management Catchment peak river flow allowances, applying both the Central (25%) and Higher Central (36%) allowances at the 2080s epoch.

Climate change uplifts will be applied directly within the hydraulic model build, based on the 1% AEP flows generated in this Flood Estimation Report.

Checks

Growth Factor Checks

Site Code	1% AEP Growth Factor	0.1% AEP / 1% AEP ratio
EMS01	3.36	1.40
WBR01	2.90	1.67

Spatial Consistency of Results

Two FEPs were calculated for this study at two separate catchments. Final calculated inflows between the catchments are consistent with regards to comparative catchment area.

Assumptions, Limitations, and Uncertainty

Assumptions Specific to This Study

- While catchment descriptors have been checked for accuracy against available data, it is assumed that the data reviewed is an accurate representation of conditions in the catchment.
- It is assumed that the catchment generally follows topography rather than artificial sewer catchments.

Limitations

- The NRFA gauge data for the Ems at Westbourne is not suitable for pooling as it's peak flow limited. Therefore, hydrograph shape has been derived from ReFH2. The Ems catchment is highly permeable and there are inherent limitations associated with groundwater influence on flood response. A conservative approach has been maintained throughout this assessment.

Uncertainty

In line with the Flood Estimation Guidelines (2025), no confidence intervals are available for catchment flows derived utilising ReFH2. There are however factorial standard errors, which are provided below:

Table: FSE for peak flows for the ReFH2.3-FEH22 model compared with observed peak flows (2-year gauged AMAX and ESS for longer return periods), from Wallingford HydroSolutions (2023).

Return period	ReFH2.3-FEH22 FSE
2	1.43
100	1.45
200	1.47
1,000	1.51
10,000	1.61

Suitability of Results for Future Studies

Future studies should review these results against other studies that have been carried out. These results should be checked against any updated peak flow datasets, industry guidance or updated software versions.

Appendix

A - FEH Statistical Method Report - EMS01

UK Design Flood Estimation

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

Date of creation: 08-01-2026 11:27:30
Software: WINFAP Version: 5.3.9403 (30273)
Peak Flow dataset: Peak Flow Dataset 14.0.1
Method: 2025
Supplementary data used: No

Site details

Site number: 1597358966
Site name: FEH_Catchment_Descriptors_475150_106150_v5_1_0_EDITED
Site location: SU 75150 06150
Easting: 475150
Northing: 106150
Catchment area: 60.10 km²
SAAR9120: 977 mm
BFHOST19scaled: 0.894
FPXT: 0.046
FARL2015: 0.987
URBEXT2015: 0.0168

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: 0.01680
UAF: 1.12096

Growth curve settings

Pooling group URBEXT Threshold: 0.030
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
42006 (Meon @ Misingford)	0.250	65	2.890	0.261	0.263	0.212	0.212
42008 (Cheriton Stream @ Swards Bridge)	0.273	53	1.370	0.264	0.266	0.402	0.402
43029 (Wylfe @ Brixton Deverill)	0.395	41	1.773	0.389	0.390	0.274	0.274
42009 (Candover Stream @ Borough Bridge)	0.503	54	1.065	0.295	0.296	0.387	0.387
41023 (Lavant @ Graylingwell)	0.514	47	1.740	0.462	0.465	0.321	0.321
27095 (Pickering Beck @ Pickering)	0.689	24	7.734	0.291	0.292	0.299	0.299
53023 (Sherston Avon @ Fosseway)	0.692	48	7.396	0.231	0.232	0.133	0.133
53028 (By Brook @ Middlehill)	0.701	43	10.703	0.174	0.175	-0.106	-0.106
42007 (Alre @ Drove Lane Alresford)	0.711	45	2.510	0.136	0.137	0.173	0.173
39020 (Coln @ Bibury)	0.713	61	3.610	0.200	0.201	0.062	0.062
39028 (Dun @ Hungerford)	0.733	56	2.165	0.240	0.241	-0.001	-0.001
44011 (Asker @ Bridport East Bridge)	0.786	29	16.566	0.216	0.218	0.136	0.136
7011 (Black Burn @ Pluscarden Abbey)	0.838	12	4.752	0.474	0.474	0.558	0.558
43014 (East Avon @ Upavon East)	0.875	54	3.844	0.214	0.216	0.080	0.080
44013 (Piddle @ Little Puddle)	0.941	32	1.018	0.476	0.478	0.233	0.233
51001 (Doniford Stream @ Swill Bridge)	0.959	56	13.094	0.311	0.314	0.352	0.352
49002 (Hayle @ St Erth)	1.050	56	4.480	0.229	0.231	0.216	0.216
39033 (Winterbourne Stream @ Bagnor)	1.070	62	0.401	0.346	0.348	0.390	0.390
Total		838					

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
42006 (Meon @ Misingford)	0.250	60	0.240	0.242	0.269	0.269
42008 (Cheriton Stream @ Swards Bridge)	0.273	52	0.259	0.261	0.420	0.420
43029 (Wylfe @ Brixton Deverill)	0.395	32	0.391	0.392	0.221	0.221
42009 (Candover Stream @ Borough Bridge)	0.503	51	0.280	0.281	0.432	0.432
41023 (Lavant @ Graylingwell)	0.514	39	0.439	0.442	0.331	0.331
27095 (Pickering Beck @ Pickering)	0.689	22	0.271	0.272	0.350	0.350
53023 (Sherston Avon @ Fosseway)	0.692	43	0.209	0.210	0.182	0.182
53028 (By Brook @ Middlehill)	0.701	38	0.152	0.154	-0.091	-0.091
42007 (Alre @ Drove Lane Alresford)	0.711	45	0.136	0.137	0.173	0.173
39020 (Coln @ Bibury)	0.713	58	0.187	0.188	0.101	0.101
39028 (Dun @ Hungerford)	0.733	47	0.199	0.200	0.054	0.054
44011 (Asker @ Bridport East Bridge)	0.786	28	0.211	0.213	0.142	0.142
7011 (Black Bum @ Pluscarden Abbey)	0.838	11	0.474	0.475	0.548	0.548
43014 (East Avon @ Upavon East)	0.875	49	0.197	0.199	0.110	0.110
44013 (Piddle @ Little Puddle)	0.941	20	0.691	0.694	-0.005	-0.005
51001 (Doniford Stream @ Swill Bridge)	0.959	51	0.290	0.293	0.403	0.403
49002 (Hayle @ St Erth)	1.050	54	0.217	0.219	0.260	0.260
39033 (Winterbourne Stream @ Bagnor)	1.070	55	0.320	0.321	0.448	0.448
Total		755				

UK Design Flood Estimation

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

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
42006 (Meon @ Misingford)	Yes	Yes	65	5	7.69	0.80	None	0.097	
42008 (Cheriton Stream @ Swards Bridge)	Yes	Yes	53	1	1.89	2.42	5	1.446	
43029 (Wylfe @ Brixton Deverill)	Yes	Yes	41	9	21.95	0.92	None	0.655	
42009 (Candover Stream @ Borough Bridge)	Yes	Yes	54	3	5.56	2.72	5	0.665	
41023 (Lavant @ Graylingwell)	Yes	Yes	47	8	17.02			1.183	
27095 (Pickering Beck @ Pickering)	Yes	Yes	24	2	8.33			0.337	
53023 (Sherston Avon @ Fosseway)	Yes	Yes	48	5	10.42	0.20	None	0.165	
53028 (By Brook @ Middlehill)	Yes	Yes	43	5	11.63	1.11	None	1.754	
42007 (Alre @ Drove Lane Alresford)	Yes	Yes	45	0	0.00	2.47	5	1.189	
39020 (Coln @ Bibury)	Yes	Yes	61	3	4.92	1.26	None	0.456	
39028 (Dun @ Hungerford)	Yes	Yes	56	9	16.07	-2.72	5	1.430	
44011 (Asker @ Bridport East Bridge)	Yes	Yes	29	1	3.45	0.24	None	1.152	
7011 (Black Bum @ Pluscarden Abbey)	Yes	Yes	12	1	8.33			1.602	
43014 (East Avon @ Upavon East)	Yes	Yes	54	5	9.26	0.00	None	0.308	
44013 (Piddle @ Little Puddle)	Yes	Yes	32	12	37.50	0.52	None	2.656	
51001 (Doniford Stream @ Swill Bridge)	Yes	Yes	56	5	8.93	0.59	None	0.648	
49002 (Hayle @ St Erth)	Yes	Yes	56	2	3.57	2.50	5	0.925	
39033 (Winterbourne Stream @ Bagnor)	Yes	Yes	62	7	11.29	1.34	None	1.332	

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
42006 (Meon @ Misingford)	75.847	990	0.049	0.985	0.012	0.931
42008 (Cheriton Stream @ Swards Bridge)	74.338	983	0.040	1.000	0.012	0.918
43029 (Wylfe @ Brixton Deverill)	50.040	1058	0.037	1.000	0.003	0.905
42009 (Candover Stream @ Borough Bridge)	72.062	897	0.039	0.957	0.006	0.924
41023 (Lavant @ Graylingwell)	86.198	1054	0.034	1.000	0.010	0.915
27095 (Pickering Beck @ Pickering)	66.260	917	0.026	0.995	0.007	0.662
53023 (Sherston Avon @ Fosseway)	77.728	897	0.070	1.000	0.010	0.725
53028 (By Brook @ Middlehill)	99.485	922	0.032	1.000	0.015	0.733
42007 (Alre @ Drove Lane Alresford)	57.447	932	0.028	0.926	0.015	0.933
39020 (Coln @ Bibury)	107.295	914	0.029	0.984	0.008	0.812
39028 (Dun @ Hungerford)	100.095	864	0.050	0.977	0.006	0.799
44011 (Asker @ Bridport East Bridge)	48.515	1003	0.025	1.000	0.017	0.629
7011 (Black Bum @ Pluscarden Abbey)	36.375	881	0.041	0.986	0.001	0.663
43014 (East Avon @ Upavon East)	85.828	830	0.070	0.999	0.015	0.788
44013 (Piddle @ Little Puddle)	34.087	1141	0.015	1.000	0.006	0.899
51001 (Doniford Stream @ Swill Bridge)	74.228	1009	0.038	0.990	0.015	0.559
49002 (Hayle @ St Erth)	48.575	1136	0.027	1.000	0.018	0.583
39033 (Winterbourne Stream @ Bagnor)	45.312	770	0.033	1.000	0.008	0.813

Pooling Group Rejected Stations

Station	Distance	Years of data	QMED AM	L-CV Observed	L-CV Deurbanised	L-SKEW Observed	L-SKEW Deurbanised	Comments
43012 (Wylfe @ Norton Bavant)	0.695	53	4.637	0.180	0.184	0.044	0.044	
44003 (Asker @ Bridport)	0.786	14	12.354	0.224	0.226	0.170	0.170	
7010 (Muckle Bum @ Brodie)	0.964	19	17.674	0.219	0.219	0.153	0.153	

UK Design Flood Estimation

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

Growth curve L-moments

Rural L-CV:	0.283	Urban L-CV:	0.280
Rural L-Skewness:	0.224	Urban L-Skewness:	0.224
Rural L-CV NFY:	0.277	Urban L-CV NFY:	0.274
Rural L-Skewness NFY:	0.241	Urban L-Skewness NFY:	0.241

Rural fitted parameters

Distribution	Location	Scale	Shape	H	Bound
GL	1.000	0.290	-0.224		-0.292
GEV	0.843	0.423	-0.083		-4.253
KAP3	0.920	0.349	-0.161	-0.400	-1.249
GL NFY	1.000	0.281	-0.241		-0.164

Goodness of fit

GL:	0.7749 *
GEV:	-1.3167 *
P3:	-3.1625
GP:	-6.2092
KAP3:	0.0385 *
GL NFY:	1.3346 *

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

Heterogeneity

Standardised test value H2: 6.5483

The pooling group is strongly heterogeneous and a review of the pooling group is essential.

Heterogeneity NFY

Standardised test value H2: 7.2953

The pooling group is strongly heterogeneous and a review of the pooling group is essential.

Standardised growth curves

Rural

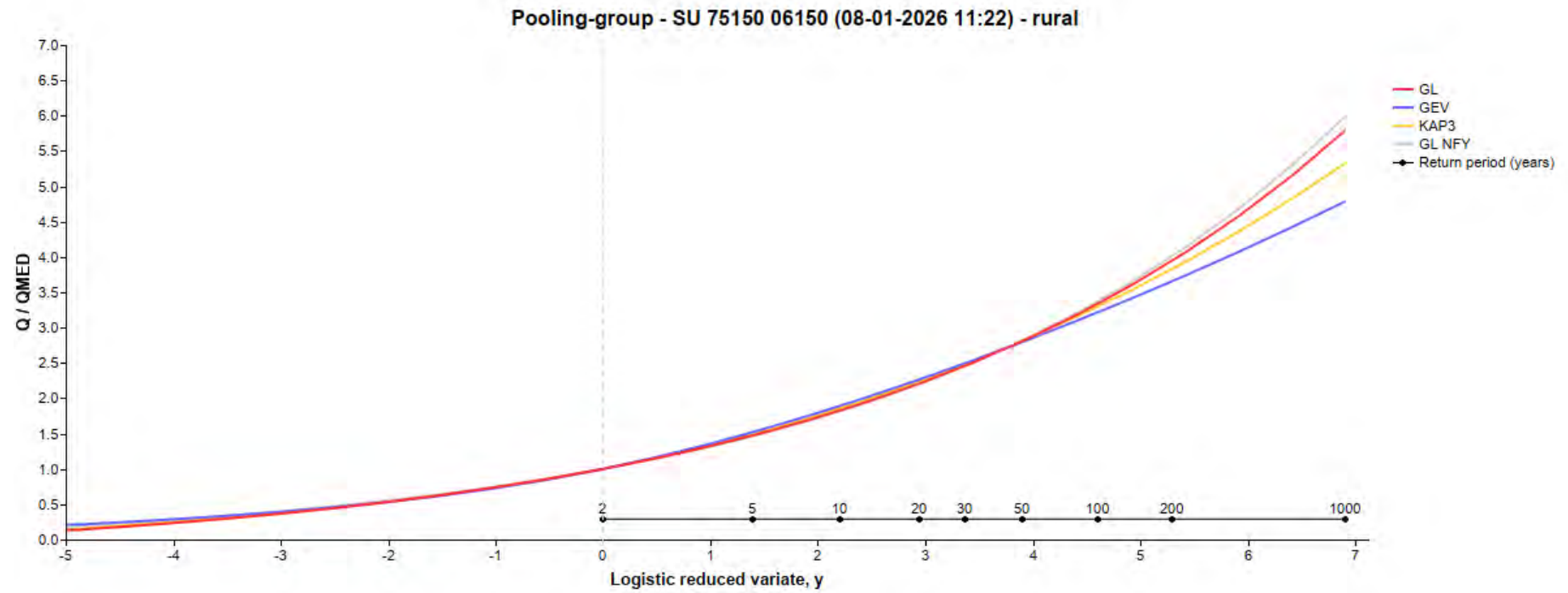
Return period	GL	GEV	KAP3	GL NFY
2	1.000	1.000	1.000	1.000
5	1.472	1.518	1.492	1.462
10	1.824	1.889	1.855	1.814
20	2.210	2.268	2.241	2.204
30	2.459	2.496	2.483	2.459
50	2.803	2.792	2.809	2.812
100	3.332	3.213	3.292	3.363
200	3.946	3.657	3.830	4.009
1000	5.796	4.789	5.331	5.995

Urban

Return period	GL	GEV	KAP3	GL NFY
2	1.000	1.000	1.000	1.000
5	1.466	1.512	1.486	1.457
10	1.814	1.879	1.844	1.804
20	2.195	2.252	2.226	2.190
30	2.442	2.478	2.466	2.441
50	2.781	2.771	2.787	2.791
100	3.304	3.186	3.264	3.334
200	3.911	3.625	3.796	3.973
1000	5.739	4.743	5.279	5.935

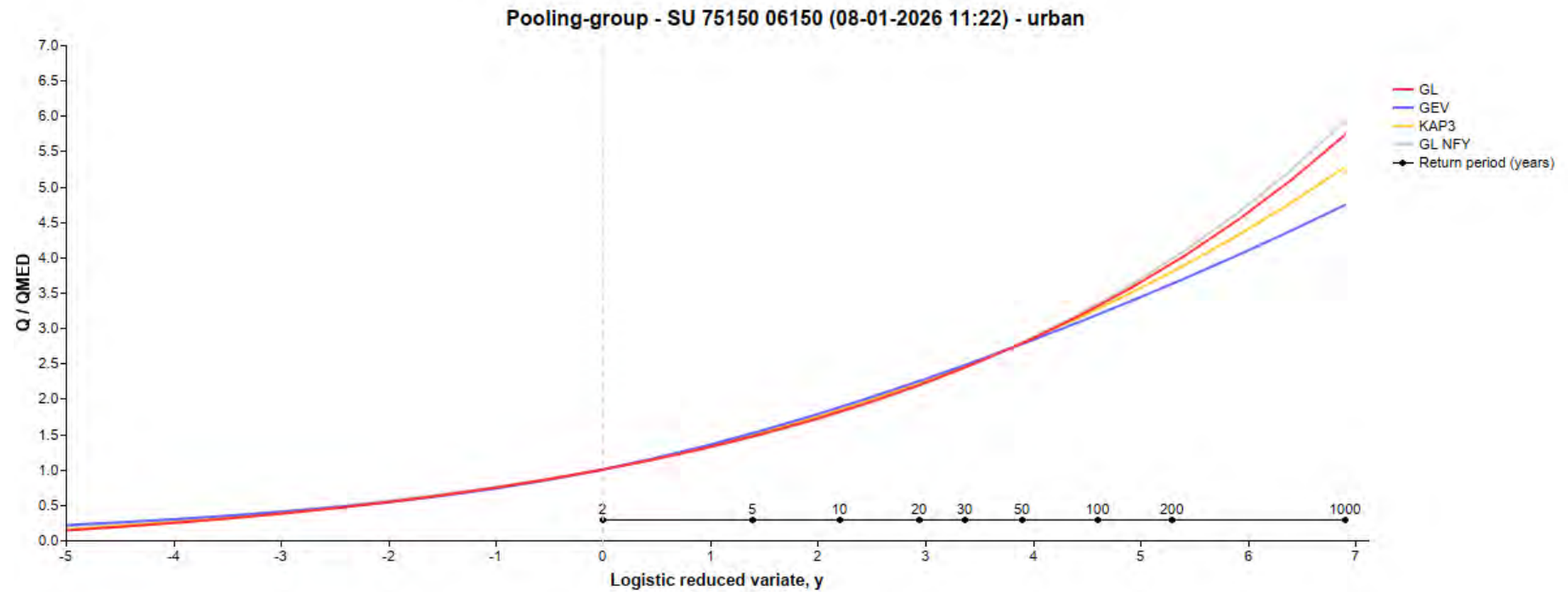
UK Design Flood Estimation

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: <0.030
 Donor adjusted FSE: 1.127
 No. of donors: 1

Donor stations

Station	Distance	Use QMED obs deurbanised	QMED obs	QMED deurbanised	QMED CDs urban	QMED CDs rural	QMED ratio
41015 (Ems @ Westbourne)	0.24	Yes	2.280	2.180	2.195	2.195	0.993

Donor suitability

Station	Suitability for QMED	Suitability for pooling	Years	Non-flood years	Percentage non-flood years	Mann Kendall (MKZ)	MKZ significance (%)	Comments
41015 (Ems @ Westbourne)	Yes	No	57	10	17.54	2.78	5	

Donor catchment descriptors

Station	Area	Centroid X	Centroid Y	SAAR9120	FPEXT	FARL2015	URBEXT2015	BFIHOST19Scaled
FEH_Catchment_Descriptors_475150_106150_v5_1_0_EDITED @ SU 75150 06150)	60.100	478377	113015	977	0.046	0.987	0.017	0.894
41015 (Ems @ Westbourne)	57.892	478472	113233	982	0.039	0.987	0.006	0.900

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
41023 (Lavant @ Graylingwell)	9.35	0.010	Yes	1.740	1.612	3.289	3.289	0.490	487719	113380	86.198	1054	0.915	1.000	47	
42006 (Meon @ Misingford)	16.43	0.012	Yes	2.890	2.583	2.293	2.293	1.127	463827	120639	75.847	990	0.931	0.985	65	
41022 (Lod @ Halfway Bridge)	19.06	0.013	Yes	16.755	16.467	15.552	15.552	1.059	491432	126899	52.438	935	0.427	0.978	54	
42008 (Cheriton Stream @ Swards Bridge)	21.95	0.012	Yes	1.370	1.245	2.531	2.531	0.492	461729	127315	74.338	983	0.918	1.000	53	
41018 (Kird @ Tanyards)	25.35	0.008	Yes	19.903	19.717	19.775	19.775	0.997	498549	128364	67.358	864	0.341	0.962	32	
42007 (Alre @ Drove Lane Alresford)	26.35	0.015	Yes	2.510	2.177	1.329	1.329	1.639	462212	133819	57.447	932	0.933	0.926	45	
42009 (Candover Stream @ Borough Bridge)	33.21	0.006	Yes	1.065	1.014	1.752	1.752	0.579	460964	141288	72.062	897	0.924	0.957	54	
39036 (Law Brook @ Albury)	43.11	0.027	Yes	0.460	0.427	1.999	1.999	0.214	507365	144918	16.062	905	0.699	1.000	54	
42003 (Lyngington @ Brockenhurst)	52.73	0.017	Yes	27.400	26.780	27.678	27.678	0.968	426195	105409	99.873	924	0.432	0.999	29	

UK Design Flood Estimation

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

QMED

Rural: 2.319 m³/s

Urban: 2.599 m³/s

UK Design Flood Estimation

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

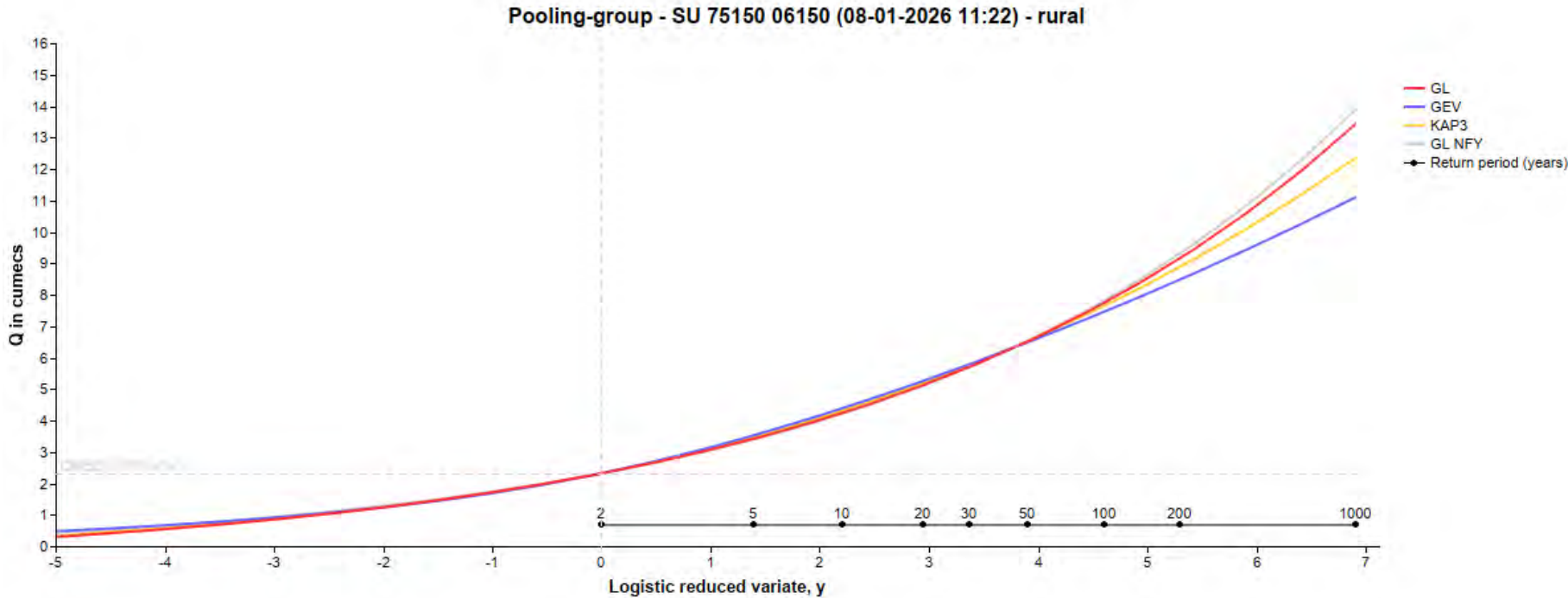
Flood Frequency Curve

Rural Flood Frequency Curve

Return period	GL (m³/s)	GEV (m³/s)	KAP3 (m³/s)	GL NFY (m³/s)
2	2.319	2.319	2.319	2.319
5	3.412	3.520	3.458	3.390
10	4.228	4.381	4.300	4.205
20	5.124	5.258	5.196	5.111
30	5.701	5.787	5.758	5.700
50	6.498	6.474	6.512	6.520
100	7.725	7.449	7.632	7.796
200	9.150	8.478	8.879	9.296
1000	13.438	11.103	12.361	13.899

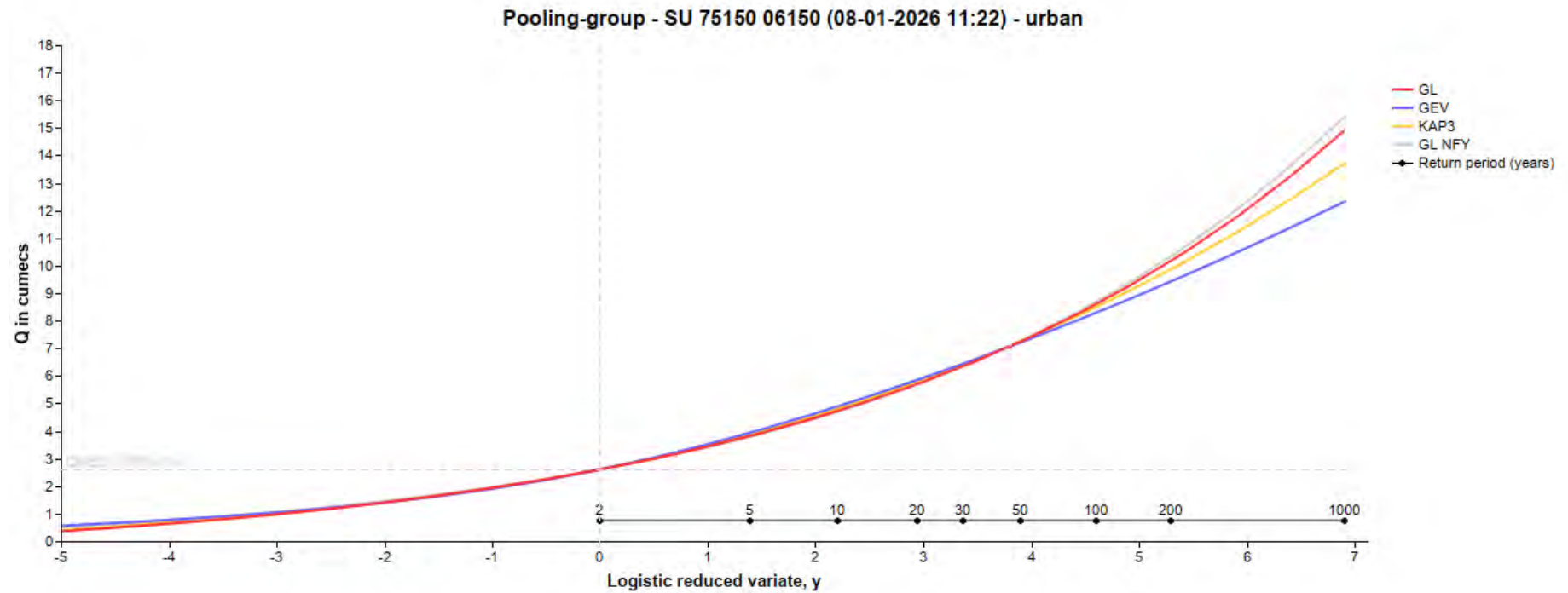
Urban Flood Frequency Curve

Return period	GL (m³/s)	GEV (m³/s)	KAP3 (m³/s)	GL NFY (m³/s)
2	2.599	2.599	2.599	2.599
5	3.810	3.930	3.861	3.786
10	4.714	4.883	4.793	4.688
20	5.706	5.854	5.786	5.691
30	6.346	6.440	6.408	6.344
50	7.228	7.201	7.244	7.253
100	8.587	8.280	8.484	8.666
200	10.166	9.420	9.865	10.327
1000	14.915	12.328	13.721	15.425



UK Design Flood Estimation

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



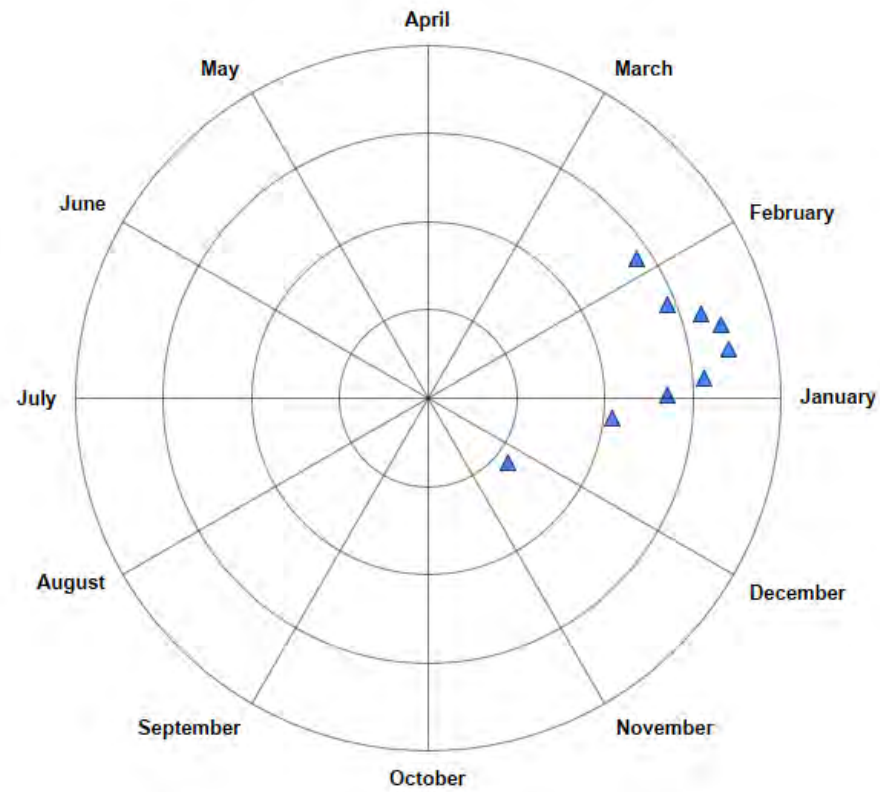
UK Design Flood Estimation

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

Appendix

Station record parameters

Flood seasonality: SU 75150 06150 (08-01-2026 11:22) - rural



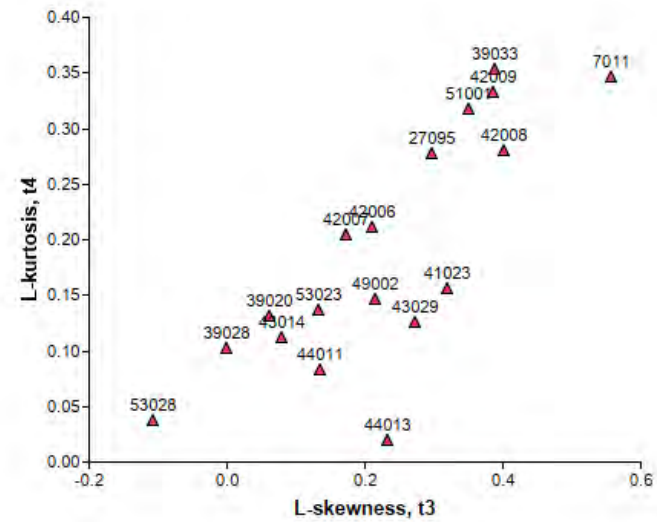
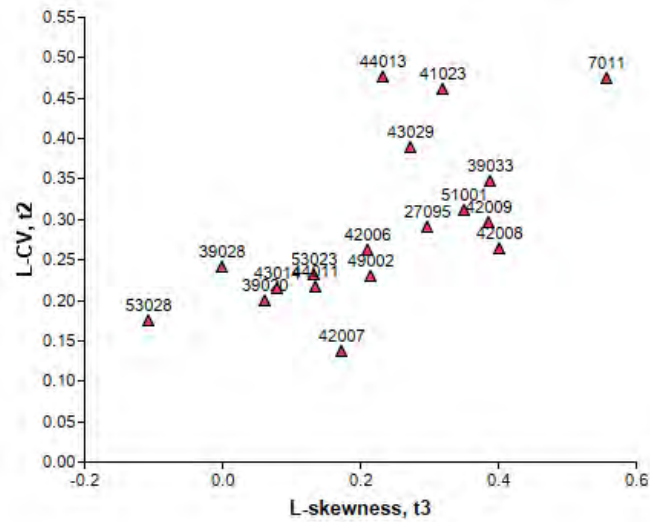
UK Design Flood Estimation

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

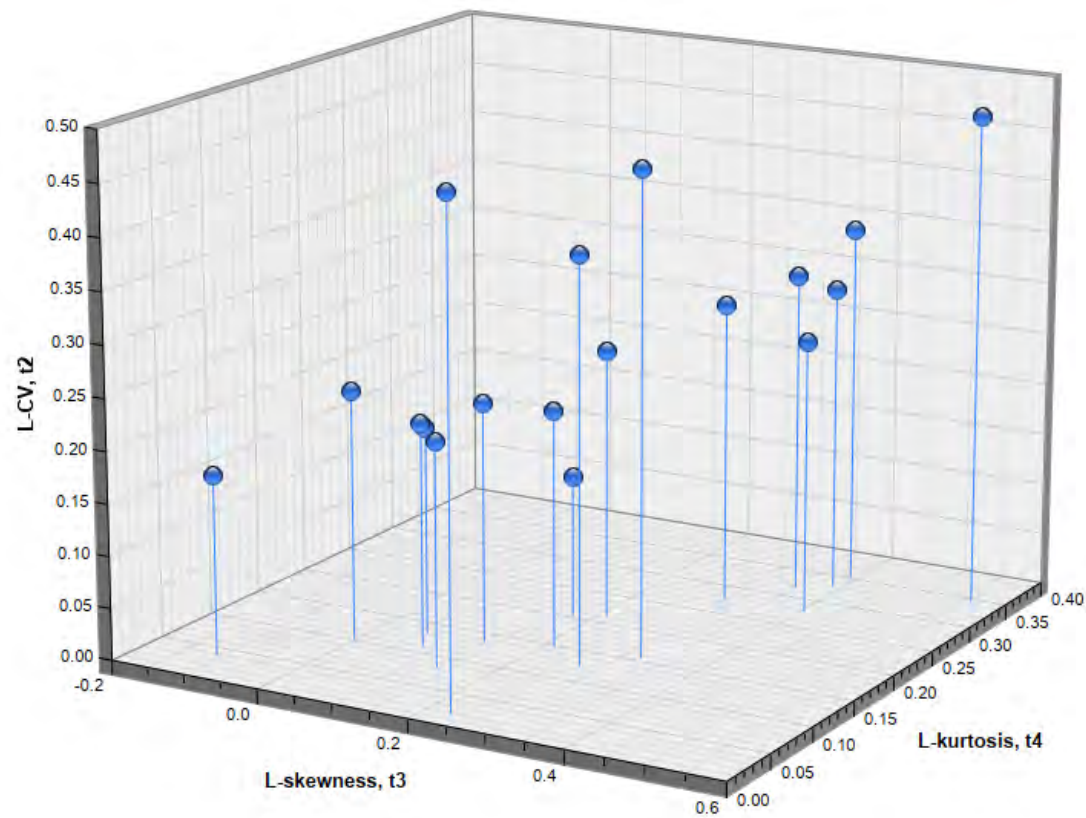
L-moment ratios - SU 75150 06150 (08-01-2026 11:22) - urban



UK Design Flood Estimation

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

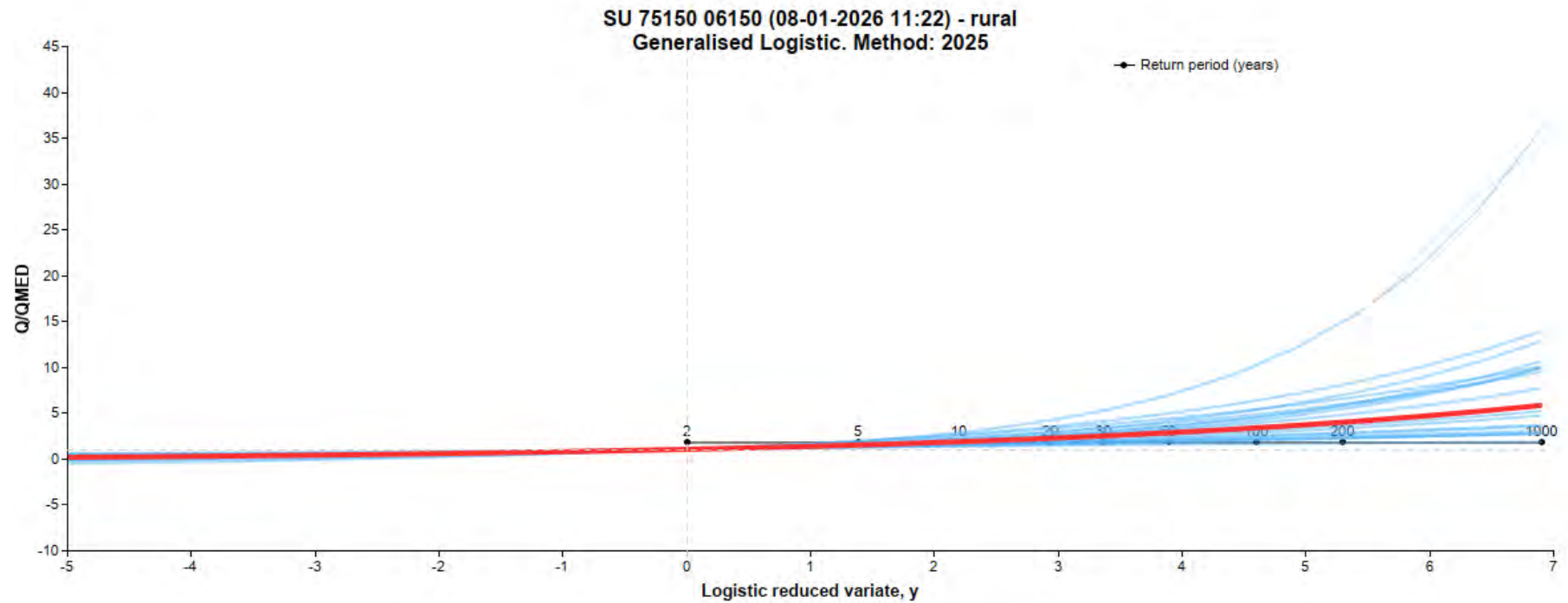
L-moment ratios - SU 75150 06150 (08-01-2026 11:22) - urban



UK Design Flood Estimation

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

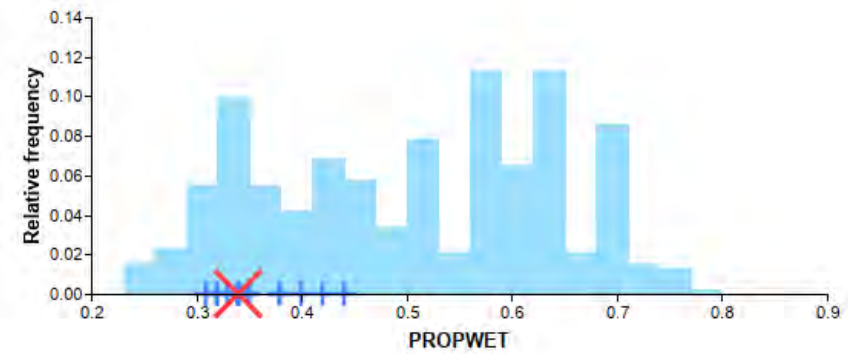
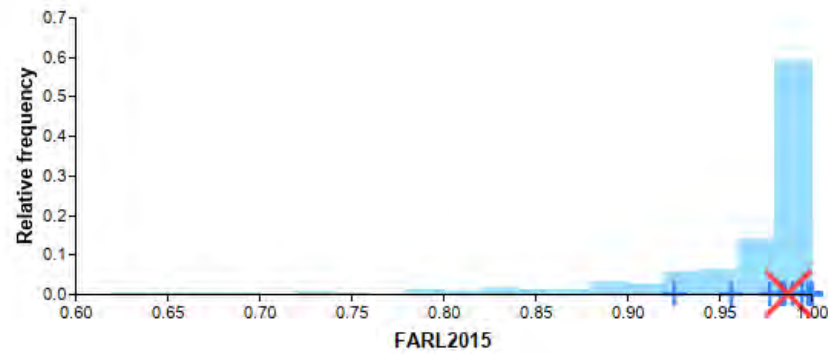
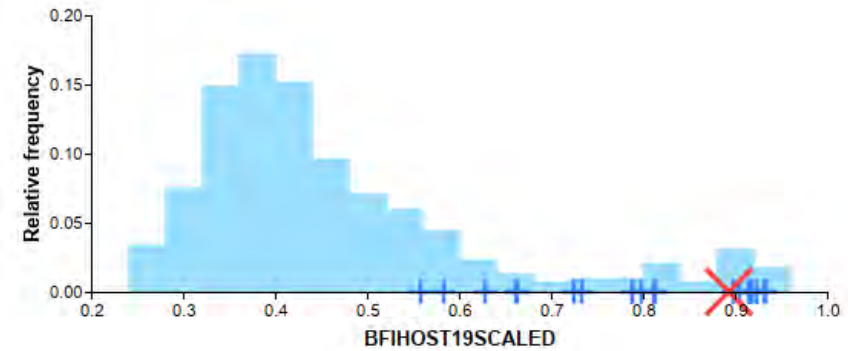
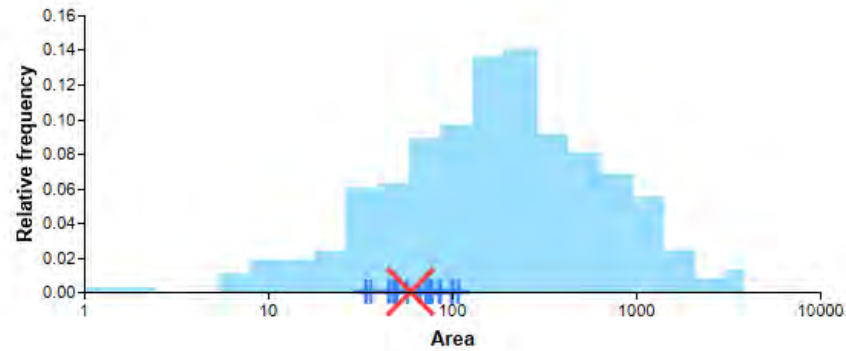
Pooling group growth curves



UK Design Flood Estimation

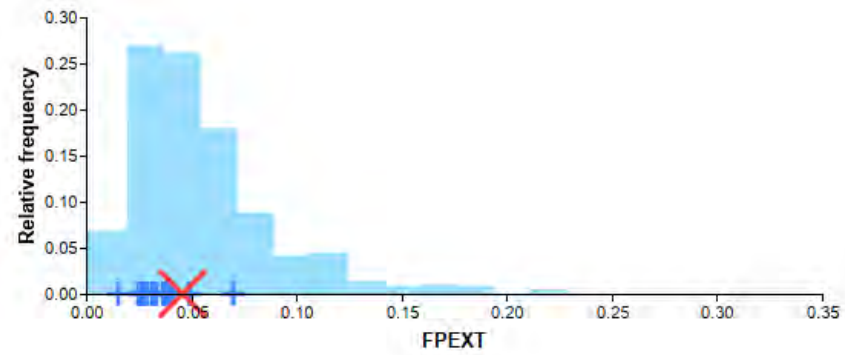
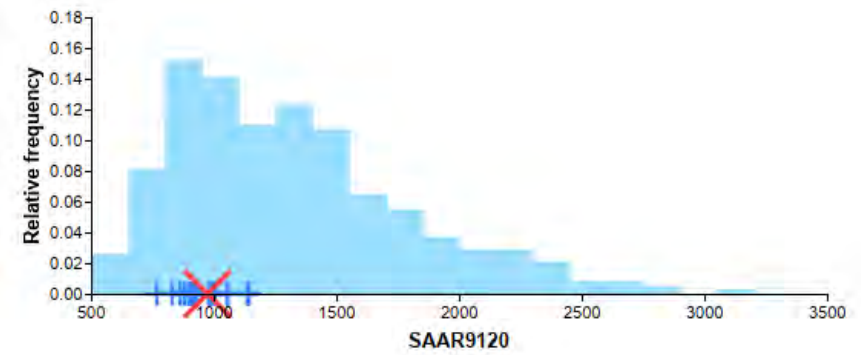
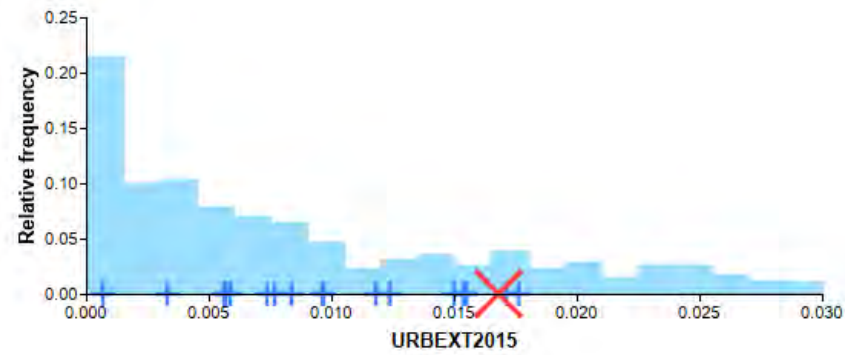
Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Catchment descriptors



UK Design Flood Estimation

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



B - ReFH2 Report EMS01

UK Design Flood Estimation

Generated on Friday, January 9, 2026 8:34:12 AM by chris
Printed from the ReFH2 Flood Modelling software package, version 4.1.8879.22310

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

Site details

Checksum: B2BF-A70C

Site name: FEH_Catchment_Descriptors_475150_106150_v5_1_0_EDITED

Easting: 475150

Northing: 106150

Country: England, Wales or Northern Ireland

Catchment Area (km²): 60.1

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH22 (mm):	94.73	Total runoff (ML):	346.42
Total Rainfall (mm):	70.37	Total flow (ML):	1494.52
Peak Rainfall (mm):	1.84	Peak flow (m ³ /s):	7.86

Parameters

Where the user has overridden 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)	25:15:00 [11:00:00]	Yes
Timestep (hh:mm:ss)	00:15:00 [01:00:00]	Yes
SCF (Seasonal correction factor)	0.78	No
ARF (Areal reduction factor)	0.95	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	50.32	No
Cmax (mm)	1136.68	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	6.28	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m ³ /s)	0.28	No
BL (hr)	79.17	No
BR	3.64	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)	1.58	No
Effective URBEXT2000	0.02	n/a
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 (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
00:00:00	0.132	0.000	0.007	0.000	0.272	0.272
00:15:00	0.140	0.000	0.007	0.000	0.271	0.272
00:30:00	0.148	0.000	0.008	0.001	0.270	0.272
00:45:00	0.157	0.000	0.008	0.002	0.270	0.272
01:00:00	0.166	0.000	0.009	0.004	0.269	0.273
01:15:00	0.175	0.000	0.009	0.007	0.268	0.275
01:30:00	0.186	0.000	0.010	0.010	0.267	0.278
01:45:00	0.196	0.000	0.010	0.014	0.266	0.281
02:00:00	0.208	0.000	0.011	0.019	0.266	0.285
02:15:00	0.220	0.000	0.012	0.025	0.265	0.290
02:30:00	0.232	0.000	0.012	0.031	0.265	0.296
02:45:00	0.246	0.000	0.013	0.039	0.264	0.303
03:00:00	0.260	0.000	0.014	0.047	0.264	0.311
03:15:00	0.275	0.000	0.015	0.057	0.263	0.320
03:30:00	0.291	0.000	0.016	0.067	0.263	0.330
03:45:00	0.308	0.000	0.017	0.079	0.263	0.341
04:00:00	0.325	0.000	0.018	0.092	0.263	0.354
04:15:00	0.344	0.000	0.019	0.106	0.263	0.369
04:30:00	0.364	0.000	0.020	0.122	0.263	0.384
04:45:00	0.384	0.000	0.021	0.139	0.263	0.402
05:00:00	0.406	0.000	0.023	0.157	0.264	0.421
05:15:00	0.430	0.000	0.024	0.177	0.264	0.442
05:30:00	0.454	0.000	0.026	0.199	0.265	0.464
05:45:00	0.480	0.000	0.027	0.222	0.266	0.489
06:00:00	0.507	0.000	0.029	0.247	0.267	0.515
06:15:00	0.536	0.000	0.031	0.274	0.269	0.543
06:30:00	0.566	0.000	0.033	0.303	0.271	0.574
06:45:00	0.598	0.000	0.035	0.333	0.273	0.606
07:00:00	0.632	0.000	0.037	0.365	0.275	0.640
07:15:00	0.667	0.000	0.040	0.399	0.278	0.676
07:30:00	0.705	0.000	0.043	0.434	0.281	0.714
07:45:00	0.744	0.000	0.045	0.471	0.284	0.755
08:00:00	0.786	0.000	0.048	0.511	0.287	0.798
08:15:00	0.829	0.000	0.052	0.552	0.291	0.844

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)
08:30:00	0.875	0.000	0.055	0.596	0.296	0.892
08:45:00	0.924	0.000	0.059	0.643	0.301	0.943
09:00:00	0.974	0.000	0.063	0.692	0.306	0.998
09:15:00	1.028	0.000	0.067	0.744	0.311	1.056
09:30:00	1.084	0.000	0.072	0.800	0.318	1.117
09:45:00	1.142	0.000	0.077	0.858	0.324	1.183
10:00:00	1.204	0.000	0.082	0.921	0.332	1.252
10:15:00	1.268	0.000	0.088	0.987	0.340	1.327
10:30:00	1.335	0.000	0.094	1.057	0.348	1.406
10:45:00	1.404	0.000	0.101	1.132	0.357	1.490
11:00:00	1.477	0.000	0.108	1.212	0.367	1.580
11:15:00	1.550	0.000	0.116	1.297	0.378	1.675
11:30:00	1.627	0.000	0.123	1.388	0.389	1.777
11:45:00	1.700	0.000	0.131	1.484	0.402	1.886
12:00:00	1.773	0.000	0.140	1.587	0.415	2.002
12:15:00	1.805	0.000	0.145	1.696	0.430	2.126
12:30:00	1.838	0.000	0.150	1.813	0.445	2.258
12:45:00	1.805	0.000	0.151	1.937	0.461	2.398
13:00:00	1.773	0.000	0.151	2.067	0.479	2.546
13:15:00	1.700	0.000	0.147	2.205	0.498	2.703
13:30:00	1.627	0.000	0.143	2.349	0.519	2.868
13:45:00	1.550	0.000	0.139	2.500	0.540	3.040
14:00:00	1.477	0.000	0.134	2.655	0.564	3.219
14:15:00	1.404	0.000	0.129	2.815	0.588	3.404
14:30:00	1.335	0.000	0.124	2.980	0.615	3.594
14:45:00	1.268	0.000	0.120	3.147	0.643	3.789
15:00:00	1.204	0.000	0.115	3.316	0.672	3.989
15:15:00	1.142	0.000	0.110	3.488	0.703	4.191
15:30:00	1.084	0.000	0.105	3.660	0.736	4.396
15:45:00	1.028	0.000	0.101	3.832	0.771	4.603
16:00:00	0.974	0.000	0.097	4.003	0.807	4.810
16:15:00	0.924	0.000	0.092	4.172	0.845	5.017
16:30:00	0.875	0.000	0.088	4.339	0.884	5.223
16:45:00	0.829	0.000	0.084	4.501	0.926	5.427
17:00:00	0.786	0.000	0.080	4.659	0.968	5.627

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)
17:15:00	0.744	0.000	0.077	4.812	1.013	5.824
17:30:00	0.705	0.000	0.073	4.957	1.058	6.016
17:45:00	0.667	0.000	0.069	5.095	1.106	6.201
18:00:00	0.632	0.000	0.066	5.225	1.154	6.379
18:15:00	0.598	0.000	0.063	5.345	1.204	6.549
18:30:00	0.566	0.000	0.060	5.455	1.255	6.710
18:45:00	0.536	0.000	0.057	5.554	1.307	6.861
19:00:00	0.507	0.000	0.054	5.641	1.360	7.002
19:15:00	0.480	0.000	0.051	5.717	1.414	7.131
19:30:00	0.454	0.000	0.049	5.780	1.469	7.248
19:45:00	0.430	0.000	0.046	5.831	1.524	7.355
20:00:00	0.406	0.000	0.044	5.870	1.579	7.450
20:15:00	0.384	0.000	0.042	5.898	1.635	7.534
20:30:00	0.364	0.000	0.040	5.916	1.691	7.607
20:45:00	0.344	0.000	0.038	5.922	1.748	7.670
21:00:00	0.325	0.000	0.036	5.919	1.804	7.723
21:15:00	0.308	0.000	0.034	5.907	1.860	7.767
21:30:00	0.291	0.000	0.032	5.886	1.916	7.801
21:45:00	0.275	0.000	0.030	5.856	1.971	7.827
22:00:00	0.260	0.000	0.029	5.819	2.026	7.845
22:15:00	0.246	0.000	0.027	5.774	2.081	7.854
22:30:00	0.232	0.000	0.026	5.722	2.135	7.857
22:45:00	0.220	0.000	0.024	5.664	2.188	7.852
23:00:00	0.208	0.000	0.023	5.600	2.241	7.841
23:15:00	0.196	0.000	0.022	5.531	2.292	7.823
23:30:00	0.186	0.000	0.021	5.456	2.343	7.800
23:45:00	0.175	0.000	0.019	5.378	2.394	7.771
24:00:00	0.166	0.000	0.018	5.295	2.443	7.738
24:15:00	0.157	0.000	0.017	5.209	2.491	7.700
24:30:00	0.148	0.000	0.017	5.120	2.538	7.658
24:45:00	0.140	0.000	0.016	5.028	2.584	7.613
25:00:00	0.132	0.000	0.015	4.935	2.629	7.564
25:15:00	0.000	0.000	0.000	4.839	2.674	7.513
25:30:00	0.000	0.000	0.000	4.742	2.716	7.458
25:45:00	0.000	0.000	0.000	4.642	2.758	7.400

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)
26:00:00	0.000	0.000	0.000	4.541	2.799	7.340
26:15:00	0.000	0.000	0.000	4.438	2.839	7.276
26:30:00	0.000	0.000	0.000	4.333	2.877	7.210
26:45:00	0.000	0.000	0.000	4.228	2.914	7.142
27:00:00	0.000	0.000	0.000	4.121	2.950	7.071
27:15:00	0.000	0.000	0.000	4.014	2.985	6.998
27:30:00	0.000	0.000	0.000	3.905	3.019	6.924
27:45:00	0.000	0.000	0.000	3.796	3.051	6.847
28:00:00	0.000	0.000	0.000	3.687	3.082	6.769
28:15:00	0.000	0.000	0.000	3.578	3.112	6.690
28:30:00	0.000	0.000	0.000	3.468	3.141	6.609
28:45:00	0.000	0.000	0.000	3.358	3.168	6.527
29:00:00	0.000	0.000	0.000	3.249	3.195	6.443
29:15:00	0.000	0.000	0.000	3.139	3.220	6.359
29:30:00	0.000	0.000	0.000	3.030	3.244	6.273
29:45:00	0.000	0.000	0.000	2.921	3.266	6.187
30:00:00	0.000	0.000	0.000	2.812	3.288	6.100
30:15:00	0.000	0.000	0.000	2.705	3.308	6.013
30:30:00	0.000	0.000	0.000	2.598	3.327	5.925
30:45:00	0.000	0.000	0.000	2.492	3.345	5.837
31:00:00	0.000	0.000	0.000	2.387	3.361	5.748
31:15:00	0.000	0.000	0.000	2.283	3.377	5.660
31:30:00	0.000	0.000	0.000	2.180	3.391	5.571
31:45:00	0.000	0.000	0.000	2.078	3.404	5.483
32:00:00	0.000	0.000	0.000	1.980	3.416	5.396
32:15:00	0.000	0.000	0.000	1.883	3.427	5.310
32:30:00	0.000	0.000	0.000	1.790	3.437	5.227
32:45:00	0.000	0.000	0.000	1.698	3.446	5.144
33:00:00	0.000	0.000	0.000	1.610	3.454	5.063
33:15:00	0.000	0.000	0.000	1.524	3.460	4.984
33:30:00	0.000	0.000	0.000	1.440	3.466	4.907
33:45:00	0.000	0.000	0.000	1.360	3.471	4.831
34:00:00	0.000	0.000	0.000	1.282	3.475	4.757
34:15:00	0.000	0.000	0.000	1.207	3.478	4.685
34:30:00	0.000	0.000	0.000	1.134	3.481	4.615

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)
34:45:00	0.000	0.000	0.000	1.065	3.482	4.547
35:00:00	0.000	0.000	0.000	0.999	3.483	4.482
35:15:00	0.000	0.000	0.000	0.936	3.483	4.419
35:30:00	0.000	0.000	0.000	0.876	3.482	4.358
35:45:00	0.000	0.000	0.000	0.819	3.481	4.299
36:00:00	0.000	0.000	0.000	0.765	3.479	4.243
36:15:00	0.000	0.000	0.000	0.714	3.476	4.190
36:30:00	0.000	0.000	0.000	0.665	3.473	4.139
36:45:00	0.000	0.000	0.000	0.620	3.470	4.090
37:00:00	0.000	0.000	0.000	0.577	3.466	4.043
37:15:00	0.000	0.000	0.000	0.537	3.461	3.998
37:30:00	0.000	0.000	0.000	0.499	3.456	3.955
37:45:00	0.000	0.000	0.000	0.464	3.451	3.914
38:00:00	0.000	0.000	0.000	0.430	3.445	3.875
38:15:00	0.000	0.000	0.000	0.399	3.439	3.838
38:30:00	0.000	0.000	0.000	0.369	3.432	3.802
38:45:00	0.000	0.000	0.000	0.341	3.426	3.767
39:00:00	0.000	0.000	0.000	0.315	3.419	3.734
39:15:00	0.000	0.000	0.000	0.290	3.411	3.702
39:30:00	0.000	0.000	0.000	0.267	3.404	3.671
39:45:00	0.000	0.000	0.000	0.245	3.396	3.641
40:00:00	0.000	0.000	0.000	0.225	3.388	3.613
40:15:00	0.000	0.000	0.000	0.206	3.380	3.586
40:30:00	0.000	0.000	0.000	0.188	3.372	3.559
40:45:00	0.000	0.000	0.000	0.171	3.363	3.534
41:00:00	0.000	0.000	0.000	0.156	3.354	3.510
41:15:00	0.000	0.000	0.000	0.141	3.346	3.487
41:30:00	0.000	0.000	0.000	0.128	3.337	3.464
41:45:00	0.000	0.000	0.000	0.115	3.327	3.442
42:00:00	0.000	0.000	0.000	0.103	3.318	3.422
42:15:00	0.000	0.000	0.000	0.093	3.309	3.402
42:30:00	0.000	0.000	0.000	0.083	3.300	3.382
42:45:00	0.000	0.000	0.000	0.074	3.290	3.364
43:00:00	0.000	0.000	0.000	0.065	3.280	3.346
43:15:00	0.000	0.000	0.000	0.057	3.271	3.328

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)
43:30:00	0.000	0.000	0.000	0.050	3.261	3.311
43:45:00	0.000	0.000	0.000	0.044	3.251	3.295
44:00:00	0.000	0.000	0.000	0.038	3.242	3.279
44:15:00	0.000	0.000	0.000	0.032	3.232	3.264
44:30:00	0.000	0.000	0.000	0.027	3.222	3.249
44:45:00	0.000	0.000	0.000	0.023	3.212	3.235
45:00:00	0.000	0.000	0.000	0.019	3.202	3.221
45:15:00	0.000	0.000	0.000	0.015	3.192	3.208
45:30:00	0.000	0.000	0.000	0.012	3.182	3.195
45:45:00	0.000	0.000	0.000	0.010	3.173	3.182
46:00:00	0.000	0.000	0.000	0.007	3.163	3.170
46:15:00	0.000	0.000	0.000	0.005	3.153	3.158
46:30:00	0.000	0.000	0.000	0.004	3.143	3.147
46:45:00	0.000	0.000	0.000	0.002	3.133	3.135
47:00:00	0.000	0.000	0.000	0.001	3.123	3.125
47:15:00	0.000	0.000	0.000	0.001	3.113	3.114
47:30:00	0.000	0.000	0.000	0.000	3.103	3.104
47:45:00	0.000	0.000	0.000	0.000	3.094	3.094
48:00:00	0.000	0.000	0.000	0.000	3.084	3.084
48:15:00	0.000	0.000	0.000	0.000	3.074	3.074
48:30:00	0.000	0.000	0.000	0.000	3.065	3.065
48:45:00	0.000	0.000	0.000	0.000	3.055	3.055
49:00:00	0.000	0.000	0.000	0.000	3.045	3.045
49:15:00	0.000	0.000	0.000	0.000	3.036	3.036
49:30:00	0.000	0.000	0.000	0.000	3.026	3.026
49:45:00	0.000	0.000	0.000	0.000	3.017	3.017
50:00:00	0.000	0.000	0.000	0.000	3.007	3.007
50:15:00	0.000	0.000	0.000	0.000	2.998	2.998
50:30:00	0.000	0.000	0.000	0.000	2.988	2.988
50:45:00	0.000	0.000	0.000	0.000	2.979	2.979
51:00:00	0.000	0.000	0.000	0.000	2.969	2.969
51:15:00	0.000	0.000	0.000	0.000	2.960	2.960
51:30:00	0.000	0.000	0.000	0.000	2.951	2.951
51:45:00	0.000	0.000	0.000	0.000	2.941	2.941
52:00:00	0.000	0.000	0.000	0.000	2.932	2.932

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)
52:15:00	0.000	0.000	0.000	0.000	2.923	2.923
52:30:00	0.000	0.000	0.000	0.000	2.914	2.914
52:45:00	0.000	0.000	0.000	0.000	2.904	2.904
53:00:00	0.000	0.000	0.000	0.000	2.895	2.895
53:15:00	0.000	0.000	0.000	0.000	2.886	2.886
53:30:00	0.000	0.000	0.000	0.000	2.877	2.877
53:45:00	0.000	0.000	0.000	0.000	2.868	2.868
54:00:00	0.000	0.000	0.000	0.000	2.859	2.859
54:15:00	0.000	0.000	0.000	0.000	2.850	2.850
54:30:00	0.000	0.000	0.000	0.000	2.841	2.841
54:45:00	0.000	0.000	0.000	0.000	2.832	2.832
55:00:00	0.000	0.000	0.000	0.000	2.823	2.823
55:15:00	0.000	0.000	0.000	0.000	2.814	2.814
55:30:00	0.000	0.000	0.000	0.000	2.805	2.805
55:45:00	0.000	0.000	0.000	0.000	2.796	2.796
56:00:00	0.000	0.000	0.000	0.000	2.788	2.788
56:15:00	0.000	0.000	0.000	0.000	2.779	2.779
56:30:00	0.000	0.000	0.000	0.000	2.770	2.770
56:45:00	0.000	0.000	0.000	0.000	2.761	2.761
57:00:00	0.000	0.000	0.000	0.000	2.753	2.753
57:15:00	0.000	0.000	0.000	0.000	2.744	2.744
57:30:00	0.000	0.000	0.000	0.000	2.735	2.735
57:45:00	0.000	0.000	0.000	0.000	2.727	2.727
58:00:00	0.000	0.000	0.000	0.000	2.718	2.718
58:15:00	0.000	0.000	0.000	0.000	2.709	2.709
58:30:00	0.000	0.000	0.000	0.000	2.701	2.701
58:45:00	0.000	0.000	0.000	0.000	2.692	2.692
59:00:00	0.000	0.000	0.000	0.000	2.684	2.684
59:15:00	0.000	0.000	0.000	0.000	2.675	2.675
59:30:00	0.000	0.000	0.000	0.000	2.667	2.667
59:45:00	0.000	0.000	0.000	0.000	2.659	2.659
60:00:00	0.000	0.000	0.000	0.000	2.650	2.650
60:15:00	0.000	0.000	0.000	0.000	2.642	2.642
60:30:00	0.000	0.000	0.000	0.000	2.634	2.634
60:45:00	0.000	0.000	0.000	0.000	2.625	2.625

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)
61:00:00	0.000	0.000	0.000	0.000	2.617	2.617
61:15:00	0.000	0.000	0.000	0.000	2.609	2.609
61:30:00	0.000	0.000	0.000	0.000	2.600	2.600
61:45:00	0.000	0.000	0.000	0.000	2.592	2.592
62:00:00	0.000	0.000	0.000	0.000	2.584	2.584
62:15:00	0.000	0.000	0.000	0.000	2.576	2.576
62:30:00	0.000	0.000	0.000	0.000	2.568	2.568
62:45:00	0.000	0.000	0.000	0.000	2.560	2.560
63:00:00	0.000	0.000	0.000	0.000	2.552	2.552
63:15:00	0.000	0.000	0.000	0.000	2.544	2.544
63:30:00	0.000	0.000	0.000	0.000	2.536	2.536
63:45:00	0.000	0.000	0.000	0.000	2.528	2.528
64:00:00	0.000	0.000	0.000	0.000	2.520	2.520
64:15:00	0.000	0.000	0.000	0.000	2.512	2.512
64:30:00	0.000	0.000	0.000	0.000	2.504	2.504
64:45:00	0.000	0.000	0.000	0.000	2.496	2.496
65:00:00	0.000	0.000	0.000	0.000	2.488	2.488
65:15:00	0.000	0.000	0.000	0.000	2.480	2.480
65:30:00	0.000	0.000	0.000	0.000	2.472	2.472
65:45:00	0.000	0.000	0.000	0.000	2.465	2.465
66:00:00	0.000	0.000	0.000	0.000	2.457	2.457
66:15:00	0.000	0.000	0.000	0.000	2.449	2.449
66:30:00	0.000	0.000	0.000	0.000	2.441	2.441
66:45:00	0.000	0.000	0.000	0.000	2.434	2.434
67:00:00	0.000	0.000	0.000	0.000	2.426	2.426
67:15:00	0.000	0.000	0.000	0.000	2.418	2.418
67:30:00	0.000	0.000	0.000	0.000	2.411	2.411
67:45:00	0.000	0.000	0.000	0.000	2.403	2.403
68:00:00	0.000	0.000	0.000	0.000	2.395	2.395
68:15:00	0.000	0.000	0.000	0.000	2.388	2.388
68:30:00	0.000	0.000	0.000	0.000	2.380	2.380
68:45:00	0.000	0.000	0.000	0.000	2.373	2.373
69:00:00	0.000	0.000	0.000	0.000	2.365	2.365
69:15:00	0.000	0.000	0.000	0.000	2.358	2.358
69:30:00	0.000	0.000	0.000	0.000	2.351	2.351

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)
69:45:00	0.000	0.000	0.000	0.000	2.343	2.343
70:00:00	0.000	0.000	0.000	0.000	2.336	2.336
70:15:00	0.000	0.000	0.000	0.000	2.328	2.328
70:30:00	0.000	0.000	0.000	0.000	2.321	2.321
70:45:00	0.000	0.000	0.000	0.000	2.314	2.314
71:00:00	0.000	0.000	0.000	0.000	2.306	2.306
71:15:00	0.000	0.000	0.000	0.000	2.299	2.299
71:30:00	0.000	0.000	0.000	0.000	2.292	2.292
71:45:00	0.000	0.000	0.000	0.000	2.285	2.285
72:00:00	0.000	0.000	0.000	0.000	2.277	2.277
72:15:00	0.000	0.000	0.000	0.000	2.270	2.270
72:30:00	0.000	0.000	0.000	0.000	2.263	2.263
72:45:00	0.000	0.000	0.000	0.000	2.256	2.256
73:00:00	0.000	0.000	0.000	0.000	2.249	2.249
73:15:00	0.000	0.000	0.000	0.000	2.242	2.242
73:30:00	0.000	0.000	0.000	0.000	2.235	2.235
73:45:00	0.000	0.000	0.000	0.000	2.228	2.228
74:00:00	0.000	0.000	0.000	0.000	2.221	2.221
74:15:00	0.000	0.000	0.000	0.000	2.214	2.214
74:30:00	0.000	0.000	0.000	0.000	2.207	2.207
74:45:00	0.000	0.000	0.000	0.000	2.200	2.200
75:00:00	0.000	0.000	0.000	0.000	2.193	2.193
75:15:00	0.000	0.000	0.000	0.000	2.186	2.186
75:30:00	0.000	0.000	0.000	0.000	2.179	2.179
75:45:00	0.000	0.000	0.000	0.000	2.172	2.172
76:00:00	0.000	0.000	0.000	0.000	2.165	2.165
76:15:00	0.000	0.000	0.000	0.000	2.158	2.158
76:30:00	0.000	0.000	0.000	0.000	2.152	2.152
76:45:00	0.000	0.000	0.000	0.000	2.145	2.145
77:00:00	0.000	0.000	0.000	0.000	2.138	2.138
77:15:00	0.000	0.000	0.000	0.000	2.131	2.131
77:30:00	0.000	0.000	0.000	0.000	2.125	2.125
77:45:00	0.000	0.000	0.000	0.000	2.118	2.118
78:00:00	0.000	0.000	0.000	0.000	2.111	2.111
78:15:00	0.000	0.000	0.000	0.000	2.105	2.105

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)
78:30:00	0.000	0.000	0.000	0.000	2.098	2.098
78:45:00	0.000	0.000	0.000	0.000	2.091	2.091
79:00:00	0.000	0.000	0.000	0.000	2.085	2.085
79:15:00	0.000	0.000	0.000	0.000	2.078	2.078
79:30:00	0.000	0.000	0.000	0.000	2.072	2.072
79:45:00	0.000	0.000	0.000	0.000	2.065	2.065
80:00:00	0.000	0.000	0.000	0.000	2.059	2.059
80:15:00	0.000	0.000	0.000	0.000	2.052	2.052
80:30:00	0.000	0.000	0.000	0.000	2.046	2.046
80:45:00	0.000	0.000	0.000	0.000	2.039	2.039
81:00:00	0.000	0.000	0.000	0.000	2.033	2.033
81:15:00	0.000	0.000	0.000	0.000	2.026	2.026
81:30:00	0.000	0.000	0.000	0.000	2.020	2.020
81:45:00	0.000	0.000	0.000	0.000	2.014	2.014
82:00:00	0.000	0.000	0.000	0.000	2.007	2.007
82:15:00	0.000	0.000	0.000	0.000	2.001	2.001
82:30:00	0.000	0.000	0.000	0.000	1.995	1.995
82:45:00	0.000	0.000	0.000	0.000	1.988	1.988
83:00:00	0.000	0.000	0.000	0.000	1.982	1.982
83:15:00	0.000	0.000	0.000	0.000	1.976	1.976
83:30:00	0.000	0.000	0.000	0.000	1.970	1.970
83:45:00	0.000	0.000	0.000	0.000	1.963	1.963
84:00:00	0.000	0.000	0.000	0.000	1.957	1.957
84:15:00	0.000	0.000	0.000	0.000	1.951	1.951
84:30:00	0.000	0.000	0.000	0.000	1.945	1.945
84:45:00	0.000	0.000	0.000	0.000	1.939	1.939
85:00:00	0.000	0.000	0.000	0.000	1.933	1.933
85:15:00	0.000	0.000	0.000	0.000	1.926	1.926
85:30:00	0.000	0.000	0.000	0.000	1.920	1.920
85:45:00	0.000	0.000	0.000	0.000	1.914	1.914
86:00:00	0.000	0.000	0.000	0.000	1.908	1.908
86:15:00	0.000	0.000	0.000	0.000	1.902	1.902
86:30:00	0.000	0.000	0.000	0.000	1.896	1.896
86:45:00	0.000	0.000	0.000	0.000	1.890	1.890
87:00:00	0.000	0.000	0.000	0.000	1.884	1.884

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)
87:15:00	0.000	0.000	0.000	0.000	1.878	1.878
87:30:00	0.000	0.000	0.000	0.000	1.872	1.872
87:45:00	0.000	0.000	0.000	0.000	1.867	1.867
88:00:00	0.000	0.000	0.000	0.000	1.861	1.861
88:15:00	0.000	0.000	0.000	0.000	1.855	1.855
88:30:00	0.000	0.000	0.000	0.000	1.849	1.849
88:45:00	0.000	0.000	0.000	0.000	1.843	1.843
89:00:00	0.000	0.000	0.000	0.000	1.837	1.837
89:15:00	0.000	0.000	0.000	0.000	1.832	1.832
89:30:00	0.000	0.000	0.000	0.000	1.826	1.826
89:45:00	0.000	0.000	0.000	0.000	1.820	1.820
90:00:00	0.000	0.000	0.000	0.000	1.814	1.814
90:15:00	0.000	0.000	0.000	0.000	1.809	1.809
90:30:00	0.000	0.000	0.000	0.000	1.803	1.803
90:45:00	0.000	0.000	0.000	0.000	1.797	1.797
91:00:00	0.000	0.000	0.000	0.000	1.792	1.792
91:15:00	0.000	0.000	0.000	0.000	1.786	1.786
91:30:00	0.000	0.000	0.000	0.000	1.780	1.780
91:45:00	0.000	0.000	0.000	0.000	1.775	1.775
92:00:00	0.000	0.000	0.000	0.000	1.769	1.769
92:15:00	0.000	0.000	0.000	0.000	1.763	1.763
92:30:00	0.000	0.000	0.000	0.000	1.758	1.758
92:45:00	0.000	0.000	0.000	0.000	1.752	1.752
93:00:00	0.000	0.000	0.000	0.000	1.747	1.747
93:15:00	0.000	0.000	0.000	0.000	1.741	1.741
93:30:00	0.000	0.000	0.000	0.000	1.736	1.736
93:45:00	0.000	0.000	0.000	0.000	1.730	1.730
94:00:00	0.000	0.000	0.000	0.000	1.725	1.725
94:15:00	0.000	0.000	0.000	0.000	1.719	1.719
94:30:00	0.000	0.000	0.000	0.000	1.714	1.714
94:45:00	0.000	0.000	0.000	0.000	1.709	1.709
95:00:00	0.000	0.000	0.000	0.000	1.703	1.703
95:15:00	0.000	0.000	0.000	0.000	1.698	1.698
95:30:00	0.000	0.000	0.000	0.000	1.693	1.693
95:45:00	0.000	0.000	0.000	0.000	1.687	1.687

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)
96:00:00	0.000	0.000	0.000	0.000	1.682	1.682
96:15:00	0.000	0.000	0.000	0.000	1.677	1.677
96:30:00	0.000	0.000	0.000	0.000	1.671	1.671
96:45:00	0.000	0.000	0.000	0.000	1.666	1.666
97:00:00	0.000	0.000	0.000	0.000	1.661	1.661
97:15:00	0.000	0.000	0.000	0.000	1.656	1.656
97:30:00	0.000	0.000	0.000	0.000	1.650	1.650
97:45:00	0.000	0.000	0.000	0.000	1.645	1.645
98:00:00	0.000	0.000	0.000	0.000	1.640	1.640
98:15:00	0.000	0.000	0.000	0.000	1.635	1.635
98:30:00	0.000	0.000	0.000	0.000	1.630	1.630
98:45:00	0.000	0.000	0.000	0.000	1.624	1.624
99:00:00	0.000	0.000	0.000	0.000	1.619	1.619
99:15:00	0.000	0.000	0.000	0.000	1.614	1.614
99:30:00	0.000	0.000	0.000	0.000	1.609	1.609
99:45:00	0.000	0.000	0.000	0.000	1.604	1.604
100:00:00	0.000	0.000	0.000	0.000	1.599	1.599
100:15:00	0.000	0.000	0.000	0.000	1.594	1.594
100:30:00	0.000	0.000	0.000	0.000	1.589	1.589
100:45:00	0.000	0.000	0.000	0.000	1.584	1.584
101:00:00	0.000	0.000	0.000	0.000	1.579	1.579
101:15:00	0.000	0.000	0.000	0.000	1.574	1.574
101:30:00	0.000	0.000	0.000	0.000	1.569	1.569
101:45:00	0.000	0.000	0.000	0.000	1.564	1.564
102:00:00	0.000	0.000	0.000	0.000	1.559	1.559
102:15:00	0.000	0.000	0.000	0.000	1.554	1.554
102:30:00	0.000	0.000	0.000	0.000	1.549	1.549
102:45:00	0.000	0.000	0.000	0.000	1.544	1.544
103:00:00	0.000	0.000	0.000	0.000	1.540	1.540
103:15:00	0.000	0.000	0.000	0.000	1.535	1.535
103:30:00	0.000	0.000	0.000	0.000	1.530	1.530
103:45:00	0.000	0.000	0.000	0.000	1.525	1.525
104:00:00	0.000	0.000	0.000	0.000	1.520	1.520
104:15:00	0.000	0.000	0.000	0.000	1.515	1.515
104:30:00	0.000	0.000	0.000	0.000	1.511	1.511

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)
104:45:00	0.000	0.000	0.000	0.000	1.506	1.506
105:00:00	0.000	0.000	0.000	0.000	1.501	1.501
105:15:00	0.000	0.000	0.000	0.000	1.496	1.496
105:30:00	0.000	0.000	0.000	0.000	1.492	1.492
105:45:00	0.000	0.000	0.000	0.000	1.487	1.487
106:00:00	0.000	0.000	0.000	0.000	1.482	1.482
106:15:00	0.000	0.000	0.000	0.000	1.478	1.478
106:30:00	0.000	0.000	0.000	0.000	1.473	1.473
106:45:00	0.000	0.000	0.000	0.000	1.468	1.468
107:00:00	0.000	0.000	0.000	0.000	1.464	1.464
107:15:00	0.000	0.000	0.000	0.000	1.459	1.459
107:30:00	0.000	0.000	0.000	0.000	1.454	1.454
107:45:00	0.000	0.000	0.000	0.000	1.450	1.450
108:00:00	0.000	0.000	0.000	0.000	1.445	1.445
108:15:00	0.000	0.000	0.000	0.000	1.441	1.441
108:30:00	0.000	0.000	0.000	0.000	1.436	1.436
108:45:00	0.000	0.000	0.000	0.000	1.432	1.432
109:00:00	0.000	0.000	0.000	0.000	1.427	1.427
109:15:00	0.000	0.000	0.000	0.000	1.423	1.423
109:30:00	0.000	0.000	0.000	0.000	1.418	1.418
109:45:00	0.000	0.000	0.000	0.000	1.414	1.414
110:00:00	0.000	0.000	0.000	0.000	1.409	1.409
110:15:00	0.000	0.000	0.000	0.000	1.405	1.405
110:30:00	0.000	0.000	0.000	0.000	1.400	1.400
110:45:00	0.000	0.000	0.000	0.000	1.396	1.396
111:00:00	0.000	0.000	0.000	0.000	1.392	1.392
111:15:00	0.000	0.000	0.000	0.000	1.387	1.387
111:30:00	0.000	0.000	0.000	0.000	1.383	1.383
111:45:00	0.000	0.000	0.000	0.000	1.378	1.378
112:00:00	0.000	0.000	0.000	0.000	1.374	1.374
112:15:00	0.000	0.000	0.000	0.000	1.370	1.370
112:30:00	0.000	0.000	0.000	0.000	1.365	1.365
112:45:00	0.000	0.000	0.000	0.000	1.361	1.361
113:00:00	0.000	0.000	0.000	0.000	1.357	1.357
113:15:00	0.000	0.000	0.000	0.000	1.353	1.353

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)
113:30:00	0.000	0.000	0.000	0.000	1.348	1.348
113:45:00	0.000	0.000	0.000	0.000	1.344	1.344
114:00:00	0.000	0.000	0.000	0.000	1.340	1.340
114:15:00	0.000	0.000	0.000	0.000	1.336	1.336
114:30:00	0.000	0.000	0.000	0.000	1.331	1.331
114:45:00	0.000	0.000	0.000	0.000	1.327	1.327
115:00:00	0.000	0.000	0.000	0.000	1.323	1.323
115:15:00	0.000	0.000	0.000	0.000	1.319	1.319
115:30:00	0.000	0.000	0.000	0.000	1.315	1.315
115:45:00	0.000	0.000	0.000	0.000	1.311	1.311
116:00:00	0.000	0.000	0.000	0.000	1.306	1.306
116:15:00	0.000	0.000	0.000	0.000	1.302	1.302
116:30:00	0.000	0.000	0.000	0.000	1.298	1.298
116:45:00	0.000	0.000	0.000	0.000	1.294	1.294
117:00:00	0.000	0.000	0.000	0.000	1.290	1.290
117:15:00	0.000	0.000	0.000	0.000	1.286	1.286
117:30:00	0.000	0.000	0.000	0.000	1.282	1.282
117:45:00	0.000	0.000	0.000	0.000	1.278	1.278
118:00:00	0.000	0.000	0.000	0.000	1.274	1.274
118:15:00	0.000	0.000	0.000	0.000	1.270	1.270
118:30:00	0.000	0.000	0.000	0.000	1.266	1.266
118:45:00	0.000	0.000	0.000	0.000	1.262	1.262
119:00:00	0.000	0.000	0.000	0.000	1.258	1.258
119:15:00	0.000	0.000	0.000	0.000	1.254	1.254
119:30:00	0.000	0.000	0.000	0.000	1.250	1.250
119:45:00	0.000	0.000	0.000	0.000	1.246	1.246
120:00:00	0.000	0.000	0.000	0.000	1.242	1.242
120:15:00	0.000	0.000	0.000	0.000	1.238	1.238
120:30:00	0.000	0.000	0.000	0.000	1.234	1.234
120:45:00	0.000	0.000	0.000	0.000	1.230	1.230
121:00:00	0.000	0.000	0.000	0.000	1.226	1.226
121:15:00	0.000	0.000	0.000	0.000	1.223	1.223
121:30:00	0.000	0.000	0.000	0.000	1.219	1.219
121:45:00	0.000	0.000	0.000	0.000	1.215	1.215
122:00:00	0.000	0.000	0.000	0.000	1.211	1.211

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)
122:15:00	0.000	0.000	0.000	0.000	1.207	1.207
122:30:00	0.000	0.000	0.000	0.000	1.203	1.203
122:45:00	0.000	0.000	0.000	0.000	1.200	1.200
123:00:00	0.000	0.000	0.000	0.000	1.196	1.196
123:15:00	0.000	0.000	0.000	0.000	1.192	1.192
123:30:00	0.000	0.000	0.000	0.000	1.188	1.188
123:45:00	0.000	0.000	0.000	0.000	1.185	1.185
124:00:00	0.000	0.000	0.000	0.000	1.181	1.181
124:15:00	0.000	0.000	0.000	0.000	1.177	1.177
124:30:00	0.000	0.000	0.000	0.000	1.173	1.173
124:45:00	0.000	0.000	0.000	0.000	1.170	1.170
125:00:00	0.000	0.000	0.000	0.000	1.166	1.166
125:15:00	0.000	0.000	0.000	0.000	1.162	1.162
125:30:00	0.000	0.000	0.000	0.000	1.159	1.159
125:45:00	0.000	0.000	0.000	0.000	1.155	1.155
126:00:00	0.000	0.000	0.000	0.000	1.151	1.151
126:15:00	0.000	0.000	0.000	0.000	1.148	1.148
126:30:00	0.000	0.000	0.000	0.000	1.144	1.144
126:45:00	0.000	0.000	0.000	0.000	1.141	1.141
127:00:00	0.000	0.000	0.000	0.000	1.137	1.137
127:15:00	0.000	0.000	0.000	0.000	1.133	1.133
127:30:00	0.000	0.000	0.000	0.000	1.130	1.130
127:45:00	0.000	0.000	0.000	0.000	1.126	1.126
128:00:00	0.000	0.000	0.000	0.000	1.123	1.123
128:15:00	0.000	0.000	0.000	0.000	1.119	1.119
128:30:00	0.000	0.000	0.000	0.000	1.116	1.116
128:45:00	0.000	0.000	0.000	0.000	1.112	1.112
129:00:00	0.000	0.000	0.000	0.000	1.109	1.109
129:15:00	0.000	0.000	0.000	0.000	1.105	1.105
129:30:00	0.000	0.000	0.000	0.000	1.102	1.102
129:45:00	0.000	0.000	0.000	0.000	1.098	1.098
130:00:00	0.000	0.000	0.000	0.000	1.095	1.095
130:15:00	0.000	0.000	0.000	0.000	1.091	1.091
130:30:00	0.000	0.000	0.000	0.000	1.088	1.088
130:45:00	0.000	0.000	0.000	0.000	1.084	1.084

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)
131:00:00	0.000	0.000	0.000	0.000	1.081	1.081
131:15:00	0.000	0.000	0.000	0.000	1.078	1.078
131:30:00	0.000	0.000	0.000	0.000	1.074	1.074
131:45:00	0.000	0.000	0.000	0.000	1.071	1.071
132:00:00	0.000	0.000	0.000	0.000	1.067	1.067
132:15:00	0.000	0.000	0.000	0.000	1.064	1.064
132:30:00	0.000	0.000	0.000	0.000	1.061	1.061
132:45:00	0.000	0.000	0.000	0.000	1.057	1.057
133:00:00	0.000	0.000	0.000	0.000	1.054	1.054
133:15:00	0.000	0.000	0.000	0.000	1.051	1.051
133:30:00	0.000	0.000	0.000	0.000	1.047	1.047
133:45:00	0.000	0.000	0.000	0.000	1.044	1.044
134:00:00	0.000	0.000	0.000	0.000	1.041	1.041
134:15:00	0.000	0.000	0.000	0.000	1.037	1.037
134:30:00	0.000	0.000	0.000	0.000	1.034	1.034
134:45:00	0.000	0.000	0.000	0.000	1.031	1.031
135:00:00	0.000	0.000	0.000	0.000	1.028	1.028
135:15:00	0.000	0.000	0.000	0.000	1.024	1.024
135:30:00	0.000	0.000	0.000	0.000	1.021	1.021
135:45:00	0.000	0.000	0.000	0.000	1.018	1.018
136:00:00	0.000	0.000	0.000	0.000	1.015	1.015
136:15:00	0.000	0.000	0.000	0.000	1.012	1.012
136:30:00	0.000	0.000	0.000	0.000	1.008	1.008
136:45:00	0.000	0.000	0.000	0.000	1.005	1.005
137:00:00	0.000	0.000	0.000	0.000	1.002	1.002
137:15:00	0.000	0.000	0.000	0.000	0.999	0.999
137:30:00	0.000	0.000	0.000	0.000	0.996	0.996
137:45:00	0.000	0.000	0.000	0.000	0.993	0.993
138:00:00	0.000	0.000	0.000	0.000	0.989	0.989
138:15:00	0.000	0.000	0.000	0.000	0.986	0.986
138:30:00	0.000	0.000	0.000	0.000	0.983	0.983
138:45:00	0.000	0.000	0.000	0.000	0.980	0.980
139:00:00	0.000	0.000	0.000	0.000	0.977	0.977
139:15:00	0.000	0.000	0.000	0.000	0.974	0.974
139:30:00	0.000	0.000	0.000	0.000	0.971	0.971

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)
139:45:00	0.000	0.000	0.000	0.000	0.968	0.968
140:00:00	0.000	0.000	0.000	0.000	0.965	0.965
140:15:00	0.000	0.000	0.000	0.000	0.962	0.962
140:30:00	0.000	0.000	0.000	0.000	0.959	0.959
140:45:00	0.000	0.000	0.000	0.000	0.956	0.956
141:00:00	0.000	0.000	0.000	0.000	0.953	0.953
141:15:00	0.000	0.000	0.000	0.000	0.950	0.950
141:30:00	0.000	0.000	0.000	0.000	0.947	0.947
141:45:00	0.000	0.000	0.000	0.000	0.944	0.944
142:00:00	0.000	0.000	0.000	0.000	0.941	0.941
142:15:00	0.000	0.000	0.000	0.000	0.938	0.938
142:30:00	0.000	0.000	0.000	0.000	0.935	0.935
142:45:00	0.000	0.000	0.000	0.000	0.932	0.932
143:00:00	0.000	0.000	0.000	0.000	0.929	0.929
143:15:00	0.000	0.000	0.000	0.000	0.926	0.926
143:30:00	0.000	0.000	0.000	0.000	0.923	0.923
143:45:00	0.000	0.000	0.000	0.000	0.920	0.920
144:00:00	0.000	0.000	0.000	0.000	0.917	0.917
144:15:00	0.000	0.000	0.000	0.000	0.914	0.914
144:30:00	0.000	0.000	0.000	0.000	0.911	0.911
144:45:00	0.000	0.000	0.000	0.000	0.909	0.909
145:00:00	0.000	0.000	0.000	0.000	0.906	0.906
145:15:00	0.000	0.000	0.000	0.000	0.903	0.903
145:30:00	0.000	0.000	0.000	0.000	0.900	0.900
145:45:00	0.000	0.000	0.000	0.000	0.897	0.897
146:00:00	0.000	0.000	0.000	0.000	0.894	0.894
146:15:00	0.000	0.000	0.000	0.000	0.892	0.892
146:30:00	0.000	0.000	0.000	0.000	0.889	0.889
146:45:00	0.000	0.000	0.000	0.000	0.886	0.886
147:00:00	0.000	0.000	0.000	0.000	0.883	0.883
147:15:00	0.000	0.000	0.000	0.000	0.880	0.880
147:30:00	0.000	0.000	0.000	0.000	0.878	0.878
147:45:00	0.000	0.000	0.000	0.000	0.875	0.875
148:00:00	0.000	0.000	0.000	0.000	0.872	0.872
148:15:00	0.000	0.000	0.000	0.000	0.869	0.869

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)
148:30:00	0.000	0.000	0.000	0.000	0.867	0.867
148:45:00	0.000	0.000	0.000	0.000	0.864	0.864
149:00:00	0.000	0.000	0.000	0.000	0.861	0.861
149:15:00	0.000	0.000	0.000	0.000	0.858	0.858
149:30:00	0.000	0.000	0.000	0.000	0.856	0.856
149:45:00	0.000	0.000	0.000	0.000	0.853	0.853
150:00:00	0.000	0.000	0.000	0.000	0.850	0.850
150:15:00	0.000	0.000	0.000	0.000	0.848	0.848
150:30:00	0.000	0.000	0.000	0.000	0.845	0.845
150:45:00	0.000	0.000	0.000	0.000	0.842	0.842
151:00:00	0.000	0.000	0.000	0.000	0.840	0.840
151:15:00	0.000	0.000	0.000	0.000	0.837	0.837
151:30:00	0.000	0.000	0.000	0.000	0.834	0.834
151:45:00	0.000	0.000	0.000	0.000	0.832	0.832
152:00:00	0.000	0.000	0.000	0.000	0.829	0.829
152:15:00	0.000	0.000	0.000	0.000	0.826	0.826
152:30:00	0.000	0.000	0.000	0.000	0.824	0.824
152:45:00	0.000	0.000	0.000	0.000	0.821	0.821
153:00:00	0.000	0.000	0.000	0.000	0.819	0.819
153:15:00	0.000	0.000	0.000	0.000	0.816	0.816
153:30:00	0.000	0.000	0.000	0.000	0.814	0.814
153:45:00	0.000	0.000	0.000	0.000	0.811	0.811
154:00:00	0.000	0.000	0.000	0.000	0.808	0.808
154:15:00	0.000	0.000	0.000	0.000	0.806	0.806
154:30:00	0.000	0.000	0.000	0.000	0.803	0.803
154:45:00	0.000	0.000	0.000	0.000	0.801	0.801
155:00:00	0.000	0.000	0.000	0.000	0.798	0.798
155:15:00	0.000	0.000	0.000	0.000	0.796	0.796
155:30:00	0.000	0.000	0.000	0.000	0.793	0.793
155:45:00	0.000	0.000	0.000	0.000	0.791	0.791
156:00:00	0.000	0.000	0.000	0.000	0.788	0.788
156:15:00	0.000	0.000	0.000	0.000	0.786	0.786
156:30:00	0.000	0.000	0.000	0.000	0.783	0.783
156:45:00	0.000	0.000	0.000	0.000	0.781	0.781
157:00:00	0.000	0.000	0.000	0.000	0.778	0.778

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)
157:15:00	0.000	0.000	0.000	0.000	0.776	0.776
157:30:00	0.000	0.000	0.000	0.000	0.773	0.773
157:45:00	0.000	0.000	0.000	0.000	0.771	0.771
158:00:00	0.000	0.000	0.000	0.000	0.769	0.769
158:15:00	0.000	0.000	0.000	0.000	0.766	0.766
158:30:00	0.000	0.000	0.000	0.000	0.764	0.764
158:45:00	0.000	0.000	0.000	0.000	0.761	0.761
159:00:00	0.000	0.000	0.000	0.000	0.759	0.759
159:15:00	0.000	0.000	0.000	0.000	0.757	0.757
159:30:00	0.000	0.000	0.000	0.000	0.754	0.754
159:45:00	0.000	0.000	0.000	0.000	0.752	0.752
160:00:00	0.000	0.000	0.000	0.000	0.749	0.749
160:15:00	0.000	0.000	0.000	0.000	0.747	0.747
160:30:00	0.000	0.000	0.000	0.000	0.745	0.745
160:45:00	0.000	0.000	0.000	0.000	0.742	0.742
161:00:00	0.000	0.000	0.000	0.000	0.740	0.740
161:15:00	0.000	0.000	0.000	0.000	0.738	0.738
161:30:00	0.000	0.000	0.000	0.000	0.735	0.735
161:45:00	0.000	0.000	0.000	0.000	0.733	0.733
162:00:00	0.000	0.000	0.000	0.000	0.731	0.731
162:15:00	0.000	0.000	0.000	0.000	0.728	0.728
162:30:00	0.000	0.000	0.000	0.000	0.726	0.726
162:45:00	0.000	0.000	0.000	0.000	0.724	0.724
163:00:00	0.000	0.000	0.000	0.000	0.722	0.722
163:15:00	0.000	0.000	0.000	0.000	0.719	0.719
163:30:00	0.000	0.000	0.000	0.000	0.717	0.717
163:45:00	0.000	0.000	0.000	0.000	0.715	0.715
164:00:00	0.000	0.000	0.000	0.000	0.712	0.712
164:15:00	0.000	0.000	0.000	0.000	0.710	0.710
164:30:00	0.000	0.000	0.000	0.000	0.708	0.708
164:45:00	0.000	0.000	0.000	0.000	0.706	0.706
165:00:00	0.000	0.000	0.000	0.000	0.704	0.704
165:15:00	0.000	0.000	0.000	0.000	0.701	0.701
165:30:00	0.000	0.000	0.000	0.000	0.699	0.699
165:45:00	0.000	0.000	0.000	0.000	0.697	0.697

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)
166:00:00	0.000	0.000	0.000	0.000	0.695	0.695
166:15:00	0.000	0.000	0.000	0.000	0.693	0.693
166:30:00	0.000	0.000	0.000	0.000	0.690	0.690
166:45:00	0.000	0.000	0.000	0.000	0.688	0.688
167:00:00	0.000	0.000	0.000	0.000	0.686	0.686
167:15:00	0.000	0.000	0.000	0.000	0.684	0.684
167:30:00	0.000	0.000	0.000	0.000	0.682	0.682
167:45:00	0.000	0.000	0.000	0.000	0.680	0.680
168:00:00	0.000	0.000	0.000	0.000	0.677	0.677
168:15:00	0.000	0.000	0.000	0.000	0.675	0.675
168:30:00	0.000	0.000	0.000	0.000	0.673	0.673
168:45:00	0.000	0.000	0.000	0.000	0.671	0.671
169:00:00	0.000	0.000	0.000	0.000	0.669	0.669
169:15:00	0.000	0.000	0.000	0.000	0.667	0.667
169:30:00	0.000	0.000	0.000	0.000	0.665	0.665
169:45:00	0.000	0.000	0.000	0.000	0.663	0.663
170:00:00	0.000	0.000	0.000	0.000	0.660	0.660
170:15:00	0.000	0.000	0.000	0.000	0.658	0.658
170:30:00	0.000	0.000	0.000	0.000	0.656	0.656
170:45:00	0.000	0.000	0.000	0.000	0.654	0.654
171:00:00	0.000	0.000	0.000	0.000	0.652	0.652
171:15:00	0.000	0.000	0.000	0.000	0.650	0.650
171:30:00	0.000	0.000	0.000	0.000	0.648	0.648
171:45:00	0.000	0.000	0.000	0.000	0.646	0.646
172:00:00	0.000	0.000	0.000	0.000	0.644	0.644
172:15:00	0.000	0.000	0.000	0.000	0.642	0.642
172:30:00	0.000	0.000	0.000	0.000	0.640	0.640
172:45:00	0.000	0.000	0.000	0.000	0.638	0.638
173:00:00	0.000	0.000	0.000	0.000	0.636	0.636
173:15:00	0.000	0.000	0.000	0.000	0.634	0.634
173:30:00	0.000	0.000	0.000	0.000	0.632	0.632
173:45:00	0.000	0.000	0.000	0.000	0.630	0.630
174:00:00	0.000	0.000	0.000	0.000	0.628	0.628
174:15:00	0.000	0.000	0.000	0.000	0.626	0.626
174:30:00	0.000	0.000	0.000	0.000	0.624	0.624

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)
174:45:00	0.000	0.000	0.000	0.000	0.622	0.622
175:00:00	0.000	0.000	0.000	0.000	0.620	0.620
175:15:00	0.000	0.000	0.000	0.000	0.618	0.618
175:30:00	0.000	0.000	0.000	0.000	0.616	0.616
175:45:00	0.000	0.000	0.000	0.000	0.614	0.614
176:00:00	0.000	0.000	0.000	0.000	0.612	0.612
176:15:00	0.000	0.000	0.000	0.000	0.610	0.610
176:30:00	0.000	0.000	0.000	0.000	0.608	0.608
176:45:00	0.000	0.000	0.000	0.000	0.606	0.606
177:00:00	0.000	0.000	0.000	0.000	0.605	0.605
177:15:00	0.000	0.000	0.000	0.000	0.603	0.603
177:30:00	0.000	0.000	0.000	0.000	0.601	0.601
177:45:00	0.000	0.000	0.000	0.000	0.599	0.599
178:00:00	0.000	0.000	0.000	0.000	0.597	0.597
178:15:00	0.000	0.000	0.000	0.000	0.595	0.595
178:30:00	0.000	0.000	0.000	0.000	0.593	0.593
178:45:00	0.000	0.000	0.000	0.000	0.591	0.591
179:00:00	0.000	0.000	0.000	0.000	0.590	0.590
179:15:00	0.000	0.000	0.000	0.000	0.588	0.588
179:30:00	0.000	0.000	0.000	0.000	0.586	0.586
179:45:00	0.000	0.000	0.000	0.000	0.584	0.584
180:00:00	0.000	0.000	0.000	0.000	0.582	0.582
180:15:00	0.000	0.000	0.000	0.000	0.580	0.580
180:30:00	0.000	0.000	0.000	0.000	0.578	0.578
180:45:00	0.000	0.000	0.000	0.000	0.577	0.577
181:00:00	0.000	0.000	0.000	0.000	0.575	0.575
181:15:00	0.000	0.000	0.000	0.000	0.573	0.573
181:30:00	0.000	0.000	0.000	0.000	0.571	0.571
181:45:00	0.000	0.000	0.000	0.000	0.569	0.569
182:00:00	0.000	0.000	0.000	0.000	0.568	0.568
182:15:00	0.000	0.000	0.000	0.000	0.566	0.566
182:30:00	0.000	0.000	0.000	0.000	0.564	0.564
182:45:00	0.000	0.000	0.000	0.000	0.562	0.562
183:00:00	0.000	0.000	0.000	0.000	0.560	0.560
183:15:00	0.000	0.000	0.000	0.000	0.559	0.559

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)
183:30:00	0.000	0.000	0.000	0.000	0.557	0.557
183:45:00	0.000	0.000	0.000	0.000	0.555	0.555
184:00:00	0.000	0.000	0.000	0.000	0.553	0.553
184:15:00	0.000	0.000	0.000	0.000	0.552	0.552
184:30:00	0.000	0.000	0.000	0.000	0.550	0.550
184:45:00	0.000	0.000	0.000	0.000	0.548	0.548
185:00:00	0.000	0.000	0.000	0.000	0.546	0.546
185:15:00	0.000	0.000	0.000	0.000	0.545	0.545
185:30:00	0.000	0.000	0.000	0.000	0.543	0.543
185:45:00	0.000	0.000	0.000	0.000	0.541	0.541
186:00:00	0.000	0.000	0.000	0.000	0.540	0.540
186:15:00	0.000	0.000	0.000	0.000	0.538	0.538
186:30:00	0.000	0.000	0.000	0.000	0.536	0.536
186:45:00	0.000	0.000	0.000	0.000	0.535	0.535
187:00:00	0.000	0.000	0.000	0.000	0.533	0.533
187:15:00	0.000	0.000	0.000	0.000	0.531	0.531
187:30:00	0.000	0.000	0.000	0.000	0.529	0.529
187:45:00	0.000	0.000	0.000	0.000	0.528	0.528
188:00:00	0.000	0.000	0.000	0.000	0.526	0.526
188:15:00	0.000	0.000	0.000	0.000	0.524	0.524
188:30:00	0.000	0.000	0.000	0.000	0.523	0.523
188:45:00	0.000	0.000	0.000	0.000	0.521	0.521
189:00:00	0.000	0.000	0.000	0.000	0.520	0.520
189:15:00	0.000	0.000	0.000	0.000	0.518	0.518
189:30:00	0.000	0.000	0.000	0.000	0.516	0.516
189:45:00	0.000	0.000	0.000	0.000	0.515	0.515
190:00:00	0.000	0.000	0.000	0.000	0.513	0.513
190:15:00	0.000	0.000	0.000	0.000	0.511	0.511
190:30:00	0.000	0.000	0.000	0.000	0.510	0.510
190:45:00	0.000	0.000	0.000	0.000	0.508	0.508
191:00:00	0.000	0.000	0.000	0.000	0.507	0.507
191:15:00	0.000	0.000	0.000	0.000	0.505	0.505
191:30:00	0.000	0.000	0.000	0.000	0.503	0.503
191:45:00	0.000	0.000	0.000	0.000	0.502	0.502
192:00:00	0.000	0.000	0.000	0.000	0.500	0.500

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)
192:15:00	0.000	0.000	0.000	0.000	0.499	0.499
192:30:00	0.000	0.000	0.000	0.000	0.497	0.497
192:45:00	0.000	0.000	0.000	0.000	0.496	0.496
193:00:00	0.000	0.000	0.000	0.000	0.494	0.494
193:15:00	0.000	0.000	0.000	0.000	0.492	0.492
193:30:00	0.000	0.000	0.000	0.000	0.491	0.491
193:45:00	0.000	0.000	0.000	0.000	0.489	0.489
194:00:00	0.000	0.000	0.000	0.000	0.488	0.488
194:15:00	0.000	0.000	0.000	0.000	0.486	0.486
194:30:00	0.000	0.000	0.000	0.000	0.485	0.485
194:45:00	0.000	0.000	0.000	0.000	0.483	0.483
195:00:00	0.000	0.000	0.000	0.000	0.482	0.482
195:15:00	0.000	0.000	0.000	0.000	0.480	0.480
195:30:00	0.000	0.000	0.000	0.000	0.479	0.479
195:45:00	0.000	0.000	0.000	0.000	0.477	0.477
196:00:00	0.000	0.000	0.000	0.000	0.476	0.476
196:15:00	0.000	0.000	0.000	0.000	0.474	0.474
196:30:00	0.000	0.000	0.000	0.000	0.473	0.473
196:45:00	0.000	0.000	0.000	0.000	0.471	0.471
197:00:00	0.000	0.000	0.000	0.000	0.470	0.470
197:15:00	0.000	0.000	0.000	0.000	0.468	0.468
197:30:00	0.000	0.000	0.000	0.000	0.467	0.467
197:45:00	0.000	0.000	0.000	0.000	0.465	0.465
198:00:00	0.000	0.000	0.000	0.000	0.464	0.464
198:15:00	0.000	0.000	0.000	0.000	0.462	0.462
198:30:00	0.000	0.000	0.000	0.000	0.461	0.461
198:45:00	0.000	0.000	0.000	0.000	0.459	0.459
199:00:00	0.000	0.000	0.000	0.000	0.458	0.458
199:15:00	0.000	0.000	0.000	0.000	0.456	0.456
199:30:00	0.000	0.000	0.000	0.000	0.455	0.455
199:45:00	0.000	0.000	0.000	0.000	0.454	0.454
200:00:00	0.000	0.000	0.000	0.000	0.452	0.452
200:15:00	0.000	0.000	0.000	0.000	0.451	0.451
200:30:00	0.000	0.000	0.000	0.000	0.449	0.449
200:45:00	0.000	0.000	0.000	0.000	0.448	0.448

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)
201:00:00	0.000	0.000	0.000	0.000	0.446	0.446
201:15:00	0.000	0.000	0.000	0.000	0.445	0.445
201:30:00	0.000	0.000	0.000	0.000	0.444	0.444
201:45:00	0.000	0.000	0.000	0.000	0.442	0.442
202:00:00	0.000	0.000	0.000	0.000	0.441	0.441
202:15:00	0.000	0.000	0.000	0.000	0.439	0.439
202:30:00	0.000	0.000	0.000	0.000	0.438	0.438
202:45:00	0.000	0.000	0.000	0.000	0.437	0.437
203:00:00	0.000	0.000	0.000	0.000	0.435	0.435
203:15:00	0.000	0.000	0.000	0.000	0.434	0.434
203:30:00	0.000	0.000	0.000	0.000	0.433	0.433
203:45:00	0.000	0.000	0.000	0.000	0.431	0.431
204:00:00	0.000	0.000	0.000	0.000	0.430	0.430
204:15:00	0.000	0.000	0.000	0.000	0.429	0.429
204:30:00	0.000	0.000	0.000	0.000	0.427	0.427
204:45:00	0.000	0.000	0.000	0.000	0.426	0.426
205:00:00	0.000	0.000	0.000	0.000	0.424	0.424
205:15:00	0.000	0.000	0.000	0.000	0.423	0.423
205:30:00	0.000	0.000	0.000	0.000	0.422	0.422
205:45:00	0.000	0.000	0.000	0.000	0.420	0.420
206:00:00	0.000	0.000	0.000	0.000	0.419	0.419
206:15:00	0.000	0.000	0.000	0.000	0.418	0.418
206:30:00	0.000	0.000	0.000	0.000	0.417	0.417
206:45:00	0.000	0.000	0.000	0.000	0.415	0.415
207:00:00	0.000	0.000	0.000	0.000	0.414	0.414
207:15:00	0.000	0.000	0.000	0.000	0.413	0.413
207:30:00	0.000	0.000	0.000	0.000	0.411	0.411
207:45:00	0.000	0.000	0.000	0.000	0.410	0.410
208:00:00	0.000	0.000	0.000	0.000	0.409	0.409
208:15:00	0.000	0.000	0.000	0.000	0.407	0.407
208:30:00	0.000	0.000	0.000	0.000	0.406	0.406
208:45:00	0.000	0.000	0.000	0.000	0.405	0.405
209:00:00	0.000	0.000	0.000	0.000	0.404	0.404
209:15:00	0.000	0.000	0.000	0.000	0.402	0.402
209:30:00	0.000	0.000	0.000	0.000	0.401	0.401

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)
209:45:00	0.000	0.000	0.000	0.000	0.400	0.400
210:00:00	0.000	0.000	0.000	0.000	0.399	0.399
210:15:00	0.000	0.000	0.000	0.000	0.397	0.397
210:30:00	0.000	0.000	0.000	0.000	0.396	0.396
210:45:00	0.000	0.000	0.000	0.000	0.395	0.395
211:00:00	0.000	0.000	0.000	0.000	0.393	0.393
211:15:00	0.000	0.000	0.000	0.000	0.392	0.392
211:30:00	0.000	0.000	0.000	0.000	0.391	0.391
211:45:00	0.000	0.000	0.000	0.000	0.390	0.390
212:00:00	0.000	0.000	0.000	0.000	0.389	0.389
212:15:00	0.000	0.000	0.000	0.000	0.387	0.387
212:30:00	0.000	0.000	0.000	0.000	0.386	0.386
212:45:00	0.000	0.000	0.000	0.000	0.385	0.385
213:00:00	0.000	0.000	0.000	0.000	0.384	0.384
213:15:00	0.000	0.000	0.000	0.000	0.382	0.382
213:30:00	0.000	0.000	0.000	0.000	0.381	0.381
213:45:00	0.000	0.000	0.000	0.000	0.380	0.380
214:00:00	0.000	0.000	0.000	0.000	0.379	0.379
214:15:00	0.000	0.000	0.000	0.000	0.378	0.378
214:30:00	0.000	0.000	0.000	0.000	0.376	0.376
214:45:00	0.000	0.000	0.000	0.000	0.375	0.375
215:00:00	0.000	0.000	0.000	0.000	0.374	0.374
215:15:00	0.000	0.000	0.000	0.000	0.373	0.373
215:30:00	0.000	0.000	0.000	0.000	0.372	0.372
215:45:00	0.000	0.000	0.000	0.000	0.371	0.371
216:00:00	0.000	0.000	0.000	0.000	0.369	0.369
216:15:00	0.000	0.000	0.000	0.000	0.368	0.368
216:30:00	0.000	0.000	0.000	0.000	0.367	0.367
216:45:00	0.000	0.000	0.000	0.000	0.366	0.366
217:00:00	0.000	0.000	0.000	0.000	0.365	0.365
217:15:00	0.000	0.000	0.000	0.000	0.364	0.364
217:30:00	0.000	0.000	0.000	0.000	0.362	0.362
217:45:00	0.000	0.000	0.000	0.000	0.361	0.361
218:00:00	0.000	0.000	0.000	0.000	0.360	0.360
218:15:00	0.000	0.000	0.000	0.000	0.359	0.359

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)
218:30:00	0.000	0.000	0.000	0.000	0.358	0.358
218:45:00	0.000	0.000	0.000	0.000	0.357	0.357
219:00:00	0.000	0.000	0.000	0.000	0.356	0.356
219:15:00	0.000	0.000	0.000	0.000	0.355	0.355
219:30:00	0.000	0.000	0.000	0.000	0.353	0.353
219:45:00	0.000	0.000	0.000	0.000	0.352	0.352
220:00:00	0.000	0.000	0.000	0.000	0.351	0.351
220:15:00	0.000	0.000	0.000	0.000	0.350	0.350
220:30:00	0.000	0.000	0.000	0.000	0.349	0.349
220:45:00	0.000	0.000	0.000	0.000	0.348	0.348
221:00:00	0.000	0.000	0.000	0.000	0.347	0.347
221:15:00	0.000	0.000	0.000	0.000	0.346	0.346
221:30:00	0.000	0.000	0.000	0.000	0.345	0.345
221:45:00	0.000	0.000	0.000	0.000	0.344	0.344
222:00:00	0.000	0.000	0.000	0.000	0.342	0.342
222:15:00	0.000	0.000	0.000	0.000	0.341	0.341
222:30:00	0.000	0.000	0.000	0.000	0.340	0.340
222:45:00	0.000	0.000	0.000	0.000	0.339	0.339
223:00:00	0.000	0.000	0.000	0.000	0.338	0.338
223:15:00	0.000	0.000	0.000	0.000	0.337	0.337
223:30:00	0.000	0.000	0.000	0.000	0.336	0.336
223:45:00	0.000	0.000	0.000	0.000	0.335	0.335
224:00:00	0.000	0.000	0.000	0.000	0.334	0.334
224:15:00	0.000	0.000	0.000	0.000	0.333	0.333
224:30:00	0.000	0.000	0.000	0.000	0.332	0.332
224:45:00	0.000	0.000	0.000	0.000	0.331	0.331
225:00:00	0.000	0.000	0.000	0.000	0.330	0.330
225:15:00	0.000	0.000	0.000	0.000	0.329	0.329
225:30:00	0.000	0.000	0.000	0.000	0.328	0.328
225:45:00	0.000	0.000	0.000	0.000	0.327	0.327
226:00:00	0.000	0.000	0.000	0.000	0.326	0.326
226:15:00	0.000	0.000	0.000	0.000	0.325	0.325
226:30:00	0.000	0.000	0.000	0.000	0.324	0.324
226:45:00	0.000	0.000	0.000	0.000	0.323	0.323
227:00:00	0.000	0.000	0.000	0.000	0.321	0.321

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)
227:15:00	0.000	0.000	0.000	0.000	0.320	0.320
227:30:00	0.000	0.000	0.000	0.000	0.319	0.319
227:45:00	0.000	0.000	0.000	0.000	0.318	0.318
228:00:00	0.000	0.000	0.000	0.000	0.317	0.317
228:15:00	0.000	0.000	0.000	0.000	0.316	0.316
228:30:00	0.000	0.000	0.000	0.000	0.315	0.315
228:45:00	0.000	0.000	0.000	0.000	0.314	0.314
229:00:00	0.000	0.000	0.000	0.000	0.313	0.313
229:15:00	0.000	0.000	0.000	0.000	0.312	0.312
229:30:00	0.000	0.000	0.000	0.000	0.312	0.312
229:45:00	0.000	0.000	0.000	0.000	0.311	0.311
230:00:00	0.000	0.000	0.000	0.000	0.310	0.310
230:15:00	0.000	0.000	0.000	0.000	0.309	0.309
230:30:00	0.000	0.000	0.000	0.000	0.308	0.308
230:45:00	0.000	0.000	0.000	0.000	0.307	0.307
231:00:00	0.000	0.000	0.000	0.000	0.306	0.306
231:15:00	0.000	0.000	0.000	0.000	0.305	0.305
231:30:00	0.000	0.000	0.000	0.000	0.304	0.304
231:45:00	0.000	0.000	0.000	0.000	0.303	0.303
232:00:00	0.000	0.000	0.000	0.000	0.302	0.302
232:15:00	0.000	0.000	0.000	0.000	0.301	0.301
232:30:00	0.000	0.000	0.000	0.000	0.300	0.300
232:45:00	0.000	0.000	0.000	0.000	0.299	0.299
233:00:00	0.000	0.000	0.000	0.000	0.298	0.298
233:15:00	0.000	0.000	0.000	0.000	0.297	0.297
233:30:00	0.000	0.000	0.000	0.000	0.296	0.296
233:45:00	0.000	0.000	0.000	0.000	0.295	0.295
234:00:00	0.000	0.000	0.000	0.000	0.294	0.294
234:15:00	0.000	0.000	0.000	0.000	0.293	0.293
234:30:00	0.000	0.000	0.000	0.000	0.292	0.292
234:45:00	0.000	0.000	0.000	0.000	0.292	0.292
235:00:00	0.000	0.000	0.000	0.000	0.291	0.291
235:15:00	0.000	0.000	0.000	0.000	0.290	0.290
235:30:00	0.000	0.000	0.000	0.000	0.289	0.289
235:45:00	0.000	0.000	0.000	0.000	0.288	0.288

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)
236:00:00	0.000	0.000	0.000	0.000	0.287	0.287
236:15:00	0.000	0.000	0.000	0.000	0.286	0.286
236:30:00	0.000	0.000	0.000	0.000	0.285	0.285
236:45:00	0.000	0.000	0.000	0.000	0.284	0.284
237:00:00	0.000	0.000	0.000	0.000	0.283	0.283
237:15:00	0.000	0.000	0.000	0.000	0.282	0.282
237:30:00	0.000	0.000	0.000	0.000	0.282	0.282
237:45:00	0.000	0.000	0.000	0.000	0.281	0.281
238:00:00	0.000	0.000	0.000	0.000	0.280	0.280
238:15:00	0.000	0.000	0.000	0.000	0.279	0.279
238:30:00	0.000	0.000	0.000	0.000	0.278	0.278
238:45:00	0.000	0.000	0.000	0.000	0.277	0.277
239:00:00	0.000	0.000	0.000	0.000	0.276	0.276
239:15:00	0.000	0.000	0.000	0.000	0.275	0.275
239:30:00	0.000	0.000	0.000	0.000	0.275	0.275
239:45:00	0.000	0.000	0.000	0.000	0.274	0.274

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km ²)	60.1	No
ALTBAR	95	No
ASPBAR	199	No
ASPVAR	0.36	No
BFIHOST	0.89	No
BFIHOST19	0.89	No
DPLBAR (km)	10.46	No
DPSBAR (mkm ⁻¹)	78.6	No
FARL	0.98	No
LDP	18.38	No
PROPWET	0.34	No
RMED1H	9.9	No
RMED1D	39.9	No
RMED2D	50.5	No
SAAR (mm)	894	No
SAAR4170 (mm)	954	No
SPRHOST	10.17	No
URBEXT2000	0.02	No
URBEXT1990	0.01	No
URBCONC	0.69	No
URBLOC	0.42	No
DDF parameter C	-0.03	No
DDF parameter D1	0.45	No
DDF parameter D2	0.28	No
DDF parameter D3	0.39	No
DDF parameter E	0.31	No
DDF parameter F	2.35	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.45	No
DDF parameter D2 (1km grid value)	0.28	No
DDF parameter D3 (1km grid value)	0.39	No
DDF parameter E (1km grid value)	0.31	No
DDF parameter F (1km grid value)	2.27	No

A - FEH Statistical Method Report - WBR01

UK Design Flood Estimation

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

Date of creation: 12-01-2026 16:14:08
Software: WINFAP Version: 5.3.9403 (30273)
Peak Flow dataset: Peak Flow Dataset 14.0.1
Method: 2025
Supplementary data used: No

Site details

Site number: 1917641482
Site name: FEH_Catchment_Descriptors_474700_105950_v5_1_0
Site location: SU 74700 05950
Easting: 474700
Northing: 105950
Catchment area: 2.77 km²
SAAR9120: 859 mm
BFHOST19scaled: 0.516
FPXT: 0.150
FARL2015: 1.000
URBEXT2015: 0.2041

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: 0.20410
UAF: 1.39292

Growth curve settings

Pooling group URBEXT Threshold: 0.250
Deurbanise Pooling Group L-moments: Yes

QMED settings

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

Growth curve data and results

UK Design Flood Estimation

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

Pooling group AM data

Station	Distance	Years of data	QMED AM	L-CV Observed	L-CV Deurbanised	L-SKEW Observed	L-SKEW Deurbanised
27073 (Brompton Beck @ Snainton Ings)	1.832	44	0.816	0.213	0.215	0.025	0.025
68021 (Arrowe Brook @ Acton Lane)	1.913	18	3.997	0.260	0.296	0.411	0.411
23018 (Ouse Burn @ Woolsington)	2.224	33	3.310	0.270	0.288	0.179	0.179
39086 (Gatwick Stream @ Gatwick Link)	2.611	49	10.068	0.146	0.166	-0.015	-0.015
19017 (Gogar Burn @ Turnhouse)	2.703	32	12.800	0.207	0.227	0.240	0.240
25019 (Leven @ Easby)	2.791	46	5.384	0.337	0.337	0.367	0.367
7009 (Mosset Burn @ Wardend Bridge)	2.819	26	7.486	0.358	0.358	0.324	0.324
45816 (Haddeo @ Upton)	2.872	31	3.456	0.283	0.283	0.410	0.410
30013 (Heighington Beck @ Heighington)	2.885	48	0.648	0.419	0.453	0.536	0.536
49005 (Bolingey Stream @ Bolingey Cocks Bridge)	2.909	14	4.057	0.268	0.270	0.323	0.323
26016 (Gypsey Race @ Kirby Grindalythe)	2.945	27	0.101	0.314	0.314	0.233	0.233
27051 (Crimple @ Bum Bridge)	2.968	52	4.641	0.215	0.216	0.132	0.132
19014 (Brox Burn @ Newliston)	2.973	28	10.521	0.219	0.244	0.168	0.168
72014 (Conder @ Galgate)	2.987	57	16.912	0.227	0.229	0.140	0.140
73015 (Keer @ High Keer Weir)	3.022	34	12.590	0.201	0.202	0.174	0.174
41020 (Bevern Stream @ Clappers Bridge)	3.086	55	13.900	0.197	0.201	0.161	0.161
76011 (Coal Burn @ Coalburn)	3.182	47	1.813	0.170	0.170	0.300	0.300
69047 (Roch @ Littleborough)	3.218	28	9.597	0.217	0.224	0.140	0.140
69008 (Dean @ Stanneylands)	3.219	58	9.957	0.240	0.254	0.313	0.313
7011 (Black Burn @ Pluscarden Abbey)	3.223	12	4.752	0.474	0.474	0.558	0.558
33054 (Babingley @ Castle Rising)	3.244	48	1.132	0.253	0.255	0.281	0.281
26015 (Driffeld Canal @ Wansford Bridge)	3.246	14	2.647	0.176	0.179	0.068	0.068
Total		801					

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
27073 (Brompton Beck @ Snainton Ings)	1.832	42	0.200	0.202	0.057	0.057
68021 (Arrowe Brook @ Acton Lane)	1.913	18	0.260	0.296	0.411	0.411
23018 (Ouse Burn @ Woolsington)	2.224	29	0.245	0.261	0.231	0.231
39086 (Gatwick Stream @ Gatwick Link)	2.611	47	0.137	0.156	0.018	0.018
19017 (Gogar Burn @ Turnhouse)	2.703	32	0.207	0.227	0.240	0.240
25019 (Leven @ Easby)	2.791	43	0.322	0.322	0.400	0.400
7009 (Mosset Burn @ Wardend Bridge)	2.819	23	0.344	0.344	0.337	0.337
45816 (Haddeo @ Upton)	2.872	30	0.277	0.278	0.425	0.425
30013 (Heighington Beck @ Heighington)	2.885	44	0.405	0.438	0.561	0.561
49005 (Bolingey Stream @ Bolingey Cocks Bridge)	2.909	14	0.268	0.270	0.323	0.323
26016 (Gypsey Race @ Kirby Grindalythe)	2.945	23	0.292	0.292	0.255	0.255
27051 (Crimple @ Bum Bridge)	2.968	48	0.203	0.204	0.157	0.157
19014 (Brox Burn @ Newliston)	2.973	28	0.219	0.244	0.168	0.168
72014 (Conder @ Galgate)	2.987	54	0.214	0.216	0.175	0.175
73015 (Keer @ High Keer Weir)	3.022	33	0.195	0.196	0.197	0.197
41020 (Bevern Stream @ Clappers Bridge)	3.086	52	0.185	0.188	0.206	0.206
76011 (Coal Burn @ Coalburn)	3.182	47	0.170	0.170	0.300	0.300
69047 (Roch @ Littleborough)	3.218	26	0.190	0.196	0.243	0.243
69008 (Dean @ Stanneylands)	3.219	57	0.233	0.247	0.340	0.340
7011 (Black Burn @ Pluscarden Abbey)	3.223	11	0.474	0.475	0.548	0.548
33054 (Babingley @ Castle Rising)	3.244	46	0.239	0.242	0.327	0.327
26015 (Driffeld Canal @ Wansford Bridge)	3.246	14	0.176	0.179	0.068	0.068
Total		761				

UK Design Flood Estimation

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

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
27073 (Brompton Beck @ Snainton Ings)	Yes	Yes	44	2	4.55	1.26	None	1.192	
68021 (Arrowe Brook @ Acton Lane)	Yes	Yes	18	0	0.00			1.129	
23018 (Ouse Burn @ Woolsington)	Yes	Yes	33	4	12.12	0.98	None	0.440	
39086 (Gatwick Stream @ Gatwick Link)	Yes	Yes	49	2	4.08	1.36	None	1.271	
19017 (Gogar Burn @ Turnhouse)	Yes	Yes	32	0	0.00	1.78	10	0.447	
25019 (Leven @ Easby)	Yes	Yes	46	3	6.52			0.337	
7009 (Mosset Burn @ Wardend Bridge)	Yes	Yes	26	3	11.54			0.873	
45816 (Haddeo @ Upton)	Yes	Yes	31	1	3.23	-0.36	None	0.715	
30013 (Heighington Beck @ Heighington)	Yes	Yes	48	4	8.33	0.68	None	1.950	
49005 (Bolingey Stream @ Bolingey Cocks Bridge)	Yes	Yes	14	0	0.00			2.906	
26016 (Gypsy Race @ Kirby Grindalythe)	Yes	Yes	27	4	14.81	-0.52	None	0.627	
27051 (Crimple @ Bum Bridge)	Yes	Yes	52	4	7.69	1.50	None	0.245	
19014 (Brox Burn @ Newliston)	Yes	Yes	28	0	0.00	0.02	None	0.389	
72014 (Conder @ Galgate)	Yes	Yes	57	3	5.26	1.24	None	0.225	
73015 (Keer @ High Keer Weir)	Yes	Yes	34	1	2.94	3.41	5	0.361	
41020 (Bevern Stream @ Clappers Bridge)	Yes	Yes	55	3	5.45	1.14	None	0.742	
76011 (Coal Burn @ Coalburn)	Yes	Yes	47	0	0.00			2.075	
69047 (Roch @ Littleborough)	Yes	Yes	28	2	7.14	1.96	10	0.803	
69008 (Dean @ Stanneylands)	Yes	Yes	58	1	1.72	1.31	None	0.388	
7011 (Black Burn @ Pluscarden Abbey)	Yes	Yes	12	1	8.33			2.515	
33054 (Babingley @ Castle Rising)	Yes	Yes	48	2	4.17	0.01	None	0.558	
26015 (Driffeld Canal @ Wansford Bridge)	Yes	Yes	14	0	0.00			1.812	

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
27073 (Brompton Beck @ Snainton Ings)	7.513	817	0.080	0.996	0.016	0.801
68021 (Arrowe Brook @ Acton Lane)	17.872	790	0.139	0.991	0.202	0.495
23018 (Ouse Burn @ Woolsington)	10.137	691	0.131	1.000	0.099	0.333
39086 (Gatwick Stream @ Gatwick Link)	32.623	898	0.103	0.972	0.199	0.504
19017 (Gogar Burn @ Turnhouse)	40.307	865	0.128	0.994	0.150	0.499
25019 (Leven @ Easby)	15.088	892	0.019	1.000	0.001	0.496
7009 (Mosset Burn @ Wardend Bridge)	28.295	918	0.060	1.000	0.000	0.608
45816 (Haddeo @ Upton)	6.808	1287	0.011	1.000	0.001	0.535
30013 (Heighington Beck @ Heighington)	23.880	631	0.119	0.988	0.121	0.859
49005 (Bolingey Stream @ Bolingey Cocks Bridge)	16.080	1073	0.023	1.000	0.015	0.562
26016 (Gypsy Race @ Kirby Grindalythe)	15.850	786	0.030	1.000	0.003	0.927
27051 (Crimple @ Bum Bridge)	8.172	866	0.013	1.000	0.009	0.329
19014 (Brox Burn @ Newliston)	37.330	910	0.074	0.989	0.167	0.422
72014 (Conder @ Galgate)	28.992	1266	0.082	1.000	0.018	0.428
73015 (Keer @ High Keer Weir)	30.043	1244	0.074	0.986	0.008	0.454
41020 (Bevern Stream @ Clappers Bridge)	35.480	931	0.076	0.980	0.026	0.361
76011 (Coal Burn @ Coalburn)	1.630	1412	0.074	1.000	0.000	0.274
69047 (Roch @ Littleborough)	14.775	1369	0.038	0.878	0.045	0.456
69008 (Dean @ Stanneylands)	58.867	991	0.103	0.984	0.091	0.569
7011 (Black Burn @ Pluscarden Abbey)	36.375	881	0.041	0.986	0.001	0.663
33054 (Babingley @ Castle Rising)	48.530	710	0.118	0.986	0.015	0.895
26015 (Driffeld Canal @ Wansford Bridge)	49.390	770	0.097	1.000	0.031	0.880

Pooling Group Rejected Stations

Station	Distance	Years of data	QMED AM	L-CV Observed	L-CV Deurbanised	L-SKEW Observed	L-SKEW Deurbanised	Comments
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UK Design Flood Estimation

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

Growth curve L-moments

Rural L-CV:	0.263	Urban L-CV:	0.230
Rural L-Skewness:	0.241	Urban L-Skewness:	0.241
Rural L-CV NFY:	0.252	Urban L-CV NFY:	0.221
Rural L-Skewness NFY:	0.266	Urban L-Skewness NFY:	0.266

Rural fitted parameters

Distribution	Location	Scale	Shape	H	Bound
GL	1.000	0.265	-0.241		-0.101
GEV	0.857	0.381	-0.107		-2.696
KAP3	0.927	0.316	-0.181	-0.400	-0.822
GL NFY	1.000	0.251	-0.266		0.059

Goodness of fit

GL:	0.9660 *
GEV:	-0.9632 *
P3:	-3.0763
GP:	-5.6080
KAP3:	0.3019 *
GL NFY:	2.4299

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

Heterogeneity

Standardised test value H2: 4.2137

The pooling group is strongly heterogeneous and a review of the pooling group is essential.

Heterogeneity NFY

Standardised test value H2: 4.2747

The pooling group is strongly heterogeneous and a review of the pooling group is essential.

Standardised growth curves

Rural

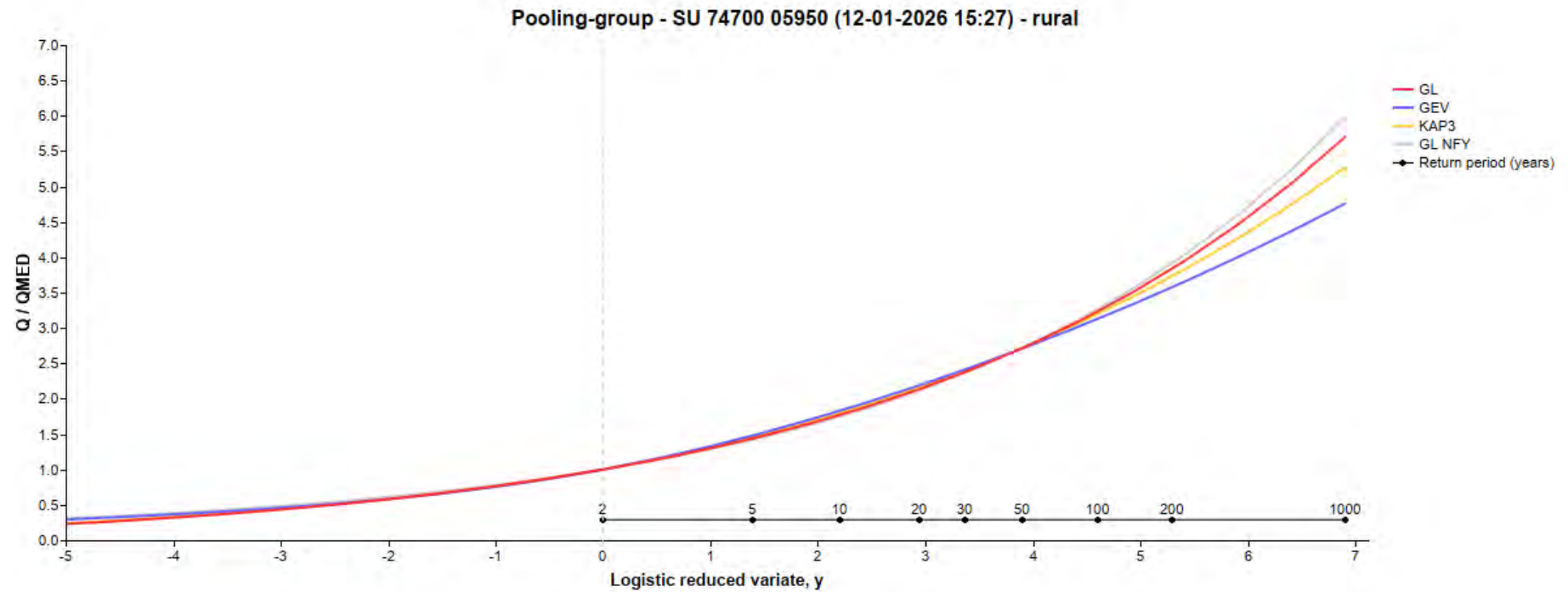
Return period	GL	GEV	KAP3	GL NFY
2	1.000	1.000	1.000	1.000
5	1.436	1.478	1.454	1.420
10	1.768	1.828	1.796	1.749
20	2.136	2.192	2.166	2.121
30	2.376	2.414	2.400	2.367
50	2.710	2.706	2.718	2.713
100	3.228	3.126	3.195	3.259
200	3.838	3.577	3.735	3.914
1000	5.708	4.762	5.277	5.983

Urban

Return period	GL	GEV	KAP3	GL NFY
2	1.000	1.000	1.000	1.000
5	1.378	1.413	1.393	1.363
10	1.665	1.716	1.688	1.647
20	1.984	2.030	2.008	1.969
30	2.191	2.222	2.211	2.182
50	2.480	2.474	2.486	2.481
100	2.929	2.838	2.899	2.954
200	3.456	3.228	3.365	3.519
1000	5.075	4.252	4.699	5.309

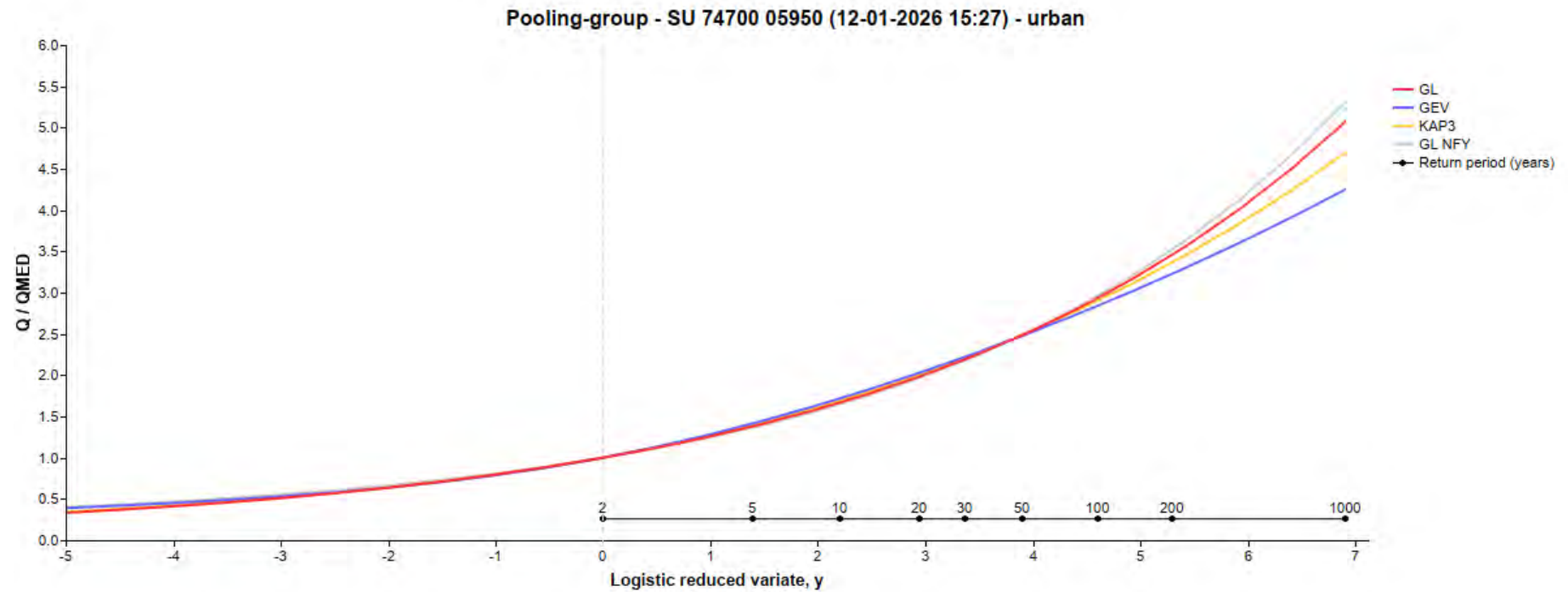
UK Design Flood Estimation

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: <0.250
 Donor adjusted FSE: 1.389
 No. of donors: 1

Donor stations

Station	Distance	Use QMED obs deurbanised	QMED obs	QMED deurbanised	QMED CDs urban	QMED CDs rural	QMED ratio
41015 (Ems @ Westbourne)	7.16	Yes	2.280	2.180	2.195	2.195	0.993

Donor suitability

Station	Suitability for QMED	Suitability for pooling	Years	Non-flood years	Percentage non-flood years	Mann Kendall (MKZ)	MKZ significance (%)	Comments
41015 (Ems @ Westbourne)	Yes	No	57	10	17.54	2.78	5	

Donor catchment descriptors

Station	Area	Centroid X	Centroid Y	SAAR9120	FPEXT	FARL2015	URBEXT2015	BFIHOST19Scaled
FEH_Catchment_Descriptors_474700_105950_v5_1_0 @ SU 74700 05950)	2.770	474308	107410	859	0.150	1.000	0.204	0.516
41015 (Ems @ Westbourne)	57.892	478472	113233	982	0.039	0.987	0.006	0.900

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
42001 (Wallington @ North Fareham)	10.75	0.070	Yes	18.015	14.656	11.158	9.077	1.615	464837	112499	111.670	930	0.721	0.974	34	
41023 (Lavant @ Graylingwell)	14.68	0.010	Yes	1.740	1.612	3.289	3.289	0.490	487719	113380	86.198	1054	0.915	1.000	47	
42006 (Meon @ Misingford)	16.88	0.012	Yes	2.890	2.583	2.293	2.293	1.127	463827	120639	75.847	990	0.931	0.985	65	
41011 (Rother @ Iping Mill)	17.96	0.037	Yes	30.279	27.934	24.101	22.235	1.256	477886	125009	156.935	995	0.615	0.974	57	
42011 (Hamble @ Frogmill)	21.49	0.037	Yes	8.047	6.836	3.611	3.068	2.228	456323	119172	55.250	925	0.816	0.983	52	
42008 (Cheriton Stream @ Swards Bridge)	23.55	0.012	Yes	1.370	1.245	2.531	2.531	0.492	461729	127315	74.338	983	0.918	1.000	53	
41022 (Lod @ Halfway Bridge)	25.94	0.013	Yes	16.755	16.467	15.552	15.552	1.059	491432	126899	52.438	935	0.427	0.978	54	
42007 (Alre @ Drove Lane Alresford)	29.05	0.015	Yes	2.510	2.177	1.329	1.329	1.639	462212	133819	57.447	932	0.933	0.926	45	
39011 (Wey @ Tilford)	30.27	0.066	Yes	26.200	20.709	25.201	19.920	1.040	477280	137531	391.325	929	0.773	0.971	70	

UK Design Flood Estimation

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

QMED

Rural: 0.868 m³/s

Urban: 1.209 m³/s

UK Design Flood Estimation

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

Flood Frequency Curve

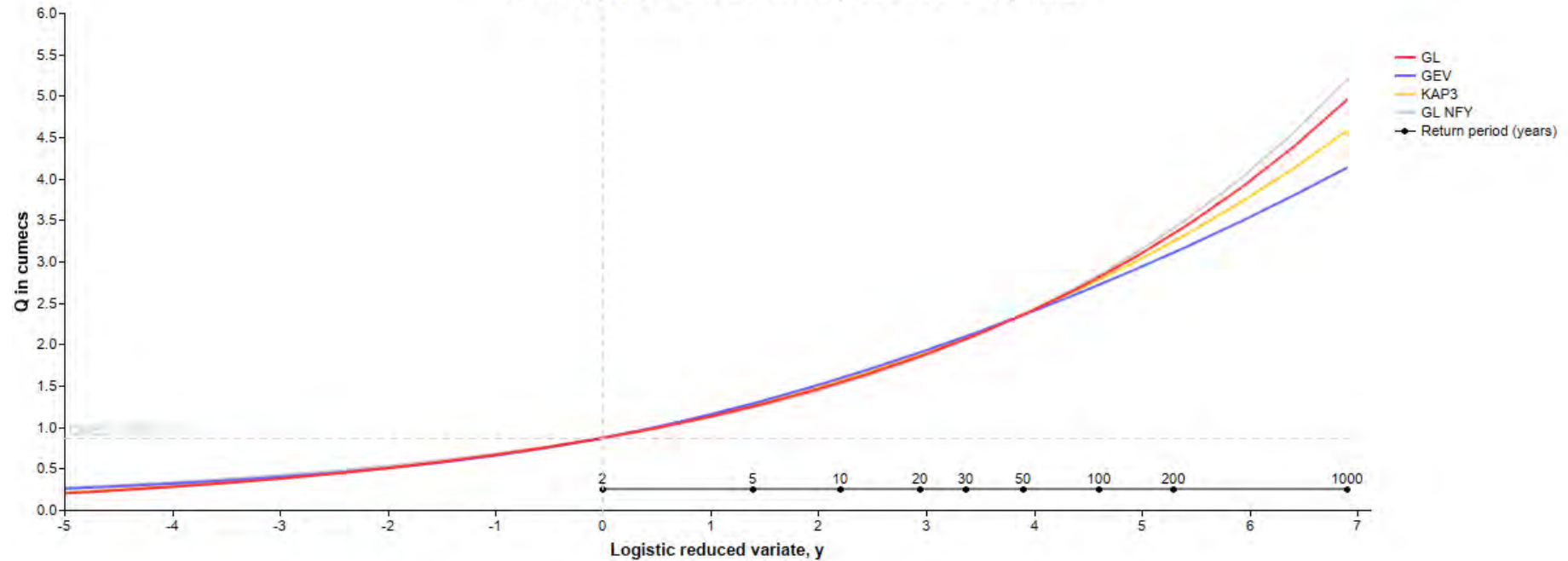
Rural Flood Frequency Curve

Return period	GL (m³/s)	GEV (m³/s)	KAP3 (m³/s)	GL NFY (m³/s)
2	0.868	0.868	0.868	0.868
5	1.247	1.283	1.262	1.233
10	1.535	1.587	1.559	1.518
20	1.855	1.903	1.880	1.841
30	2.063	2.096	2.084	2.055
50	2.353	2.349	2.360	2.355
100	2.803	2.714	2.774	2.830
200	3.332	3.106	3.242	3.398
1000	4.956	4.134	4.581	5.195

Urban Flood Frequency Curve

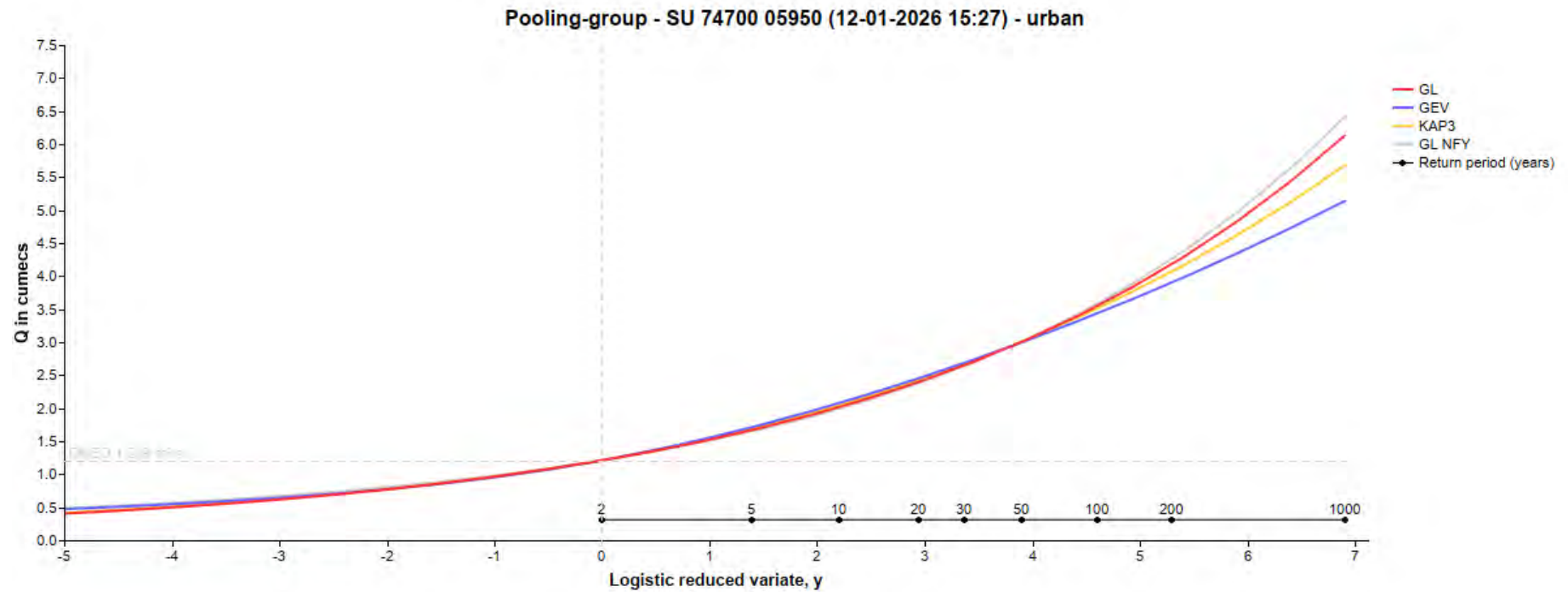
Return period	GL (m³/s)	GEV (m³/s)	KAP3 (m³/s)	GL NFY (m³/s)
2	1.209	1.209	1.209	1.209
5	1.666	1.709	1.684	1.649
10	2.013	2.075	2.042	1.992
20	2.399	2.455	2.429	2.381
30	2.650	2.687	2.674	2.638
50	2.999	2.992	3.006	3.000
100	3.542	3.432	3.506	3.572
200	4.180	3.904	4.070	4.256
1000	6.137	5.142	5.683	6.421

Pooling-group - SU 74700 05950 (12-01-2026 15:27) - rural



UK Design Flood Estimation

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



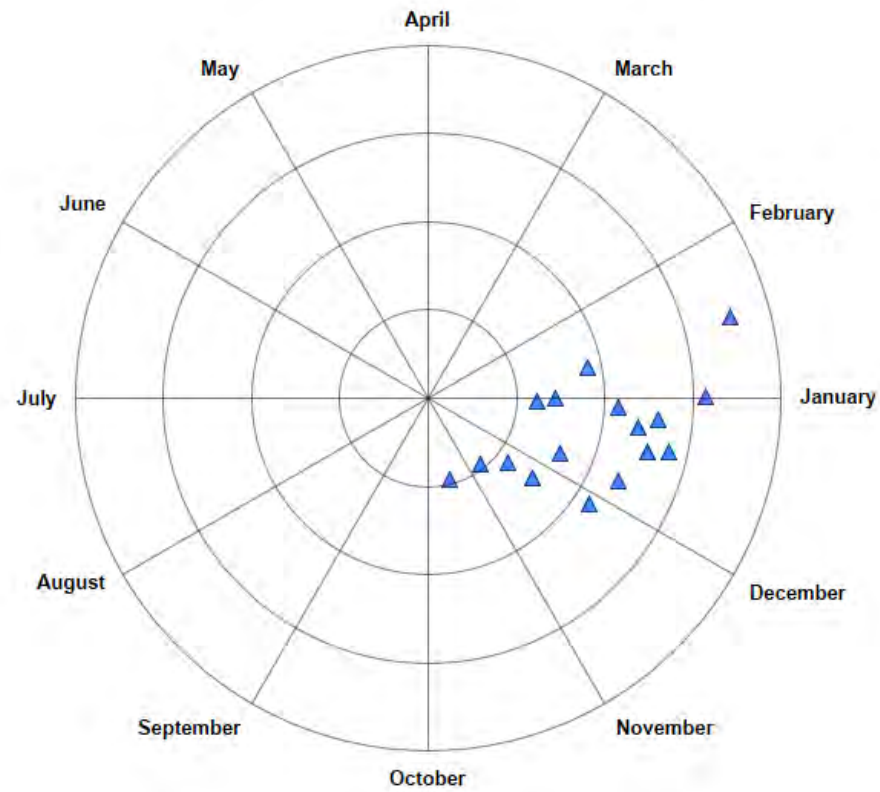
UK Design Flood Estimation

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

Appendix

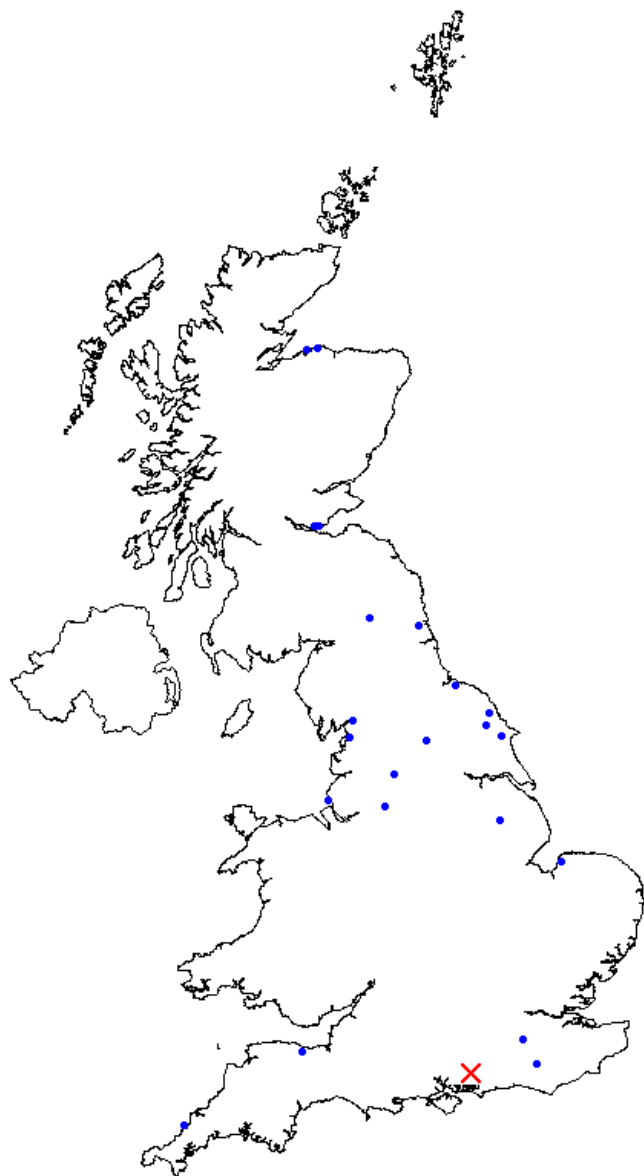
Station record parameters

Flood seasonality: SU 74700 05950 (12-01-2026 15:27) - urban



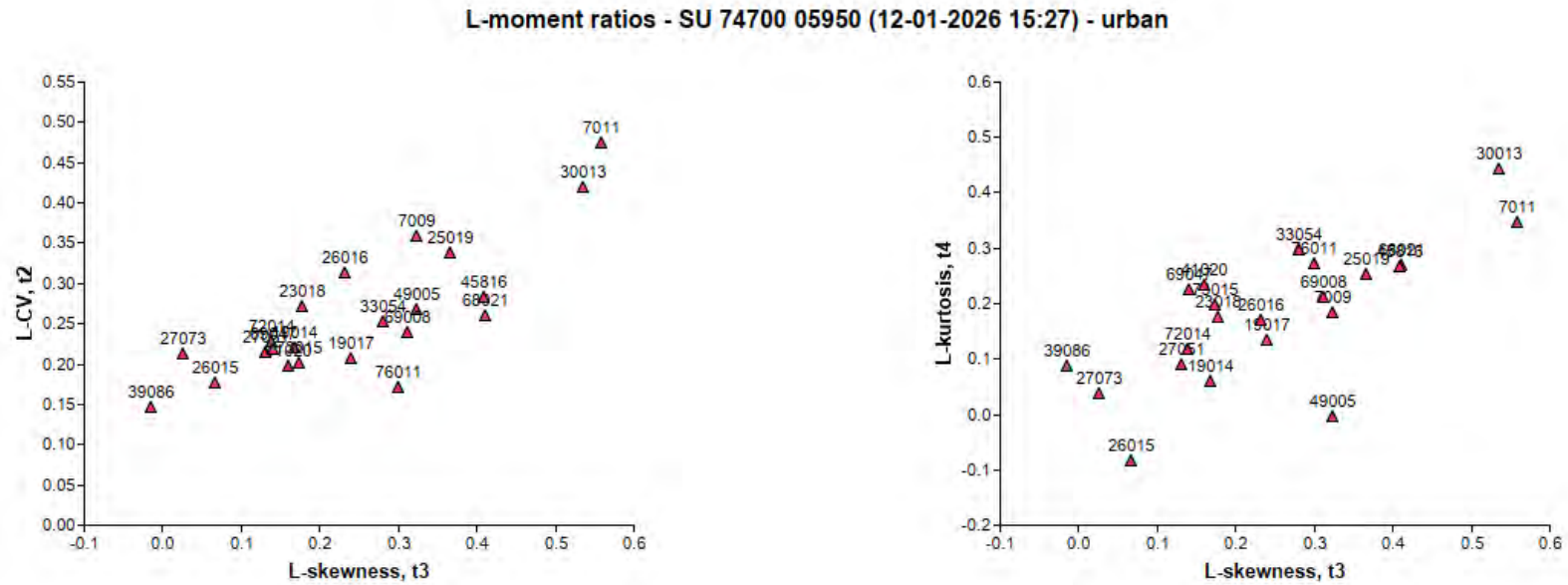
UK Design Flood Estimation

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



UK Design Flood Estimation

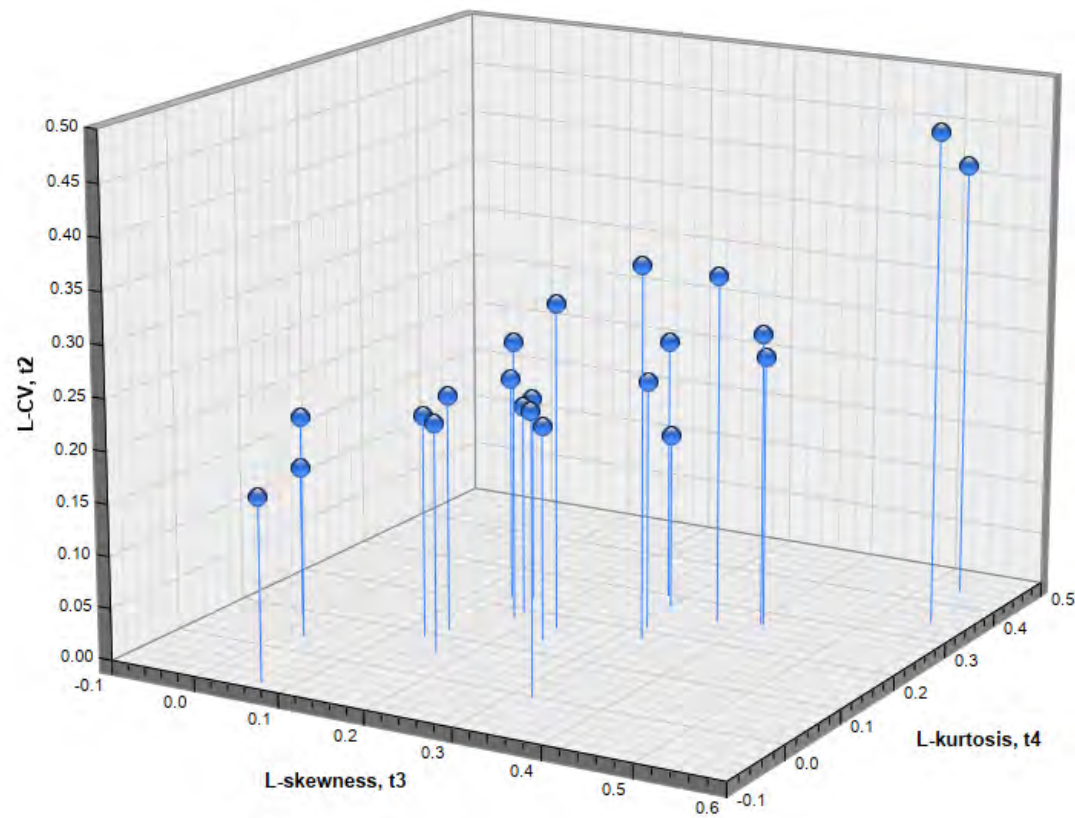
Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method



UK Design Flood Estimation

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

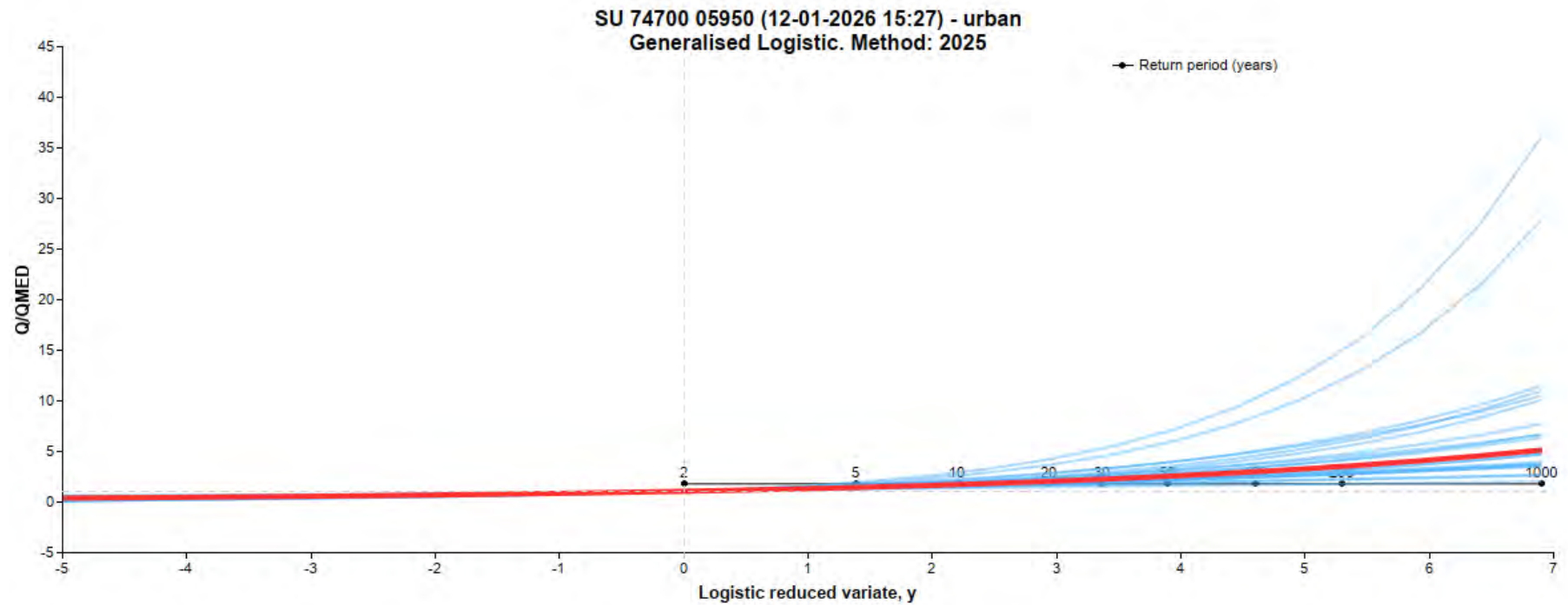
L-moment ratios - SU 74700 05950 (12-01-2026 15:27) - urban



UK Design Flood Estimation

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

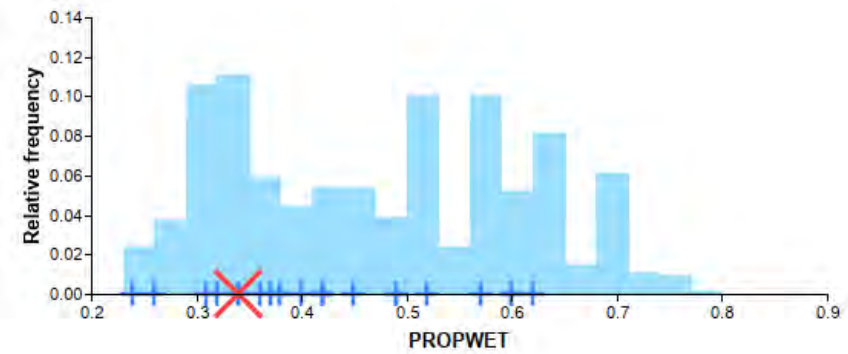
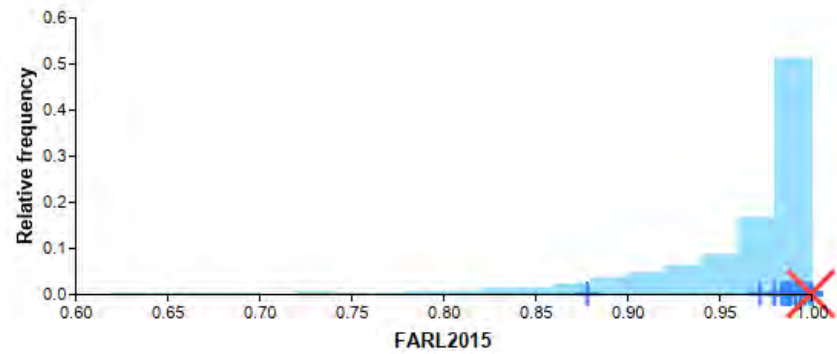
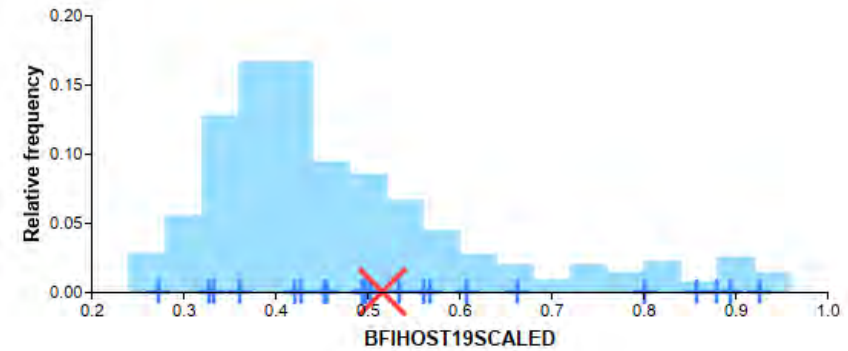
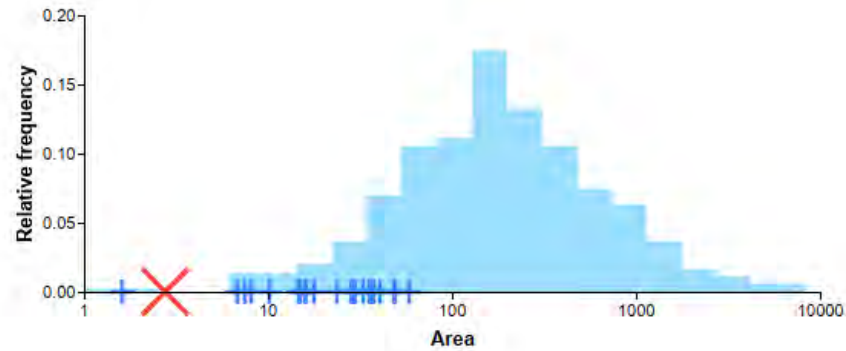
Pooling group growth curves



UK Design Flood Estimation

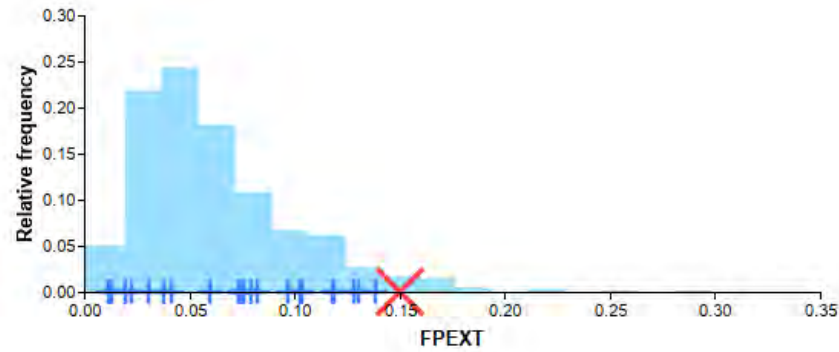
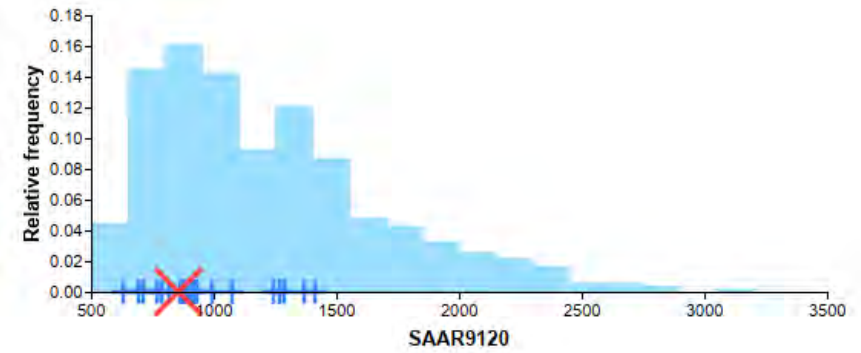
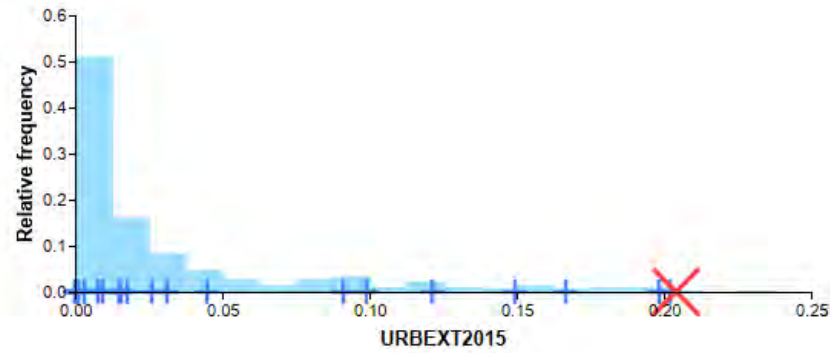
Summary of ESS/Pooled Estimation Analysis using the Flood Estimation Handbook Statistical Method

Catchment descriptors



UK Design Flood Estimation

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



B - ReFH2 Report WBR01

UK Design Flood Estimation

Generated on Tuesday, January 13, 2026 7:39:12 PM by chris
Printed from the ReFH2 Flood Modelling software package, version 4.1.8879.22310

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

Site details

Checksum: 61D6-F405

Site name: FEH_Catchment_Descriptors_474700_105950_v5_1_0

Easting: 474700

Northing: 105950

Country: England, Wales or Northern Ireland

Catchment Area (km²): 2.77

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH22 (mm):	65.97	Total runoff (ML):	42.70
Total Rainfall (mm):	46.38	Total flow (ML):	120.13
Peak Rainfall (mm):	3.93	Peak flow (m ³ /s):	1.95

Parameters

Where the user has overridden 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)	07:45:00 [06:30:00]	Yes
Timestep (hh:mm:ss)	00:15:00 [00:30:00]	Yes
SCF (Seasonal correction factor)	0.72	No
ARF (Areal reduction factor)	0.97	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	94.82	No
Cmax (mm)	431.37	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.64	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m ³ /s)	0.07	No
BL (hr)	39.38	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)	0.8	No
Effective URBEXT2000	0.19	n/a
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 (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
00:00:00	0.303	0.000	0.084	0.000	0.063	0.063
00:15:00	0.364	0.000	0.102	0.001	0.062	0.063
00:30:00	0.437	0.000	0.125	0.002	0.062	0.064
00:45:00	0.525	0.000	0.150	0.005	0.061	0.067
01:00:00	0.630	0.000	0.181	0.010	0.061	0.071
01:15:00	0.756	0.000	0.218	0.017	0.061	0.078
01:30:00	0.906	0.000	0.263	0.027	0.061	0.087
01:45:00	1.085	0.000	0.318	0.039	0.060	0.100
02:00:00	1.298	0.000	0.383	0.056	0.060	0.116
02:15:00	1.551	0.000	0.463	0.076	0.061	0.137
02:30:00	1.850	0.000	0.559	0.103	0.061	0.164
02:45:00	2.203	0.000	0.675	0.135	0.062	0.197
03:00:00	2.615	0.000	0.814	0.175	0.062	0.237
03:15:00	3.090	0.000	0.981	0.223	0.064	0.287
03:30:00	3.611	0.000	1.172	0.281	0.065	0.347
03:45:00	3.930	0.000	1.307	0.351	0.068	0.419
04:00:00	3.611	0.000	1.230	0.434	0.071	0.504
04:15:00	3.090	0.000	1.075	0.529	0.074	0.603
04:30:00	2.615	0.000	0.925	0.635	0.079	0.714
04:45:00	2.203	0.000	0.791	0.748	0.085	0.833
05:00:00	1.850	0.000	0.672	0.867	0.091	0.958
05:15:00	1.551	0.000	0.569	0.987	0.099	1.087
05:30:00	1.298	0.000	0.480	1.108	0.108	1.216
05:45:00	1.085	0.000	0.404	1.224	0.118	1.343
06:00:00	0.906	0.000	0.339	1.335	0.130	1.465
06:15:00	0.756	0.000	0.283	1.437	0.142	1.578
06:30:00	0.630	0.000	0.237	1.525	0.155	1.680
06:45:00	0.525	0.000	0.198	1.598	0.170	1.767
07:00:00	0.437	0.000	0.165	1.653	0.185	1.838
07:15:00	0.364	0.000	0.138	1.689	0.201	1.890
07:30:00	0.303	0.000	0.115	1.708	0.218	1.926
07:45:00	0.000	0.000	0.000	1.709	0.234	1.944
08:00:00	0.000	0.000	0.000	1.694	0.252	1.946
08:15:00	0.000	0.000	0.000	1.664	0.269	1.933

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)
08:30:00	0.000	0.000	0.000	1.622	0.285	1.907
08:45:00	0.000	0.000	0.000	1.570	0.302	1.872
09:00:00	0.000	0.000	0.000	1.511	0.318	1.829
09:15:00	0.000	0.000	0.000	1.447	0.333	1.780
09:30:00	0.000	0.000	0.000	1.379	0.348	1.727
09:45:00	0.000	0.000	0.000	1.309	0.362	1.670
10:00:00	0.000	0.000	0.000	1.237	0.375	1.612
10:15:00	0.000	0.000	0.000	1.164	0.387	1.551
10:30:00	0.000	0.000	0.000	1.091	0.399	1.490
10:45:00	0.000	0.000	0.000	1.019	0.409	1.429
11:00:00	0.000	0.000	0.000	0.950	0.419	1.369
11:15:00	0.000	0.000	0.000	0.882	0.428	1.310
11:30:00	0.000	0.000	0.000	0.817	0.437	1.254
11:45:00	0.000	0.000	0.000	0.756	0.444	1.200
12:00:00	0.000	0.000	0.000	0.698	0.451	1.149
12:15:00	0.000	0.000	0.000	0.642	0.458	1.100
12:30:00	0.000	0.000	0.000	0.589	0.463	1.053
12:45:00	0.000	0.000	0.000	0.539	0.468	1.008
13:00:00	0.000	0.000	0.000	0.492	0.473	0.965
13:15:00	0.000	0.000	0.000	0.448	0.477	0.925
13:30:00	0.000	0.000	0.000	0.406	0.481	0.886
13:45:00	0.000	0.000	0.000	0.367	0.484	0.851
14:00:00	0.000	0.000	0.000	0.331	0.486	0.817
14:15:00	0.000	0.000	0.000	0.298	0.488	0.786
14:30:00	0.000	0.000	0.000	0.267	0.490	0.757
14:45:00	0.000	0.000	0.000	0.239	0.491	0.730
15:00:00	0.000	0.000	0.000	0.212	0.492	0.704
15:15:00	0.000	0.000	0.000	0.187	0.493	0.680
15:30:00	0.000	0.000	0.000	0.164	0.493	0.656
15:45:00	0.000	0.000	0.000	0.142	0.492	0.634
16:00:00	0.000	0.000	0.000	0.122	0.492	0.613
16:15:00	0.000	0.000	0.000	0.103	0.490	0.593
16:30:00	0.000	0.000	0.000	0.086	0.489	0.575
16:45:00	0.000	0.000	0.000	0.070	0.487	0.558
17:00:00	0.000	0.000	0.000	0.057	0.486	0.542

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)
17:15:00	0.000	0.000	0.000	0.046	0.483	0.529
17:30:00	0.000	0.000	0.000	0.036	0.481	0.517
17:45:00	0.000	0.000	0.000	0.029	0.479	0.507
18:00:00	0.000	0.000	0.000	0.022	0.476	0.498
18:15:00	0.000	0.000	0.000	0.017	0.473	0.491
18:30:00	0.000	0.000	0.000	0.013	0.471	0.484
18:45:00	0.000	0.000	0.000	0.010	0.468	0.478
19:00:00	0.000	0.000	0.000	0.007	0.465	0.472
19:15:00	0.000	0.000	0.000	0.005	0.462	0.467
19:30:00	0.000	0.000	0.000	0.003	0.459	0.463
19:45:00	0.000	0.000	0.000	0.002	0.457	0.459
20:00:00	0.000	0.000	0.000	0.001	0.454	0.455
20:15:00	0.000	0.000	0.000	0.000	0.451	0.451
20:30:00	0.000	0.000	0.000	0.000	0.448	0.448
20:45:00	0.000	0.000	0.000	0.000	0.445	0.445
21:00:00	0.000	0.000	0.000	0.000	0.442	0.442
21:15:00	0.000	0.000	0.000	0.000	0.440	0.440
21:30:00	0.000	0.000	0.000	0.000	0.437	0.437
21:45:00	0.000	0.000	0.000	0.000	0.434	0.434
22:00:00	0.000	0.000	0.000	0.000	0.431	0.431
22:15:00	0.000	0.000	0.000	0.000	0.429	0.429
22:30:00	0.000	0.000	0.000	0.000	0.426	0.426
22:45:00	0.000	0.000	0.000	0.000	0.423	0.423
23:00:00	0.000	0.000	0.000	0.000	0.420	0.420
23:15:00	0.000	0.000	0.000	0.000	0.418	0.418
23:30:00	0.000	0.000	0.000	0.000	0.415	0.415
23:45:00	0.000	0.000	0.000	0.000	0.413	0.413
24:00:00	0.000	0.000	0.000	0.000	0.410	0.410
24:15:00	0.000	0.000	0.000	0.000	0.407	0.407
24:30:00	0.000	0.000	0.000	0.000	0.405	0.405
24:45:00	0.000	0.000	0.000	0.000	0.402	0.402
25:00:00	0.000	0.000	0.000	0.000	0.400	0.400
25:15:00	0.000	0.000	0.000	0.000	0.397	0.397
25:30:00	0.000	0.000	0.000	0.000	0.395	0.395
25:45:00	0.000	0.000	0.000	0.000	0.392	0.392

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)
26:00:00	0.000	0.000	0.000	0.000	0.390	0.390
26:15:00	0.000	0.000	0.000	0.000	0.387	0.387
26:30:00	0.000	0.000	0.000	0.000	0.385	0.385
26:45:00	0.000	0.000	0.000	0.000	0.382	0.382
27:00:00	0.000	0.000	0.000	0.000	0.380	0.380
27:15:00	0.000	0.000	0.000	0.000	0.377	0.377
27:30:00	0.000	0.000	0.000	0.000	0.375	0.375
27:45:00	0.000	0.000	0.000	0.000	0.373	0.373
28:00:00	0.000	0.000	0.000	0.000	0.370	0.370
28:15:00	0.000	0.000	0.000	0.000	0.368	0.368
28:30:00	0.000	0.000	0.000	0.000	0.366	0.366
28:45:00	0.000	0.000	0.000	0.000	0.363	0.363
29:00:00	0.000	0.000	0.000	0.000	0.361	0.361
29:15:00	0.000	0.000	0.000	0.000	0.359	0.359
29:30:00	0.000	0.000	0.000	0.000	0.356	0.356
29:45:00	0.000	0.000	0.000	0.000	0.354	0.354
30:00:00	0.000	0.000	0.000	0.000	0.352	0.352
30:15:00	0.000	0.000	0.000	0.000	0.350	0.350
30:30:00	0.000	0.000	0.000	0.000	0.348	0.348
30:45:00	0.000	0.000	0.000	0.000	0.345	0.345
31:00:00	0.000	0.000	0.000	0.000	0.343	0.343
31:15:00	0.000	0.000	0.000	0.000	0.341	0.341
31:30:00	0.000	0.000	0.000	0.000	0.339	0.339
31:45:00	0.000	0.000	0.000	0.000	0.337	0.337
32:00:00	0.000	0.000	0.000	0.000	0.335	0.335
32:15:00	0.000	0.000	0.000	0.000	0.332	0.332
32:30:00	0.000	0.000	0.000	0.000	0.330	0.330
32:45:00	0.000	0.000	0.000	0.000	0.328	0.328
33:00:00	0.000	0.000	0.000	0.000	0.326	0.326
33:15:00	0.000	0.000	0.000	0.000	0.324	0.324
33:30:00	0.000	0.000	0.000	0.000	0.322	0.322
33:45:00	0.000	0.000	0.000	0.000	0.320	0.320
34:00:00	0.000	0.000	0.000	0.000	0.318	0.318
34:15:00	0.000	0.000	0.000	0.000	0.316	0.316
34:30:00	0.000	0.000	0.000	0.000	0.314	0.314

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)
34:45:00	0.000	0.000	0.000	0.000	0.312	0.312
35:00:00	0.000	0.000	0.000	0.000	0.310	0.310
35:15:00	0.000	0.000	0.000	0.000	0.308	0.308
35:30:00	0.000	0.000	0.000	0.000	0.306	0.306
35:45:00	0.000	0.000	0.000	0.000	0.304	0.304
36:00:00	0.000	0.000	0.000	0.000	0.302	0.302
36:15:00	0.000	0.000	0.000	0.000	0.300	0.300
36:30:00	0.000	0.000	0.000	0.000	0.298	0.298
36:45:00	0.000	0.000	0.000	0.000	0.297	0.297
37:00:00	0.000	0.000	0.000	0.000	0.295	0.295
37:15:00	0.000	0.000	0.000	0.000	0.293	0.293
37:30:00	0.000	0.000	0.000	0.000	0.291	0.291
37:45:00	0.000	0.000	0.000	0.000	0.289	0.289
38:00:00	0.000	0.000	0.000	0.000	0.287	0.287
38:15:00	0.000	0.000	0.000	0.000	0.285	0.285
38:30:00	0.000	0.000	0.000	0.000	0.284	0.284
38:45:00	0.000	0.000	0.000	0.000	0.282	0.282
39:00:00	0.000	0.000	0.000	0.000	0.280	0.280
39:15:00	0.000	0.000	0.000	0.000	0.278	0.278
39:30:00	0.000	0.000	0.000	0.000	0.277	0.277
39:45:00	0.000	0.000	0.000	0.000	0.275	0.275
40:00:00	0.000	0.000	0.000	0.000	0.273	0.273
40:15:00	0.000	0.000	0.000	0.000	0.271	0.271
40:30:00	0.000	0.000	0.000	0.000	0.270	0.270
40:45:00	0.000	0.000	0.000	0.000	0.268	0.268
41:00:00	0.000	0.000	0.000	0.000	0.266	0.266
41:15:00	0.000	0.000	0.000	0.000	0.265	0.265
41:30:00	0.000	0.000	0.000	0.000	0.263	0.263
41:45:00	0.000	0.000	0.000	0.000	0.261	0.261
42:00:00	0.000	0.000	0.000	0.000	0.260	0.260
42:15:00	0.000	0.000	0.000	0.000	0.258	0.258
42:30:00	0.000	0.000	0.000	0.000	0.256	0.256
42:45:00	0.000	0.000	0.000	0.000	0.255	0.255
43:00:00	0.000	0.000	0.000	0.000	0.253	0.253
43:15:00	0.000	0.000	0.000	0.000	0.251	0.251

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)
43:30:00	0.000	0.000	0.000	0.000	0.250	0.250
43:45:00	0.000	0.000	0.000	0.000	0.248	0.248
44:00:00	0.000	0.000	0.000	0.000	0.247	0.247
44:15:00	0.000	0.000	0.000	0.000	0.245	0.245
44:30:00	0.000	0.000	0.000	0.000	0.244	0.244
44:45:00	0.000	0.000	0.000	0.000	0.242	0.242
45:00:00	0.000	0.000	0.000	0.000	0.241	0.241
45:15:00	0.000	0.000	0.000	0.000	0.239	0.239
45:30:00	0.000	0.000	0.000	0.000	0.237	0.237
45:45:00	0.000	0.000	0.000	0.000	0.236	0.236
46:00:00	0.000	0.000	0.000	0.000	0.234	0.234
46:15:00	0.000	0.000	0.000	0.000	0.233	0.233
46:30:00	0.000	0.000	0.000	0.000	0.232	0.232
46:45:00	0.000	0.000	0.000	0.000	0.230	0.230
47:00:00	0.000	0.000	0.000	0.000	0.229	0.229
47:15:00	0.000	0.000	0.000	0.000	0.227	0.227
47:30:00	0.000	0.000	0.000	0.000	0.226	0.226
47:45:00	0.000	0.000	0.000	0.000	0.224	0.224
48:00:00	0.000	0.000	0.000	0.000	0.223	0.223
48:15:00	0.000	0.000	0.000	0.000	0.221	0.221
48:30:00	0.000	0.000	0.000	0.000	0.220	0.220
48:45:00	0.000	0.000	0.000	0.000	0.219	0.219
49:00:00	0.000	0.000	0.000	0.000	0.217	0.217
49:15:00	0.000	0.000	0.000	0.000	0.216	0.216
49:30:00	0.000	0.000	0.000	0.000	0.215	0.215
49:45:00	0.000	0.000	0.000	0.000	0.213	0.213
50:00:00	0.000	0.000	0.000	0.000	0.212	0.212
50:15:00	0.000	0.000	0.000	0.000	0.210	0.210
50:30:00	0.000	0.000	0.000	0.000	0.209	0.209
50:45:00	0.000	0.000	0.000	0.000	0.208	0.208
51:00:00	0.000	0.000	0.000	0.000	0.207	0.207
51:15:00	0.000	0.000	0.000	0.000	0.205	0.205
51:30:00	0.000	0.000	0.000	0.000	0.204	0.204
51:45:00	0.000	0.000	0.000	0.000	0.203	0.203
52:00:00	0.000	0.000	0.000	0.000	0.201	0.201

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)
52:15:00	0.000	0.000	0.000	0.000	0.200	0.200
52:30:00	0.000	0.000	0.000	0.000	0.199	0.199
52:45:00	0.000	0.000	0.000	0.000	0.198	0.198
53:00:00	0.000	0.000	0.000	0.000	0.196	0.196
53:15:00	0.000	0.000	0.000	0.000	0.195	0.195
53:30:00	0.000	0.000	0.000	0.000	0.194	0.194
53:45:00	0.000	0.000	0.000	0.000	0.193	0.193
54:00:00	0.000	0.000	0.000	0.000	0.191	0.191
54:15:00	0.000	0.000	0.000	0.000	0.190	0.190
54:30:00	0.000	0.000	0.000	0.000	0.189	0.189
54:45:00	0.000	0.000	0.000	0.000	0.188	0.188
55:00:00	0.000	0.000	0.000	0.000	0.187	0.187
55:15:00	0.000	0.000	0.000	0.000	0.185	0.185
55:30:00	0.000	0.000	0.000	0.000	0.184	0.184
55:45:00	0.000	0.000	0.000	0.000	0.183	0.183
56:00:00	0.000	0.000	0.000	0.000	0.182	0.182
56:15:00	0.000	0.000	0.000	0.000	0.181	0.181
56:30:00	0.000	0.000	0.000	0.000	0.180	0.180
56:45:00	0.000	0.000	0.000	0.000	0.178	0.178
57:00:00	0.000	0.000	0.000	0.000	0.177	0.177
57:15:00	0.000	0.000	0.000	0.000	0.176	0.176
57:30:00	0.000	0.000	0.000	0.000	0.175	0.175
57:45:00	0.000	0.000	0.000	0.000	0.174	0.174
58:00:00	0.000	0.000	0.000	0.000	0.173	0.173
58:15:00	0.000	0.000	0.000	0.000	0.172	0.172
58:30:00	0.000	0.000	0.000	0.000	0.171	0.171
58:45:00	0.000	0.000	0.000	0.000	0.170	0.170
59:00:00	0.000	0.000	0.000	0.000	0.169	0.169
59:15:00	0.000	0.000	0.000	0.000	0.167	0.167
59:30:00	0.000	0.000	0.000	0.000	0.166	0.166
59:45:00	0.000	0.000	0.000	0.000	0.165	0.165
60:00:00	0.000	0.000	0.000	0.000	0.164	0.164
60:15:00	0.000	0.000	0.000	0.000	0.163	0.163
60:30:00	0.000	0.000	0.000	0.000	0.162	0.162
60:45:00	0.000	0.000	0.000	0.000	0.161	0.161

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)
61:00:00	0.000	0.000	0.000	0.000	0.160	0.160
61:15:00	0.000	0.000	0.000	0.000	0.159	0.159
61:30:00	0.000	0.000	0.000	0.000	0.158	0.158
61:45:00	0.000	0.000	0.000	0.000	0.157	0.157
62:00:00	0.000	0.000	0.000	0.000	0.156	0.156
62:15:00	0.000	0.000	0.000	0.000	0.155	0.155
62:30:00	0.000	0.000	0.000	0.000	0.154	0.154
62:45:00	0.000	0.000	0.000	0.000	0.153	0.153
63:00:00	0.000	0.000	0.000	0.000	0.152	0.152
63:15:00	0.000	0.000	0.000	0.000	0.151	0.151
63:30:00	0.000	0.000	0.000	0.000	0.150	0.150
63:45:00	0.000	0.000	0.000	0.000	0.149	0.149
64:00:00	0.000	0.000	0.000	0.000	0.148	0.148
64:15:00	0.000	0.000	0.000	0.000	0.148	0.148
64:30:00	0.000	0.000	0.000	0.000	0.147	0.147
64:45:00	0.000	0.000	0.000	0.000	0.146	0.146
65:00:00	0.000	0.000	0.000	0.000	0.145	0.145
65:15:00	0.000	0.000	0.000	0.000	0.144	0.144
65:30:00	0.000	0.000	0.000	0.000	0.143	0.143
65:45:00	0.000	0.000	0.000	0.000	0.142	0.142
66:00:00	0.000	0.000	0.000	0.000	0.141	0.141
66:15:00	0.000	0.000	0.000	0.000	0.140	0.140
66:30:00	0.000	0.000	0.000	0.000	0.139	0.139
66:45:00	0.000	0.000	0.000	0.000	0.138	0.138
67:00:00	0.000	0.000	0.000	0.000	0.138	0.138
67:15:00	0.000	0.000	0.000	0.000	0.137	0.137
67:30:00	0.000	0.000	0.000	0.000	0.136	0.136
67:45:00	0.000	0.000	0.000	0.000	0.135	0.135
68:00:00	0.000	0.000	0.000	0.000	0.134	0.134
68:15:00	0.000	0.000	0.000	0.000	0.133	0.133
68:30:00	0.000	0.000	0.000	0.000	0.132	0.132
68:45:00	0.000	0.000	0.000	0.000	0.132	0.132
69:00:00	0.000	0.000	0.000	0.000	0.131	0.131
69:15:00	0.000	0.000	0.000	0.000	0.130	0.130
69:30:00	0.000	0.000	0.000	0.000	0.129	0.129

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)
69:45:00	0.000	0.000	0.000	0.000	0.128	0.128
70:00:00	0.000	0.000	0.000	0.000	0.127	0.127
70:15:00	0.000	0.000	0.000	0.000	0.127	0.127
70:30:00	0.000	0.000	0.000	0.000	0.126	0.126
70:45:00	0.000	0.000	0.000	0.000	0.125	0.125
71:00:00	0.000	0.000	0.000	0.000	0.124	0.124
71:15:00	0.000	0.000	0.000	0.000	0.123	0.123
71:30:00	0.000	0.000	0.000	0.000	0.123	0.123
71:45:00	0.000	0.000	0.000	0.000	0.122	0.122
72:00:00	0.000	0.000	0.000	0.000	0.121	0.121
72:15:00	0.000	0.000	0.000	0.000	0.120	0.120
72:30:00	0.000	0.000	0.000	0.000	0.120	0.120
72:45:00	0.000	0.000	0.000	0.000	0.119	0.119
73:00:00	0.000	0.000	0.000	0.000	0.118	0.118
73:15:00	0.000	0.000	0.000	0.000	0.117	0.117
73:30:00	0.000	0.000	0.000	0.000	0.117	0.117
73:45:00	0.000	0.000	0.000	0.000	0.116	0.116
74:00:00	0.000	0.000	0.000	0.000	0.115	0.115
74:15:00	0.000	0.000	0.000	0.000	0.114	0.114
74:30:00	0.000	0.000	0.000	0.000	0.114	0.114
74:45:00	0.000	0.000	0.000	0.000	0.113	0.113
75:00:00	0.000	0.000	0.000	0.000	0.112	0.112
75:15:00	0.000	0.000	0.000	0.000	0.112	0.112
75:30:00	0.000	0.000	0.000	0.000	0.111	0.111
75:45:00	0.000	0.000	0.000	0.000	0.110	0.110
76:00:00	0.000	0.000	0.000	0.000	0.109	0.109
76:15:00	0.000	0.000	0.000	0.000	0.109	0.109
76:30:00	0.000	0.000	0.000	0.000	0.108	0.108
76:45:00	0.000	0.000	0.000	0.000	0.107	0.107
77:00:00	0.000	0.000	0.000	0.000	0.107	0.107
77:15:00	0.000	0.000	0.000	0.000	0.106	0.106
77:30:00	0.000	0.000	0.000	0.000	0.105	0.105
77:45:00	0.000	0.000	0.000	0.000	0.105	0.105
78:00:00	0.000	0.000	0.000	0.000	0.104	0.104
78:15:00	0.000	0.000	0.000	0.000	0.103	0.103

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)
78:30:00	0.000	0.000	0.000	0.000	0.103	0.103
78:45:00	0.000	0.000	0.000	0.000	0.102	0.102
79:00:00	0.000	0.000	0.000	0.000	0.101	0.101
79:15:00	0.000	0.000	0.000	0.000	0.101	0.101
79:30:00	0.000	0.000	0.000	0.000	0.100	0.100
79:45:00	0.000	0.000	0.000	0.000	0.100	0.100
80:00:00	0.000	0.000	0.000	0.000	0.099	0.099
80:15:00	0.000	0.000	0.000	0.000	0.098	0.098
80:30:00	0.000	0.000	0.000	0.000	0.098	0.098
80:45:00	0.000	0.000	0.000	0.000	0.097	0.097
81:00:00	0.000	0.000	0.000	0.000	0.096	0.096
81:15:00	0.000	0.000	0.000	0.000	0.096	0.096
81:30:00	0.000	0.000	0.000	0.000	0.095	0.095
81:45:00	0.000	0.000	0.000	0.000	0.095	0.095
82:00:00	0.000	0.000	0.000	0.000	0.094	0.094
82:15:00	0.000	0.000	0.000	0.000	0.093	0.093
82:30:00	0.000	0.000	0.000	0.000	0.093	0.093
82:45:00	0.000	0.000	0.000	0.000	0.092	0.092
83:00:00	0.000	0.000	0.000	0.000	0.092	0.092
83:15:00	0.000	0.000	0.000	0.000	0.091	0.091
83:30:00	0.000	0.000	0.000	0.000	0.090	0.090
83:45:00	0.000	0.000	0.000	0.000	0.090	0.090
84:00:00	0.000	0.000	0.000	0.000	0.089	0.089
84:15:00	0.000	0.000	0.000	0.000	0.089	0.089
84:30:00	0.000	0.000	0.000	0.000	0.088	0.088
84:45:00	0.000	0.000	0.000	0.000	0.088	0.088
85:00:00	0.000	0.000	0.000	0.000	0.087	0.087
85:15:00	0.000	0.000	0.000	0.000	0.087	0.087
85:30:00	0.000	0.000	0.000	0.000	0.086	0.086
85:45:00	0.000	0.000	0.000	0.000	0.085	0.085
86:00:00	0.000	0.000	0.000	0.000	0.085	0.085
86:15:00	0.000	0.000	0.000	0.000	0.084	0.084
86:30:00	0.000	0.000	0.000	0.000	0.084	0.084
86:45:00	0.000	0.000	0.000	0.000	0.083	0.083
87:00:00	0.000	0.000	0.000	0.000	0.083	0.083

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)
87:15:00	0.000	0.000	0.000	0.000	0.082	0.082
87:30:00	0.000	0.000	0.000	0.000	0.082	0.082
87:45:00	0.000	0.000	0.000	0.000	0.081	0.081
88:00:00	0.000	0.000	0.000	0.000	0.081	0.081
88:15:00	0.000	0.000	0.000	0.000	0.080	0.080
88:30:00	0.000	0.000	0.000	0.000	0.080	0.080
88:45:00	0.000	0.000	0.000	0.000	0.079	0.079
89:00:00	0.000	0.000	0.000	0.000	0.079	0.079
89:15:00	0.000	0.000	0.000	0.000	0.078	0.078
89:30:00	0.000	0.000	0.000	0.000	0.078	0.078
89:45:00	0.000	0.000	0.000	0.000	0.077	0.077
90:00:00	0.000	0.000	0.000	0.000	0.077	0.077
90:15:00	0.000	0.000	0.000	0.000	0.076	0.076
90:30:00	0.000	0.000	0.000	0.000	0.076	0.076
90:45:00	0.000	0.000	0.000	0.000	0.075	0.075
91:00:00	0.000	0.000	0.000	0.000	0.075	0.075
91:15:00	0.000	0.000	0.000	0.000	0.074	0.074
91:30:00	0.000	0.000	0.000	0.000	0.074	0.074
91:45:00	0.000	0.000	0.000	0.000	0.073	0.073
92:00:00	0.000	0.000	0.000	0.000	0.073	0.073
92:15:00	0.000	0.000	0.000	0.000	0.072	0.072
92:30:00	0.000	0.000	0.000	0.000	0.072	0.072
92:45:00	0.000	0.000	0.000	0.000	0.072	0.072
93:00:00	0.000	0.000	0.000	0.000	0.071	0.071
93:15:00	0.000	0.000	0.000	0.000	0.071	0.071
93:30:00	0.000	0.000	0.000	0.000	0.070	0.070
93:45:00	0.000	0.000	0.000	0.000	0.070	0.070
94:00:00	0.000	0.000	0.000	0.000	0.069	0.069
94:15:00	0.000	0.000	0.000	0.000	0.069	0.069
94:30:00	0.000	0.000	0.000	0.000	0.068	0.068
94:45:00	0.000	0.000	0.000	0.000	0.068	0.068
95:00:00	0.000	0.000	0.000	0.000	0.068	0.068
95:15:00	0.000	0.000	0.000	0.000	0.067	0.067
95:30:00	0.000	0.000	0.000	0.000	0.067	0.067
95:45:00	0.000	0.000	0.000	0.000	0.066	0.066

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)
96:00:00	0.000	0.000	0.000	0.000	0.066	0.066
96:15:00	0.000	0.000	0.000	0.000	0.065	0.065
96:30:00	0.000	0.000	0.000	0.000	0.065	0.065
96:45:00	0.000	0.000	0.000	0.000	0.065	0.065
97:00:00	0.000	0.000	0.000	0.000	0.064	0.064
97:15:00	0.000	0.000	0.000	0.000	0.064	0.064
97:30:00	0.000	0.000	0.000	0.000	0.063	0.063
97:45:00	0.000	0.000	0.000	0.000	0.063	0.063

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km ²)	2.77	No
ALTBAR	20	No
ASPBAR	162	No
ASPVAR	0.66	No
BFIHOST	0.5	No
BFIHOST19	0.52	No
DPLBAR (km)	1.91	No
DPSBAR (mkm ⁻¹)	20.5	No
FARL	1	No
LDP	3.37	No
PROPWET	0.34	No
RMED1H	9.3	No
RMED1D	35.8	No
RMED2D	44.5	No
SAAR (mm)	760	No
SAAR4170 (mm)	823	No
SPRHOST	36.8	No
URBEXT2000	0.19	No
URBEXT1990	0.13	No
URBCONC	0.89	No
URBLOC	0.74	No
DDF parameter C	-0.03	No
DDF parameter D1	0.45	No
DDF parameter D2	0.29	No
DDF parameter D3	0.4	No
DDF parameter E	0.31	No
DDF parameter F	2.27	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.45	No
DDF parameter D2 (1km grid value)	0.28	No
DDF parameter D3 (1km grid value)	0.39	No
DDF parameter E (1km grid value)	0.31	No
DDF parameter F (1km grid value)	2.27	No