Lime Down E2 - Hydraulic Modelling Report

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Lime Down E2 - Hydraulic Modelling Report

For: Island Green Power UK Ltd

Site: Lime Down Solar Farm E2

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Issue-01

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Reference of Terms

Annual Exceedance Probability (AEP)

The AEP is the chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is usually expressed as a percentage.

Aquifers

- Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- Secondary A Aquifers are 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'.
- Secondary B Aquifers are 'predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers'.
- Secondary Undifferentiated Aquifers are assigned in 'cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'.
- Unproductive Strata are 'rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow'.

Canal Failure

Canal failure can occur due to high-intensity rainfall or structural failure and can be dangerous due to the rapid release of large volumes of water. It is typically limited to raised canal reaches and can result in a rapid peak in flow followed by a gradual reduction.

Climate Change (CC)

A change in global or regional climate patterns. For flood risk, CC are assessed in terms of allowances which are predictions of anticipated change for peak river flow, peak rainfall intensity, sea level rise and offshore wind speed and extreme wave height. CC scenario data exists across different epochs (time periods) to determine the needs for climate resilience measures. CC data is requested as part of an EAPD request. If a separate ESG Flood Risk and CC Assessment is needed, additional CC data will be required.

Environment Agency (EA) and EA Product Data (EAPD)

The EA is the lead organisation for providing flood and coastal risk management and warnings of flooding from Main Rivers and on the coast. For sites within or in close elevational proximity to Flood Zone 2 or Flood Zone 3, EAPD is ordered to obtain more detailed flood risk data such as flood depths, breach and overtopping mapping and fluvial/tidal risks associated with CC.

Fluvial Flooding

Fluvial flooding typically occurs when a river's capacity is exceeded, and the excess water overtops the riverbanks. It can also occur when the watercourse has a high level downstream, perhaps due to structures or blockage, thus limiting conveyance. This creates a backup of water which can overtop the banks. Typical flooding issues occur when the natural floodplain has been urbanised and the river has been confined. EA mapping defines three zones of different flood risk, the third of which is subdivided into two categories:

- Zone 1 “Low probability of flooding” – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 “Medium probability of flooding” – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year;
- Zone 3a “High probability of flooding” – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year; and
- Zone 3b “Functional floodplain” – A sub-part of Zone 3, this zone comprises land where water has to flow or be stored in times of flood. This zone is not normally included within the national Flood Map for Planning and is calculated where necessary using detailed hydraulic modelling.

Groundwater Flooding

Groundwater flooding is caused by the emergence of water from beneath the ground at either point or diffuse locations when the natural level of the water table rises above ground level. This can result in deep and long-lasting flooding of low-lying or below-ground infrastructure such as underpasses and basements. Groundwater flooding can cause significant damage to property, especially in urban areas, and can pose further risks to the environment and ground stability.

Sewer Flooding

Flooding from sewers primarily occurs when flow entering a system exceeds available capacity or if the network capacity has been reduced through blockage or collapse. In the case of surface water sewers that discharge to watercourses, the same effect can be caused as a result of high-water levels in the receiving watercourse. As a result, water can begin to surcharge the sewer network, emerging at ground level through gullies and manholes and potentially causing flooding to highways and properties. If this occurs flooding can represent a significant hazard to human health due to the potential for contaminants in flood water.

Source Protection Zones

Source Protection Zones (SPZs) are areas of land through which water infiltrates into a groundwater borehole, well or spring that is used for public drinking water supply. These zones show the risk of contamination from potential pollution. SPZ’s have been created as public facing boundaries where discrete groundwater bodies within SPZ’s have been dissolved on zone number where common boundaries and overlaps have been removed. SPZs are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction.

- Zone 1 (Inner Protection Zone) is defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50-metre radius.
- Zone 2: (Outer Protection Zone) - This zone is defined by the 400-day travel time from a point below the water table. Additionally, this zone has a minimum radius of 250 or 500 metres, depending on the size of the abstraction.
- Zone 3: (Total catchment) - This zone is defined as the total area needed to support the abstraction or discharge from the protected groundwater source. A further Zone 4, or ‘Zone of Special Interest’ was previously defined for some groundwater sources.

Surface Water Runoff

Surface water runoff is defined as water flowing over the ground that has not yet entered a drainage channel or similar. It usually occurs because of an intense period of rainfall which exceeds the infiltration capacity of the ground. Typically, runoff occurs on sloping land or where the ground surface is relatively impermeable. The ground can be impermeable either naturally due to the soil type or geology, or due to development which places impervious material over the ground surface (e.g. paving and roads).

Tidal Flooding

Tidal flooding is caused by high tides coinciding with a low-pressure storm system which raises sea and tidal water levels, overwhelming coastal and river defences. This may be made worse by gale-force winds blowing the raised body of water up tidal river basins some distance from the coast, due to floodwater being forced up the tidal reaches of rivers and estuaries. Such flooding may become more frequent in future years due to rising sea levels.

Reservoirs Failure

Reservoir failure can be a particularly dangerous form of flooding as it results in the sudden release of large volumes of water that can travel at high velocity, causing deep and widespread flooding. The likelihood of this occurring is low as large reservoirs are managed in accordance with the Reservoirs Act 1975. The EA's online reservoir inundation map illustrates the maximum flood extents that could occur in the event of a reservoir.

1. Introduction

1.1 Acknowledgement

1.1.1 This report has been prepared for the sole and exclusive use of Island Green Power UK Ltd in accordance with the scope of work presented via email by Arthian, dated 09/04/2026. This report is based on information and data collected by Arthian. Should any of the information be incorrect, incomplete, or subject to change, Arthian may wish to revise the report accordingly.

1.1.2 Arthian have been instructed to undertake a hydraulic modelling exercise to define fluvial flood risk associated with Rodbourne Brook and thus inform the development proposals comprising a solar farm development within Lime Down E2.

1.2 Project Understanding

1.2.1 It is understood that the Environment Agency (EA) does not hold a detailed hydraulic model for the Rodbourne Brook, and the current Flood Map for Planning and Flood Zones within the study are derived from strategic national-scale datasets. As such, a site-specific hydraulic model has been developed to define fluvial flood risk associated with the Rodbourne Brook, in order to inform the proposed solar farm development within Lime Down E2.

1.2.2 This hydraulic modelling exercise includes the production of a 1D-2D ESTRY-TUFLOW hydraulic model of the Rodbourne Brook, informed by a channel survey undertaken by Storm Geomatics (June 2026).

1.2.3 The results of this hydraulic modelling have been used to inform the Flood Risk Assessment (FRA) for Lime Down E2: **ES Volume 3, Appendix 11-8: Flood Risk Assessment and Outline Drainage Strategy - Lime Down E2 (Rev 4) [EN010168/APP/6.3]** submitted at Deadline 4 of Examination.

1.2.4 It should be noted that the watercourse that is subject of this modelling study is referred to as both Rodbourne Brook and Gabriel's Well. Although it is referred to as the Gabriel's Well in the FRA, it will hereafter be referred to as Rodbourne Brook in this report, to align with the naming convention used in the supporting channel survey and hydrological assessment.

1.3 Project Limitations

1.3.1 The wider Arthian limitations are contained within Appendix A.

2. Model Build

2.1 Model Setup

2.1.1 The model domain, resolution, and other parameterisation were selected to provide a stable and hydraulically representative simulation of the watercourse and adjacent floodplain, while remaining proportionate to the scale and purpose of the assessment. Key model parameters are outlined in Table 1, with additional details discussed in the coming sections.

Table 1. Model Set Up and Key Parameters

Arthian Model Reference and Version:	317212_EA/09_v1
Simulation Type:	Fluvial
Model Type:	1D/2D ESTRY-TUFLOW
Software Builds:	TUFLOW 2026.2.0 (*latest build available at the time of simulation*)
Model Extent:	The model location and extent are shown in Figure 1.
Data Sources:	**Channel Survey:** A channel survey of the site was undertaken by Storm Geomatics in June 2026 and provided in georeferenced CAD format. The survey covered Rodbourne Brook for its full length within the study area. **Digital Terrain Model (DTM) data:** EA LiDAR DTM data (1m resolution) has been used beyond the extents of the channel survey and provides the base DTM, providing full coverage of the model extent.
Cell Size:	Cell size set to 2m – this is a suitable cell size to represent the flood mechanisms appropriately, and to utilise the underlying terrain data without negatively impact the simulation run times.
Building Representation:	There are very few buildings present within the model domain, however, OS MasterMap data was used to define land use, including building footprints. A high roughness was applied to all buildings to represent internal walls and contents, with a roughness value of 0.5s/m$^{1/3}$ used.
Existing Flood Defences:	The EA Spatial Flood Defences with Standardised Attributes dataset indicates there are no formal engineered flood defences present within the model domain. A natural high ground feature is present adjacent to the watercourse, which is captured in DTM data.

Initial Conditions:	Initial conditions for all simulations were generated based on an initial steady state run, with a constant inflow applied at the upstream boundary. A constant flow equal to 0.776m^3/s has been applied, based on the initial value in the inflow hydrographs, which is considered to be indicative of more typical everyday flow conditions. This allowed water levels and channel storage to be established across the model domain prior to the design event simulations, thus improving numerical stability and reducing model warm-up effects. The outputs from the constant flow run were then used to initialise each subsequent event simulation.
Boundary Conditions:	As no existing hydrology assessment is available for the study area and no gauge station data is available at the study location, design inflow hydrographs were generated for the Rodbourne Brook catchment using both the ReFH2 rainfall-runoff method and the updated 2025 FEH Statistical method in line with the latest hydrological guidance. Assessment and comparison of both methods found the FEH Statistical method to provide greater peak flow estimates for the study area; therefore, to ensure a precautionary and suitably conservative assessment for the site, the higher FEH Statistical flows were selected for use in the hydraulic modelling. Peak flow hydrographs were applied as lumped sum at the head of Rodbourne Brook for the hydraulic model extent. Peak flow estimates for the two methods for the AEP events of interest are detail in Section 2.2 and an FEH calculation Proforma detailing the full assessment methodology and reasoning is provided in Appendix B. Downstream conditions have been applied using a fixed water level of 69.0m AOD. This fixed water level has been derived from the EA LiDAR DTM, based on the extent of the current EA Flood Zones plus Climate Change dataset to provide a conservative assessment of the downstream conditions.
Roughness Approach and Values:	Manning's n based on Chow (1959), survey, photographs, and aerial imagery. Land use based on OS MasterMap data. <u>Land Use Type Roughness ($s/m^{1/3}$)</u> General Surface....................0.030 Industrial Land.....................0.030 Land/Gardens......................0.060 Rough ground/scrub.............0.080 Roads, tracks, and paths......0.020 Buildings..............................0.500 Following a review of the OS MasterMap data against Google Satellite Imagery, it was noted that areas consisting of grass and trees were not being accurately represented, and manual alterations were made to improve the accuracy of the land use within the model domain.
Structures:	All structures identified during the channel survey were reviewed as part of the model build. The features that were considered likely to influence conveyance and water levels were represented within the model using surveyed or estimated dimensions, as appropriate. As such, all key structures were represented within the model.

Other DTM Adjustments:	There are two small bridge structures within the upstream extent of the model, the wider road decks of which are not accurately represented within the LiDAR DTM. As such, 2d_zsh regions, based on channel survey data of hydraulic structures, were implemented to more appropriately represent the raised deck area across the channel and floodplain associated with the bridge structures ROD01_03365 and ROD01_03107.
Timestep:	1D timestep set to 0.25s. 2D timestep set to 0.50s.
Non-Default Parameters:	No default parameters changes required.
Further Comments:	N/A.

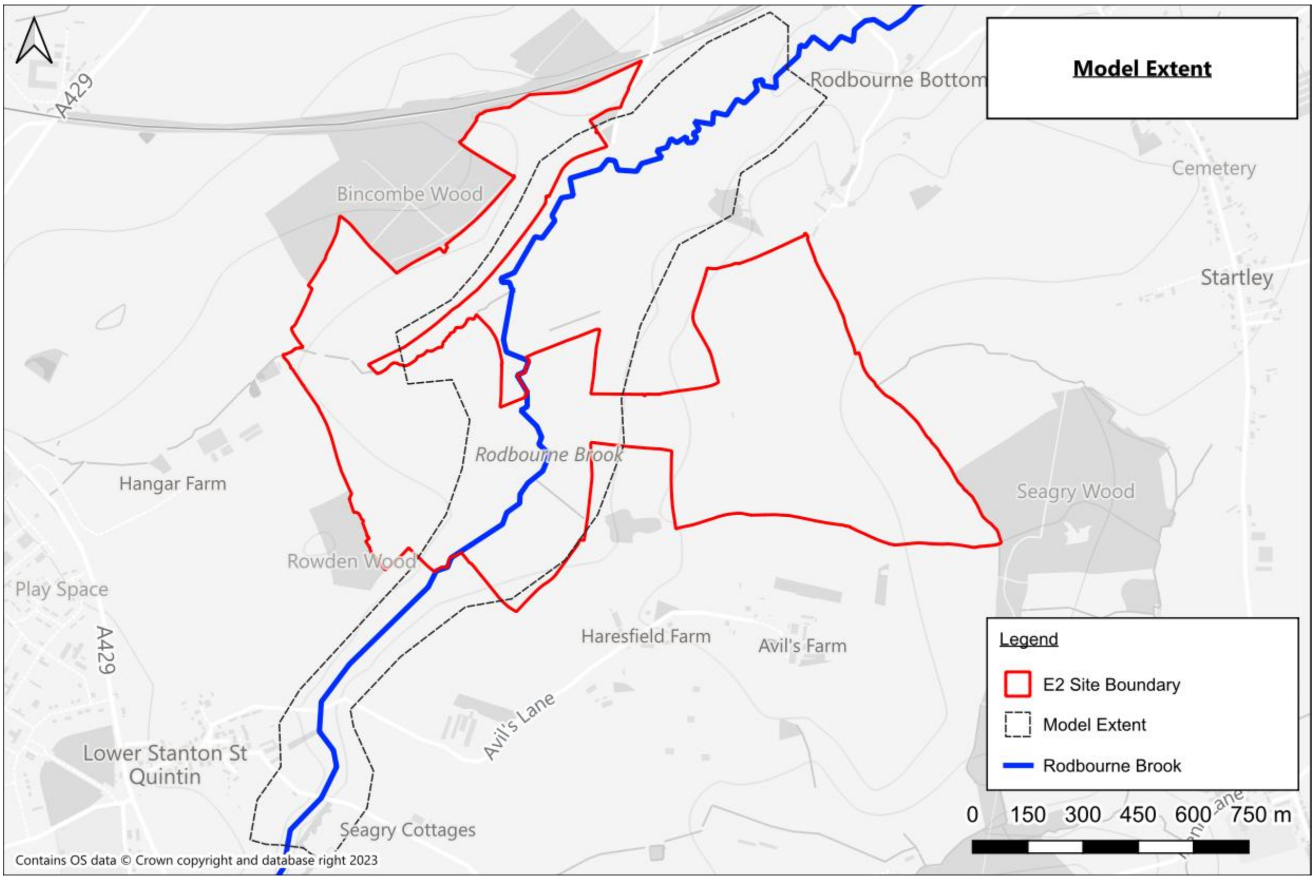

Figure 1: Model Extent

2.2 Simulated Flood Events and Scenarios

2.2.1 The model was used to simulate the following present-day fluvial events: 3.33%, 1% and 0.1% Annual Exceedance Probability (AEP) events. The model was also used to simulate the following events that account for future climate change predictions: 3.33% plus Climate Change (+CC) (39%), 3.33%+CC (71%), 1%+CC (39%), and 1%+CC (71%) AEP events.

2.2.2 Only the baseline (pre-development) scenario has been modelled, as the proposed solar development does not involve significant changes to topography, land use, or drainage characteristics that would affect the modelled flood response.

2.2.3 As detailed in the accompanying FRA, the potential for floodwaters to interact materially with the solar PV panels or their supports is limited, as the development in impacted areas is raised above the design flood level with an appropriate freeboard allowance. Where Solar PV Panels are located within the 1% AEP plus climate change design flood extent, the lowest leading edge of the panels will be set no less than 600mm above the design flood level, with the final panel mounting height, tilt or tracker arrangement confirmed at detailed design. As a result, any associated displacement of floodplain storage is only associated with the solar panel supports and is considered negligible.

2.2.4 Therefore, the development is not expected to materially alter flood risk within the model domain and the implementation of specific flood compensation measures in these locations is not considered necessary or proportionate. As such, a proposed scenario assessment has not been carried out as a part of this modelling study.

2.3 Model Assumptions and Limitations

2.3.1 The hydraulic model has been developed using industry-standard methods in accordance with current EA guidance. Nevertheless, all models are simplifications of real-world systems, and several assumptions and limitations apply.

- **Topography and survey data:** The model topography is based on the EA LiDAR (1m resolution) DTM. This is assumed to be representative of current ground levels; however, small-scale features such as embankments, field boundaries, or minor channels that are below the resolution of the LiDAR DTM may not be fully captured. Following the addition of the aforementioned DTM adjustments, a desktop review of the catchment, and comparison with existing flood mapping dataset, the model is indicated to be performing appropriately.

- **Hydrological inputs:** Hydrological inflows were derived using ReFH2 rainfall-runoff modelling and FEH Statistical analysis in line with current EA guidance, with ReFH2 used to define hydrograph shape and FEH methods used to inform peak flow estimation. Catchment losses were not accounted for within the hydrological assessment and not represented explicitly within the hydraulic model. The design flows were applied at the model inflow location at the upstream extent of the model domain.

- **Downstream boundary condition:** The downstream water levels have been implemented in the model both in-channel and on the floodplain using a fixed water level over time, set at 69.00m AOD. This fixed water level was derived from the EA LiDAR DTM, based on the ground levels at the extent of the current EA Flood Zones. A water level of 69.00m AOD has been used to provide a conservative assessment of the downstream conditions. As this is a conservative approach, sensitivity testing has been undertaken to assess the influence of the downstream boundary on the site, with the downstream water levels being adjusted by ±300mm for the full duration of the time series.

- **Channel and Structure Geometry:** Following a desktop review of received data, the channel and structure cross-sections included in the channel survey were considered appropriate for use and so have been incorporated into this model. The route of the channel through the domain and between the cross sections included in the channel survey has been informed by the LiDAR DTM, which has been assumed to accurately represent the channel beds and banks. Following a review of the channel survey, it was noted that the upstream extent of structure 'ROD_02113' is included in the survey, however, the downstream extent has not been included in the survey. Given the structure comprises a small footbridge with a length of 3m and following a review of google satellite imagery and the LiDAR DTM, it has been assumed that the upstream cross-section is representative of the channel in the area and can be used as a proxy for the downstream cross-section.

- **Land Use:** Manning's roughness values have been assigned using typical roughness categories prescribed in Chow (1959)[1], and have also been informed by survey photographs, LiDAR texture and local land-use. Although roughness varies seasonally, the adopted values represent standard practice and are appropriate for design-event modelling. As discussed further below, sensitivity testing has also been completed on this hydraulic model, globally adjusting the roughness coefficients by ±20%.

2.4 Model Health and Stability

2.4.1 A review of the log files confirms that there are no comments, warnings or errors warranting attention.

2.4.2 There are no negative depths reported in any existing baseline simulations.

2.4.3 Mass balance error statistics show that the 1D model achieves between ±1% cumulative mass balance error for all existing baseline simulations.

2.4.4 The 2D mass balance error is shown to peak at -3.75% during some of the existing baseline simulations, notably at the initial wetting phase and at the end of the existing baseline model simulations, which is understood to be a result of the nature of the floodplain characteristics and sinuosity of the channel through the model. The model simulation results for each of the AEP events run during the existing baseline simulation phase show a similar nature of flooding throughout the model domain, and a comparison of these results against the EA Flood Map for Planning Flood Zone extents shows the modelled flood extents and nature of flooding is largely similar. This is indicative of the model's stability. Furthermore, the mass balance error during the simulation peak, which is at approximately 4.5 hours, is within the tolerable range of ±1%, thus indicating that the model is stable suitable to inform the Lime Down E2 FRA.

2.5 Results Summary

2.5.1 Model results show that during the 3.33% AEP event, there is overtopping of the channel banks of the Rodbourne Brook, and there is shallow depth flooding (<300mm) present within Lime Down E2.

[1] Chow, V.T. (1959) Open-Channel Hydraulics. McGraw-Hill, New York, NY.

2.5.2 During the 1%, 1%+CC (39%), and 0.1% AEP events, the general nature of the flood extents is shown to be similar to the 3.33% AEP event, with floodplain inundation across Lime Down E2 and the wider study area being relatively shallow, with depths typically less than 300mm for the majority of the flood plain.

2.5.3 For all the assessed AEP events, areas of greater flood depths are largely confined to the Rodbourne Brook watercourse corridor and the immediate overbank margins. The overall hydraulic response across the developable area is therefore considered to be characterised by shallow, low-energy overbank flow rather than deep and fast-flowing conditions.

2.5.4 Maximum flood depths and extents for the 3.33% AEP, 1%, 1%+CC (39%), and 0.1% AEP events are present in Figures 2, 3, 4 and 5, respectively. Additional details of flood depths within the site boundary, and potential impacts to the development proposals, are provided in the FRA.

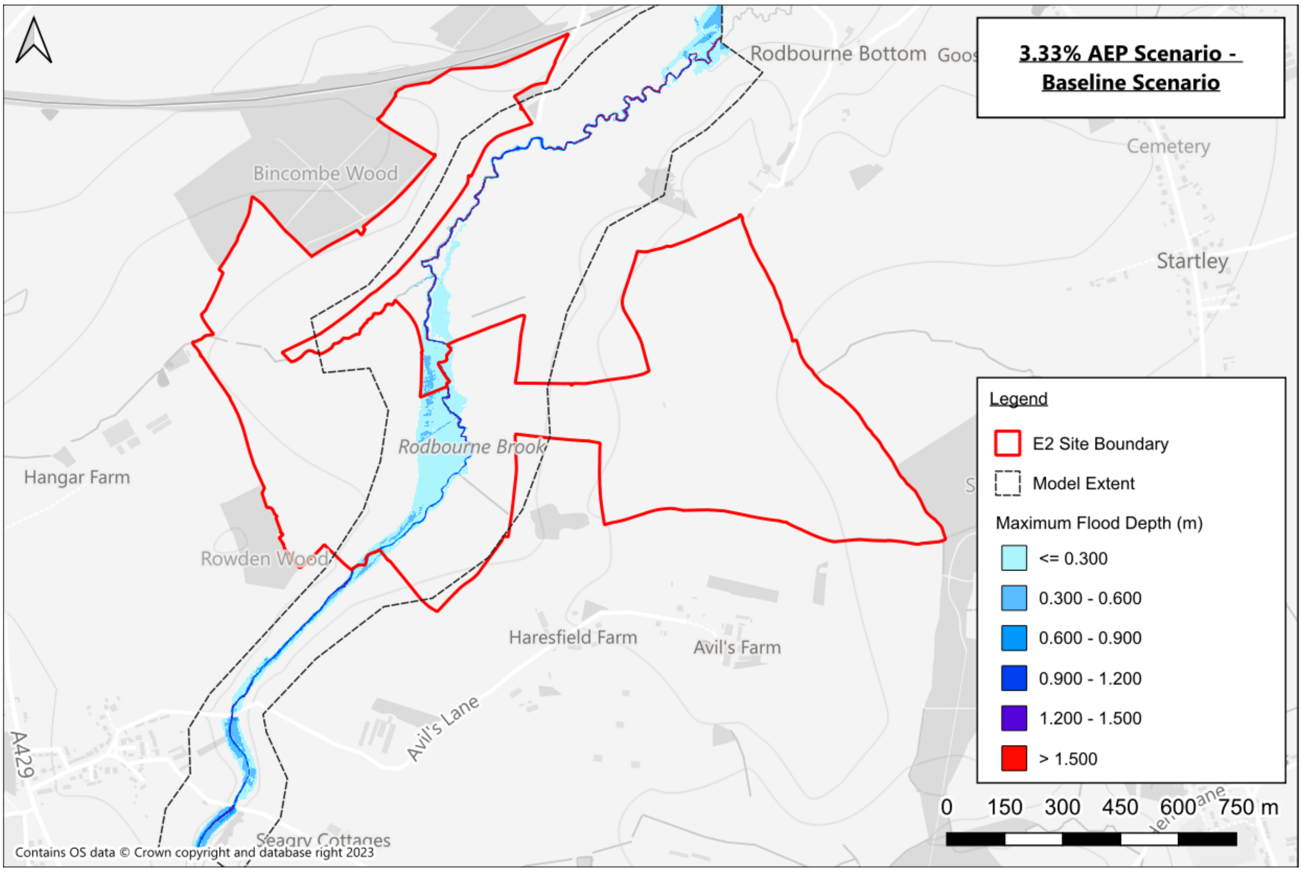

Figure 2: Maximum Flood Depths - 3.33% AEP - Baseline Scenario

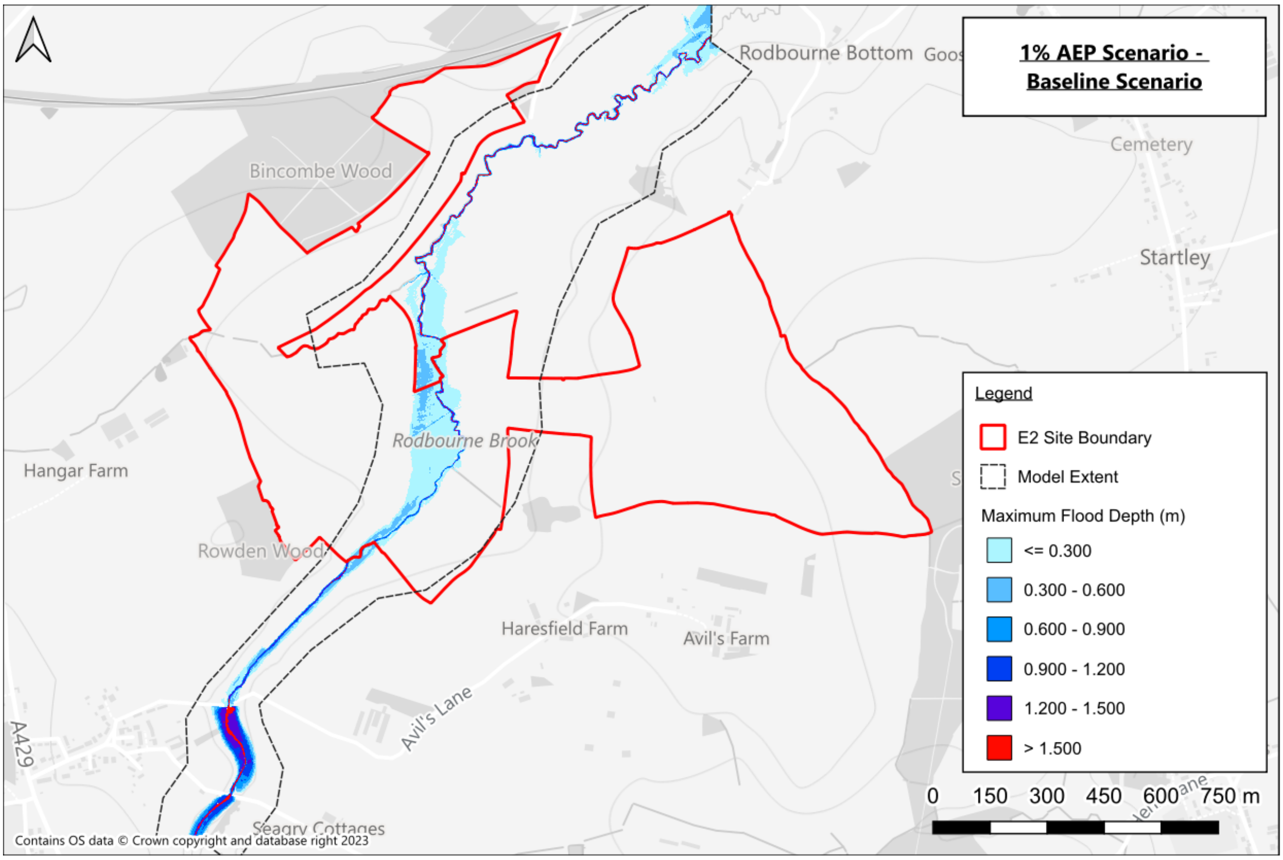

Figure 3: Maximum Flood Depths - 1% AEP Baseline Scenario

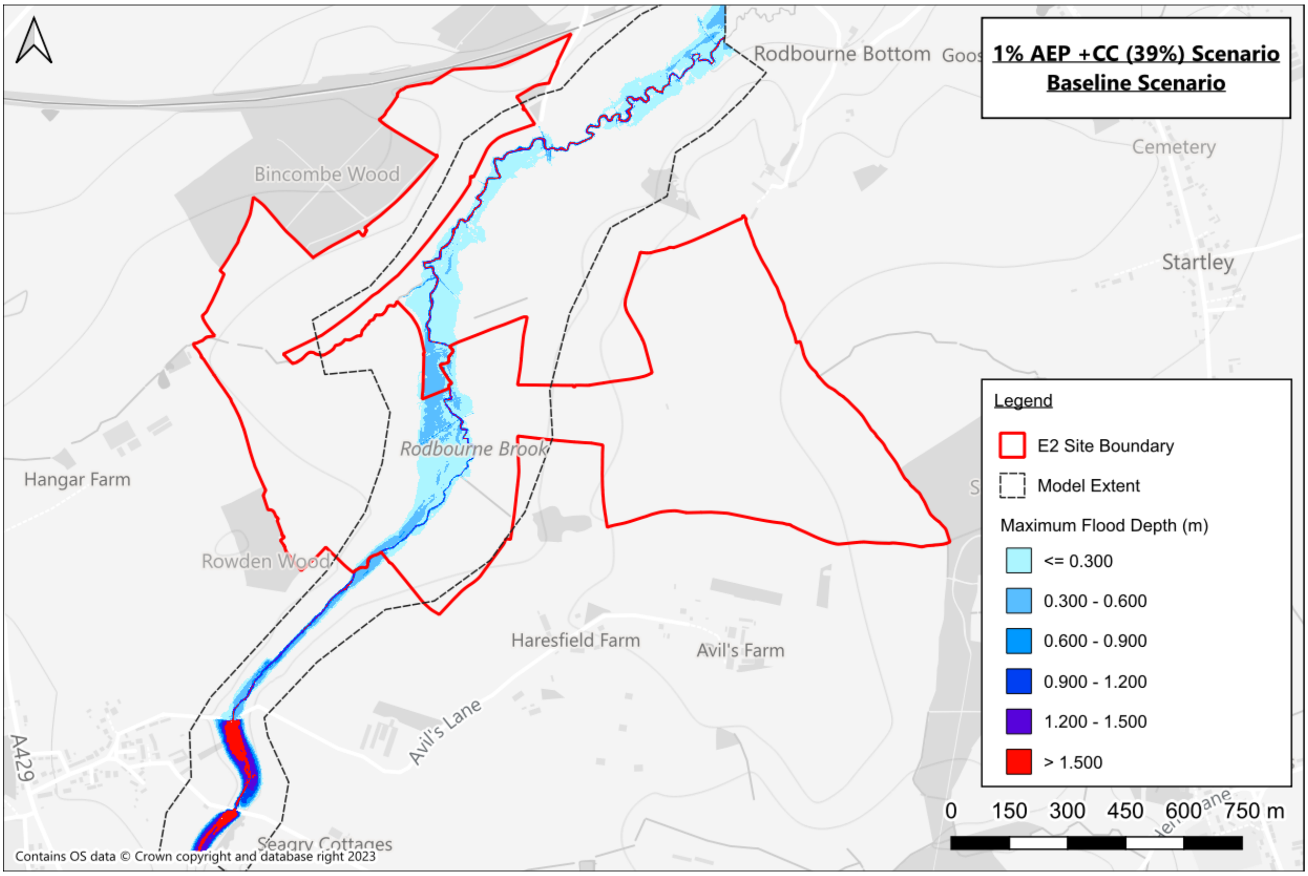

Figure 4: Maximum Flood Depths - 1% AEP +CC (39%) - Baseline Scenario

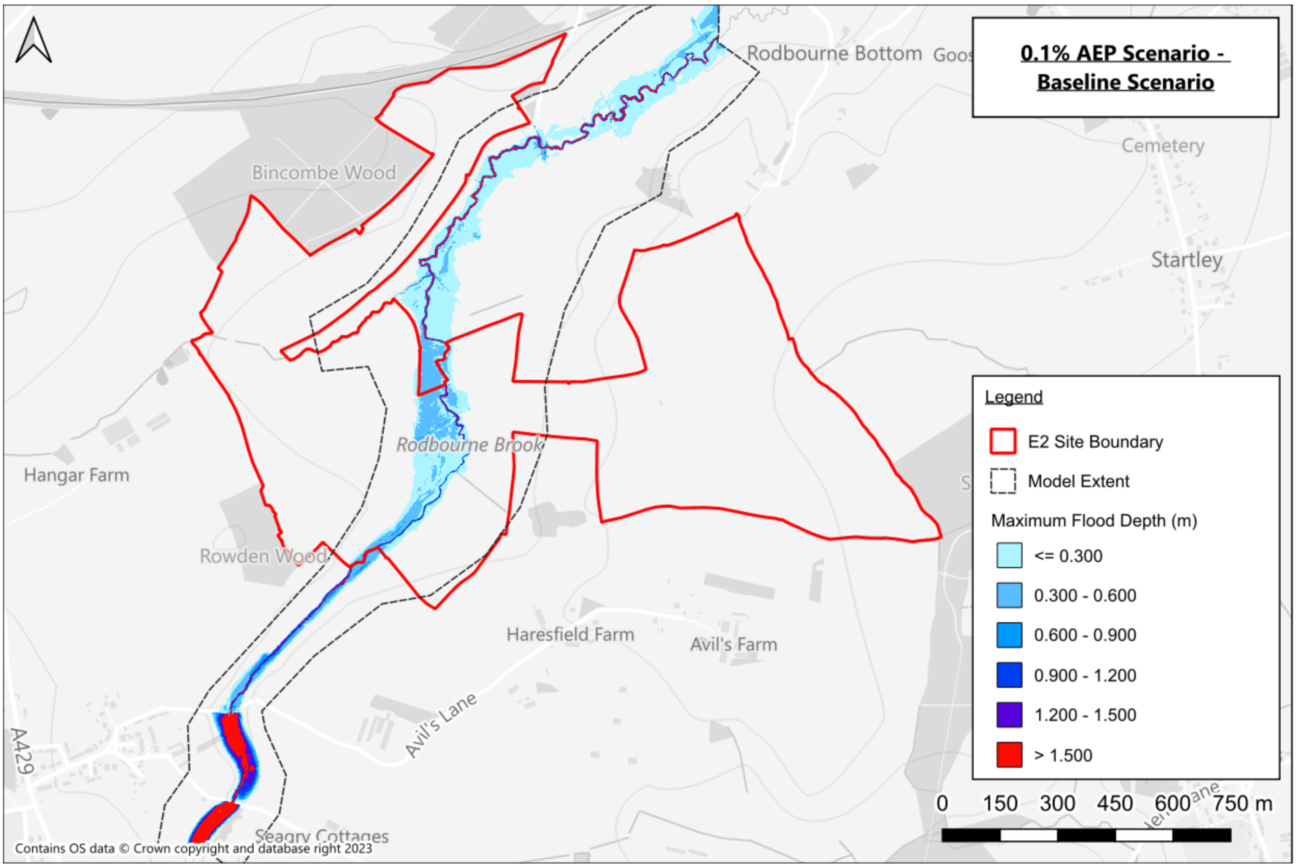

Figure 5: Maximum Flood Depths - 0.1% AEP - Baseline Scenario

2.6 Model Verification and Sensitivity Testing

2.6.1 A comparison has been undertaken between the modelled flood extents, including the 1% and 0.1% AEP modelled flood extents and the EA Flood Map for Planning Flood Zones 2 and 3 extents.

2.6.2 As illustrated in Figure 6, the results demonstrate a good overall level of agreement with regards to the spatial distribution of flooding and the general extent of inundation along the main watercourse corridor. There are minor localised differences present, which are expected given the differences in model resolution, topographic representation and underlying assumptions. However, there is no material conflict in the predicted floodplain behaviour across Lime Down E2, and so the site-specific modelling is considered to provide a robust and proportionate refinement of the strategic Flood Map for Planning dataset.

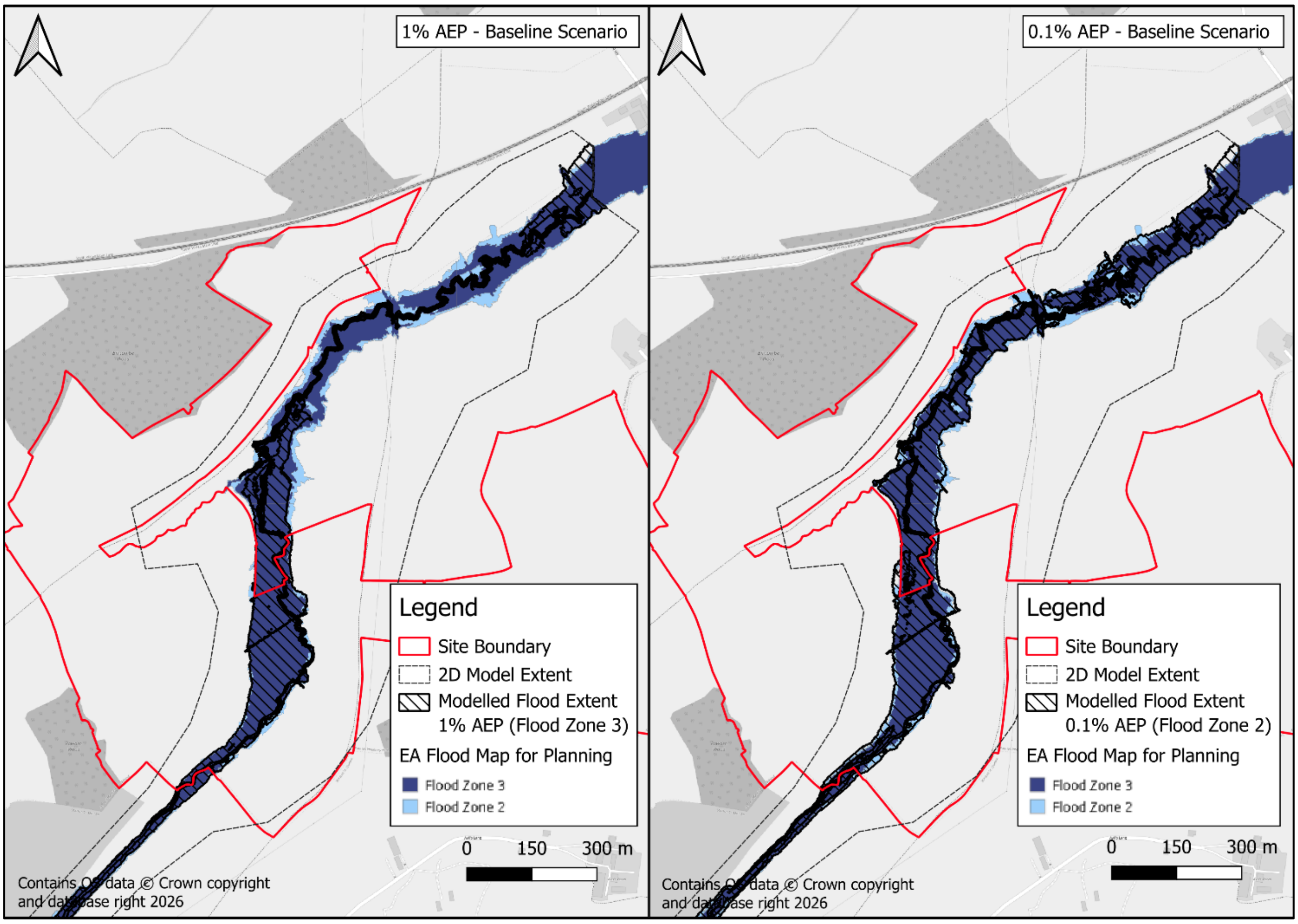

Figure 6: Flood Extent Comparison

2.6.3 Sensitivity testing was undertaken on key model parameters to assess the robustness of the results. The following variations were applied to the 1%+CC (39%) simulation:

- ST1 and ST2: Manning's roughness values across the model domain: ±20%
- ST3 and ST4: Flow inflow values: ±20%
- ST5 and ST6: Downstream boundary conditions fixed water level: ±300mm

2.6.4 The adopted sensitivity ranges (±20% for roughness and inflows, ±300mm for downstream boundary condition and outflow water levels) are considered proportionate and representative of reasonable uncertainty in hydrological estimation, roughness parameterisation and assumed structure geometry for a rural catchment of this scale.

2.6.5 Given the baseline downstream boundary fixed water level was set at 69.00m AOD, based on the EA Flood Map for Planning Flood Zone extents, a ±300mm variation was applied to the downstream boundaries water levels. This is considered to provide a meaningful test of boundary condition sensitivity while remaining within realistic hydraulic bounds.

2.6.6 The model outputs were not found to be particularly sensitive to any tested parameters, with relatively minor variations observed in peak flow and flood extents and depths for all tests across much of the model. This suggests that the model is reasonably robust to typical uncertainties in input data and configuration.

2.6.7 When applying a ±20% change to the Manning's roughness values across the model domain, the flood extents are shown to remain similar to the normal conditions scenario, with minor variations shown in the flood depths across the floodplain. When applying an uplift of ±20% to the Manning's roughness values, flood depths through Lime Down E2 are shown to typically vary by approximately ±100mm. The upstream extent of the model is shown to be more sensitive to alterations in Manning's roughness values, with depths shown to vary by ±200mm at this point.

2.6.8 With regards to applying an uplift of ±20% to the flow inflow values, the flood extents are shown to have a marginally greater extent when applying a 20% increase values, while extents decrease slightly in line with the 20% reduction in values. As the adopted design flows were derived in accordance with current Environment Agency guidance, these variations are considered to reflect reasonable hydrological uncertainty rather than indicate any deficiency in the baseline assessment.

2.6.9 When applying a ±300mm uplift to the downstream boundary, the flood extents and depths within the majority of the model domain are shown to remain the same as during the existing baseline simulations, with flood depths varying by ±<10mm. Flood extents and depths are shown to increase and decrease at the downstream extent of the model, corresponding to the location of the variation in the set level of the downstream boundary, with flood depths varying by ±300mm as expected.

2.6.10 As such, the sensitivity testing demonstrates that the model responds in a hydraulically realistic manner to changes in key parameters, while the principal conclusions regarding flood behaviour and depth across Lime Down E2 remain consistent. This model is therefore considered robust and appropriate for assessing flood risk for the study area.

3. Conclusions and Recommendations

3.1 Conclusions

3.1.1 In the absence of an existing EA hydraulic model of Rodbourne Brook, a site-specific 1D-2D hydraulic model has been developed to assess fluvial flood risk to Lime Down E2. This has been undertaken to inform the layout of the proposed solar farm development within Lime Down E2. The model has been constructed using detailed channel survey data, supported by EA LiDAR, and represents the hydraulic behaviour of the main watercourse and adjacent floodplain at a resolution proportionate to the scale and the catchment and the development.

3.1.2 Hydrological inputs were derived using ReFH2 rainfall-runoff modelling and FEH Statistical methods in accordance with current EA guidance, with conservative FEH Statistical peak flows adopted. Inflows were applied using a catchment-based approached, and the model configuration incorporates appropriate boundary conditions, structures and parameterisation to simulate both in-channel and overbank processes. Model health checks, mass balance performance and numerical stability testing indicate that the model performs reliably and is suitable for assessment purposes.

3.1.3 Predicted flooding across Lime Down E2 is relatively shallow for all events, with depths typically less than 500mm across Lime Down E2 during all simulated events. There are some areas within Lime Down E2 with depths up to 800m, which are contained within onsite topographical low spots such as small onsite ditches. Areas susceptible to greater flood depths are largely confined to the existing watercourse corridor and immediately adjacent topographically low-lying areas. The overall hydraulic response across the developable area is characterised by shallow, low-energy overbank flooding as opposed to deep or fast-flowing conditions.

3.1.4 Comparison of the modelled flood extents with the EA Flood Map for Planning, inclusive of the projected extents when accounting for climate change, shows very good overall agreement, indicating that the model provides an appropriate refinement of the strategic mapping for this location. Furthermore, sensitivity testing demonstrates that the model responds realistically to variations in key parameters.

3.1.5 On this basis, the hydraulic modelling provides a robust and proportionate technical evidence base for defining flood risk within Lime Down E2, informing the proposed solar farm development and assessing fluvial flood risk to the proposed development, and informing the FRA's findings.

3.2 Recommendations

3.2.1 The modelling results indicate that flood risk across the developable area is dominated by shallow fluvial flooding. It is recommended that the development layout continues to consider these findings, including appropriate siting, finished levels and management of residual flood risk in accordance with national planning policy and EA guidance.

Appendices

Appendix A- Limitations

Limitations

This report contains recommendations from Arthian, which are based on the information listed in the report and reflect the professional opinions of an experienced Environmental Consultant. Arthian obtained, reviewed, and evaluated information from the Client and others to prepare this report. The conclusions, opinions, and recommendations presented in this report are based on this information. However, Arthian does not guarantee the accuracy of the information provided and will not be held responsible for any opinions or conclusions reached based on information that is later proven to be inaccurate.

This report was prepared exclusively for the Client and for the specific purpose for which Arthian was instructed. It is not intended for use by anyone other than the Client without Arthian's written consent. Any unauthorized use of this report is at the sole risk of the user. Anyone using or relying on this report, other than the Client, agrees to indemnify and hold harmless Arthian from any claims, losses, or damages arising from the performance of the work by the Consultant.

Appendix B – FEH Calculation Record

Annex B - Flood Estimation Handbook (FEH) Proforma

For: Island Green Power UK Ltd

Site: Lime Down Solar Farm Parcel E2

Date: 10/07/2026

Document Ref: 320560

Issue-01

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Quality Assurance

Issue Record

Revision	Description	Date	Author	Reviewer	Approver
V1.0	Final	10/07/2026	JE	DH	DH

Initials	Name	Position	Signature
JE	[redacted]	Senior Flood Risk and Drainage Consultant	[redacted]
DH		Technical Lead, Water Environment	

Contents

Abbreviations

AEP	annual exceedance probability
AM	Annual Maximum
AREA	Catchment area (km^2)
BFI	Base Flow Index
BFIHOST	Base Flow Index derived using the HOST soil classification
CPRE	Council for the Protection of Rural England
FARL	FEH index of flood attenuation due to reservoirs and lakes
FEH	Flood Estimation Handbook
FSR	Flood Studies Report
HOST	Hydrology of Soil Types
NRFA	National River Flow Archive
OS	Ordnance Survey
POT	Peaks Over a Threshold
QMED	Median Annual Flood (with return period 2 years)
ReFH	Revitalised Flood Hydrograph method
ReFH2	Revitalised Flood Hydrograph 2 method
SAAR	Standard Average Annual Rainfall (mm)
SPR	Standard percentage runoff
SPRHOST	Standard percentage runoff derived using the HOST soil classification
Tp(0)	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	Revised index of urban extent, measured differently from URBEXT1990
WINFAP-FEH	Windows Frequency Analysis Package – used for FEH statistical method

1. Summary of Assessment

1.1 Summary

Catchment location	The study catchment for Rodbourne Brook is located in the Avon Bristol and North Somerset Streams Management Catchment, northeast of Bristol and west of Swindon. The catchment flow estimation point is located at National Grid Reference (NGR) ST 93448 82763, just south of Rodbourne.
Purpose of study and scope	Hydrological analysis has been carried out to derive peak flow estimates for Rodbourne Brook. This study aims to derive peak flow estimates for a range of AEP events to inform hydraulic modelling of the watercourse.
Key catchment features	Key catchment characteristics for Rodbourne Brook are outlined below: • The catchment predominantly consists of rural land. Stanton St Quinton falls within the catchment and makes up the majority of the small extent of urban area; • No Notable tributaries are located along Rodbourne Brook for the study area. One minor tributary is located downstream of Lower Stanton St Quinton, which falls within the corresponding hydraulic model study area; • The catchment has a moderate gradient with a generally consistent profile along its length; • Catchment geology comprises a mix of moderately permeable and impermeable soils, consisting of slowly permeable seasonally wet loamy and clayey soils with impeded drainage or shallow soils over limestone; and, • No notable reservoirs or larger waterbodies are located in the catchment.
Flooding mechanisms	Flood mapping from the EA’s NAFRA2 dataset indicates that flooding along Rodbourne Brook is largely confined to the low lying land immediately adjacent to the channels, reflecting the generally channelised nature of the watercourses and the capacity of the adjoining functional floodplain to contain out of bank flows.

Gauged / ungauged	No river gauge stations are located along the study watercourse.
Final choice of method	The statistical method is preferred for peak flow estimates.
Key limitations / uncertainties in results	As the catchment is ungauged and there is inherent uncertainty in the estimated QMED value.

1.2 Note on Flood Frequencies

The frequency of a flood can be quoted in terms of a return period, which is defined as the average time between years with at least one larger flood, or as an annual exceedance probability (AEP), which is the inverse of the return period.

The results presented in this document are quoted in terms of return period. The table below provides a quick conversion between return periods and annual exceedance probabilities.

AEP (%)	50	20	10	5	4	3.33	0	1.33	1	0.5	0.2	0.1
Return Period (yrs)	2	5	10	20	25	30	50	75	100	200	500	1000

2. Method Statement

2.1 Requirements for Flood Estimates

Overview	This study aims to derive peak flow estimates for Rodbourne Brook for a range of AEP events to inform hydraulic modelling of the watercourse. The study catchment for Rodbourne Brook is located in the Avon Bristol and North Somerset Streams Management Catchment, northeast of Bristol and west of Swindon
Project Scope	Peak flow estimates are required at a flow estimation point (RB01) located at NGR ST 93448 82763.

2.2 The Catchment

Description	The FEH derived catchment for Rodbourne Brook drains an area of 27.92km^2. The FEH catchments for the flow estimation points are illustrated in Annex B1. The Rodbourne Brook catchment predominantly consists of rural land. Stanton St Quinton falls within the catchment and makes up the majority of the small extent of urban area. The catchment has a moderate gradient with a generally consistent profile along its length. Catchment geology comprises a mix of moderately permeable and impermeable soils, consisting of slowly permeable seasonally wet loamy and clayey soils with impeded drainage or shallow soils over limestone. No notable reservoirs or larger waterbodies are located in the catchment.

2.3 Source of Flood Peak Data

Overview	NRFA peak flows dataset, Version 14.0.1, released August 2025. This contains data up to water year 2024.

2.4 Gauging Stations (flow or level)

Watercourse	Station Name	Gauging Authority Number	NRFA Number	Catchment area (km^2)	Type (rated / ultrasonic / level...)	Start of record and end if station closed
The Rodbourne river gauge station (53020 Gauze Brook @ Rodbourne) is located a short distance downstream of the study area downstream of Rodbourne Brooks confluence with the River Avon. However, this station is designated as a low flow station to monitor the impact of groundwater abstraction/recharge on river flow and is not indicated as being suitable for QMED estimates or pooling. Rodbourne is therefore considered to be ungauged within the study area.						

2.5 Data Available at Gauging Stations

Station Name	Start and end of NRFA flood peak record	Updated for this study?	Suitable for QMED?	Suitable for Pooling?	Data quality check needed?	Other comments on station and flow data quality
No gauge data available.						

2.6 Rating Equations

Station Name	Type of rating	Rating review needed?	Comments and link to any rating reviews
No gauge data available.			

2.7 Other Data Available

Type of data	Data relevant to this study?	Data available?	Source of data	Details
Check flow gaugings (if planned to review ratings)	Yes.	No.	N/A.	N/A.
Historical flood data	Yes.	No.	N/A.	N/A.
Flow or river level data for events	Yes.	No.	N/A.	N/A.
Rainfall data for events	Yes.	No.	N/A.	N/A.
Potential evaporation data	No.	No.	N/A.	N/A.
Results from previous studies	Yes.	No.	N/A.	N/A.
Other data or information	No.	No.	N/A.	N/A.

2.8 Hydrological Understanding of Catchment

Plots of flow data and interpretation	No gauge data available.
Plots of flood peak data and interpretation	

Unusual catchment features	Rodbourne Brook is predominantly rural, covers an area with soils of mixed permeability, has a moderate gradient, and no notable reservoirs of large waterbodies are located within the catchment. No unusual catchment features are noted for the study area.

2.9 Initial Choice of Approach

Is FEH appropriate?	Yes.
Initial choice of method(s) and reasons **How will hydrograph shapes be derived if needed?** **Will the catchment be split into subcatchments? If so, how?**	Both the Statistical and ReFH2 methods are appropriate noting no significant influence from attenuation within the catchment. A single lumped sum peak flow estimates have been produced for Rodbourne Brook (RB01) noting no notable tributaries are present within the study area. The watershed catchment used to inform the lumped sum estimate is illustrated in Annex B1.

Software to be used (with version numbers)	FEH Web Service[1] / WINFAP 5.3[2] / ReFH2.3.

[1] CEH 2015. The Flood Estimation Handbook (FEH) Online Service, Centre for Ecology & Hydrology, Wallingford, UK.
[2] WINFAP 5.3 © Wallingford HydroSolutions Limited 2012.

3. Locations of Flood Estimates

3.1 Summary of Subject Sites

The table below lists the locations of subject sites. The site codes listed below are used in all subsequent tables.

Site code	Type of estimate L: Lumped catchment AW: Area Weighted	Watercourse	Description of site	Easting	Northing	AREA on FEH Webservice (km^2)	Revised AREA if altered
RB01	L	Rodbourne Brook	Rural catchment	393400	182750	27.92	27.72

3.2 Important Catchment Descriptors at Each Site

Site code	FARL2015	PROPWET	BFIHOST2019 Scaled	DPLBAR (km)	DPSBAR (m/km)	SAAR 9120 (mm)	URBEXT2015	FPEXT
RB01	0.99	0.34	0.653	7.75	24.8	852	0.018	0.104

3.3 Check Catchment Descriptors

Record how catchment boundary was checked and describe any changes	Initial catchment extents were generated by FEH web service. Rolling ball analysis, using 1m EA LiDAR data, was performed in QGIS to confirm the rural extents for the catchment. This assessment showed a negligible change in catchment area for RB01. The FEH catchment and updated catchment area are illustrated in in Annex B1.

	Given the rural nature of the study catchment, the catchment boundary has been validated against available topographical data, which should reasonably represent the true contributing area. In the absence of significant urban development, sewer networks are unlikely to extend or reduce the topographic catchment, and therefore are not expected to materially influence the delineation. Given the mix of permeable and impermeable geological conditions across the catchment, flow behaviour is not expected to be materially influenced by groundwater conditions or by any potential differences between the topographic catchment and the groundwater body catchment. As such, the delineated surface water catchment is considered an appropriate representation of the contributing area for hydrological assessment.
Record how other catchment descriptors were checked and describe any changes.	Aerial mapping, LiDAR data and British Geological Survey mapping were used to reconfirm the suitability of remaining existing catchment descriptor values. Given the negligible change in catchment area, and based on a review of the aforementioned data, the existing descriptors are considered to continue to provide a reasonable representation of catchment characteristics.
Source of URBEXT	URBEXT2015.
Method for updating of URBEXT	URBEXT2015 was updated to 2025 using the formula outlined in The FEH 2025 Statistical Method Update (v1.2).

4. Statistical Method

4.1 Application of Statistical method

What is the purpose of applying this method?	To derive peak flow estimates for a range of AEP events for Gauze Brook and for comparison against ReFH2 peak flow estimates.

4.2 Overview of estimation of QMED at each subject site

Site code	QMED (rural) from CDs (m^3/s)	Final method	Data transfer				Urban Adjustment Factor, UAF	Final estimate of QMED (m^3/s)
			NRFA numbers for donor sites (see 4.3)	Distance between centroid, d_{sg} (km)	Moderated QMED adjustment factor, (A/B)[a]	If more than one donor Weighted ave. adjustment		
RB01	3.41	DT	8	-	-	1.168	Study catchment is rural. UAF not applied.	3.98
Are the values of QMED spatially consistent?						NA. Single peak flow estimate point.		
Method used for urban adjustment for subject and donor sites						WINFAP v5.3[3]		

[3] WINFAP 5.3 Urban adjustment procedures.

4.3 Search for donor sites for QMED (if applicable)

Comment on potential donor sites	WINFAP5 was used to identify suitable donors and a review of WINFAP's initial selection for the catchment was carried out and suitability of potential donor sites considered. Station 53008 (Avon @ Great Somerford) was initially considered as the sole donor station due to its close proximity, its location within the same wider watershed catchment, and its broadly comparable SAAR, FARL2015 and BFIHOST19Scaled values. However, although the station shares similar catchment characteristics, its catchment area is substantially larger than both the study catchment. As the default donor station selection provides a set of gauges with a range of contributing areas closer to the study catchment, this provides greater confidence that a QMED adjustment ratio appropriately reflecting local hydrological behaviour is captured. Retaining the default set of eight donor stations also represents a precautionary approach, as it results in a larger adjusted QMED estimate, ensuring conservatism in subsequent flow calculations. Noting the above, WINFAP's default donor station selections have been retained. Default donor sites are outlined in Section 4.4 below.

4.4 Donor sites chosen and QMED adjustment factors

NRFA no.	Method (AM or POT)	Adjustment for climatic variation?	QMED from flow data (A)	QMED from catchment descriptors (B)	Adjustment ratio (A/B)
53008	AM	No	39.241	29.495	1.291
53023	AM	No	7.396	6.610	1.086
53028	AM	No	10.703	8.252	1.236
53017	AM	No	13.946	9.856	1.363
39037	AM	No	3.183	3.180	0.941
43017	AM	No	5.486	2.967	1.726
43028	AM	No	1.965	1.783	1.087

NRFA no.	Method (AM or POT)	Adjustment for climatic variation?	QMED from flow data (A)	QMED from catchment descriptors (B)	Adjustment ratio (A/B)
43014	AM	No	3.844	4.416	0.821

4.5 Derivation of Pooling Groups

Name of group	Site code from whose descriptors group was derived	Subject site treated as gauged? (enhanced single site analysis)	Changes made to default pooling group, with reasons	Weighted average L-moments L-CV and L-skew (before urban adjustment)
RB01	RB01	No	Several sites removed due to high BFIHOST values, negative skew, and high discordancy. The adjusted pooling group gives improved distribution fit and greater growth curve values.	L-CV: 0.276 L-SKEW: 0.193
Note: Pooling groups were derived using the redeveloped pooling method outlined in The FEH 2025 Statistical Method Update (June 2025).				

4.6 Derivation of flood growth curves at subject sites

Site code	Method (SS, P, ESS, J)	If P, ESS or J, name of pooling group	Distribution used and reason for choice	Note any urban adjustment or permeable adjustment	Parameters for distribution (location, scale and shape after adjustments)	Growth factor for 100-year return period
RB01	P	RB01	General logistic – gives larger growth curve values.	NA. Study catchment is rural. Pooling group stations have low percentage of non-flood years.	Location: 1 L-CV: 0.276 L-SKEW: 0.193	3.09

Notes:

Methods: SS – Single site; P – Pooled; ESS – Enhanced single site; J – Joint analysis. Urban adjustments are all carried out using the method of Kjeldsen (2010). Growth curves were derived using the procedures from Science Report SC050050 (2008).

4.7 Flood Estimates from Statistical Method

Site code	Flood peak (m^3/s) for the following return periods (in years)										
	2	5	10	20	25	30	50	75	100	200	1000
RB01	3.98	5.76	7.05	8.43	8.91	9.31	10.51	11.54	12.32	14.38	20.38

Site code	Flood peak (m^3/s) for the following return periods (in years)	
	100 +CC(39%)	100 +CC(71%)
RB01	17.12	21.07

5. Revitalised Flood Hydrograph 2 (ReFH2) method

5.1 Application of the ReFH2 method

What is the purpose of applying this method?	To derive peak flow estimates for a range of AEP events for Rodbourne Brook and for comparison against ReFH2 peak flow estimates.

5.2 Parameters for ReFH2 model

Site code	Method	Tp (hours)	Cmax (mm)	PR_{imp} % runoff for impermeable surfaces	BL (hours)	BR*
RB01	CD	7.63	607.80	70	61.30	2.53
Brief description of any flood event analysis carried out	NA.					
Methods: OPT: Optimisation, BR: Baseflow recession fitting, CD: Catchment descriptors, DT: Data transfer (give details)						

* For the 100 year scenario

5.3 Design events for ReFH2 method: Lumped catchments

Site code	Urban or rural	Season of design event (summer or winter)	Storm duration (hours)	Reason for selecting storm duration

RB01	Rural	Winter	13.00	An assessment of a range of storm durations for the study catchments shows a small variation in peak flow estimates. Default critical duration of 13 hours retained.

5.4 Flood estimates from the ReFH2 method

Site code	Flood peak (m^3/s) for the following return periods (in years)										
	2	5	10	20	25	30	50	75	100	200	1000
RB01	2.36	3.10	3.68	4.35	4.60	4.81	5.49	6.12	6.60	7.89	11.31

ite code	Flood peak (m^3/s) for the following return periods (in years)	
	100 +CC(39%)	100 +CC(71%)
RB01	9.17	11.29

6. Discussion and summary of results

6.1 Comparison of results from different methods

Site code	2 year			100 year		
	Statistical peak flow (m^3/s)	ReFH2 peak flow (m^3/s)	Ratio (Stats/ReFH2)	Statistical peak flow (m^3/s)	ReFH2 peak flow (m^3/s)	Ratio (Stats/ReFH2)
RB01	3.98	2.36	1.69	12.32	6.60	1.87

6.2 Final choice of method

Choice of method and reasons	The Statistical method is preferred. While it provides a comparable growth curve estimate, it provides more liberal estimates of QMED, offering a precautionary basis for design. As the Statistical method QMED estimate is derived from observed gauge data rather than solely from catchment descriptor based estimates, there is greater confidence that they more accurately reflect the catchment's hydrological behaviour. Given the rural nature of catchment, rural peak flow estimates have been taken forwards. The Final pooling group is provided in Annex B2. Growth curve and flood frequency curve comparison plots are provided in Annex B3.

How will the flows be applied to a hydraulic model?	Peak flow estimates have been used to derive hydrographs for the study catchment, which will be applied to the hydraulic model upstream inflows and lateral inflows. As the Statistical method has been selected as the preferred approach, the associated storm duration and hydrograph profile have been based on those generated by the ReFH2. Given the rural nature of catchment, rural peak flow estimates and winter storm duration and profile has been taken forwards. The application of RB01 peak flow estimates will be applied at the head of Rodbourne Brook within the hydraulic model extent. Additional details outlining the application of hydrographs are providing in the hydraulic modelling note.

6.3 Assumptions, limitations and uncertainty

List the main assumptions made (specific to this study)	• It is assumed the default ReFH2 parameters for Tp scaling factor are suitable for this study. • It is assumed that a uniform storm duration is appropriate.

	• It was not possible to sensibility check catchment boundaries on the ground. It is assumed that the catchment boundaries, checked using LiDAR and OS mapping, are accurate. • It is assumed that all the gauging stations used in the analysis are stationary. Non-stationarity has not been considered in the analysis. • It is assumed the groundwater catchment extent mirrors the topographical catchment.
Discuss any particular limitations	The lack of gauge data is a limitation to providing confidence in the flow estimates.
Provide information on the uncertainty in the design peak flow estimates and the methodology used	The lack of gauge data for the study catchments leads to increased uncertainty in the derived peak flows. Uncertainty in peak flow estimates is discussed further in Section 6.6.
Comment on the suitability of the results for future studies	The results could be easily replicated and/or updated for future studies in the study catchments. However, the results of the analysis should be considered in the context of the needs of this study. Future users of this assessment should, at the very minimum, satisfy themselves that the flows are suitable for use in their work. Site specific studies may require new estimates. Additionally, if hydrometric data becomes available or the methods are updated, the estimates should be revisited.
Give any other comments on the study	No additional comments.

6.4 Checks

Are the results consistent, for example at confluences?	Lumped approach.

What do the results imply regarding the return periods / frequency of floods during the period of record?	No gauged record available for Rodbourne Brook.
What is the range of 100-year growth factors? Is this realistic?	100-year growth factors fall in typical range and realistic.
If 1000-year flows have been derived, what is the range of ratios for 1000-year flow over 100-year flow?	The 1000/100 ratio for the statistical method and ReFH2 method are outlined below.
How do the results compare with those of other studies? Explain any differences and conclude which results should be preferred.	No previous study is available for comparison.
Are the results compatible with the longer-term flood history?	No detailed historic flood data is available for comparison.
Describe any other checks on the results,	NA.

Site Code	Statistical 1000/100 ratio	ReFH2 1000/100 ratio
RB01	1.66	1.71

6.5 Final Results

Site code	Method	Flood peak (m^3/s) for the following return periods (in years)										
		2	5	10	20	25	30	50	75	100	200	1000

RB01	Stats	3.98	5.76	7.05	8.43	8.91	9.31	10.51	11.54	12.32	14.38	20.38

Site code	Flood peak (m^3/s) for the following return periods (in years)	
	100 +CC(39%)	100 +CC(71%)
RB01.06	17.12	21.07

6.6 Uncertainty

Uncertainty in peak flow estimates	Uncertainty is not currently shown for pooled analysis in WINFAP5, except for the factorial standard error (fse) of QMED. As outlined in the UK Centre for Ecology and Hydrology *Uncertainty in FEH Methods* (Issue 2), applying the donor transfer method provides a notable reduction in FSE, with the use of multiple donor stations offering a clear advantage over using no donors. In the absence of site-specific gauge data to support single site or enhanced single site analysis, the default eight donor stations have been retained to provide greater confidence in the QMED estimate and the resulting flood frequency curve. While there may be some variation in the ‘true’ peak flow estimate values, those outlined in this report are considered likely to be near the estimates reported in Section 6.5.

If flood hydrographs are needed for the next stage of the study, where are they provided?	Full hydrographs are provided in hydraulic modelling files.

Annex B1 – Study Catchments

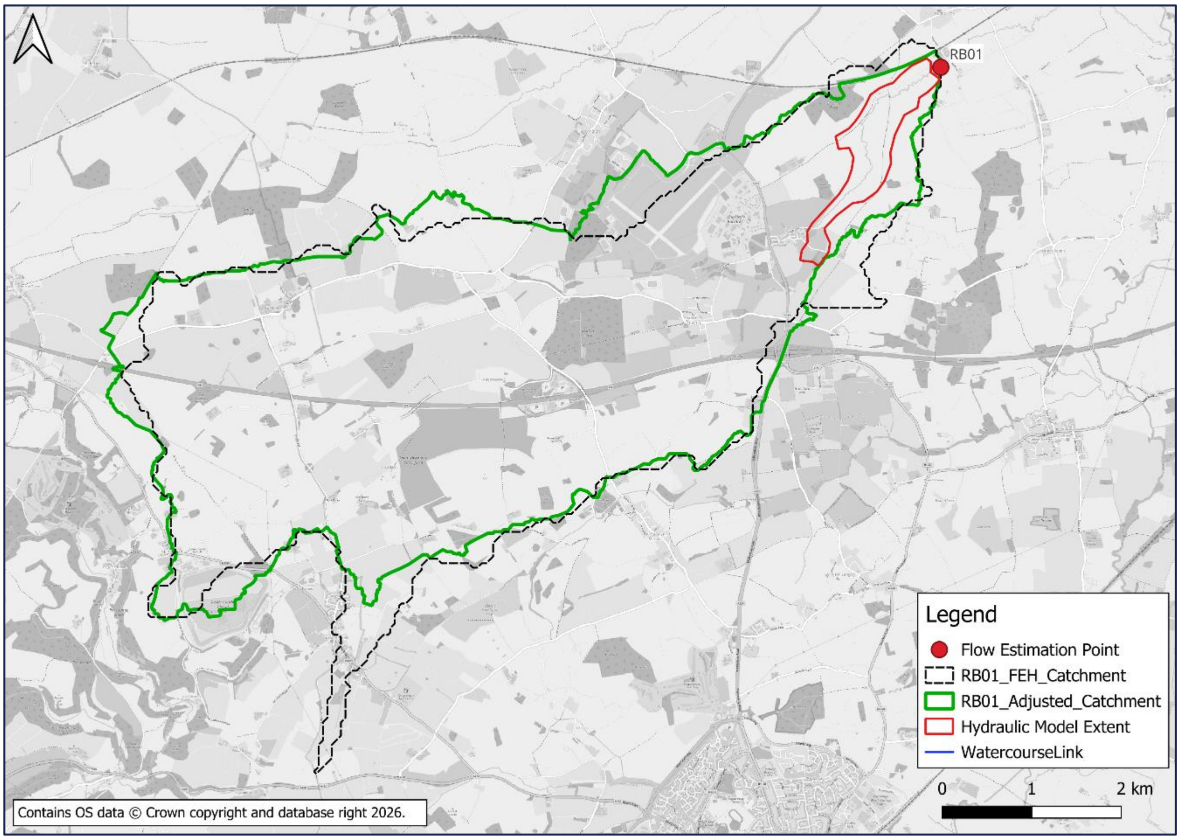

Figure 1: Study Catchment

Annex B2 – Pooling Groups

Table 1: RB01 Adjusted Pooling Group

RD01 Adjusted Pooling Group							
Station	Distance (SDM)	Years of data	QMED AM	L-CV Observed	L-CV Deurbanised	L-SKEW Observed	L-SKEW Deurbanised
7009 (Mosset Burn @ Wardend Bridge)	0.814	26	7.486	0.358	0.358	0.324	0.324
7011 (Black Burn @ Pluscarden Abbey)	1.098	12	4.752	0.474	0.474	0.558	0.558
53023 (Sherston Avon @ Fosseway)	1.216	48	7.396	0.231	0.232	0.133	0.133
7010 (Muckle Burn @ Brodie)	1.274	19	17.674	0.219	0.219	0.153	0.153
53017 (Boyd @ Bitton)	1.281	51	13.946	0.235	0.239	0.084	0.084
43014 (East Avon @ Upavon East)	1.32	54	3.844	0.214	0.216	0.08	0.08
30004 (Lymn @ Partney Mill)	1.36	62	7.184	0.225	0.227	0.029	0.029
39042 (Leach @ Priory Mill Lechlade)	1.413	52	3.2	0.194	0.195	0.064	0.064
27073 (Brompton Beck @ Snainton Ings)	1.431	44	0.816	0.213	0.215	0.025	0.025
39033 (Winterbourne Stream @ Bagnor)	1.436	62	0.401	0.346	0.348	0.39	0.39
9006 (Deskford Burn @ Cullen)	1.467	14	19.727	0.293	0.293	0.119	0.119
41022 (Lod @ Halfway Bridge)	1.52	54	16.755	0.29	0.292	0.157	0.157
44003 (Asker @ Bridport)	1.579	14	12.354	0.224	0.226	0.17	0.17
44011 (Asker @ Bridport East Bridge)	1.579	29	16.566	0.216	0.218	0.136	0.136
27095 (Pickering Beck @ Pickering)	1.598	24	7.734	0.291	0.292	0.299	0.299
54036 (Isbourne @ Hinton on the Green)	1.62	52	13.996	0.321	0.325	0.298	0.298
20007 (Gifford Water @ Lennoxlove)	1.646	51	17.28	0.304	0.305	0.175	0.175
51001 (Doniford Stream @ Swill Bridge)	1.656	56	13.094	0.311	0.314	0.352	0.352
73015 (Keer @ High Keer Weir)	1.689	34	12.59	0.201	0.202	0.174	0.174
25019 (Leven @ Easby)	1.695	46	5.384	0.337	0.337	0.367	0.367

Weighted Means	0.0734
H2 Value	5.1668

Goodness of Fit	Generalised Logistic	Generalised Extreme Value	Kappa 3
	1.5908	-0.9682	-6.7352

Annex B3 – Data Comparison

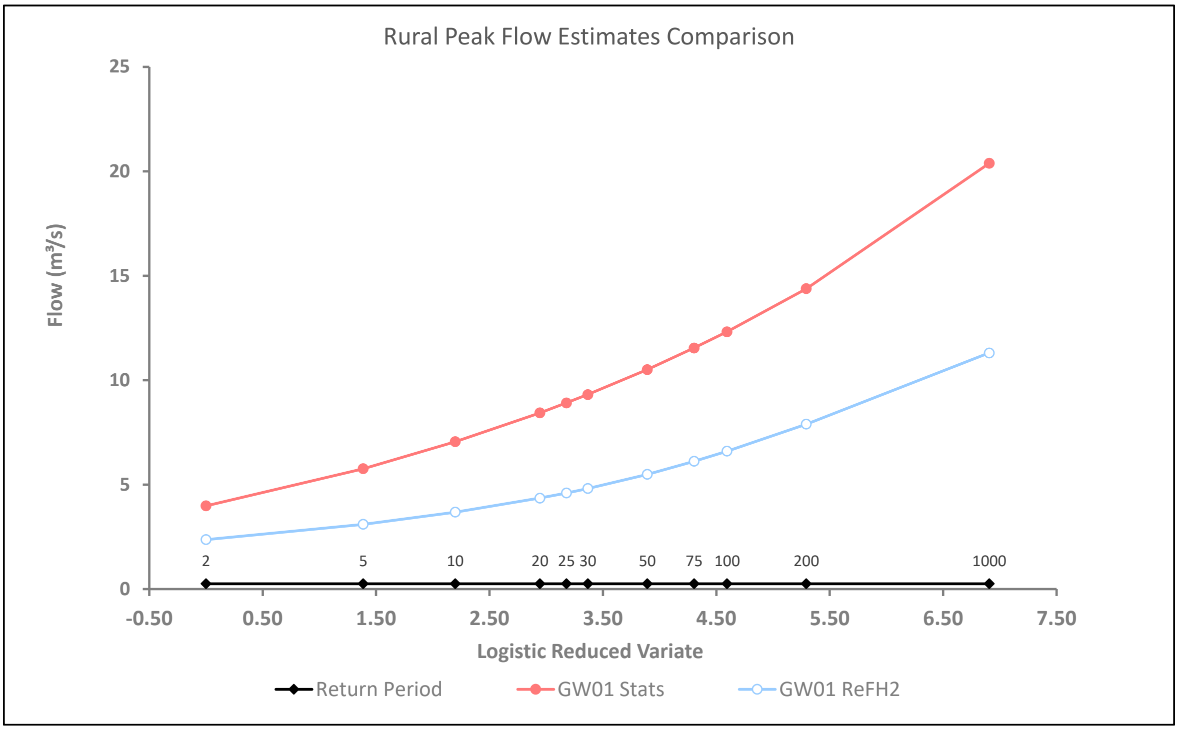

Figure 2: Rural Peak Flow Estimates Comparison

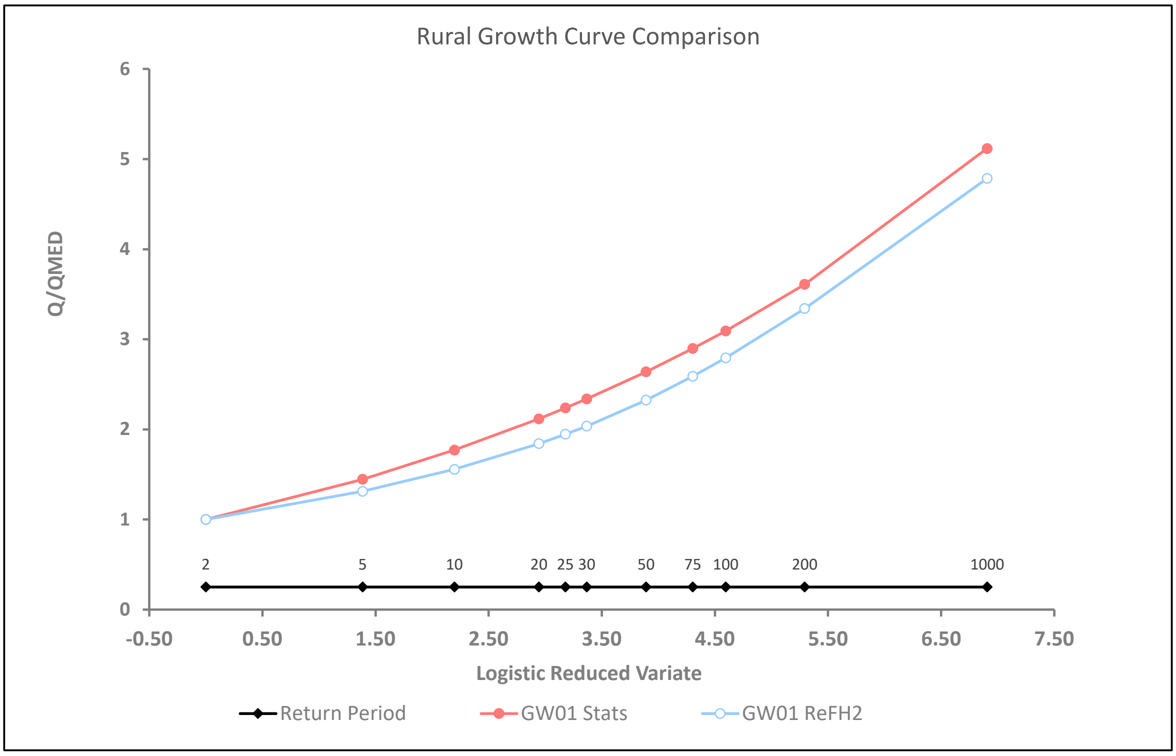

Figure 3: Rural Growth Curve Comparison