Appendix D

Flood Model Summary

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MODEL PARAMETERS

Introduction

As no existing modelled data was available for the undesignated watercourses at the site, a coarse hydraulic model suitable to the scale and nature of the proposed development and associated risk, was developed for the site. An Infoworks ICM linked 1D-2D model has been developed for the site, allowing more accurate determination of flood levels and extents at the site.

HYDROLOGICAL ASSESSMENT

The estimation of peak flow for the required design annual probability has been necessary to determine the peak inflow and hydrograph for input to an unsteady state hydraulic model.

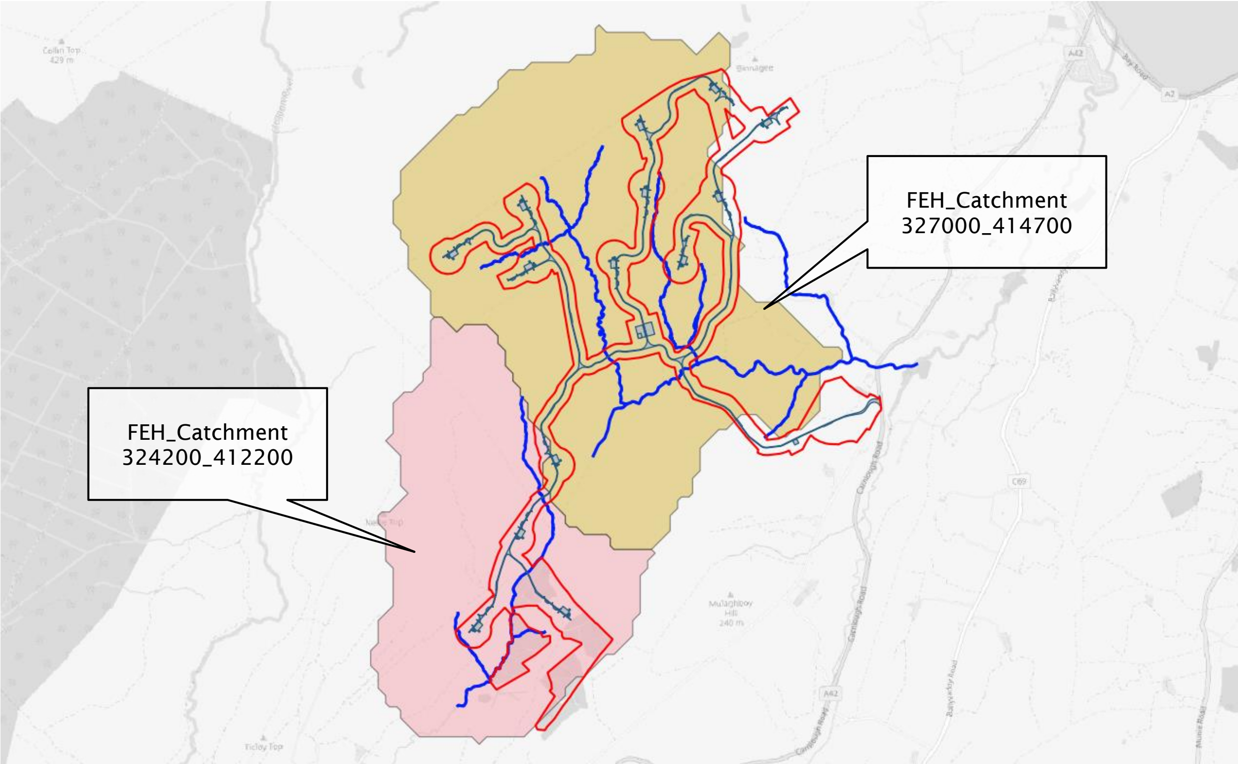
The derivation of the 1% AEP peak flow and hydrograph for the undesignated watercourses was assessed using the FEH Revitalised Flood Hydrograph (ReFH) Method. The method is deemed appropriate where best practice guidance directs practitioners to FEH-based methods in all instances, and where catchments investigated are small and there is little useful local or comparable data to inform a Statistical analysis.

Site-specific flow-accumulation raster analysis based on site survey and the OSNI Northern Ireland 10m DTM was used to determine a conservative estimate of the catchments draining to the areas of interest, and the ReFH2 flow for the FEH catchment scaled pro-rata by areal extent.

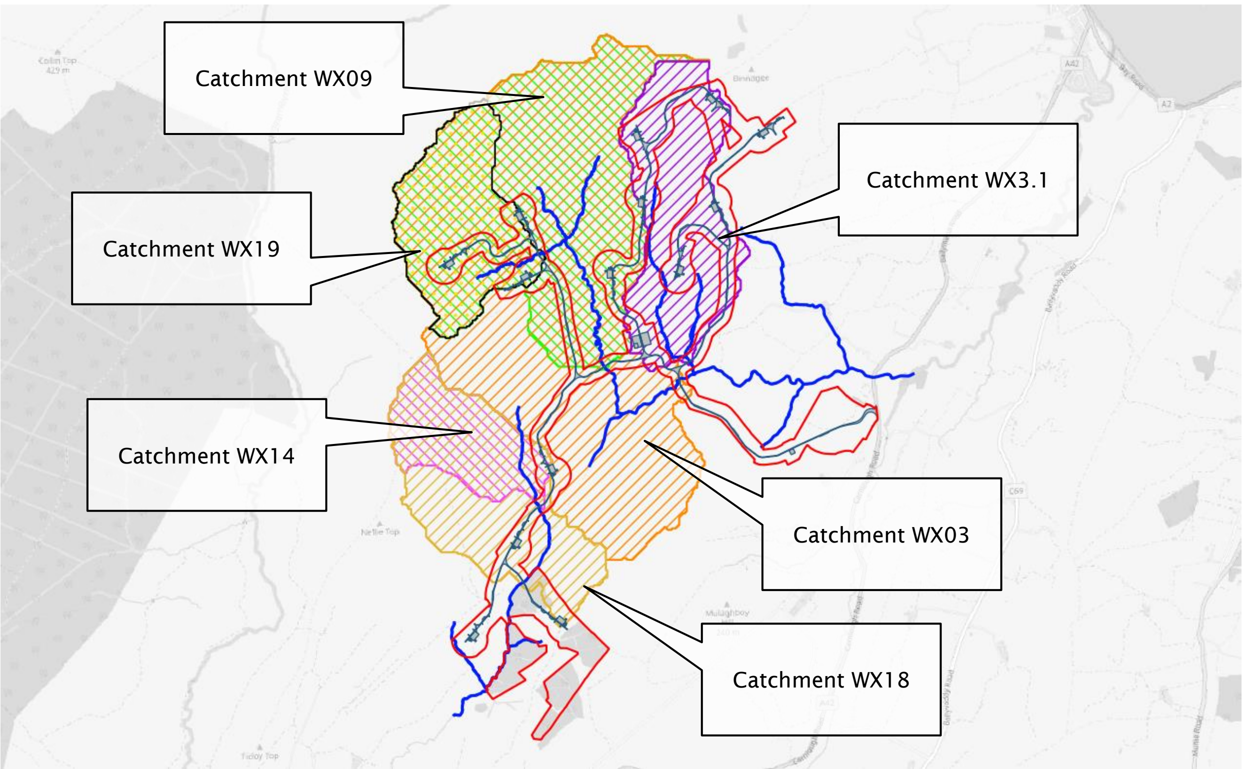
As per DfI guidance[3], an effect of climate change has been derived by applying an uplift of +20% to the estimated flow.

[3] DfI. (2019). Technical Flood Risk Guidance in relation to Allowances for Climate Change in Northern Ireland. Available from: https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/technical-flood-risk-guidance-in-allowances-for-climate-change-6feb19.PDF. [Accessed: 23/11/2021].

Hydrological Catchment



Assessed Catchments at Location of Proposed Crossings



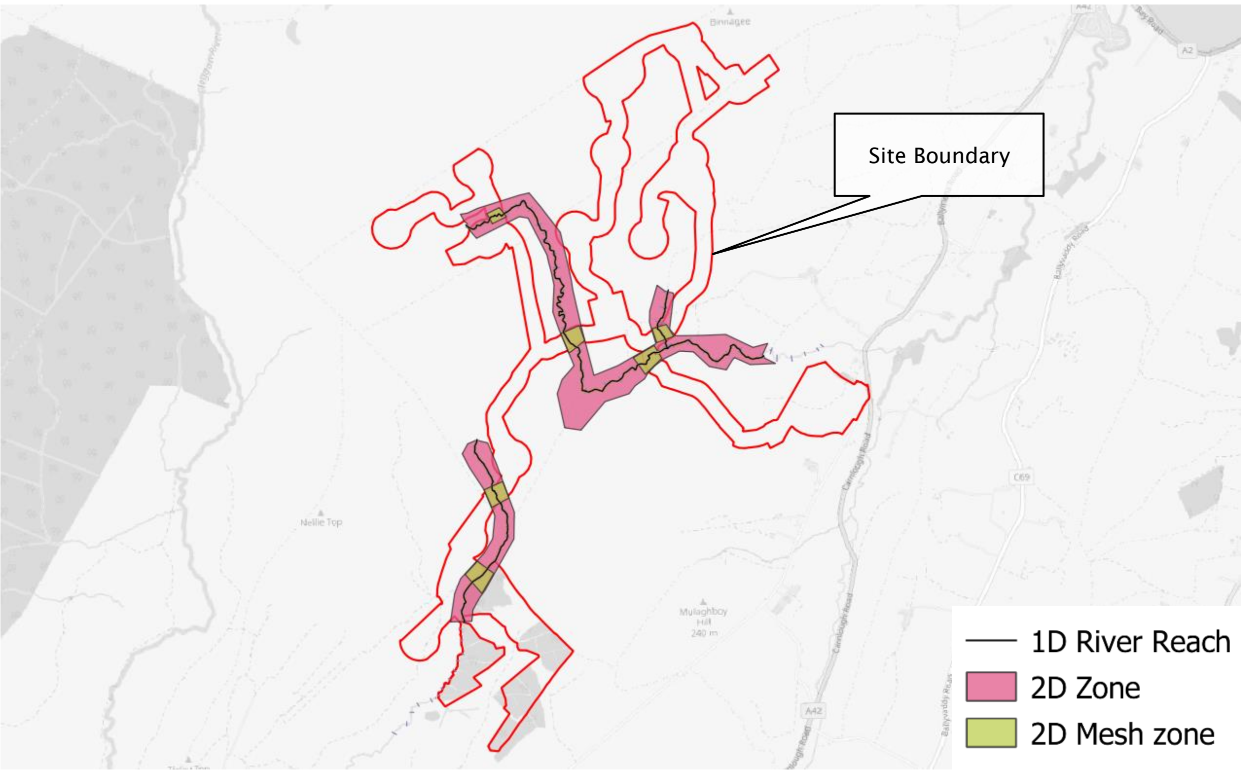
Hydrology Summary

Analysis Method	1% AEP Design Flow (m3/sec)
FEH ReFH2 Method Northern Catchment	14.7
FEH ReFH2 Method Southern Catchment	7.10

Detailed calculations for the determination of the flows are contained within Appendix E.

MODEL GEOMETRY

Model Extents



2-Dimensional Surface Model Areas

Topography

Model topography was based on a detailed site-specific UAV survey which gathered a high-resolution point cloud. The UAV survey was cleaned to a “bare earth” digital terrain model (DTM) and exported for use at a 0.5m grid resolution. The resolution was adopted so that small drainage features (which may be <1m in size on plan) were captured and defined in the terrain model.

The use of point-cloud derived DTM data is likely to underrepresent channel capacity and overestimate flooding due to it underestimating below-water ground levels and levels under vegetation, and as such is precautionary and suitable for planning purposes.

2D Zone

The terrain model was loaded into InfoWorks ICM as a ground model, and subsequently converted into 2D mesh elements (the surface used to simulate flows across the topography within the model). The 2D zone has a maximum triangle area of 64m^2, minimum area of 16m^2, with 2D mesh zones included at culvert locations maximum triangle area of 10m^2 and minimum area of 2m^2.

Boundary Conditions

The boundary condition for 1D and 2D elements is set as the normal depth of flow for the element gradient at that location. The downstream boundary is sited at an elevation 5m lower than the area of interest in order to ensure that variance in the boundary condition could have no backwater effect that would affect prediction of water levels at the bridge location.

Surface Roughness

A Manning's n Roughness value of 0.05 has been conservatively applied to the whole 2D zone to represent the area over which water would flow which comprises a combination of rough grass.

Surface Infiltration

It is noted that no infiltration has been included in the model in keeping with the approach used in similar DfI Rivers SFRA detailed models. The absence of infiltration in the model is likely to present conservative results.

1-Dimensional Model Elements

Cross sections

The river reach is derived from discrete cross sections sampled from the DTM formed from height data described previously.

Channel Roughness

An in-channel roughness Manning's n of 0.35 is adopted as representative of the observed channel conditions.

Structures

No structures are represented in the present-day scenario.

Proposed Scenario

The proposed scenario is represented by inclusion of an embankments at each crossing location imposed on the 2D zone as a mesh level zone. Conservative crest heights in excess of actual heights likely required have been adopted to provide conservative upstream peak flood levels.

The main river culverts are included as conduits on the river reach with roughness 0.035 (representative of stream substrate) and upper roughness of 0.016 (representative of precast concrete). Inlet losses are represented by the FHWA methodology per industry norms.

Where applicable, flood conveyance culverts are included as conditions with roughness of 0.016 (representative of precast concrete), connected to mesh elements by Outfall 2D nodes with elevations equal to the connected mesh element.

Assumptions and Limitations of Modelling

The representation of any complex system by a model requires a number of assumptions to be made. In the case of the hydraulic model developed for the purposes of the study it is assumed that:

- The terrain model sufficiently accurately represents the surface topography and associated flow paths.
- The design flows are an accurate representation of flows of a given return period.
- Roughness does not vary with time.

The primary limitations of the study are noted as follows:

- No allowance for infiltration has been made within the model;
- The model does not represent any topographic features smaller than the minimum resolution of the underlying terrain model derived for the site.

MODEL SENSITIVITY

Model roughness is intentionally precautionary and at the higher end of permissible Manning's N roughness values for the conditions observed. Sensitivity testing for further increases in roughness would be an unreasonable requirement.

Flows are conservative and include uplifts for climate change for the default scenario and are taken for a flow extraction point downstream of the area of interest and so are likely to represent a sufficiently precautionary estimate without need for further stress testing.

The model boundary condition is sited >5m downgradient of the site and so further stress testing of boundary condition on the area of interest can be discounted.

The model can therefore be deemed reliable / conservative and is and fit for its intended purpose of a precautionary evaluation of flood risk and culvert opening sizes at the site.