Date	18th May 2022	Issued version	1
Author	Eric Gillies, cbec eco-engineering UK Ltd		
Technical & Comm. Reviewer	Martin Kernan, cbec eco-engineering UK Ltd		
To	SERT		
Project	UK 20-1057 Emm Brook		
Subject	Model re-run for updated 100 year return period flows.		

1. INTRODUCTION

This report describes additional flood modelling of the Emm Brook existing condition and the Emm Brook re-alignment.

The hydrology for the project was updated in 2022 to account for an increased URBEXT parameter, and this increased the 100 year return interval flood peak estimate from the previously modelled 10.83 m^3/s to 15.10 m^3/s. Updated model runs were undertaken for unsteady (ReFH derived) hydrographs for the following flows in Table 1 and hydrograph (scaled to each flow peak) in Figure 1.

Table 1 Peak flows used in the model.

Flow description	Discharge peak [m^3/s]
Original model 100 year RP peak (2020)[1]	10.83
Updated 100 year RP peak (2022)	15.10
Updated 100 year RP peak + 14% climate uplift	17.21
Updated 100 year RP peak + 35% climate uplift	20.38

[1] For reference only; this flow was modelled as part of the original 2020 study.

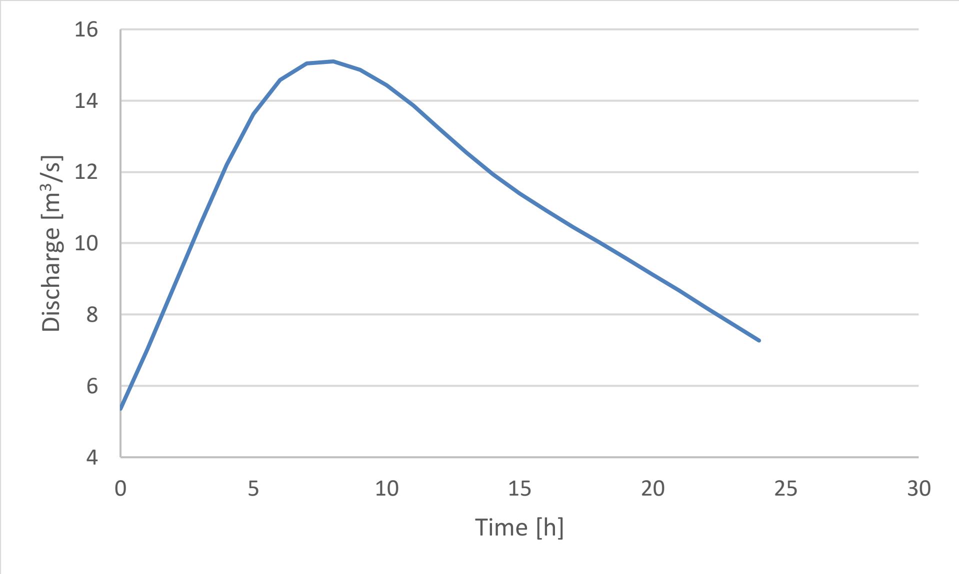

Figure 1 Unsteady hydrograph used for modelling. Note: this hydrograph was derived using ReFH v2.3 in the absence of relevant gauge data.

The hydraulic model for the project has previously been approved via the EA FMAT process, and is fully described in the report issued to the EA: U20-1057 Emm Brook Model Update Report (*cbec*, 23/12/20).

The model contains all bridges (two existing channel bridges and three design channel bridges) as pressure/overtop weir units and is fully 2D elsewhere. As part of the model checking/QC process, all bridges and overtop units were checked at the higher flows to determine whether the increased flows caused a change to soffit interaction or overtopping. Also checked were model "glass-walling", and any increased inundation of property.

- There were no substantive changes to soffit nor deck overtoppings as a result of the higher flows, other than a slight increase in levels at each structure (i.e. if a structure overtopped/water interacted with soffit at the updated flow estimate, it already overtopped/water interacted with the soffit at the original flow estimate).
- The model did not glass-wall anywhere even at the 100 year RP plus 35% climate uplift.
- There were no interactions with any property at any of the modelled flows.
- No substantive changes to the model were required to accommodate the increased flows, other than an extrapolation of the downstream boundary rating curve to accommodate the highest flow.

2. UPDATED FLOOD MAPS

Maximum water depth during the unsteady flood hydrograph is mapped in Figure 2, Figure 3 and Figure 4 for the updated 100 year, 100 year plus 14% (central estimate 2080) and 100 year plus 35% return period flows for the Emm Brook existing condition and design condition. Difference maps of Design water level minus existing water level peak are also included in Figure 5, Figure 6 and Figure 7. The results are consistent with expectations and previous modelling:

- There are no significant changes to inundation between existing and design
- The design slightly lowers levels upstream, by increasing conveyance through the design channel on the right floodplain.
- Water levels at the existing bridges are very slightly reduced (1-3 cm) and slightly increased by 4 cm on the most downstream design bridge, but this afflux is limited to 4 m upstream of the structure.

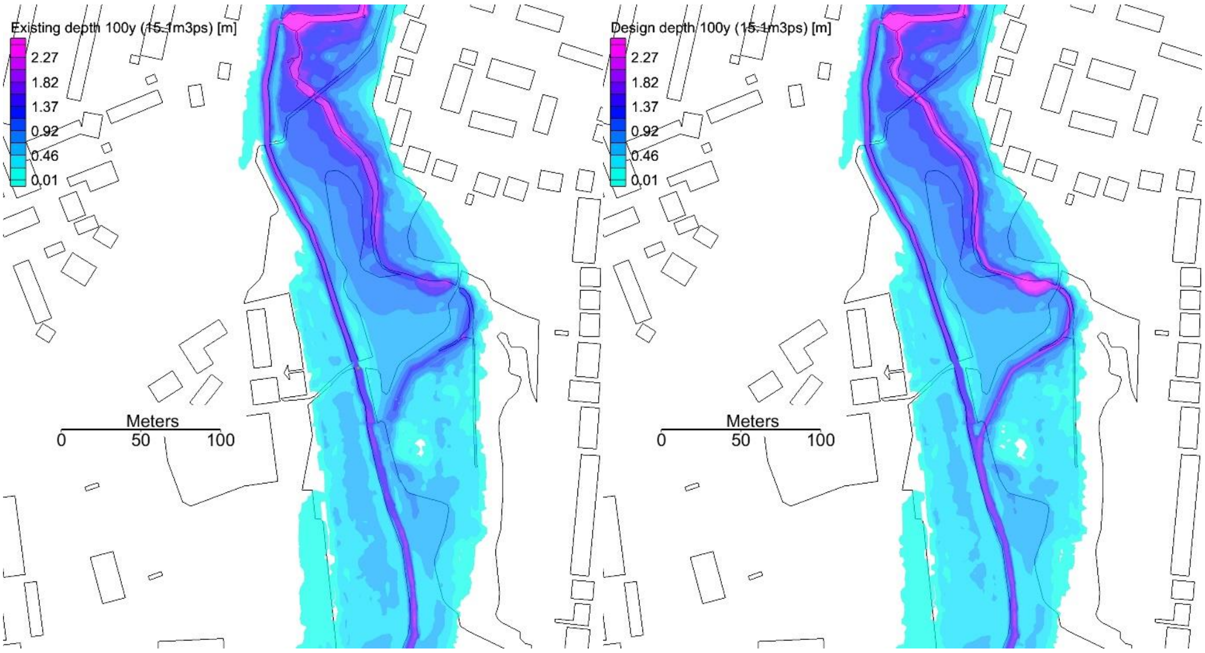

Figure 2 100 year return period (15.10 m^3/s) peak inundation for existing (left) and design (right) condition.

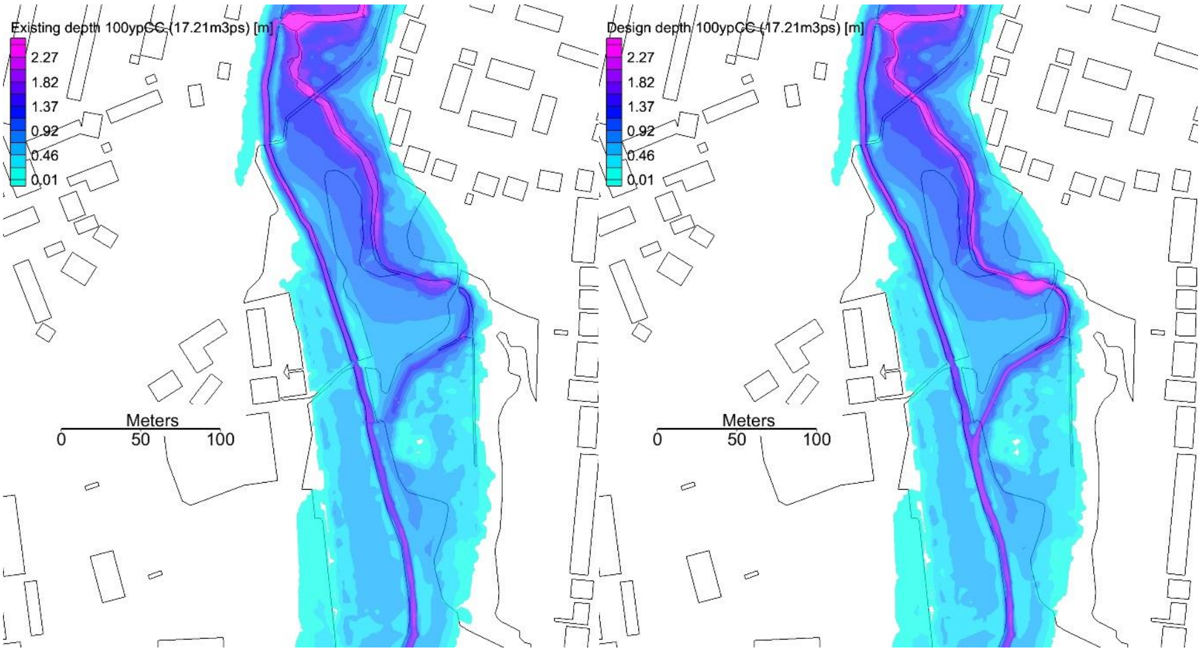

Figure 3 100 year return period plus 14% central 2080 climate change estimate (17.21 m^3/s) peak inundation for existing (left) and design (right) condition.

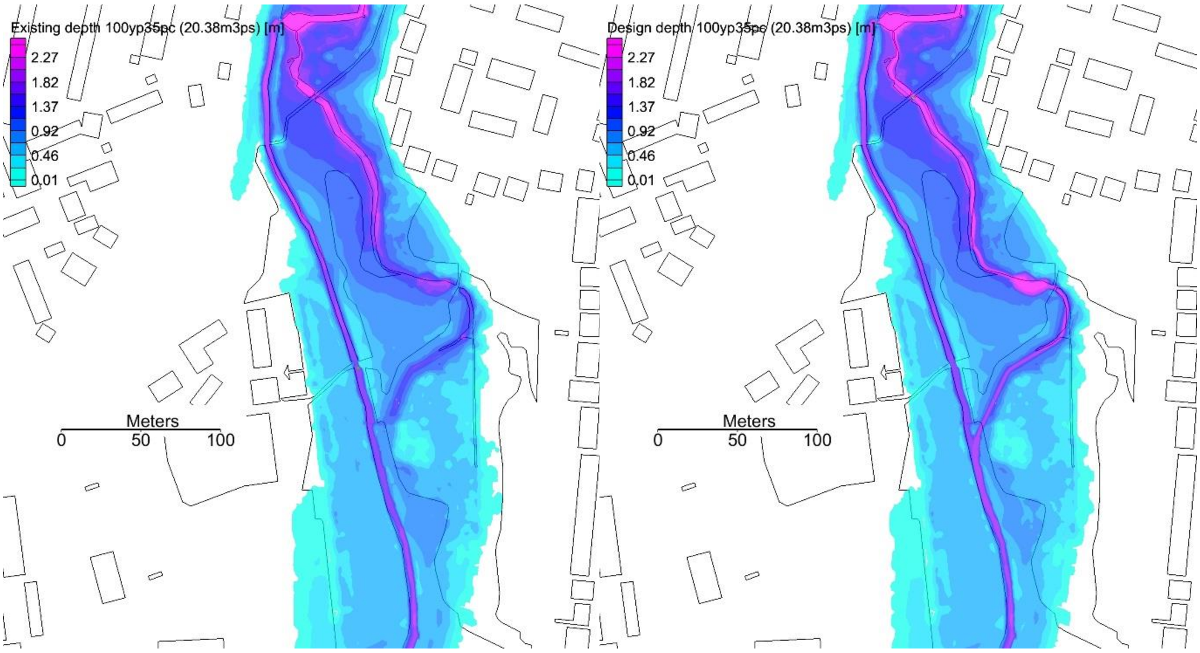

Figure 4 100 year return period plus 35% (20.38 m^3/s) peak inundation for existing (left) and design (right) condition.

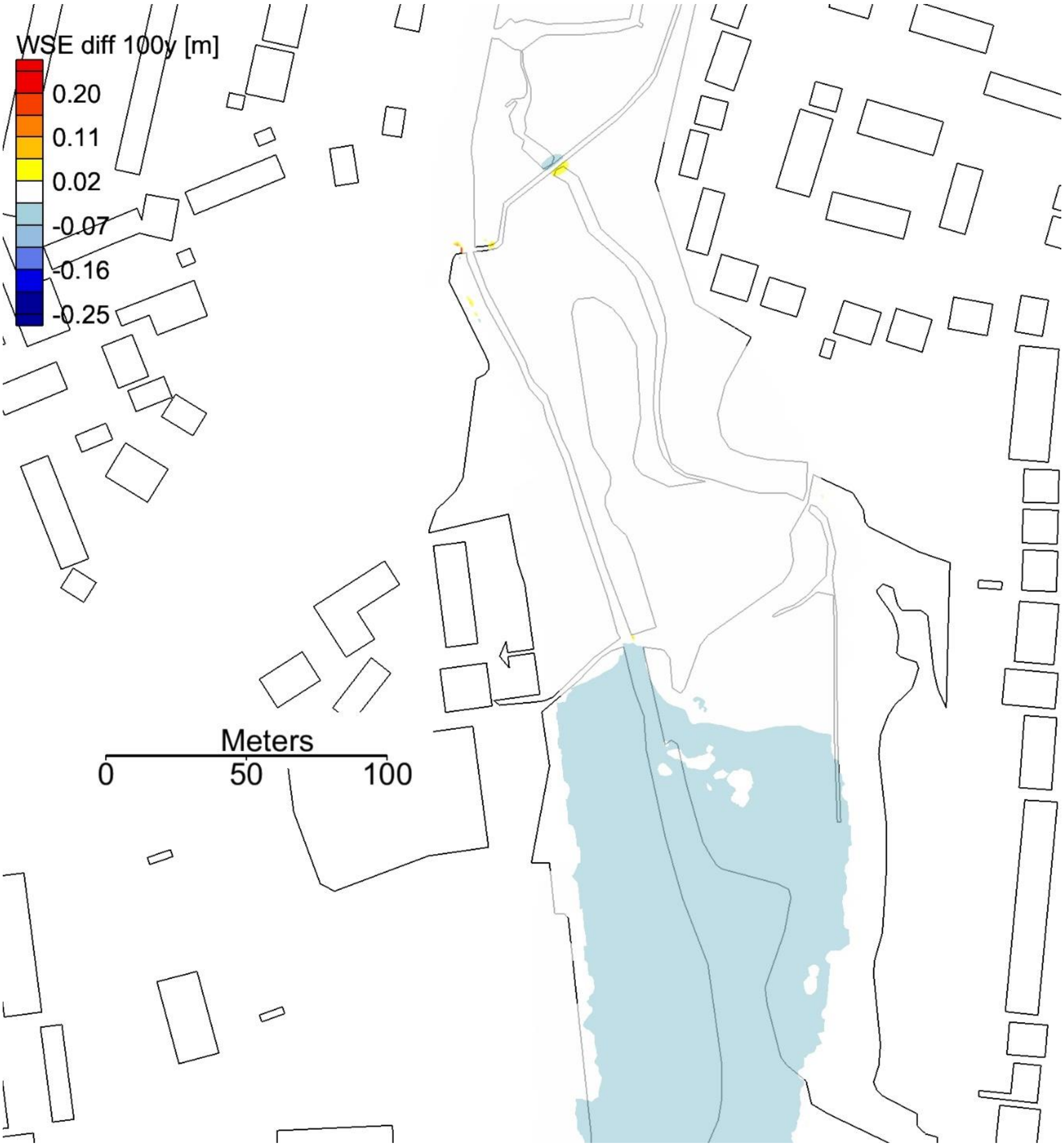

Figure 5 Peak water level difference map (design - existing) for the 100 year return period (15.10 m^3/s) flood.

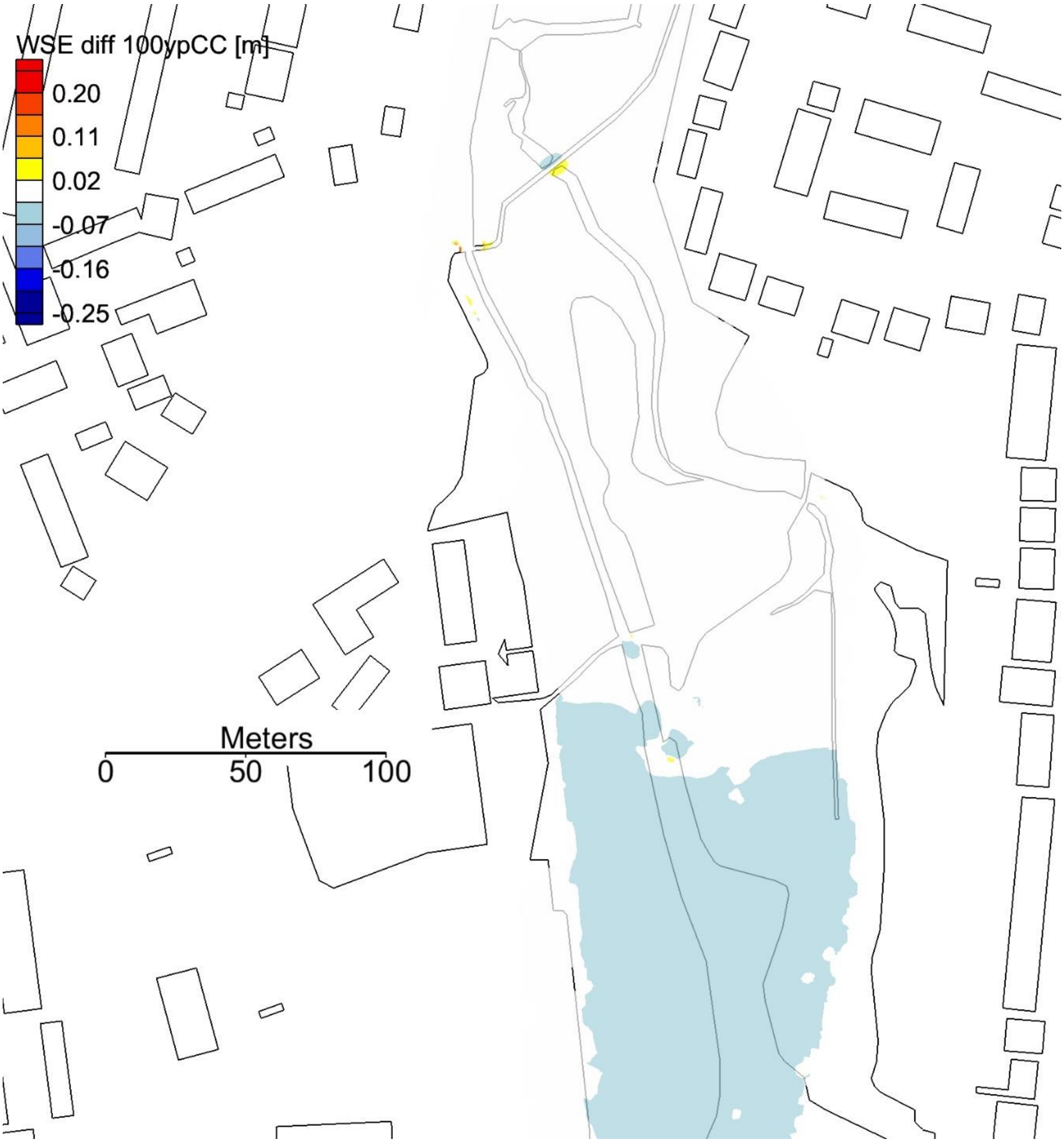

Figure 6 Peak water level difference map (design - existing) for the 100 year return period plus 14% central 2080 climate change estimate (17.21 m^3/s) flood.

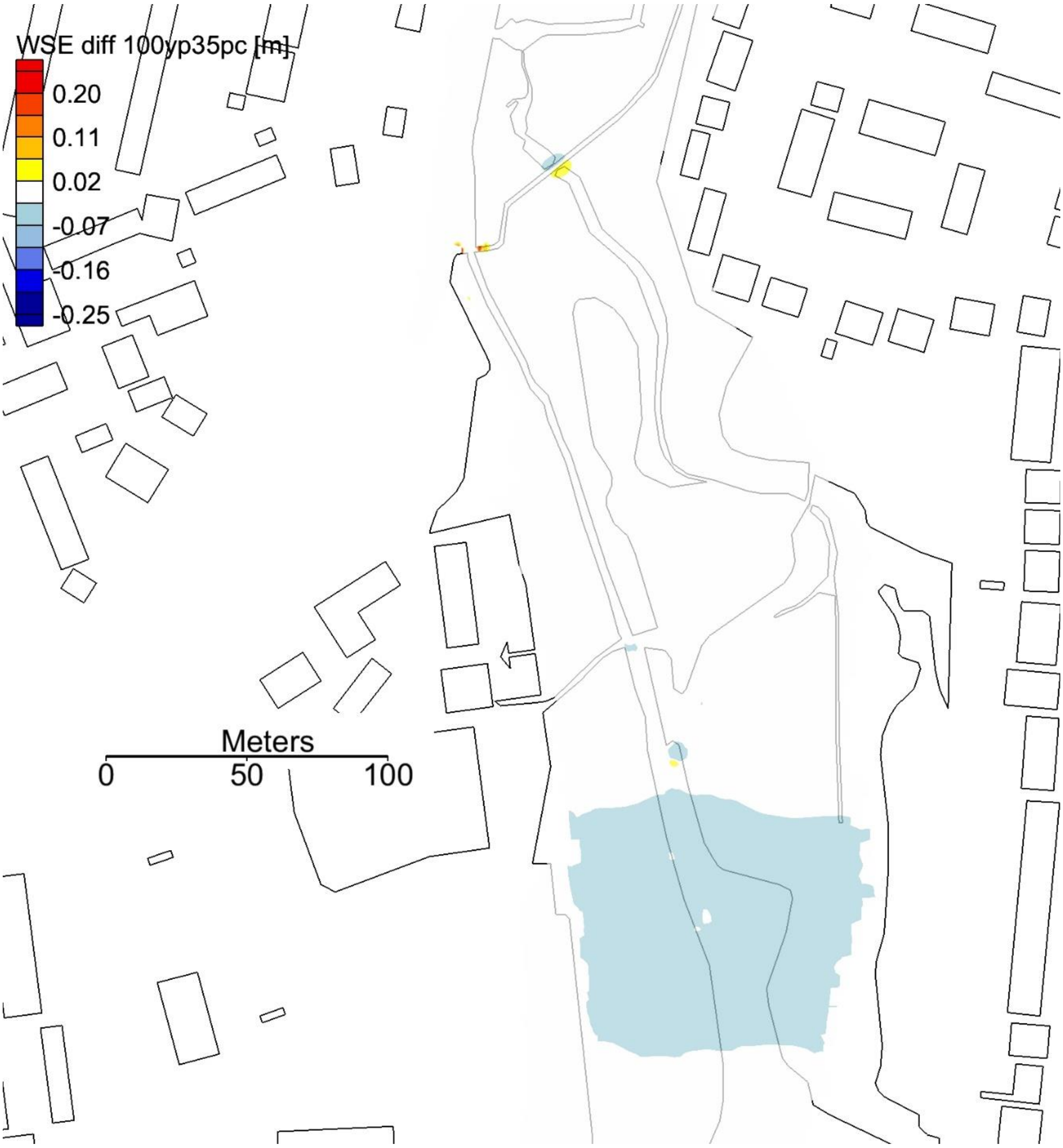

Figure 7 Peak water level difference map (design - existing) for the 100 year return period plus 35% (20.38 m^3/s) flood.

3. PASS-FORWARD FLOW

Downstream pass-forward flow was calculated for each modelled flow and is tabulated in Table 2. There is no increase in pass-forward flow as a result of the design. Figure 8 shows the pass-forward flow hydrograph for the 100 year plus 14% climate uplift flood. At no point in this hydrograph are design pass-forward flows higher than those for the existing condition.

Table 2 Pass-forward flow peaks.

Return period & flow uplift%	Existing peak [m3/s]	Design peak [m3/s]
100	15.08	15.07
100+14% CC	17.20	17.16
100+35%	20.36	20.33

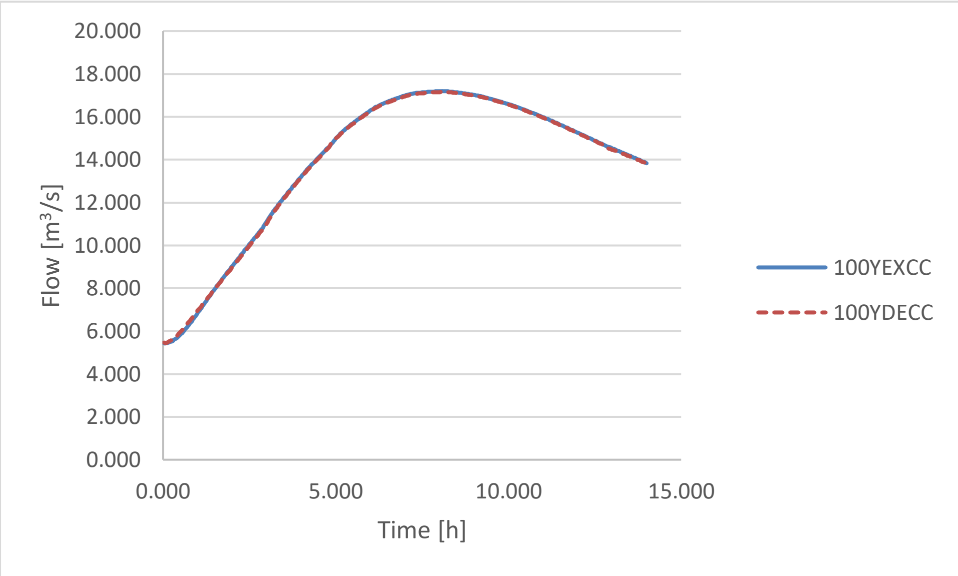

Figure 8 Pass-forward flow hydrograph for the 100 year return period flood plus 14% central 2080 estimate of climate uplift.