A1 Birtley to Coal House

Scheme Number: TR010031

Technical Note - Flood Risk Compensation

Planning Act 2008

Rule 8(1)(b)

Infrastructure Planning (Examination Procedure Rules) 2010

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Technical Note - Flood Risk Compensation

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TABLES

FIGURES

1 INTRODUCTION

1.1.1. This Technical Note has been prepared for the A1 Birtley to Coal House Scheme at the request of the Environment Agency for further details on how the floodplain compensation in Coal House Roundabout will operate during flood events. This request was made during a meeting on 2 April 2020 between Highway's England's representatives and the Environment Agency. This floodplain compensation is required to offset the loss of River Team floodplain as a result of the proposed construction of the additional piers to support the widened Kingsway Viaduct.

1.1.2. The flood regime of the River Team has been assessed using the Environment Agency's Integrated Catchment Model as detailed within **Chapter 13: Road Drainage and the Water Environment** of the ES **[APP-034]**. **Paragraph 4.2.12** and **paragraph 4.2.13** of **Appendix 13.1: Flood Risk Assessment** of the ES **[APP-163]** provides further detail on the floodplain compensation. In summary the floodplain compensation is:

a. Required for the climate change scenarios only, as the location of the piers to support the widened Kingsway Viaduct are only inundated for the 1 in 100 year event with climate change (+25% and +50%) scenarios; and

b. For the design event, the 1 in 100 year plus 50% climate change scenario, the required floodplain compensation is 7.6m^3.

2 FLOODPLAIN COMPENSATION APPROACH

2.1.1. **Figure 13.7: Flood Plain Compensation Area** of the ES **[APP-099]** (which is reproduced in **Figure 1** below) outlines the proposed location of the floodplain compensation (shown in orange). This Technical Note has been produced following further interrogation of the hydraulic model and demonstrates how the flood regime works within the immediate area of the Coal House Roundabout.

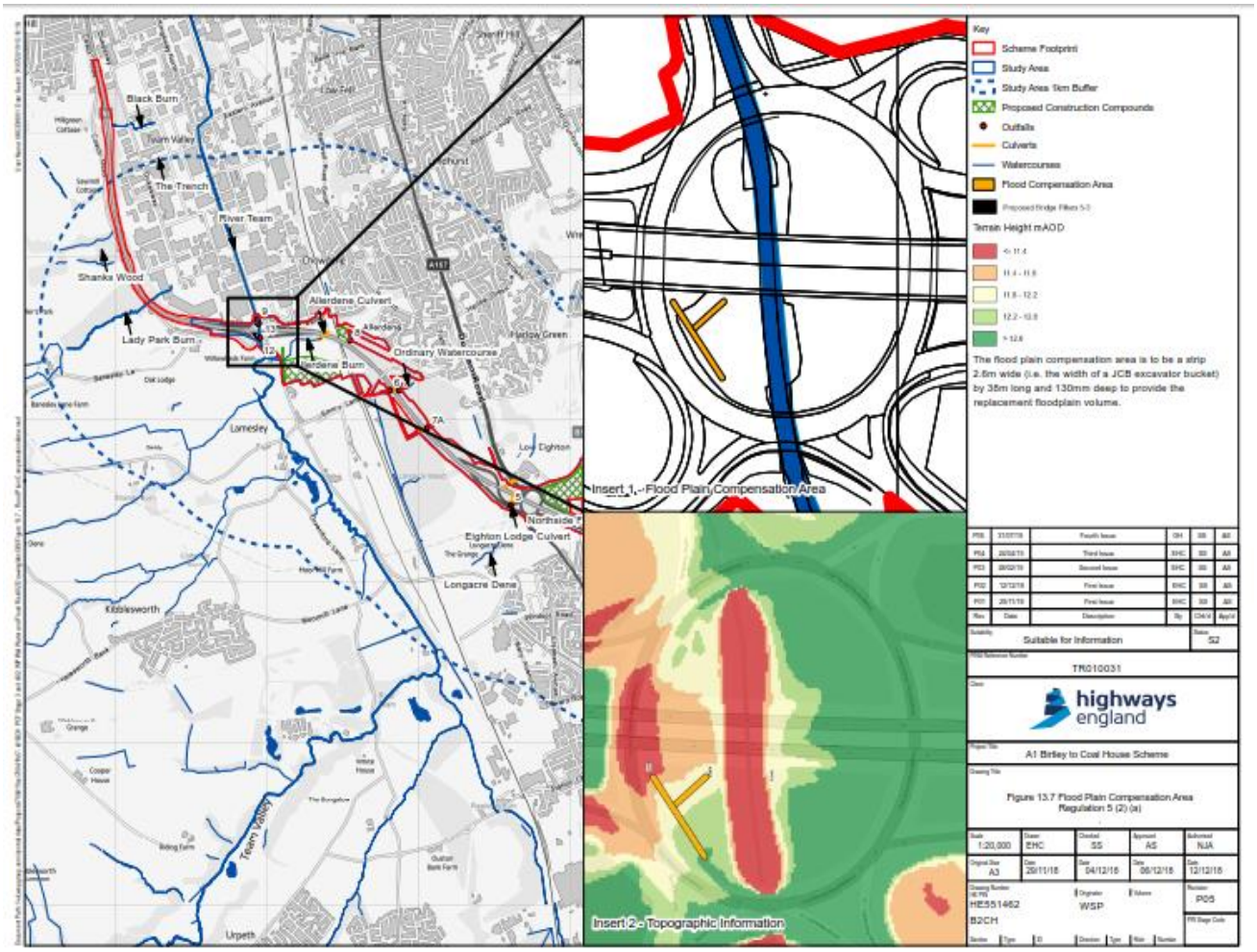


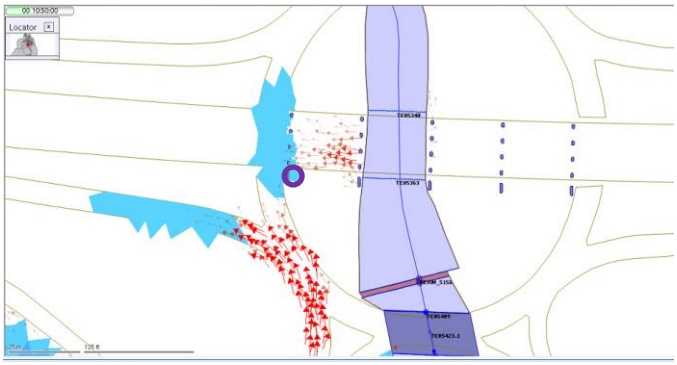
Figure 1 - Figure 13.7: Flood Plain Compensation Area of the ES

2.1.2. The design of the flood compensation area is outlined in **paragraph 4.2.13** of **Chapter 13: Road Drainage and the Water Environment** of the ES **[APP-034]** as a practical and easy to construct approach, based upon a 2.6m wide (width of a JCB excavator bucket) by 36m long strip which would be lowered by 130mm. Given the local topography and the need to provide compensation across all the depth bands, there is an over compensation of storage.

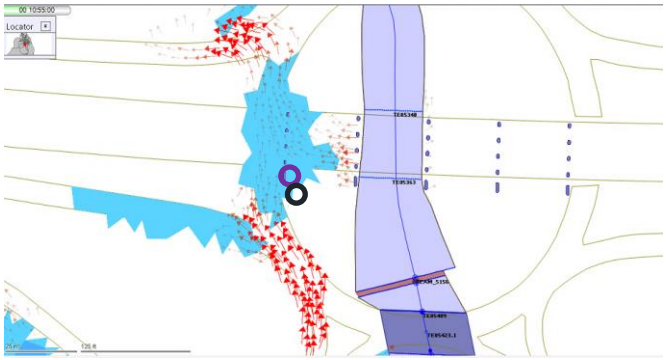
2.1.3. The compensation area is located within the maximum modelled flood extents of the 1 in 100 year plus 50% climate change floodplain. The floodplain compensation approach has

been developed to provide compensation on a level for level basis and accounting for the timing and onset of flooding through the flood event by bringing land which is dry at that timestep into the floodplain, as shown by the indicative drawings in **Figure 2** below, these are extracts of the Integrated Catchment Modelling (ICM) model, showing the progression of the flood waters along with the area which will be utilised for the floodplain compensation. As the flood progresses the flood waters will get deeper eventually returning to their pre-compensation depth / elevation. This has been accommodated within the calculations by ensuring that only the existing flood depth over the land lowering is removed from the calculations.

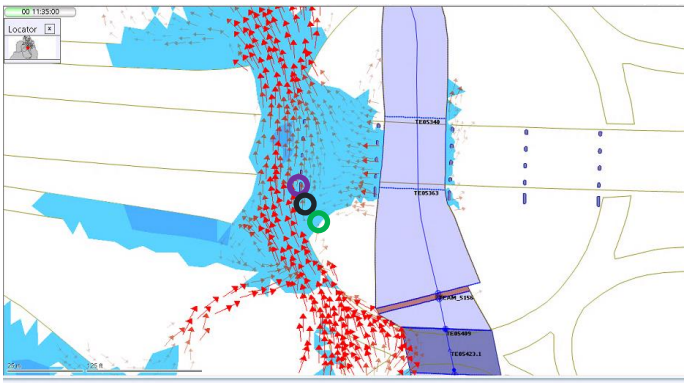
Timestep 1 (Area Providing Compensation in Purple)



Timestep 2 (Area Providing Compensation in Red)



Timestep 3 (Area Providing Compensation in Green)



Timestep 4 (Area Providing Compensation in Pink)

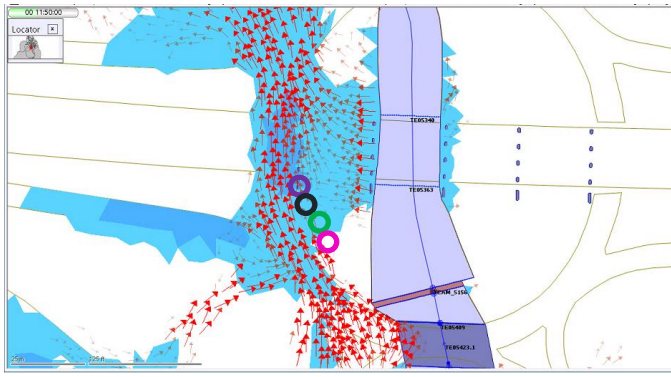


Figure 2 - Indicative Flood Compensation Areas

2.1.4. **Chapter 13: Road Drainage and the Water Environment** of the ES **[APP-034]** outlines that an additional section of floodplain compensation (as shown in **Figure 1** above) was incorporated into the design to ensure an appropriate connection to the River Team to ensure that flood waters could access this area, i.e. this area was not contributing to compensation provision. These areas are illustrated within **Figure 3**. The additional interrogation that has been undertaken at this stage has shown that the inclusion of this additional section is not the best way for providing the connectivity, therefore, the revised

flood compensation area is shown in **Figure 4**, with the floodplain compensation area remaining the same.

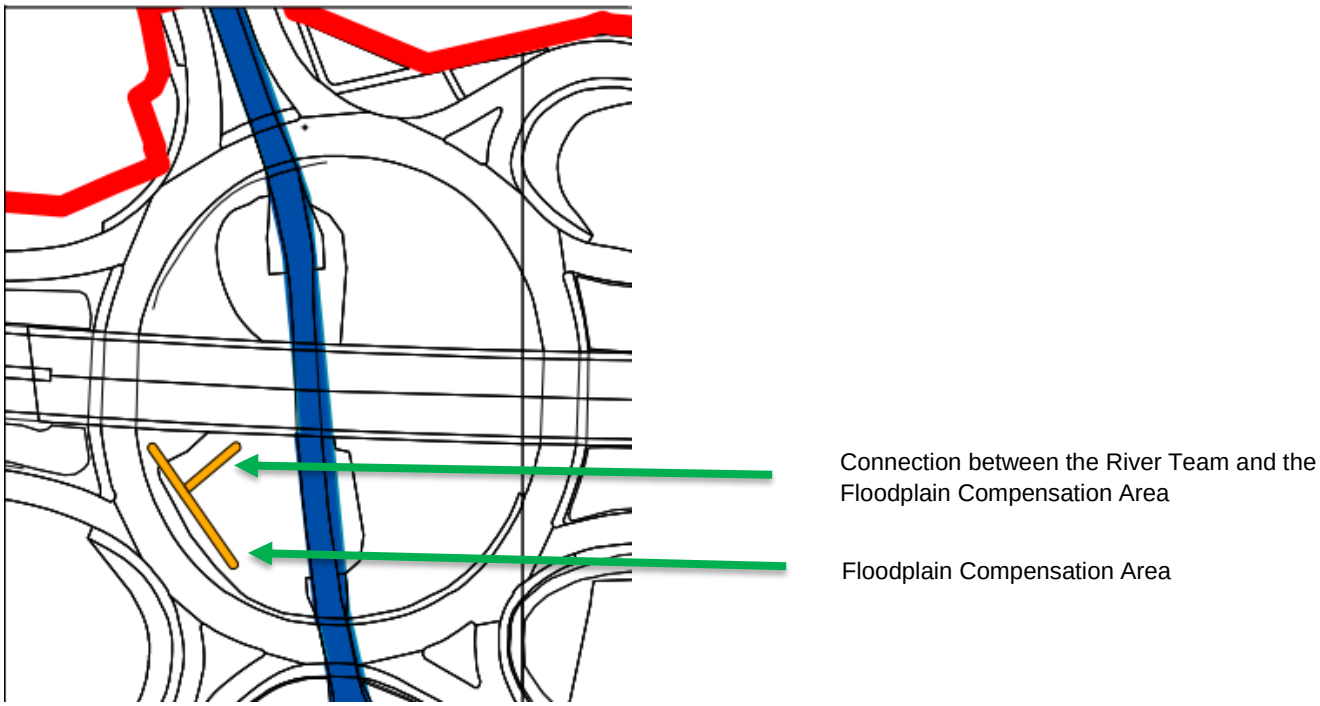


Figure 3 - Original Flood Plain Compensation Area (shown in orange)

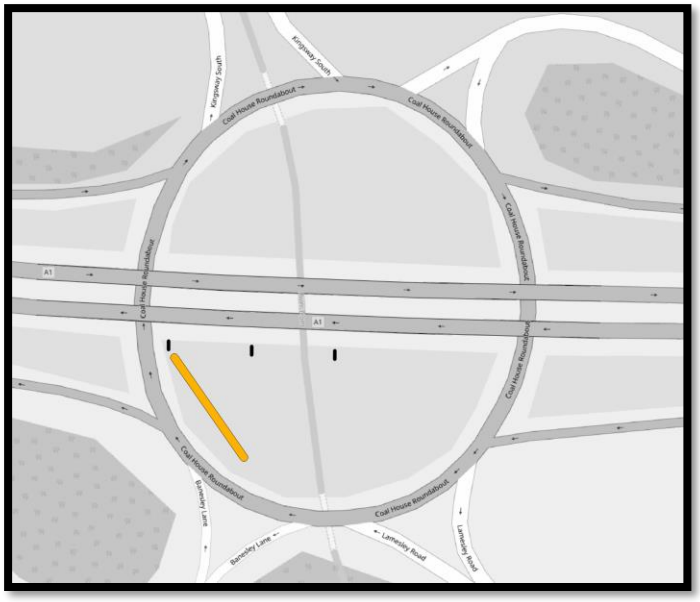


Figure 4 - Revised Flood Plain Compensation Area (shown on orange)

2.2 FLOOD COMPENSATION STORAGE CALCULATIONS

As part of this exercise the flood compensation storage calculations were also refined and are detailed in **Table 2-1**. The calculations demonstrate that 8.4m^3 of floodplain compensation storage is required and that the proposed compensation results in an oversupply of compensation in all bands.

Table 2-1 - Flood compensation volumes for the 1 in 100 year plus 50% scenario

Level Bands (m ODN)	Required Compensatory Storage (m^3)	Storage Provided (m^3) by 130mm Excavation over Proposed Area
11 - 11.25	0.00	0.03
11.25 - 11.5	0.72	0.91
11.5 - 11.75	0.75	0.81
11.75 - 12	1.33	2.90
12 - 12.25	2.26	2.31
12.25 - 12.5	2.26	3.00
12.5 - 12.75	1.10	1.47
12.75 - 13	0.00	0.00
Total:	**8.4**	**11.4**

2.2.1. The calculations have been undertaken on the Digital Terrain Model (DTM) that the ICM model was based on, a 1m rectangular grid; the flood level and ground level information which was extracted at the centroid of each cell. The input DTM was used over the ICM model mesh to improve accuracy in the volume calculation, as the ICM mesh triangles have simplified the DTM through sampling and interpolation. The grid information for the area in which the flood plain compensation is proposed was extracted into a spreadsheet and the compensation calculated on a level for level, volume for volume basis.

2.2.2. The topography of the area in which the floodplain compensation is to be provided is shown in **Figure 5**, with the red and orange areas showing areas of lower ground and the green and yellow areas showing areas of higher land.

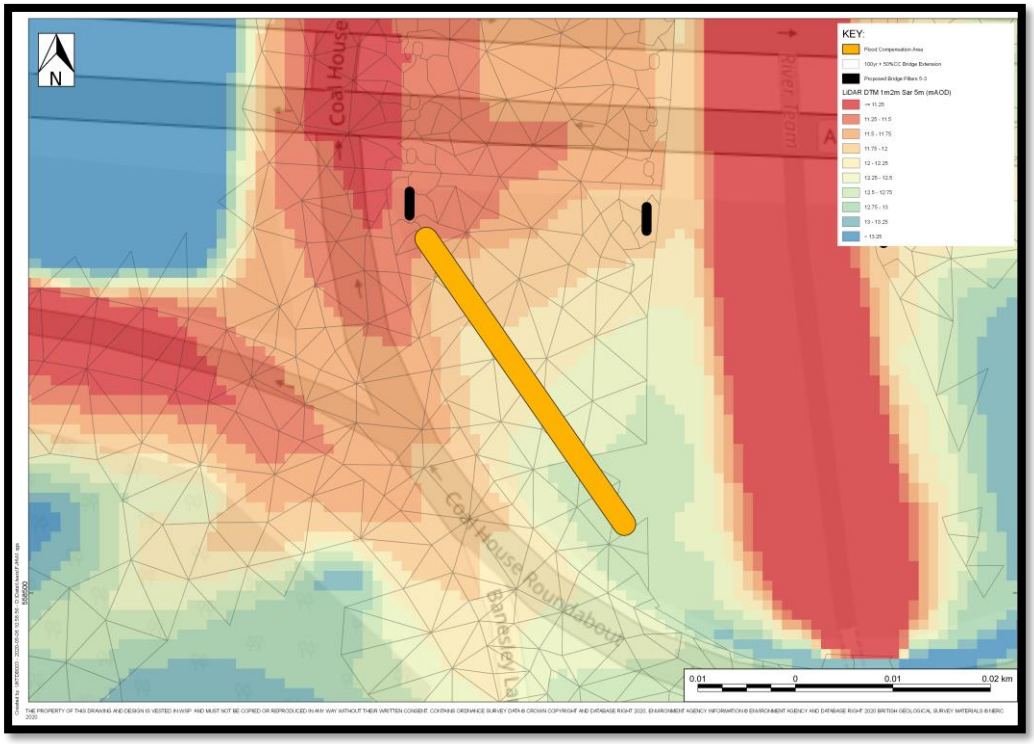


Figure 5 - Local Topography (two of the three piers that are within the floodplain shown in black)

2.2.3. The top soil scrape will be a 130mm scrape across the entire length, this will provide a slope that mirrors the existing ground contours and a long profile for both the existing and proposed scenarios is provided in **Figure 6**.

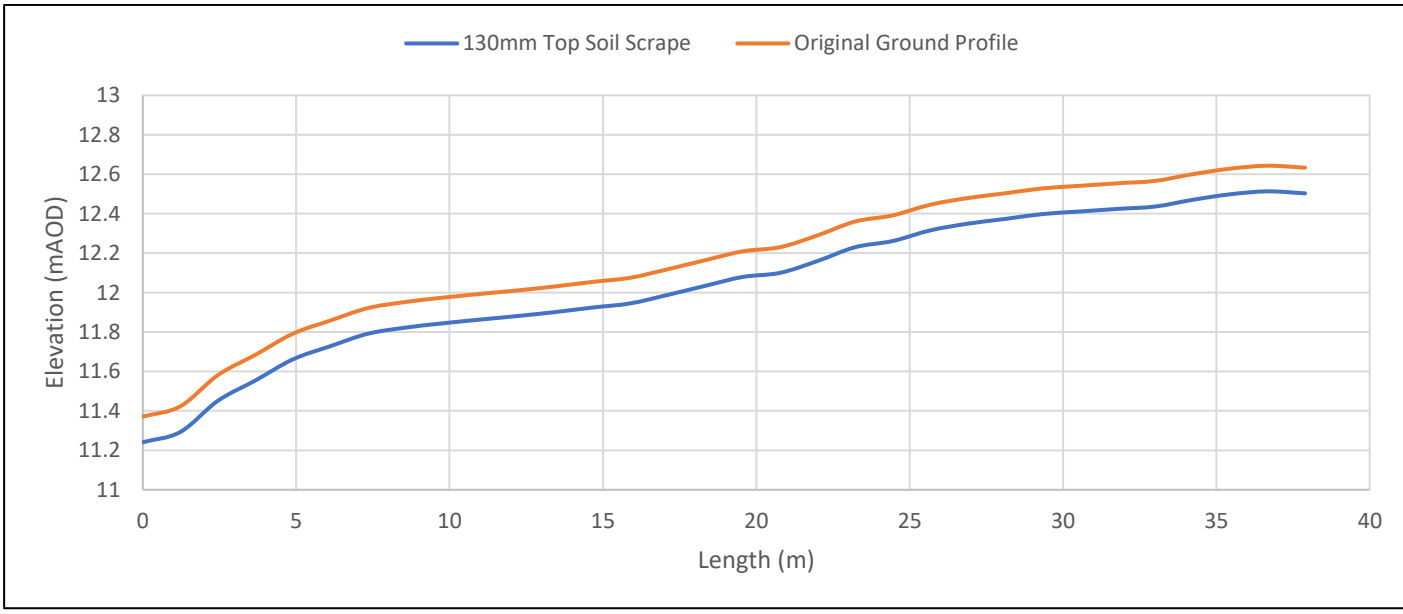


Figure 6 - Long profile of the flood compensation area from the piers to the Coal House roundabout

3 FLOOD PLAIN COMPENSATION – FLOOD REGIME

3.1.1. Whilst the flood compensation has been designed to provide the required compensation for the 1 in 100 year + 50% climate change event, as agreed with the Environment Agency, the figures show the flood extents for the 1 in 1,000 year event. The flood depths are very similar, with the 1 in 1,000 year flood depths being slightly greater, this is detailed in **Table 4-1** of **Appendix A** of **Appendix 13.1: Flood Risk Assessment** of the ES [**APP-163**], of which the key aspects are reproduced in **Table 3-1** below for ease.

Table 3-1 - 1 in 100 year +50% Climate Change and 1 in 1,000 year flood depth comparison (Extract of Table 4-1 of Appendix A of the FRA)

Scenario	AEP (Return period)	Flood depth (m)				
		Pillar 5	Pillar 4	Pillar 3	Pillar 2	Pillar 1
Baseline	1% +50% CC (1 in 100 year +50% CC)	1.219	0.662	0.648	0	0
Proposed		1.223	0.656	0.656	0	0
Difference (mm)		4	-6	8	0	0
Baseline	0.1% (1 in 1000 year)	1.297	0.733	0.731	0	0
Proposed		1.315	0.753	0.727	0	0
Difference (mm)		18	20	-4	0	0

3.1.2. The progression of the flood event is shown in **Figure 7** to **Figure 13** below, these are extracts from the ICM model for the Scheme for the 1 in 1,000 year event which was approved by the Environment Agency. These Figures are screenshots from the baseline ICM model at pertinent timescales as the flood wave advances, these show the flood extents (blue) and the flow velocities (red arrows).

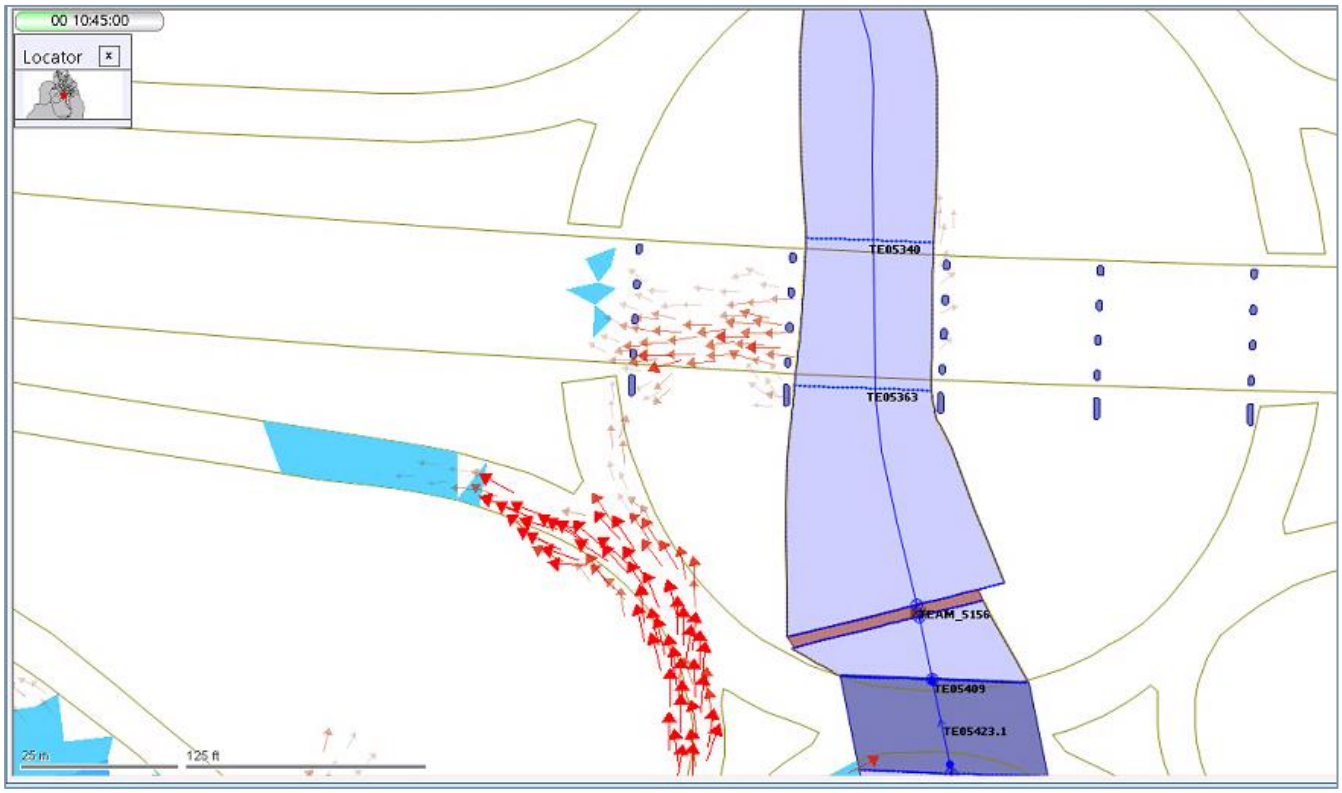


Figure 7 - Timestep 10h:45 for the 1 in 1,000 year baseline scenario

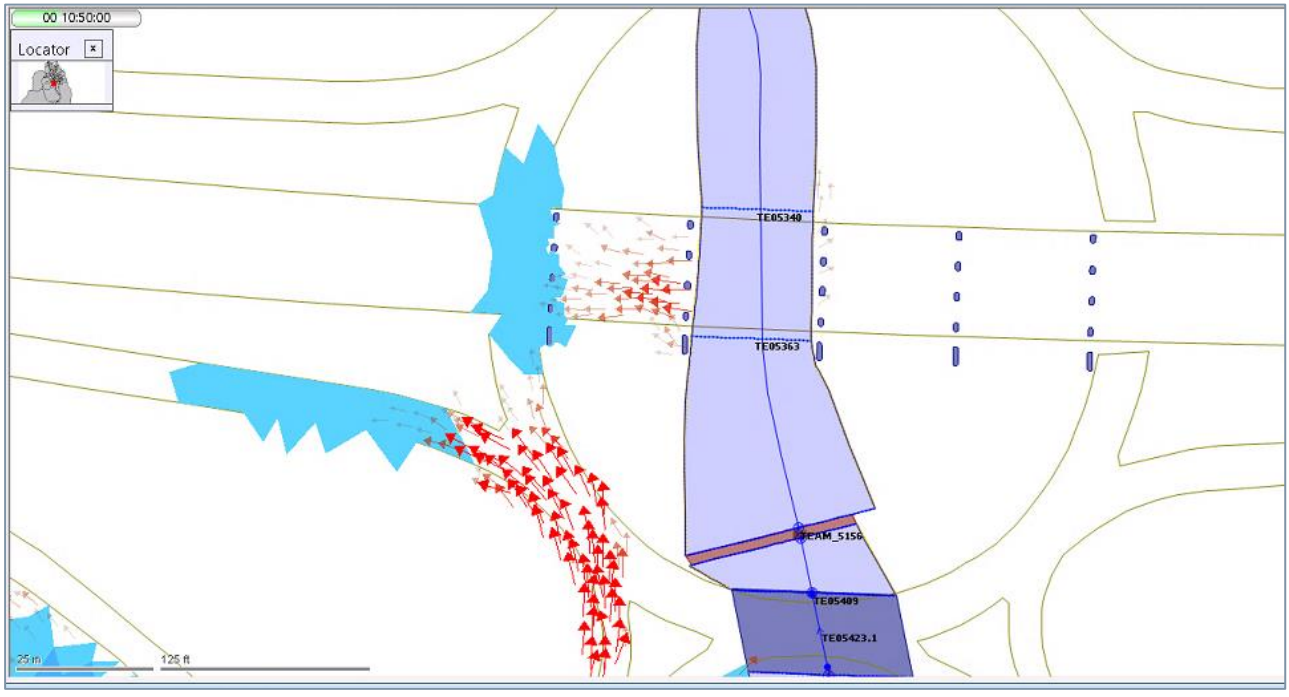


Figure 8 - Timestep 10h:50 for the 1 in 1,000 year baseline scenario

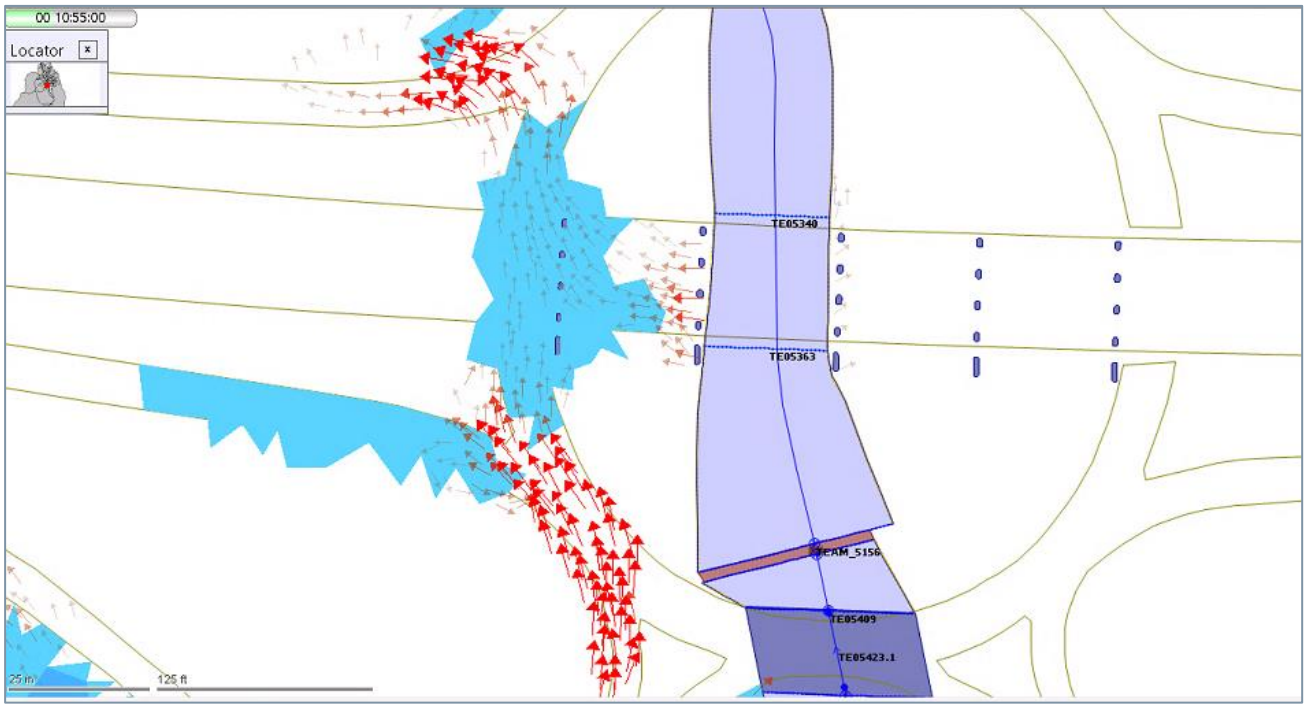


Figure 9 - Timestep 10h:55 for the 1 in 1,000 year baseline scenario

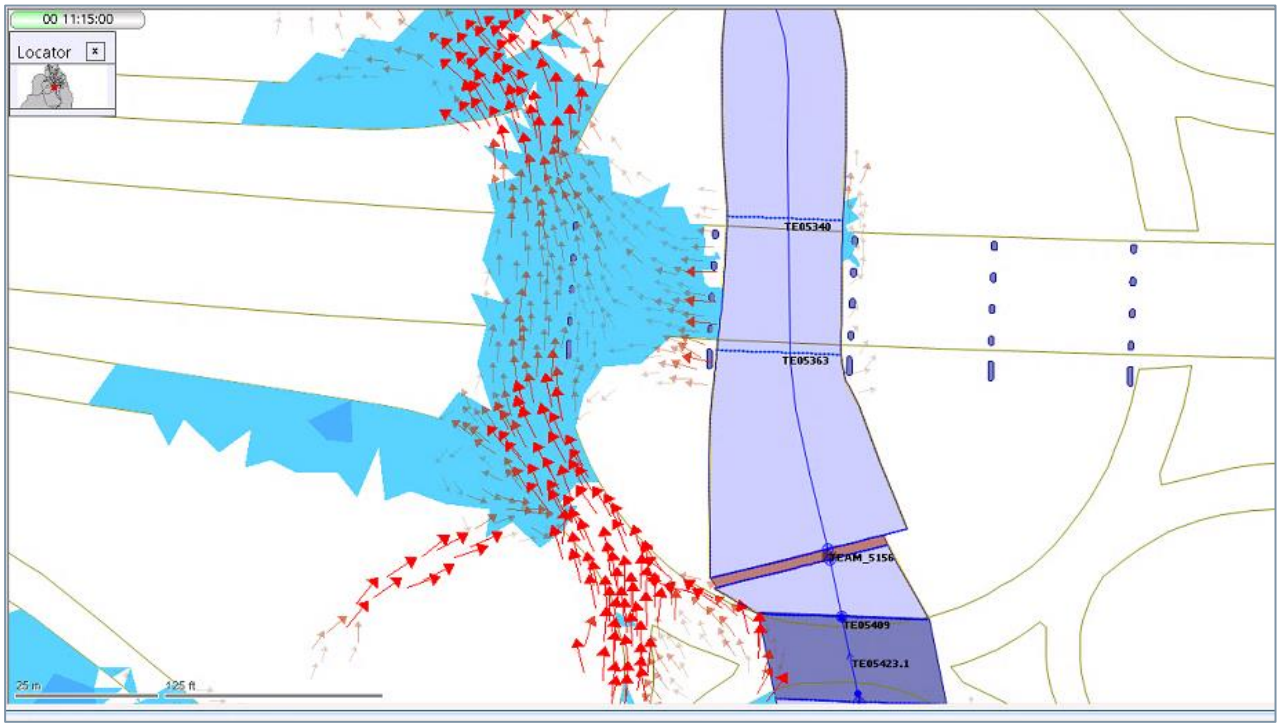


Figure 10 - Timestep 11h:15 for the 1 in 1,000 year baseline scenario

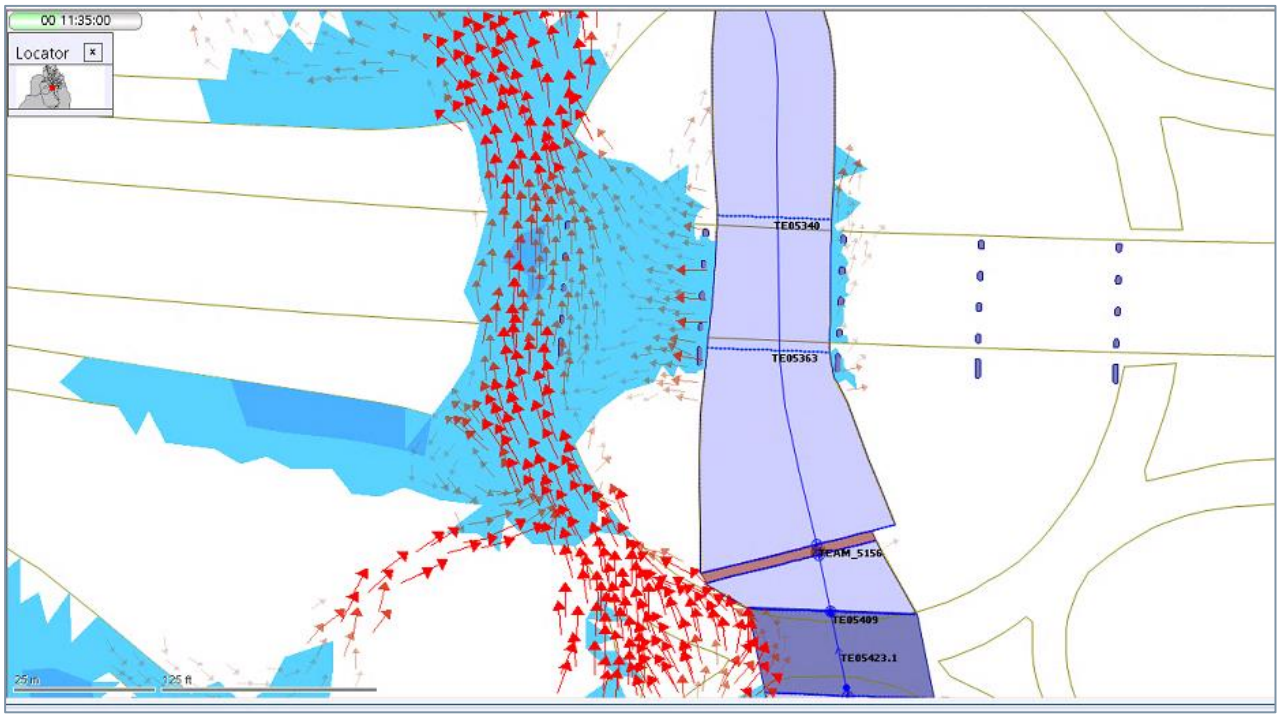


Figure 11 - Timestep 11h:35 for the 1 in 1,000 year baseline scenario

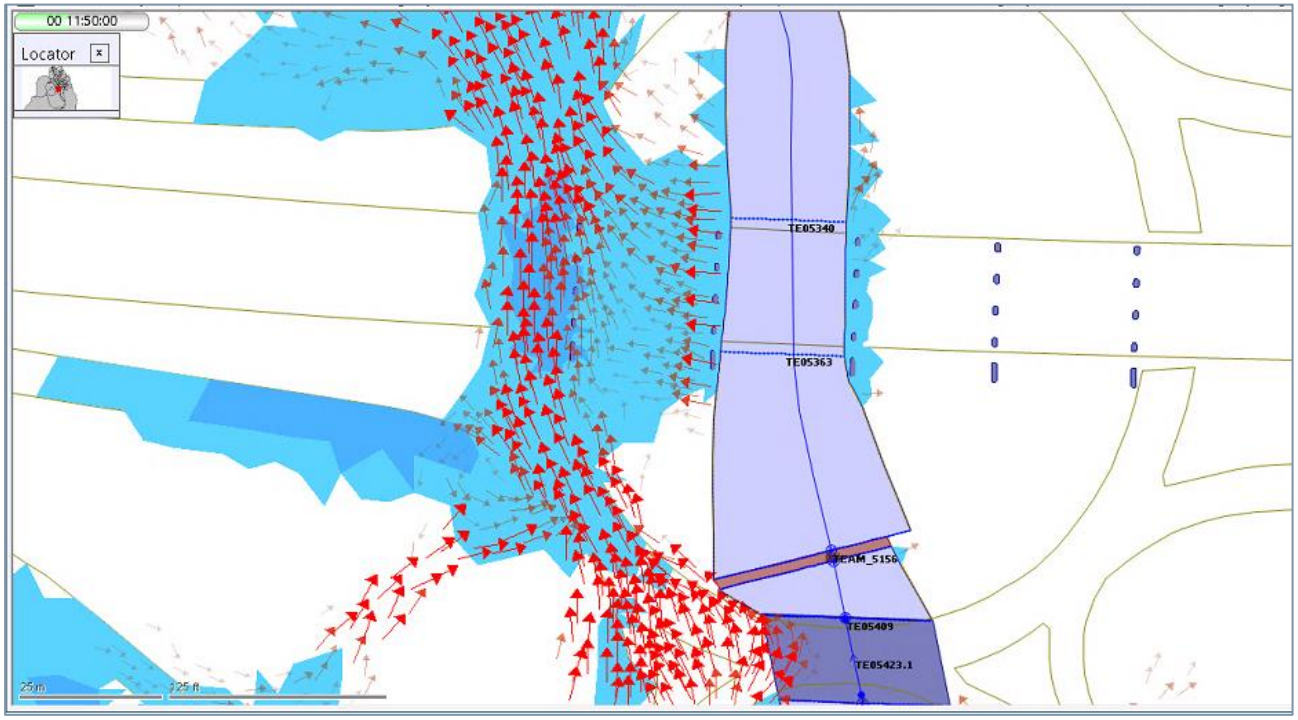


Figure 12 - Timestep 11h:50 for the 1 in 1,000 year baseline scenario

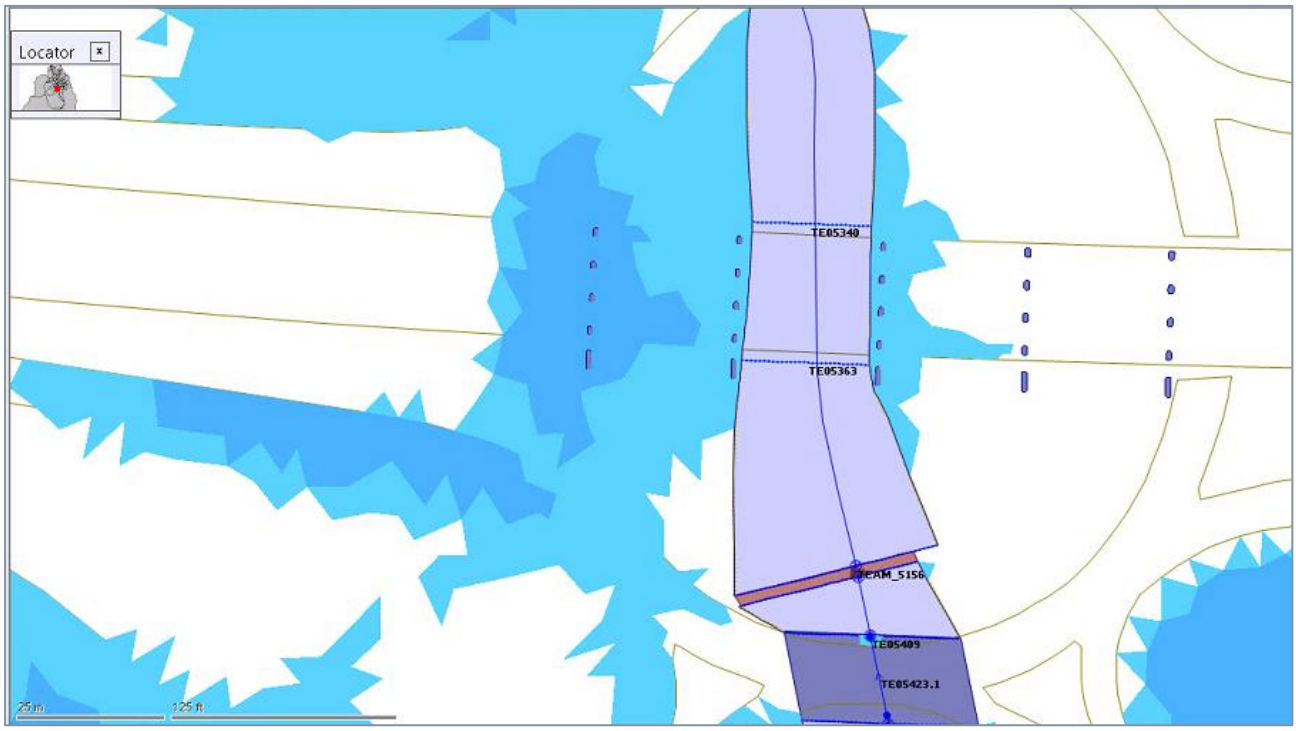


Figure 13 – Peak Extents for the 1 in 1,000 year baseline scenario

4 SUMMARY

4.1.1. This Technical Note demonstrates that the floodplain compensation storage is provided on a level for level, volume for volume basis to offset the loss of floodplain associated with the additional piers for the Kingsway Viaduct extension for events greater than the 1 in 100 year scenario.

4.1.2. The floodplain compensation is provided within the 1 in 100 year +50% climate change flood plain extents, by assessing the progression of the flood wave and bringing land into the floodplain earlier than under the baseline scenario and ensuring that a betterment through over provision of floodplain is created on a level for level, volume for volume basis.

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