Homes England

The Housing and Regeneration Agency

West of Ifield, Crawley

Phase 1 Flood Risk Assessment Addendum with Hydraulic Modelling Report

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Version 1 - Planning submission

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Flood Risk Assessment Addendum

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Appendices

Appendix A

Hydraulic Modelling Report

1 Introduction

1.1 Project Background

Arcadis Consulting (UK) Ltd (Arcadis) has been commissioned by Homes England to support the Flood Risk Assessment (FRA) process for the development of a residential-led mixed use settlement on land to the west of Ifield, West Sussex. This will include a new road, the Crawley Western Multi-Modal Corridor which is described further in section 3.

This FRA addendum describes and discusses three scheme scenarios relating to the Crawley Western Multi-Modal Corridor and its associated flood compensation design, and provides supplementary information separate to the site wide FRA (see section 1.2).

The flood risk associated with the detailed design of the Crawley Western Multi-Modal Corridor has been assessed using hydraulic modelling; the Environment Agency have been consulted on, and have approved, the hydraulic modelling of the River Mole carried out to inform this FRA addendum. At the time of writing, the Environment Agency have not provided comments on the predicted impacts of the updated Crawley Western Multi-Modal corridor on flood risk.

1.2 Scope of this Report

This addendum report should be read in conjunction with document 162007949-RAM-ZZ-XX-RP-WA-00002_P6 West of Ifield Flood Risk Assessment[1] (referred to as the Ramboll FRA throughout this addendum report) which is written in support of a hybrid planning application (part outline and part full) for the West of Ifield site. This addendum report provides supplementary detail covering the specific flood risk related to the detailed design of the Crawley Western Multi-Modal Corridor (full (Phase 1) element). The Ramboll FRA provides comprehensive up to date flood risk information which is also applicable to the Crawley Western Multi-Modal Corridor and therefore this information has not been duplicated within this FRA addendum but instead the section headings in this report cross reference the relevant Ramboll FRA sections.

[1] Ramboll (June 2025) West of Ifield Flood Risk Assessment. Report reference162007949-RAM-ZZ-XX-RP-WA-00002-S3-P06_WoI FRA.pdf

2 Policy Framework

Refer to Section 2 of the Ramboll FRA for details which are applicable to this FRA addendum.

3 Site Description

The proposed development is described in full in section 3.3 of the Ramboll FRA. This FRA addendum provides specific detail on the flood risks associated with the Crawley Western Multi-Modal Corridor which forms part of the full (Phase 1) element. The location plan is shown in Figure 3-1.

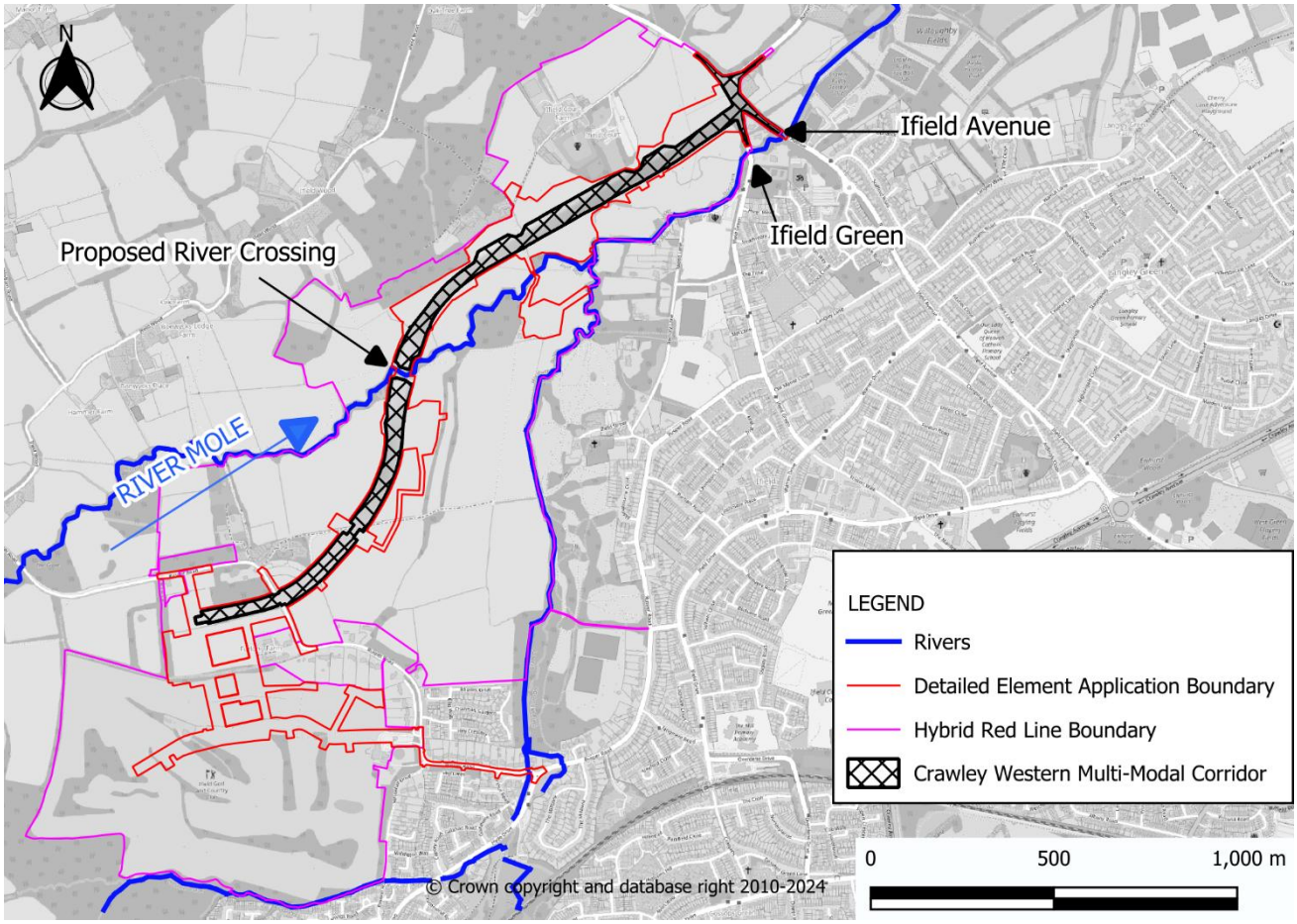


Figure 3-1: Site Location Plan

The Crawley Western Multi-Modal Corridor will link the southern area of the West of Ifield development site to the existing Ifield Avenue. The corridor will be located on an embankment which is raised above surrounding ground levels, tying into existing levels at Ifield Avenue.

The alignment of the corridor has been in development since 2019 and has involved extensive consultation with West Sussex County Council and relevant local authorities. Community engagement and pre-application discussions have also been held to ensure that the scheme follows a design response that is aligned with local objectives. The final design takes into account multiple constraints including flood risk, a scheduled ancient monument north of the River Mole, the requirement to incorporate active travel provision, presence of veteran and rare trees, ecological habitats for bats and birds and proximity of existing properties. This latest design therefore represents the optimal balance between all identified constraints.

The corridor embankment encroaches onto the existing flood plain of the River Mole at the north eastern end, therefore inclusion of the embankment in the model is key to assessing any impacts. The highway will cross the River Mole at approximate National Grid Reference (NGR) TQ 242 377. The proposed bridge will have a single span with abutments set back approximately 8m from the watercourse and a soffit level of 66.48mAOD which is 2.3m above the 1 in 100 annual chance plus 40% climate change peak flood level. The depth of

water on the floodplain in the 1 in 100 annual chance plus climate change event is less than 4cm in this location meaning that impacts on floodplain storage are negligible however patterns of floodplain conveyance are altered. Further details are included in Appendix A.

To offset the loss of floodplain storage caused by the embankment two flood compensation areas (FCAs) have been designed. The FCAs are designed to function in a similar way to an online storage solution; water flows out of the River Mole channel and into the FCAs during a flood event. As flood levels recede, water will flow back out of the FCA into the River Mole. A central channel has been included in the design of the FCA, set at the elevation of the adjacent River Mole thus allowing the FCAs to fill and empty passively. Details of the FCA maintenance is contained within the West of Ifield LEMP (report 10051123-ARC-XXX-XX-RP-LA-0001). A schematic of the Bridge design is included in Appendix A and Figure 3-2 shows the location of the FCAs and proposed highway embankment elevations.

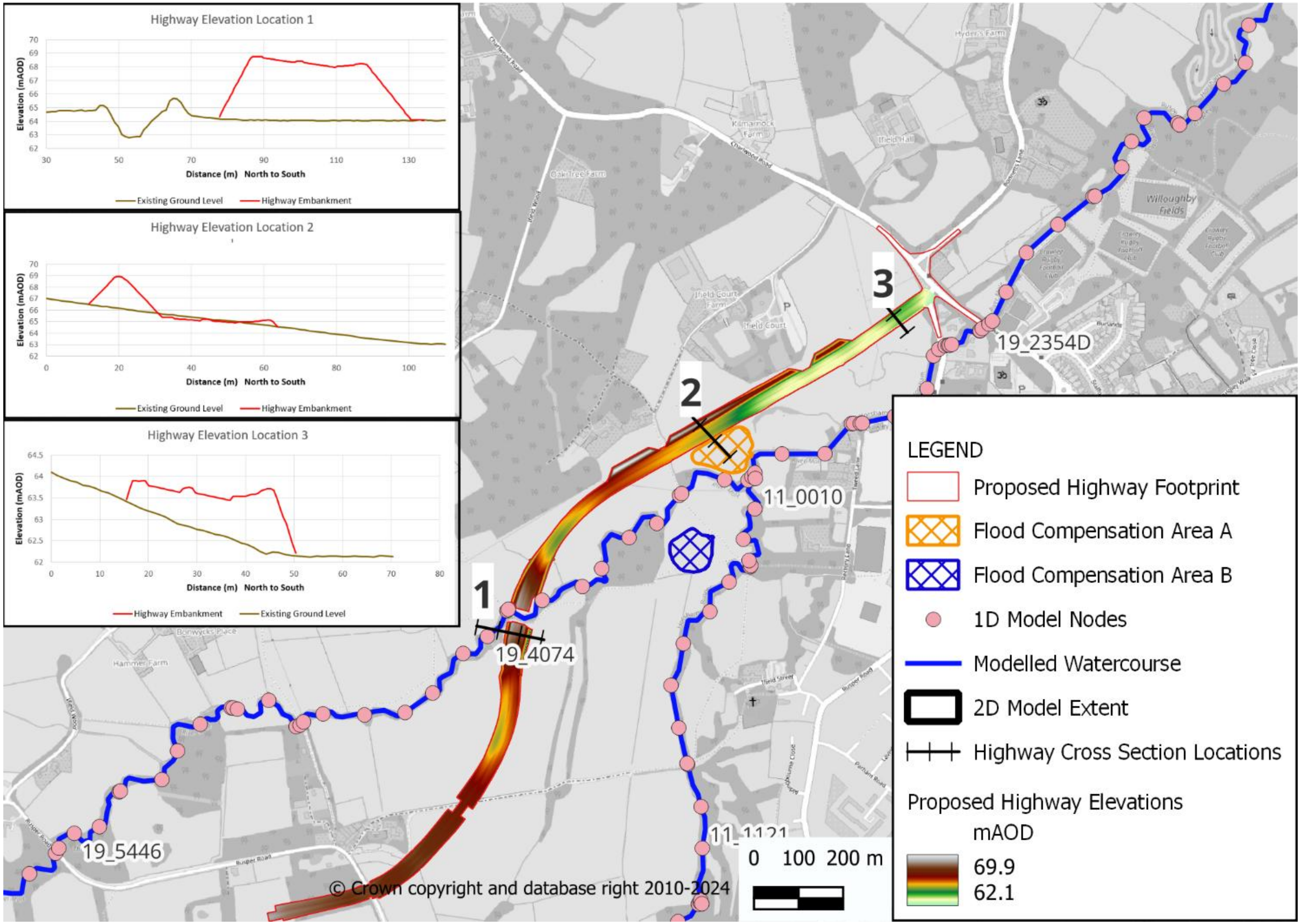


Figure 3-2: Proposed Scheme

4 Review of Baseline Data

4.1 Geological Setting

The text in the Ramboll FRA is applicable.

4.2 Hydrological Setting

The text in the Ramboll FRA is applicable.

4.3 Fluvial and Tidal Flood Zone Status

Section 4.3 of the Ramboll FRA describes the flood zone status for the hybrid application boundary. Figure 4-1 below overlays the current Environment Agency flood zones with the Crawley Western Multi-Modal Corridor.

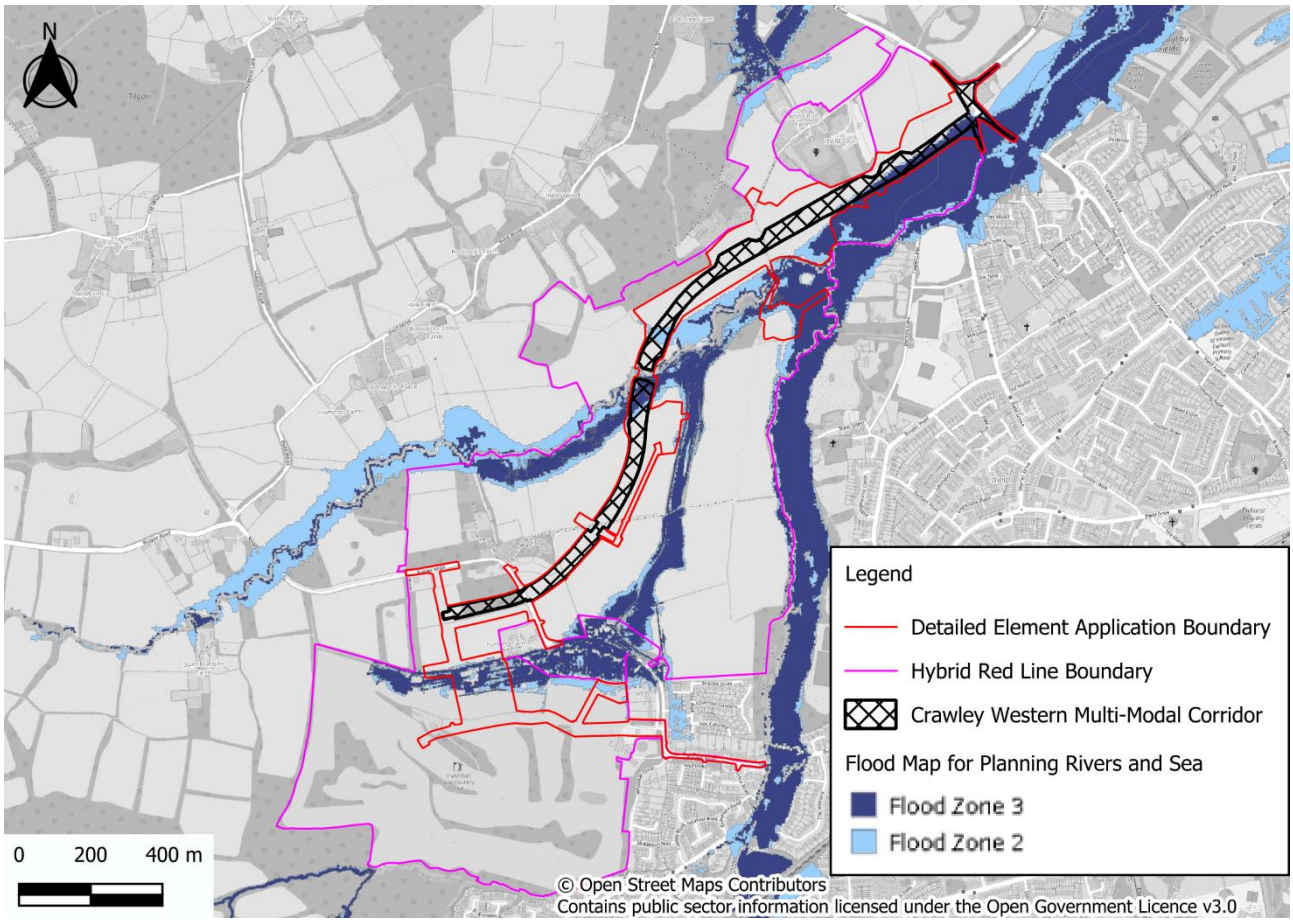


Figure 4-1: Environment Agency Fluvial Flood Zones

The Crawley Western Multi-Modal Corridor, which will link the southern area of the West of Ifield development site to the existing Ifield Avenue, is partially located within Flood Zone 3 (Figure 4-1). Hydraulic modelling of the River Mole and Ifield Brook was completed to understand the impact of flooding on the Crawley Western Multi-Modal Corridor and to identify any potential increases in flood risk to third parties resulting from the Crawley Western Multi-Modal Corridor. This work is summarised in section 5 with the detailed hydraulic modelling report included in Appendix A.

4.4 Flood Defences

There are no formal flood defences on the River Mole in the vicinity of the Crawley Western Multi-Modal Corridor. Environment Agency data records natural high ground to be present along the banks of the watercourse.

4.5 Surface Water Flood Risk

Section 4.5 of the Ramboll FRA details the Surface Water Flood Risk for the hybrid application boundary. Figure 4-2 below overlays the Environment Agency surface water map with the Crawley Western Multi-Modal Corridor. This shows the surface water flood extents to be predominantly constrained to the watercourse corridors. Parts of the proposed Crawley Western Multi-Modal Corridor are located within area of high surface water flood risk, this is discussed in more detail in section 5.

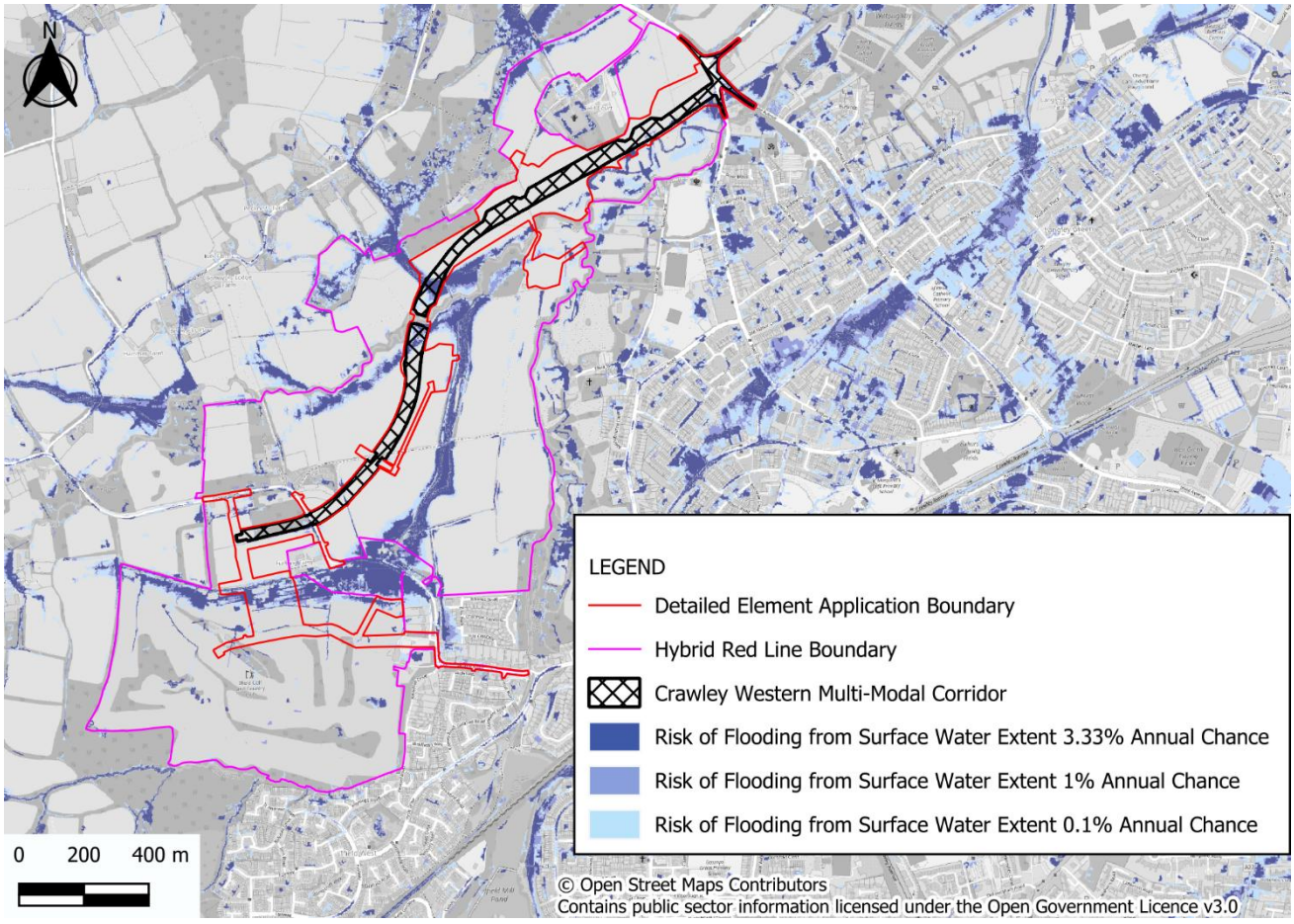


Figure 4-2: Environment Agency Surface Water Flood Risk

4.6 Groundwater Flood Risk

The text in the Ramboll FRA is applicable.

4.7 Risk from Reservoirs and Other Artificial Sources

Figure 4-3 below overlays the current Environment Agency reservoir flood map with Crawley Western Multi-Modal Corridor. It shows that parts of the corridor are at risk of flooding from reservoirs. However, the Environment Agency ensures that reservoirs are inspected regularly, and essential safety work is carried out meaning that a risk of failure is extremely low.

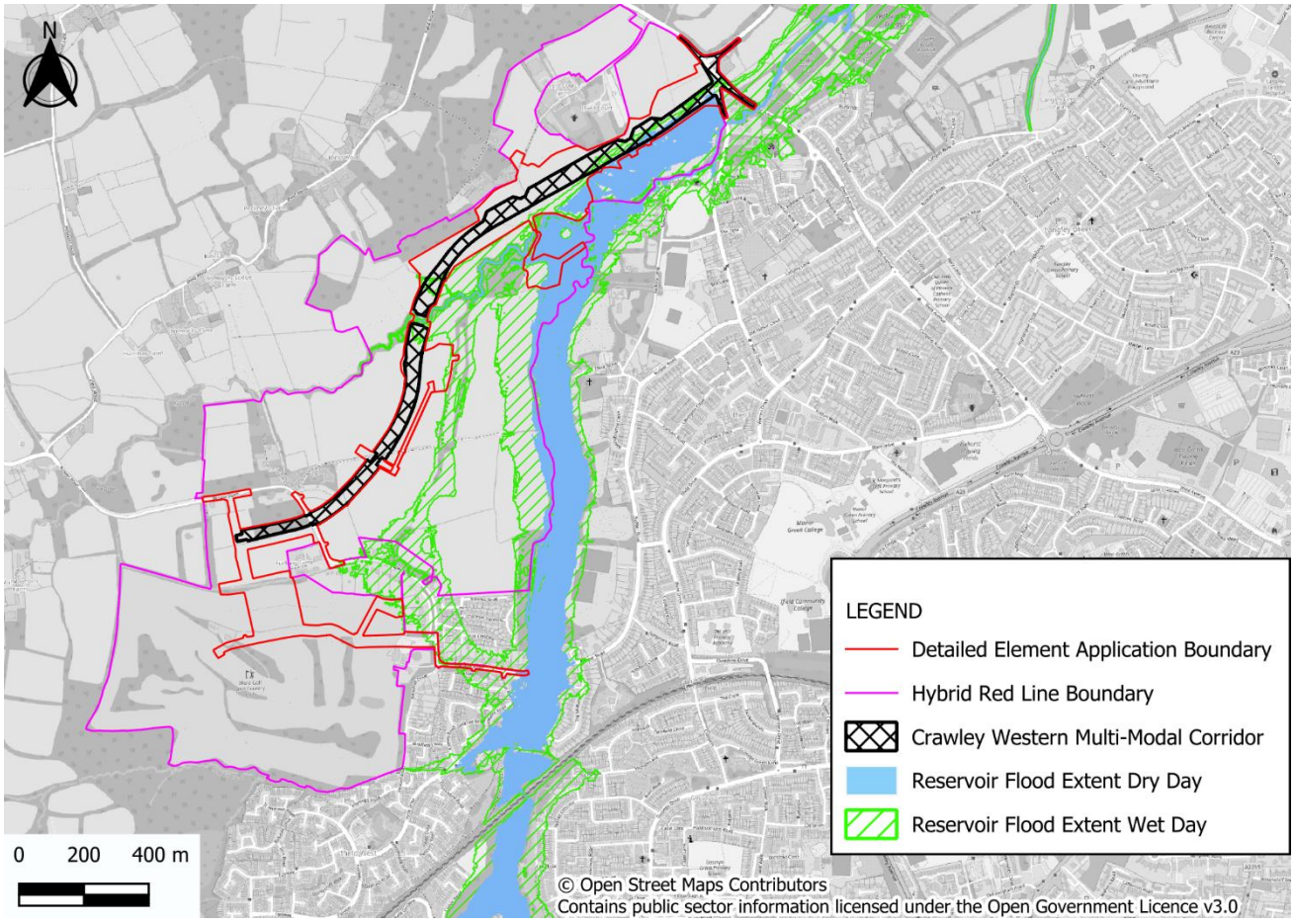


Figure 4-3: Environment Agency Risk of Flooding from Reservoirs Map

4.8 Historic Flooding

Figure 4-4 below overlays the Environment Agency Recorded Flood Outlines with the Crawley Western Multi-Modal Corridor. This shows that the very northern end of the corridor falls within an area recorded as flooding in the past.

In a meeting held with the Environment Agency and Homes England in April 2024, Arcadis were not made aware of any recent flood events occurring on the site.

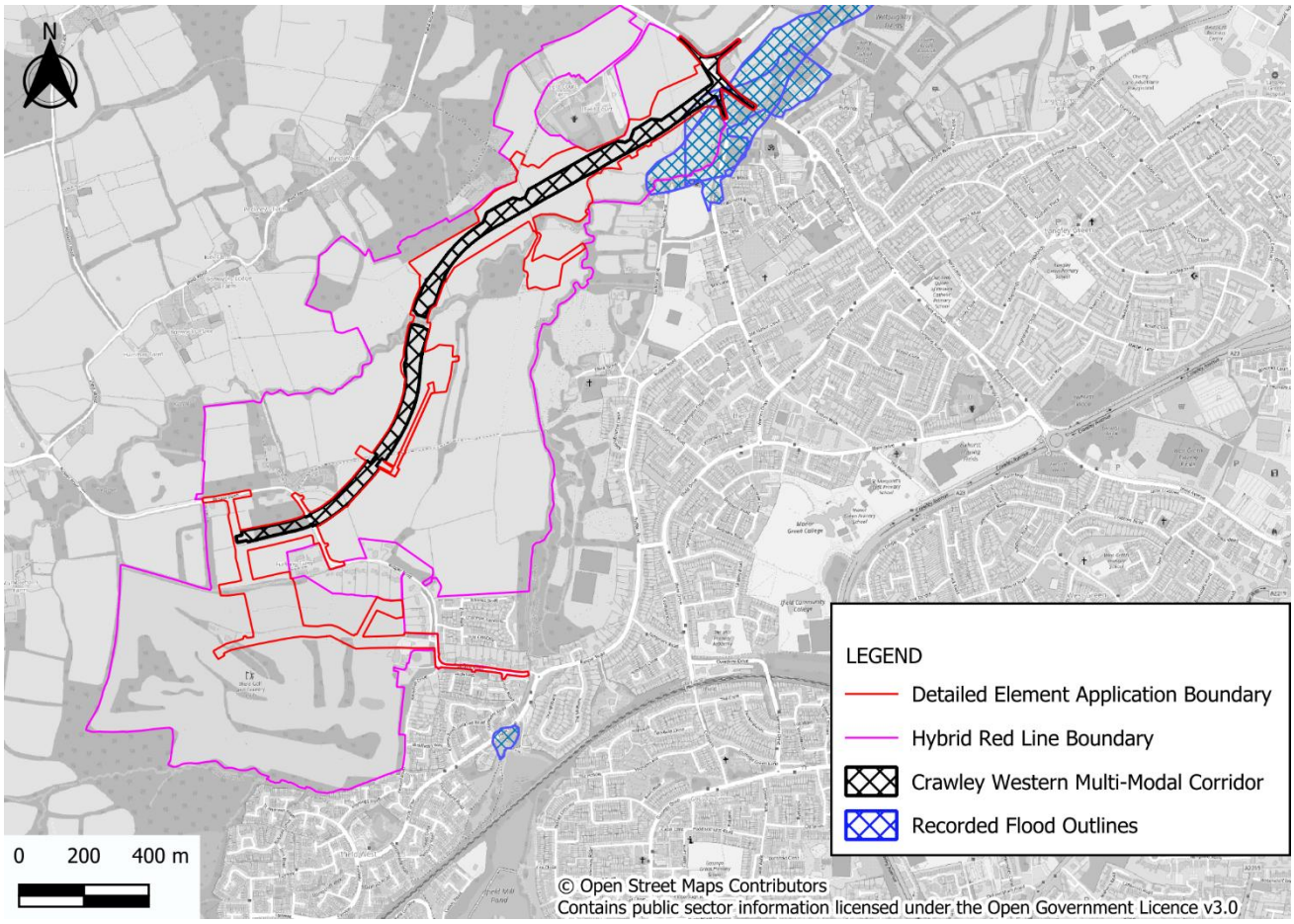


Figure 4-4: Environment Agency Recorded Flood Outlines

5 Assessment of Flood Risk

5.1 Proposed Development

This FRA addendum only considers the flood risk implications related to the Crawley Western Multi-Modal Corridor in detail, supported by detailed hydraulic modelling.

Section 4 provides a summary of the existing flood risk sources and identifies that the Crawley Western Multi-Modal Corridor could be at high fluvial and surface water flood risk. These two sources are considered in more detail below. Flood risk from all other sources is not considered to pose an onerous risk to the Crawley Western Multi-Modal Corridor and is therefore not considered further within this FRA addendum.

5.2 Sequential Test and Exception Test

The text in the Ramboll FRA Section 5.3, 5.4 and 5.5 is applicable to this FRA addendum, covering as it does, the entirety of the West of Ifield development.

5.3 Fluvial Flood Risk and Mitigation

5.3.1 Hydraulic Model Summary

Hydraulic modelling has been used to support the development of the detailed application design of the Crawley Western Multi-Modal Corridor. The hydraulic model used to inform a previously issued version of the Ramboll FRA (April 2023) has been reused to inform this FRA Addendum. This model was reviewed and approved by the Environment Agency[2] in 2023. Following this, the existing model was reviewed by Arcadis, some minor updates made and the model reused to assess the latest Crawley Western Multi-Modal Corridor design. In addition, new design hydrology was prepared for the 1 in 30 annual chance event to support the most up to date definition of the functional floodplain. These updates are described in more detail in the hydraulic modelling report included in Appendix A.

A schematic of the updated baseline model is presented in Figure 5-1 with additional details and supplementary technical information provided in the hydraulic modelling report included in Appendix A.

[2] Communications via email, Ref: West of Ifield : ENVPAC/1/SSD/00250 - 28 November 2022 10:35

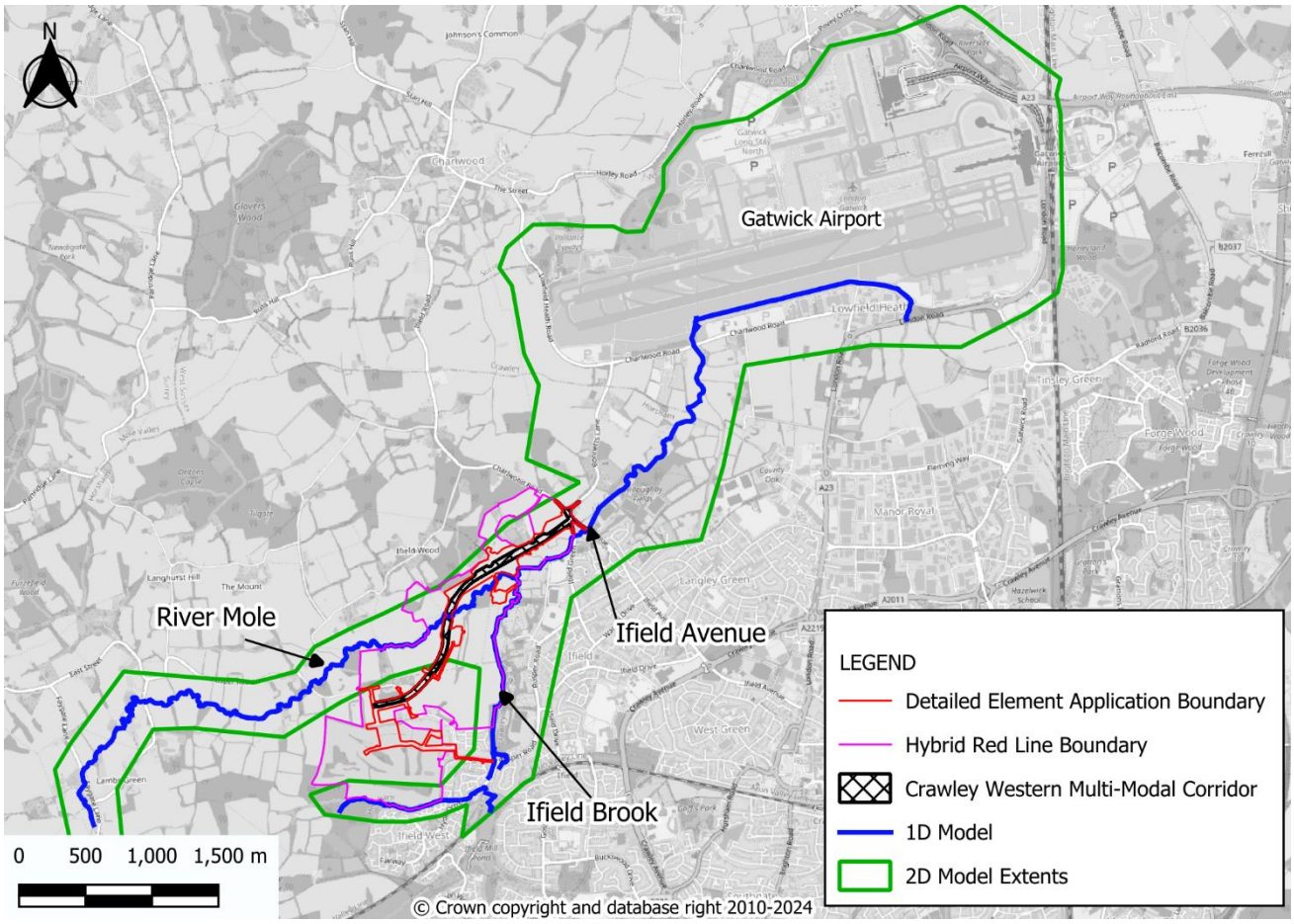


Figure 5-1: Baseline Model Schematic

A schematic of the with scheme model is presented in Figure 5-2 with additional details and supplementary information provided in the hydraulic modelling report (Appendix A). The with scheme model includes a representation of the Crawley Western Multi-Modal corridor and the two flood compensation areas. Information on the volumes provided by the flood compensation areas is included in Appendix A.

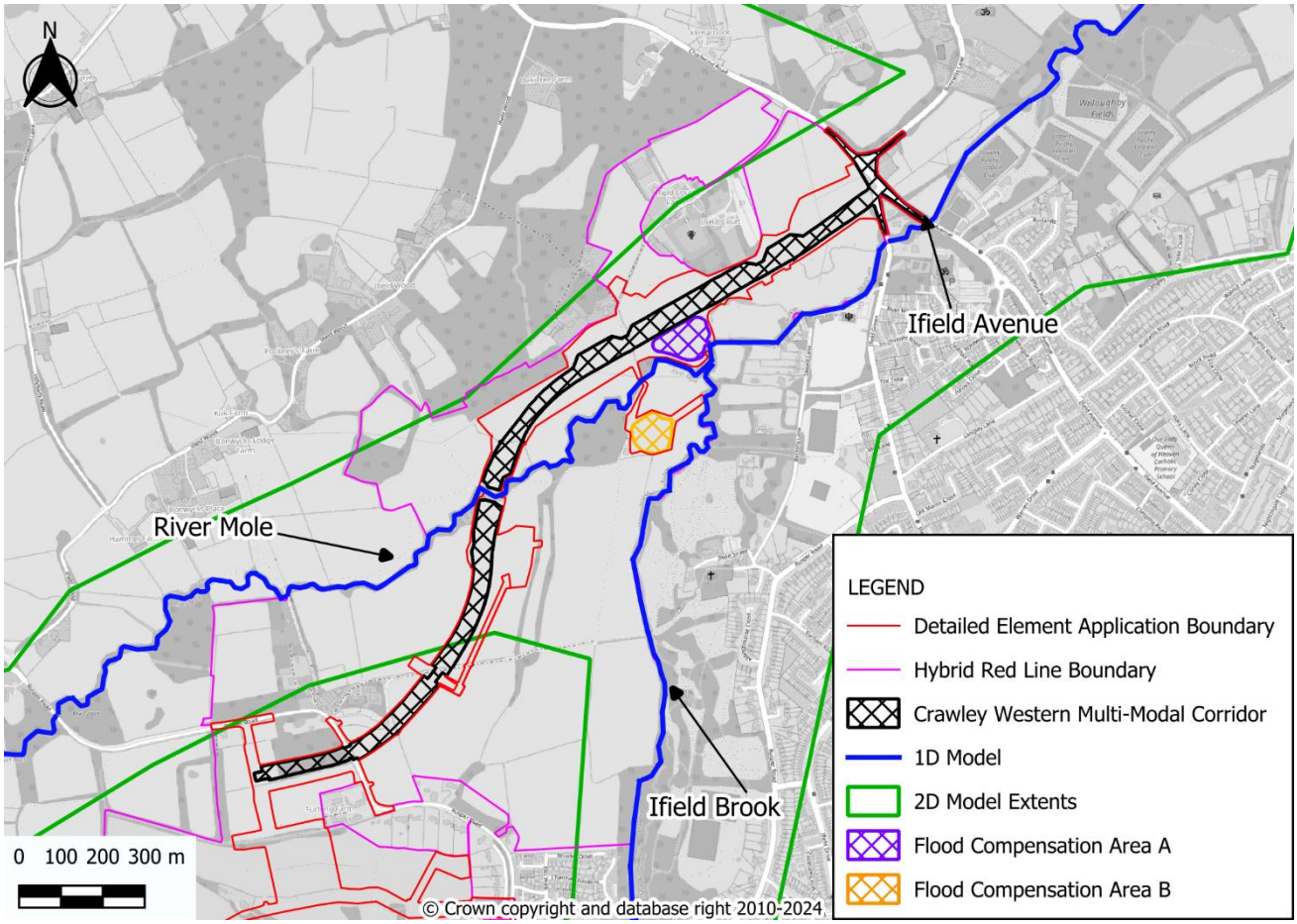


Figure 5-2: With Scheme Model Schematic

Three scenarios were assessed using the updated hydraulic model:

- Proposed Crawley Western Multi-Modal Corridor (embankment and bridge) only
- Proposed Crawley Western Multi-Modal Corridor (embankment and bridge) and flood compensation area A
- Proposed Crawley Western Multi-Modal Corridor (embankment and bridge) and flood compensation areas A and B

5.3.2 Impacts of Modelling Proposed Corridor Only

A comparison of the change in flood depths with the scheme in place for the 1 in 100 annual chance event plus climate change has been made. The difference in modelled flood depths between the baseline and with scheme scenario have calculated and used to create a depth difference map (Figure 5-3) for the 1 in 100 annual chance plus climate change event. The green colours on the difference map refer to areas where the depth has reduced in the with scheme scenario compared to the baseline and yellow and orange colours where depths have increased as a result of the with scheme scenario. All increases are within the hybrid application boundary and do not encroach onto third party land. A full set of drawings showing the results for both the 12 hour and 24 hour storm duration is included in Appendix A.

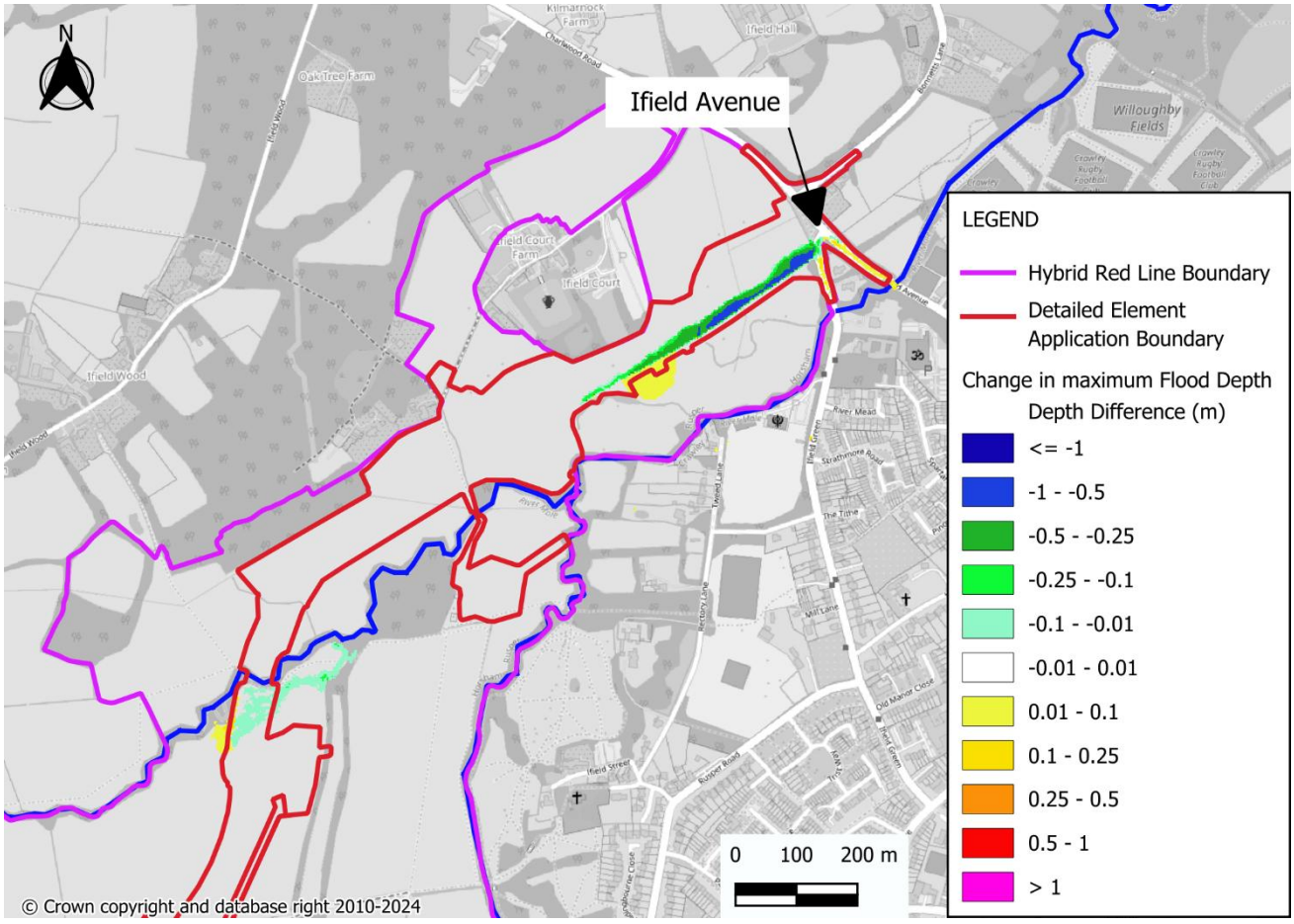


Figure 5-3: Depth difference plot, with scheme peak flood depths minus updated baseline peak flood depths, 1 in 100 annual chance plus climate change, 12 hour storm duration.

An assessment of the change in flow rates and volumes passing downstream of Ifield Avenue has been made to confirm that no unacceptable third party impacts are predicted to occur as a result of the scheme. Figure 5-4 presents the hydrographs for the 1 in 100 annual chance event inclusive of climate change for the updated baseline and with scheme scenario. The changes in the peak flows and volumes passing downstream of Ifield Avenue are negligible with no change in the peak flow and an increase in total volume of 0.04%, therefore no further consultation with third parties has been carried out as part of this FRA.

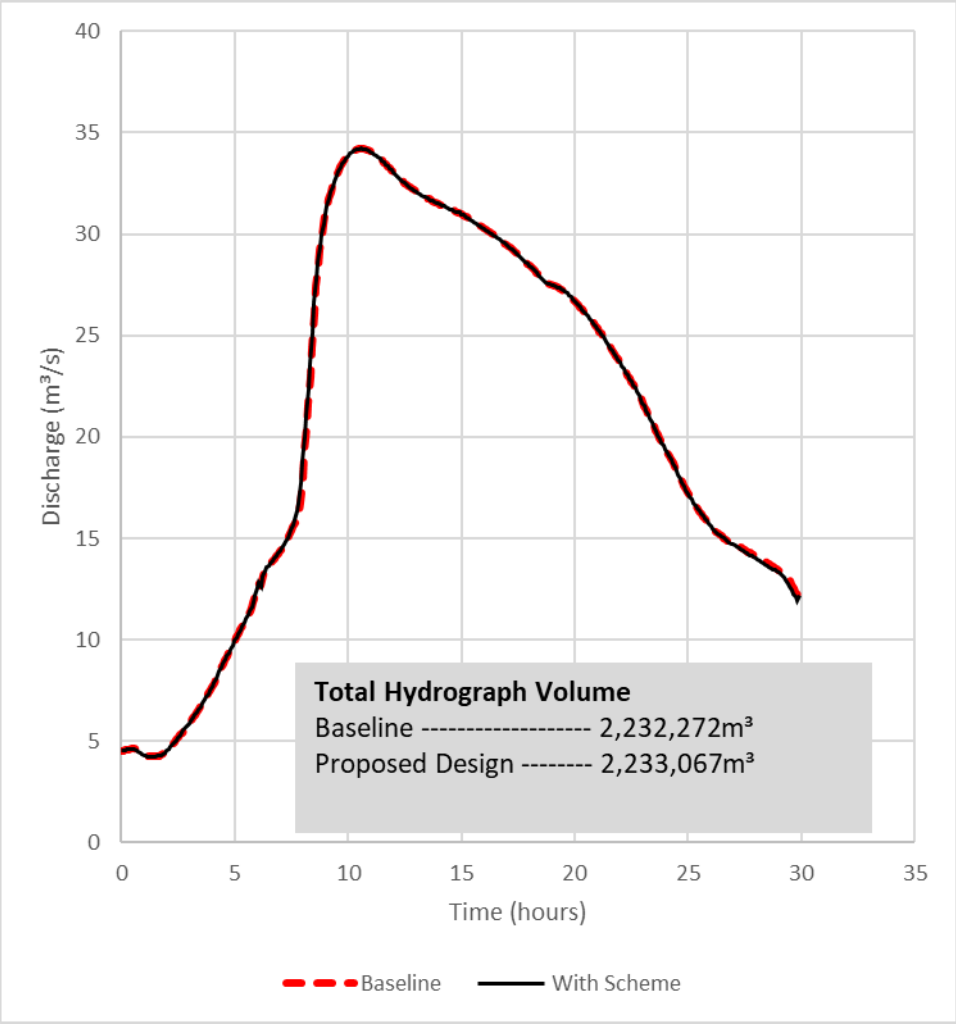


Figure 5-4: Flow hydrograph at Ifield Avenue, updated baseline and with scheme scenarios, 1 in 100 annual chance plus climate change, 12 hour storm duration.

5.3.3 Impacts of Modelling Proposed Corridor and FCA A

A comparison of the change in flood depths with the scheme and FCA A in place for the 1 in 100 annual chance event plus climate change has been made. A depth difference plot is shown in Figure 5-5. All increases are within the hybrid application boundary and do not encroach onto third party land.

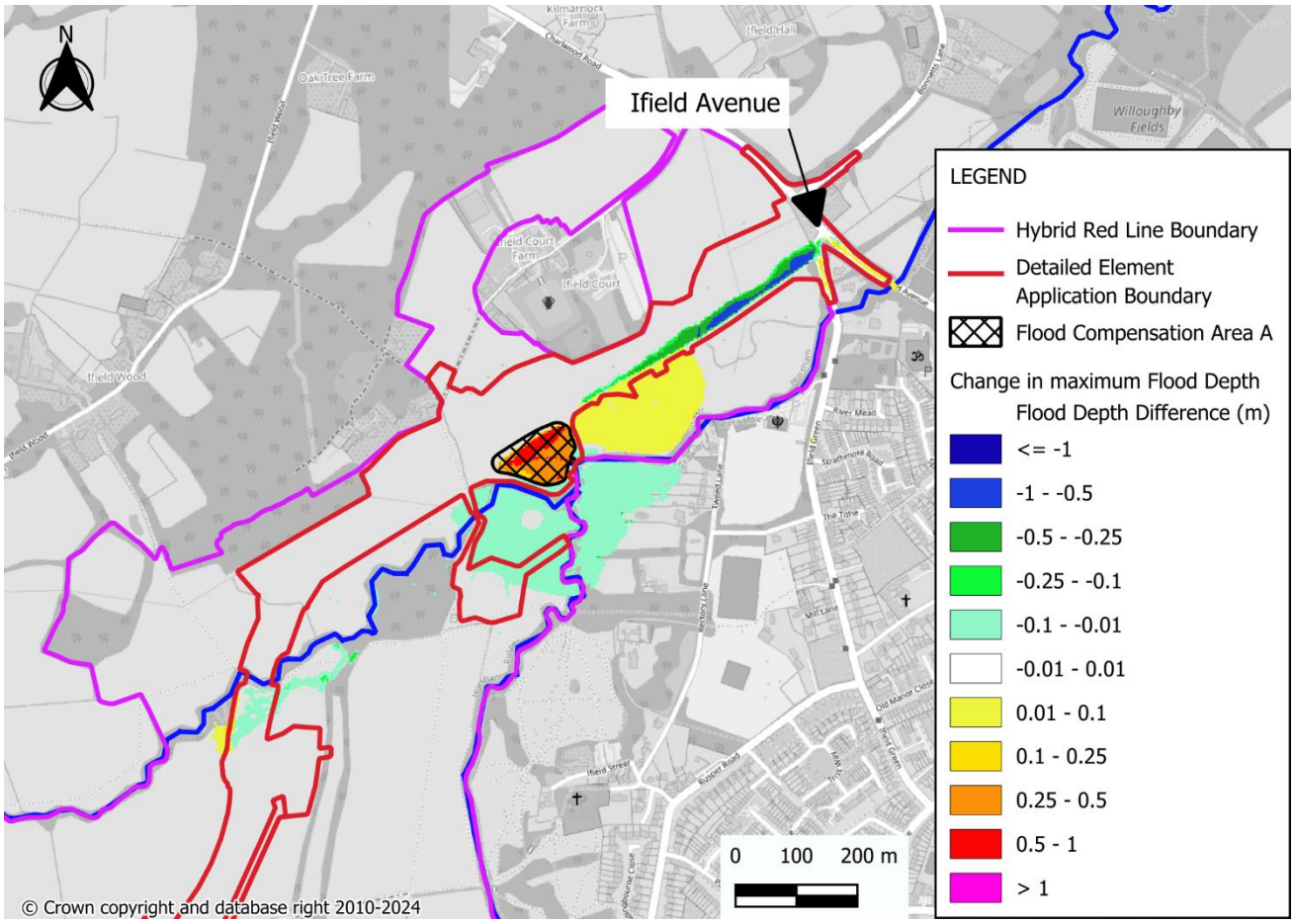


Figure 5-5: Depth difference plot, with scheme and FCA A peak flood depths minus updated baseline peak flood depths, 1 in 100 annual chance plus climate change, 12 hour storm duration.

Figure 5-6 presents the hydrographs for the 1 in 100 annual chance event inclusive of climate change for the updated baseline and with scheme and FCA A scenarios. The changes in the peak flows and volumes passing downstream of Ifield Avenue are negligible with no change in peak flow predicted and the total volume predicted to reduce by 0.02%.

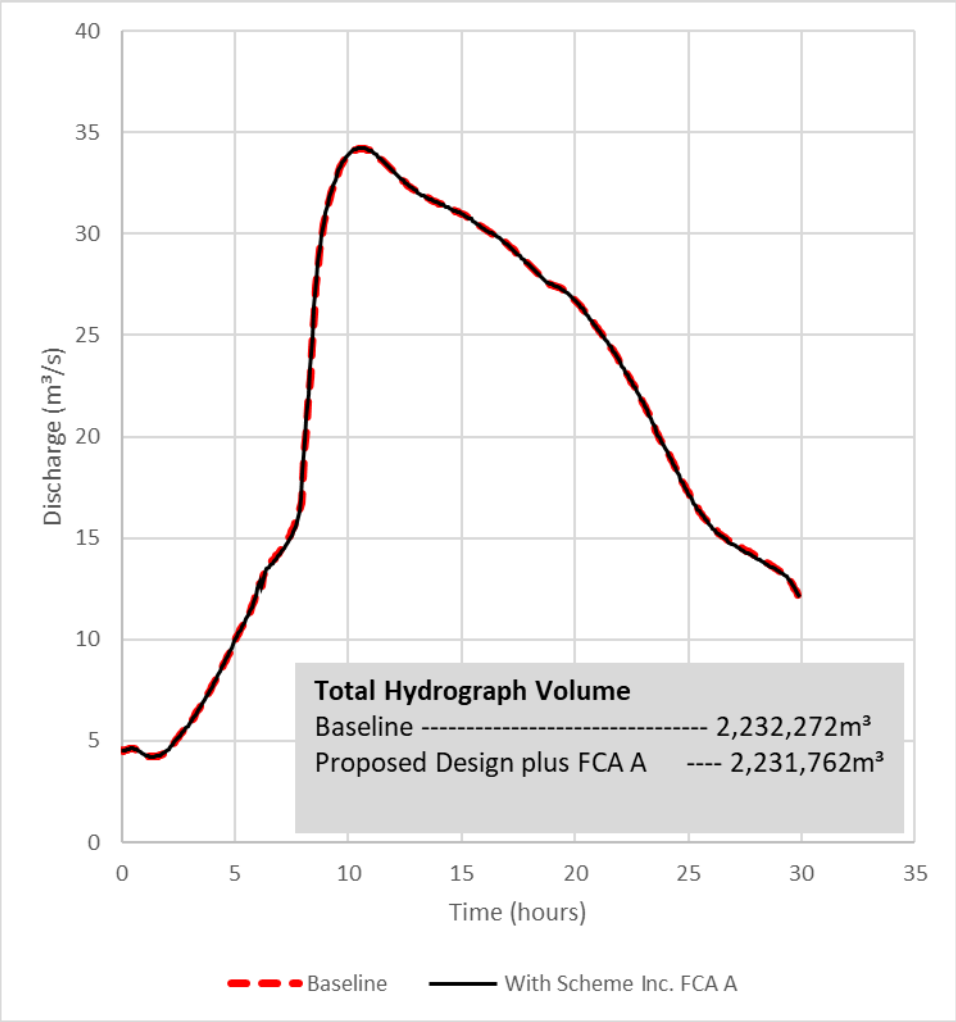


Figure 5-6: Flow hydrograph at Ifield Avenue, updated baseline and with scheme and FCA A scenarios, 1 in 100 annual chance event plus climate change, 12 hour storm duration.

The FCA is predicted to become active in the 1 in 5 annual chance event (smallest design flood event modelled) however FCA A only becomes partially inundated for a duration of four hours (for the 12 hour critical storm duration).

5.3.4 Impacts of Modelling Proposed Corridor, FCA A and FCA B

A comparison of the change in flood depths with the scheme, FCA A and FCA B in place for the 1 in 100 annual chance event plus climate change has been made. A depth difference plot is shown in Figure 5-7. All increases are within the hybrid application boundary and do not encroach onto third party land.

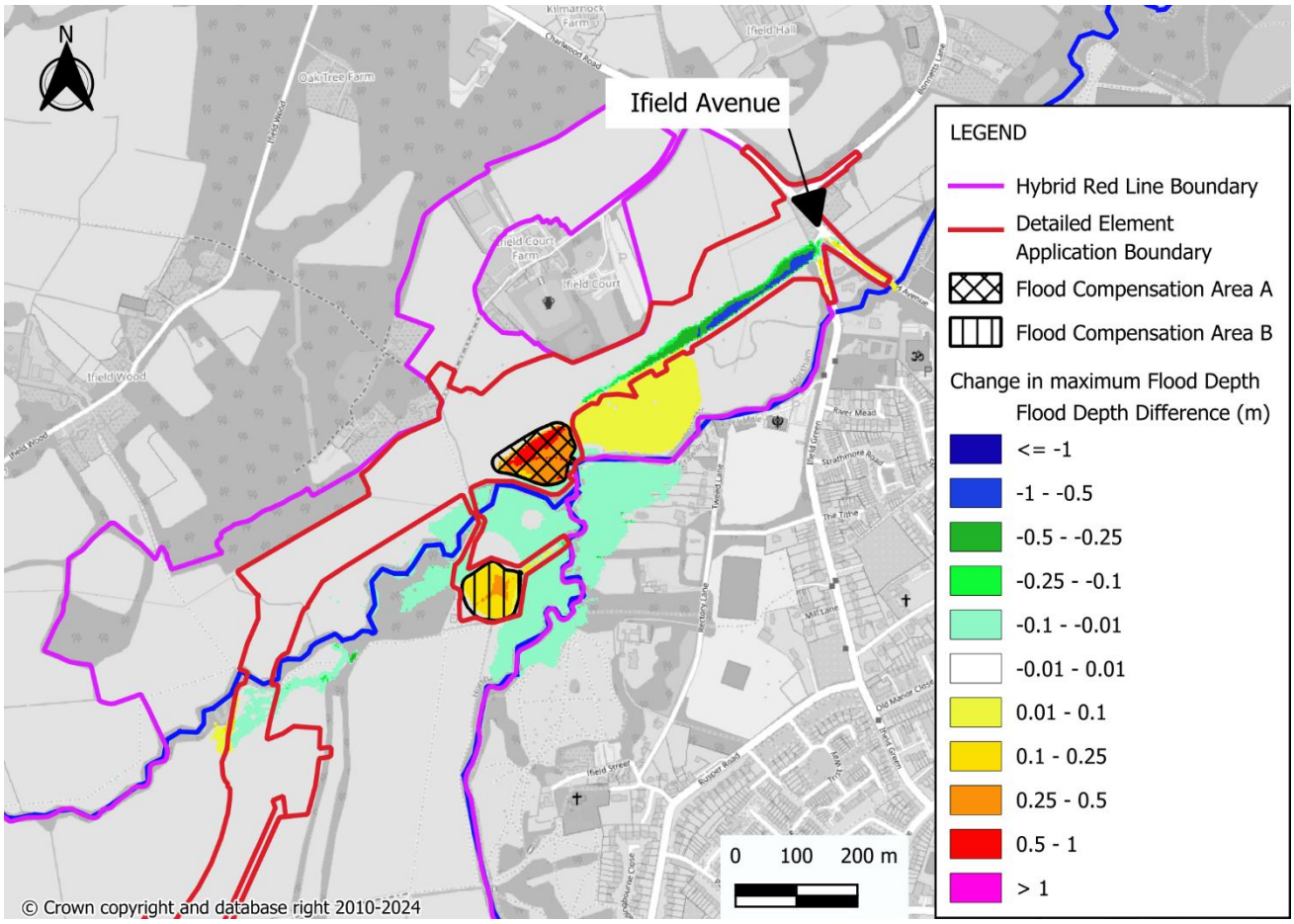


Figure 5-7: Depth difference plot, with scheme FCA A and FCA B peak flood depths minus updated baseline peak flood depths, 1 in 100 annual chance event plus climate change, 12 hour storm duration.

Figure 5-8 presents the hydrographs for the 1 in 100 annual chance event inclusive of climate change for the updated baseline and with scheme and FCA A and B scenarios The changes in the peak flows and volumes passing downstream of Ifield Avenue are negligible with no change in peak flow predicted and the total volume predicted to reduce by 0.03%.

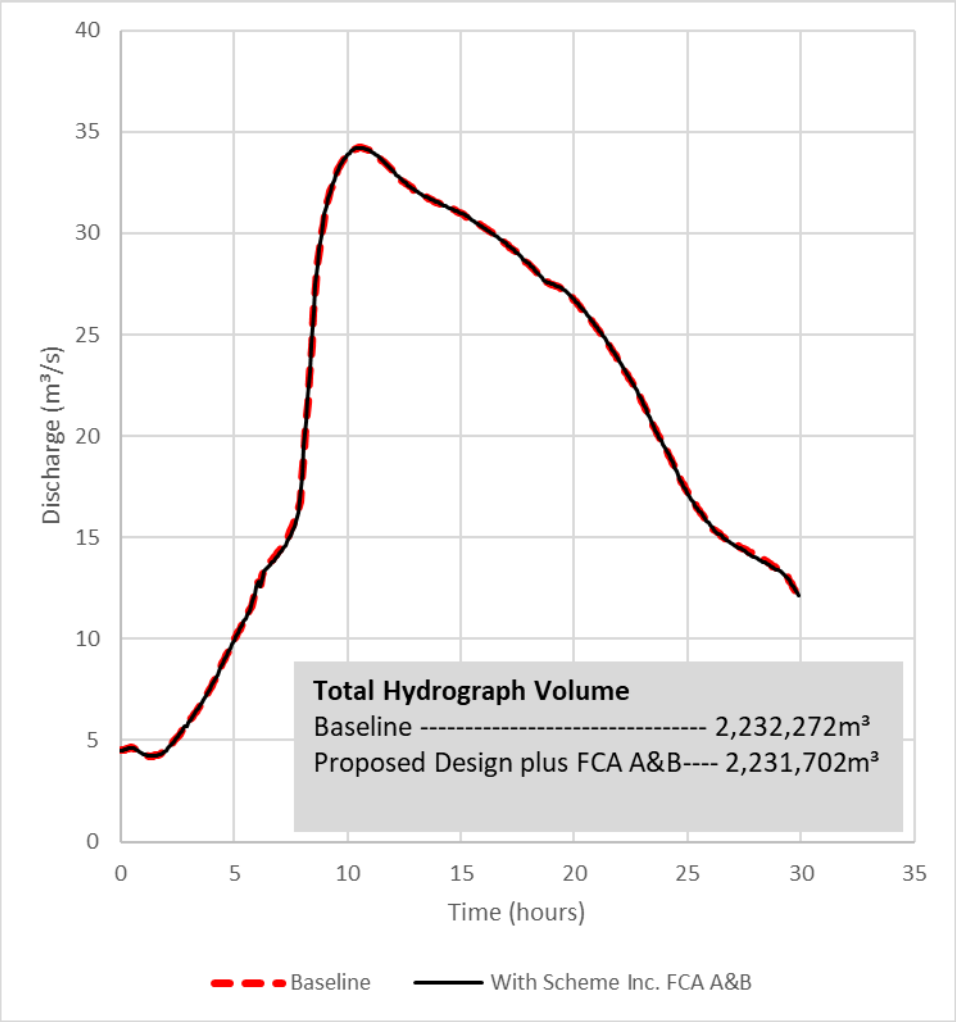
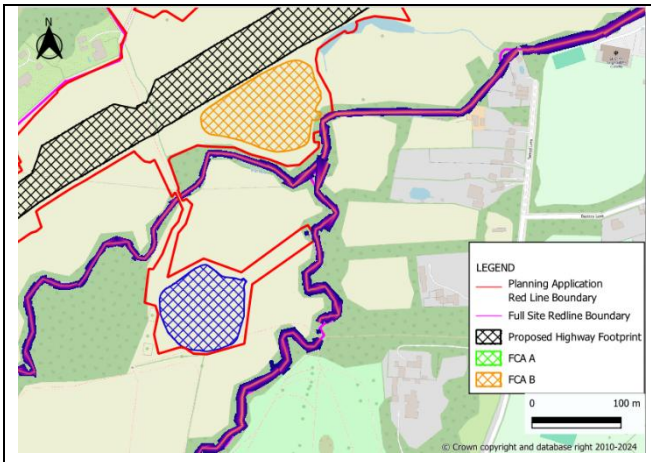


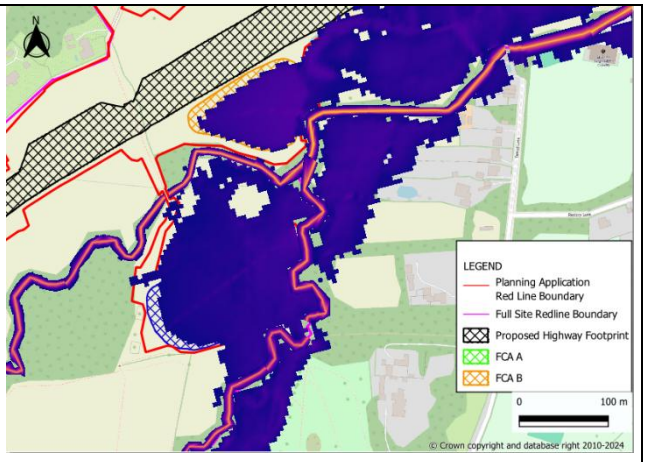
Figure 5-8: 1% AEP CC Flow hydrograph at Ifield Avenue, updated baseline and with scheme, FCA A and FCA B scenarios, 1 in 100 annual chance event plus climate change, 12 hour storm duration.

Both the FCAs are predicted to become active in the 1 in 5 annual chance (smallest design flood event modelled). FCA A is partially flooded with flood water receding between three and four hours after it first becomes inundated. FCA B is partially inundated; flood water recedes between two and three hours after it first becomes inundated. FCA B receives flood water from the channel connecting it with the River Mole as well as from some overland flow from upstream.

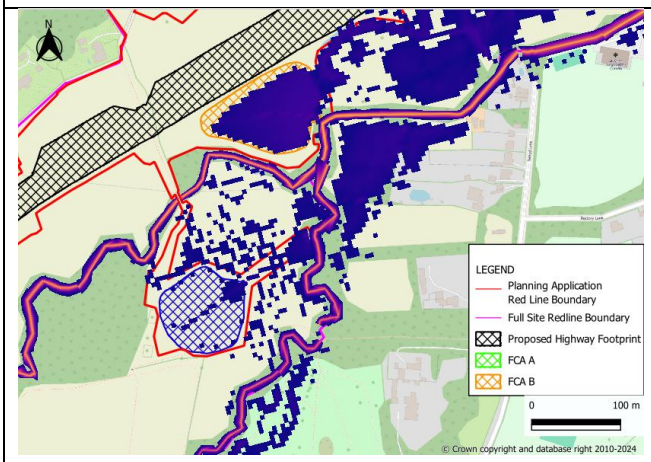
The flow mechanisms for the filling and emptying of the FCAs are presented in Figure 5-9 and Figure 5-10 for the 1 in 30 annual chance event and the 1 in 100 annual chance event including climate change respectively. The FCAs drain passively and are largely empty 24 to 36 hours later.



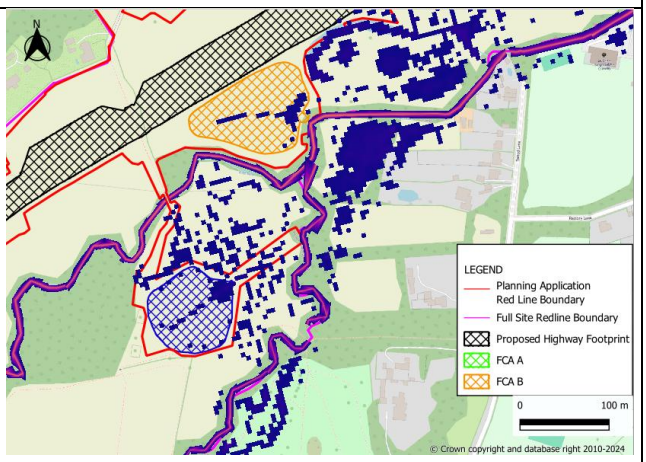
Flood extent at +06 hours



Flood extent at +10 hours



Flood extent at +20 hours



Flood extent at +30 hours

Figure 5-9: Flood progression plot, 1 in 30 annual chance event plus climate change, 12 hour storm duration.

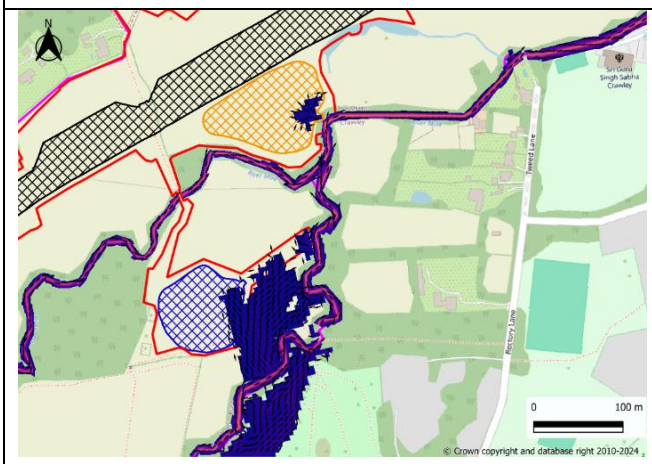
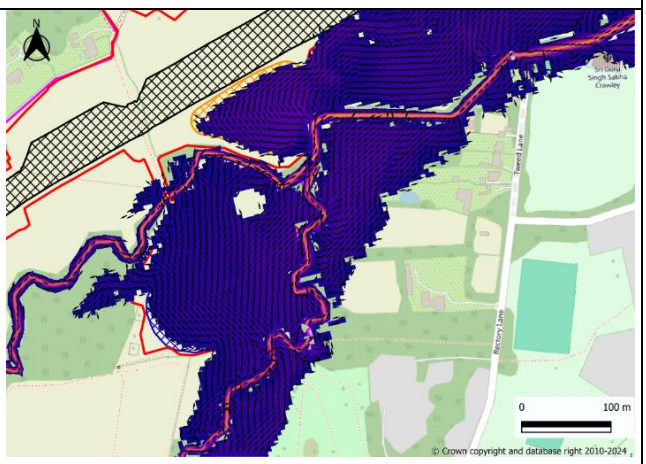
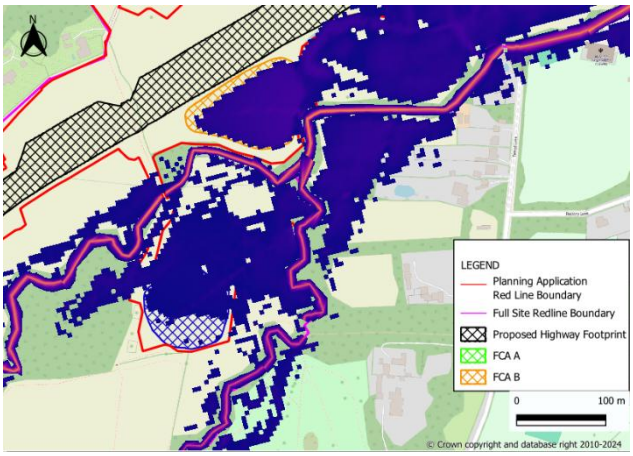
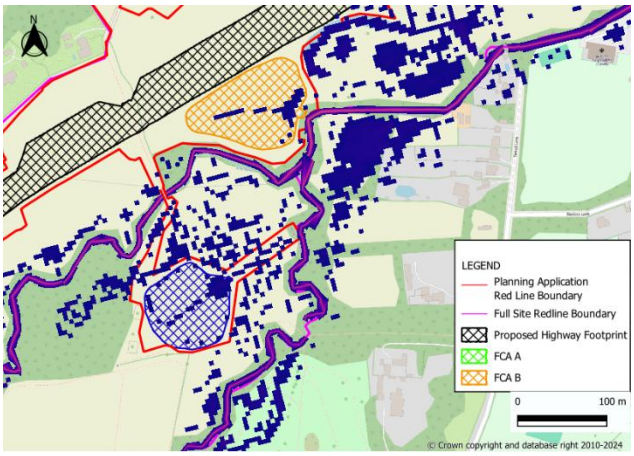
1 in 100 annual chance event plus climate change 12 hour storm duration	
	
Flood extent at +6 hours	Flood extent at +10 hours
	
Flood extent at +24 hours	Flood extent at +36 hours

Figure 5-10: Flood progression plot, 1 in 100 annual chance event plus climate change, 12 hour storm duration.

5.3.5 Summary of Impact on Fluvial Flood Risk within the Site Boundary

Mapped flood extents for the with scheme model for the 1 in 30, 1 in 100 (with and without climate change) and 1 in 1000 annual chance events are included in Appendix A. This demonstrates that the scheme is not predicted to flood in all events up to and including the 1 in 1000 annual chance. Proposed development across the wider site is located outside of the floodplain.

5.4 Surface Water Flood Risk and Mitigation

The surface water flood risk maps (section 4) show several overland flow paths in the vicinity of the Crawley Western Multi-Modal Corridor. The largest of these is associated with the River Mole and can be considered a fluvial flood extent and is therefore addressed under the above fluvial flood risk section. The remaining overland flow paths that are impacted by the Crawley Western Multi-Modal Corridor are associated with various field ditches and the increase in impermeable land surface. A surface water drainage strategy[3] has been developed that mitigates the impact of the Crawley Western Multi-Modal Corridor and therefore the surface water flood risk both to and resulting from the proposal is considered acceptable.

[3] Arcadis (June 2025), 10051123-ARC-050-ZZ-TR-CE-00002 Surface Water Drainage Design Report

6 Conclusions

An addendum to the West of Ifield Flood Risk Assessment report prepared by Ramboll has been written to assess in detail the flood risk associated with the Crawley Western Multi-Modal Corridor. This addendum report should be read in conjunction with the Ramboll FRA[1].

The hydraulic model originally developed by Ramboll for a previous issue of their FRA has been updated by Arcadis to represent the baseline scenario; updated topographical data was used and improvements to the boundaries between the 1D and 2D elements of the model were made.

New design hydrology for the 1 in 30 annual chance (3.33% AEP) flood event has been generated to define the functional floodplain.

A with scheme model has been developed by adding the proposed Crawley Western Multi-Modal Corridor embankment and crossing of the River Mole along with two floodplain compensation areas to the updated baseline model.

Model results show that the Crawley Western Multi-Modal Corridor is not at risk of flooding for all modelled events up to and including the 1 in 1000 annual chance event.

The proposed floodplain compensation areas are hydraulically connected to the River Mole and are designed to fill and empty passively. They are operational in the smallest design flood event modelled, the 1 in 5 annual chance; inundation is predicted to last for up to four hours in FCA A and three hours in FCA B.

Modelled peak flood depths are increased as a result of the scheme regardless of whether the floodplain compensation areas are included; placement of the highway embankment in the floodplain restricts the floodplain flow pathways causing an increase in flood depths which is constrained to the hybrid application boundary. However, the presence of the floodplain compensation areas do provide a minor benefit in terms of reducing the total volume of flow which passes downstream of Ifield Avenue.

Any increases in flood depths resulting from the scheme occur within the hybrid planning application boundary and are within areas already predicted to flood and thus remote from developed areas.

Hydraulic modelling of the proposed Crawley Western Multi-Modal Corridor has demonstrated that the proposals will be safe for the development life and do not increase flood risk downstream nor impact third party flood risk.

Surface water flood risk does not pose a risk to the proposed development and the impacts of the development will be adequately mitigated via a suitable surface water drainage strategy.

Appendix A

Hydraulic Modelling Report

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