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EWR-P1- Level 3 FRA: Langford Lane

Wallingford HydroSolutions Limited

Network Rail

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For and on behalf of Wallingford HydroSolutions Ltd.

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Contents

1 Introduction

1.1 Background

Environmental Resources Management (ERM) and Wallingford HydroSolutions Ltd. (WHS) completed a Level 2 Flood Risk Assessment (FRA) in 2009 (including a revision in July 2010), together with a Technical Paper[1] outlining potential flood storage mitigation requirements for the proposed Chiltern Railways Bicester to Oxford improvement scheme in support of an application for an Order under the Transport and Works Act 1992 (TWA) by Chiltern Railways (CRCL). The TWA Order was granted by the Secretary of State for Transport in October 2012. This gives statutory powers to authorise the East West Rail Phase 1 (EWR P1) project, comprising the redevelopment and operation of the railway between Oxford and Bicester. The project seeks to introduce a new, fast service between London and Oxford.

The Level 2 FRA was conducted in accordance with Planning Policy Statement 25: Development and Flood Risk (PPS25), and its Practice Guide companion. The Level 2 FRA document highlighted a number of locations along the railway corridor where proposed developments lie within Flood Zones 2 or 3 and could potentially have impacts upon the incidence of local flooding. The report identified a number of assessment points (AP's) along the route of the EWR P1 that require further consideration in a Level 3 FRA. These assessment points included AP6 – New Langford Lane Road and Overbridge.

1.2 Scope of Level 3 FRA

This document constitutes a Level 3 FRA for the proposed works at AP6 - Langford Lane as required by Planning Condition 12 of deemed planning permission granted alongside the Order under the Transport and Works Act 1992.

This document also provides the information required by the National Planning Policy Framework (NPPF) and the associated requirements of PPS25.

This FRA document has been commissioned to address the flood risk issues that result from the construction of the new Langford Lane access road and over bridge. The location of the proposed roadway is shown in Figure 1 below. The proposed works involve the creation of a new access road and overbridge to allow for a level crossing to be closed on the existing Langford Lane. The purpose of this FRA is to quantify any adverse impacts on flood risk and provide sustainable and effective mitigation where required to mitigate any impacts.

Surface water and safe access and egress issues will be dealt with in separate submissions.

[1] WHS. 2010. Chiltern Railways Bicester to Oxford Improvements Level 2 Flood Risk Assessment

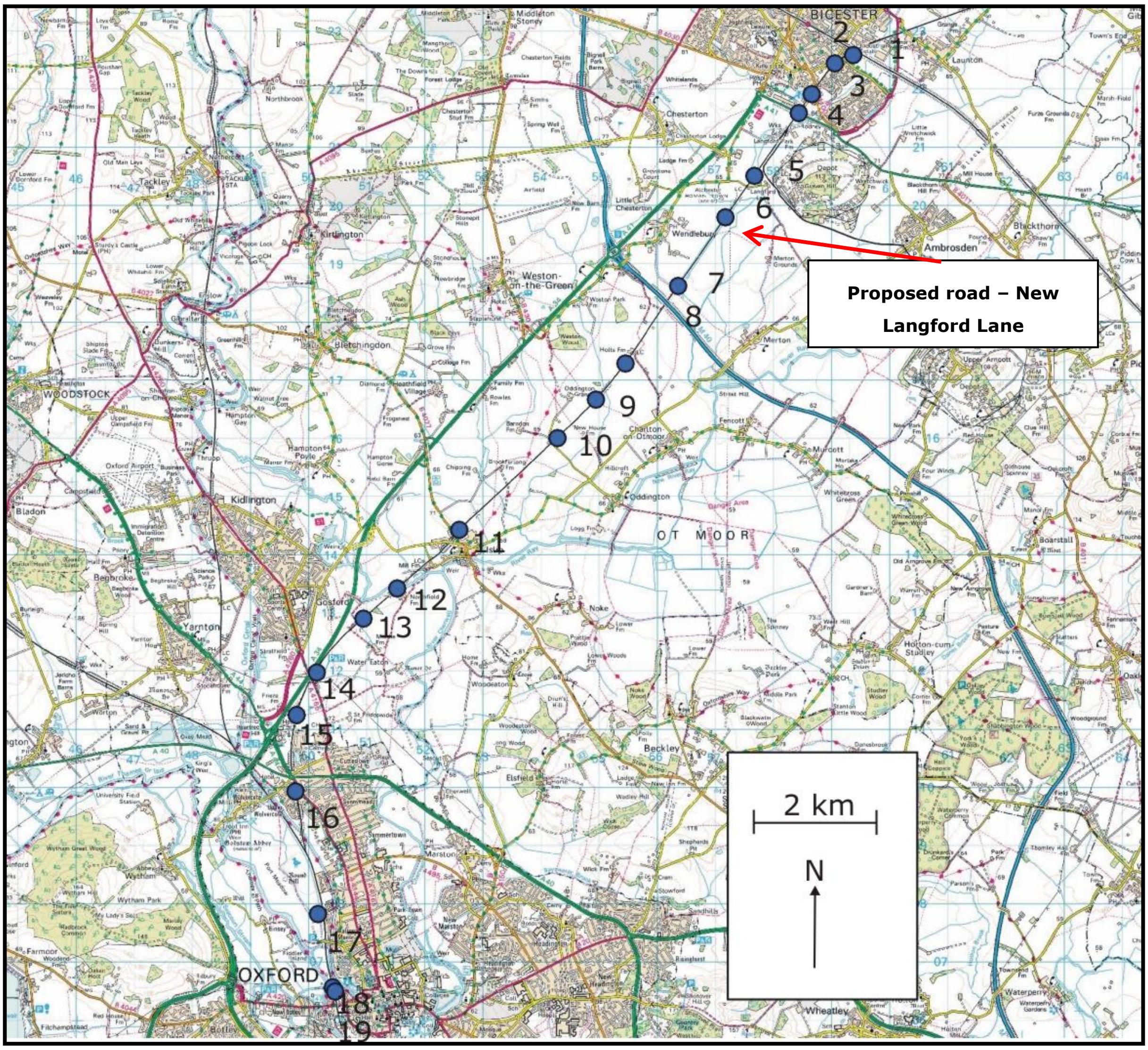

Figure 1 – Scheme Overview showing various assessment points.

2 Site Description

2.1 Overview

EWR P1 is a major package of infrastructure investments including: the dualing of the line between Bicester town and Oxford North Junction; a new independent line being built between Oxford North Junction and Oxford station, using a disused track bed parallel to the existing railway; the existing stations at Bicester Town and Islip will be rebuilt, and a new station built at Water Eaton Parkway; and at Oxford the disused parcels platforms at the north end of the station will be removed and replaced for passenger use for Chiltern Railways services. In order to allow for increased train speeds, a number of level crossings will also be closed along the rail line.

This site specific Level 3 FRA considers work at AP6 – New Langford Lane and Overbridge.

2.2 Description of proposed works

An existing level crossing will be closed on Langford Lane, and as such a new road will be constructed with a new overbridge over the railway line. The road will pass through a number of fields and requires 3 crossing points across watercourses. The proposed alignment has been determined by a number of constraints, most notably the proximity of the Alcester Roman town, which is a scheduled ancient monument. Hence the road alignment heads south through adjacent fields to avoid encroachment into the scheduled monument before crossing the railway line. Figure 2 highlights the proposed alignment of the new Langford Lane, and highlights the current location of the level crossing that will be closed.

The proposed road alignment is within Flood Zones 2 and 3 as defined by the Environment Agency (EA) Flood Maps (see Figure 3). As a result of the flood risk in the area, flood risk to and as a result of the road construction must be considered, with any detrimental impacts mitigated against.

The surrounding catchment is predominantly rural, with a number of isolated buildings along Langford lane. The dominant land use is agriculture and pasture land. The floodplain is very flat with few areas of high ground. The area is rich in archaeology, with the former Roman town of Alcester being located to the north and north-west of the proposed alignment. Three main watercourses are located near the site, the Langford Brook, Gagle Brook and Wendlebury Brook. There are also a large number of drainage ditches which criss-cross the floodplain. Watercourses in the area typically have raised banks, which are often higher than the floodplain around them. The alignment of the Langford Brook suggests that it could have been artificially altered in the past. The watercourses are considered in more detail within the hydraulic model report[2] provided alongside this report.

[2] WHS, 2013, Langford Lane – Hydraulic Model Report

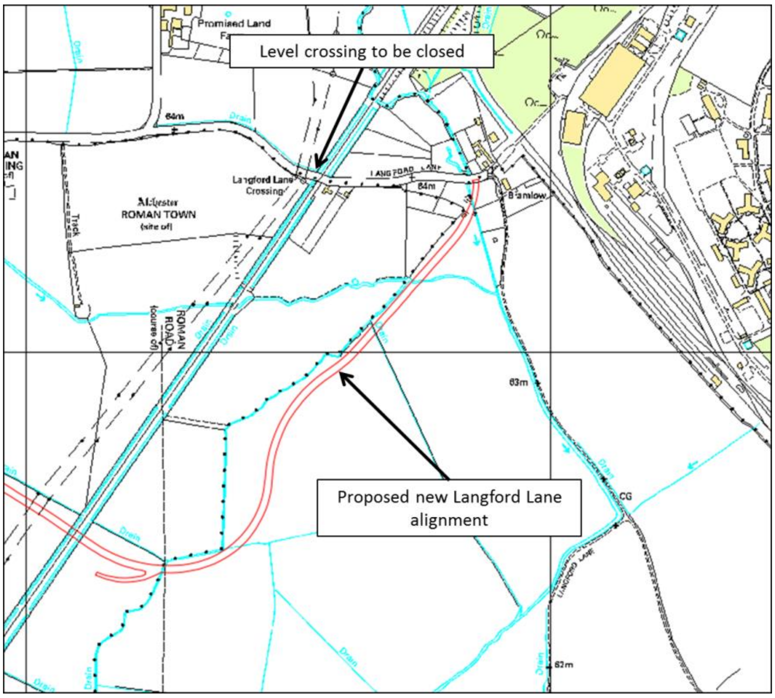

Figure 2 – Proposed alignment of the new Langford Lane, showing the location of the level crossing to be closed as part of the scheme.

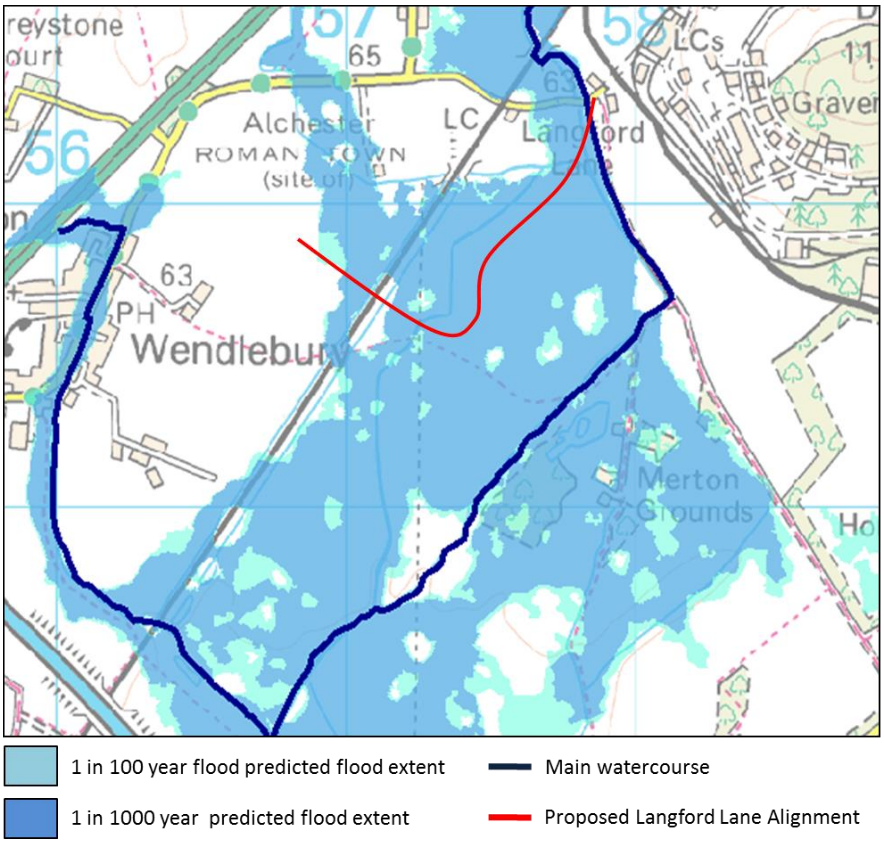

Figure 3 – Proposed alignment of Langford Lane in relation to the EA flood maps

3 Flood Risk Impacts

3.1 Overview

The proposed alignment of the new Langford Lane is within Flood Zone 3 of the EA flood risk maps. The proposed alignment will result in the requirement for the construction of three new crossing points across the Langford Brook, Gagle Brook and a large un-named watercourse. The proposed crossings will have soffit levels set above the 1 in 100 year flood level with allowance for climate change, and will take the form of clear span crossings.

3.2 Data Sources used and proposed methodology

The EA Flood Maps in the area are based on two separate sources of modelling data.

The EA produced a 1D-2D hydraulic model for the Langford Brook, developed for Strategic Flood Risk Assessment (SFRA) purposes. This is the most up to date and detailed data available and is the basis of the EA flood mapping upstream of the railway embankment (north of Langford Lane). This modelling was undertaken by Peter Brett Associates (PBA) in 2009 using ISIS-TUFLOW.

The flood-mapping south of the railway embankment in the location of the new Langford Lane is based on JFLOW data. JFLOW is acknowledged as providing a relatively coarse indication of flood extent and is generally not to be used for design purposes. As such the flood level data available for the area in the vicinity of the existing Langford Lane and proposed new road is insufficient and not considered to be accurate enough for use in this FRA.

As a result of the above, WHS undertook additional new hydraulic modelling extending the current EA approved model downstream to the River Ray. This will also allow for modelling of the impacts of a proposed new access road adjacent to the M40 and includes sections of the Gagle Brook, Wendlebury Brook, Merton Ditch and two drainage ditches considered to be of hydraulic importance. During the undertaking of the new modelling, the existing model held by the EA was reviewed to confirm it is suitable and appropriate for use and conforms to current good model practice.

Analysis of the 1 in 100 year plus climate change event was considered and used as the basis of calculations for soffit levels at crossing points. Following design of the carriageway and crossing structures, the model was re-run (post development) allowing a consideration of potential flood risk changes in the local area as a result of the development.

Further information with regards to the model setup is provided within the model report provided alongside this report[2].

Hydrological analysis was also undertaken to calculate design flows. Further information on the hydrological methodology and the calculated design flows are provided with the hydrological study report provided alongside this report.[3]

To summarise, the following data sources / sets have been used by this study;

- Detailed vertical alignment cross sections of the proposed Langford Lane development;

[3] WHS. 2013, Langford Lane – Hydrology Report

- LiDAR data have been purchased through Geomatics Group. This has a 2m resolution, with a vertical accuracy of +/- 0.15 m;
- The Scheme Boundary, this boundary incorporates land within the Limits of Deviation (LOD) and those areas of the Limits of Land to be Acquired and Used (LLAU) where Chiltern Railways has the legal powers to install flood mitigation, without further land acquisition.
- Hydraulic modelling outputs from an updated version of the EA Bicester Model, undertaken by WHS, are used to delineate the inundation area and obtain design flood levels for the 1:100 year (plus climate change allowance) event. The original model was developed for SFRA purposes. WHS has undertaken work to upgrade and extend the existing model with more up to date topographic data and a finer resolution 2D grid to facilitate modelling of the proposed works. Further details of the modelling undertaken are found in the report provided alongside this submission[2].

3.3 Model results

3.3.1 Baseline conditions

Figure 7 highlights the predicted flood extent during the 1 in 100 year plus climate change event on the watercourses in the vicinity of Langford Lane for the baseline scenario. The predicted extent shows that the vast majority of the proposed alignment is outside of the predicted flood extent.

As shown by Figure 7 the predicted flood extent is considerably reduced over that predicted by the Environment Agency flood risk mapping. There are a number of reasons for this clear difference in extent. The main factors for this are considered to be the limitations of JFLOW modelling (basis of the current Environment Agency flood-map). The original JFlow model does not model the capacity of river channels accurately as it is based on a ground DTM. As such, it is likely that floodplain flows are more likely to occur, as the capacity of channels is reduced, if modelled at all. The model is likely to have used a grid cell size of greater than $10m^2$, as such the capacity of the channel where modelled may be over conservative in nature and is unlikely to have picked up the raised banks of the watercourses.

The Environment Agency Flood Map also suggests that the culvert underneath the existing Langford Brook may not have been modelled within the JFlow model, as the bridge and watercourse at this location are outside of Flood Zone 3. As such, in the JFlow model it appears that flood waters back up upstream of the existing road crossing before spilling over Langford Lane (at points that are lower than the bridge deck). This changes the flood mechanisms considerably, forcing more flood water out onto the floodplain. The flood waters then flow directly south and, given the reduced accuracy grid cell size, are unlikely to return "in channel" as the Gagle Brook channel is unlikely to be well defined within the JFlow model. This therefore over predicts the flood extent south of Langford Lane including the location around the un-named watercourse.

The updated model has also allowed for the presence of raised banks along the watercourse to be considered in more detail and better represented. As a result, more flow is retained within channel. Manning's values, both in stream and on the floodplain, have also been refined resulting in reductions in predicted flood extent. As highlighted within Figure 4 below, flood flows are retained in bank, for the northerly reach of the un-named tributary, resulting in the significant reduction in flood extent in the 2D domain. As shown within Figure 5, the raised embankments noted within this channel result in the retention of flows within stream.

The flood extent is also notably reduced along the Gagle Brook. 1 in 100 year plus climate change flows are relatively low for this watercourse, reaching a maximum of 1.17 cumecs. As such, given the channel's capacity see Figure 6, flood waters are also retained in channel. Within the original EA flood maps, again modelled by JFlow, the relatively narrow channel is unlikely to have been modelled within the original 2D domain, meaning the floodwaters flow across the floodplain with no account of in channel capacity. As such the JFlow model provides this very extensive flood extent with predicted low flood depths.

Although the flood extent predicted is reduced, a small proportion of the road alignment was shown to be within the flood extent, therefore consideration of flood consequence, and flood compensatory storage was undertaken.

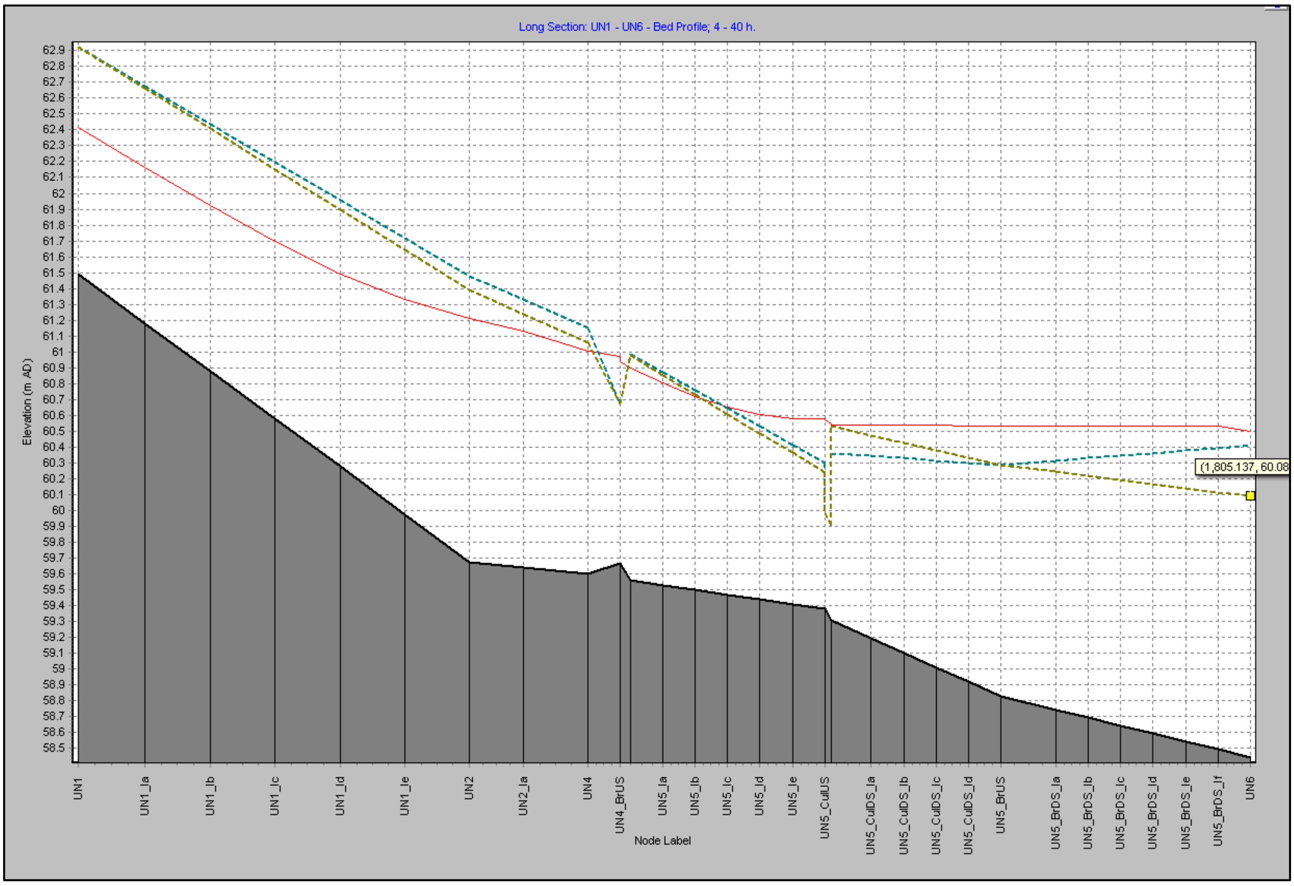

Figure 4 – Maximum flood level predicted during the 1 in 100 year plus climate change event on the un-named watercourse. Flood flows are retained in bank for the northern reach.

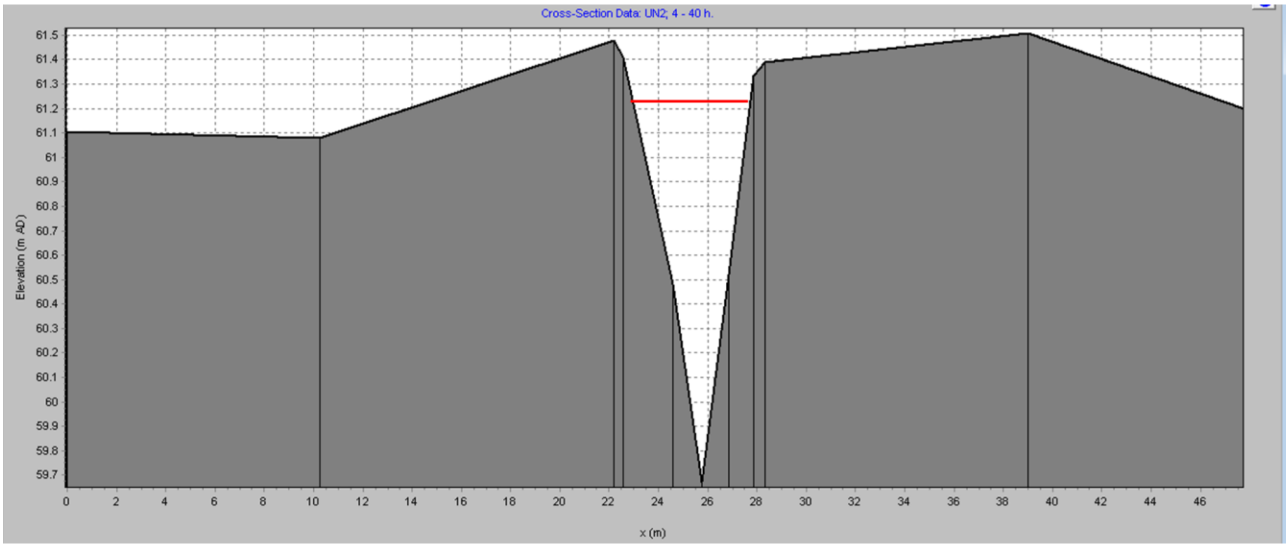

Figure 5 – Maximum flood level predicted during the 1 in 100 year plus climate change event on the un-named watercourse at section UN2. This cross section was clipped so that the floodplain was modelled in 2D, this image highlights the role the raised river banks play in preventing the surrounding land from flooding during the 1 in 100 year plus climate change event.

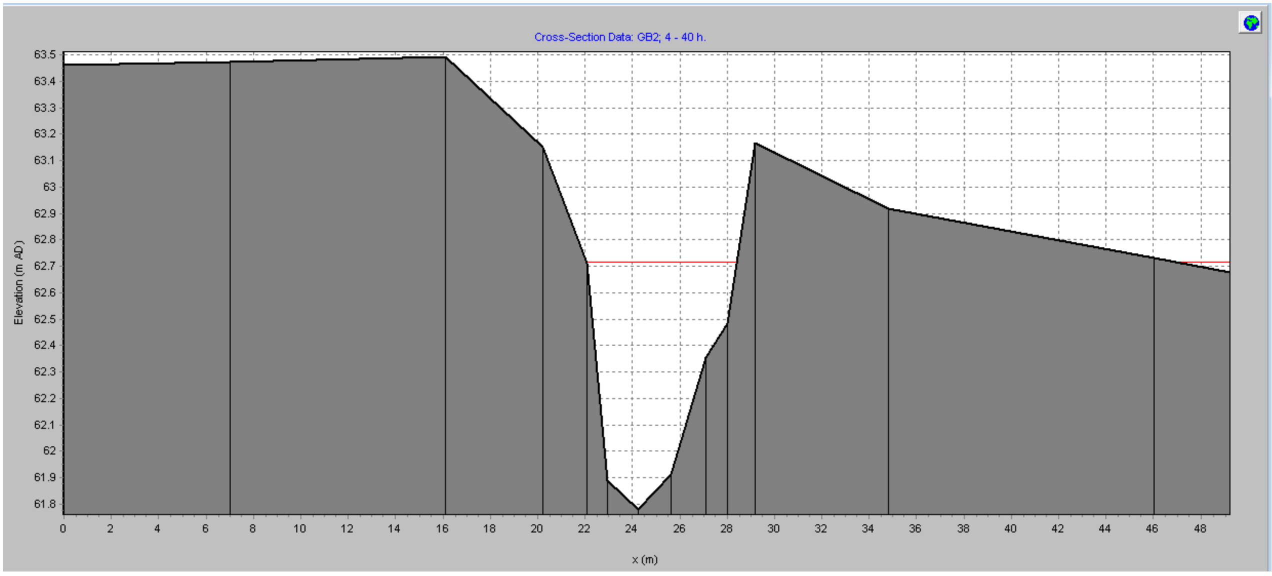

Figure 6 – Maximum flood level predicted during the 1 in 100 year plus climate change event on the Gagle Brook section GB2. This cross section was clipped so that the floodplain was modelled in 2D, this image has been created so as to highlight the channel capacity in relation to the maximum predicted flood level.

3.3.2 Post Development

The model was run for the post development scenario. This was undertaken to consider the flood impacts in the surrounding area as a result of the small encroachment into the flood extent and the 3 clear span crossings of the watercourses.

A summary table of the predicted maximum flood levels within the 1D network as a result of the proposed development are provided within the model report[2] provided alongside this report. As outlined within the table, flood levels do not change as a result of the clear span bridges or the small encroachment into the flood extent. This is as expected due to the proposed bridge crossings having no in stream influence and due to the majority of the flow remaining in channel adjacent to the proposed alignment.

Figure 7 shows the predicted post development flood extent in relation to the baseline extent. This shows there is no significant change in the predicted extent. A small reduction in extent is predicted and this is due to the assumed raising of a low point within the drainage channel bank, which previously allowed out of bank flows to occur.

Figure 8 below shows a summary of the change in flood depth as a result of the proposed development. As shown, no significant increase in flood depths is predicted. Minor increases are found in two locations; however these occur in isolated cells along the unnamed tributary (immediately downstream of the crossing), and on the Gagle Brook (downstream of the crossing).

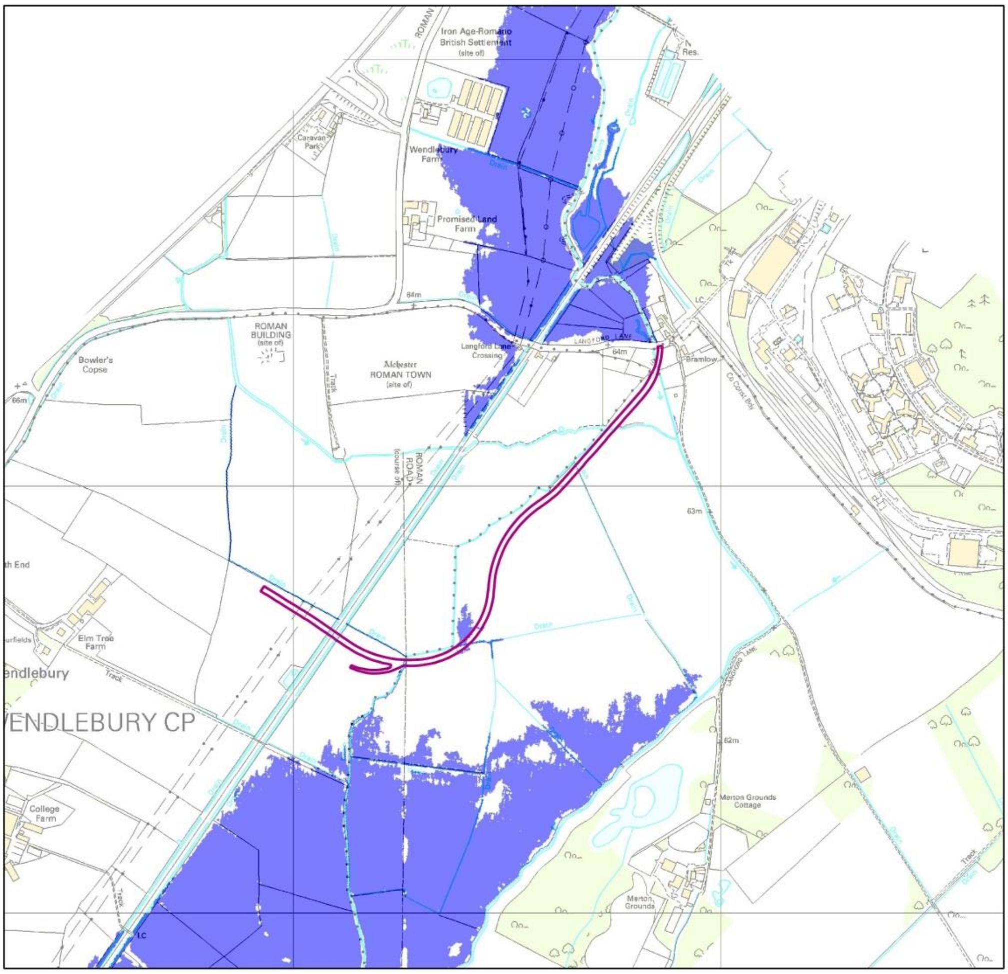

Figure 7 – Predicted 1 in 100 year plus climate change flood extent in relation to the proposed road alignment for the baseline scenario (Blue = Baseline, Red = Post development).

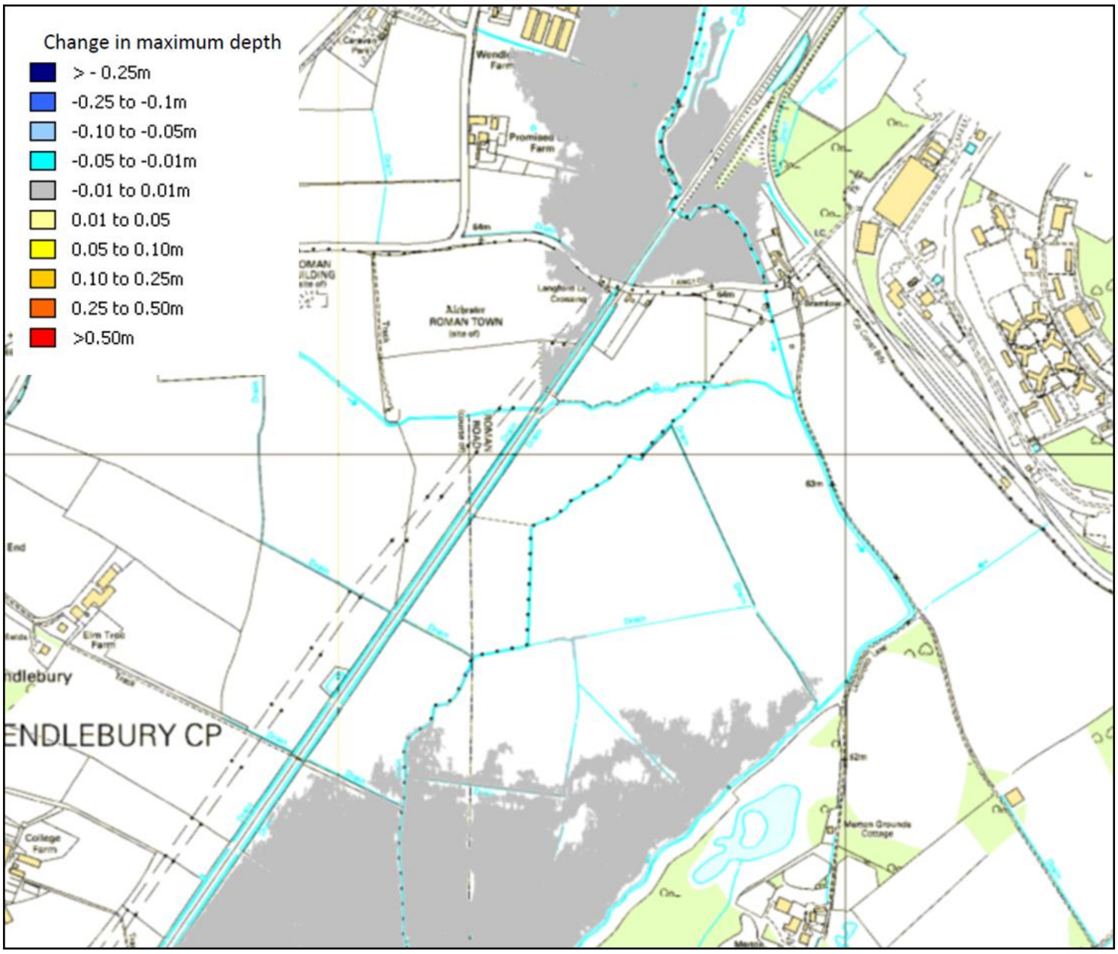

Figure 8– Predicted change in flood depth as a result of the proposed development for the 1 in 100 year plus climate change event

Flood extents for the 1 in 100 year plus climate change event are considerable both upstream of the existing Langford Lane, and closer to Wendlebury downstream. Significant volumes of water are held upstream of the existing Langford Lane, which is raised above the floodplain and is a considerable restriction to conveyance. Bed levels are also significantly lower downstream of the existing Langford Lane crossing, as such the associated maximum flood levels are lower as shown within the 1D model results.

3.4 Floodplain Storage Loss Analysis

The baseline model results have shown that the majority of the proposed access road lies outside of the 1 in 100 year plus climate change flood extent. However, as a very small proportion of the proposed road is within the predicted 1 in 100 year plus climate change flood extent, some consideration of floodplain storage is required.

Figure 9 highlights the area of the development considered to be within the flood extent.

A culvert will be constructed through the carriageway to maintain the drainage ditch flow route. Hence analysis was undertaken on the floodplain storage loss “out of channel”.

Flood depths above ground levels in this area are on average 0.02m. Hence the volume was calculated as approximately 10m^3 highlighting the shallow flood depths in this area. This volume is very small and insignificant in relation to the wider floodplain storage available locally. However, due to the local archaeological constraints, it is proposed that this storage is compensated for at the MOD sidings works location upstream of the Langford Lane. At this location a disused rail embankment is to be excavated to provide additional storage. The 10m^3 will be compensated for on a volume for volume basis, as ground levels are significantly higher than those in this area and therefore does not allow for level for level compensation to be achieved. Figure 10, below highlights the location of the disused rail embankment that is to be excavated.

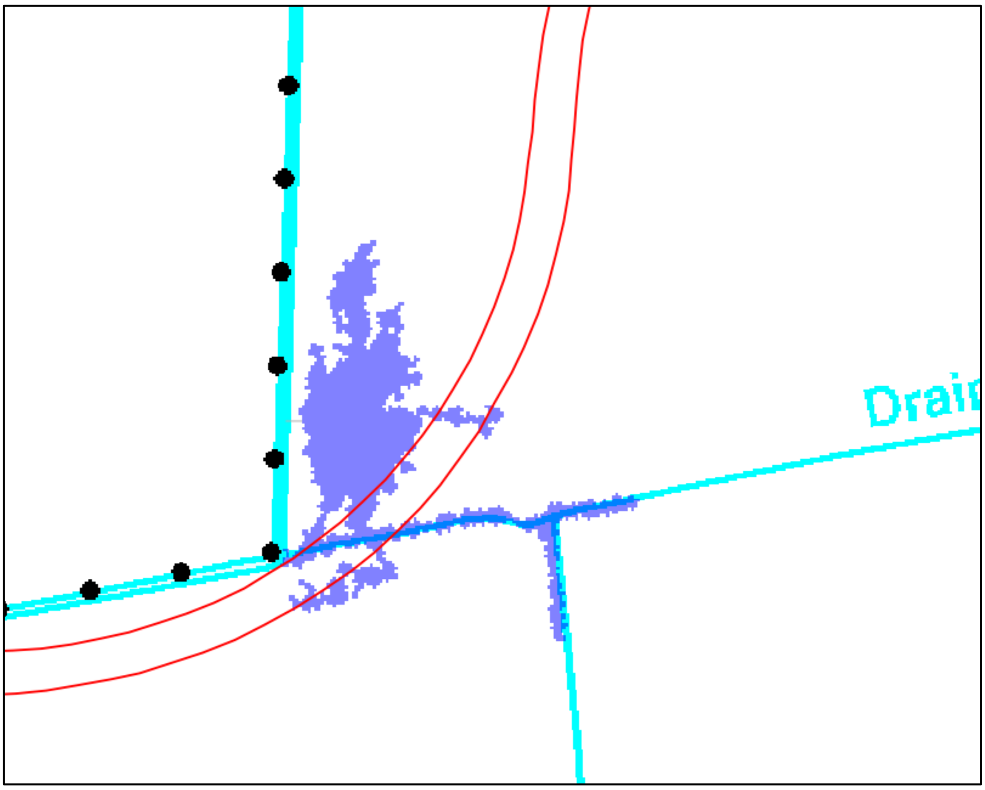

Figure 9 – Area of development considered to be within the flood extent during a 1 in 100 year plus climate change event.

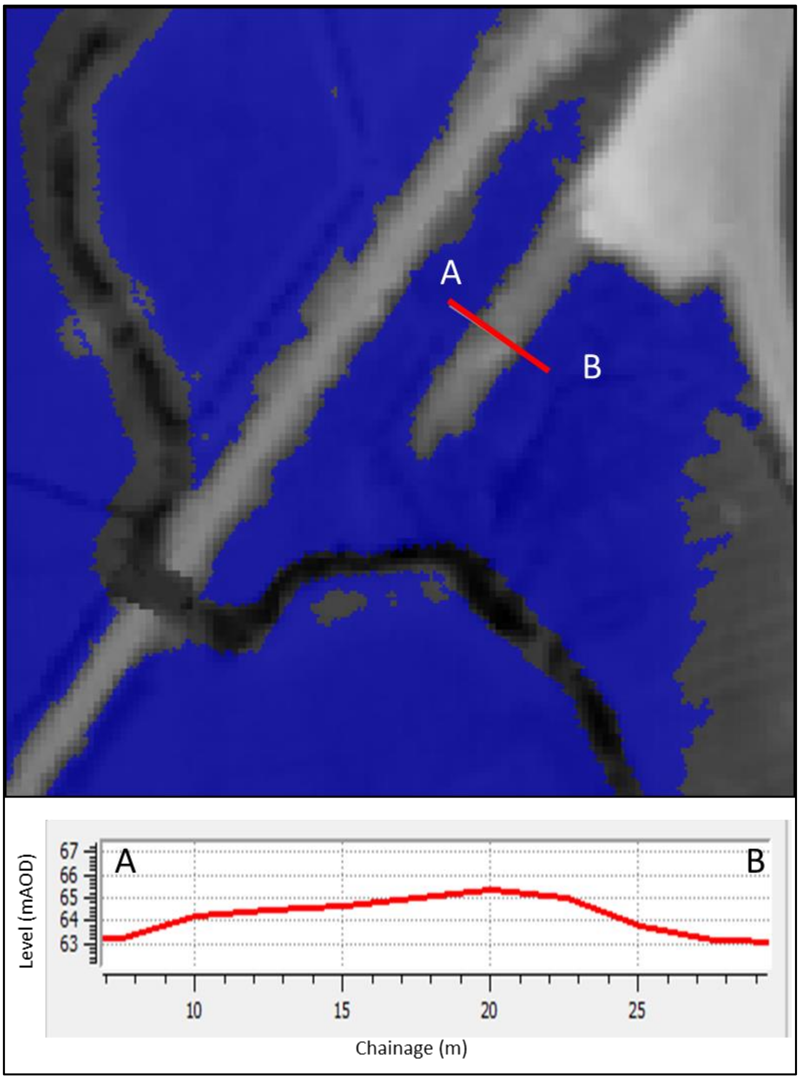

Figure 10 – Location of disused rail embankment to be removed to provide flood compensatory storage

4 Conclusions

The key conclusions of this FRA are as follows:

- The refined 1D-2D baseline modelling has demonstrated a significant reduction in flood extent over that shown in the EA Flood Maps, which are based in JFlow modelling.
- The proposed development will use clear span bridges and therefore is predicted to cause no impact to flood levels within stream.
- The proposed development does include a raised embankment, however as the majority of the proposed alignment is outside of the flood extent, no significant impact is predicted from hydraulic modelling
- Post development modelling predicts a total volume of flood plain storage loss of $10m^3$, which is insignificant in relation to the wider floodplain. However, this will be compensated for to the north of Langford Lane as part of the MOD sidings compensatory storage package of works.

4.1 Future Considerations

A 'Works Approval' is to be submitted separately in due course for the proposed works in this area, under the provisions of Schedule 15 of the TWA Order. Works Approvals will also be required for any temporary works within 16 metres of the main watercourses such as Langford Brook or within flood zones 2 and 3.

There are some points that need to be considered by the contractor in relation to the temporary works required during the construction phase of the new Langford Lane. These include:

- All compounds, stockpiles and other works will need to be kept outside Flood Zones 2 & 3 and be sited within Flood Zone 1.

- All temporary haul roads within Flood Zones 2 and 3 will need to be kept at grade to avoid any requirement for compensatory flood storage.

- All roads should be constructed with a permeable hard-core or stone surface to avoid increasing the impermeable footprint of the site.

Chiltern Railways will submit applications for the permanent Works Approvals and the Contractor will submit applications for temporary works approvals, where necessary.