The Greenway

Flood risk technical note

Project:	The Greenway (Planning Application Reference: 4457/APP/2021/2212)		
Reference:	J923.01-DN-LON-004-TN-Z-0001		
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Subject:	Flood Risk technical note for a temporary bridge structure over Ickenham Stream		

1 Background

1.1 Project Background

Due to a third-party (HS2) infrastructure scheme, a Thames Water sewer in Ickenham, South West of the Greenway, is being diverted. In order to facilitate this diversion a temporary crossing over the Ickenham Stream is required. A planning application was submitted to the London Borough of Hillingdon for works associated with the diversion of the sewer. These works included the temporary crossing over the Ickenham Stream. The planning application reference is 4457/APP/2021/2212.

1.2 Background to this document

The temporary bridge has been classified as being within flood zone 3, which is land defined by the planning practice guidance[1] as having a high probability of flooding. The temporary structure, even though it may be required to evacuate the project location, can be considered to be ‘water compatible’.

Prior to the works being submitted for planning approval to the London Borough of Hillingdon, a previous consultant had consulted with the Environment Agency (EA) but a Flood Risk Assessment (FRA) was not submitted. The EA subsequently objected to the application.

In order to overcome this objection, the EA have recommended the applicant submit additional information. The EA further explain, that as the crossing is only temporary a full FRA is not required and a technical note which includes an assessment of flood risk may be sufficient.

1.3 Scope of this document

This technical note has been produced in order the overcome the EA’s objection with the proposed temporary crossing over Ickenham Stream.

This document therefore summarises the proposed works, the residual flood depths, and any changes in flood mechanism in order to confirm that:

- The proposed temporary crossing does not increase flood risk to third party receptors in a 1% Annual Exceedance Probability with an allowance for CC (1%AEP+CC).
- The propose temporary crossing does not create a risk to life within the project boundary in a 1%AEP+CC event.

[1] Flood risk assessments if you're applying for planning permission - GOV.UK (www.gov.uk)

2 Location

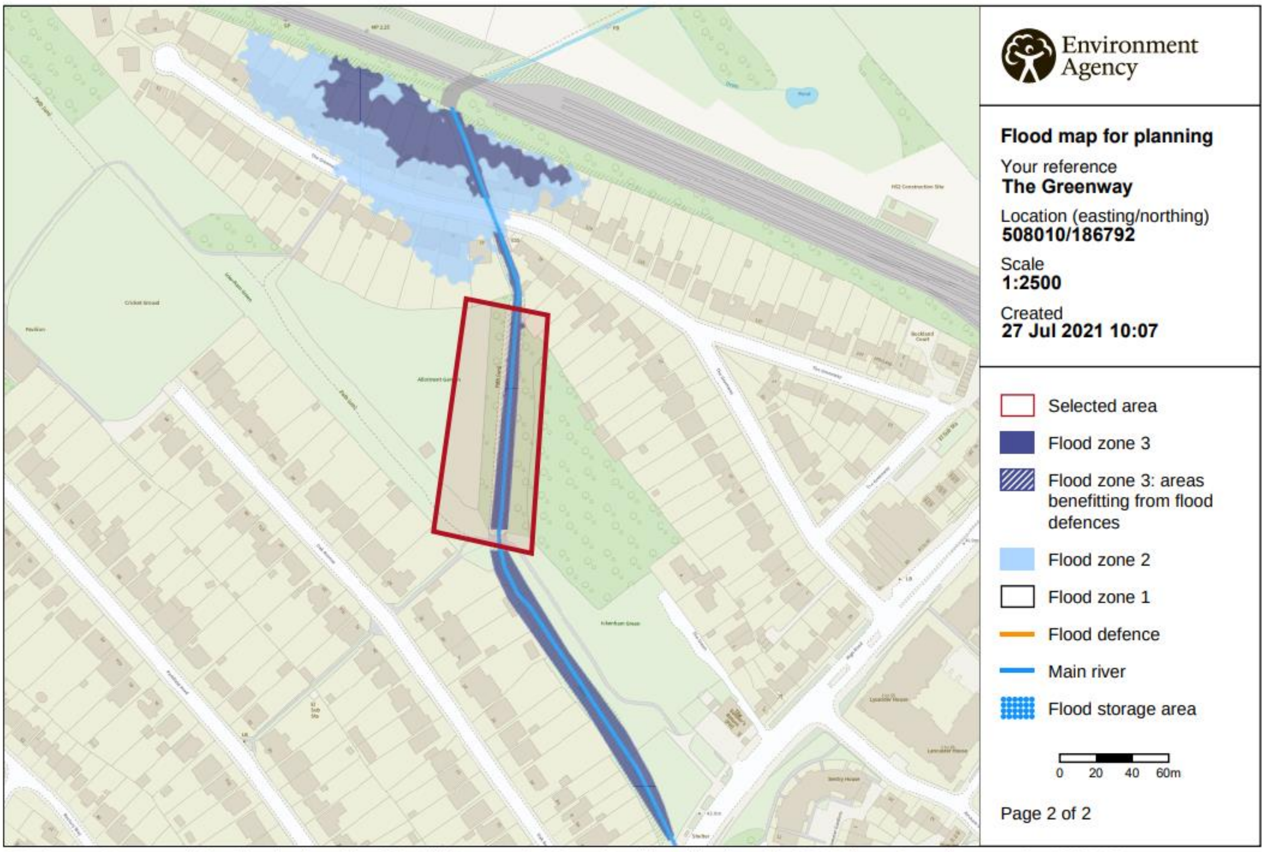
2.1 Project Location

Figure 2.1 shows the approximate project location, Coordinates: 508012,186761, which is within 20m of an EA designated main river. Due to access reasons, it is unpracticable to locate the temporary crossing to an area that does not include Flood Zone 3, as recommended as part of sequential testing.

The temporary crossing will allow pedestrian and vehicular access to the main project location, this will in turn facilitate the construction of a major third-party infrastructure project as such this would meet the requirements of exception testing.

The figure shows that although the project location is Flood Zone 3, the flood zone is narrow and entirely within the watercourse, meaning out of bank flooding is not expected.

Figure 2.1: Project Location



Source: [Flood map for planning - GOV.UK (flood-map-for-planning.service.gov.uk)](flood-map-for-planning.service.gov.uk)

2.2 Local Site History

It is understood that the flood risk zone is limited to the river channel and the flooding zone does not go into the adjacent allotments.

It has been discussed, between the previous consultant Jacobs and the EA, that the EA are attempting to understand the local flow regime. As a result of the ‘dry’ culvert under the existing railway and multiple drainage ditches (located in the golf course) being blocked, the flow regime is not apparent. It is understood that this channel has minimal flow, and large ‘flood flows’ are not expected.

It is understood that the EA are trying to resolve this flow issue, and this may result in some changes to the flow parameters prior to the commencement of the works.

3 Modelling and Hydrology

3.1 Modelling (Ickenham Stream)

The potential flood risk to the project location has been assessed based on the results of a 1D-2D Hydrodynamic model. The model and the hydrology have been developed by a third party for use as part of the HS2 Enabling works, and signed off for use by the EA in December 2019[2].

This model, in accordance with the wider infrastructure project brief and scope includes two diversion schemes. A Concept Design scenario for the permanent watercourse diversion and a Temporary scenario for the temporary diversion scheme, which will only be in place for a few years while the Ruislip Golf Course is closed for the third-party infrastructure works. It is currently unknown as to when the temporary bridge structure will be installed/removed in comparison to the wider works, as such all three scenarios have been assessed.

The model is a 1D-2D Estry-Tuflow model which was developed from an existing 1D-2D ISIS Tuflow model of the River Pinn and all its tributaries, provided by the Environment Agency (EA ISIS-TUFLOW 2016 model).

The Ickenham Stream has been represented by utilising 1D cross sections in Estry, with the structures generally represented as bridges or culverts. This is with exception for the structure which allows flow under the exiting railway, this structure is sufficiently large as to not present a hydraulic restriction, as such this is modelled as a channel with no connection to the floodplain.

The floodplain is modelled in 2D by Tuflow, this software allows topographic features such as floodplain roughness and levels to be represented.

[2] 1EW02-CSJ-DS-NTE-SS05_SL07-000001

3.2 Hydrology

3.2.1 Climate Change

As detailed in Section 1.3, the flood risk has been assessed for a 1% AEP +CC event.

The proposed temporary crossing was included within a hydraulic model (which was approved for use by EA 20/12/2019), this modelling uses outdated climate change values. As of July 2021, the climate change values have been updated shows the previously modelled and the latest climate change values. It shows how the new values are less than those used within the modelling. As the existing climate change is conservative the flood risk assessment utilises these pre-existing/conservative values.

Table 3-1: Climate Change Allowance

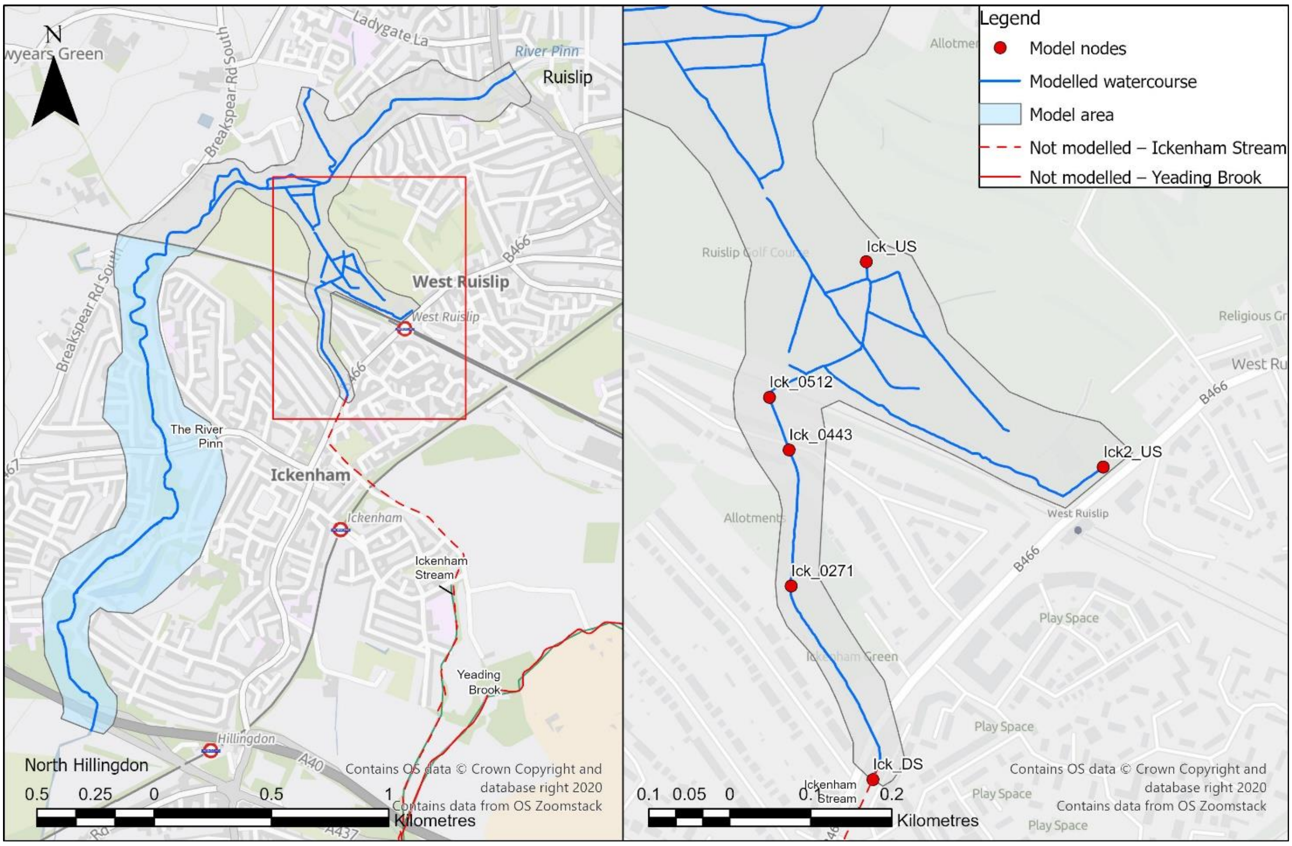
River Basin District	Allowance Category	Outdated – Total potential change anticipated for 2080's (2070 to 2115)	Latest – Total potential change anticipated for 2080's (2070 to 2115)	Change in allowance
Thames	Upper End	70%	54%	-16%
	Higher Central	35%	27%	-8%
	Central	25%	17%	-8%

Source: Climate change allowances for peak river flow in England (arcgis.com)

3.2.2 Inflows

Figure 3.1 shows the extents of the hydraulic model, it also includes a call out box over Ickenham Stream. The inset figure shows Ickenham Stream, which includes the project location and the associated boundary conditions. Ickenham stream flows into Yeading Brook, although the model does not fully represent the length until this confluence.

Figure 3.1: Model location and Inflows



Source: 23480_EST_BAS_DES_C100_70 model approved for use by EA 20/12/2019

The baseline hydrology was completed as part of the approved model, whilst the raw hydrological assessment has not been provided, the hydrology shows two intervening catchments in the area. These intervening catchments denoted as Pinn_09 and Pinn_10, drain to Ickenham Stream within the area of interest. These two catchments have had their flow proportioned over two and three locations respectively. This mean the two catchments are represented by five inflows, this can be seen in Table 3-2.

Table 3-2: Ickenham Stream Inflows

Inflow	Catchment	Catchment Peak Q (m^3/s) 1%+70%cc	Proportion	Individual Peak Q (m^3/s) 1%+70%cc
ICK_US	Pinn_09	0.58	50%	0.29
ICK2_US	Pinn_09		50%	0.29
ICK_0512	Pinn_10	0.28	33%	0.09
ICK_0443	Pinn_10		34%	0.10
ICK_0271	Pinn_10		33%	0.09

In total these two catchments (the five inflow sources) have a peak flow in the 1%AEP + 70%cc event of 0.88m3/s. This total flow is the maximum input into the model, and not necessarily the predicted flow, for predicted flow information please refer to Section 5.

3.2.3 Boundary Conditions

The downstream of Ickenham Drain is controlled by a water level of 41.5mAOD, the model information supplied does not discuss what this level relates too, though it is noted that the level is nearly ‘bank full’ at the downstream of the modelled stream, suggesting this is based on a downstream condition. This level does not vary with scenario/event magnitude.

3.3 Calibration\Verification

As part of a model review[3], it was noted that the model has been considerably developed from the original baseline, and as such would benefit from re calibration. The report notes that there is less flooding in the updated model than the original, this reduction in flooding can also be seen when comparing the EA and the model flood maps. The EA flood maps indicate that there is a hydraulic restriction when Ickenham Stream passes under an existing railway, which leads to third party flooding.

Figure 3.2 is a photo of the structure under the existing railway track. The opening on the right of the image is to allow flow to pass, whilst the opening on the left is for pedestrian access. In this photo, the watercourse is dry which confirms the poor flow conditions mentioned in Section 2.2. It is also apparent that the structures are of sufficient size to not cause a hydraulic restriction, as mentioned in Section 3.1, for the magnitude of flows detailed in Section 3.2.1.

Figure 3.2: Existing route under railway

Source: J923.01-AA-LON-100-AS-N-0030

[3] 1D and 1D-2D Model Audit Report, Jacobs 2019

The available baseline model does not show a flood risk to the third-party properties in the largest event simulated, 1%AEP+70%CC

Based on the available evidence, it can be concluded that for Ickenham Stream in isolation, the reduced flood risk does appear to be based on improved data/representation of structures and as such the caveat regards re-calibration holds less relevance. The robustness of this conclusion is further bolstered by the EAs investigation into the flow regime in this area, and the lack of local flood history/knowledge.

4 The Scheme

4.1 Wider Enabling Works

This hydraulic technical note is to discuss the hydraulic risk associated with the placement of a temporary bridge over the Ickenham Stream, however, this works does need to be considered as part of the wider works on the stream.

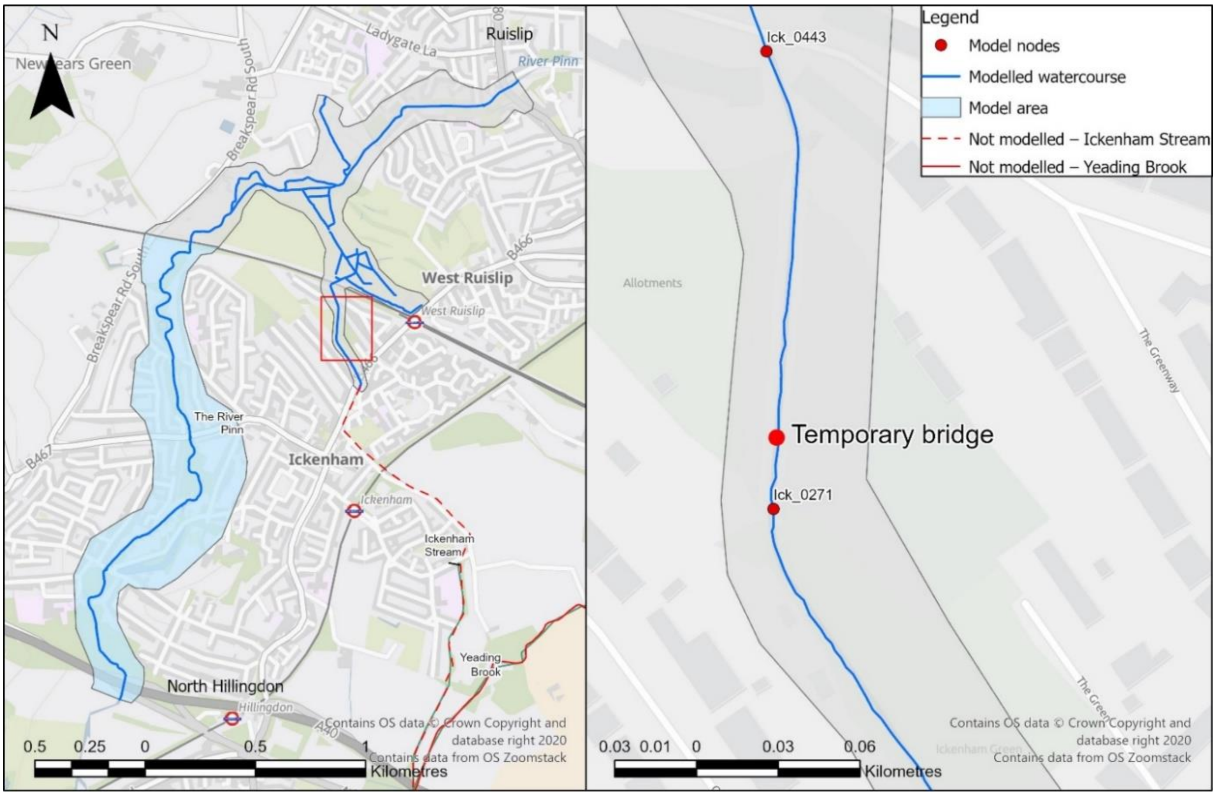
As part of the wider infrastructure project enabling works, Ickenham Stream is being split. As a result of this 'splitting' the drains/watercourse to the north of the existing railway will be directed to the River Pinn. The remaining Ickenham Stream to the south of the existing railway will flow towards Yeading Brook, and there will no longer be a flow route under the existing railway.

To reflect the various stages of works, along with a Baseline (present day) scenario the hydraulic model also includes a 'Temporary' phase and a 'Concept Design' model arrangement. Both of these arrangements include the separation within Ickenham Stream.

4.2 Temporary Bridge

Figure 4.1 illustrates the location of the proposed temporary bridge. This is approximately 40m upstream of an existing footbridge over Ickenham Stream. The bridge is to span Ickenham stream with no supports or abutments in the channel itself. As such, the bridge will not pose a hydraulic restriction unless the channel was to exceed the bank levels. The temporary bridge has been designed and will be constructed in accordance with the Technical Standard – Flood Risk (HS2-HS2-EV-STD-000-000011).

Figure 4.1: Location of temporary bridge



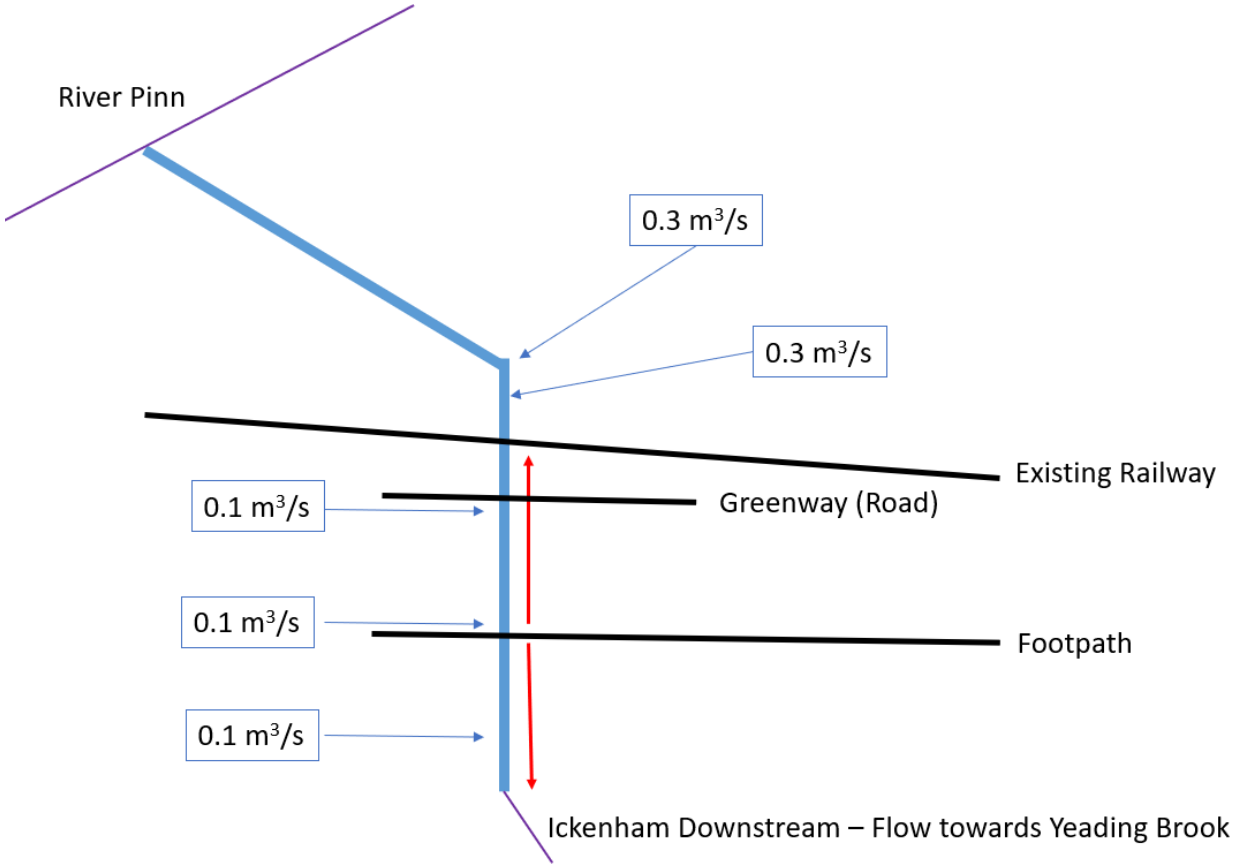
Source: MML 2021

5 Hydraulic Results

5.1 Flow Routes

Section 2.2 detailed how the current flow routes within Ickenham stream are under investigation, the hydraulic model suggests that the flow does not all flow 'downstream' towards the confluence with Yeading Brook, but instead can flow towards the River Pinn, away from the temporary bridge location. Figure 5.1 shows than in the baseline scenario, the vast majority of the flow tends towards the River Pinn and away from Ickenham Stream downstream boundary.

Figure 5.1: Flow Route Schematic (baseline)



Source: MML 2021

This current flow route indicates that only $0.1m^3/s$ would flow towards the 'downstream' and the confluence with Yeading Brook in the 1%AEP +70%CC event baseline scenario.

Once the scheme works has started and Ickenham Stream is no longer able to flow under the existing railway, as detailed in Section 4.1, the peak flow in Ickenham Stream is approximately $0.3m^3/s$.

5.2 Flood Risk

Table 5-1 lists the potential water levels upstream and downstream of the proposed bridge location for the three models, that maximum water elevation is shown to be 41.88mAOD. The abutments and the soffit of the temporary bridge will be approximately the same as the bank level, which based on lidar and modelled bank levels is approximately 43.8mAOD, nearly 2m above the water level. As such the temporary bridge will not pose a hydraulic restriction or create any increase flood risk to third parties (satisfying the requirements of U&A Ref ID 50).

Table 5-1: Levels 1%AEP+70%CC

	Baseline scenario	Temporary scenario	Concept design scenario
Upstream (Ick_0365.1)	41.63 mAOD	41.88 mAOD	41.88 mAOD
Downstream (Ick_0271B.1)	41.63 mAOD	41.82 mAOD	41.82 mAOD

Note: Values have been rounded up for conservatism

In Section 3.2.3 the downstream condition of Ickenham Stream is discussed, whilst the reason for the level being set at 41.5mAOD is not detailed within the model, based on the predicted flows in the stream it suggests this level is driven by downstream conditions and not by the flow in the stream.

If the downstream level was sufficient to cause flooding at the proposed bridge location (> 43.5mAOD), large residential areas would already be inundated. Suggesting that such a level is improbable, and the uncertainty around the boundary condition is irrelevant to the flood risk of the temporary bridge structure.

5.3 Sensitivity

Although simulations have not been run, sensitivity on the Downstream Boundary and the Inflows has been considered.

5.3.1 Sensitivity - Inflow

Typically, for sensitivity testing inflows are varied +/- 10%, due to the ‘trapezoidal’ shape of the channel, a 10% increase in inflow would results in less than a 10% increase in depth. This result would still be considerably below bank full, and the temporary bridge will still not be a hydraulic restriction.

5.3.2 Sensitivity – Downstream Boundary

In Section 3.2.3 the downstream condition of Ickenham Stream is discussed, whilst the reason for the level being set at 41.5mAOD is not detailed within the model, based on the predicted flows in the stream it suggests this level is driven by downstream conditions and not by the flow in the stream.

If the downstream level was sufficient to cause flooding at the proposed bridge location (> 43.5mAOD), large residential areas would already be inundated. Suggesting that such a level is improbable, and the uncertainty around the boundary condition is irrelevant to the flood risk of the temporary bridge structure.

A sensitivity test would typically apply an uplift value of around 10 – 20% of channel depth, this increase is relatively minor and would not result in a sufficient back water impact to cause flooding.

6 Conclusion

Based on the hydraulic modelling results presented in Section 5.2, the temporary bridge structure will not pose any form of hydraulic restriction, and in turn it will not increase the flood risk to third party receptors of create an increased hazard to the project location.