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Clare Hall

Proposed Cambourne to Cambridge Busway – Bin Brook Crossing and Impact on Clare Hall

Flood Risk Proof of Evidence – Graham Sinclair

BSc (Hons), MSc, DIC, C.WEM, MCIWEM

Objector No: OBJ213

Inquiry Reference: TWA/24/APP/03

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CONTENTS

1.0	EXECUTIVE SUMMARY
2.0	QUALIFICATIONS AND EXPERIENCE
3.0	INTRODUCTION
4.0	APPLICATION BACKGROUND
5.0	RELEVANT PLANNING POLICY
6.0	INADEQUACY OF THE WSP SUBMISSION
7.0	LIKELY IMPACTS ON CLARE HALL – CCE MODELLING
8.0	POLICY TEST – PPG, NPPF PARA 177, 178 (B), 179 and 181 – IMPACT ON FLOOD RISK ELSEWHERE AND FLOODPLAIN COMPENSATION
9.0	POTENTIAL MITIGATION AND ASSOCIATED VIABILITY
10.0	SUMMARY AND CONCLUSIONS

FIGURES

4.1	Clare Hall Land Ownership Extent
4.2	Flood Map for Planning
6.1	TR13.1-1-3 – WSP Baseline vs Proposed change in peak flood water level for the 1% AEP with 19% climate change allowance
6.2	WSP Impact Grid 10m bridge at 1mm tolerance
1.1	1% AEP 19% CC impact of the proposed development on Flood levels
7.2	1% AEP 19% CC impact of the proposed development on immediate downstream velocity
2.1	CCE Proposed Mitigation Interventions
9.2	1% AEP 19% CC impact of the proposed development on Flood levels with mitigation
9.3	1% AEP 19% CC impact of the proposed development on immediate downstream velocity with mitigation

GLOSSARY

Term	Meaning
1D	One-Dimensional
2023 JBA Model	This is the latest EA model for the full Bin Brook catchment.
2024 CCE Model	This is the name for the model updated by CCE for the purpose of undertaking a hydraulic assessment of the proposed busway and its implications on flood risk for Clare Hall and surrounding areas.
2D	Two-Dimensional
AEP	Annual Exceedance Probability
C2C	Cambourne to Cambridge
CC	Climate Change
CCC	Cambridgeshire County Council
CCE	Create Consulting Engineers
CH2M	CH2M Hill Engineering, now Jacobs.
Clare Hall College	The land under the ownership of Clare Hall college
DfT	Department for Transport
EA	Environment Agency
ES	Environmental Statement
FM	Flood Modeller hydraulic modelling software
FRA	Flood Risk Assessment
GCP	Greater Cambridge Partnership
Glasswalling	The unnatural build up of floodwaters against the edge of a model extent.
JBA	JBA Consulting
NPPF	National Planning Policy Framework
NRFA	National River Flow Archive
PPG	Planning Practice Guidance
Purchase Order Limits	The area of land being purchased permanently for the construction of the Proposed Busway.
QMED	Median annual maxima flood equating to the 1 in 2 year 50% AEP Event.
RAG Model Review	Standardised EA Red Amber Green Model review spreadsheets.
STW	Sewage Treatment Works
SuDS	Sustainable Drainage Strategies
The Applicant	Cambridgeshire County Council.
The Application	This is the November 2024 DfT submission by the applicant.
The Gough Way 2017 Model	This is the preceding EA model for Bin Brook, published in 2017 focussing on the Gough Way Estate. This model is used by WSP as the basis for their modelling work.

Term	Meaning
The Proposed Busway/Development	The proposed C2C Busway development
TUFLOW	Two-dimensional Unsteady FLOW hydraulic modelling software
WBD	Womble Bond Dickinson
WSP	William Sale Partnership Engineering Company that completed the FRA and Hydraulic Modelling to support the Application.
WSP Model	This is the model used to inform the Applicant's Flood Risk Assessment and Hydrology.

1.0 EXECUTIVE SUMMARY

- 1.1 This Proof of Evidence sets out why the proposed Cambourne to Cambridge (C2C) busway scheme, in its current form, is not compliant with National and Local flood risk policy. It concludes that the scheme presents unacceptable off-site impacts, most notably to the land and assets of Clare Hall, Cambridge, the estate of Gough Way and to the wider Bin Brook catchment.
- 1.2 In support of the application, WSP submitted hydraulic modelling to assess flood risk associated with the proposed embankment and bridge crossing of Bin Brook. However, this modelling is fundamentally flawed. It is based on an outdated and superseded version of the Bin Brook model. It does not reflect current hydrological conditions and fails to capture wider floodplain and catchment impact necessary to provide a robust assessment of the flood risk caused as a result of the Proposed Development.
- 1.3 The Environment Agency (EA) has objected to the modelling on the basis of technical reasoning and required updates. At the time of writing, it is understood that this objection remains in place and there is no evidence that approval has been granted. The model cannot be relied on to demonstrate that the proposed development will not increase flood risk elsewhere.
- 1.4 Create Consulting Engineers (CCE) have undertaken independent hydraulic modelling (on behalf of Clare Hall) using the most recent EA approved version of the Bin Brook model. This updated model incorporated improved hydrology, benchmarking against gauged flows to calculate QMED and historic flood events to calibrate the overall model build (undertaken by JBA Consulting who built the original model), which therefore complies with current national guidance.
- 1.5 The 2024 CCE Model demonstrates that there are increased flood levels and flood extents that extend beyond the Compulsory Purchase Order Limits of the Proposed Busway. It also highlights that there are increases to in-channel velocities and flood risk upstream and downstream of the proposed bridge structure. These increases are observed by up to 100% which gives rise to a clear erosion risk to land within the ownership of Clare Hall. The proposed scheme also produces a net loss of floodplain storage, due to land raising in Flood Zone 3b.
- 1.6 The above findings indicate that the proposed scheme does not comply with the requirements of the Sequential Test and Exception Test due to increased flood risk elsewhere, increased velocities, lack of proposed mitigation and ultimately the availability of a sequentially preferable alternative route.
- 1.7 CCE have demonstrated through independent hydraulic modelling a potential solution that adheres to the National Planning Policy Framework (NPPF) requirements for flood risk management, however delivery of this solution is not possible as there is inadequate space within the compulsory Purchase Order Limits and deemed planning permission has not been sought for the necessary works. Therefore, the application fails key policy tests and would result in an unacceptable increase in flood risk and erosion to land and assets outside the application boundary.
- 1.8 The approach the Applicant has followed thus fails to reflect the objectives and requirements of the NPPF.

2.0 QUALIFICATIONS AND EXPERIENCE

- 2.1 My name is Graham Sinclair. I hold a Bachelor of Science (with honours) degree in Geography from the University of Leicester and a Master of Science degree in Hydrology and Water Resources Management from Imperial College London. I have been a chartered member of the Chartered Institute of Water and Environmental Management since March 2018.
- 2.2 I am a Technical Director at Create Consulting Engineers Ltd. and lead the water and flood risk team across all regions of the UK. I have over thirteen years of experience in flood risk and drainage consultancy, during which time I have specialised in advising developers and landowners regarding flood risk management and mitigation, as well as surface and foul water drainage solutions.
- 2.3 As part of the preparation for this inquiry, I was instructed by Clare Hall in May 2024 to provide expert advice and subsequently evidence regarding flood risk related matters. This proof of evidence is associated with the section of the proposed busway that runs adjacent to Clare Hall and includes the proposed crossing of Bin Brook. I can confirm that I assisted in the preparation of the Clare Hall's statement of case and that I have visited the appeal site on a number of occasions to fully understand the area and its hydrological context.

Declaration

- 2.4 The evidence that I have prepared and provided for this Inquiry (Ref. TWA/24/APP/03) in this proof of evidence is true and the opinions expressed are my true and professional opinions.

3.0 INTRODUCTION

The Submitted Application

- 3.1 Create Consulting Engineers (CCE) has been instructed to provide expert flood risk advice for a proposed busway known as the 'Cambourne to Cambridge (C2C) Transport Works Order' specifically regarding its potential impact on Clare Hall College, Cambridge.
- 3.2 On 7 May 2024, CCE were contacted by Professor Alan Short of Clare Hall regarding proposals to route a busway alongside Clare Hall, including the expropriation of Rifle Range Road and construction of a raised causeway approximately 2.0m above existing levels, with an opening for the Bin Brook River. Clare Hall requested a flood risk analysis, citing concerns that the college had experienced severe flooding around 20 years ago and that the new busway could exacerbate flood risk to the college and surrounding area.

Chronology of Communication

- 3.3 Below, is a chronology of the relevant communications to date. This sets out the narrative of CCE's involvement with the proposed scheme and highlights the lack of engagement by the Applicant.
- 3.4 In July 2022, Clare Hall's solicitors, Dentons, wrote to Cambridgeshire County Council (CCC) and the Greater Cambridge Partnership (GCP) drawing attention to the flood risks that would be potentially resultant of the proposed West Cambridge to Grange Road section of the C2C route (July 2022 Letter). A summary of the 'Flood Risk' section is provided below:
- A section of the proposed route near Bin Brook lies in a medium to high flood risk area. Constructing the bridge and associated infrastructure will require major earthworks and significant engineering to mitigate the flood risk. An Environmental Impact Assessment should fully assess the extent of these engineering requirements. While the consultation brochure acknowledges the need for additional flood storage it lacks clarity on the scale and impact of such measures. Part of the college grounds also lie within the floodplain and rely on a unique drainage system, along Rifle Range Road, which the brochure fails to consider. Potential disruption to this system and alterations to the floodplain could negatively affect the floodplain.
- 3.5 CCC, the 'Applicant', submitted the application for The Cambourne to Cambridge Order in November 2024 and included the following documentation relevant to flood risk:
- Environmental Statement (ES) (November 2024) (CD1-11.13.01).
 - Flood Risk Assessment (FRA) / Hydraulic Modelling Report (October 2024) (CD1-11.13.02).
 - Water Framework Directive Screening and Scoping Assessment (October 2024) (CD1-11.13.03)
- 3.6 Objections were then made against the scheme by Clare Hall (CD2-OBJ-213) and by the EA (CD2-OBJ-301) in January 2025.
- 3.7 Within the Objection Letter by Dentons on 7 January 2025, (CD2-OBJ-213) the key flood risk comments were as follows:

- The flood risk information provided by the Applicant in support of the scheme is wholly insufficient and does not yet demonstrate that the objectives of the NPPF (CD8-01) have been complied with.
- Clare Hall believes that the flood modelling and mitigation report commissioned by the college demonstrates that there is a significant increase in flood risk associated with the scheme and that these risks have been inadequately assessed as part of the proposed busway route.
- The current scheme would have a material impact on increasing flow rates and water levels, which can cause scour, bank stability, damage to bridges, mobilisation of debris and potential negative outcomes on buildings at Clare Hall.

3.8 CCE Queries sent to GCP by Dentons on 17 February 2025 (February 2025 Queries List) included the following concerns regarding flood risk from the Applicant's submitted FRA (CD1-11.13.02):

- The Applicant indicated that consultation with the EA was conducted via email; however, there is no evidence that the EA were fully engaged in the process up to submission since their involvement some time before. Specifically, there was no record of a RAG spreadsheet or equivalent feedback being returned to the Applicant.
- CCE requested confirmation of the full hydraulic model name and baseline details used. This information is typically stated at the beginning of a modelling report and is currently missing.
- CCE asked that the full extent of potential impact on the upstream Gough Way estate be shown in one of the images provided by the Applicant, as key areas appeared to be excluded.
- CCE observed clear signs of impoundment in one of the submitted images, which warrants further investigation. CCE requested the same modelling results using a finer threshold value to support this analysis and recommended the inclusion of a long section to identify precisely where impoundment occurs and its downstream effects.
- CCE raised concerns about the submitted impact grid, noting that a lower-than-expected threshold was used, resulting in unnatural hydraulic behaviour. Clarification on this issue was requested.
- CCE noted that the 1 in 1000 year flood event with climate change showed an increased risk at Clare Hall, exceeding the submitted threshold marker (10 mm), with additional increases observed upstream. This suggests the proposed scheme may be altering flow regimes along the Bin Brook river, and further investigation is required. CCE requested further impact grids to assess this more thoroughly.

3.9 Hydraulic Modelling Report comments and queries were also included as follows:

- CCE requested clarification on whether blockage testing had been undertaken as part of the modelling.
- CCE asked how the bridge structure was represented in the model, specifically to ensure that any losses to the bridge abutments were correctly calculated. Further clarification was also requested on the cross sections used to retain the bridge shape.
- CCE requested detail to better understand how key structures were incorporated into the model.
- CCE raised concerns about obvious gaps in the 1D domain at known structure locations, noting that some structures preset in the EA model were not retained within the Applicant submitted model.
- CCE noted changes in flood extent in Clare Hall and upstream, as show in the change in extent image, had not been discussed, despite the likelihood of corresponding changes in flood levels.

- CCE asked for a lower threshold value to be applied to the depth image to provide a greater confidence in results.
- CCE noted a lack of discussion in the results section regarding changes to the flow profile through the bridge structure. This is a concern, as altered flow regimes could influence peak flow rates through Clare Hall and potentially impact the college. Clarification was requested.

3.10 Finally, comments and queries on the Hydrology Report were as follows:

- CCE noted that the flows rates used in the submitted FRA are between 15%–20% lower than the EA model. Justification required.
- CCE requested a comparison between the submitted model and preceding EA model, in terms of flood extents and hydrological estimates.

3.11 On 25 March 2025, Dentons sent a letter to the Applicant reiterating the requests previously made by CCE in our earlier correspondence (March 2025 Queries List).

3.12 On 8 April 2025, GCP wrote a letter to Dentons responding to a number of the queries previously raised. Whilst this letter provided some information that had not been shared previously, it failed to provide a lot of the detail required, stating that more information would be shared on the conclusion of the EA review which was still ongoing.

3.13 Clare Hall submitted their Statement of Case on 11 April 2025 (CD23-17 OBJ-214 SoC).

3.14 On 2 July 2025, Dentons, on behalf of Clare Hall issued a note to the inspector regarding the Proposed Scheme (ES note) as agreed at the Pre-Inquiry Meeting. The ES note was prepared to specifically identify the areas where Clare Hall consider the environmental information submitted to date to be deficient and where further information is required.

3.15 On 17 July 2025, Dentons sent a letter (July 2025 Queries List) to Womble Bond Dickinson (solicitors representing the Applicant) to confirm Clare Hall's intention to agree a Statement of Common Ground with the Applicant and to also highlight information outstanding to date. From a flood risk perspective, Annex 2 to that letter contained the following outstanding queries:

- The original model used for the baseline has not been named, despite the Applicant stating that they provided the modelling to the EA in February 2025 and it is anticipated that the name of the model will be released once the EA finished their review. From CCE/Dentons perspective, we have been requesting this information since submission of the objection letter.
- A zoomed-out version of depth extent of the estate upstream has still not been provided.
- A long section of the channel affected has not been provided.
- A flood modelling report has not been provided.
- An explanation for the gaps CCE noted at known structure locations has not been provided.
- An analysis has not been provided regarding the flow rates and bridge structure impact on Clare Hall.
- The 15–20% increase in flow rates have not yet been justified.
- No comment or justification has been made regarding the CCE assertion about the lesser detailed model submitted by the Applicant.
- Further justification if required to address the requirements of the Sequential Test.

3.16 An ES addendum (written by WSP), was submitted on 23 July 2025 (CD1-10.07) and made the following points:

- WSP state that the new proposed crossing and embankment across Bin Brook will have little impact on the flood risk.
- WSP state that water levels decrease along the Bin Brook, downstream of the proposed route, reducing flood risk to third parties including Clare Hall. Water levels upstream of the crossing point would be similar to the baseline with 8mm increased in depths over a short reach of the watercourse. WSP then states that this difference in flood extent is not considered an increase as it would not affect any buildings or assets.
- WSP acknowledge that no floodplain compensation is proposed for the embankment introduced within the floodplain. They seek to justify this by stating that the removal of the existing bridge, combined with the introduction of the proposed embankment and bridge, results in no significant impact on flood levels, thereby negating the need for compensation.

3.17 These matters are addressed further below in the main body of my Proof of Evidence.

3.18 At the time of writing there is nothing to indicate that the EA has withdrawn its objection (CD2-OBJ-301) relating to the hydrological assessment and hydraulic modelling on which this Proof of Evidence is based. The Applicant has submitted hydraulic modelling (undertaken by WSP), but as far as CCE is aware, the EA has not approved this work.

3.19 On 24 July 2025, during the preparation of this Proof of Evidence, the Clare Hall team received a data package submission directly from WSP. This included the original model submitted to the EA in July 2023 and the updated model submitted in February 2025. The package also contained additional documentation relating to the EA's approval process and the Applicant's submission, including the EA RAG review spreadsheet and WSP's responses to the EA's comments submitted as part of the February 2025 update. This information provided long-awaited insight into the model build and results, which had previously been unavailable and had significantly hindered CCE's ability, on behalf of Clare Hall to undertake a comprehensive review of the submission.

3.20 However, critically, no information was provided regarding the EA's response to the February 2025 submission. As such, there remained a six-month gap – between February and July 2025 – during which it was presumed that ongoing dialogue occurred between WSP and the EA.

3.21 A meeting between CCE and the applicant was held on 7 August 2025. In this meeting the remaining queries raised by CCE on the WSP modelling were discussed. The applicant confirmed that the data package provided on 24 July 2025 remains current with the updates request by the EA not undertaken. WSP instead have undertaken further testing of their model to endeavour to justify its findings.

3.22 It was confirmed by the applicant that discussions with the EA are ongoing. CCE requested that this dialogue is shared. Pending the receipt of this information and the EA decision, our review necessarily has had to continue on the basis of the submitted information and our own hydraulic modelling. The Applicant, within their Statement of Case (CD23-01, section 14.30.2), states that they addressed the EA objection (detailed above) by providing the modelling and associated reporting to the EA following receipt of their request (February 2025) and further follow up hydrology sensitivity tests (May 2025).

3.23 Further to the meeting on 7 August 2025 WSP issued a revised information pack on 8 August 2025 to CCE including further EA reviews, which provided some clarity on the aforementioned six month gap in the information. These RAG reviews, dated most recently 24 July 2025 and supplied to the EA by Arcadis confirm a number of outstanding items in relation to the modelling where further information/clarification is required to make it fit for purpose. These include:

- Model hydrology using outdated data.

- Inconsistencies in level representation in channel banks.
- Issues with glass walling and model boundaries.
- Lacking detail with regards structures and their inclusion in the modelling.
- Lack of calibration to historic data.
- Incorrectly executed sensitivity testing.

- 3.24 It is unclear why this information was not provided at an earlier stage, having regard to the flood risk concerns raised in Clare Hall's objection and Statement of Case and the repeated requests for information to enable the flood risk implications to be understood. The lack of timely and transparent communication has resulted in CCE undertaking additional and unnecessary work to interpret the model without access to adequate supporting information – an outcome that could have been avoided through more effective engagement by the Applicant.
- 3.25 CCE has therefore been placed in a difficult position. This Proof of Evidence has been prepared based on the Applicant's submitted hydraulic modelling, without any assurance that the modelling has been, or will be, accepted or given the requisite technical sign off by the EA.
- 3.26 This situation clearly has the potential to result in work undertaken by CCE proving to be abortive. This has arisen directly as a result of the Applicant's inadequate initial assessment and report, its lack of engagement on this matter and failure to resolve these issues in good time prior to the start of this inquiry.
- 3.27 In July 2024, CCE contacted the EA to confirm receipt of the Bin Brook 2023 model and advised that we were in the process of reviewing it and preparing a proposed scope of works. We also requested EA support through a purchase order for input on both the scope and methodology.
- 3.28 In August 2024, the EA responded, requesting further clarification on the proposed development under question and noting that they had limited capacity for model reviews and meeting attendance due to workload pressures from large scale strategic sites. CCE responded to confirm the details around the proposed Busway and that we were instructed by Clare Hall to undertake the modelling exercise. The EA subsequently confirmed that they would not be able to validate any modelling related to third party developments. They advised that only pre-application advice would be available in this case.
- 3.29 Based on the submitted information on which this Proof of Evidence has been compiled, it is important to note that neither the hydraulic modelling undertaken by WSP (on behalf of the Applicant) nor that prepared by CCE (on behalf of Clare Hall) has received formal approval from the EA. The WSP modelling has been submitted as part of the Department for Transport (DfT) submission without confirmation that the EA's comments and requested clarifications – outlined in their formal objection – have been addressed.
- 3.30 Similarly, CCE's modelling remains unvalidated, as the EA confirmed that it is unable to review the modelling as CCE do not act for the applicant. As a result, CCE is having to proceed with the preparation of this evidence without the benefit of agreed or verified modelling.
- 3.31 CCE has made every possible effort to thoroughly assess the potential impacts of the proposed development. This has involved undertaking extensive and detailed work, including comprehensive assessment and analysis (without receipt of necessary data). Moreover, these efforts have come at a considerable cost to the objector, Clare Hall.

Scope of Works

3.32 This Proof of Evidence will focus on flood risks, flood mitigation, and associated matters, specifically in relation to the section of the Proposed C2C busway that crosses the Bin Brook and the associated impacts this will have on areas upstream, as well as land under the control of Clare Hall immediately downstream.

3.33 The objectives for this Proof of Evidence are to:

- Provide expert flood risk evidence in respect of Clare Hall and surrounding land, to assess the extent to which there is compliance with the NPPF (CD 8-01) and associated Planning Practice Guidance (PPG)¹;
- Consider the adequacy of the flood modelling undertaken by the Applicant with respect to national standards;
- Assess the risk and implications of flooding surrounding land from fluvial sources as a result of the proposed Bin Brook crossing; and
- Consider the potential future impacts of climate change over the lifetime of the proposed development.

3.34 My Evidence is structured in the following manner:

- Chapter 1 provides an Executive Summary.
- Chapter 2 outlines my qualifications and experience that equip me to provide expert advice on flood risk at the inquiry.
- Chapter 3 introduces the scheme, summarises the application, correspondence to date and details the scope of works addressed within this Proof of Evidence.
- Chapter 4 provides the history and background of the application and outlines the chronology of past actions.
- Chapter 5 summarises relevant planning policy with respect to flood risk as well as standards for Hydraulic modelling.
- Chapter 6 details the inadequacy of the WSP modelling by examining the model version used.
- Chapter 7 provides information on the likely impacts on Clare Hall by reference to CCE's modelling.
- Chapter 8 addresses NPPF paragraph 181, 178 (b) and 179 regarding the impact on flood risk elsewhere and floodplain compensation.
- Chapter 9 considers potential mitigation for the flood risks associated with the scheme as identified in CCE's hydraulic modelling report.
- Chapter 10 provides conclusions regarding the level and significance of adverse effects, non-compliance with relevant policy and the weight that ought to be given to these matters by the decision maker.

¹ Ministry of Housing, Communities and Local Government., Flood Risk and Coastal Change Planning Practice Guidance: <https://www.gov.uk/guidance/flood-risk-and-coastal-change> [Accessed July 2025]

4.0 APPLICATION BACKGROUND

Context

- 4.1 The full Transport Work Order relates to the proposed Cambourne to Cambridge (C2C) busway. However, this Proof of Evidence focuses solely on the section of the route that runs east to west along Rifle Range Road, which borders the southern edge of Clare Hall. The alignment crosses the Bin Brook channel and associated floodplain just upstream of Clare Hall.
- 4.2 The purpose of this Proof is to assess the proposed route, specifically in terms of its flood risk implications and potential impacts on Clare Hall and the surrounding area, including land both upstream and downstream of the Bin Brook crossing.
- 4.3 Bin Brook is a watercourse in southwestern Cambridge that flows from Hardwick in the west to join the River Cam just upstream of Jesus Lock. The Brook passes through and underneath both the eastern most section of the proposed C2C busway and Clare Hall. It is classified as a Main River by the EA.
- 4.4 The layout of Clare Hall, along with its arrangement in relation to Bin Brook and Rifle Range Road are shown on 4.1 below.

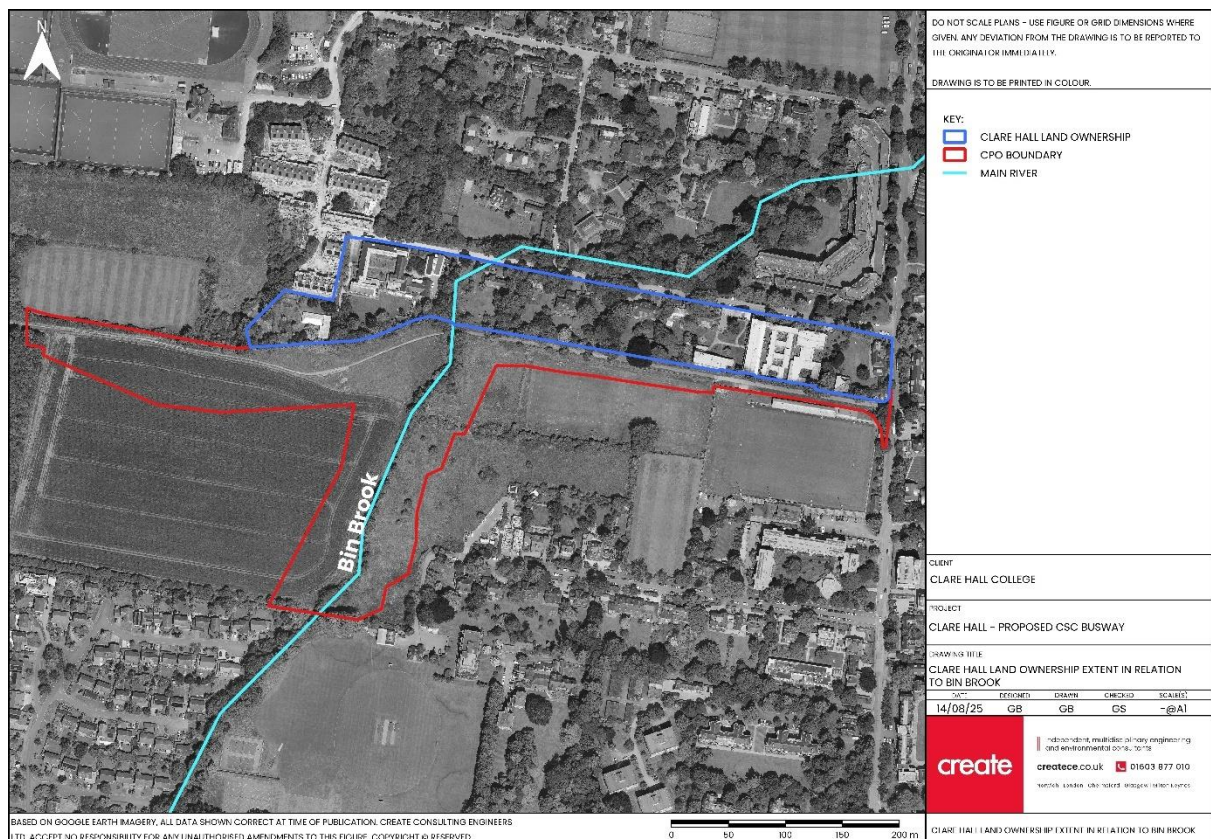


Figure 4.1: Clare Hall Land Ownership Extent

Fluvial Flood Risk Summary

- 4.5 Flooding from tidal or fluvial sources is shown within the Flood Map for Planning. This is a resource that displays areas in England that are at risk of flooding from rivers or the sea, as well as identifying any locations that are protected from flood defences. It is utilised to inform planning decisions, raise awareness of flood risk and design suitable mitigation measures, if necessary, for development.
- 4.6 The latest Flood Map for Planning² shows Clare Hall and associated land to be located within all three Flood Zones (Figure 4.2).

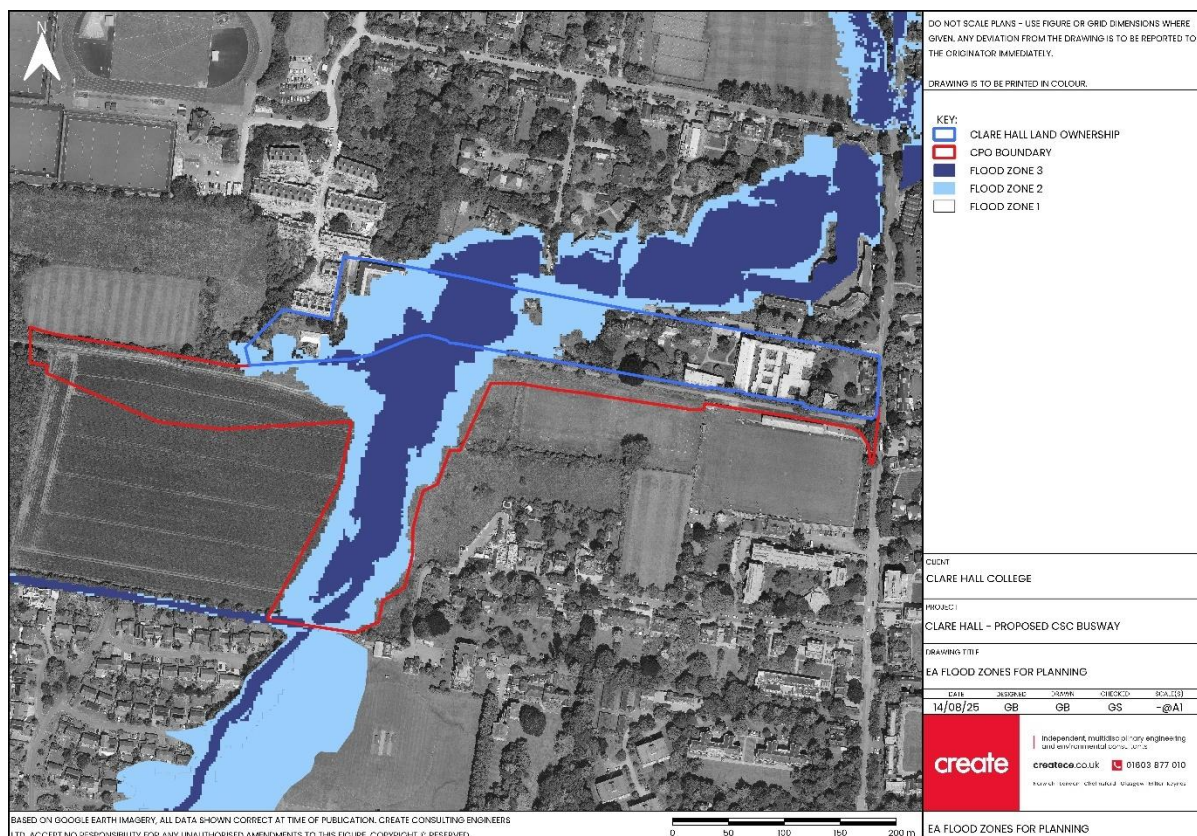


Figure 4.2 Flood Map for Planning

- 4.7 For context within the Flood Map for Planning, Flood Zone 1 is land assessed as having less than a 0.1% AEP (Annual Exceedance Probability) risk of flooding from rivers or the sea in any given year. Flood Zone 2 comprises land assessed as having a 1% AEP (1 in 100 years) to 0.1% AEP (1 in 1000 years) chance of flooding from rivers, or between a 0.5% AEP (1 in 200 years) and 0.1% AEP chance of flooding from the sea in any given year. Flood Zone 3 is land with a 1% AEP or greater chance of flooding from rivers or a 0.5% AEP or greater risk of flooding from the sea in any given year. These zones are often referred to contextually as 'High,' Medium,' and 'Low' flood risk, respectively.

Relevant Background

- 4.8 The Applicant submitted the Application on 12 November 2024. The EA subsequently provided comments (CD2-OBJ-301) on the proposals, which are detailed in this section.

² Environment Agency., 2021. Flood Map for Planning (Rivers and Sea) – Flood Zone 2 and Flood Zone 3. [Online]. Available at: <https://data.gov.uk/dataset/cf494c44-05cd-4060-a029-35937970c9c6/flood-map-for-planning-rivers-and-sea-flood-zone-2> [Accessed August 2025]

- 4.9 The EA requested submission of the full hydraulic model (dated 15 November 2023) due to multiple issues, stating it was unsuitable for its intended use. Specific concerns were raised regarding the 1D model, 2D model and the 1D/2D linkages within the model, all of which required further review. The EA also noted that the representation of bank lines and structures needed improvement and highlighted that the 1 in 1000-year event (with a 19% climate change uplift), resulted in 'glasswalling' against the model. The term 'glasswalling' refers to the artificial blocking of water flood water against the edge of the hydraulic model, as if there were an invisible, impermeable wall. It prevents water from entering or exiting a model domain. This is not a representative of normal hydraulic behaviour, and when it occurs – intentionally or due to model setup issues, it should be addressed to understand how the water would behave under realistic conditions.
- 4.10 Additionally, the EA requested further information to increase confidence in the model outputs. Certain elements of the model, such as elevation values being used to represent structures, were flagged for reassessment. This approach can lead to inaccurate results, as elevation alone does not capture the hydraulic behaviour of features like culverts, embankments, bridges or weirs. Such structures should be represented using appropriate hydraulic components with defined parameters, rather than relying solely on ground elevation data.
- 4.11 The EA also requested the submission of a model log to document all modelling decisions, which is essential to support the review process, along with the standard model report. This had not been provided at the time of CCE's hydraulic modelling. The modelling log was received from WSP on 24 July 2025; however, it should be noted that the modelling log has only been updated to November 2024, corresponding to the point of the Applicant's submission.
- 4.12 Based on the above assessment and the chronology presented in Chapter 3.0, my position is that Clare Hall and the EA's concerns have not been adequately addressed, for the reasons set out in the detailed sections below.

5.0 RELEVANT PLANNING POLICY

- 5.1 I provide below a summary of the national and local planning policy relevant to the proposed busway, which forms the basis on which my evidence is presented.
- 5.2 It is appropriate that reference is made to the relevant planning policies of the Development plan and material considerations, including the NPPF (CD 8-01) and PPG¹.
- 5.3 Those policies considered to be the most relevant to my evidence are within the following documents:
- Planning Practice Guidance¹ – Flood Risk and Coastal Change
 - National Planning Policy Framework (CD8-01)
 - Hydraulic modelling Guidance³
 - South Cambridgeshire Local Plan (CD6-02)
 - Cambridge Local Plan (CD6-01)
 - Greater Cambridge Sustainable Design and Construction SPD (CD7-16)
 - Cambridgeshire Flood and Water SPD (CD7-14)
- 5.4 The policies in the NPPF (CD8-01) should be interpreted alongside the PPG¹ and relevant case law^{Error! Bookmark not defined.}, which confirms that the PPG¹ holds the same legal status as the NPPF as a statement of policy. The NPPF sets out overarching principles and objectives, while the PPG¹ provides guidance on practical application and interpretation. Both are material considerations at the planning stage.

Flood Risk

- 5.5 The PPG¹ on flood risk and coastal change outlines when an FRA is required (paragraph 006 to 009), what the FRA should include (paragraph 010 to 014), the Sequential and Exception Tests (paragraphs 015 to 022) and how flood risk to the development and surrounding areas must be managed from all sources, both now and in the future.
- 5.6 The key principles regarding flooding within the NPPF (CD 8-01) are in the section "*Planning and Flood Risk*", starting at paragraph 170 which details that development should be avoided in flood risk areas. Also where necessary, safety for the development lifetime should be ensured whilst not increasing flood risk elsewhere.
- 5.7 The NPPF also outlines the overarching general principles for the sequential based approach (paragraph 170) which details that a risk-based approach should be used for applications in areas at current or future flood risk (paragraph 173).
- 5.8 The main aim of the Sequential Test is to steer development to areas of lowest flood risk (as per paragraph 174), it makes clear that 'development should not proceed if suitable lower-risk sites are available'.
- 5.9 The general principle of determining the acceptability of development in flood zones, as detailed in the PPG¹ is to apply the Sequential Test, as detailed above. This test steers development away from areas at greater risk, using the Flood Zone classification by way of hierarchy. Table 1 of the PPG¹ details the flood zone classifications, namely that Flood Zone 1 is low risk and suitable for all development, Flood Zone 2 has medium risk and allows development with an FRA including suitable mitigation. Flood Zond 3a is high risk with stricter controls and may require extra testing for sensitive uses, whilst Flood

Zone 3b is the functional floodplain which floods regularly and where only essential or water compatible development is permitted.

- 5.10 There is an exception to providing the sequential approach, paragraph 175 states that if there is no part of the proposed development that would be at risk of flooding, the test need not apply. However, this is clearly not the case for the proposed scheme due to the location of the Bin Brook in Flood Zone 3, and the alternative route within Adams Road being largely within Flood Zone.
- 5.11 Once having undertaken the Sequential Test and if lower risk areas aren't suitable (CD 8-01) (Paragraph 177), then the Exception Test might need to be applied. This will only occur if it has proven that there are no reasonably available, lower risk sites suitable for the proposed development to which the development could be steered towards, as detailed in the PPG¹ paragraph 032.
- 5.12 The Exception Test as detailed in paragraphs 178 and 179 of the NPPF requires it to be demonstrated that:
- a) *The development should provide wider sustainability benefits outweighing the flood risk; and*
 - b) *The development will be safe for its lifetime, not increase flood risk elsewhere, and ideally reduce risk overall.*
- 5.13 Both parts of the exception test have to be met.
- 5.14 Policy CC/9 of the South Cambridgeshire Local Plan (CD6-02, pages 109-111) states that development is only acceptable if the NPPF's Sequential and Exception Tests (if required) are passed, flood risk is not increased elsewhere and opportunities to reduce flood risk are taken.
- 5.15 Policy 32 of the Cambridge Local Plan (CD6-01) permits development where flood risk is properly assessed, the site lies outside of the EA's Flood Zone 3b, is water-compatible or a minor development or is located in Flood Zone 2, where any flood risk is mitigated through flood resilient design. If located in Flood Zone 3, the site layout and boundary must be given careful consideration to ensure that floodwaters are not restricted, preventing increase in risk to adjacent properties.
- 5.16 Chapter 5 within the Cambridgeshire Flood and Water SPD (CD7-14) emphasises a sequential approach to site layout, encourages green infrastructure for flood storage and amenity public areas and details the necessity for flood resilient design. It also highlights the importance of maintaining floodplain capacity and requires level-for-level, volume-for-volume floodplain compensation where land raising occurs, which is particularly relevant given the proposed development's proximity to the Bin Brook watercourse.

Acceptability of Development in the Flood Zone

- 5.17 The proposed busway is classified as 'Essential Infrastructure' in Annex 3: Flood Risk Vulnerability Classification of the NPPF (CD8-01), meaning it can cross flood-prone areas. According to the PPG¹ Table 2, the Exception Test is not needed for essential Infrastructure in Flood Zones 1 and 2 but is required in Flood Zone 3a and 3b, where infrastructure must remain safe and operational during floods. For Flood Zone 3b, within which the proposed scheme sits, the design (where it has passed the Exception Test) must ensure it does not block floodwater, reduce floodplain storage, or worsen flooding elsewhere.

Hydraulic Modelling Guidance

- 5.18 Key guidance for hydraulic modelling can be found on the GOV.UK Website under 'Using Modelling for Flood Risk Assessments'³. The key points are to use industry standard software, accurately represent the site's features, use up to date rainfall and climate change data, follow official guidelines, and test different flood scenarios including before and after development. The requirements of this guidance are further drawn out in the following section which critiques the submitted hydraulic modelling.

³ GOV.UK., 2013. *Using modelling for flood risk assessments*. [Online]. Available at: Using modelling for flood risk assessments – GOV.UK (Accessed July 2025)

6.0 INADEQUACY OF THE WSP SUBMISSION

- 6.1 The section below provides a review of the WSP hydraulic modelling statements, identifies where the submitted materials fall short of the relevant guidance and details how it relates to the latest approved EA modelling of the catchment.
- 6.2 The WSP Hydraulic Modelling statements include the WSP Hydraulic Modelling Report (Annex TR13.1.1 Hydraulic Modelling Report of CD-11) which was submitted as an appendix to the FRA (CD1-11.13.02), itself an appendix of the ES, to the DfT on 4th November 2024. The report summarises the hydraulic modelling work that was done by WSP to support the FRA for the C2C proposed busway.
- 6.3 The Hydraulic Modelling Report contains details of the approach followed to establish a baseline flood risk level to the development, and the approach to test the impacts of the development. This report has since been supplemented by the Applicant's responses to queries raised by Clare Hall in the form of a letter⁴, an addendum to the ES published July 2025 (CD1-10.06 and CD1-10.07) and the Applicant's Statement of Case (CD23-01 CC SoC).
- 6.4 In this section, details are provided of areas where the submitted information falls short of what is required by established guidance or provides insufficient evidence to support the conclusions made. The document is also compared against the latest available EA hydraulic model for the catchment (ENV0002539C-JBA-XX-CA-RP-MO-L0116_1-A6-C01-L0116_1-EA0-LOD0-BB_Main_Report.pdf).
- 6.5 Finally, these reports are now augmented by a data package received from WSP dated 24 July 2025 and a further meeting with WSP on 7 August 2025. This data package includes the model files previously submitted to the EA in 2023 and to the EA in February 2025. It also contains some of the quantitative information that was requested from the Applicant on 17 February 2025, 25 March 2025 and 17 July 2025, but which had not been forthcoming, despite several requests, as explained in Chapter 3.0. Given the lateness of this submission, a section has been added to each critique below setting out how the data submission relates to the assessment previously made.

Model Version

- 6.6 In section 1.3.1 of the WSP Hydraulic Modelling Report, the Applicant states that an existing EA 1D/2D model is used as the starting point for the work, however the report does not confirm which model is used. This information was not forthcoming until the Applicant responded to an information request by Clare Hall dated 8 April 2025⁵ confirming that it was the 2017 Gough Way Model that was used, initially prepared by CH2M. Further confusion arose from the Applicant's Statement of Case (CD23-01 CCC SoC), specifically in section 11.20.3, where the Applicant states that multiple models were used as a source for the WSP hydraulic modelling assessment.
- 6.7 This lack of clarity as to which model was used for the submission, and therefore what information was relied upon in the WSP assessment, led to delays in the review of the hydraulic modelling and also inhibited the independent flood risk assessment process. The data submittal on 24 July 2025 shows that it was indeed the Gough Way Estate 2017 model that was used as the starting point, but that significant changes were made to the model to incorporate updated survey information.

⁴ Clare Hall responses to Dentons Signed 08/04/2025

⁵ Clare Hall responses to Dentons Signed 08/04/2025

- 6.8 The WSP hydraulic modelling report lacks sufficient information to fully review a hydraulic model build, therefore it is not possible, based on the model alone, to fully understand how the model was built, the sources of information used, or to assess the adequacy of the methodologies applied. It is unclear which elements of the model build are maintained from previously approved models or edited bespoke for this model build. This further limited our ability to undertake a detailed review of the submittal as the scale of the change compared to the EA approved model is unclear. Based on the information package received on 24 July 2025 this is a concern that was raised by the EA who in item 18.1 of the EA RAG spreadsheet state that:

The supplied memo is insufficient and lacks information about the location of the updates to the model etc.. A model report should include: an overview of model build including a model schematic, hydraulic roughness (including photographs) and representation of any defence networks or use of non-standard elements discussion of structures (including photographs and details of how they have been modelled) comment on model stability and measure taken to improve stability justification of any remaining errors and warning messages produced etc..

- 6.9 Given that WSP's subsequent submittal is only marginally different to the previous submittal that was the basis for that EA comment, it is clear the document remains insufficient.
- 6.10 The latest EA approved model for the Bin Brook catchment is the 2023 JBA Bin Brook Flood Model. This model supersedes the Gough Way 2017 model and is designed to represent the full catchment risk. There is no mention of this model in any of the documents that have been submitted and therefore there is no confirmation that the work used to build the 2023 JBA model was incorporated into the WSP hydraulic modelling work, even as a comparison and check against the extents published.
- 6.11 The 2023 JBA model, and the 2024 CCE model, which is based on the 2023 JBA Model, use the latest information, methodology and guidance. It also includes a representation of a wider area of the catchment and calibration. Ensuring the use of the latest available hydrological and hydraulic information, as well as adherence to latest guidance is a prerequisite of the EA hydraulic model review process.

Survey Information

- 6.12 Section 1.3.4 of the WSP Hydraulic modelling report (Annex TR13.1.1 Hydraulic Modelling Report of CD1-11.13.02), indicates that in May 2022 a survey was undertaken for Bin Brook and its associated structures which was used to update the hydraulic model. This survey information is not included in the submission nor is there a structure list to describe the key structures that are included and their associated details. This has been requested previously as part of the Queries List sent to GCP by Dentons (17 February 2025), Letter to GCP (25 March 2025) and the Letter to Womble Bond Dickinson (UK) LLP (WBD) highlighting outstanding information 17 July 2025))⁶. This correspondence is detailed in section 3.
- 6.13 No further information was provided in the Applicant's response to the Clare Hall comments in either the letter (Dated 8 April from GCP to Dentons), the statement of case (CD23-01 CCC SoC) nor the ES Chapter Addendum (CD1-10.07). In the response letter (Dated 8 April from GCP to Dentons) the Applicant stated that full information of the model design will be released upon the completion of the EA review, however whilst this process continued the information was being withheld from the remainder of the interested parties which inhibits their ability to fully assess the proposals. We believe that this inappropriate and has led to the undertaking of work and analysis that may prove to have

⁶ Letter to Greater Cambridge Partnership dated 21/03/2025 reference TZZH/079640.00001

been unnecessary and/or abortive and come at significant time and cost to the objector. This could easily have been avoided by proper engagement from the Applicant with the requests made for further information.

- 6.14 The importance of the survey information is that understanding how key structures in and around the Proposed Busway are represented in the baseline scenario, as well as how the in channel has been represented, is key to understanding the baseline flood risk against which the developed case is compared. The fact that this information was not included inhibited the review process and does not allow CCE to confirm or critique the baseline flood extents.
- 6.15 Conversely the 2023 JBA Model reporting includes both a structure list as well as the surveyed features of those structures. The JBA reporting has information on each of the structures that are included in the model throughout the river reach. This data can then be used to check the hydraulic model and ensure that hydraulic representation is based on real world measurements and that all key structures are included.
- 6.16 On 24 July 2025 the Applicant provided the survey information and the model files which permits a review of the structures included in the baseline hydraulic model. As suspected from the review of the November submission, there are several structures in and around the purchase order area that are not included in the hydraulic model. These missing structures were flagged by the EA in item 5.1 of their review spreadsheet:

There appear to be two footbridges which have been omitted from both the survey and the model, at the downstream extent of the Bin Brook diversion channel (NGR 543488, 258057) and at Clare Hall (NGR 543601, 258334).

- 6.17 Despite the EA comment, these structures are still not within the latest version of the model received. Our position is that given the sensitivity of the design and the proximity of these structures to the proposed development, a complete hydraulic model should include them. These structures will have a material impact on flow patterns. Discussions with WSP on 7 August 2025 indicate that WSP's position on this has not changed.

Model Hydrology

- 6.18 In section 1.3 of the Supporting Hydrology Report (CD1-11.13.02, Annex TR13.1.1) the Applicant states that the high flows Version 10 National River Flow Archive (NRFA) database is used for the model flood estimation report. This data is not the most up to date database. At the time of the model submission in November 2024, the high flows version 12.1 was available and should have been used in preference to version 10 as this can affect design flow rates, and can have an influence on the performance of the proposed development at the design flood event. The CCE hydrology utilises NRFA version 12 for its hydrological assessment. Ensuring that flood risk assessments use the most up to date information available at the time of submittal is a directive set out in the EA guidance for using hydraulic modelling for flood risk assessments⁷.
- 6.19 Section 1.3.5 of the WSP Hydraulic Model Report (CD1-11.13.02, Annex 1-TR13.1.1) states that there are no flow gauges on the watercourse that can be used to improve model calibration and hydrology estimates. This is further stated in the Supporting Hydrology Report (Annex TR13.1.2) section 1.4 of the FRA (CD1-11.13.02) where the Applicant references the Bin Brook level gauge but states that as it is a water level station it is not for use in flood estimation. This means that the design flood estimates in

⁷ <https://www.gov.uk/guidance/using-modelling-for-flood-risk-assessments>

the Supporting Hydrology report (CDI-11.13.02, Annex 1-TR13.1.2) are all ungauged assessments which will have a greater degree of uncertainty than gauged assessments.

- 6.20 The 2023 JBA Model assessment identifies a level gauge within the catchment located at NGR 542750 257550 along the Bin Brook upstream of Gough Way Estate. This gauge does not have a rating curve, however JBA used the hydraulic modelling of the gauge to establish a rating for the level gauge to derive flow rates from the historic level data. JBA used this information to inform the QMED estimation, which is the basis for their hydrological assessment, which CCE retained in the 2024 CCE Model.
- 6.21 EA guidance recommends the use of gauge data where possible. This is set out in the EA Flood Estimation Guidelines document (LIT 11832), that states that "Flood Frequency is best estimated from gauged data" and that "Catchment descriptors are used as a last resort". Given the existence of the level gauge, it would be expected that this gauge is used to support the hydrological assessments to improve certainty in the WSP reporting. Uncertainty in hydrology means greater uncertainty in the results of the WSP model report.
- 6.22 Furthermore, in the WSP report there is no reference to additional sources of information used in developing the model hydrology. The EA guidance suggests in the Flood Estimation Guidelines document (section 2.2), that historical data reviews should be undertaken to understand the context of the estimates derived in the flood estimation process. There is no indication that the estimates derived in the WSP hydrology document are compared back against historical studies or that any attempts at contextualising the flows are made. This increases uncertainty in the results.
- 6.23 The 2023 JBA Model and the 2024 CCE Model both use historical data studies and use references to recent hydrological events to better understand the flood estimation rates. Consequently, when comparing like for like flood estimation points, the WSP estimated design flow rates are 15-20% lower than the CCE design flow rates and are lower than the EA Approved 2023 JBA Model design flow rates. There is no commentary in the WSP model report comparing their estimated flows against the Gough Way 2017 model, upon which their work is based. There are sections in both the flood estimation report and the hydraulic model report that leave space for the comparison of results against known previous studies, but no information is provided on this in the WSP submittal. This is important because a 15-20% variation in inflow rates can alter significantly the design flood levels that are being used to design the proposed development and therefore alter significantly the potential impact the development is having on surrounding landowners.

Model Results Verification

- 6.24 Section 1.3.6 of the WSP reporting (CDI-11.13.02 Appendix TR13.1.1), states that there is no historical flow or flood data available for model verification, and there is no indication that the WSP submittal considered historic flood events in the catchment. These events are useful to verify the model results to ensure that the performance of the model (i.e. the combination of the hydrology being used and the hydraulic design) is performing broadly how the river has been known to perform in past flood events. Undertaking such an assessment is used to reduce the uncertainty of the design flows in the WSP submission which has implications on the sizing and assessment of the development.
- 6.25 The 2024 CCE Model reporting and the 2023 JBA Model reporting include model calibration efforts using rainfall from known historic events to calibrate the model physical build, and cross referencing those events with known historical flood outlines. The data used in this calibration and hydrological analysis is the 15-minute rainfall data from the Bourn STW, the Flame Dyke and the Uttons Drove

loggers. This rainfall is run through the model for given historical events, and the progress of the flood is matched with historical records.

- 6.26 When considering the high flood impact history of the catchment this is an essential element of the hydraulic model build. The WSP hydraulic model report does not reference any known historic rainfall or flood events, nor is there any attempt to calibrate against any historic flood events. This further disassociates the model from the catchment reality and increases uncertainty in the results. Including such verification processes ensures that the model is performing as the river has been known to perform in the past given similar rainfall and adds confidence to the hypothetical design events typically used to size developments.

Model Results

- 6.27 The model report also describes the approach to the design which is to set the soffit of the proposed busway above the design flood event level plus freeboard, and the desire to minimise bridge span where possible. The existing structure at Rifle Range Road is to be removed. According to the hydraulic modelling report (CD1-11.13.02 Appendix TR13.1.1), it is stated that the soffit level would be the design event plus 300mm freeboard. At this location, the design event maximum water level is 9.37mAOD, resulting in a soffit level of 9.67mAOD as stated in the FRA. However, the soffit level shown in the final drawings is higher, at 9.976mAOD, providing approximately 600m of freeboard – likely influenced by the road level design.
- 6.28 The results presented are two impact grids. These images both show the proposed development and part of the model extent upstream and downstream of the proposed development. Only the design event (1% AEP with 19% climate change) is shown. Only 2D flood levels are displayed, the 1D element is cut out of the model. On Plate TR13.1-1-3 (Figure 6.2 below), the impact grid is shown, symbolised to remove all values between -10mm and 10mm. This impact grid shows a slight reduction in flood levels downstream and an increase in levels upstream. The impact grid also shows a banded isolated increase in the area upstream of the bridge.



Figure 6.1 TR13.1-1-3 WSP Baseline vs Proposed change in peak flood water level for the 1% AEP with 19% climate change allowance

6.29 Plate TR13.1-1-2 (Figure 6.1) shows a change in extent for the same area and same return period event. There are increases in area upstream of the development, however the image extent does not include areas of Gough Way or areas further upstream for review.

6.30 Whilst the report asserts that these results indicate the WSP submission adheres to the requirements of the NPPF (CD 8-01), there are several elements of the presentation that do not allow the verification of this assertion. First the tolerance used on the images is 10mm, meaning that any changes below 10mm are not shown. This is in contradiction to the EA guidance for impact assessment, the EA online guidance on using flood modelling for flood risk assessment states that⁸:

You should carry out this analysis [the impact of a development on offsite flood risk] without including any allowance for model calculation error ('modelling tolerance'). If you identify any change in flood risk as part of the model calculation error, you'll need to provide robust technical analysis and reporting to support this.

6.31 Therefore, we would expect to see the unedited impact grids of the development. These comments have been presented to the Applicant and confirmation has been received in the statement of case (CD23-17 OBJ-214, section 11.20.07) and in the addendum to the Environment Statement (CD1-107 section 3.1.2) that there are indeed increases to the maximum water level upstream and outside of the order limits in areas adjacent to the Gough Way Estate. As discussed in the policy sections below this is in contravention of the NPPF (CD 8-01).

6.32 These confirmations are further corroborated by the model files received from WSP on 24 July 2025 and in a meeting on 7 August 2025. In these files, WSP provided Clare Hall with the maximum flood extent grids derived from the hydraulic models. These grids enable CCE, on behalf of Claire Hall, to

⁸ <https://www.gov.uk/guidance/using-modelling-for-flood-risk-assessments>

directly review the impacts. As anticipated, it is evident that there are offsite increases in flood risk within the Gough Way estate and to a lesser extent within Clare Hall itself. The impact grid is illustrated in Figure 6.2.

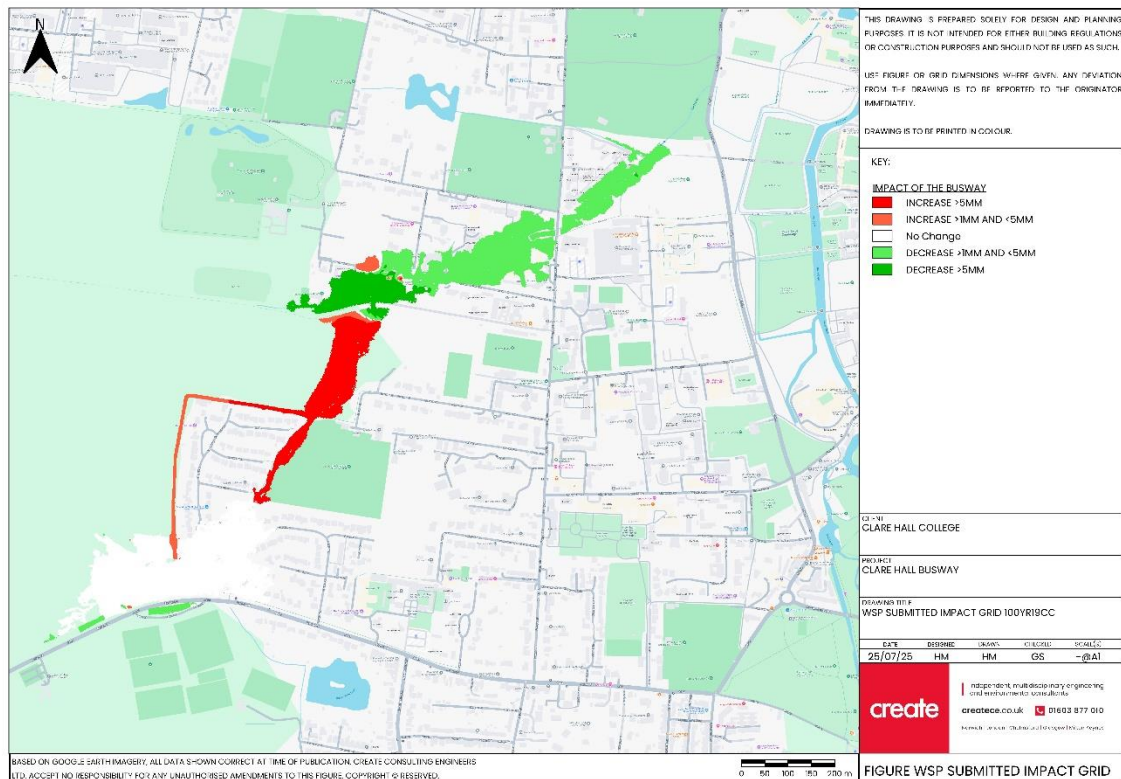


Figure 6.2: WSP Impact Grid 10m bridge at 1mm tolerance

Submitted Flood Risk Assessment

- 6.33 The submitted FRA document (Appendix TR13.1) states in section 1.3.1 that consultation with the EA was undertaken via emails, and, according to the Cambourne to Cambridge – Clare Hall Questions letter received March 2025, the EA objection (dated January 2025) remains against the application as their review has not been completed.
- 6.34 In fact, many of the items queried and requested as part of the liaison between Clare Hall and the applicant were not provided given that the “EA review is still currently ongoing”. If substantive items that are part of the submittal cannot be provided, then the impacts of the application on Clare Hall and the surrounding area cannot be properly assessed.
- 6.35 As mentioned in the model results section above, the model files submitted on 25 July 2025 and the applicant in meetings held 7 August 2025 agree that there is an increase in offsite flood risk upstream of the proposed busway, and to a lesser degree, downstream of the proposed busway. This is now supported by the ES Note addendum (CD1-10.07) which states in section 3.3.2 that there would be an increase in depth of 8mm upstream of the Bin Brook within the Gough Way Estate. The applicant has stated that this increase is occurring in areas already subjected to large scale inundation, however this increase is in direct contravention of the NPPF (CD8-01) which states that developments should aim to create a betterment to existing flood risk. Gough Way Estate has recently experienced significant flood events in 2001 and 2012 which would now be worsened by the proposed development.

- 6.36 The applicant also asserts in the ES Addendum (CD1-10.07) that there is no need to include flood plain compensation equal to that of the introduced embankment. This alludes to the fact that according to the NPPF (CD8-01), a development either has to provide level-for-level, volume-for-volume calculations showing that it is providing sufficient mitigation in the design to offset the impacts of the development or else a development must provide EA approved flood risk modelling that demonstrates that there is no offsite adverse impacts to flood risk. The applicant is arguing that their reporting achieves the latter and therefore the former is not required. CCE and Clare Hall contest this assertion.
- 6.37 Paragraphs 3.1.8, 3.1.10 and 3.1.11 of the ES Addendum (CD1-10.07) provide the rationale for why the Sequential Test identified Rifle Range Road as the preferred option over Adams Road. It is suggested that there are additional surface water risk and fluvial flood risk challenges along Adams Road with insufficient space available to implement sufficient effective mitigation measures. The applicant argues that this was the case considering the previous set of National flood risk maps, and that the situation has worsened since then. A review of the surface water fluvial flood risk maps for planning on the EA website indicates that the flooding does not affect Adams Road to a significant degree, instead affecting built up areas adjacent to the road or Grange Road to the north east. The impact along Grange Road and the impact this would have on bus routing would affect both Adams Road and Rifle Range Road options equally. This is important as when comparing this alternative to the proposed route the degree of flood risk posed is much less when considering the flood zone classification associated with the Bin Brook crossing.

7.0 LIKELY IMPACTS ON CLARE HALL – CCE MODELLING

- 7.1 In order to provide independent testing of the proposed development, CCE was instructed to build a hydraulic model of the catchment. This model was used to establish updated baseline metrics for the catchment and to independently test the proposed development. The full CCE model report is included as CD23-17 OBJ-213.
- 7.2 To begin the assessment CCE requested the latest EA approved hydraulic model in June 2024. The model received was the EA Approved 2023 JBA Model. In accordance with EA guidelines and standard practice the model was updated by CCE to take into account any changes to guidance or available data since it was built.
- 7.3 The results of the 2024 CCE Model indicate that when the development is tested in the latest model, and the tolerance is reduced to 1mm, there are offsite impacts observed in the results both upstream and downstream at each of the events studied as shown on Figure 3.
- 7.4 The Applicant's Statement of Case (CD23-17 OBJ-214) and the Applicant's Addendum to the ES chapter (CD1-10.07) both acknowledge that there are offsite increases that are not clearly presented in the WSP hydraulic modelling report (CD1-11.13.02 Appendix TR13.1.1), nor the WSP FRA (CD1-11.13.02). As demonstrated in Figure 6.2 above when the WSP impact grid is restyled using 1mm tolerance, the distribution of impact is very similar to the CCE results upstream of the proposed development in regard to the impact on the Gough Way Estate. There are some differences downstream of the proposed development where the WSP results show blanket reductions and the CCE results show some areas of increase.
- 7.5 This is the result of the increased flow rates in the developed case interacting with the footbridge within Clare Hall, immediately downstream of the proposed busway bridge. This interaction is accentuating areas of increase that are noted in the WSP Modelling results downstream of the bridge structure.

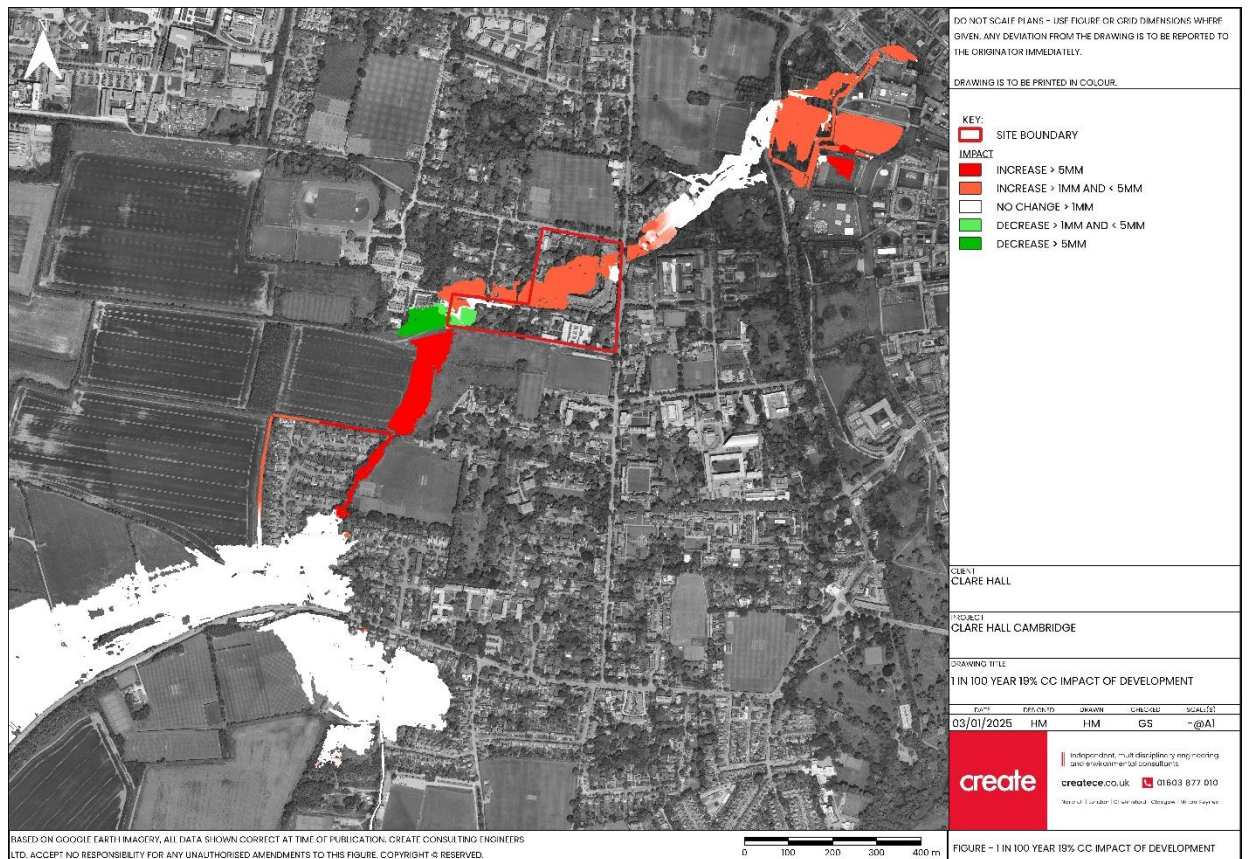


Figure 3.1: 1% AEP 19% CC impact of the proposed development on Flood levels

- 7.6 Aside from the impact grids and change in extent shown in the WSP hydraulic modelling report (CD1-11.13.02 Appendix TR13.1.1), no other results have been provided. Given that the proposal is for a new bridge structure across Bin Brook, the impact on in channel levels and flow rates should be reviewed. This includes reviewing how the change in the floodplain influences the velocity rates through the channel.
- 7.7 The independent CCE assessment included a review of the impact of the development on velocity. This assessment indicated that there was an increase in channel velocity by between 50 and 100% as a result of the development. For the design event this results in velocity increasing from 0.4m/s in the channel to 0.8m/s as shown on Figure .2. The impact of the development on velocity and flow rate through the structure is not discussed in the WSP report (CD1-11.13.02 Appendix TR13.1.1). These increases in offsite velocity are considered to be in contravention of guidance.

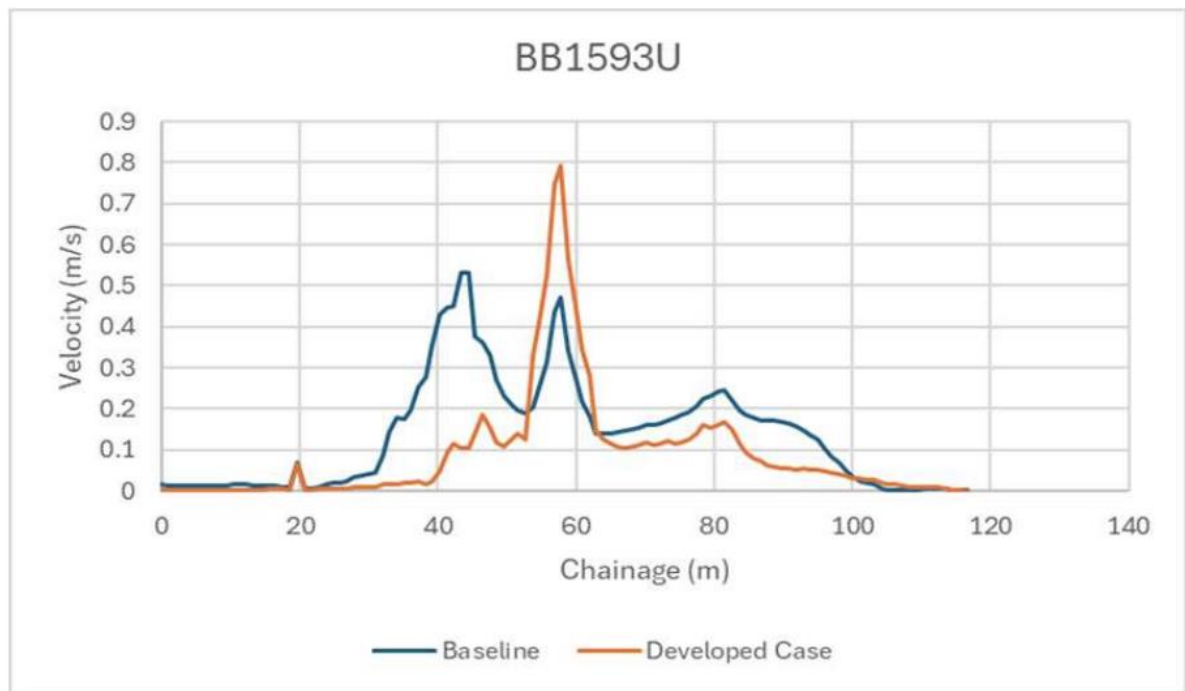


Figure 7.2: 1% AEP 19% CC impact of the proposed development on immediate downstream velocity

8.0 POLICY TEST – PPG, NPPF PARA 177, 178 (B), 179 and 181 – IMPACT ON FLOOD RISK ELSEWHERE AND FLOODPLAIN COMPENSATION

- 8.1 This section will detail the assessment of the flood risk evidence against key policy sections of the NPPF (CD8-01) and PPG¹ in terms of the sequential test, the exception test and paragraph 181 of the NPPF (CD8-01).
- 8.2 The key parts of the NPPF (CD8-01) addressed within this section are Paragraphs 173-175, 177, 178 (b), 179 and Paragraph 181. The PPG¹, South Cambridgeshire Local Plan (CD6-02), Cambridge Local Plan (CD6-01) and Greater Cambridge Sustainable Design and Construction SPD (CD7-16) are also addressed in this chapter.
- 8.3 Impacts on flood risk elsewhere and floodplain compensation have been assessed in two separate ways. Firstly, through an assessment of the developed case scheme, as part of the modelling carried out by CCE to understand the direct impacts on surrounding flood risk and whether the scheme can be seen to increase flood risk elsewhere. The 2024 CCE Model is deemed more appropriate for this assessment given the significant limitations outlined above, making the WSP modelling unfit for purpose.
- 8.4 Secondly, the EA require that new developments do not result in a loss of floodplain storage post-development. Any proposed development must match the floodplain storage on a volume-for-volume and level-for-level basis compared to the pre-development scenario, where proposed development is located within Flood Zone 3, this must also account for climate change. Within the PPG1 it is stated that 'Where flood storage from any source of flooding is to be lost as a result of development, on-site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided'.

The Sequential Test

- 8.5 The purpose of the Sequential Test is to direct development to areas with the lowest risk of flooding (CD8-01, para 173). Development should not be permitted if there are reasonably available alternative sites in areas of lower flood risk (CD8-01, para 173). The test also ensures that within the site layout, built development is avoided in areas at risk of flooding, both now and in the future (CD8-01, para 175).
- 8.6 The development is not policy compliant because it fails to satisfy the Sequential Test, so it is in contravention of CD8-01, paragraph 173. Furthermore, an alternative option is presented in the Transport Proof of Evidence of Mr Kamran Haider, which proposes a solution located largely in Flood Zone 1. From a flood risk perspective, this alternative is therefore considered sequentially preferable.
- 8.7 This alternative route proposed is along Adams Road. The Applicant has released an Addendum to the ES Chapter (CD1-10.07) which acknowledges the existence of the alternative route along Adams Road and suggests there are several reasons, some relating to flood risk, for which the Adams Road route is inferior to the Rifle Range Route. Several of these comments appear to be retrospectively arrived at, particularly because no formal Sequential Test was submitted as part of the application, either as part of the Flood Risk Assessment (CD1-11.13.02) or as a stand-alone document. Details on these comments are previously summarised in Chapter 6 above with further evidence presented by

Clare Hall as to the preference of the Adams Road route included in the Planning and Highways proofs of evidence by Ms. Jessica Wilson and Mr Kamran Haider respectively.

- 8.8 Further to the above, Policy CC/9 of the South Cambridgeshire Local Plan (CD6-02, pages 109-111) requires the Sequential Test to be passed for development to proceed, which is not the case as described above, showing a clear failure to accord with this development plan policy.

The Exception Test and Loss of Flood Storage

- 8.9 The purpose of the Exception Test is to ensure that development in areas of higher flood risk is both justified and safe – but it can only be applied *after* the Sequential Test has demonstrated that that no suitable lower-risk sites are available. As noted above, the Sequential Test has not been applied by the Applicant in relation to the Proposed Development and, in any event would not be passed due to the availability of a sequentially preferable alternative route.
- 8.10 With respect to the Exception Test, Paragraph 178 (b) of the NPPF (CD8-01) requires that it be demonstrated that the development will not increase flood risk elsewhere. However, Figure 7.1 of this proof of evidence shows that according to the independent CCE modelling, the proposed scheme would result in modelled flood impacts upstream and downstream for the 1% AEP plus climate change design event, indicating that flood risk is not contained within proposed development's red line boundary. Figure 6.1 further supports this analysis; this image was created using information received on 24 July 2025 and shows the WSP impact grids at 1mm tolerance. This image also shows offsite increases to flood risk. In addition we should not forget the significant increases in velocity discussed in Chapter 7.0 which also create increased flood risks as a result of the scheme. This is a direct contravention of NPPF paragraph 178 (b) and therefore the proposed development would fail the Exception Test.
- 8.11 In addition the failure to pass the Exception test also results in a contravention of Policy CC/9 of the South Cambridgeshire Local Plan (CD6-02, pages 109-111) and Policy 32 of the Cambridge Local Plan (CD6-01) given the increases in flood risk offsite.
- 8.12 The PPG¹ paragraph 049 also requires that where flood storage from any source of flooding is to be lost as a result of development, on site level for level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. The Applicant has not done this, demonstrating a clear contravention of this requirement.
- 8.13 Building on this, the requirements for Essential Infrastructure in the functional floodplain (Flood Zone 3b), as outlined in the notes to Table 2 of the PPG¹ state that there is a requirement for no net loss of flood storage, no impeding of flows and no increase in flood risk elsewhere. The proposals in their current form, fail to adhere to any of these requirements, as demonstrated by the 2024 CCE Model and assessment presented earlier in this Proof of Evidence, and as demonstrated through the review of the WSP submitted modelling files.
- 8.14 These are fundamental requirements of development in the functional floodplain, and none appear to have been considered by the Applicant in their proposals to date. This results in an unacceptable increase in flood risk to nearby parties, both upstream and downstream of the proposed busway. The Applicant makes no effort to mitigate the impacts associated with the loss of floodplain storage or to address the fact that the busway significantly impedes floodplain flow pathways. The proposals in their current form are therefore wholly unacceptable given the clear contravention of a number of national and local policy requirements, listed above.

- 8.15 This further shows a failure to adhere to Chapter 5 within the Cambridgeshire Flood and Water SPD (CD7-14) which highlights the importance of maintaining floodplain capacity and requires level-for-level, volume-for-volume floodplain compensation where land raising occurs.

Paragraph 181 NPPF

- 8.16 Paragraph 181 of the NPPF (CD8-01) requires that development in areas at risk of flooding should only be permitted where it can be demonstrated through a site-specific FRA that flood risk will not be increased elsewhere. It also includes a range of specific requirements, including ensuring that residual risks are managed safely, and that development incorporates appropriate flood resilience and resistance measures.
- 8.17 The proposed development does not comply with Paragraph 181 of the NPPF (CD8-01) for several reasons. Firstly, the modelling represented within Figure 7.1 clearly shows that the scheme would result in modelled flood impacts upstream and downstream for the 1% AEP plus climate change design event. This indicates that the flood risk is not contained within the purchase order limits for the proposed busway, contrary to paragraph 181 which requires that flood risk elsewhere must not be increased. This is further corroborated by information provided by WSP for the submitted model as well.
- 8.18 Furthermore, due to the inclusion of a bridge structure over the Bin Brook, part of development proposals, changes in the floodplain have led to an increase of between 50-100% in channel velocity downstream, as confirmed by CCE's independent assessment. This results in increased risk to Clare Hall College which is immediately downstream of the proposed development as shown on figures 4.4 and 4.5 in the flood note within the Clare Hall Statement of Case (CD23-17 OBJ-213 SoC). These impacts are beyond the Proposed Busway Purchase Order Limits boundary, breaching paragraph 181 of the NPPF (CD8-01).

9.0 POTENTIAL MITIGATION AND ASSOCIATED VIABILITY

- 9.1 In the application, the applicant stated that a series of mitigation modelling runs were undertaken to iteratively develop a low-impact design adhering to planning guidance. The application references modelling runs based on scenarios with adjusted bridge widths of 10m, 16m, and 21m as well as scenarios introducing flood plain compensation. The results of these scenarios and the impacts that each have upon the results are not shared, neither is the logic that results in the selection of the final scenario.
- 9.2 CCE has also examined potential mitigation measures for the proposed development to address paragraph 178(b) of the NPPF (CD8-01). A Full list of the mitigation measures and the result of each scenario is included in the 2024 CCE Model Hydraulic Modelling report (CD23-17 OBJ-213 SoC – Document 9). One potential mitigation option would be altering the bridge width to reduce its capacity, thereby reducing the velocity rates and flow rates passing into Clare Hall. However, this approach was disregarded (due to the additional impoundment it would create and thus requirement for additional flood storage) in favour of the two final mitigation approaches that have been identified as follows:
- Adding flood storage upstream of the proposed crossing to offset the storage loss as a result of the structure; and
 - Realigning the busway to reduce velocity impacts immediately downstream and contain them within busway land.
- 9.3 These tests are presented in the CCE Hydraulic Model report (CD 23-17 OBJ-213 SoC Document 12). The end result is a combination of realignment and storage. Realignment has the benefit of ensuring sufficient distance between the proposed crossing and Clare Hall for velocity rates to equalise, and storage provides sufficient additional volume to offset the remainder of offsite impacts.
- 9.4 The mitigation design is shown in Figure 9.1: **CCE Proposed Mitigation Interventions**.¹ with the associated level impact in Figure 9.2: **1% AEP 19% CC impact of the proposed development on Flood levels with mitigation**.² and velocity impact in Figure 9.3: **1% AEP 19% CC impact of the proposed development on immediate downstream velocity with mitigation**. From these results it can be seen that the development is now demonstrating a net positive in regard to flood risk and flood levels within the catchment, with no offsite increases to flood levels and areas of decrease in flood risk.
- 9.5 Regarding velocity, it can be seen in the Figure 9.3 that the realignment provides sufficient space between the proposed development and Clare Hall for the velocities to equalise much closer to the previous peak value, mitigating the impact of the development and reducing potential for additional offsite flow rates.



Figure 9.1: CCE Proposed Mitigation Interventions

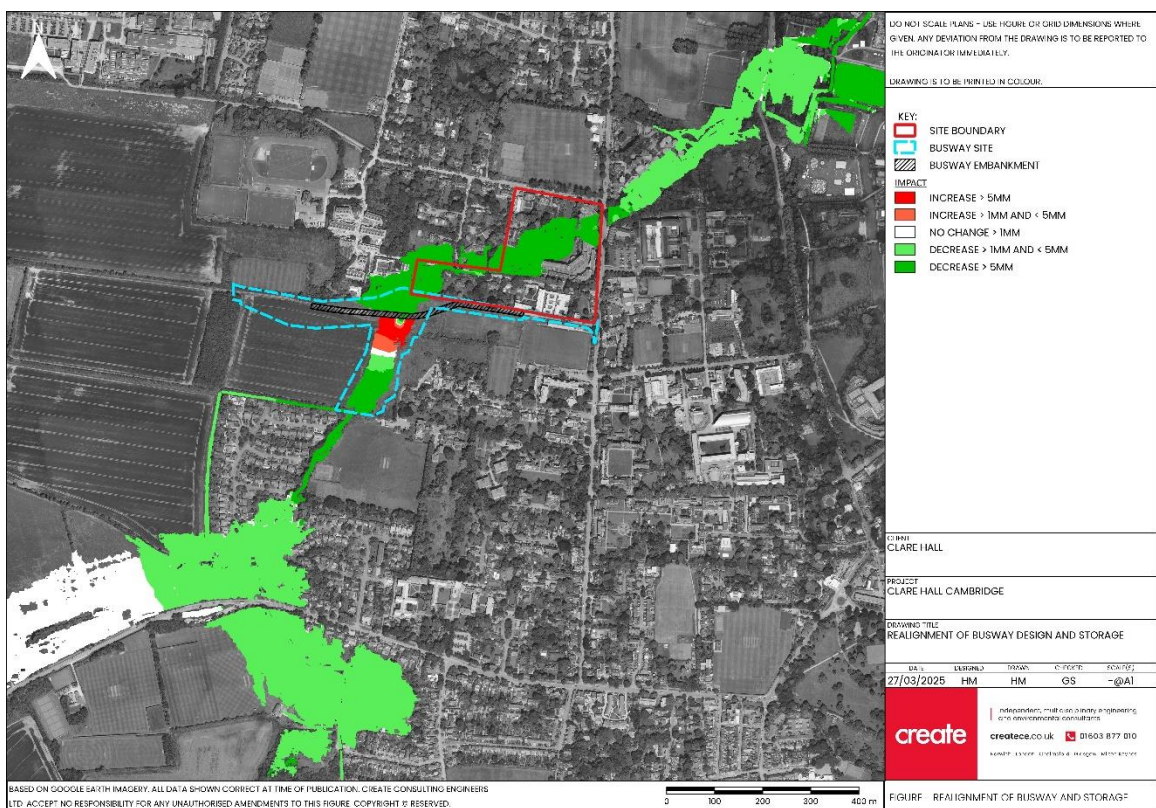


Figure 9.2: 1% AEP 19% CC impact of the proposed development on Flood levels with mitigation

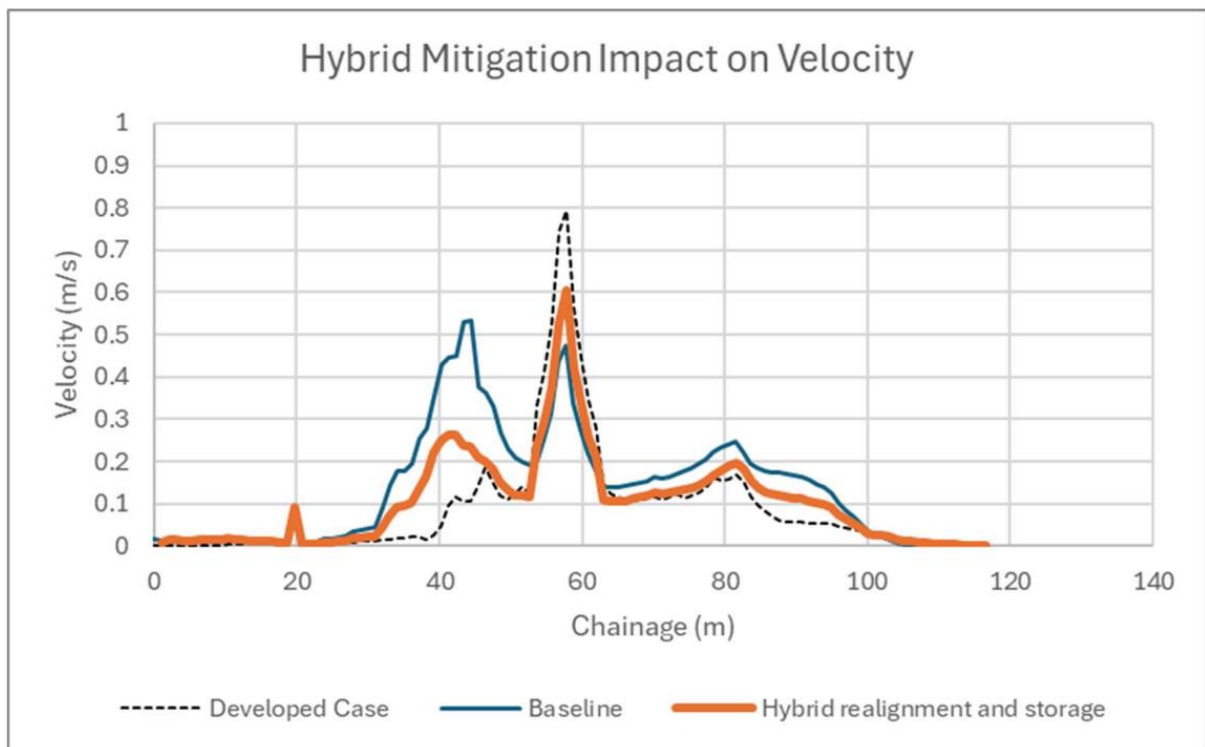


Figure 9.3: 1% AEP 19% CC impact of the proposed development on immediate downstream velocity with mitigation

- 9.6 Whilst this mitigation option appears to be viable in principle it is important to consider this in the context of the current proposals and the applicant's inability to deliver this option within the boundary of the application. As is clear from the above, the re-aligned busway lies beyond the compulsory purchase order limits. Furthermore, the volume of flood storage required (see Figure 9.1: **CCE Proposed Mitigation Interventions**), along with its likely impact on the surrounding landscape, has not been addressed in the submitted Landscape and Visual Impact Assessment nor ES. Therefore, drawing on this I have to conclude that it is not possible for these mitigating factors to be included within the bounds of the current application (see CD23-178 OBJ-213 SoC sections 6.4.7 – 6.4.8 for further details).
- 9.7 The modelled flood impacts associated with the current proposals conflict with national and local policy requirements relating to flood risk. Without appropriate mitigation in place to address and reduce these impacts, the scheme would result in offsite increases in flood levels which are contrary to policy and could pose unacceptable risk to surrounding properties and infrastructure. Compliance with policy demands that development proposals not only avoid increasing flood risk elsewhere but also demonstrate a clear strategy for managing and mitigating any potential impacts. As such, without mitigation the proposals in their current form are not policy compliant.
- 9.8 A key issue is that the Applicant's own assessment does not acknowledge the scale or significance of the offsite impacts, nor does it demonstrate a full understanding of the need for mitigation. The modelling presented fails to identify and quantify the extent of the adverse impacts in sufficient detail, and the Applicant has not provided a credible mitigation strategy. This omission undermines the robustness of the ES chapter (CD1-09) and the FRA (CD1.11.13.02 Appendix TR13.1). As a consequence of this, I believe that the Applicant has failed to establish that the scheme, as proposed, is capable of being made policy compliant through appropriate mitigation.

- 9.9 CCE's assessment indicates that effective mitigation is possible in principle. However, implementing such mitigation would require development outside of the current purchase order limits of the proposed C2C busway, including land that is not currently under the control of the Applicant. This presents a significant delivery constraint. The scale and nature of the mitigation, which is likely to include the reconfiguration of land, provision of compensatory flood storage and potential alteration to third-party land, means that it cannot be assumed to be deliverable without additional land agreement and planning consents. Therefore, even if the mitigation is technically viable, it is not practically achievable within the scope of works within the current application.
- 9.10 Furthermore, there has been no assessment by the Applicant of the environmental impacts or planning implications of the necessary mitigation measures. The ES (CDI-09) does not consider the landscape or ecological impacts of the required flood storage works, nor does it assess any potential impacts on any receptors beyond the purchase order limits of the proposed C2C busway. This lack of thorough assessment and evidence in relation to necessary mitigation creates a substantial evidence gap and further weakens the case for approving the proposals their current form.

10.0 SUMMARY AND CONCLUSIONS

- 10.1 proposed scheme does not accord with both local and national policy and guidance, and the development proposals cause adverse impact to both Clare Hall and the surrounding area.
- 8.1 In order to support the C2C busway application, WSP undertook hydraulic modelling to support the proposal to cross Bin Brook using the alignment of the existing track associated with Rifle Range Road. The key differences between the existing and proposed layout, are that an embankment will be created across the Bin Brook floodplain, and new much larger bridge structure constructed in place of the existing bridge.
- 8.2 The modelling undertaken by WSP and submitted in support of the above proposal (CD1-11.13.02 Appendix TR13.1.1), is not fit for purpose. This largely stems from the fact that it uses a now out of date model, includes poor representation of catchment hydrology and survey, and as reiterated by the objection raised by the EA (CD2-OBJ-301), has not gained EA approval. This model therefore cannot be relied upon to provide a robust or adequate assessment of the proposed development. Furthermore, the results of the modelling work subsequently provided in the ES addendum (CD1-10.07) and in data packages received on 25 July 2025, indicate that there remain offsite increases to flood risk within the Gough Way Estate and in some isolated areas within Clare Hall, downstream of the proposed busway. This means that assertions in the FRA (CD1.11.13.02 Appendix TR13.1), that there are no offsite increases to flood risk are incorrect.
- 8.3 CCE have undertaken a separate modelling exercise using the 2023 JBA Model (a more up to date EA approved model for the catchment), which uses more reliable hydrology (benchmarking against in catchment gauged flows and historic events) and has been produced (as well as updated) in line with the latest current government guidance. This presents the floodplain in its totality and allows a proper assessment of wide scale impacts beyond the narrow margins presented by WSP.
- 8.4 I, therefore, have to base my assessment on the more accurate and reliable 2024 CCE Model. This shows impacts in flood level and extent, as well as flow velocity, beyond the bounds of the application site and increases in velocity downstream. An assessment of potential mitigation options shows these impacts can be solved, however the mitigation measures required are not possible within the bounds of the purchase order limits.
- 8.5 Building on the above it is evident the development, as proposed, fails the Sequential Test and Exception Test (See chapter 8 above) and thus is not in accordance with the NPPF (CD8-01) Paragraph 177, 178(b), 179 and 181 as there is an increase in flood risk elsewhere as a result of the proposals. This also follows into the PPG¹ and confirms a contravention of paragraph 031 as well as the South Cambridgeshire Local Plan (CD6-02, pages 109-111) Policy CC/9.
- 8.6 The development also fails to meet the criteria required for development within the functional floodplain (Flood Zone 3b) in that no level-for-level or volume-for-volume floodplain compensation is proposed, thus creating a net loss in floodplain storage. In addition, the scheme impedes floodplain flows and thus contravenes the requirements of the PPG¹ at paragraph 049 and the notes to Table 2.
- 8.7 On the basis of the above I must conclude that significant weight should be given to the increased flood risks posed by the proposed C2C busway in the vicinity of Clare Hall.

Clare Hall

Proposed Cambourne to Cambridge Busway – Bin Brook Crossing and Impact on Clare Hall

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