



# The Sizewell C Project

## 5.5 Two Village Bypass Flood Risk Assessment Addendum

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## EXECUTIVE SUMMARY

NNB Generation Company (SZC) Limited (SZC Co.) submitted an application for a Development Consent Order (DCO) to the Planning Inspectorate under the Planning Act 2008 for the Sizewell C Project (referred to as the 'Application') in May 2020. The Application was accepted for examination in June 2020. As part of the submission the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5.) [\[APP-119\]](#) and its accompanying appendices were provided to assess the existing flood risk from all sources of flooding both to and from the proposed two village bypass development.

The **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5.) [\[APP-119\]](#) confirmed that, following review of all sources of flooding there would be no additional flooding to properties as a result of the proposed development. While there was a slight increase in flood risk, the impact was concluded as being very low, as it was very localised i.e. affecting agricultural land immediately upstream of the proposed bridge crossing over the River Alde and only affected low-lying areas that were already at risk of flooding.

Following submission of the application, review of the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5.) [\[APP-119\]](#) and subsequent consultation with the Environment Agency, a number of comments have been received. These comments were primarily in relation to the hydraulic modelling, including queries on general model schematisation and overall model performance, as well as comments on construction phasing, surface water drainage and the need for a flood risk emergency plan. While the Environment Agency agreed that the impact of flooding was low, they also requested that agreement be sought with the landowner affected by the localised increase in flood depth to confirm that the increase in risk was accepted.

To provide clarification additional modelling, including sensitivity testing, has been carried out. Additionally, this Flood Risk Addendum and its accompanying appendices provide clarification on the comments received. SZC Co. is currently in talks with and will continue to engage with the landowner for the affected area, with the view to obtaining confirmation that the increased flood depth, hazard and velocity is accepted by the landowner.

The results of the additional modelling exercise, including sensitivity testing, has confirmed that the conclusions presented in the Two Village Bypass Flood Risk Assessment Addendum remain unchanged from those set out in the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5.) [\[APP-119\]](#) submitted as part of the Application.

## 1 INTRODUCTION

- 1.1.1 NNB Generation Company (SZC) Limited (SZC Co.) submitted an application for a Development Consent Order (DCO) to the Planning Inspectorate under the Planning Act 2008 for the Sizewell C Project (referred to as the ‘Application’) in May 2020. The Application was accepted for examination in June 2020.
- 1.1.2 Since the submission of the Application, SZC Co. has continued to engage with the local authorities, environmental organisations, local stakeholder groups and the public to gather their responses to the Application. This process has identified potential opportunities for changing the Application to further minimise impacts on the local area and environment in many cases, whilst reflecting the further design detail that has come forward in preparation for implementation of the Sizewell C Project.
- 1.1.3 In addition to the proposed changes, SZC Co. has continued to develop the detail of its proposals and of the implementation of the Sizewell C Project (the ‘Project’), and has undertaken some additional environmental assessment work in response to continuing engagement with stakeholders. This ‘Additional Information’ adds to the information supporting the Application and should assist interested parties in their understanding of matters.
- 1.1.4 The proposed changes and the Additional Information are described and assessed in a number of updates and Addenda to the originally submitted application documents.
- 1.1.5 This report provides additional information to support the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5) [\[APP-119\]](#) for the Project, which was provided in support of the Application.
- 1.1.6 This **Two Village Bypass Flood Risk Assessment (FRA) Addendum** presents additional information provided in response to further engagement with key stakeholders including the Environment Agency’s Relevant Representation on the Sizewell C Development Consent Order, dated 30<sup>th</sup> September 2020 (Ref. 1.1.1). An overview of the Relevant Representation on flood risk matters in connection with the two village bypass is provided in **APPENDIX A**:
- 1.1.7 This **Two Village Bypass FRA Addendum** document also presents additional information in response to further comments from the

Environment Agency received on 5<sup>th</sup> February 2020 and subsequently, post Application, on 4<sup>th</sup> August 2020 (collated in **APPENDIX B**).

- 1.1.8 A review of the Relevant Representation identified one key focus area for further assessment, in relation to flood risk, which is addressed in **Section 2.1** of this document. Additional assessments undertaken in response to the additional Environment Agency's supplementary responses are provided in **Section 2.2**.
- 1.1.9 Further clarifications in response to additional issues raised by the Environment Agency's August 2020 response are provided in **Section 3**.
- 1.1.10 A number of sensitivity tests have been requested by the Environment Agency. These are commonplace tests in flood risk assessment and provide an understanding of the response of the hydraulic model to changes in input data or parameters. Essentially the purpose of the sensitivity tests are to show whether the model has proportionate responses to modest changes in input data or parameters and thereby to provide evidence of the model's robustness and assurance in the output values.
- 1.1.11 Note that this document presents additional work only and should be read alongside the original documentation submitted as part of the Application.

## 2 LOCALISED CHANGES TO FLOOD RISK RESULTING FROM THE TWO VILLAGE BYPASS

### 2.1 Summary of received comments from the Environment Agency

#### a) Summary of Relevant Representation

- 2.1.1 The Environment Agency's Relevant Representation Extract of the Environment Agency Relevant Representation related to flood risk states:

*"The FRA has assessed fluvial flood risk and demonstrated some localised areas of increased depths as a result of the proposals. Confirmation of written consent from the landowner must be included in the FRA that they accept the increased flood depth, hazard and velocity on their land in order for this to be acceptable without further mitigation as required by EN-6 3.6.16."*

- 2.1.2 The **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5) [[APP-119](#)] confirmed that, following review of all sources of flooding there would

be no additional flooding to properties as a result of the proposed development.

2.1.3 While there was a slight increase in flood risk, the impact was concluded as being very low, as it was very localised in nature i.e. immediately upstream of the proposed bridge crossing over the River Alde and only affected low-lying areas of agricultural land that were already at risk of flooding. These results were presented as Plates 6.20 – 6.22 in **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [\[APP-120\]](#).

2.1.4 Whilst the Environment Agency acknowledged that the impact of flooding was low, they also requested that agreement be sought with the landowner affected by the localised increase in flood depth to confirm that the increase in risk was accepted.

2.1.5 SZC Co. is currently in talks with and will continue to engage with the landowner of the affected area, with the view to obtaining confirmation that the increased flood depth, hazard and velocity is accepted.

2.1.6 The Environment Agency also identified additional issues regarding other technical elements of the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5) [\[APP-119\]](#) and **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [\[APP-120\]](#), which are summarised and addressed in the following sections.

b) Further technical comments raised by Environment Agency

2.1.7 The majority of the additional issues raised by the Environment Agency related to the hydraulic model, including model schematisation and general model performance. As such, additional assessment was required in the form of sensitivity testing, within the hydraulic model, to understand the impact of the testing on the flood risk results. The sensitivity testing aims to understand how changes in the model parameters affect the results of the modelling and whether this has an impact on flood risk to and from the proposed development.

2.1.8 A summary of the issues raised, and the appropriate sensitivity tests requested are provided as follows:

- applying appropriate Tidal Boundary Uplifts (2030 and 2140);
- 1D and 2D roughness testing (plus 20%, minus 20%);
- adjusting 2D roughness value of bank stability patch;

- 2D Floodplain drain capacity;
- bridge and culvert blockage scenario (70%); and
- including western culvert through the embankment.

2.1.9 For more comprehensive details of the issues raised and justification for undertaking these sensitivity tests, see the collated comments from the Environment Agency (**APPENDIX A**).

## 2.2 Additional assessment to further technical comments (sensitivity and blockage testing)

### a) Approach

2.2.1 This section briefly outlines the sensitivity and blockage testing approach, which has been provided in response to further technical comments from the Environment Agency (**APPENDIX A**). The details of the sensitivity and blockage testing undertaken have been set out in the **Two Village Bypass Modelling Report Addendum (APPENDIX C)**.

2.2.2 The aim of the sensitivity and blockage testing was to incorporate a number of changes to the model parameters based on the Environment Agency comments as detailed in **Section 2.1** (see also **APPENDIX A**). The aim of the sensitivity testing was to re-assess the flood risk relating to the proposed development and test whether the conclusions set out within the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5) [[APP-119](#)] and **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [[APP-120](#)] are still appropriate.

2.2.3 Each sensitivity and blockage test was performed as an iteration to the **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [[APP-120](#)] and each sensitivity test was undertaken independently of one another to ensure that the results of each test could be assessed appropriately. The methodology for each test is detailed in the **Two Village Bypass Modelling Report Addendum (APPENDIX C)**.

### b) Results

2.2.4 Following completion of each of the sensitivity tests the results were reviewed and difference grids between the with scheme and baseline were produced, and the sensitivity changes within both of the models noted, where appropriate. In some of the sensitivity tests there was no change identified.

- 2.2.5 Following the adjustment of the tidal boundary uplifts for each of the development phases (i.e. 2030 and 2140), it was identified that there was no increase in flood risk as a result of the revised assumptions. The difference in flood depths was unchanged from that which was reported in the **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [[APP-120](#)].
- 2.2.6 The same conclusion was made having run the sensitivity testing for the increased (plus 20%) and decreased (minus 20%) roughness tests, the alteration of roughness to the bank stability patch, the reduction in floodplain drain capacity and the incorporation of the additional western culvert.
- 2.2.7 For the sensitivity test comprising a 70% blockage of the proposed bridge crossing over the River Alde and the sensitivity test incorporating a western culvert through the embankment, results of the testing showed a further increased impact of the scheme compared to that originally presented, with very localised flood depths increasing by up to 0.45m. The model schematisation for each of these tests is set out in more detail in the **Two Village Bypass Modelling Report Addendum (APPENDIX C)**.
- 2.2.8 Despite this further localised increase, the change in flood risk to the two village bypass and surrounding areas was considered to be negligible given that these flood depths did not coincide with an increased flood extent in the wider floodplain.
- 2.2.9 Furthermore, the potential for 70% blockage of the proposed bridge crossing over the River Alde which is 60m wide, with a soffit level of approximately 12mAOD (at the crossing location) is considered to be unlikely. This conclusion is based on the soffit level being significantly higher than the extreme event peak water levels, which are up to 6mAOD. As a result, this means that the potential for blockage and the resulting impact on flood risk is very low.
- 2.2.10 Additionally, the impact of the proposed development on the gauging station (Alde\_07061u) as a result of the changes in the sensitivity tests was found to be negligible. For seven out of the eight scenarios undertaken the maximum difference in peak level was 0.01m or less, between the baseline and with scheme scenarios. For only one scenario, the decreased (minus 20%) roughness scenario, there was a maximum difference in peak level of 0.02m between the baseline and with scheme scenarios.



### c) Conclusion

- 2.2.11 Overall change in flood levels, as a result of the sensitivity testing, was either unchanged from that which was concluded in the **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [\[APP-120\]](#) (when reviewing the Tidal Boundary Uplifts, stability patch, roughness testing, drain capacity, additional culvert), or very localised to the development (where increases in flood depths were considered to be more significant (i.e. during the blockage scenario testing)).
- 2.2.12 As a result of the sensitivity testing the assessment found that in the majority of the scenarios there was no change in flood risk. Where the sensitivity testing demonstrated an increase in flood depth this was found to be a localised increase. Therefore, the change in flood risk to the two village bypass and surrounding areas was considered to be negligible given that the increase in flood depths did not coincide with an increased flood extent in the wider floodplain. Therefore, the conclusions related to flood risk are unchanged from those presented in the **Two Village Bypass Flood Risk Assessment** (Doc Ref. 5.5) [\[APP-119\]](#) and **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [\[APP-120\]](#).

## 3 ADDITIONAL CLARIFICATIONS

- 3.1.1 As a result of the Relevant Representation and the comments received from the Environment Agency both prior to and following the Application there were a number of further clarifications requested that have been considered within this FRA Addendum.
- 3.1.2 These additional comments focused on the following areas:
- review of the options considered for the provision of additional culverts within the floodplain;
  - construction phase and methodology;
  - requirement for a Flood Risk Emergency Plan; and
  - surface water drainage design.
- 3.1.3 To address these further comments, the detailed table presented in the Environment Agency's response has been reproduced in **Appendix A** of this Addendum. with supporting clarifications provided against individual points. Where further response or information was required to these

additional comments, further information has been provided in the following sections.

a) Additional culverts

3.1.4 In the Environment Agency's additional responses, it was stated:

*“Sensitivity testing was undertaken by increasing the number of culverts under the embankment but this has not been provided ... Provide evidence from culvert sensitivity runs in the FRA and/or modelling report that this did not improve the impact on flood risk and the environment so the decision making is transparent.”*

3.1.5 To consider flood risk and to aid in the development of the design for the two village bypass a number of options related to the provision of culverts in the embankment for the highway were considered. To assess the sensitivity of the flood risk on the number of the culverts that were incorporated sensitivity testing was carried out.

3.1.6 The results from the sensitivity runs incorporating a varying number of culverts, produced varying improvement. The results of the modelling found that the options incorporating a larger number of culverts, i.e. up to 20 culverts, resulted in a diminishing improvement as the number of culverts increased. Therefore, including a larger number of culverts did not result in a significant improvement or reduction in either flood depths or extents in the floodplain and the optimum number of culverts was identified.

3.1.7 **Table 3.1** shows the relative benefits provided by the consideration of up to eight culverts within the design and the limited additional benefit of the provision of 14 and 20 additional culverts in alleviating flood depths.

3.1.8 For more information on the location of the floodplain points, set out in **Table 3.1**, refer to the **Two Village Bypass Modelling Report Addendum (APPENDIX C)**.

**Table 3.1: Increase in maximum flood depths (m) for the testing and design of the culverts over the baseline 100 year plus 35% climate change allowance run, for selected points in the floodplain upstream of the embankment**

Floodplain point	Sensitivity Test – 1 culvert	Sensitivity Test – 4 culverts	Embedded Design – 8 culverts	Sensitivity Test – 14 culverts	Sensitivity Test – 20 culverts
East_1	0.27	0.14	0.10	0.08	0.08

West_1	0.45	0.24	0.18	0.11	0.11
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3.1.9 As such, it was shown that the incorporation of additional culverts, beyond the eight culvert scenario, would not provide significant improvement in reducing flood risk and would not reduce the impact of the scheme on flood risk, back to the baseline scenario. This localised and limited betterment of flood depths was not considered sufficient to outweigh the additional construction considerations and environmental impacts.

3.1.10 Therefore, the addition of these culverts (within the design) was not considered in further detail.

#### b) Construction

3.1.11 In the Environment Agency's additional responses, it was stated:

*"No information is provided on the construction phase & methodology. It is important that we understand how the bridge crossing and embankment is likely to be constructed and how this will impact on flood risk. It must also assess if it is likely to impact the gauge at Farnham."*

3.1.12 Prior to commencing construction, a Flood Risk Activity Permit (FRAP) will be required for any activity on a floodplain and / or which erects a permanent structure over a main river. An application will need to be made to the Environment Agency and this will be submitted in accordance with the relevant permitting regulations.

3.1.13 As part of the FRAP application, it will be necessary to provide a Construction Method Statement setting out the construction methodology, the duration of works and the proposed programme. This should include plans to avoid periods of high flows (typically winter) and where areas of storage for materials or plant are required in relation to the channel and the wider floodplain. The construction phasing would be planned to minimise the floodplain constraints beyond those identified within the final design. The embankments would be constructed with the proposed culverts in situ rather than constructing the culverts after the construction of the embankment.

3.1.14 It is currently understood that the works will require an application under the Standard Rules process for flood risk which includes, but is not limited to, works that will require installation of a clear span bridge, temporary

dewatering of a main river and temporary storage on the floodplain of a main river.

- 3.1.15 Should the design of the proposed two village bypass development be such that it is not classified as Standard Rules permit application, it is acknowledged that a Bespoke permit application will be required.
- 3.1.16 The relevant environmental permitting requirements will be identified and the necessary permit obtained prior to commencement of works on the two village bypass at the River Alde crossing. Currently there is limited information available on the proposed construction method and phasing of works, as these will be dependent on the development of the detailed design.
- 3.1.17 Consideration of flood risk during the construction phase is included in the Flood Risk Emergency Plan (**APPENDIX D**), the rationale behind which is summarised briefly at **Section 3.1(c)**.
- 3.1.18 Furthermore, a review of the potential impact on water levels at the Farnham gauging station has been carried out and summarised in **Modelling Report Addendum (APPENDIX C)**. In line with the conclusions of **Appendix A: Two Village Bypass Modelling Report** (Doc Ref. 5.5) [[APP-120](#)], the overall impact of the proposed development on flood levels at the gauging station, with the sensitivity tests is considered negligible.

c) Flood Risk Emergency Plan

- 3.1.19 In the Environment Agency's additional responses, it was stated:

*"Paragraph 8.1.5 mentioned Flood Emergency Plan and 8.1.6 references EA flood warning service. Please be aware that Fluvial flood warnings from the Environment Agency's Flood Warning Service are not available for the 2VB site. It is possible that fluvial flooding could occur without warning so it must be clear to site users during construction and road users what they should do in a flood. This should be set out in a Flood Warning and Evacuation Plan."*

- 3.1.20 A Flood Risk Emergency Plan (FREP) describes the evacuation procedure and need for safe refuge in response to a flood.
- 3.1.21 A FREP has been developed to detail the procedures that will be required during construction of the two village bypass (**APPENDIX D**). The FREP has been completed in accordance with the guidance provided by the



Association of Directors of Environment, Economy, Planning & Transport (ADEPT) and the Environment Agency (Ref. 1.1.2).

- 3.1.22 Guidance for a FREP indicates it can either form part of a Flood Risk Assessment or be a standalone document. Whilst the FREP for the two village bypass has been included as **APPENDIX D** of this Addendum, it is written such that it can be read as a standalone document, to aid in future updates, as necessary.
- 3.1.23 Within a FREP it is necessary to consider the timing of the proposed works, whether there are tools available for forecasting the potential for flooding to occur, the identification of evacuation areas, refuges and shelters and will detail the roles required to ensure that the FREP is implemented during an event. A FREP is also required to consider the response needed following a flooding event.
- 3.1.24 The FREP for the two village bypass focuses on the risk to people during the construction phase. This is on the basis that once constructed, the two village bypass will be elevated, above the adjacent floodplain, by the embankment such that the maximum flood levels would be significantly below the level of the road (i.e. the road will be greater than 3m above the maximum water level).
- 3.1.25 In addition, once the road is completed and the temporary construction works are removed there will be no requirement for the longer-term use of the wider floodplain. Therefore, there is no requirement for the FREP to consider emergency response / evacuation or the need for safe refuge once the two village bypass is operational.

d) **Surface Water Drainage Design**

- 3.1.26 In the Environment Agency's additional responses, it was stated:

*"The FRA states that the proposed road will not be at risk of surface water flooding, however, this does not appear to be based upon the sound evidence base of a detailed surface water drainage strategy.*

*Detail on surface water drainage provided in Table 7.1 is high level and does not include information discussed in previous meetings."*

- 3.1.27 The **Flood Risk Assessment** (Doc Ref. 5.5) [\[APP-119\]](#) identified that the design of the surface water drainage for the two village bypass has been

summarised in an **Outline Drainage Strategy** submitted as part of the Application in **Appendix 2A, Volume 2, Chapter 2** of the **ES** (Doc Ref. 6.3) [[APP-181](#)].

- 3.1.28 The development of the detailed drainage design is ongoing, incorporating infiltration and attenuation features, enabling the potential for the proposed works to impact surface water flood risk to be appropriately mitigated.
- 3.1.29 In accordance with the outline design, submitted as part of the Application, the A12/A1094 Eastern Roundabout and A12 Western Roundabout are considered unsuitable for the use of swales and therefore it is proposed to include piped drainage networks which outfall to respective infiltration basins.
- 3.1.30 Elsewhere, along the two village bypass and its access roads, the surface water drainage would ensure that runoff from the paved road is into swales alongside it. An infiltration basin (separate to those provided for the roundabout runoff) is to be provided to the east of the embankment so that surface water from the swales, which cannot infiltrate directly into the ground can be diverted into this infiltration basin.
- 3.1.31 Additionally, drainage of the River Alde embankment and bridge is not to swale, in accordance with the requirements of the Environment Agency and Suffolk County Council. The drainage from the embankment and bridge will be via piped network to the A12 infiltration basin, ensuring no discharge of highway runoff into the River Alde.
- 3.1.32 Due to a number of factors including limited access to land, at the time of the Application it was not possible to determine actual infiltration rates.
- 3.1.33 Following submission of the Application infiltration testing has been carried out to validate the proposed outline drainage works for the two village bypass.
- 3.1.34 These infiltration tests confirm that, despite infiltration rates varying at different locations, the infiltration rates are sufficient to confirm the proposed outline drainage strategy of infiltration to ground, and the results of this have been discussed with Suffolk County Council.
- 3.1.35 Additionally, the work shows that a discharge or outfall into the River Alde is not required and will not be progressed within the detailed drainage design.
- 3.1.36 Further details on the evolving design for the surface water drainage and, thereby the management of surface water flood risk continue to be

developed and will be finalised post-DCO. However, the ongoing design of the surface water drainage, incorporating attenuation and controlled discharge via infiltration, is such that the proposed development would not have an impact on surface water flooding.

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## References

- 1.1 Environment Agency. September 2020. Relevant Representation on Sizewell C Development Consent Order (AE/2020/125515/01).
- 1.2 Environment Agency and Association of Directors of Environment, Economy, Planning & Transport (ADEPT). September 2019. Flood risk emergency plans for new development – A guide for planners: How to consider emergency plans for flooding as part of the planning process. September 2019. (Online) Available from:  
<https://www.adeptnet.org.uk/system/files/documents/ADEPT%20%26%20EA%20Flood%20risk%20emergency%20plans%20for%20new%20development%20September%202019....pdf>.