highways england

A47 North Tuddenham to Easton Dualling

Scheme Number: TR010038

Volume 9
9.12 Additional Information for the Lead Local Flood Authority (LLFA) and the Environment Agency

The Infrastructure Planning (Examination Procedure) Rules 2010
Rule 8(1)(c)

Planning Act 2008

October 2021

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

The A47 North Tuddenham to Easton Development Consent Order 202[x]

ADDITIONAL INFORMATION FOR LEAD LOCAL FLOOD AUTHORITY (LLFA) AND THE ENVIRONMENT AGENCY

Regulation Number:	Rule 8(1)(c)
Planning Inspectorate Scheme Reference	TR010038
Application Document Reference	TR010038/EXAM/9.12
BIM Document Reference	HE551489-GTY-LSI-000-RP-TX-40006
Author:	A47 North Tuddenham to Easton Project Team, Highways England

Version	Date	Status of Version
Rev 0	October 2021	Deadline 3

CONTENTS

1 INTRODUCTION

1.1.1 This document presents further information from Highways England (the Applicant) in response to the relevant representations from Norfolk County Council (NCC), as the Lead Local Flood Authority (LLFA), and the Environment Agency as indicated in the Applicant's Responses to Relevant Representations (**REP1-13**), submitted at Deadline 1, would be provided to the Examining Authority (ExA) at Deadline 3.

2 RR-037.60 NORFOLK COUNTY COUNCIL

2.1.1 In the Applicant's response RR-037.60, in the Applicant's Responses to Relevant Representations (**REP1-013),** to NCC's Relevant Representation (**RR-061**) it was stated that additional information would be provided to satisfy the requests for further clarification raised in the letter dated 16 March 2021 (FW/2021_0166). NCC's letter provided comments on Environmental Statement Appendix 13.1 Flood Risk Assessment (**APP-124** and **APP-125**) and can be found in Appendix A of this document; the paragraphs in this letter have been numbered (NCC_M21_P1…P14) to respond to in a clear manner. The Applicant has continued to consult with NCC since their Relevant Representation was published to ensure their concerns are being addressed adequately.

2.2 NCC_M21_P2 - Oak Farm Culvert Flood Compensation Storage

2.2.1 The Proposed Scheme crosses the Oak Farm watercourses and overlaps an area of existing floodplain northeast and upstream of the existing A47. An orifice plate and bund will be installed to retain the relocated accumulated water. This results in a net betterment in terms of flood risk (a reduction in flood depths and extents) downstream, but will displace floodwater further upstream.

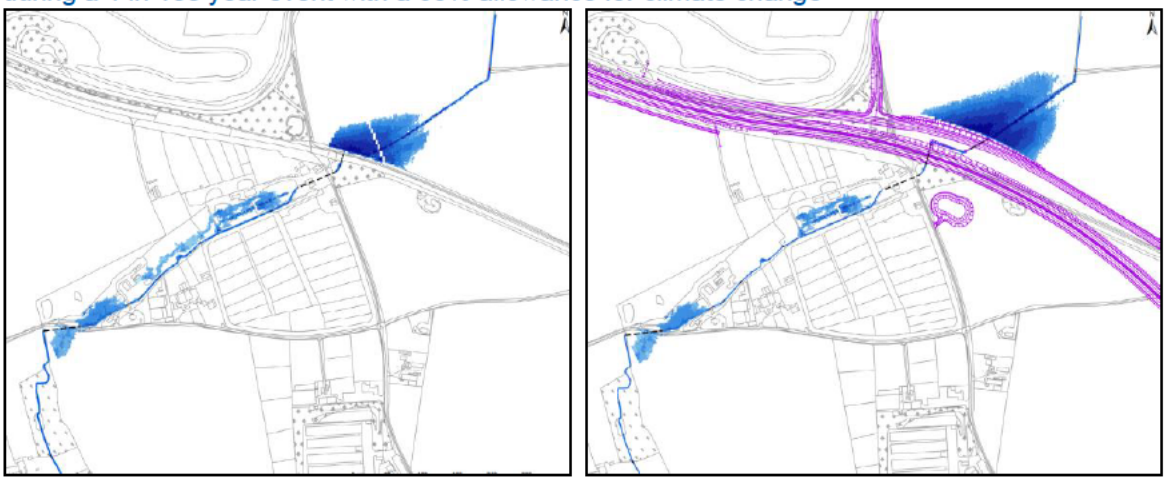
2.2.2 The loss of floodplain volume resulting from the widened dual carriageway and the new local access road was estimated to be 2,785m^3. This also includes the area between the widened dual carriageway and the new access road. The estimate was based on the 100-year (plus 35% climate change) baseline peak flood level of 44.4m above ordnance datum (AOD), as previously agreed with the Environment Agency. A summary of the estimated level for level volume lost is given in Table 2-1.

Table 2-1 Oak Farm floodplain volume analysis

Elevation slice (m AOD)	Area (m^2)	Contour Interval (m)	Volume per contour (m^3)
43.2-43.4	82.7	0.2	16.5
43.4-43.6	233.8	0.2	46.8
43.6-43.8	902.0	0.2	180.4
43.8-44.0	2094.2	0.2	418.8
44.0-44.2	4111.5	0.2	822.3
4.2-44.4	6499.8	0.2	1300.0
Total Volume (m^3)			**2784.8**

2.2.3 It can be seen from Figure 2-1 that water pooling south of the existing A47 at Oak Farm has been shifted uphill by the Scheme. It can also be seen that the Scheme stores more water than the present arrangement. Flood extents downstream of the proposed section have been reduced as a result of the additional storage.

Figure 2-1 Comparison of flood extents along the Oak Farm watercourse pre- and post-development during a 1 in 100 year event with a 65% allowance for climate change



2.2.4 It should be noted that the throttling effect of the orifice ensures that there will be an increase in available floodplain volume upstream of the proposed development when compared to the present arrangement, as shown in Table 2-2.

Table 2-2 Oak Farm floodplain volume analysis upstream of the existing and proposed roads

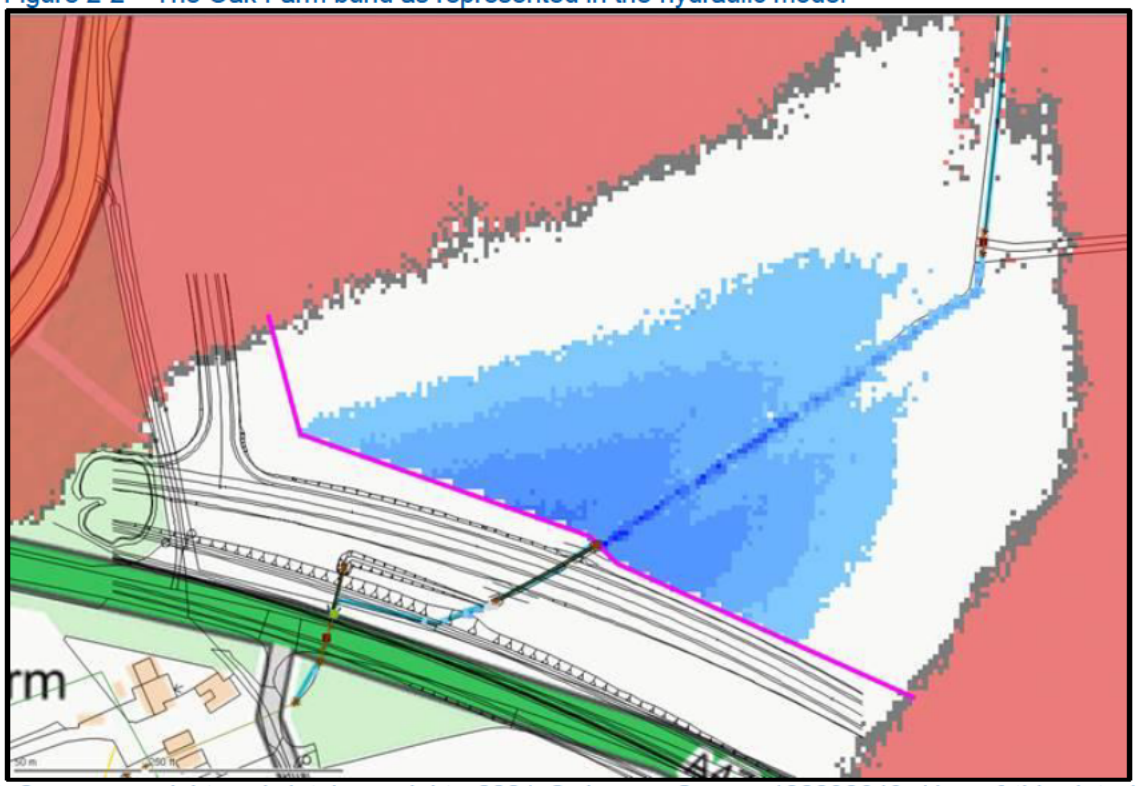
Scenario	Pre-development		Post-development	
	Flood volume upstream (m^3)	Max water level (m AOD)	flood volume upstream (m^3)	max water level (m AOD)
1 in 30 year	307	43.826	1344	44.771
1 in 100 year	819	44.078	3615	45.089
1 in 100 year 35% CC	2470	44.442	6559	45.337
1 in 100 year 65%CC	4303	44.688	9388	45.513
1 in 100 year 80%CC	6058	44.863	13319	45.708
1 in 1000 year	5901	44.849	12508	45.671
1 in 100 (65% CC) 50% blockage	N/A		21757	46.044

2.2.5 It can be seen from Table 2-2 that floodplain storage is approximately doubled in the post-development scenario.

2.3 NCC_M21_P3 - Oak Farm Bund

2.3.1 The bund crest near the junction of Lynn Road will be level and tie-into existing ground level, the design and drawings will be updated to reflect this in the detailed design stage. The hydraulic model features a bund that has a level crest and ties into existing ground levels; hence the predictions presented in the FRA, with regards to peak water levels and storage volumes, are sound. The representation of the bund in the hydraulic model can be seen in Figure 2-2. It can be seen that the bund, represented as the pink line, ties into a grey contour representing 46.5mAOD – the crest level.

Figure 2-2 – The Oak Farm bund as represented in the hydraulic model



2.4 Letter reference NCC_M21_P4 – Orifice Plate and Debris

2.4.1 The Applicant intends to control flow at Oak Farm Bund with an orifice plate. Several scenarios were considered at this location, as shown below in Table 2-3. An orifice plate was selected as it is relatively inexpensive and robust compared to other measures, whilst also offering the most flexibility to future change.

Table 2-3 Oak Farm flow control device choice

Option	For	Against
Free discharge	No need to store water or build bund	Exacerbates flood risk downstream
Throttled with pipe	Less costly than a flow control device	Prone to blockage, expensive to adapt to future change
Throttled with orifice plate	Allows the scheme to adapt to future change and is easy to inspect and maintain. Low cost and simple.	Doesn't set a limit on peak flow
Throttle with hydrobrake or similar	Set a limit on peak flow	Requires more effort to maintain and inspect, shorter operational life compared to the orifice. Future adaptation will be more expensive. Disconnection of watercourse habitat.

2.4.2 Land in the area is sloping at around 1 in 125 and covered with hedge lined positively drained arable farm. Around 0.13km^2 of deciduous woodland sits in the northeast of the catchment, as shown in Figure 2-3. Around 500m of the stream has woodland on one bank. Noting these factors the blockage potential from upstream debris is estimated to be medium according to Table 7.2 of the CIRIA *Culvert, screen and outfall manual (C786).*

2.4.3 To reduce the risk of blockage the Applicant has specified a screen on the culvert inlet at Oak Farm. The appropriate area of screen will be calculated in the detailed design stage. The screen will have safe access for maintenance such that the screen can be raked following extreme rainfall. Safe vehicle access will also be provided from the proposed new local access road. This access will also be designed in detailed design stage. Freeboard allowance was built into the bund in the event that the screen becomes blinded.

2.4.4 The impact of blockage was considered in the FRA (**APP-124 and APP-125**), and Table 6.1 of the FRA is reproduced in Table 2-4 below to show there is 531mm of freeboard to the crest level of the bund for a 50% blockage event. For a 1 in 100 year event plus 80% climate change allowance and a 1 in 1000 year event there is freeboard of 0.792m and 0.829m respectively.

Table 2-4 Peak water levels upstream of the embankment for the 100-year (65% climate change) event

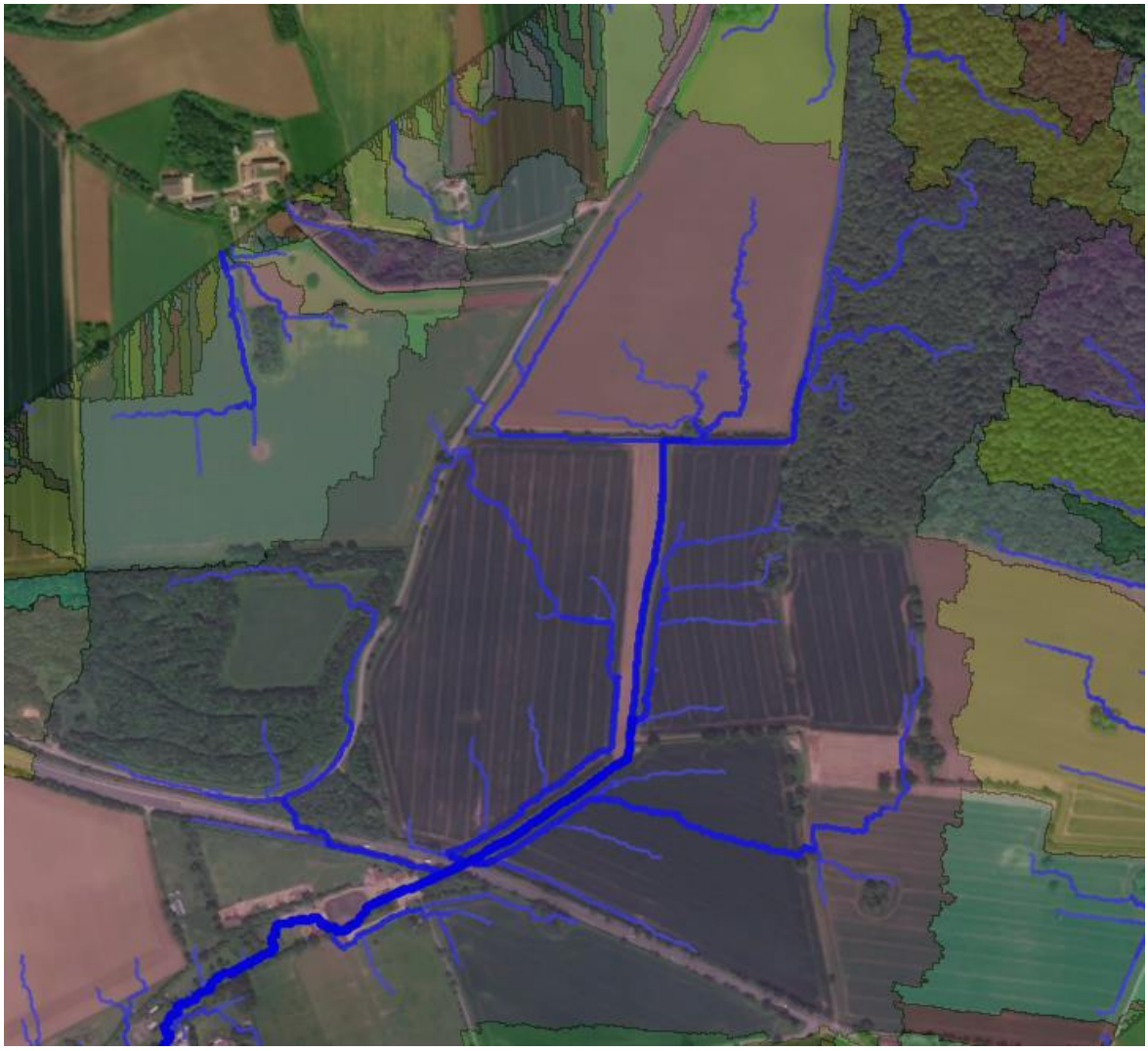
	No blockage	10% blockage		50% blockage	
	level (mAOD)	level (mAOD)	Difference (mm)	Level (mAOD)	Difference (mm)
Upstream of culvert	45.513	45.613	100	46.044	531
Freeboard (m)	0.987	0.887	-	0.456	-

2.4.5 The Applicant has demonstrated that there is freeboard in the proposed crest level of the flood bund for the design event (1 in 100 year plus 65% blockage) when blockage is considered, and that a debris screen will be provided to manage the impact of debris on the control structure. It has also been demonstrated that there is freeboard in the bund crest level beyond the design event.

2.4.6 The level of the overflow weir on the orifice control structure will be determined in the detailed design stage as the design is developed further. The Applicant expects that the overflow will be set to maintain a minimum freeboard of 300mm. At this level the overflow would be expected to activate for a 100-year event with a 65% climate change allowance and a 90% blockage to the culvert.

2.4.7 Should exceedance flows occur beyond those scenarios described above, flood waters are likely to accumulate downstream of the flood bund on the proposed local access road and in the area between the local access road and the proposed A47 mainline. If maintained correctly the residual risk, associated with events more extreme than the design event, is estimated to be negligible.

Figure 2-3 Approximate hydrological catchment showing areas of woodland.



2.5 Letter reference NCC_M21_P5 – Maintenance and Operation

2.5.1 The ownership of the culvert, screen, access road and bund arrangement for operation and maintenance will be confirmed as part of the current discussions between Highways England and Norfolk County Council to agree operational maintenance arrangements and asset transfer post Scheme construction.

2.5.2 The schedule for operation and maintenance will be developed in the detailed design stage when the detailed design is better understood. The CIRIA *Culvert, screen and outfall manual* (C786) and *Culvert design and operation* (C720) will be followed. When assessing blockage using the hazard matrix in Table 7.2 of CIRIA C786, it is expected that the Probability of blockages would be medium / low and the Consequence of blockage would be low. The Applicant does not expect remote monitoring will be needed, and that routine inspection will be adequate.

2.5.3 The Applicant expects that the Operation and Maintenance Plan, to be developed in the detailed design stage, will specify the monitoring of assets via regular manual inspection and following high rainfall. The operational plan will also cover for example, access, parking, lighting, equipment storage, emergency access, method statement for clearance tasks. Expected water levels will be provided such that the return period of an event can be compared to observed water levels. This will allow performance to be estimated and tracked. Emergency procedures and unsafe actions will also be noted in the plan. A typical outline inspection schedule is as follows:

- Culverts:
  - General inspection ~2yrs
  - Principal Inspection (based on operator's risk assessment): ~6yrs
- Screen/headwall/orifice/manhole:
  - inspection / clearance (based on operator's risk assessment): 4 visits per year (twice in winter) and following heavy rainfall
- Bund:
  - Inspection / grass cutting twice per year

2.6 Letter reference NCC_M21_P6 - Landowner

2.6.1 The requirement for the land within the DCO boundary and the purpose for which it will be used has been previously raised with landowner. The Applicant is due to meet the landowner in early October 2021 to provide further details of the proposals and to discuss the additional flood storage on their land. NCC will be updated following this meeting.

2.7 Letter reference NCC_M21_P7 – Hockering Culvert

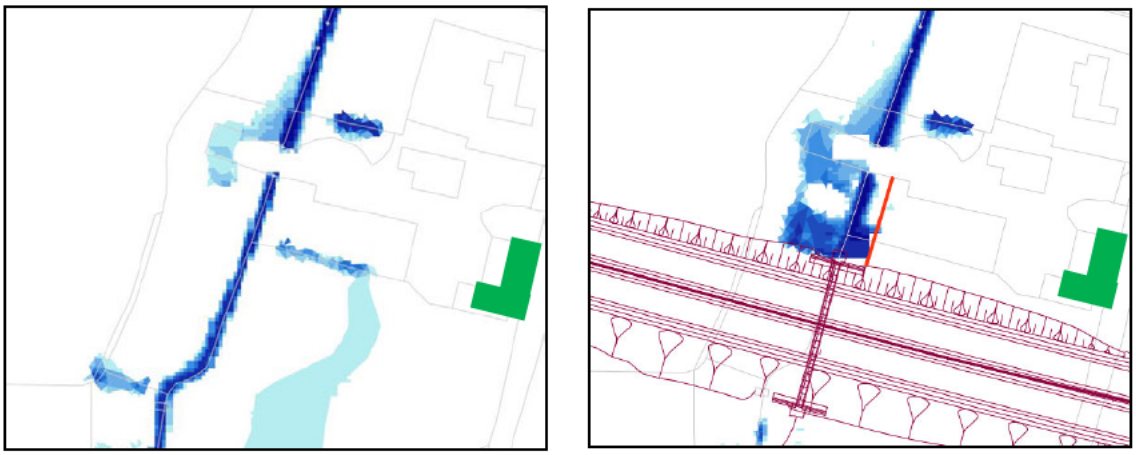
2.7.1 We note that Hockering culvert (referred to in the DCO submission as the Newgate House Culvert) is defined as an ordinary watercourse and falls within the Norfolk Rivers Internal Drainage Board (IDB) area. Please see our below response to letter reference NCC_M21_P10 regarding IDB consultation on Hockering culvert.

2.7.2 The Flood Risk Assessment (**APP-124** and **APP-125**) noted that peak water levels in the proposed Hockering culvert were sensitive to blockage and could, in rare circumstances, cause flooding to a nearby building. Due to this risk and other concerns raised by NCC and the Environment Agency, the Applicant has revised the Hockering hydraulic model, converting it from a 1D model to a 1D-2D model to provide a more accurate representation of the floodplain in the area. The revised model takes advantage of a more recent LiDAR dataset allowing for better quality flood mapping and improved confidence in model predictions. Details of the revisions made to the model can be found in revised A47 Tuddenham Hydraulic Modelling report (Annex A of the Flood Risk Assessment) which will be shared with the ExA, NCC and the Environment Agency at Deadline 5. The revised model will also be submitted for approval to the Environment Agency.

2.7.3 In the revised model the Applicant has tested a 1 in 100 year event scenario that includes a 65% allowance for climate change, 50% blockage on the culvert and a 'bank full' condition at the downstream boundary. This combination of factors represents a reasonable 'worst case' scenario and would be very unlikely to occur. It was found that the flood risk previously identified was not now observed – this was in part due to better representation of the proposed works in this location including tying the river bank into the proposed road embankment.

2.7.4 The position of the tie-in can be seen in Figure 2-4, marked in red. The tie-in will be detailed during detailed design, but it is simply a continuation of the existing river bank into the road embankment. The extension of the bank does not affect storage in the floodplain, as defined by the 1 in 100 year event plus 35% climate change scenario, and does not require compensation storage. The green polygon highlights the position of the building previously thought to be at risk.

Figure 2-4 Comparison of flood extents along the Hocking watercourse pre- and post-development during a 1 in 100 year event with a 65% allowance for climate change (and 50% blockage post-development)



2.8 Letter reference NCC_M21_P8 - Mapping

2.8.1 The Flood Risk Assessment (**APP-124** and **APP-125**) presents results from a 1D hydraulic model. When the modelling was commenced in Stage 3, a 1D model was preferred as the LiDAR available at the time was unsuitable for use as a 2D domain and hence also for flood mapping. Since then, a more accurate LiDAR dataset was published, and in response to various queries raised by NCC and the Environment Agency regarding the proposed Hockering culvert, the Applicant has now revised the model to include the updated LiDAR. This has also allowed production of a revised set of flood maps; see Appendix B. The differences in peak water level predictions can be seen in Table 2-5, the average change is 13mm and overall results are reasonably similar.

2.8.2 No depth difference maps have been supplied for technical reasons. Depth difference maps are reliant on the quality and resolution of the ground model. Most scenarios considered remain 'in bank' and the channel is not well represented in the either the new or older LiDAR datasets. When reviewing the depth difference maps anomalies associated with LiDAR resolution were present, The Applicant has opted to not include these maps to avoid confusion.

Table 2-5 Comparison of the original 1D model and the revised 1D/2D model output

Object ID	1D model level (mAOD)		Revised 1D/2D model level (mAOD)		Difference (mm)	
	No blockage	50% blockage	No blockage	50% blockage	No blockage	50% blockage
	Level (m AOD)	Level (m AOD)	Level (m AOD)	Level (m AOD)		
NEWG02_0337	31.04	31.04	31.04	31.04	0.000	0.000
IINT	30.49	30.49	30.477	30.477	-0.013	-0.013
INT	29.945	29.948	29.928	29.93	-0.017	-0.018
INT	29.523	29.562	29.529	29.567	0.006	0.005
NEWG02_0143	29.426	29.489	29.427	29.493	0.001	0.004
INT	28.808	29.353	28.811	29.373	0.003	0.020
A47 Inlet	28.477	29.357	28.482	29.366	0.005	0.009
A47 Outlet	28.056	28.056	28.059	28.059	0.003	0.003
INT	27.893	27.893	27.898	27.898	0.005	0.005
NEWG02_0021	27.7	27.7	27.7	27.7	0.000	0.000

2.8.3 Flood risk to the nearby properties is predicted to be negligible. It can be seen from Table 2-6 that water levels are largely unaffected by the proposed Hockering culvert. Detriment peaks at 2mm at cross-section *NEWG02_0143,* which is considered within model tolerance so is not significant. Some localised betterment is present due to slightly increased river capacity from the re-alignment.

Table 2-6 Comparison of baseline and post-development water levels

Object ID	100 year No CC Peak water level (m AOD)			100 year + 65% CC Peak water level (m AOD)		
	Baseline	post dev	Diff (mm)	Baseline	Post Dev	Diff (mm)
NEWG02_0697	34.899	34.899	0	35.091	35.091	0
INT1	34.756	34.756	0	34.958	34.958	0
NEWG02_0648	34.480	34.480	0	34.792	34.792	0
INT2	34.416	34.416	0	34.577	34.577	0
INT3	33.757	33.757	0	33.910	33.910	0
INT4	33.117	33.117	0	33.349	33.349	0
NEWG02_0494	32.946	32.946	0	33.252	33.252	0
INT5	32.556	32.556	0	33.241	33.241	0
INT6	32.414	32.414	0	33.243	33.243	0
NEWG02_0416	32.326	32.326	0	33.227	33.227	0
A47						
NEWG02_0337	30.858	30.858	0	31.040	31.040	0

Object ID	100 year No CC Peak water level (m AOD)			100 year + 65% CC Peak water level (m AOD)		
	Baseline	post dev	Diff (mm)	Baseline	Post Dev	Diff (mm)
INT7	30.310	30.310	0	30.477	30.477	0
INT8	29.777	29.777	0	29.929	29.928	0
INT9	29.277	29.278	2	29.530	29.529	-1
NEWG02_0143	29.161	29.163	2	29.428	29.427	-1
INT10	28.618	28.603	-15	28.820	28.811	-9
INT - BRG US	28.360	28.229	-131	28.518	28.482	-36
INT12	28.098	-	-	28.240	-	-
INT - BRG DS	-	27.895	-		28.053	-
INT13	27.822	-	-	27.973	-	-
INT13b	-	27.704	-	-	27.862	-
NEWG02_0021	27.412	27.412	0	27.586	27.584	-2

2.8.4 Residual flood risk to the receptors (i.e. flood risk beyond the design event) is slightly reduced or unchanged by the Scheme.

2.9 Letter reference NCC_M21_P9 - Maintenance and Operation

2.9.1 As described in our response to letter reference NCC_M21_P9 above, the Applicant does not believe further mitigation will be required at the Hockering culvert as there is no longer a flood risk to the building shown in Figure 2-4. The ownership of the culvert for operation and maintenance will be confirmed as part of the current discussions between Highways England and Norfolk County Council to agree operational maintenance arrangements and asset transfer post Scheme construction.

2.9.2 The blockage risk is estimated to be low based on two factors: (1) there are a number of culverts upstream that will limit the supply of debris to the proposed culvert; and (2) the culvert aperture is large, 2.05 by 2.05m (with a 300mm bed layer), allowing most debris to pass through. The FRA incorrectly mentions a debris screen would be provided at this location. The proposed culvert provides mammal passage which is not easily combined with a debris screen. The Applicant has considered a 50% blockage scenario to ensure that the culvert design is robust, given the supply of debris and the geometry of the culvert 50% blockage is highly conservative.

2.9.3 The schedule for operation and maintenance will be developed at the detailed design stage when the detailed design is better understood. The CIRIA *Culvert, screen and outfall* (C786) and *Culvert design and operation* (C720) manuals will be followed. When assessing blockage using the hazard matrix in Table 7.2 of CIRIA C786 it is expected the Probability of blockages would be low and the Consequence of blockage would be low. The Applicant does not expect remote monitoring or property level resilience will be necessary, and that routine inspection will be adequate.

2.9.4 The Applicant expects that the Operation and Maintenance Plan, to be developed in the detailed design stage, will specify the monitoring of assets via regular manual inspection and following high rainfall. The operational plan will also cover access, parking, lighting, equipment storage, emergency access, method statement for clearance tasks, etc. Expected water levels will be provided such that the return period of an event can be compared to observed water levels. This will allow performance to be estimated and tracked. Emergency procedures and unsafe actions will also be noted in the plan. A typical outline inspection schedule is as follows:

- Culverts:
  - General inspection ~2 years
  - Principal Inspection (based on operator's risk assessment): ~6 years
- Headwall:
  - inspection / clearance (based on operator's risk assessment): 4 visits per year (twice in winter) and following heavy rainfall

2.10 Letter reference NCC_M21_P10 – Flood Compensation Storage

Oak Farm

2.10.1 The Flood Risk Assessment (**APP-124** and **APP-125**) states that with the Scheme there is a loss of floodplain storage of 2,785m^3 due to the proposed widening of the existing A47, the local access and the flood bund which protects the proposed road from flooding. The FRA and section 2.2 above note that flood waters are displaced upstream and, due to the need to throttle flows by the use of an orifice to protect the proposed road from flooding, the volume of water increases compared to that which accumulates behind the existing A47 under baseline conditions (Table 2-2; 1 in 100 year event plus 65% allowance for climate change). The flood bund and orifice arrangement has the additional benefit of reducing flood risk downstream, south of the existing A47. The design of the bund and the orifice will be further developed at the next stage and under Requirement 4 'Environmental Management Plan' of the dDCO (**REP2-005**) NCC, as the Lead Local Flood Authority, would have the opportunity to review and comment.

2.10.2 Due to the footprint of the Scheme overlying land immediately upstream of the existing A47, it is not possible to provide level for level flood compensation storage. Neither is it possible to provide a functioning flood compensation area downstream of the existing A47 due to the throttling effects on the existing A47 culvert. Flood storage, as indicated in Table 2-2, is provided upstream albeit displaced and flooding arable land that was not previously flooded. Reprofiling and lowering the land in this area could reduce the footprint of the flooded area. However, the earthworks required to do this would unnecessarily impact the arable land and environment in this area.

2.10.3 As stated in our response to Letter reference NCC_M21_P6, we are continuing to consult with the landowner on the implications of this to their land.

Hockering

2.10.4 It is noted in Section 2.7 that the Applicant has revised the Hockering hydraulic model converting it from a 1D model to a 1D-2D model, thereby providing a more accurate representation of the floodplain in the area. The revised model takes advantage of a more recent LiDAR dataset allowing for better quality flood mapping and improved confidence in model predictions.

2.10.5 As part of the revision to the Hockering hydraulic model, we have recalculated the lost floodplain storage to be 11m^3 (without any uncertainty allowance) for the 1 in 100 year event plus a 35% climate change allowance. It can be seen from Table 2-4 that the Scheme does not cause meaningful detriment to water levels upstream or downstream of the proposed culvert. This is a result of storage in the realigned watercourse and the large culvert aperture.

2.10.6 Given the lack of meaningful detriment, small loss of floodplain storage and the improved confidence in the hydraulic model, it is proposed that no flood compensation area is provided.

2.10.7 Further to NCC's reminder that the Hockering watercourse is under the jurisdiction of Norfolk Rivers IDB, the Applicant has further consulted the IDB on the matter of Hockering culvert. The Applicant notes that the IDB has already been consulted on various matters relating to the Scheme.

2.11 Letter reference NCC_M21_P11 – River Tud Compensation Storage

2.11.1 Please see Section 3 'RR-066.27 Environment Agency' of this report.

2.12 Letter reference NCC_M21_P12 – Construction Phase Mitigation

2.12.1 NCC raised concerns in their Relevant Representation (**RR-061**) and in their letter dated 16 March 2021 (see Appendix A of this report) concerning the lack of information regarding the proposed drainage approach during the construction phase. In the Applicant's Response to the Relevant Representations (**REP1-013**) the Applicant stated that the temporary drainage design strategy will be provided as part of the Environmental Management Plan (EMP) (**APP-143**). Delivery of this commitment will be secured through the dDCO (**REP2-005**) Requirements 4 and 8. An outline Water Management and Monitoring Plan (WMMP) (**TR010038/EXAM/9.13**), which when finalised will form Annex B.7 of the second iteration of the EMP, sets outs the principles adopted in the temporary drainage strategy. The temporary drainage strategy will be developed and documented within the WMMP during the detailed design stage, building on the findings of the FRA (**APP-124** and **APP-125**) and Drainage Strategy (**APP-126** and **APP-127**) to ensure no increase in flood risk during construction. NCC will be given the opportunity to review and comment on the WMMP.

2.13 Letter reference NCC_M21_P13 - SFRA

2.13.1 Please refer to the Applicant's response RR-037.61 (**REP1-013**) to NCC's Relevant Representation (**RR-061**).

2.14 Letter reference NCC_M21_P14 - Consents

2.14.1 Please refer to the Applicant's response RR-037.62 (**REP1-013**) to NCC's Relevant Representation (**RR-061**).

3 RR-066.27 ENVIRONMENT AGENCY

3.1.1 The Flood Risk Assessment (**APP-124** and **APP-125**) presented the floodplain storage volume lost due to the River Tud crossing abutments. Further assessment has been undertaken to confirm that the lost floodplain storage can be provided in the area proposed in the dDCO application. It can be seen from Table 2-8 that 1277m^3 would be lost from the floodplain and that 1759m^3 would be replaced. The location of replacement volumes can be seen in Figure 2.6.

Table 2-8 Comparison of floodplain volumes lost and replaced for a 1 in 100 year event with a 35% allowance for climate change

Elevation (m AOD)	Volume lost (m³)	Volume added (m³)
21-8.22.0	35	35
22.0-22.2	318	319
22.2-22.4	659	659
22.4-22.6	265	746
Total volume (m³)	1277	1759

Figure 2-6 Indicative outline of proposed River Tud flood compensation area based on the volumes added in Table 2-6.

3.1.2 The Environment Agency is a named consultee under dDCO (**REP2-005**) Requirement 4 'Environmental Management Plan. Under Requirement 4, the Environment Agency will be consulted to review and comment on the detailed design of the River Tud flood compensation area.

4 RR-066.31 ENVIRONMENT AGENCY

4.1.1 In response to queries raised by NCC and the Environment Agency regarding flood risk at the proposed culvert near Hockering, The Applicant has updated the flood risk model to improve its accuracy. The Applicant has opted to update the model, as discussed in section 2.7, rather than confirming that the FRA uncertainty allowance was sufficient. The revised flood risk mapping is presented in Appendix B. The model improvements have enabled a more detailed assessment of compensation storage, The Applicant now estimates that 11m^3 of compensation storage would be required. This estimate was taken from the 1 in 100 year scenario with a 35% allowance for climate change.

4.1.2 A reasonable worst-case scenario could be assumed to be a 1 in 100 year event, including a 65% allowance for climate change and a 'bank full' condition at the downstream boundary. In this scenario compensation storage rises to 18m^3. If the Applicant takes a very conservative view and adds a 100% uncertainty allowance on this figure the Hockering culvert requires 36m^3 of compensation storage. The Applicant does not believe that compensation storage will be necessary for this small loss of floodplain.

5 RR-066.32 ENVIRONMENT AGENCY

5.1.1 In the Applicant's response to the Environment Agency's Relevant Representation, the Applicant committed to providing further assessment information to inform the impact of shading by the River Tud Crossing on the Water Framework Directive (WFD) biological elements. A river condition survey is planned in October 2021 to enable the biodiversity river metric to be used to quantify baseline habitats, habitats lost, restored and created. The ExA will be kept informed of the outcome of this exercise during the DCO Examination process. The outcome will also be recorded in the Statement of Common Ground with the Environment Agency (**TR010038/EXAM/8.2**). If required, appropriate updates will be made to the DCO application documents and submitted to the ExA.

6 RR-066.34 ENVIRONMENT AGENCY

6.1.1 In the Applicant's Response to the Environment Agency's Relevant Representation, the Applicant committed to providing further assessment information to provide confidence in the potential enhancement measures in the vicinity of the River Tud Crossing to compensate and mitigate against the impacts on aquatic and riparian ecology. A river condition survey is planned in October to enable the biodiversity river metric to be used to quantify baseline habitats, habitats lost, restored and created. The ExA will be kept informed of this exercise during the DCO Examination process. The outcome will also be recorded in the Statement of Common Ground with the Environment Agency (**TR010038/EXAM/8.2**). If required, appropriate updates will be made to the DCO application documents and submitted to the ExA.

7 RR-066.35 ENVIRONMENT AGENCY

7.1.1 In the Applicant's response to the Environment Agency's Relevant Representation, the Applicant committed to providing further assessment information to demonstrate that the proposed measures will provide adequate compensation for the impacts on the specific ecology of the Oak Farm and Hockering watercourses from the permanent loss of riparian habitat. A river condition survey is planned in October to enable the biodiversity river metric to be used to quantify baseline habitats, habitats lost, restored and created. The ExA will be kept informed of this exercise during the DCO Examination process. The outcome will also be recorded in the Statement of Common Ground with the Environment Agency (**TR010038/EXAM/8.2**). If required, appropriate updates will be made to the DCO application documents and submitted to the ExA.

APPENDIX A - NCC'S LETTER DATED 16 MARCH 2021 (FW/2021_0166)

Norfolk County Council
Community and Environmental Services
County Hall
Martineau Lane
Norwich
NR1 2SG

via e-mail
FAO: Jason Ball
SWECO

NCC contact number: [redacted]
Textphone: [redacted]

CC: Stephen Faulkner
Norfolk County Council Principal Planner

Your Ref: A47 N Tuddenham to Easton
Date: 16 March 2021

My Ref: FW/2021_0166
Tel No.: [redacted]
Email: [redacted]@norfolk.gov.uk

Dear Dr Ball,

A47 North Tuddenham to Easton Improvements – Flood Risk Assessment Initial Review

Thank you for the providing the Flood Risk Assessment (FRA) for initial review by email on 24th February 2021. Our review of the information provided has led to the following comments.

Oak Farm Culvert

We are glad the proposed scheme at the Oak Farm culvert is able to improve the attenuation of flows through the culvert, reduce the downstream water levels through Oak farm and to retain the water upstream of the culvert while retaining a minimum freeboard in excess of 300mm. The information provided regarding the volume of water accumulated upstream determines the volume of water for the proposed arrangement and future flows. However, the pre-development volume of water accumulated is in a different section of the report to the post development accumulation of water. Therefore, it is not possible to clearly compare the pre and post development volumes as was previously requested in out letter dated 9th February 2021. Please update the FRA to present this information more clearly to clarify the situation.

The bund shown on the plan near the junction of the Lynn Road with the connection to the old A47 continues to show that it does not tie into the existing similar ground levels, while the FRA indicates that the bund will tie into ground with similar ground levels. We would continue to recommend that the western extent of the bund is tied into ground of a similar level to ensure mitigation and update the relevant documents to ensure consistency.

We note that you intend to control flow into the culvert with a 300mm orifice plate, although there is no discussion in the FRA regarding alternative flow control approaches that have been considered or the justification of the orifice plate being selected. The FRA does not report on the assessment of debris for this catchment and whether this is a residual risk present for this control structure and how debris would be managed.

Regarding the maintenance and operation of the bund and the orifice plate, we will seek clarification of the proposed owner along with the monitoring and maintenance schedule for both structures.

We acknowledge that discussions are reported to have occurred with the landowner upstream of the Oak Farm culvert, although no evidence of an agreement in principle has been presented in the FRA. It is recommended that this information is included in the FRA.

Hockering Culvert

The proposed Hockering culvert is on an ordinary watercourse under the jurisdiction of the IDB. We acknowledge that the proposed culvert is shown to provide a freeboard exceeding 600mm during the 1% plus 65% climate change allowance. However, the FRA reports that during the assessment of the culvert blockage scenarios, the water levels are shown to be sensitive to blockage and could lead to the potential of internal property flooding.

After reviewing the FRA, the supporting modelling report and the associated drawings provided, further information of the mapped extent of the flooding for the residual flood risk associated with the blockage of the culvert was not found and would be expected due to the level of potential residual risk presented to a neighbouring property at risk of flooding.

In addition, the FRA lacked sufficient detail on the mitigation solution and the supporting maintenance plan for the mitigation to reasonably limit this residual risk. While the FRA identifies the need for maintenance, no further information is provided regarding the inspection frequency or monitoring measures. There is no discussion in the FRA on the consideration of potential property level resilience or the use of remote sensing in terms of water levels which could be considered for such a location. The inclusion of a debris screen has been mentioned briefly, however the hydraulic modelling does not include a debris screen in the post development representation.

Flood Storage Compensation

We are concerned with the over-statement of the LLFA's support in the FRA and feel it does not represent the LLFA pre-application responses in particular relating to the flood storage compensation associated with the Oak Farm and Hockering culverts. We have not stated in our responses that no flood storage compensation is required, yet this is the message conveyed in the FRA. We remind you that in our letter dated 9th February, we inform SWECO that the watercourse at the Hockering culvert is in the jurisdiction of the IDB and that further information would be required. While in relation to the Oak Farm culvert, we have requested further information that demonstrates that the same flood storage volume would be provided upstream of the culvert albeit at a higher level. Therefore, we have not indicated that flood storage compensation is not required, and it will be necessary for you to correct the FRA prior to DCO submission.

River Tud Crossing

As previously indicated in our letter dated 27th January 2021, we note the initial flood storage loss volumes and levels have been calculated to assess the amount of flood storage compensation required. We note that an area of land has been identified,

however, we have not seen a proposed design for this area of a level that confirms that suitable flood storage compensation can be achieved within this area. Whilst we agree in principle to the design approach and direction the flood storage compensation is headed, we would require some more detail on the proposed design. At present, the information provided is limited to a location. Further information that would be required includes a comparison of the flood storage compensation volume to be provided by level band.

Construction Phase Mitigation

The construction phase mitigation measures presented in the FRA are “high level generic” approaches and do not relate specifically to the phased construction of the new dual carriage way. There is no explanation of the what the proposed temporary drainage works will include or where the different feature will be located. It is indicated in the FRA that “where practical, the Proposed Scheme drainage will be constructed in the early phases of the project.” However, there is no further information about the phasing of either the temporary or permanent drainage works or information about how this relates to the construction phasing of the proposed scheme. Further information is expected to demonstrate that flood risk will not be increased elsewhere in the relevant catchments during the construction phase.

General Comments

We would like to make you aware that the Greater Norwich Level 2 Strategic Flood Risk Assessment was published in February 2021 and can be found at https://www.gnlp.org.uk/regulation-19-publication/evidence-base in its own section. We suggest an appropriate amount of information is included in the

Please note that any works on ordinary watercourses and flow paths are likely to require ordinary watercourse consent applications. The design information including location, type, size, justification for its need and any appropriate environmental assessments will be required to support any ordinary watercourse consent applications. It will also be necessary for the contractor to obtain appropriate consents from the LLFA prior to undertaking work on the site.

Further information can be found on the Norfolk County Council Flood and Water Management website at: https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-homeowners/consent-for-work-on-ordinary-watercourses

Should you have any further queries, please contact the LLFA directly.

Yours sincerely,

Sarah

Sarah Luff
Strategic Flood Risk Planning Officer

Lead Local Flood Authority

Disclaimer

We have relied on the accuracy and completeness of the information supplied to us in providing the above advice and can take no responsibility for incorrect data or interpretation, or omissions, in such information. If we have not referred to a particular issue in our response, it should not be assumed that there is no impact associated with that issue.

APPENDIX B - REVISED HOCKERING TRIBUTARY FLOOD MAPPING

Figure 0.1 Hockering section locations

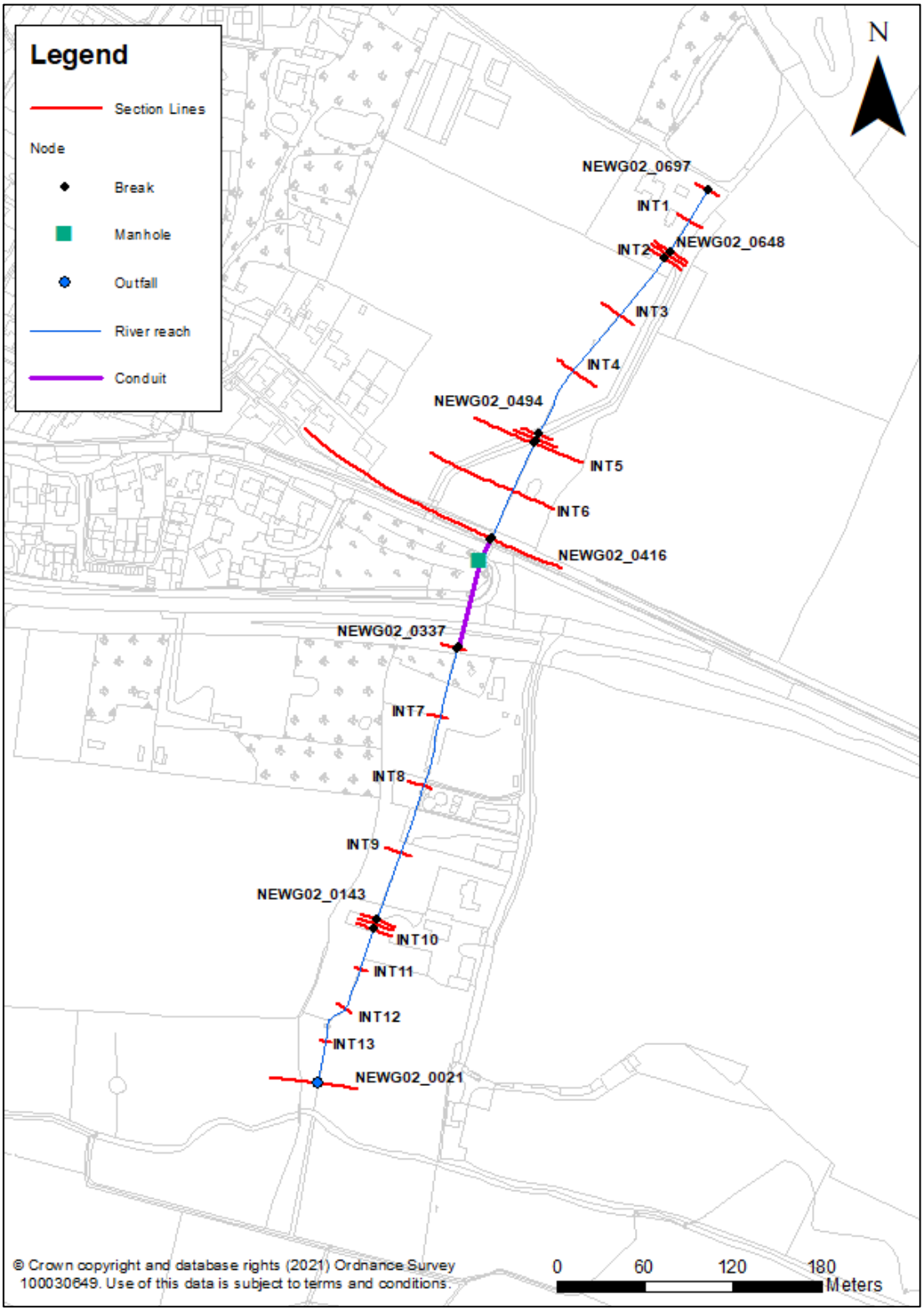


Figure 0.2 Hockering Baseline full flood extent

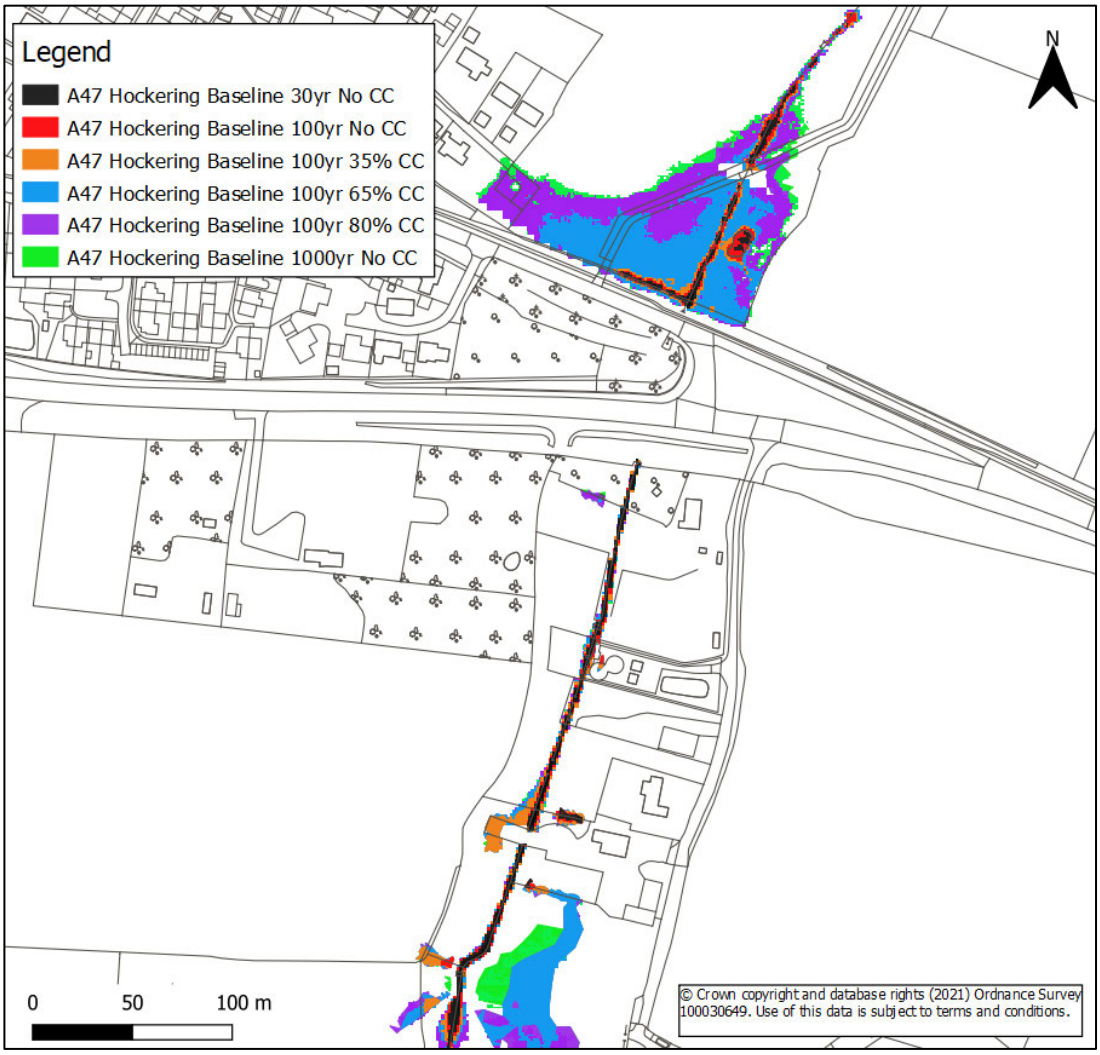


Figure 0.3 Hockering Proposed Scheme full flood extent

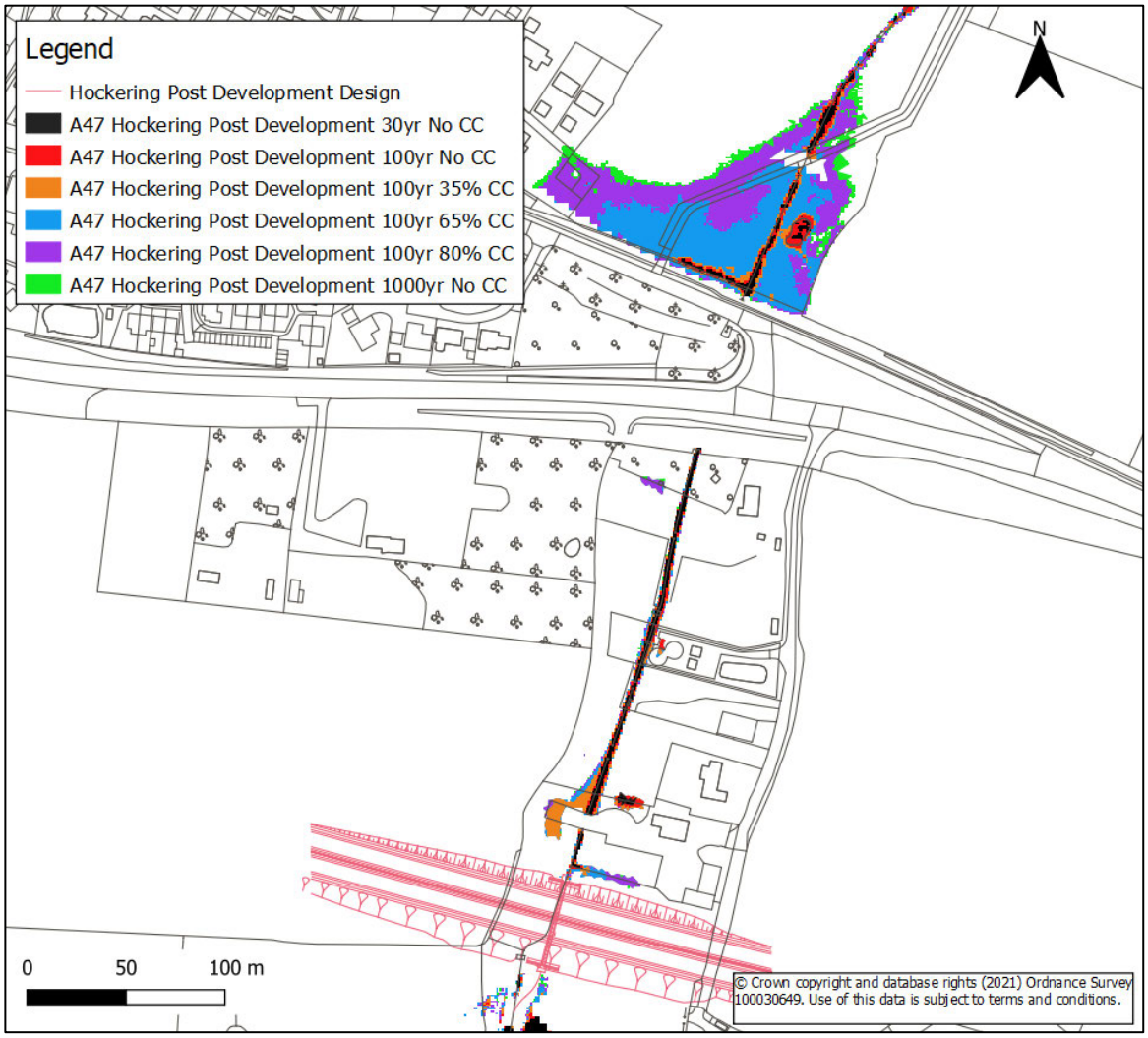


Figure 0.4 Baseline: 1 in 100-year event with no climate change allowance

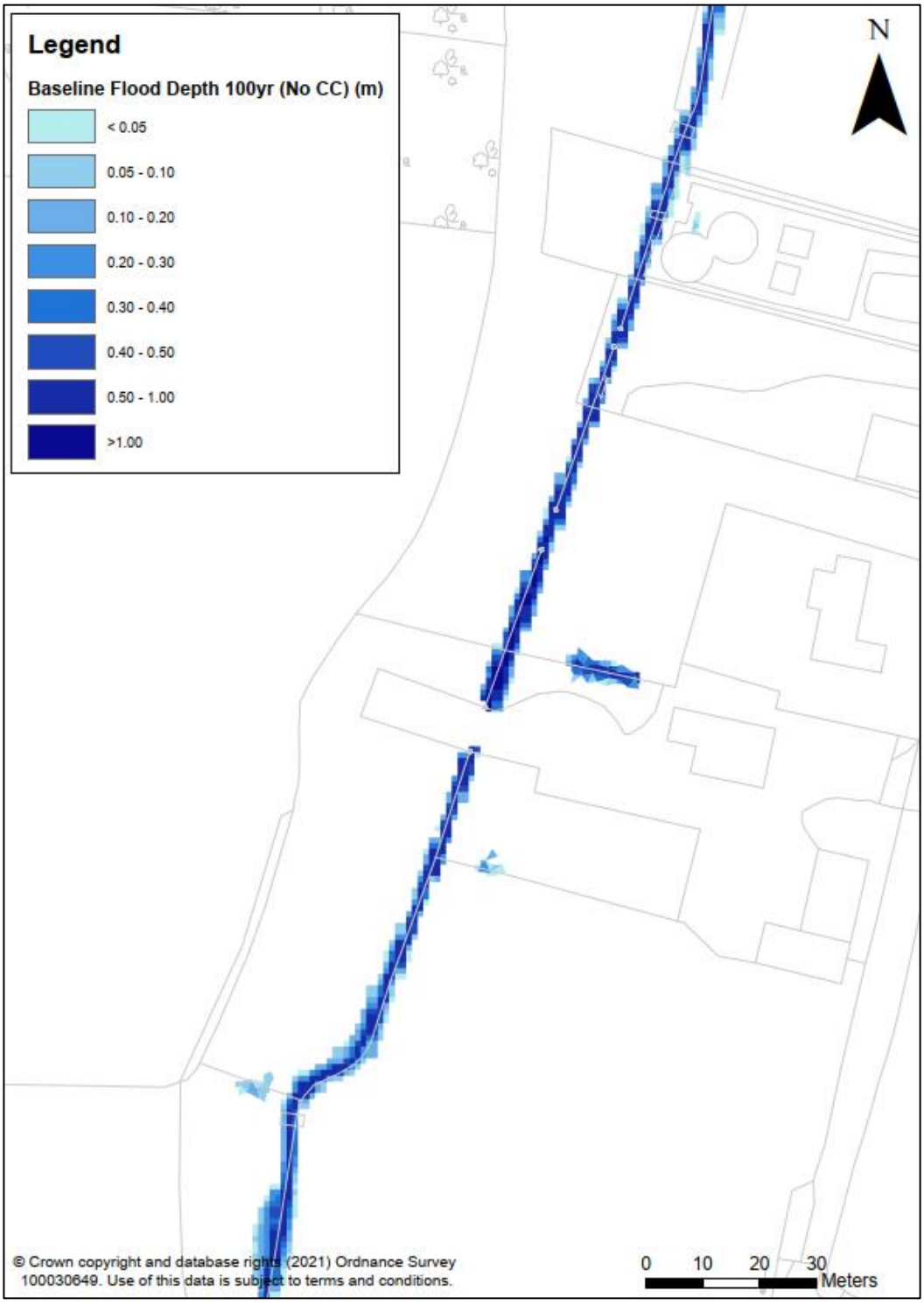


Figure 0.5 Baseline: 1 in 100-year event with 35% climate change allowance

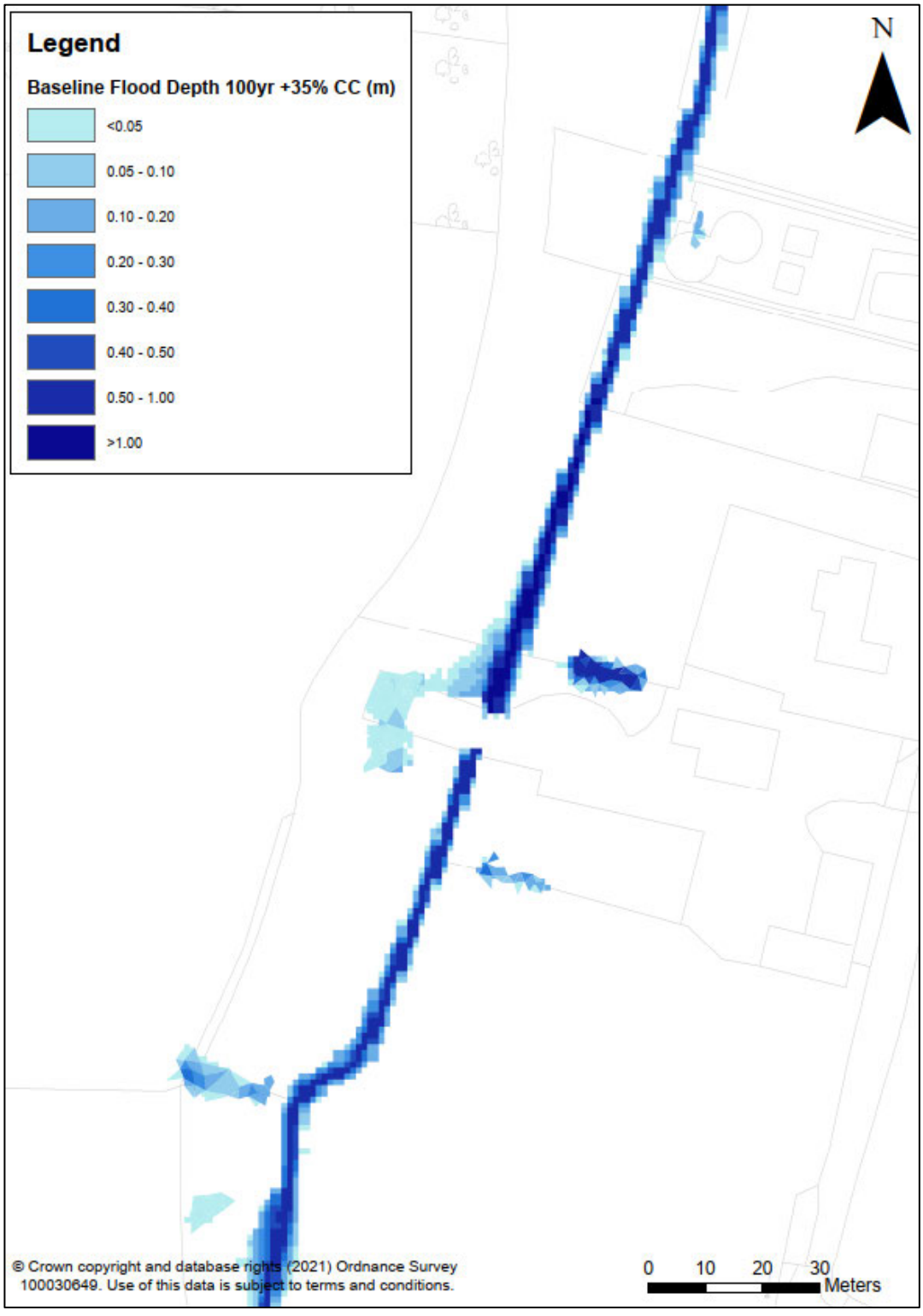


Figure 0.6 Baseline: 1 in 100-year event with 65% climate change allowance

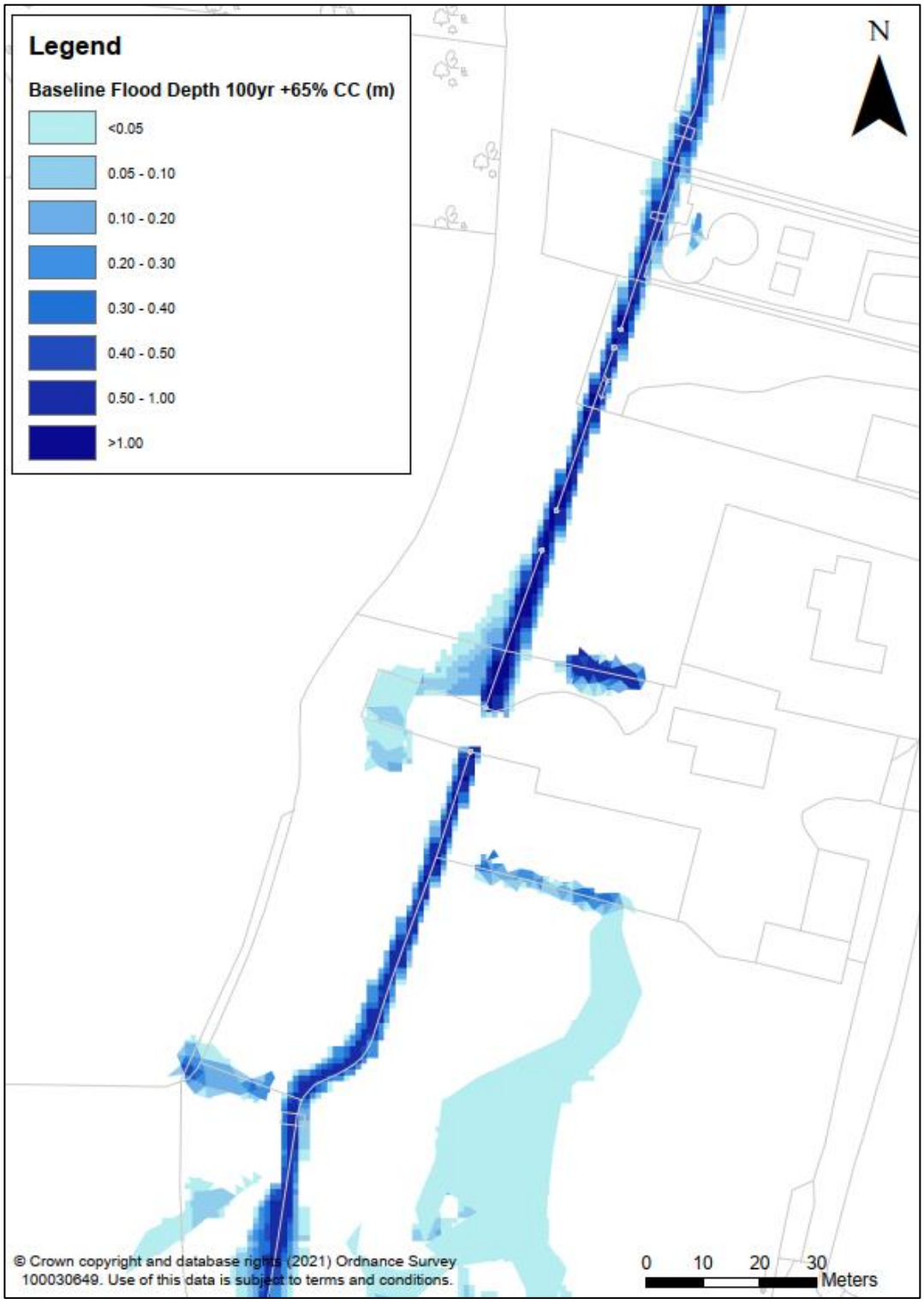


Figure 0.7 Proposed Scheme: 1 in 100-year event with no climate change allowance

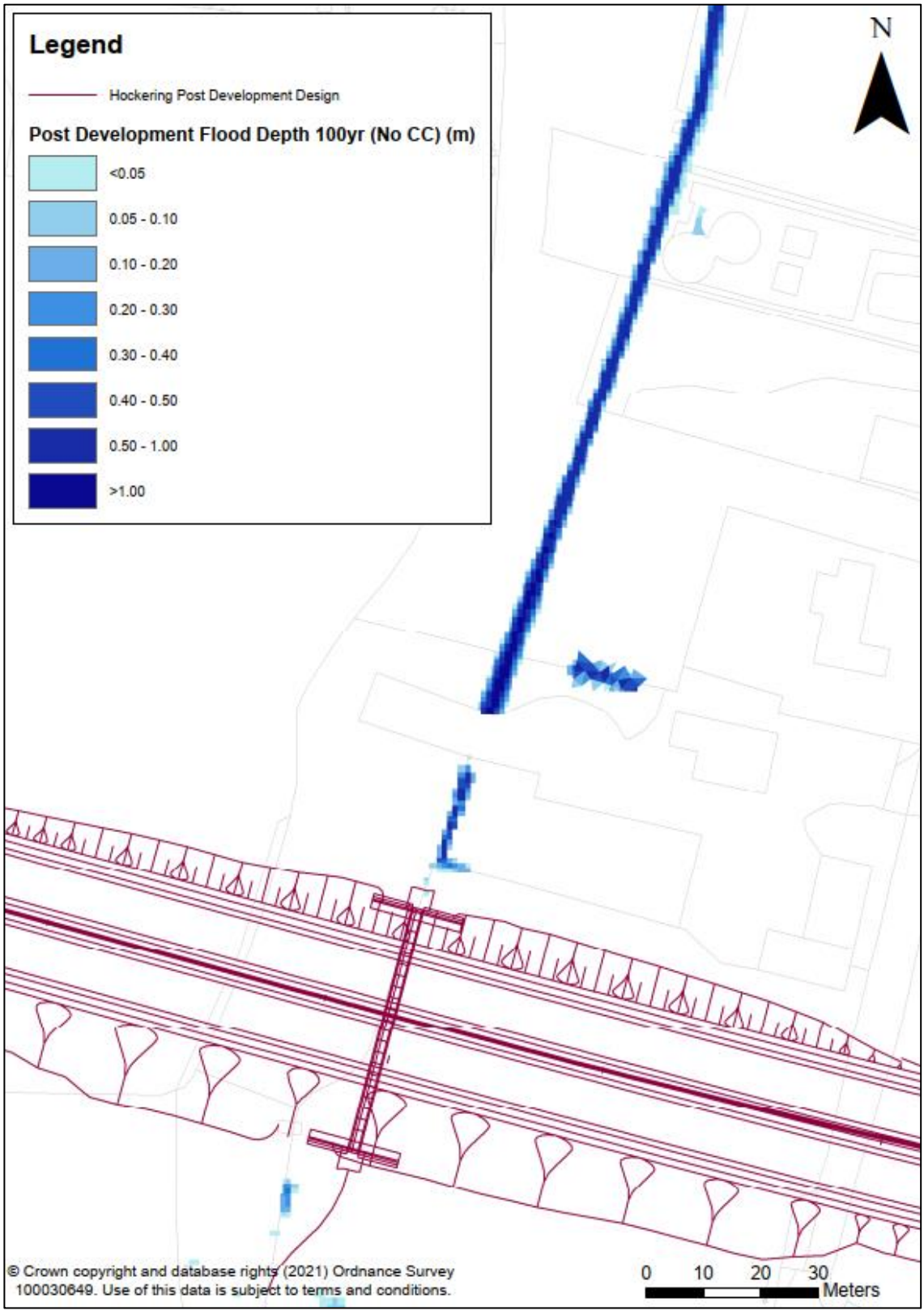


Figure 0.8 Proposed Scheme: 1 in 100-year event with 35% climate change allowance

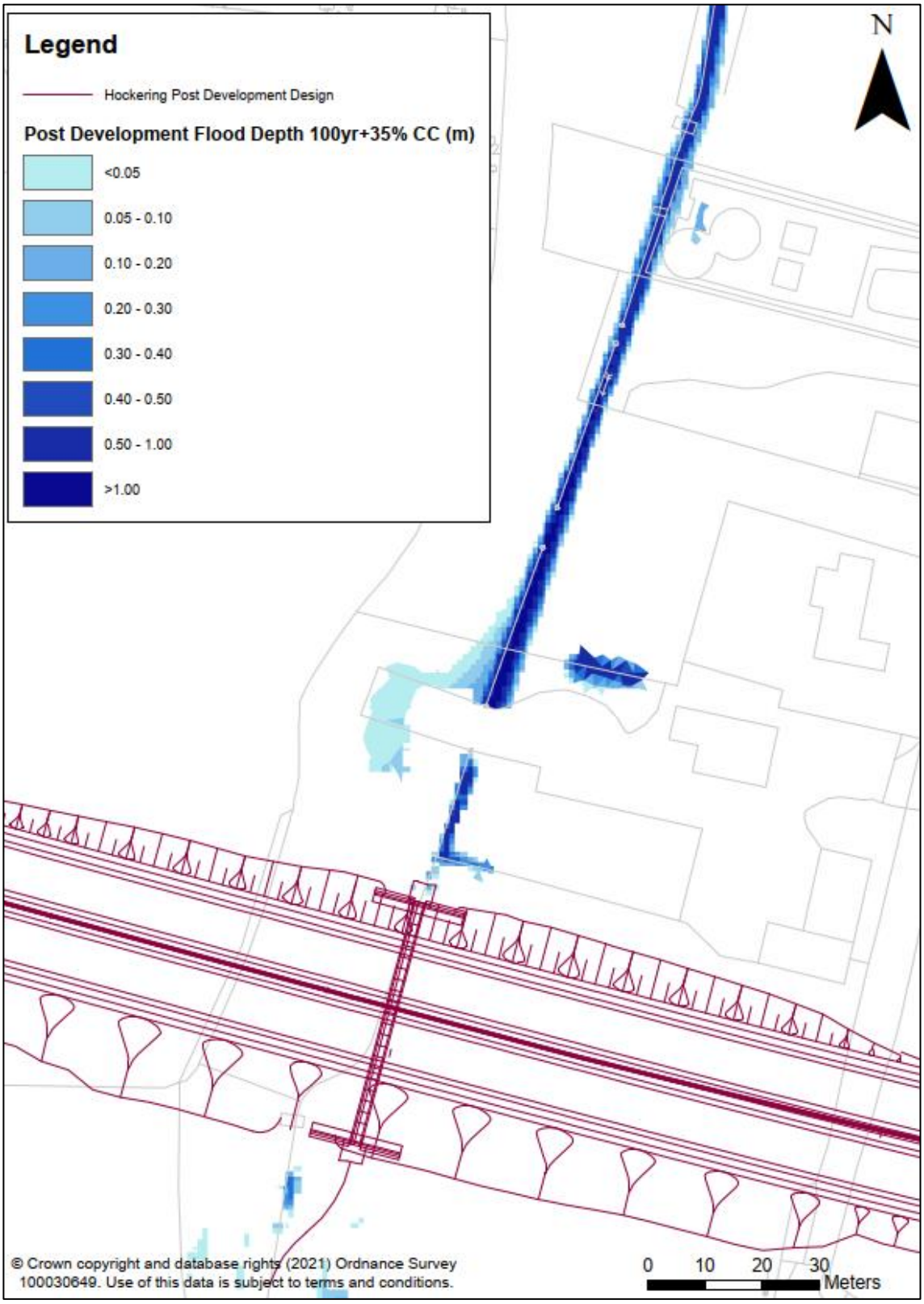


Figure 0.9 Proposed Scheme: 1 in 100-year event with 65% climate change allowance