In Parliament – Session 2022 - 2023

HS2

High Speed Rail (Crewe – Manchester)

Supplementary Environmental Statement 2 and Additional Provision 2 Environmental Statement

Volume 5: Appendix WR-005-0MA06

Water resources and flood risk

Flood risk assessment

MA06: Hulseheath to Manchester Airport

S117

In Parliament – Session 2022 - 2023

HS2

High Speed Rail (Crewe – Manchester)

Supplementary Environmental Statement 2 and Additional Provision 2 Environmental Statement

Volume 5: Appendix WR-005-0MA06
Water resources and flood risk
Flood risk assessment
MA06: Hulseheath to Manchester Airport

S117

Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

High Speed Two (HS2) Limited
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA

Telephone: 08081 434 434

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

A report prepared for High Speed Two (HS2) Limited:

ARUP+ ERM | FOSTER + PARTNERS | JACOBS
RAMBOLL | TYPSA | COSTAIN

MWJV
Mott MacDonald | WSP

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact High Speed Two (HS2) Limited.

recycle

Printed in Great Britain on paper containing 100% recycled fibre.

Contents

Tables

Figures

1 Introduction

1.1 Structure of this appendix

1.1.1 This report is an appendix to the water resources and flood risk assessment which forms part of Volume 5 of the Supplementary Environmental Statement 2 (SES2) and Additional Provision Environmental Statement (AP2 ES) for the Hulseheath to Manchester Airport (MA06) community area.

1.1.2 This appendix provides details of changes to the flood risk assessment (FRA) since the production of the High Speed Two (HS2) (Crewe – Manchester) Environmental Statement (ES)[1] (the main ES) and the HS2 High Speed Rail (Crewe – Manchester) Background Information and Data (BID)[2] (the main BID reports) which accompanied the main ES published in 2022.

1.1.3 An assessment on the impact of the original scheme on flood risk was undertaken as part of the water resources and flood risk assessment reported in the main ES (Volume 2: Community Area report: Hulseheath to Manchester Airport (MA06) and Volume 5, Appendix: WR-003-0MA06).

1.1.4 This appendix should be read in conjunction with Volume 5: Appendix WR-005 of the main ES for the Hulseheath to Manchester Airport (MA06) community area.

1.1.5 In order to differentiate between the original scheme and subsequent changes, the following terms are used:

- 'the original scheme' – the hybrid Bill (the Bill) scheme submitted to Parliament in 2022, which was assessed in the main ES;
- 'the SES1 scheme' – the original scheme with any changes described in SES1 that are within the existing powers of the Bill;
- 'the AP1 revised scheme' – the original scheme as amended by SES1 changes and AP1 amendments;
- 'the SES2 scheme' – the original scheme with any changes described in SES1 (submitted in July 2022) and the SES2; and

[1] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Environmental Statement.* Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

[2] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data.* Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

- 'the AP2 revised scheme' – the original scheme as amended by SES1 and SES2 changes (as relevant) and AP2 amendments.

1.1.6 The purpose of this document is to report any changes or updates to environmental information and scheme design or assumptions that have occurred since the main ES, which will result in a change in effects and/or the introduction of new effects on flood risk receptors.

1.1.7 This FRA considers SES2 changes to baseline data and four AP2 amendments which were identified in the Hulseheath to Manchester Airport (MA06) community area that had implications for flood risk.

1.1.8 The hydraulic modelling described in this assessment can be found in the following reports:

- Hydraulic modelling report – Tributaries of Millington Clough, Volume 5, Appendix: WR-006-00001 of the main ES;
- Hydraulic modelling report – Tributaries of Birkin Brook, AP2 and SES2 Volume 5, Appendix: WR-006-00010;
- Hydraulic modelling report – River Bollin, AP2 and SES2 Volume 5, Appendix: WR-006-00011; and
- Hydraulic modelling report – Timperley Brook, Volume 5, Appendix: WR-005-00007 of the main ES.

1.1.9 Maps relevant to this appendix are contained in the SES2 and AP2 ES Volume 5 Water resources and flood risk Map Book: Water Resources and Flood Risk Map Series WR-05 and WR-06.

1.2 Assessment methodology

1.2.1 This FRA has been carried out in general accordance with the requirements of the National Planning Policy Framework (NPPF)[3]. The NPPF aims to prevent inappropriate development in areas at flood risk. Where development is necessary in such areas, the NPPF requires local planning authorities to ensure any development is safe from flooding, does not increase flood risk elsewhere and reduces flood risk where possible.

1.2.2 The methodology, design criteria and data sources used in this FRA are set out in the main ES Environmental Impact Assessment Scope and Methodology Report (SMR)[4] and the SES2

[3] Ministry of Housing, Communities and Local Government (2021), *National Planning Policy Framework*. Available online at: https://www.gov.uk/government/publications/national-planning-policy-framework--2.

[4] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Environmental Statement, Environmental Impact Assessment Scope and Methodology Report,* Volume 5, Appendix CT-001-00001. Available online at: https://www.gov.uk/government/collections/hs2-phase2b-crewe-manchester-environmental-statement.

and AP2 ES Volume 5, Appendix: CT-001-00005 Water resources and flood risk – Technical note – Updated guidance on flood risk assessment.

Part 1: Supplementary Environmental Statement

2 Flood risk baseline

2.1.1 The original flood risk baseline is set out in the main ES Volume 5, Appendix: WR-005-0MA06.

2.1.2 In the main ES, hydraulic analysis was carried out for the viaduct crossing locations at Blackburn's Brook, Birkin Brook and the River Bollin. These assessments were carried out using the UK Climate Projections 2009 (UKCP09) climate change (CC) allowances. The guidance for application of the UKCP09 was to use the Upper End allowance, which in this case was an increase in peak river flows of 70%.

2.1.3 In July 2021, the Environment Agency published revised guidance for assessing the impact of CC on peak river flows to reflect the UK Climate Projections (UKCP18)[5]. The revised guidance indicates that for essential infrastructure, the Environment Agency's 'Higher central' allowance for the peak river flow should be used. The revised guidance provides peak river flow allowances by management catchment instead of river basin district. Blackburn's Brook, Birkin Brook and the River Bollin are located within the Upper Mersey Management Catchment.

2.1.4 The baseline environmental information has been updated to include new CC guidance. The corresponding 'Higher central' peak river flow CC allowance for the Upper Mersey Management Catchment is 53%. This leads to a reduction in the peak river flows which need to be applied compared to the main ES. The updated assessment has not identified any new flood risk receptors for these watercourses.

2.1.5 In the main ES, hydraulic modelling was carried out for Agden Brook (reported in the Hydraulic modelling report – Tributaries of Millington Clough, Volume 5, Appendix: WR-006-00001) and Timperley Brook (reported in the Hydraulic modelling report – Timperley Brook, Volume 5 Appendix: WR-006-00007). Both of the catchments were modelled using direct rainfall modelling due to the small catchment size. Therefore, in the main ES the climate allowance (UKCP09) applied was a 40% increase in peak rainfall intensity.

2.1.6 In May 2022, the Environment Agency published revised guidance and peak rainfall intensity allowances using the UKCP18 local projections of extreme rainfall[5]. In May 2022, the Environment Agency published revised guidance and peak rainfall intensity allowances using the UKCP18 local projections of extreme rainfall[5]. The updated guidance states that the 'Upper end' peak rainfall intensity allowance should be used for all developments with a lifespan beyond 2100. For Agden Brook and Timperley Brook the modelling has been

[5] Environment Agency (2022). *Flood risk assessments: climate change allowances*. Available online at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

updated to include the new peak rainfall intensity climate allowance of 45%. The modelling indicates no new flood risk receptors compared to the main ES, for either watercourse.

3 Flood risk assessment

3.1 Introduction

3.1.1 This FRA focuses on:

- assessing the change in impact of the SES2 scheme, compared to the original scheme, on peak flood levels and extents relative to the SES2 baseline;
- determining whether changes to flood risk impacts relative to those reported in the main ES have the potential to lead to new or different significant flood risk effects;
- determining whether the embedded mitigation and additional mitigation measures included in the SES2 scheme can be refined, in the event that new or different significant effects are identified, without resorting to additional Bill powers to mitigate the change in flood risk impact; and, if not,
- establishing what additional mitigation may be required in order to reduce the change in flood risk impact as far as reasonably practicable.

3.2 Culverts

3.2.1 In the main ES, culvert design details were provided along with the estimated peak flow during the 1 in 100 year plus CC (40%) event. To account for the increase in peak rainfall intensity CC allowance to 45%, the estimated peak flows have been recalculated. The original scheme culverts are set out in Table 1; their sizes and locations remain unchanged since the main ES. The table has been updated for the SES2 scheme to show the updated design flows. These values indicate that the culverts in the original scheme are of sufficient size to convey the estimated increase in peak flow (1 in 100 year + 45% CC).

3.2.2 The updated analysis of the culverts shows that there will be no new or different significant effects on flood risk as a result of changes in design flow associated with the updated CC allowances.

Table 1: Details of original scheme culvert design, peak flow (from main ES and SES2 and AP2 ES) and capacity

Watercourse/ location	Structure name	Estimated 1.0% AEP peak flow (m^3/s)	Estimated 1.0% AEP + 40% CC peak flow (m^3/s) as reported in main ES[6]	Estimated 1.0% AEP + 45% CC peak flow (m^3/s) for SES2[6]	Culvert location	Culvert capacity (m^3/s)[7]
Tributary of Timperley Brook 1 – offline	Hasty Lane offline culvert	0.5	0.64	0.90	CT-06-356 I6, J6, CT-06-357a A7, B7 and C7	4.6
Timperley Brook	Timperley Brook inverted siphon	2.8	4.03	5.04	CT-06-357a C7, C6 and C5	6.6
Tributary of Birkin Brook 4 – offline	Ashley Road offline west culvert	0.8	1.23	1.50	CT-06-354 D6/E6	6.4
Tributary of Birkin Brook 1 – offline	Ashley Road offline east culvert	2.4	3.51	4.28	CT-06-354 H8	6.2

3.3 Viaducts

3.3.1 In the main ES, hydraulic analysis was carried out using simplified 2D modelling to assess the potential impacts of the original scheme on peak flood levels at Blackburn's Brook, Birkin Brook and the River Bollin. These models have been updated to identify any new or different significant effects due to the updated peak river flow CC allowance[5].

3.3.2 For Blackburn's Brook, the hydraulic analysis of head losses associated with the viaduct piers was reported in the main ES. The analysis indicated a negligible impact (less than a 1mm change in peak flood level). This will result in a negligible effect, which is not significant. The updated hydraulic analysis at Blackburn's Brook indicates no new or different significant effects on flood risk due to SES2 baseline changes. The SES2 modelled head loss remains at

[6] The CC allowance is applied to the rainfall intensity and the Revitalised Rainfall-Runoff Model version 2.2 (ReFH2) is used to determine the peak flow generated. Therefore, a 5% increase in peak rainfall intensity allowance can lead to a greater than 5% increase in peak river flow.

[7] The capacity of culvert quoted is the free flowing capacity of the culvert excluding the allowances for 300mm of substrate at the culvert invert (to allow for natural bed reinstatement) and 300mm freeboard to the culvert soffit above the design flood level. In some cases, the design capacity of the culverts is substantially greater than required to convey the estimated peak design flow. During design development, the culverts will be designed, where practicable, to achieve sediment equilibrium, with consideration given where necessary, to culvert size and/or the installation of benching to create a low flow channel to reduce sediment accumulation and increased risk of blockage. Designs will be in accordance with HS2 Technical Standards alongside consideration of guidance such as CIRIA C786 Culvert, screen and outfall manual.

less than 1mm, and no new receptors are impacted. Therefore, the impact remains as negligible, leading to a negligible effect, which is not significant.

3.3.3 At Birkin Brook, hydraulic analysis of head losses associated with the viaduct piers was reported in the main ES. The analysis indicated that there is an increase in peak water level of up to 60mm upstream and a localised decrease in peak water level of 20mm downstream. The impact is highly localised to the location of the piers (within 10m of the piers) and would affect agricultural land, a moderate value receptor. The increase in peak flood level was classified as a minor impact as it is a highly localised impact constrained to the immediate vicinity of the piers, leading to a minor adverse effect, which is not significant. The updated hydraulic analysis at Birkin Brook indicates no new or different significant effects on flood risk due to the SES2 baseline changes. The SES2 modelled head loss is up to 20mm affecting the same area of agricultural land, a moderate value receptor. Therefore, the impact on the agricultural land remains as minor, leading to a minor effect, which is not significant.

3.3.4 For the River Bollin, hydraulic analysis of head losses associated with the piers of the River Bollin viaduct was reported in the main ES. This analysis indicated that the viaduct piers have the potential to cause highly localised (within 5m of the piers) increases in peak flood levels of up to 60mm upstream and decreases in peak flood levels of 80mm downstream of the piers. The increase in peak flood levels was classified as a minor impact as it is a highly localised impact. This impact will affect woodland, a low value receptor, and agricultural land, a moderate value receptor, leading to a minor adverse effect, which is not significant. The decrease in peak flood level downstream is classified as a minor impact as it is highly localised. This impact will affect woodland, a low value receptor, leading to a minor beneficial effect, which is not significant. The updated hydraulic analysis at the River Bollin indicates no new or different significant effects on flood risk due to the SES2 baseline changes. The SES2 modelled head loss upstream of the piers of up to 29mm affecting the same receptors. Therefore, the impact on the woodland and agricultural land remains as minor, leading to minor adverse effects, which are not significant.

3.3.5 Additional changes have been put forward as an AP2 amendment, which could also impact on the River Bollin: reconfiguration of M56 Junction 6 (AP2-006-014). The assessment of the AP2 revised scheme is set out in Part 2 of this report.

3.4 Agden Brook

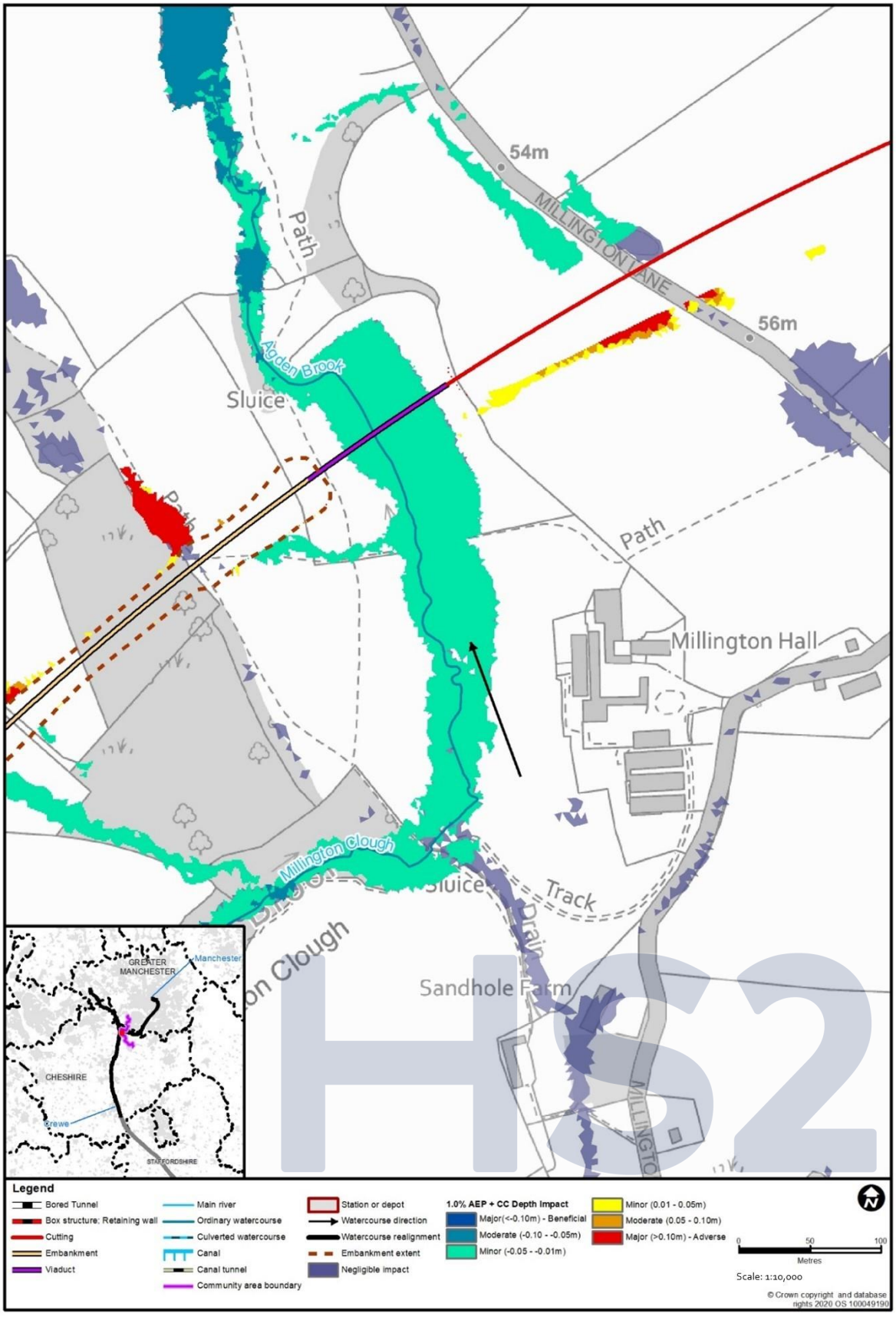
3.4.1 In the main ES, Agden Brook was modelled as part of the Millington Clough and tributaries hydraulic model (Volume 5, Appendix: WR-006-00001 of the main ES). The hydraulic modelling of Agden Brook showed that the original scheme had the potential to reduce peak water levels by up to 50mm. The decreases in peak flood levels were assessed to be minor impacts, on moderate value agricultural land, leading to minor beneficial effects, which are not significant.

3.4.2 Due to the SES2 baseline changes this modelling has been updated to take into account the increase in peak rainfall intensity CC allowance from 40% to 45%. The modelling indicates a decrease in peak water levels of up to 45mm compared to baseline, affecting the same receptors. Therefore, the impact on the agricultural land remains as minor, leading to minor beneficial effects, which are not significant.

3.4.3 The updated hydraulic analysis at Agden Brook indicates no new of different significant effects on flood risk due to the SES2 baseline changes. The SES2 model results are presented in Figure 1.

3.4.4 It should be noted that the decrease in peak flood levels at Agden Brook viaduct, along with some isolated patches of increased water level, are due to runoff being intercepted by the embankment upstream of the viaduct, on the north and south side of the route. The runoff is cut off at the embankment, which results in less floodwater reaching the Agden Brook viaduct, and consequently an increase in flood depths locally where water has ponded against the railway embankment. It should be noted that the runoff ponding in these areas will be intercepted by a proposed ditch at the toe of the embankment (which is not included in the hydraulic model at present), which will discharge just downstream of the Agden Brook viaduct. It is anticipated therefore that the added provision of land drainage at the embankment toe will remove the ponding predicted by the hydraulic model, and that there will no longer be a reduction in peak water levels at the Agden Brook viaduct.

Figure 1: Agden Brook impact map for the 1.0% AEP + CC flood event



3.5 Tributaries of Birkin Brook 1 to 3

3.5.1 The main ES reported that due to the diversion of Tributary of Birkin Brook 1, through the existing northern Mid-Cheshire Line culvert, there would be an increased depth of flooding of greater than 100mm. This was assessed to be a major adverse impact affecting moderate value agricultural land to the east and the very high value Mid-Cheshire Line. These impacts would result in major adverse effects, which are significant.

3.5.2 The updated hydraulic modelling of the tributaries of Birkin Brook indicates no new or different significant effects on flood risk due to the SES2 baseline changes. The SES2 modelled increase in peak flood levels affecting the Mid-Cheshire Line and agricultural land remains greater than 100mm. Therefore, the impacts on the agricultural land and Mid-Cheshire Line remain as major, leading to major adverse effects, which are significant.

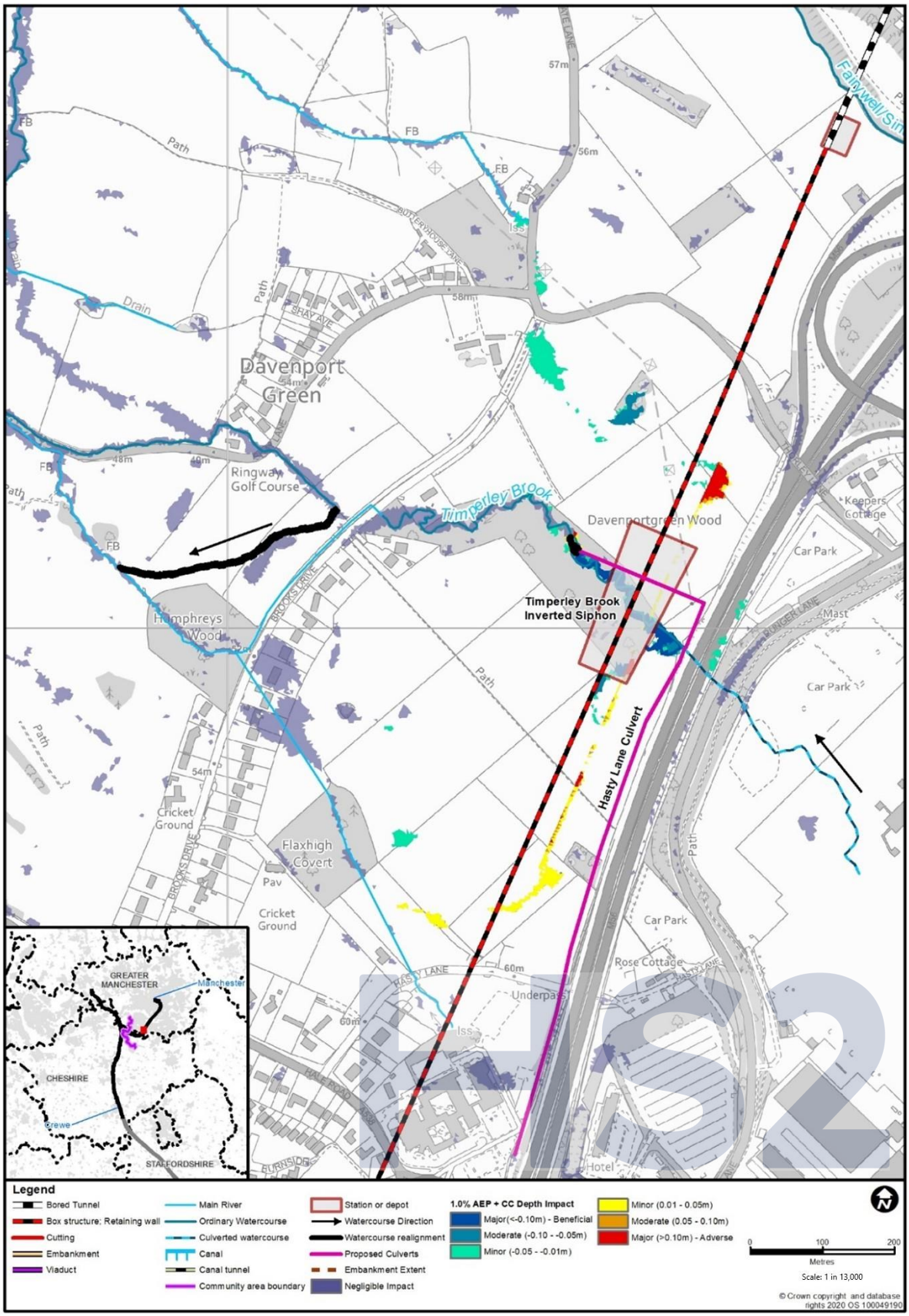
3.5.3 Additional mitigation has been provided as an AP2 amendment, Mobberley Road watercourse diversions (AP2-006-010). The assessment of the AP2 revised scheme is set out in Part 2, Section 7 of this report.

3.6 Timperley Brook

3.6.1 In the main ES, hydraulic modelling of Timperley Brook reported increases in peak flood level of greater than 100mm along the upstream side of the original scheme retained cutting (Manchester Airport High Speed Station cutting retaining wall north) and decreases of up to 50mm downstream of the siphon. The upstream increases in peak flood level relate to ponding of water on the upstream side of the retained cutting. This water will be collected by scheme drainage to prevent any increase in flood risk. Therefore, the impact on flood risk was assessed to be negligible, leading to a negligible effect, which is not significant.

3.6.2 The updated modelling of Timperley Brook results in no change to the reported flood risk due to the changes in SES2 baseline (see Figure 2). The precautionary flood risk mitigation will remain in place and the flood risk impact from the SES2 scheme remains as negligible, leading to a negligible effect, which is not significant.

Figure 2: Timperley Brook impact map from the 1.0% AEP + CC (UKCP18) flood event



4 Flood risk management measures

4.1.1 The overall approach to flood risk mitigation on the original scheme is set out in the main ES Volume 5, Appendix: WR-005-0MA06. No new or different flood risk management measures are required arising from the SES changes.

4.1.2 In the main ES, replacement floodplain storage (RFS) has been proposed on a precautionary basis for Blackburn's Brook, Birkin Brook, River Bollin and Agden Brook. This RFS is included to address loss of floodplain storage due to encroachment of embankments into the floodplain and/or construction of viaduct piers within the floodplain. The provision for RFS has been made using a 1m excavation depth and doubling the calculated compensation volume required.

4.1.3 The assessment of the SES2 changes to CC guidance and allowances has shown that no changes to the provision of replacement floodplain storage proposed in the main ES are required.

Part 2: Additional Provision 2 Environmental Statement

5 AP2 amendments and flood risk implications

5.1.1 Table 2 shows the AP2 amendments in the Hulseheath to Manchester Airport (MA06) community area that have implications for flood risk.

Table 2: AP2 amendments with implications for flood risk

AP2 Reference	Description	Implications
AP2-006-010	Additional land permanently required for watercourse diversions at Mobberley Road	Construction of additional culverts, a new weir, new access bridge, and a drainage ditch
AP2-006-014	Additional land permanently required to reconfigure M56 Junction 6	Major highway realignment, junction reconfiguration, and associated works
AP2-006-022	Additional land permanently required for the extension of Metrolink provisions at Manchester Airport High Speed station	New 330m of embankment and retaining wall
AP2-006-018	Additional land permanently required for modifications to WFD mitigation for Timperley Brook	Open channel creation and habitat enhancement on Timperley Brook and Tributary of Timperley Brook 1

5.1.2 This FRA focuses on assessing:

- the potential impact on peak flood levels and flood extent from the changes to the watercourse diversions in the Mobberley Road area that could lead to new or different flood risk effects based on hydraulic modelling;
- the potential impact on peak flood levels and flood extent from the changes to watercourses, including diversions, culverts and bridges due to the reconfiguration of M56 Junction 6 and associated works, based on hydraulic analysis and modelling;
- the potential impact on peak flood levels and flood extent from the changes associated with the Metrolink provisions; and
- the potential impact on peak flood levels and flood extent from the changes due to the modification of mitigation for Timperley Brook.

6 Flood risk baseline

6.1.1 The flood risk baseline is set out in the main ES Volume 5, Appendix WR-005-0MA06.

6.2 Additional land permanently required for watercourse diversions at Mobberley Road (AP2-006-010)

6.2.1 The Environment Agency's risk of flooding from surface water (RoFSW) dataset for the 1 in 1000 (0.1%) AEP flood event indicates that the surface water flow path associated with tributaries of Birkin Brook 1 to 3 crosses the original scheme at Ashley Railhead. The receptors at risk from surface water flooding relating to tributaries of Birkin Brook 1 to 3 are presented below. The relative vulnerability to flooding of each receptor (as defined in NPPF and Table 55 of the SMR) is also indicated:

- Mobberley Road (less vulnerable);
- agricultural land (less vulnerable); and
- Mid-Cheshire Line (essential infrastructure).

6.3 Additional land permanently required to reconfigure M56 Junction 6 (AP2-006-014)

6.3.1 The Environment Agency's flood map for planning (rivers and sea) dataset provides an indication of flood zones for main rivers. This dataset was used to assess the receptors at potential risk from flooding. The AP2 revised scheme crosses the River Bollin flood zone 2 and 3.

6.3.2 The receptors potentially at risk of flooding from the River Bollin upstream and downstream of the AP2 revised scheme are presented below. The relative vulnerability to flooding of each receptor (as defined in NPPF and Table 55 of the SMR) is also indicated:

- agricultural land (less vulnerable);
- scrubland (water compatible); and
- woodland (water compatible).

6.4 Additional land permanently required for modifications to Water Framework Directive (WFD) mitigation for Timperley Brook (AP2-006-018)

6.4.1 In the main ES, hydraulic modelling was carried out due to the presence of the Manchester Airport High Speed station within the Timperley Brook floodplain. This modelling was carried out using the peak rainfall intensity CC allowance of 40%, based on UKCP09.

6.4.2 In May 2022, the Environment Agency published revised guidance for assessing the impact of CC on peak rainfall intensity to reflect the UKCP18[5]. The modelling has been updated to include the new peak rainfall intensity CC allowance of 45%. The modelling indicates no new flood risk receptors compared to the main ES.

6.5 Additional land permanently required for the extension of Metrolink provisions at Manchester Airport High Speed station (AP2-006-022)

6.5.1 The Environment Agency's RoFSW dataset for the 1 in 1000 (0.1%) AEP flood event indicates that a surface water flow path crosses the original scheme. This flow path extends from the east of Brooks Drive, along Roaring Gate Lane to join Tributary of Timperley Brook 3. The receptors at risk from surface water flooding near Roaring Gate Lane are:

- agricultural land (less vulnerable);
- residential properties on Roaring gate Lane (more vulnerable);
- Brooks Drive, Roaring Gate Lane and Thorley Lane (less vulnerable); and
- woodland (water compatible).

7 Flood risk assessment

7.1 Additional land permanently required for watercourse diversions at Mobberley Road (AP2-006-010)

7.1.1 In the main ES, it was reported that tributaries of Birkin Brook 1 to 3 would need to be realigned/diverted to allow for the presence of Ashley Railhead. These watercourses would be diverted under the Mid-Cheshire Line in the existing northern culvert. Hydraulic analysis showed that due to the increase in peak flow thorough this culvert there was the potential for an increased depth of flooding of greater than 100mm. This would impact on the agricultural land to the east and the Mid-Cheshire Line, leading to major adverse effects, which are significant. This amendment is brought forward to remove these significant effects.

7.1.2 Since the main ES, further hydraulic modelling has been carried out. Further details can be found in the Tributaries of Birkin Brook hydraulic modelling report, SES2 and AP2 ES Volume 5, Appendix: WR-006-00010.

7.1.3 This amendment has been brought forward to remove the flood risk impacts reported in the main ES. This amendment includes a weir and overflow channel to provide additional flood conveyance beneath the Mid-Cheshire Line. The watercourse diversions (AP2-006-010) have been modelled as a series of culverts and channels, passing beneath the existing Mid-Cheshire Line. An overflow channel has been modelled, including a weir with a crest level set 0.3m above existing bed level and six box culverts beneath the Mid-Cheshire Line and Ashley railhead.

7.1.4 Figure 3 sets out the new watercourse realignments and culverts put forward for this amendment. As reported in the main ES, Tributary of Birkin Brook 1 will be realigned to the north. Two new access culverts will be provided on this realignment to allow field access (Tributary of Birkin Brook 1 offline east and west culverts). The realigned watercourse will join with Tributary of Birkin Brook 2 and pass beneath the Mid-Cheshire Line. The watercourse will then flow south beneath the realigned Ashley Road (Ashley Road offline east culvert) before re-joining the original alignment. During construction Ashley Railhead will be present on the western side of the Mid-Cheshire Line. Temporary culverts will therefore be provided to transfer the realigned Tributary of Birkin Brook 1 and 2 beneath the railhead (Ashley Railhead offline temporary culvert north). Once construction is complete the temporary culverts will be removed, and the watercourse returned to open channel.

7.1.5 In order to provide additional flood flow conveyance, an overflow channel for Tributary of Birkin Brook 1 has been included in this amendment. When flow increases in the watercourse, the new weir structure will overtop, and the flood flows will travel along the

existing alignment of Tributary of Birkin Brook 1. The flood flows will be transferred beneath the Mid-Cheshire Line via replacement culverts (Mid-Cheshire Line offline south culverts). An overflow channel will then pass around the realigned junction between Mobberley Road and Ashley Road (with new culverts provided beneath Mobberley Road: Mobberley Road offline culvert), before re-joining the original course of Tributary of Birkin Brook 1. During construction Ashley Railhead will be present on the western side of the Mid-Cheshire Line. Temporary culverts will therefore be provided to transfer the flood overflow channel of Tributary of Birkin Brook 1 beneath the railhead (Ashley Railhead offline temporary culvert south). Once construction is complete the temporary culverts will be removed, and the watercourse returned to open channel.

7.1.6 The hydraulic modelling incorporates the watercourse diversions amendment (AP2-006-010) along with the SES2 baseline change. The modelled impact on peak flood levels is shown in Figure 4. This modelling indicates that there is the potential for a reduction in flood depth of up to 50mm on the Mid-Cheshire Line and up to 100mm on the agricultural land to the north-east of the northern culvert.

7.1.7 The reduction in flood risk to the Mid-Cheshire Line and adjacent fields, is due to flood flow being diverted into the southern channel. This reduction in flood risk can be adjusted to ensure no increase in flood flows downstream by adjusting the height of the overflow weir to balance the flood flows between the two channels.

7.1.8 This amendment will therefore lead to the removal of the permanent major adverse effects on flood risk reported in the main ES at the Mid-Cheshire Line and agricultural land to the east.

Figure 3: Watercourse diversions and culverts associated with the watercourse diversions at Mobberley Road (AP2-006-010)

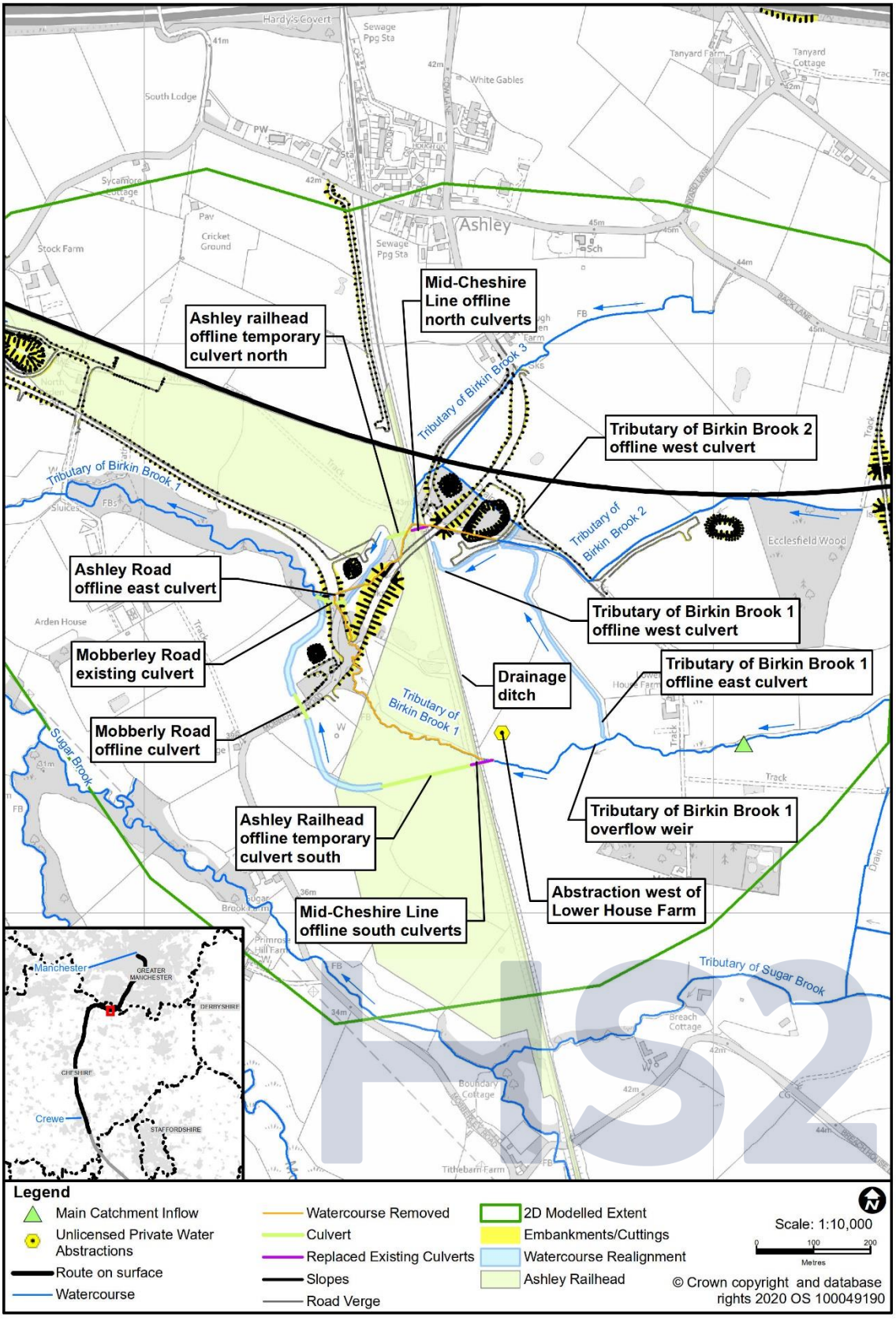
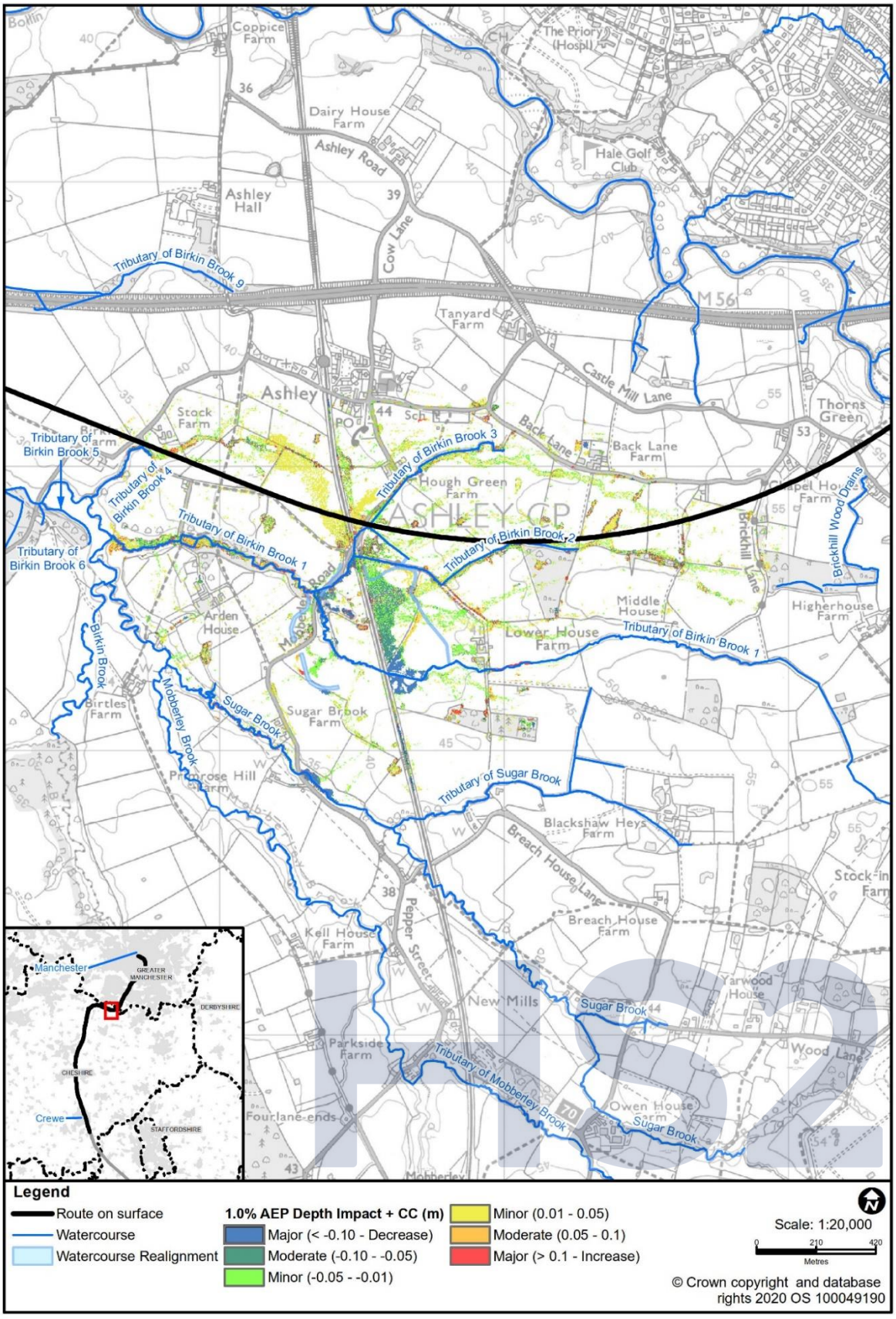


Figure 4: Tributaries of Birkin Brook impact map for the 1.0% AEP + CC flood event



7.1.9 The watercourse diversions amendment (AP2-006-010) includes new culverts. The hydraulic model has been used to define the 1.0% AEP plus CC event and to select a cross section that can convey this peak flow. Culvert design allows for 300mm freeboard to the soffit above this design flood level and also 300mm of substrate at the culvert invert. The details of the new culvert design applied to the AP2 revised scheme are provided in Table 3 and shown in Figure 3.

Table 3: Details of AP2 culvert design at tributaries of Birkin Brook

Watercourse/ location	Structure name	Estimated 1.0% AEP peak flow (m^3/s)	Climate change allowance (peak rainfall intensity)	Estimated 1.0% AEP + CC peak river flow (m^3/s)[6]	Culvert dimensions (m)	Culvert capacity (m^3/s)[7]
Tributary of Birkin Brook 1 (realigned watercourse)	Tributary of Birkin Brook 1 offline east culvert	0.18	45%	0.26	1.35m high by 1.35m wide	1.2
Tributary of Birkin Brook 1 (realigned watercourse)	Tributary of Birkin Brook 1 offline west culvert	1.77	45%	2.56	1.35m high by 1.35m wide	3.5
Tributary of Birkin Brook 1 (realigned watercourse)	Mid-Cheshire Line offline north culvert	1.10	45%	1.60	1.35m high by 1.35m wide	1.7
Tributary of Birkin Brook 1 (realigned watercourse)	Ashley Railhead offline temporary culvert north	1.10	N/A[8]	N/A[8]	1.35m high by 1.35m wide	1.7
Tributary of Birkin Brook 2	Tributary of Birkin Brook 2 offline east culvert	1.23	45%	1.79	1.35m high by 1.35m wide	5.9
Tributary of Birkin Brook 2	Tributary of Birkin Brook 2 offline west culvert	1.10	45%	1.60	1.35m high by 1.35m wide	2.5
Tributary of Birkin Brook 3	Tributary of Birkin Brook 3 offline culvert	0.65	45%	0.94	1.35m high by 1.35m wide	2.4
Tributary of Birkin Brook 1 (overflow channel)	Mobberley Road offline culvert	2.33	45%	3.38	6 no. 1.35m high by 1.35m wide	16.9
Tributary of Birkin Brook 1 (overflow channel)	Mid-Cheshire Line offline south culvert	2.33	45%	3.38	6 no. 1.35m high by 1.35m wide	16.9

Watercourse/ location	Structure name	Estimated 1.0% AEP peak flow (m^3/s)	Climate change allowance (peak rainfall intensity)	Estimated 1.0% AEP + CC peak river flow (m^3/s)[6]	Culvert dimensions (m)	Culvert capacity (m^3/s)[7]
Tributary of Birkin Brook 1 (overflow channel)	Ashley Railhead offline temporary culvert south	2.33	N/A[8]	N/A[8]	3 no. 1.35m high by 1.35m wide	8.5

7.2 Additional land permanently required to reconfigure M56 Junction 6 (AP2-006-014)

7.2.1 The main ES identified localised increases in peak flood levels (within 5m of the piers) on the River Bollin associated with the viaduct piers for the original scheme crossing. This was classified as minor impact affecting woodlands (low value receptor) and resulted in a minor adverse effect, which is not significant.

7.2.2 The additional land permanently required for the reconfiguration of M56 Junction 6 (AP2-006-014) amendment includes an extension to the existing M56 River Bollin underbridge. In the main ES, the original scheme consisted of a viaduct crossing of the River Bollin that does not affect the floodplain other than at viaduct piers. Therefore, it was determined through the decision tree process that modelling was not required. The reconfiguration of M56 Junction 6 will involve the widening of an existing motorway overbridge of the River Bollin including embankments and wingwalls within the floodplain. Therefore, for the AP2 revised scheme, hydraulic modelling has been carried out of the HS2 viaduct crossing and M56 bridge extension. Further details can be found in the River Bollin hydraulic modelling report, SES2 and AP2 ES Volume 5, Appendix: WR-006-00011.

7.2.3 The HS2 viaduct crossing has been modelled as a series of piers across the River Bollin. The M56 extended motorway crossing has been represented as an extension to the existing structure dimensions on both the upstream and downstream side. Additional replacement floodplain storage provided in the AP2 revised scheme to compensate for the encroachment of embankments and wingwalls into the floodplain has also been included in the model. This has been included as level for level compensation, located on sloping ground with an average 1m excavation depth adjacent to the River Bollin. The 45% peak rainfall intensity and 53% peak river flow allowances have been used to take account of the future effects of CC on design flows.

7.2.4 The modelled impact of the AP2 revised scheme is presented in Figure 5. This takes into account both the HS2 route crossing and the widening of the M56 crossing. The results of

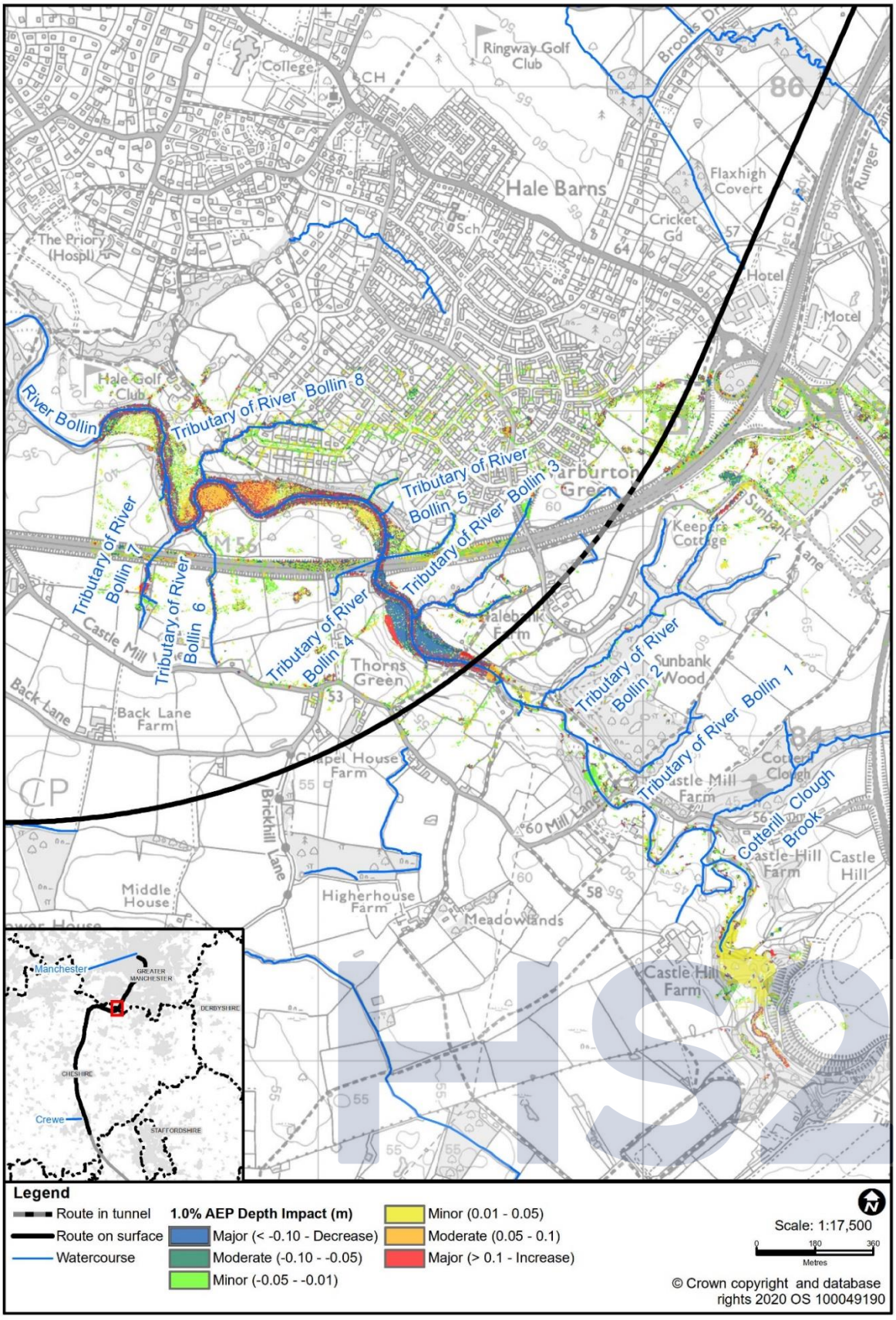
[8] Temporary culverts are designed for the 1 in 100 year event without CC, as they will not be present during operation of the scheme.

the modelling indicate that with the RFS in place, the AP2 revised scheme will result in the following changes in peak flood levels in areas already at risk of flooding:

- an approximate increase in peak flood levels of 20mm on the left bank[9] 150m upstream of the HS2 route crossing. The receptor is woodland (low value); therefore, this is a minor impact, leading to a negligible effect, which is not significant;
- an approximate increase in peak flood levels of 80mm on the left and right banks 70m upstream of the HS2 route crossing. The receptors are woodland (low value); therefore, this is a moderate impact, leading to a minor adverse effect, which is not significant;
- an approximate decrease in peak flood levels of 40mm on the right bank 180m downstream of the HS2 route crossing and 300m upstream of the AP2 M56 underbridge extension. The receptor is scrubland (low value); therefore, this is a minor impact, leading to a negligible effect, which is not significant;
- an approximate increase in peak flood levels of 60mm on the left bank 300m downstream of the HS2 route crossing and 170m upstream of the AP2 M56 underbridge extension. The receptor is scrubland (low value); therefore, this is a moderate impact, leading to a minor adverse effect, which is not significant;
- an approximate decrease in peak flood levels of 150mm on right bank 50m downstream of the AP2 M56 underbridge extension. The receptor is woodland (low value); therefore, this is a major impact, leading to a minor beneficial effect, which is not significant; and
- an approximate increase in peak flood levels of 75mm on the left and right banks 400m to 800m downstream of the AP2 M56 underbridge extension. The receptors are grassland and golf course (low value receptors); therefore, this is a moderate impact, leading to a minor adverse effect, which is not significant.

[9] The left bank refers to the bank of a river that is on the left side when facing downstream.

Figure 5: River Bollin impact map for the 1.0% AEP + CC flood event



7.2.5 The reconfiguration of M56 Junction 6 (AP2-006-014) also includes new culverts on a number of the tributaries of River Bollin. Hydraulic calculations have been carried out to size these culverts. The Revitalised Flood Hydrograph Model version 2.2 (ReFH2)[10] has been used to determine the peak flow generated during the 1.0% AEP event, with an appropriate CC allowance applied (as set out in the SMR). Culvert design allows for 300mm freeboard to the soffit above this design flood level and also 300mm substrate at the culvert invert. The details of the new culvert design applied to the AP2 revised scheme are provided in Table 4, and the locations of the culverts are presented in Figure 6.

[10] Wallingford HydroSolutions (2016). *Revitalised Flood Hydrograph Model ReFH2. Technical Guidance.*

Figure 6: New culverts associated with the reconfiguration of M56 Junction 6 (AP2-006-014)

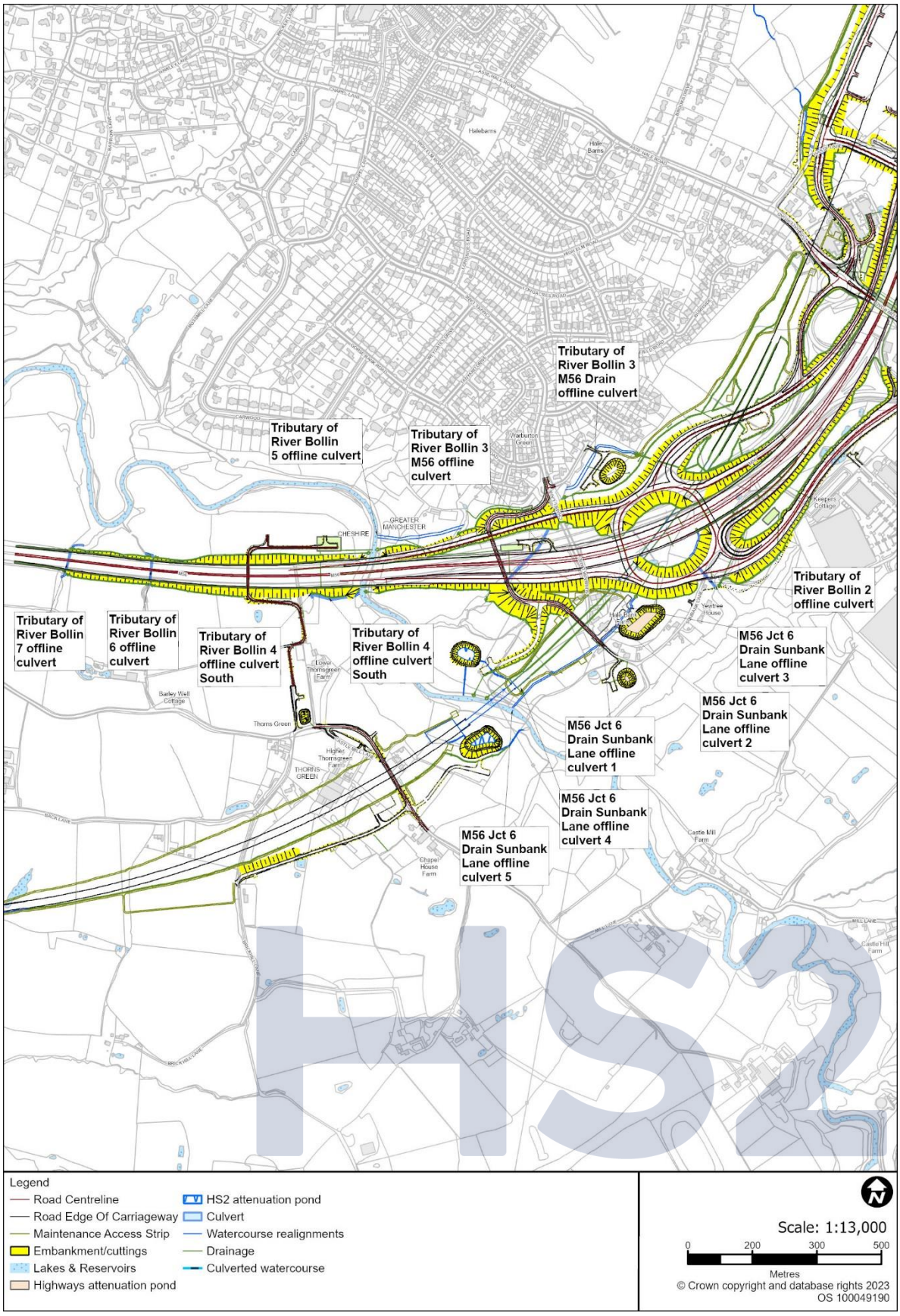


Table 4: Details of AP2 culvert design at tributaries of River Bollin

Watercourse/ location	Structure name	Estimated 1.0% AEP peak flow (m^3/s)	Estimated 1.0% AEP + CC (40%) river flow (m^3/s)	Estimated 1.0% AEP + CC (45%) river flow (m^3/s)[6]	Culvert dimensions (m)	Culvert capacity (m^3/s)[7]
Tributary of River Bollin 7	Tributary of River Bollin 7 offline culvert	0.79	1.10	1.14	1.35m high by 1.35m wide	4.3
Tributary of River Bollin 6	Tributary of River Bollin 6 offline culvert	1.00	1.40	1.45	1.35m high by 1.35m wide	4.6
Tributary of River Bollin 5	Tributary of River Bollin 5 offline culvert	0.28	0.39	0.40	1.35m high by 1.35m wide	1.5
Tributary of River Bollin 4	Tributary of River Bollin 4 offline culvert north	0.21	0.30	0.31	1.35m high by 1.35m wide	1.6
Tributary of River Bollin 4	Tributary of River Bollin 4 offline culvert south	0.21	0.30	0.31	1.35m high by 1.35m wide	3.1
Tributary of River Bollin 3	Tributary of River Bollin 3 M56 offline culvert	0.44	0.61	0.63	1.35m high by 1.35m wide	4.8
Tributary of River Bollin 3	Tributary of River Bollin 3 M56 drain offline culvert	0.24	0.34	0.35	1.35m high by 1.35m wide	1.7
Tributary of River Bollin 2	Tributary of River Bollin 2 offline culvert	0.23	0.32	0.33	1.35m high by 1.35m wide	5.6
Drain to M56 1	M56 jct 6 drain Sunbank Lane offline culvert 1	0.21	0.30	0.31	1.35m high by 1.35m wide	4.0
Drain to M56 1	M56 jct 6 drain Sunbank Lane offline culvert 2	0.06	0.09	0.09	1.35m high by 1.35m wide	2.7
Drain to M56 1	M56 jct 6 drain Sunbank Lane offline culvert 3	0.06	0.09	0.09	1.35m high by 1.35m wide	2.6
Drain to M56 1	M56 jct 6 drain Sunbank Lane offline culvert 4	0.21	0.30	0.31	1.35m high by 1.35m wide	4.7
Drain to M56 1	M56 jct 6 drain Sunbank Lane offline culvert 5	0.21	0.30	0.31	1.35m high by 1.35m wide	1.5

7.3 Additional land permanently required for modifications to Water Framework Directive (WFD) mitigation for Timperley Brook (AP2-006-018)

7.3.1 The modification of mitigation for Timperley Brook (AP2-006-018) includes new culverts on Timperley Brook and Tributary of Timperley Brook 1. Hydraulic calculations have been carried out to size these culverts. The ReFH2[10] has been used to determine the peak flow generated during the 1.0% AEP event, with an appropriate CC allowance applied (as set out in the SMR) to calculate the required conveyance capacity. Culvert design allows for 300mm freeboard to the soffit above this design flood level for ordinary watercourses and 600mm freeboard for the main river and 300mm substrate at the culvert invert. The details of the new culvert design applied to the modification of mitigation for Timperley Brook (AP2-006-018) are provided in Table 5.

Table 5: Details of AP2 culvert design at Timperley Brook and Tributary of Timperley Brook 1

Watercourse / location	Structure name	Estimated 1.0% AEP peak flow (m^3/s)	Climate change allowance (peak rainfall intensity)	Estimated 1.0% AEP + CC river flow (m^3/s)[6]	Culvert dimensions of opening (m)	Culvert capacity (m^3/s)[7]
Timperley Brook	Timperley Brook field access culvert north	3.88	45%	5.62	3 no box culvert 1.35m high by 1.35m wide	5.7
Timperley Brook	Timperley Brook field access culvert south	3.88	45%	5.62	3 no box culvert 1.35m high by 1.35m wide	5.7
Tributary of Timperley Brook 1	Tributary of Timperley Brook 1 offline culvert south	0.71	45%	1.04	1.35m high by 1.35m wide	2.6
Tributary of Timperley Brook 1	Tributary of Timperley Brook 1 offline culvert north	0.71	45%	1.04	1.35m high by 1.35m wide	3.4

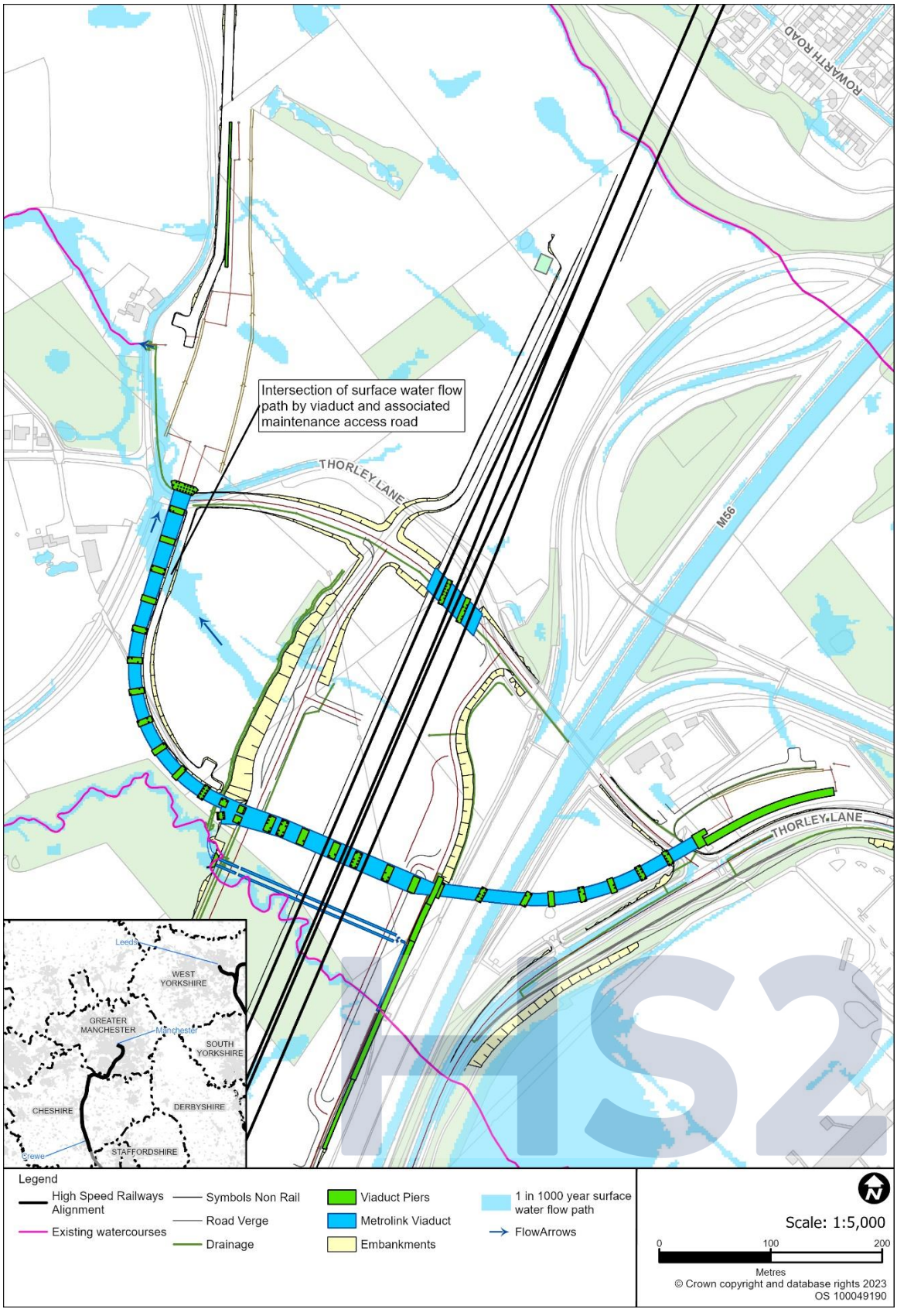
7.4 Additional land permanently required for the extension of Metrolink provisions at Manchester Airport High Speed station (AP2-006-022)

7.4.1 The Metrolink provisions amendment (AP2-006-022) includes a Metrolink station viaduct, Metrolink Station approach west bridge, Thorley Lane west approach viaduct and Roaring Gate Lane retaining wall for the Metrolink. The Thorley Lane west approach viaduct and associated maintenance access road will cross the Roaring Gate Lane surface water flow path, and the Roaring Gate Lane retaining wall will run alongside the flow path. The flow path is shown in Figure 7.

7.4.2 The interaction of the flow path with the Metrolink provisions amendment (AP2-006-022) will be addressed using a local drainage solution provided alongside Roaring Gate Lane. This ditch will be designed to replicate the natural pattern of overland flow as far as practicable to ensure the risk of surface water flooding is unchanged.

7.4.3 The maintenance access road will be partly on shallow embankment and could form a barrier to surface water flood flow. This is assessed as a moderate impact to the proposed woodland mitigation, leading to a minor effect which is not significant.

Figure 7: Extent of the Environment Agency's RoFSW dataset, surface water flow path Roaring Gate Lane



8 Additional flood risk management measures

8.1 Additional land permanently required for watercourse diversions at Mobberley Road (AP2-006-010)

8.1.1 Further modelling is required to refine the design of the mitigation embedded into the AP2 revised scheme. With further design development, particularly of the overflow weir structure, it is considered that all the significant flood risk effects reported in the main ES would be removed. No further mitigation is considered necessary.

8.1.2 The next stage of the design process will involve incorporation of topographical survey and structures information into the existing hydraulic model to improve the representation of existing watercourses. Designs for the culverts will be incorporated into the hydraulic model along with the identified overflow channel and weir. The mitigation measures will be refined during design development to ensure that there is no increase in flood flows downstream, and no increase in flood risk upstream of the Mid-Cheshire Line.

8.2 Additional land permanently required to reconfigure M56 Junction 6 (AP2-006-014)

8.2.1 Changes in peak flood levels along the floodplain of the River Bollin have been identified associated with the additional land permanently required for the reconfiguration of M56 Junction 6 (AP2-006-014) amendment. Mitigation in the form of three new RFS areas has been included within the design, in addition to the RFS location in the original scheme. With the incorporation of the embedded RFS mitigation, no new or different significant effects are anticipated.

8.2.2 The next stage of the design process will involve incorporation of topographical survey information into the existing hydraulic model to improve the representation of existing watercourses. Designs for the viaduct, culverts and underbridge will be incorporated into the hydraulic model along with the identified RFS. At this stage a scour assessment will also be undertaken to ensure that there are no significant increases in stream velocity which could lead to scour upstream and downstream of the extended M56 River Bollin underbridge. If additional scour is likely to occur, scour protection will be included. The design of the three additional replacement floodplain storage areas will be refined during design development to ensure no potential significant effects on flood risk.

8.3 Additional land permanently required for the extension of Metrolink provisions at Manchester Airport High Speed station (AP2-006-022)

8.3.1 There is the potential for increased peak flood levels to the east of the maintenance access road embankment associated with the Metrolink viaduct (AP2-006-022). This increase in flood level is not assessed as significant. However, the access road goes into cutting just south of the flow path and any increase in flood levels could lead to a risk of flooding to the maintenance access road. During design progression, mitigation measures will be included if required to ensure no increase in flood risk due to the AP2 revised scheme.

9 Summary of significant flood risk effects

9.1.1 Hydraulic modelling and analysis have identified no new or different significant effects as a result of the AP2 revised scheme.

9.1.2 Hydraulic modelling of the tributaries of Birkin Brook has shown that AP2 amendment Mobberley Road watercourse diversions (AP2-006-010) will lead to the removal of the permanent major adverse effects on flood risk reported in the main ES at the Mid-Cheshire Line and agricultural land to the east.

9.2 Conclusions

9.2.1 The assessment indicates that, subject to the implementation of the avoidance and mitigation measures identified, further design refinement and the measures included in the draft water resources operation and maintenance plan of the main ES (Volume 5, Appendix WR-007-00000), the AP2 revised scheme will not result in any significant adverse effects on flood risk in the Hulseheath to Manchester Airport (MA06) community area.

9.2.2 The Mobberley Road watercourse diversions (AP2-006-010) will lead to the removal of the permanent major adverse effects on flood risk reported in the main ES at the Mid-Cheshire Line and agricultural land to the east.

9.2.3 The hydraulic modelling of the River Bollin, incorporating the RFS mitigation, has identified changes in peak flood levels upstream and downstream of the AP2 revised scheme. However, none of these changes result in a significant flood risk effect. Three new areas of RFS have been provided, along with the location from the original scheme. During design progression the RFS will be refined to ensure no change to flood risk at receptors affected by flooding in the River Bollin.

9.2.4 There is the potential for increased peak flood levels to the east of the maintenance access road embankment associated with the Metrolink viaduct (AP2-006-022). This increase in flood level is not assessed as significant. However, the access road goes into cutting just south of the flow path and any increase in flood levels could lead to a risk of flooding to the maintenance access road. During design progression, mitigation measures will be included if required to ensure not significant increase in flood risk associated with the AP2 revised scheme.

hs2.org.uk

High Speed Two (HS2) Limited
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA
Freephone: 08081 434 434
Minicom: 08081 456 472
Email: HS2enquiries@hs2.org.uk