HIGH SPEED RAIL (LONDON - WEST MIDLANDS)

Supplementary Environmental Statement and Additional Provision 2 Environmental Statement

Volume 5 | Technical appendices CFAs 23-26

CFA23 | Balsall Common and Hampton-in-Arden

CFA24 | Birmingham Interchange and Chemsley Wood

CFA26 | Washwood Heath and Curzon Street

July 2015

SES and AP2 ES 3.5.1.10

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HIGH SPEED RAIL (LONDON - WEST MIDLANDS)

Supplementary Environmental Statement and Additional Provision 2 Environmental Statement

Volume 5 | CFA23 | Balsall Common and Hampton-in-Arden

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This table shows the topics covered by the technical appendices in this volume, and the reference codes for them.

CFA name and number	Topic	Code
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	Community	CM-001-023
	Cultural heritage	CH-004-023
	Sound, noise and vibration	SV-003-023
		SV-004-023
	Water resources and flood risk assessment	WR-002-023
		WR-003-023
CFA24, Birmingham Interchange and Chemlsley Wood	Air quality	AQ-001-024
	Community	CM-001-024
	Sound, noise and vibration	SV-003-024
CFA26, Washwood Heath to Curzon Street	Community	CM-001-026
	Cultural heritage	CH-003-026
	Sound, noise and vibration	SV-003-026

Environmental topic:	Air quality	AQ
Appendix name:	Data appendix	001
Community forum area:	Balsall Common and Hampton-in-Arden	023

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1 Introduction

1.1 Structure of this air quality assessment appendix

1.1.1 This appendix provides an update to Appendix AQ-001-023 from the main Environmental Statement (ES) (Volume 5, Appendix AQ-001-023). This update should be read in conjunction with Appendix AQ-001-023 from the main ES.

1.1.2 This appendix is structured as follows:

- Baseline air quality data (Section 2); and
- Air quality assessment - road traffic (Section 3).

1.1.3 Maps referred to throughout this air quality appendix are contained in the Volume 5 Air Quality Map Book, within this Supplementary Environmental Statement (SES) and Additional Provision 2 ES (AP2 ES).

1.2 Scope of this assessment

1.2.1 This air quality assessment considers changes to local air quality as a result of:

- corrections to Appendix AQ-001-023 from the main ES;
- changes to the design or construction assumptions which do not require changes to the Bill;
- changes to the design of the scheme that are outside the existing limits of the Bill (i.e. AP2 amendments); and
- updates to traffic models.

Methodology, data sources and design criteria

1.2.2 The assessment scope, key assumptions and limitations for air quality are set out in Volume 1, the Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001 - 000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2) of the main ES as amended by the SMR Addendum 2 (Volume 5: Appendix CT-001-000/3 of the SES and AP2 ES), which was produced to specifically amend and advance the SMR for AP2. The SMR Addendum 2 focuses on updates and refinements to: the establishment of the baseline and definition of the survey; the scope of the air quality assessment; and the assessment methodology.

2 Baseline air quality data

2.1 Existing air quality

2.1.1 The combined impact of the SES and AP2 revised scheme has led to an increase in the change in vehicle movements on some road links when compared with the original scheme, during the construction phase. On some of these road links, the change has now exceeded the screening criteria and further assessment of local air quality impacts is required.

2.1.2 To undertake this assessment, additional baseline information was required.

Background pollutant concentrations

2.1.3 The background concentrations used in the assessment are shown in Table 3. Background concentrations are below the national air quality objective values at the additional receptors considered in this assessment.

3 Air quality assessment - road traffic

3.1 Overall assessment approach

3.1.1 The overall assessment approach remains the same as described in Appedix AQ-001-023 of the main ES. Where changes to this aproach have been employed, these are detailed in section 3.2.

3.2 Model inputs and verification

Model parameters for detailed assessment

3.2.1 ADMS-Roads was used for the detailed assessment. A surface roughness length of 1.5m, meteorological site surface roughness length of 0.2m, minimum Monin Obukhov length of 100m and latitude of 52.5 degrees were used in the detailed assessment. All other parameters were model default settings. Meteorological data from the Birmingham Elmdon monitoring site was used.

Model verification

3.2.2 Verification was undertaken for the base year of 2012 for NO2 comparing monitored and modelled concentrations. The results of this comparison are shown in Table 1.

Table 1: Comparison of monitored and modelled NO2 concentrations

Site	Monitored concentration (µg/m³)	Modelled concentration (µg/m³)	Difference [(modelled - monitored)/monitored] * 100
Diffusion tube on Kenilworth Road	26.4	22.8	-14
Diffusion tube on Balsall Street East	20.0	18.5	-8
Diffusion tube on Balsall Street East	17.6	17.7	0.5

3.2.3 All modelled NO2 concentrations are within ±25% of monitored concentrations. Therefore, no model adjustment was undertaken.

3.3 Construction traffic

3.3.1 Construction traffic data used in this assessment are detailed in Volume 5 Appendix TR-001-000. Scenarios assessed were without the original scheme and with the original scheme (months 30, 35 and 44 of the construction period). The maximum change in months 30, 35 and 44 has been assessed for each of the receptors.

Receptors assessed

3.3.2 The additional receptors located within this area are listed in Table 2. The impact of the combined SES and AP2 revised scheme has been considered at these locations.

Table 2: Modelled receptors (construction phase)

Receptor	Description/location	Ordnance Survey (OS) coordinates	Scenarios assessed with the scheme
23-2	101 Kenilworth Road	423578, 277914	Month 30
23-11	Rookery	422984,282942	Month 35
23-12	Bibury	422104,279866	Month 35
23-13	Lodge Farm	423362,278347	Month 35
23-14	175 Kenilworth Road	423694,277643	Month 35
23-15	495 Kenilworth Road	424141,276606	Month 35
23-16	67 Kelsey Lane	424628,276314	Month 35

Background concentrations

3.3.3 The background concentrations used in the assessment are shown in Table 3 and obtained from the Defra maps for 2017 and Air Pollution Information System website[1].

Table 3: Background 2017 concentrations at assessed receptor grid squares

Receptor (or zone of receptors)	Concentrations (µg/m³)		
	NOx	NO2	PM10
23-2	23-2	19.2	13.7
23-11	23-11	23.0	16.2
23-12	23-12	19.4	13.8
23-13	23-13	18.3	13.2
23-14	23-14	19.2	13.7
23-15	23-15	19.7	14.1
23-16	23-16	19.7	14.1

[1] http://www.apis.ac.uk/

Detailed modelling results

3.3.4 This section provides the summary of the modelled pollutant concentrations for the assessed receptors. The magnitude of change and impact descriptor are also derived following the Environmental Protection UK (EPUK) methodology[2].

Table 4: Summary of ADMS-Roads annual mean NO2 results (construction phase)

Receptor	Concentrations (µg/m³)		Change in concentrations (µg/m³)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with original scheme			
23-2	28.2	29.2	1.0	Small	Negligible
23-11	28.2	28.4	0.2	Imperceptible	Negligible
23-12	17.0	17.3	0.3	Imperceptible	Negligible
23-13	18.9	19.2	0.3	Imperceptible	Negligible
23-14	20.1	20.5	0.4	Small	Negligible
23-15	19.8	20.3	0.4	Small	Negligible
23-16	16.4	17.0	0.6	Small	Negligible

Table 5: Summary of ADMS-Roads annual mean PM10 results (construction phase)

Receptor	Concentrations (µg/m³)		Change in concentrations (µg/m³)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with original scheme			
23-2	17.5	17.6	0.1	Imperceptible	Negligible
23-11	17.5	17.5	<0.1	Imperceptible	Negligible
23-12	14.9	15.0	<0.1	Imperceptible	Negligible
23-13	16.0	16.0	0.1	Imperceptible	Negligible
23-14	15.4	15.4	<0.1	Imperceptible	Negligible
23-15	15.0	15.1	<0.1	Imperceptible	Negligible
23-16	14.4	14.5	0.1	Imperceptible	Negligible

[2] http://www.environmental-protection.org.uk/wp-content/uploads/2013/07/EPUK-Development-Control-Planning-for-Air-Quality-2010.pdf

Assessment of significance

3.3.5 The impact at the worst affected receptor for changes to annual mean NO2 concentrations is small. Where total pollutant concentrations are below the national air quality objective value, this equates to a negligible effect on local air quality, which is not significant. Imperceptible changes to PM10 will also have a negligible effect, which is not significant.

3.3.6 Air Quality effects at human health receptors arising from changes to traffic associated with the construction of the original scheme are insignificant, as pollutant concentrations are well below the relevant air quality standards and the impact descriptor at all receptors is negligible.

4 References

Air Pollution Information System website: http://www.apis.ac.uk/

Environmental Protection UK (EPUK) Air Quality Assessmenet Methodology: http://www.environmental-protection.org.uk/wp-content/uploads/2013/07/EPUK-Development-Control-Planning-for-Air-Quality-2010.pdf

Environmental topic:	Community	CM
Appendix name:	Community assessment	001
Community forum area:	Balsall Common and Hampton-in-Arden	23

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1 Introduction

1.1.1 This appendix provides an update to the Appendix CM-001-023 Community assessment from the main Environmental Statement (ES) as a result of the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with Appendix CM-001-023 Community assessment from the main ES.

1.1.2 This appendix is structured as follows:

- Part 2: Additional Provision 2 Environmental Statement
  - Community impact assessment record sheets - construction; and
  - Community impact assessment record sheets - operation.

Part 2: Additional Provision 2 Environmental Statement

2 Community impact assessment record sheets - construction

2.1 Kenilworth Greenway

Table 1: Kenilworth Greenway community impact assessment record sheet

Resource name	**Kenilworth Greenway**
Community forum area (CFA)	CFA23-Balsall Common and Hampton-in-Arden
Resource type	Open space
Resource description/profile	The Kenilworth Greenway, described as a linear country park and a permissive bridleway, is used by pedestrians, cyclists and horse riders. The Kenilworth Greenway runs from the A429 Coventry Road, to the north of Kenilworth village, in a north westerly direction to the outskirts of Balsall Common, south of Truggist Lane, approximately 6130m in total length. The Kenilworth Greenway runs along the line of the dismantled Kenilworth to Balsall Common line and has received Sustrans investment to become part of the national cycle network. The most northern section of the Kenilworth Greenway which runs from the north of B4101 Waste Lane at Burton Green to the south of Berkswell station is approximately 850m in length and is within the land required for the construction of the original scheme. Further south the Kenilworth Greenway is addressed in Stoneleigh, Kenilworth and Burton Green CFA (see main ES and SES and AP2 ES Volume 2, CFA Report 18, Section 5, Community).
Assessment year	Construction phase (2017+)
Impact 1: temporary loss of land	Impact: the main ES reported approximately 850m of the Kenilworth Greenway, within CFA23, would be removed during the construction of the original scheme for use as a construction haul road. The existing route of the Kenilworth Greenway would therefore be closed to the public for a period of approximately four years and three months. A temporary alternative route would be provided to the south-west of the existing Greenway which would be of an equivalent standard, adding an additional 100m in length. To the south-east, the alternative route would continue into Kenilworth, Stoneleigh and Burton Green (CFA18). To the north-west the temporary route would join with an existing public right of way (PRoW) (Footpath M191), which is used to access the existing Greenway, adjacent to Berkswell railway station. The original line of the Greenway will be reinstated once construction is complete. In addition to this, the proposed amendment will extend the Kenilworth Greenway to Berkswell Station car park and Truggist Lane, replacing footpath M191 south of the Kenilworth Greenway, and Footpath M196 between Truggist Lane and M191, which are currently used to access the northern extent of the Kenilworth Greenway. The temporary loss of these PRoW to access the Kenilworth Greenway will be mitigated by the

Resource name	Kenilworth Greenway
	provision of an alternative access route along Footpath M196, Barretts Lane, Sunnyside Lane, Station Road and Truggist Lane, adding an additional 86om to the route. Duration of land take: approximately four years and three months, with the area for the extension only required for the final three months.
Assessment of magnitude	Negligible: a temporary alternative route will be provided.
Relevant receptors	The Kenilworth Greenway is used by cyclists, horse riders and pedestrians.
Assessment of sensitivity of receptors (s) to impact	Low: there is a network of local PRoW and public open spaces within the area, providing alternatives for walking, cycling and horse-riding.
Significance rating of effect	Negligible adverse effect, not significant: users of the Kenilworth Greenway could continue to walk, cycle and ride horses along the temporary replacement route. The proposed extension of the Kenilworth Greenway will not give rise to a new or different significant effect and will not change the level of significance of the effects reported in the main ES and/or the AP1 ES.
Proposed mitigation options for significant effects	No further mitigation identified.
Residual effects significance rating	Negligible adverse effect, not significant: users of the Kenilworth Greenway could continue to walk, cycle and ride horses along the temporary replacement route. The proposed extension of the Kenilworth Greenway will not give rise to a new or different significant effect and will not change the level of significance of the effects reported in the main ES and/or the AP1 ES.

2.2 The Island Project School

Table 2: The Island Project School community impact assessment record sheet

Resource name	The Island Project School
CFA	CFA23-Balsall Common and Hampton-in-Arden
Resource type	Community
Resource description/profile	The Island Project School at Diddington Hall is an independent school that serves 26 children with Autism and Aspergers Syndrome from ages 5 to 19 years. The grounds of Diddington Hall extend primarily to the west towards Diddington Lane, east towards the A452 Kenilworth Road and south towards Hampton-in-Arden village. The grounds extent to approximately 1.6ha in total. The outdoor space around the building is a teaching resource used for learning and plays activities and is in continual use by pupils during the school day. This includes the track to Diddington Hall, which leads on to Diddington Lane and connecting footpaths to Hampton-in-Arden village. Pupils at the school use Diddington Lane to provide pedestrian access to Hampton-in-Arden village centre, as part of general life skills education. In addition, the track of Diddington Lane

Resource name	The Island Project School
	forms the main access to the school; the front entrance accessed directly off the A452 Kenilworth Road is not used.
Assessment year	Construction phase (2017+)
Impact 1: reduced accessibility	Impact: the main ES reported that pupils of The Island Project School, at Diddington Hall, regularly use Diddington Lane as a pedestrian route, to access Hampton-in-Arden village as part of life skills education. Diddington Lane would be stopped up to vehicles permanently as part of the original scheme, whilst pedestrian access would be removed temporarily during the construction period. During the construction period there would be no temporary alternative footpath provided. Pupils and staff wishing to access Hampton-in-Arden from Diddington Hall would therefore be required to use the A452 Kenilworth Road and the B4102 Meriden Road. This is not considered to be a suitable alternative route. The relevant section of Diddington Lane would be designated as a bridleway with access provided beneath the proposed Shadow Brook underbridge following the construction period. The proposed amendment to realign Dididngton Lane will provide an alternative route between the school and Hampton-in-Arden throughout the construction period, as the realigned Diddington Lane will be opened prior to closing the existing Diddington Lane. However, the realigned Diddington Lane will be located within a large construction area, including heavy machinery and tall cranes, large scale earth moving operations, haul roads and two construction compounds. Due to the sensitivity of the pupils, this alternative route is likely to remain unsuitable for some pupils at certain points within the construction schedule. Duration of impact: approximately three years.
Assessment of magnitude	High: pedestrian access from the school to the village centre, which is required on at least a weekly basis, will be temporarily lost due to the unsuitability of using the realigned Diddington Lane during the construction period.
Relevant receptors	The school has approximately 26 pupils and approximately 11 staff.
Assessment of sensitivity of receptors (s) to impact	High: the school accommodates a high proportion of more vulnerable children, with a limited ability to absorb change.
Significance rating of effect	Major adverse significant: isolation of the Island Project School. The proposed Diddington Lane realignment will not give rise to a new or different significant effect and will not change the level of significance of the effects reported in the main ES and/or the AP1 ES.
Proposed mitigation options for significant effects	HS2 Ltd will work closely with The Island Project School to identify reasonably practicable measures to mitigate the residual significant isolation and amenity effects, including discretionary measures identified in the draft Code of Construction Practice (CoCP).
Residual effects significance rating	Major adverse significant: isolation of the Island Project School. The proposed Diddington Lane realignment will not give rise to a new or different significant effect and will not change the level of significance of

Resource name	The Island Project School
	the effects reported in the main ES and/or the AP1 ES.

3 Community impact assessment record sheets - operation

3.1 Kenilworth Greenway

Table 3: Kenilworth Greenway community impact assessment record sheet

Resource name	Kenilworth Greenway
CFA	CFA23-Balsall Common and Hampton-in-Arden
Resource type	Open space
Resource description/profile	The Kenilworth Greenway, described as a linear country park and a permissive bridleway, is used by pedestrians, cyclists and horse riders. The Kenilworth Greenway runs from the A429 Coventry Road, to the north of Kenilworth village, in a north-westerly direction to the outskirts of Balsall Common, south of Truggist Lane, approximately 613om in total length. The Kenilworth Greenway runs along the line of the dismantled Kenilworth to Balsall Common line and has received Sustrans investment to become part of the national cycle network. The most northern section of the Kenilworth Greenway, which runs from the north of B4101 Waste Lane at Burton Green to the south of Berkswell station, is approximately 85om in length and is within the land required for the construction of the original scheme. Further south the Kenilworth Greenway is addressed in Stoneleigh, Kenilworth and Burton Green CFA (see main ES and SES and AP2 ES Volume 2, CFA Report 18, Section 5, Community).
Assessment year	Construction phase (2017+)
Impact 1: improved access	Impact: the proposed amendment will improve access from the south into Balsall Common village and, in particular, to Berkswell Station. This will improve connectivity between Burton Green and Balsall Common, in particular to public transport connections. An alternative route to access the temporary alternative route of the Kenilworth Greenway will be provided along Footpath M196, Barretts Lane, Sunnyside Lane, Station Road and Truggist Lane, adding an additional 86om to the route. Duration of improved access: permanent.
Assessment of magnitude	Beneficial: access will be improved for pedestrians, cyclists and horse riders.
Relevant receptors	The Kenilworth Greenway is used by cyclists, horse riders and pedestrians.
Assessment of sensitivity of receptors (s) to impact	Low: there is a network of local PRoW and public open spaces within the area, providing alternatives for walking, cycling and horse-riding.
Significance rating of effect	Beneficial effect: access will be improved for pedestrians, cyclists and horse riders.

Resource name	**Kenilworth Greenway**
	The proposed extension of the Kenilworth Greenway will not give rise to a new or different significant effect and will not change the level of significance of the effects reported in the main ES and/or the AP1 ES.
Proposed mitigation options for significant effects	No mitigation required.
Residual effects significance rating	Beneficial effect: access will be improved for pedestrians, cyclists and horse riders. The proposed extension of the Kenilworth Greenway will not give rise to a new or different significant effect and will not change the level of significance of the effects reported in the main ES and/or the AP1 ES.

Environmental topic:	Cultural heritage	CH
Appendix name:	Survey reports	004
Community forum area:	Balsall Common and Hampton-in-Arden	023

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1 Introduction

1.1.1 This appendix provides an update to Appendix CH-004-023 Cultural heritage survey reports from the main Environmental Statement (ES) as a result of design changes AP2-023-005 assessed as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with Appendix CH-004-023 Cultural heritage survey reports from the main ES.

2 Geophysical surveys

2.1 Land west of Diddington Lane

Introduction

2.1.1 This document presents the results of geophysical survey, non-intrusive field evaluations, undertaken in the administrative area of Solihull Metropolitan Borough Council (SMBC) on the route of the proposed Phase One of HS2 during September 2014.

Project background

2.1.2 The survey location was guided by a risk-based approach to archaeological assessment, as set out in the HS2 Cultural Heritage Technical Note (C250-ARP-EV-NOT-000-000803).

2.1.3 The aim of this survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey areas, including both the testing of previously recorded sites and the identification of additional locations of archaeological potential not previously recorded.

2.1.4 The results of the survey will be combined with data from other archaeological assessments carried out as part of the project, such as desk-top studies, geophysical and fieldwalking surveys. Information collected will contribute to the development of the programme of archaeological works for Phase One of HS2.

Summary archaeological/historic background

2.1.5 The survey area is located within community forum area (CFA)23, Archaeological Character Area (ACA) 008 (Alluvial Deposits: Diddington Hall) and archaeological character subzone (ASZ) 23-46 (clays and silts west of Diddington Lane) [1].

2.1.6 The approximate 7.7ha site was under arable use, where the topography sloped down from south to north and leveled off towards Shadow Brook.

2.1.7 The site lies on a bedrock that comprises the Mercia Mudstone Group, predominantly red, less commonly green-grey, mudstones and subordinate siltstones with a thick horizon of interbedded sandstone, known as the Arden Sandstone Member. This solid geology is overlain by a continuous cover of glacial deposits and alluvial superficial deposits. Most of the glacial deposits comprise sands and gravels, which form an extensive but now dissected deposit beneath the axis of the River Blythe valley. The soils comprise Brockhurst 1 association (711b): slowly permeable seasonally waterlogged reddish fine loamy over clayey soils[2] .

2.1.8 The proposed survey area is situated south-west of the shrunken medieval settlement of Diddington (asset reference BAH211) that includes Diddington Hall (asset reference BAH216), a late 16th century country house with 19th century alterations. The dominant feature of the landscape within which the survey area was located is ridge and furrow (for example, asset references BHA265 and BHA252), which is present in varying of preservation. This feature provides evidence of the agricultural utilisation of the medieval landscape and may be assumed to be associated with the nearby settlement of a similar date.

2.1.9 Within the local area, no previous archaeological works have been undertaken. This results in an absence in the historic environment record (HER) and uncertainty as to the possible presence of below ground remains. However, this data gap may be a true reflection of the archaeological character of the area or that the medieval and post-medieval ridge and furrow may mask evidence of earlier activity.

2.1.10 Within the vicinity of the survey area, no previous archaeological work had been undertaken. LiDAR analysis identified areas of ridge and furrow and a relict headland within this area, but no other archaeological remains were recorded. Therefore, the site was selected for survey in order to provide a representative sample, to assess the degree to which ridge and furrow may have masked or had an adverse impact on any possible underlying archaeological remains. The survey area therefore has been assessed as having a risk rating of 2 (High).

Methodology

2.1.11 All survey work was carried out in accordance with the current Historic England (HE) guidelines[3].

2.1.12 All survey grid positioning was carried out using Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS equipment. The geophysical survey areas were georeferenced relative to the Ordnance Survey (OS) National Grid by tying in to local detail and corrected to the base mapping provided by the client. These tie-ins are presented in Figure 5, Figure 10 and Figure 15. Please refer to these diagrams when re-establishing the grid or positioning trenches.

2.1.13 The magnetometer surveys were carried out with Bartington Grad 601-2 fluxgate gradiometers, collecting data every 0.25m along traverses 1m apart. Data processing has been performed as appropriate using an in-house software package (GeoSuB) employing the following processing steps: zero mean traverse, step correction (de-stagger) and interpolation (on the Y-axis).

2.1.14 Data is presented as greyscale () and XY trace plots. The former enables simple feature identification and basic interpretation whilst the latter allows for analysis of the shape of the individual anomalies in order to better characterise the recorded responses.

Limitations

2.1.15 Magnetic survey is an exceedingly effective technique for site evaluation providing fast data acquisition and responding, to some degree, to the majority of archaeological site-types. The

[1] Refer to The Environmental Statement. Details of the Archaeological Character Areas and archaeological subzones can be found in Volume 5 Technical Appendices, CFA23 Balsall Common and Hampton-in-Arden Baseline report (CH-001-023) Cultural heritage. The location of the archaeological character sub-zones is shown Volume 5 Map books

[2] Soils of England and Wales (1983) Sheet 3, Midland and Western England. Soil Survey of England and Wales, Harpenden

[3] Historis England (2008) Geophysical Survey in Archaeological Field Evaluation

technique relies upon enhancement of naturally occurring iron-bearing compounds in the soil through anthropogenic activity. Detection rates can be poor where archaeological sites have only seen temporary and/or sporadic occupation or where there is insufficient activity to drive the enhancement; this is often true of lithic-era sites. Success may also be limited over soils that are deficient in iron compounds, providing little material to be subject to enhancement. Conversely, the strength of response from soils and geological units which are naturally magnetic, for example igneous formations and soils derived thereof, may mask any subtler archaeological enhancement within.

2.1.16 The presence of ferrous structures either above or below ground (buildings, pylons, fences, pipes etc.) will produce very strong magnetic fields which will extend far beyond their physical footprint. The strength of these magnetic 'shadows' is such that they will mask practically any archaeological anomalies. Similarly, later features and demolition spreads or imported consolidation material can produce areas of magnetic disturbance that will mask underlying features.

2.1.17 As a general rule, the Bartington Grad601 instruments allow for a depth of investigation of approximately 1m, depending on the strength of the field produced by the buried feature; below this depth only particularly enhanced material will be detected with any kind of confidence.

Assumptions

2.1.18 The survey area contains small-scale ferrous anomalies, most clearly represented by sharp 'spikes' in the XY trace plots, and are typically assumed to be modern debris within the topsoil unless the site type or a priori knowledge suggests otherwise.

Results interpretation

2.1.19 A former field division bisected the data on a north-east to south-west alignment, and was shown on mapping dating from 1887. A band of magnetic disturbance surrounded the majority of the old boundary, which suggests the 'noise' was associated with the destruction/ infilling of the boundary feature.

2.1.20 A few ploughing trends were seen within the data that reflect the alignment of the current field boundaries.

2.1.21 In the south of the dataset, a cluster of ferrous responses (marked as Magnetic Disturbance on the interpretation diagram) may have been associated with a former tree bowl or buried modern rubble.

2.1.22 The majority of the responses were in the form of small ferrous responses, these can be best seen in the XY trace plots as sharp spikes and are due to iron debris within the topsoil, or on the surface, and are deemed modern in origin.

Interpretation

2.1.23 No anomalies of archaeological interest were detected by the magnetic survey.

2.1.24 A former field boundary was seen bisecting the area, which corresponded to historic mapping. A band of magnetic disturbance was visible surrounding the old boundary, suggesting the disturbance was related to the flattening of the boundary.

Conclusion

2.1.25 The aim of the survey was to establish the presence/ absence of possible archaeological remains. Due to the uncertainty about the presence of possible remains that may predate the known medieval ridge and furrow, the survey area was selected. The survey results did not reveal any evidence for pre-medieval remains.

References

British Geological Survey, (2014), Geology of Britain Viewer; 1:50,000 scale geology; centred on 422740, 279474; http://mapapps.bgs.ac.uk/geologyofbritain/home.html; accessed 15/10/2014

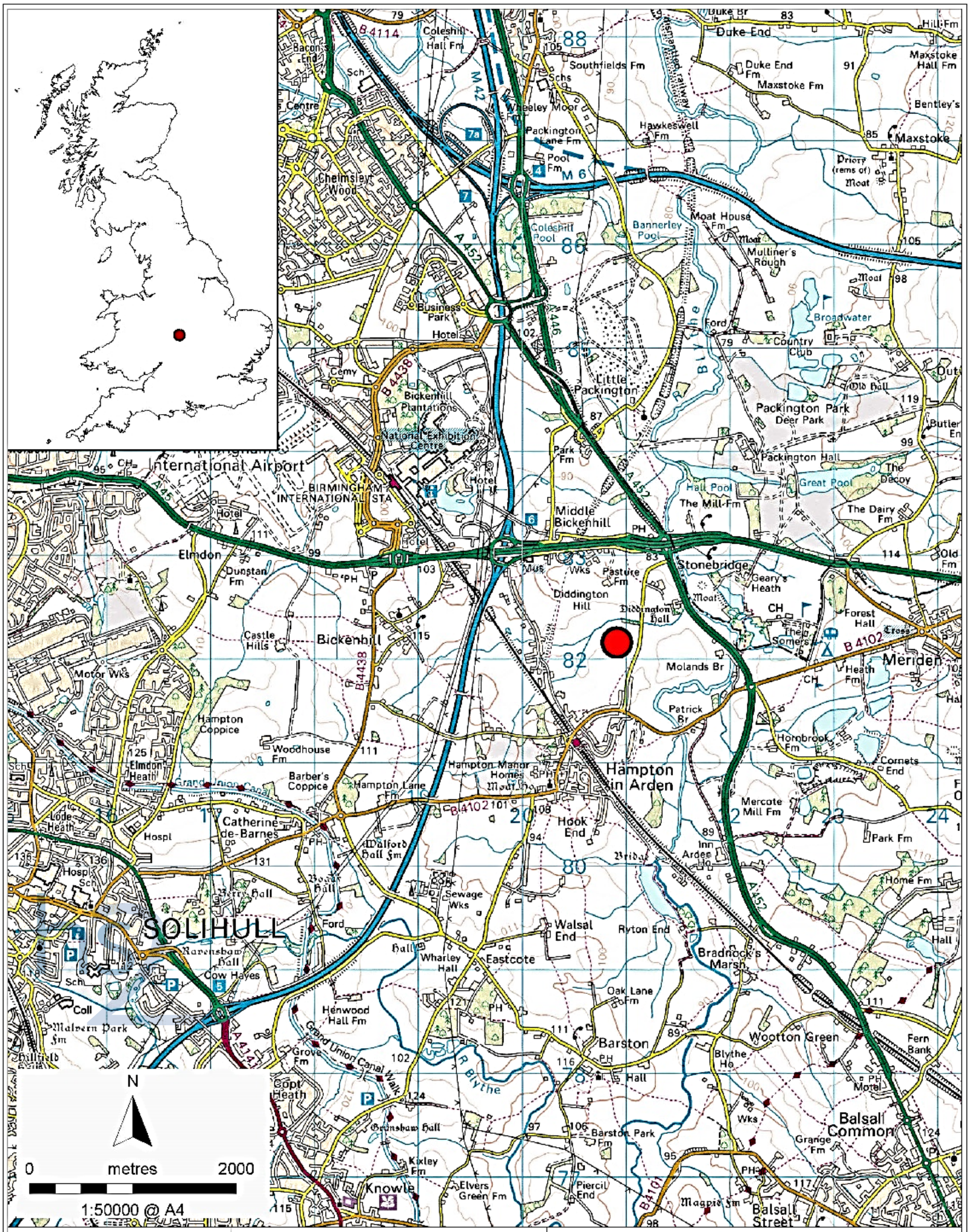
British Geological Survey, (2014), Geology of Britain Viewer; 1:50,000 scale geology; centred on 422204, 280077; http://mapapps.bgs.ac.uk/geologyofbritain/home.html; accessed 14/10/2014

British Geological Survey, (2014), Geology of Britain Viewer; 1:50,000 scale geology; centred on 421000, 282268; http://mapapps.bgs.ac.uk/geologyofbritain/home.html; accessed 13/10/2014

English Heritage, (2008), Geophysical Survey in Archaeological Field Evaluation: https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/; accessed 15/10/2014

Soils of England and Wales, (1983), Sheet 3, Midland and Western England. Soil Survey of England and Wales, Harpenden.

Figures



GSB PROSPECTION Ltd

GSB Prospection Ltd
Cowburn Farm, 21 Market Street
Thornton, Bradford, BD13 3HW
+44 (0)1274 835016

sumo

Site Location

Project: G1484/1 Headland at Diddington

Title: Site Location

Drawn by: ELBrunning

Figure 1

Figure 2: Location of survey area, 1:2,500

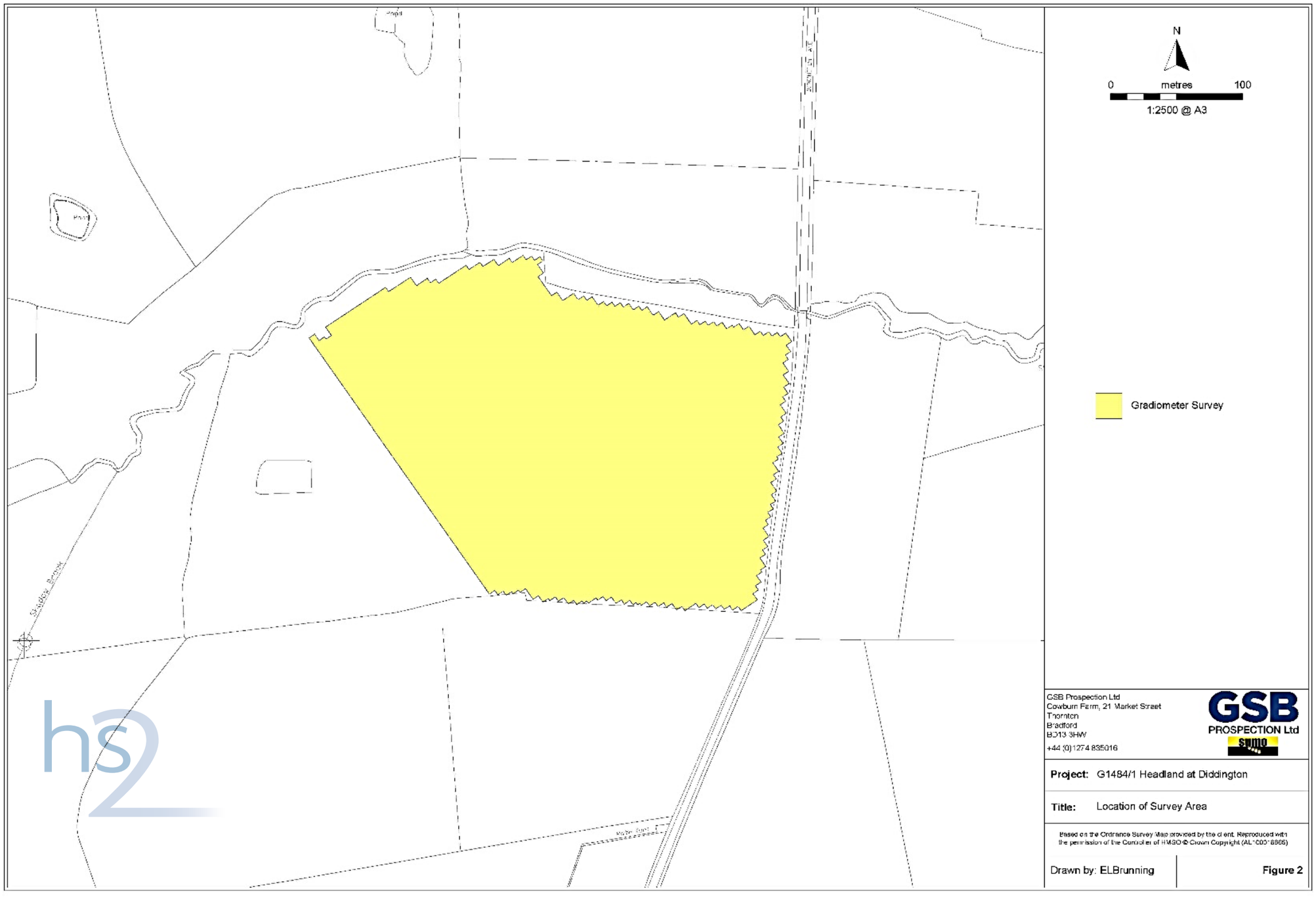
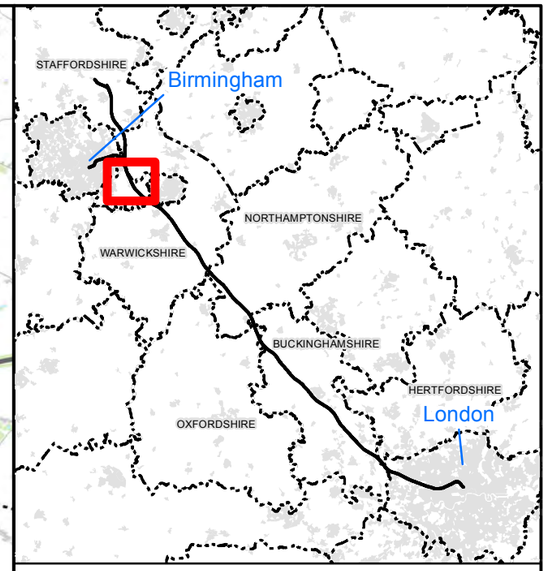


Figure 3: Greyscale plot, 1:100

Figure 4: Interpretation plot, 1:100



Map Series Information:

This map series shows archaeological geophysical survey locations within the land required for the construction of the Proposed Scheme.

Note: Not all data layers in the legend are represented on every map.

Main Map Legend

- Route in tunnel
- Route on surface
- Depot, station, headhouse or portal building
- Community forum boundary
- Existing railway station
- County boundary
- District/Borough boundary

- Map sheets included in this community forum with amendment
- Map sheets included in this community forum with no amendment
- Map sheets not included in this community forum

Map Number: CH-07-INDEX-CFA23

Map Name: Index Map of: Archaeological Geophysical Survey – Location SES and AP2 ES

Community Forum Area CFA23: Balsall Common & Hampton-in-Arden

Scale at A3: 1:50,000

0 500 1,000 1,500 2,000 Metres

Registered in England. Registration number 06791686.
Registered office:One Canada Square, London, E14 5AB.

Doc Number: C254-ARP-EV-MAP-040-000540-AP02-P01

Date: 09/06/15

BIRMINGHAM INTERCHANGE & CHELMSLEY WOOD

BALSALL COMMON & HAMPTON-IN-ARDEN

NORTH WARWICKSHIRE BOROUGH

SOLIHULL METROPOLITAN BOROUGH

Mill Farm Barns

Stone Bridge

River Blythe

Meriden Mill Farm

Mouldings Green Farm

Hornbrook Farm

Diddington Farm

The Island Project School

Diddington Hill

Park Farm

Dismantled Rail Line

Patrick Farm

Patrick Bridge

Pasture Farm

HD14

Middle Bickenhill

Hampton-in-Arden

A452 CHESTER ROAD

A452 KENILWORTH ROAD

A45 BIRMINGHAM ROAD

A45 COVENTRY ROAD

EAST WAY

M42

DIDDINGTON LANE

B4102 HAMPTON LANE

B4102 MERIDEN ROAD

CORNETS END LANE

PACKINGTON LANE

MIDDLE BICKENHILL LANE

COVENTRY ROAD

PENDIGO WAY

SOUTH WAY

OLD STATION ROAD

STATION ROAD

THE CRESCENT

MARSH LANE

SHADOW BROOK LANE

B4102 HIGH STREET

FENTHAM ROAD

ELM TREE RISE

BELLEMERE ROAD

THE GROVE

SOUTH CAR PARK ROAD

Legend

- Route in tunnel
- Route on surface
- Depot, station, headhouse or portal building
- Land potentially required during construction
- Community forum boundary
- County boundary
- District/Borough boundary

Areas surveyed in 2013

- Fieldwalking surveys completed
- Geophysical surveys completed

Area identified for survey 2014

- Geophysical and Fieldwalking surveys
- Geophysical surveys

Map Number: CH-07-305

Map Name: Archaeological Geophysical Survey - Location SES and AP2 ES

Community Forum Area CFA23: Balsall Common and Hampton in Arden

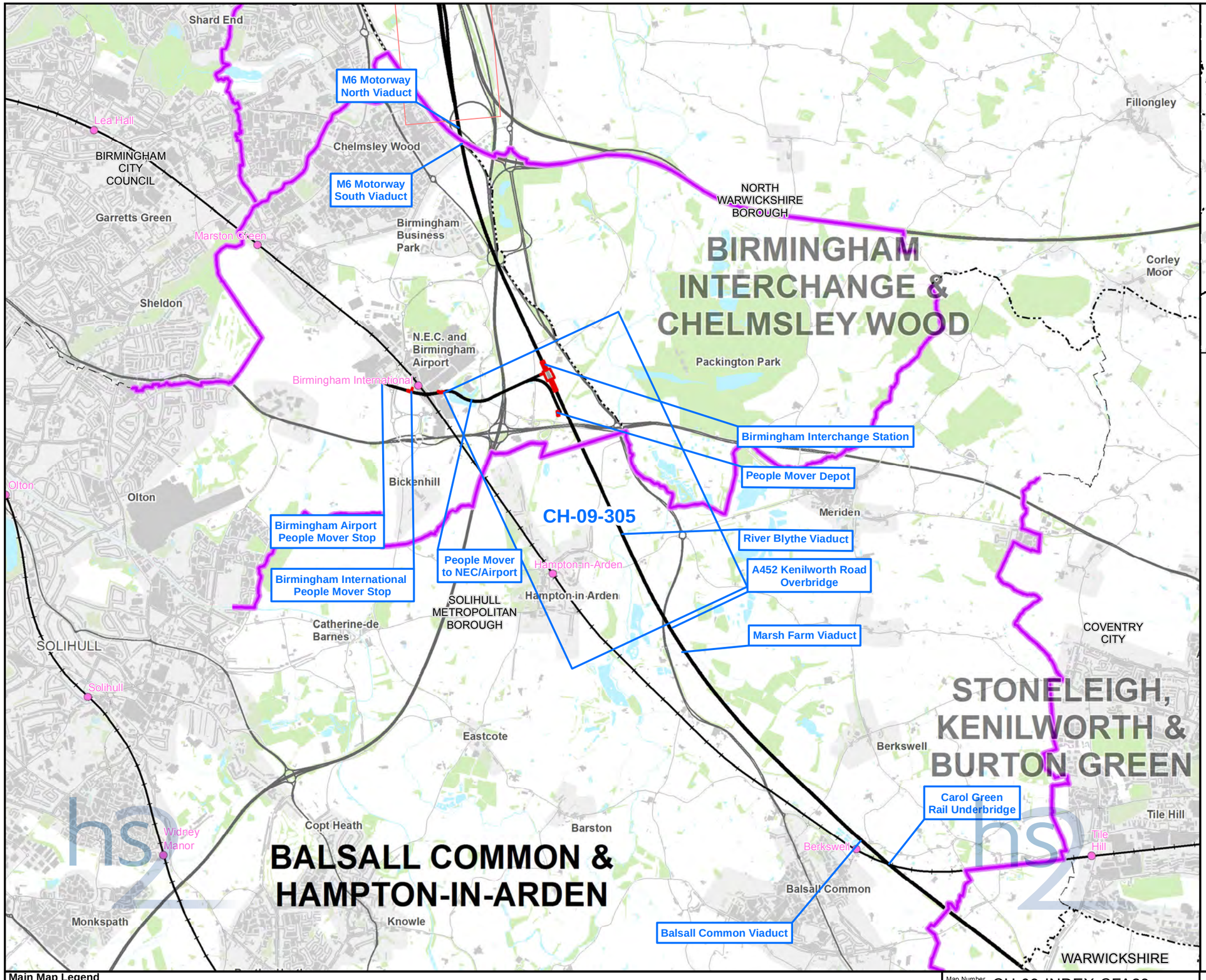
Scale at A3: 1:10,000

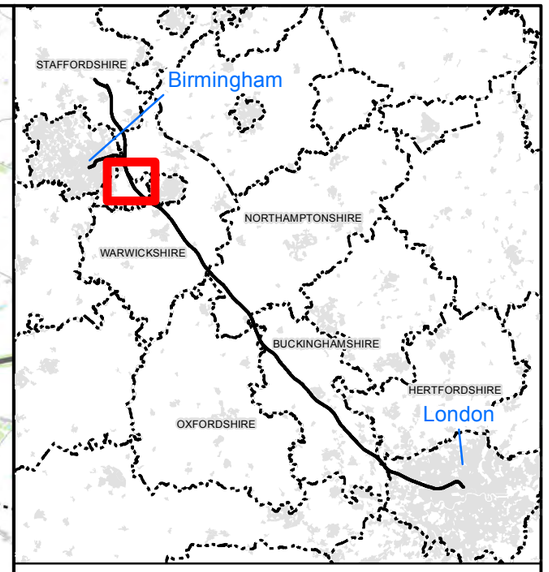
0 100 200 300 400 Metres

Registered in England. Registration number 06791686. Registered office:One Canada Square, London, E14 5AB.

Doc Number: C254-ARP-EV-MAP-040-000526-AP02-P01

Date: 09/06/15





Map Series Information:

This map series shows magnetometer survey results within the land required for the construction of the Proposed Scheme.

Note: Not all data layers in the legend are represented on every map.

Main Map Legend

- Route in tunnel
- Route on surface
- Depot, station, headhouse or portal building
- Community forum boundary
- Existing railway station
- County boundary
- District/Borough boundary

- Map sheets included in this community forum with amendment
- Map sheets included in this community forum with no amendment
- Map sheets not included in this community forum

Map Number: CH-09-INDEX-CFA23

Map Name: Index Map of: Archaeological Geophysical Survey – Magnetometer Data Plot SES and AP2 ES

Community Forum Area CFA23: Balsall Common & Hampton-in-Arden

Scale at A3: 1:50,000

0 500 1,000 1,500 2,000 Metres

Registered in England. Registration number 06791686.
Registered office:One Canada Square, London, E14 5AB.

Doc Number: C254-ARP-EV-MAP-040-000541-AP02-P01

Date: 09/06/15

BIRMINGHAM INTERCHANGE & CHELMSLEY WOOD

NORTH WARWICKSHIRE BOROUGH

SOLIHULL METROPOLITAN BOROUGH

BALSALL COMMON & HAMPTON-IN-ARDEN

Hampton-in-Arden

Meriden Mill Farm

Hornbrook Farm

Mouldings Green Farm

Stone Bridge

River Blythe

Diddington Farm

The Island Project School

Diddington Hill

Park Farm

Dismantled Rail Line

Pasture Farm

Patrick Farm

Patrick Bridge

Middle Bickenhill

A452 CHESTER ROAD

A452 KENILWORTH ROAD

A45 BIRMINGHAM ROAD

A45 COVENTRY ROAD

EAST WAY

M42

PACKINGTON LANE

DIDDINGTON LANE

B4102 HAMPTON LANE

CORNETS END LANE

B4102 MERIDEN ROAD

MIDDLE BICKENHILL LANE

PENDIGO WAY

SOUTH WAY

OLD STATION ROAD

SOUTH CAR PARK ROAD

THE GROVE

THE CRESCENT

STATION ROAD

SHADOWBROOK LANE

B4102 HIGH STREET

FENTHAM ROAD

MEADOW DRIVE

CLOSE

PEEL

ELM TREE RISE

MARSH LANE

BELLEMERE ROAD

Legend

- Route in tunnel
- Route on surface
- Depot, station, headhouse or portal building
- Land potentially required during construction
- Community forum boundary
- County boundary
- District/Borough boundary
- Edge of geophysical survey

Map Number: CH-09-305

Map Name: Archaeological Geophysical Survey – Magnetometer Data Plot SES and AP2 ES

Community Forum Area CFA23: Balsall Common and Hampton in Arden

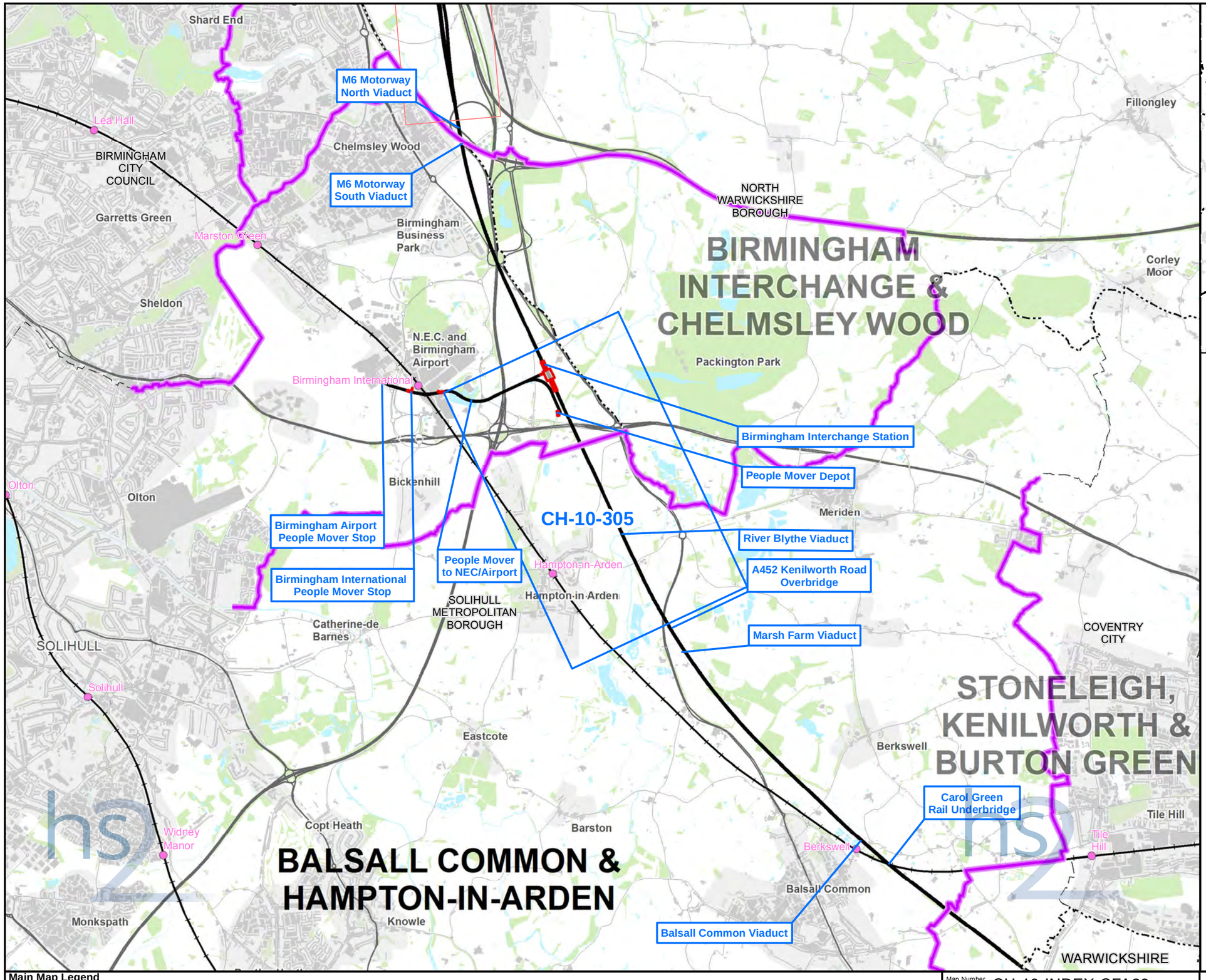
Scale at A3: 1:10,000

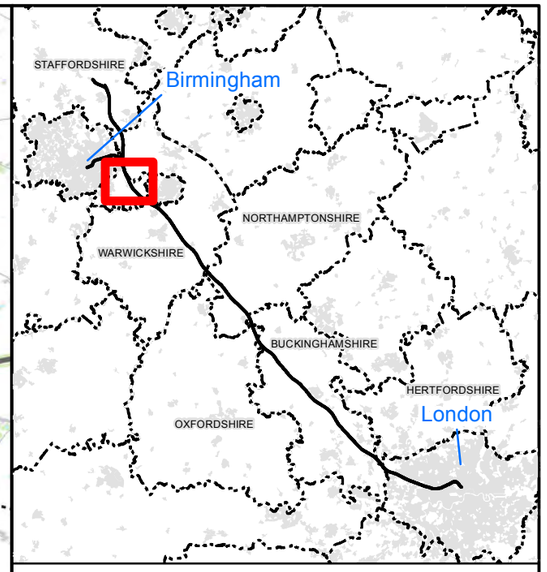
0 100 200 300 400 Metres

Registered in England. Registration number 06791686. Registered office:One Canada Square, London, E14 5AB.

Doc Number: C254-ARP-EV-MAP-040-000564-AP02-P01

Date: 09/06/15





Map Series Information:

This map series shows interpretation of magnetometer survey results within the land required for the construction of the Proposed Scheme.

Main Map Legend

- Route in tunnel
- Route on surface
- Depot, station, headhouse or portal building
- Community forum boundary
- Existing railway station
- County boundary
- District/Borough boundary

- Map sheets included in this community forum with amendment
- Map sheets included in this community forum with no amendment
- Map sheets not included in this community forum

Note: Not all data layers in the legend are represented on every map.

Map Number: CH-10-INDEX-CFA23

Map Name: Index Map of: Archaeological Geophysical Survey – Interpretation Plot SES and AP2 ES

Community Forum Area CFA23: Balsall Common & Hampton-in-Arden

Scale at A3: 1:50,000

0 500 1,000 1,500 2,000 Metres

Registered in England. Registration number 06791686.
Registered office:One Canada Square, London, E14 5AB.

Doc Number: C254-ARP-EV-MAP-040-000542-AP02-P01

Date: 09/06/15

BIRMINGHAM INTERCHANGE & CHELMSLEY WOOD

NORTH WARWICKSHIRE BOROUGH

SOLIHULL METROPOLITAN BOROUGH

BALSALL COMMON & HAMPTON-IN-ARDEN

Meriden Mill Farm

Hornbrook Farm

Mouldings Green Farm

Stone Bridge

River Blythe

Diddington Farm

The Island Project School

Diddington Hill

Park Farm

Dismantled Rail Line

Pasture Farm

Patrick Farm

Patrick Bridge

Middle Bickenhill

Hampton-in-Arden

A452 CHESTER ROAD

A452 KENILWORTH ROAD

A45 BIRMINGHAM ROAD

A45 COVENTRY ROAD

EAST WAY

M42

DIDDINGTON LANE

PACKINGTON LANE

B4102 HAMPTON LANE

CORNETS END LANE

MIDDLE BICKENHILL LANE

COVENTRY ROAD

BENDIGO WAY

SOUTH WAY

OLD STATION ROAD

SOUTH CAR PARK ROAD

THE GROVE

STATION ROAD

MARSH LANE

THE CRESCENT

B4102 MERIDEN ROAD

SHADOWBROOK LANE

B4102 HIGH STREET

FENTHAM ROAD

MEADOW DRIVE

CLOSE

PEEL

ELM TREE RISE

BELLEMERE ROAD

B4102 MERIDEN ROAD

Legend

- Route in tunnel
- Route on surface
- Depot, station, headhouse or portal building
- Land potentially required during construction
- Community forum boundary
- County boundary
- District/Borough boundary
- Edge of geophysical survey

Geophysical survey results

- Possible archaeology (VWR)
- Plough
- Ferrous

Map Number: CH-10-305

Map Name: Archaeological Geophysical Survey – Interpretation Plot SES and AP2 ES

Community Forum Area CFA23: Balsall Common and Hampton in Arden

Scale at A3: 1:10,000

0 100 200 300 400 Metres

Registered in England. Registration number 06791686. Registered office:One Canada Square, London, E14 5AB.

Doc Number: C254-ARP-EV-MAP-040-000565-AP02-P01

Date: 09/06/15

Environmental topic:	Sound, noise and vibration	SV
Appendix name:	Construction assessment report	003
Community forum area:	Balsall Common and Hampton-in-Arden	023

Contents

List of tables

1 Introduction

1.1.1 This appendix provides an update to Appendix SV-003-023 construction assessment report for community forum area (CFA) 23 from the main Environmental Statement (ES) as a result of design changes AP2-023-004 and AP2-023-005, as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with Appendix SV-003-026 Construction assessment report from the main ES.

2 Scope, assumptions and limitations

2.1 Changes of relevance to this assessment

2.1.1 AP2-023-004 relates to the extension of the River Blythe viaduct.

2.1.2 AP2-023-005 relates to the realignment of Diddington Lane.

3 Effects arising during construction

3.1 Avoidance and mitigation measures

3.1.1 These are unchanged from those set out in the main ES, Volume 2, Balsall Common and Hampton-in-Arden (CFA Report 23), Section 11.

3.2 Quantitative identification of impacts and effects

Ground-bourne vibration

3.2.1 Table 1 sets out the changes to the main ES, Volume 5, Appendix, SV-003-023, Sound, Noise and Vibration Assessment for the relevant assessment locations for AP2-023-004. Explanation of the information within this table is provided in Appendix SV-001-000 and Appendix SV-003-023 (Volume 5 of the main ES).

3.2.2 No change to ground-bourne vibration impacts are anticipated due to AP2-023-005.

Table 1: Assessment of construction vibration at residential and non-residential receptors (AP2-023-004)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Peak particle velocity (PPV) [mm/s] on foundation	Typical/highest monthly indoor vibration dose value (VDV) [$m/s^{1.75}$]		Construction activity resulting in highest forecast vibration levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
			Day 07:00-23:00	Night 23:00-07:00											
181976	Patrick Farm, B4102 Meriden Road, Hampton-in-Arden, Solihull	1.12	0.11/0.40	-	Earthworks	A	1	R	T	-	-	Y	3	-	~
181976	Commercial units, Patrick Farm, B4102 Meriden Road, Hampton-in-Arden, Solihull	1.12	0.011/0.40	-	Earthworks	B	18	V_3	T	-	-	N	-	-	

Airbourne sound: direct impacts and effects

3.2.3 Table 2: Assessment of construction noise at residential and non-residential receptors (AP2-023-004) sets out the changes to the main ES, Volume 5, Appendix, SV-003-023, Sound, Noise and Vibration Assessment for the relevant assessment locations for AP2-023-004.

3.2.4 Table 3: Assessment of construction noise at residential and non-residential receptors (AP2-023-005)sets out the changes to the main ES, Volume 5, Appendix, SV-003-023, Sound, Noise and Vibration Assessment for the relevant assessment locations for AP2-023-005.

3.2.5 Explanation of the information within all these tables is provided in Appendix SV-001-000 and Appendix SV-003-023 (Volume 5 of the main ES).

Table 2: Assessment of construction noise at residential and non-residential receptors (AP2-023-004)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 07:00-19:00	Evening 19:00-23:00	Night 23:00-07:00											
181976	Patrick Farm, B4102 Meriden Road, Hampton-in-Arden, Solihull	64/76 [A]	-	-	Day: Earthworks	S	1	R	T	-	-	Y	D 9	NI	CSV23-D01
181976	Commercial units Patrick Farm, B4102 Meriden Road, Hampton-in-Arden, Solihull	64/76	-	-	Day: Earthworks	B	18	G5	T	-	-	N	D 3	-	CSV23-N03

Table 3: Assessment of construction noise at residential and non-residential receptors (AP2-023-005)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 07:00-19:00	Evening 19:00-23:00	Night 23:00-07:00											
176243	Pasture Farm, Diddington Lane, Hampton-in-Arden	63/68 [A]	50/54 [B]	50/54 [C]	Day: Site clearance; Eve: A45 Coventry Road overbridge piling; Night: A45 Coventry Road overbridge piling	A	1	R	T	-	-	N	D 5	-	~
176243	Commercial units, Pasture Farm, Diddington Lane, Hampton-in-Arden	63/68	-	-	Day: Site clearance	B	3	G5	T	-	-	N	-	-	
182120	The Island Project School, Diddington Lane, Meriden, Coventry	53/60	41/45	-	Day: Vegetation clearance; Eve: A45 Coventry Road overbridge piling	B	1	G4	S	-	-	N	D 4	-	CSV23-N04
182073	Diddington Farm, Diddington Lane, Meriden, Coventry	55/62 [A]	44/48 [B]	44/48 [C]	Day: Vegetation clearance; Eve: A45 Coventry Road overbridge piling; Night: A45 Coventry Road overbridge piling	NA	1	R	T	-	-	N	-	-	

3.3 Assessment of significance of effects

Residential receptors: direct effects - individual dwellings

AP2-023-004

3.3.1 The proposed amendment is to extend the River Blythe viaduct, which replaces the works to construct Patrick embankment in this area. The extended viaduct also replaces the B4102 Meriden Road underbridge works. Patrick Farm is located adjacent to the southern end of the viaduct. The residential property at Patrick Farm was estimated in the main ES as likely to qualify for noise insulation as a result of daytime construction noise levels being above the noise insulation trigger. In addition, an adverse daytime construction vibration effect was predicted at the property.

3.3.2 At Patrick Farm, the typical monthly daytime construction noise levels under the proposed amendment will decrease by 1dB, no change to the highest monthly level is predicted. The duration of the impact at the residential property, at Patrick Farm, is anticipated to be reduced from one year and five months to nine months. This is due to the removal of the works to construct the B4102 Meriden Road underbridge, which concentrated a range of works in close proximity to Patrick Farm. The replacement of this bridge with an extended viaduct means works are not as concentrated in the vicinity of the farm. However, as the levels are comparable with the original scheme, the property remains as estimated to be likely to qualify for noise insulation.

3.3.3 A slight change to the daytime vibration impact at Patrick Farm, reported in the main ES, is anticipated. Therefore, the proposed amendment will not give rise to a materially different significant effect, the adverse effect, as reported in the main ES remains.

AP2-023-005

3.3.4 The proposed amendment introduces additional construction works not assessed in the main ES. No receptors are immediately adjacent to the works, the closest residential receptors include the individual properties Pasture Farm and Diddington Farm.

3.3.5 No significant effect was identified in the main ES at the residential property Pasture Farm, although the impact screening criterion was exceeded for daytime construction noise for a total of seven months. No significant effect was identified in the main ES at the residential property Diddington Farm.

3.3.6 At Pasture Farm, the typical and highest monthly daytime construction noise levels are unchanged from the main ES, therefore the impact screening criterion for residential properties is still exceeded. However, the duration of the impact will be reduced slightly by two months. This is due to the removal of the need to construct Pasture Farm overbridge under the proposed amendment. As reported in the main ES this is an individual property not a community, therefore, the main ES did not identify a significant effect and the proposed amendment will not give rise to a new or different significant effect.

3.3.7 At Diddington Farm, the predicted typical daytime construction noise level will be unchanged, the highest monthly level will be increased by 2dB. As in the main ES, the

impact screening criterion is not exceeded at this property and a significant effect is not identified.

3.3.8 The proposed amendment will not give rise to a new significant effect at a residential property, as reported in the main ES.

Non-residential receptors - direct effects

AP2-023-004

3.3.9 The proposed amendment is to extend the River Blythe viaduct, which replaces the works to construct Patrick embankment in this area. The extended viaduct also replaces the B4102 Meriden Road underbridge works. Patrick Farm is located adjacent to the southern end of the viaduct. A significant effect was anticipated at the commercial units at Patrick Farm due to daytime construction noise levels.

3.3.10 At Patrick Farm, the typical monthly daytime construction noise levels under the proposed amendment will decrease by 1dB, no change to the highest monthly level is predicted. The duration of the impact at the commercial units is reduced from six months to three months. This is due to the removal of the works to construct the B4102 Meriden Road underbridge, which concentrated a range of works in close proximity to Patrick Farm. The replacement of this bridge with an extended viaduct means works are not as concentrated in the vicinity of the farm. However, as the levels are comparable with the original scheme the significant effect at the commercial units remains.

3.3.11 Since the completion of the main ES, planning permission has been granted for a further nine commercial units at Patrick Farm, this is included in the assessment of this proposed amendment by increasing the 'number of impacts represented' from nine to 18.

AP2-023-005

3.3.12 The proposed amendment introduces additional construction works not assessed in the main ES. No receptors are immediately adjacent to the works, the closest non-residential receptors include the commercial units at Pasture Farm and the Island Project School.

3.3.13 No significant effect was identified in the main ES at the commercial premises at Pasture Farm. The main ES identified a significant daytime construction noise effect at the Island Project School.

3.3.14 At Pasture Farm, the typical and highest monthly daytime construction noise levels will be unchanged from the main ES. A significant effect is not identified at the commercial units at Pasture Farm in the main ES or under the proposed amendment; the impact screening criteria for commercial premises is not anticipated to be exceeded.

3.3.15 At the Island Project School, the typical daytime construction noise level will be unchanged, the highest monthly level will be increased by 1 dB and the duration of the impact will be unchanged at four months.

3.3.16 The proposed amendment will not give rise to a new significant effect as reported in the main ES; a materially different significant effect is not anticipated at the Island Project School, compared to that reported in the main ES.

Environmental topic:	Sound, noise and vibration	SV
Appendix name:	Operational assessment report	004
Community forum area:	Balsall Common and Hampton-in-Arden	023

Contents

List of tables

1 Introduction

1.1.1 This appendix provides an update to Appendix SV-004-023 Operational assessment report for community forum area (CFA) 23 Balsall Common and Hampton-in-Arden from the main Environmental Statement (ES) as a result of an ES correction, as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with the Appendix SV-004-023 Operational assessment report from the main ES.

2 Scope, assumptions and limitations

2.1 Changes of relevance to this assessment

ES Correction

2.1.1 In response to an ES correction, an operational sound, noise and vibration assessment was undertaken at the Patrick's Farm outbuildings, which were identified in the main ES as non-sensitive uses. However, further information was received which has confirmed these buildings as offices.

3 Effects arising during operation

3.1 Avoidance and mitigation measures

3.1.1 These are set out in main ES, Volume 2, Report CFA23, section 11.

3.2 Quantitative identification of impacts and effects

Ground-bourne sound and vibration

3.2.1 The amendments do not alter the assessment of operational ground-bourne sound and vibration identified in main ES Appendix SV-001-000.

Airbourne sound: direct impacts and effects

3.2.2 The direct effects from the operation of the original scheme including altered roads and railway lines are presented in Table 1 for Patrick Farm offices.

3.2.3 The assessment information, impact criteria and significance criteria for the assessment of the incorporated mitigation case at residential and non-residential receptors are presented in Table 1. The results should be considered in conjunction with the information contained in main ES map series SV-02 in the CFA23 Volume 5 sound, noise and vibration map book.

3.2.4 Explanation of the Table 1 information is provided in main ES, Volume 5: Appendix SV001-000 and Appendix Sv-004-023.

Table 1: Operational noise – detailed results (AP2 ES amended, and allowing for consented planning permission for nine additional offices)

Impact criteria											**Significance criteria**								
Assessment Location ID	Area represented	HS2 Only			Do minimum (Opening year)			Do something (Opening year +15)		Change		Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Mitigation of effect	Significant effect
		Day *	Night **	Max ***	Day *	Night **	Max ***	Day *	Night **	Day *	Night **									
901046	Patricks Farm Barns, Meriden Road, Hampton-in-Arden (offices)	70	61	90/92	48	41	36	70	61	23	20	B	18	G5	T	L	-	-	-	OSV23-N01

Direct impact - Summary

3.2.5 The operational airbourne noise impacts identified in Table 1 are summarised in Table 2, including those included in main ES Appendix 5, SV-004-023 Table 4.

Table 2: Summary of operational airbourne sound impacts

Receptor	Number of Impacts		
	Minor	Moderate	Major
Residential properties	49	38	15
Non-residential properties	2	0	12
Quiet Areas	None	None	None

3.3 Assessment of significance of effects

Residential receptors: direct effects- individual dwellings

3.3.1 No change from main ES.

Residential receptors: direct effects- communities

3.3.2 No change from main ES.

Residential receptors: indirect effects

3.3.3 No change from main ES.

Non-residential receptors: direct effects

3.3.4 The residential area of the farm has been considered within the residential assessment. The outbuildings at Patrick's Farm were identified in the main ES as farm outbuildings that are not sensitive to noise. However, this was incorrect, as the buildings are offices. These offices are converted agricultural buildings and ventilation is assumed to be provided by opening windows.

3.3.5 Patrick's Farm offices are identified, on a precautionary basis, as being subject to a significant adverse effect denoted by OSV23-No1. This may take the form of the activity disturbance to the people using the offices.

Non-residential receptors: indirect effects

3.3.6 No change from main ES.

Cumulative effects

3.3.7 No change from main ES.

Environmental topic:	Water resources and flood risk assessment	WR
Appendix name:	Water resources assessment	002
Community forum area:	Balsall Common and Hampton-in-Arden	023

Contents

List of tables

1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

1.1.1 This appendix provides an update to Appendix WR-002-023, Water resources assessment of the main Environmental Statement (ES) (Volume 5, WR-002-023, Section 3.5). These two documents should be read in conjuction.

1.1.2 This appendix is structured as follows:

- Part 1: Supplementary Environmental Statement (SES); and
- Part 2: Additional Provision 2 Environmental Statement (AP2 ES).

1.1.3 Two specific appendices for each community forum area (CFA) are provided. For CFA23 these are:

- a water resources assessment (i.e. this appendix); and
- a flood risk assessment (SES AP2 Appendix WR-003-023).

1.1.4 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5 water resources map book.

Part 1 Supplementary Environmental Statement

2 Baseline data update

2.1 General

2.1.1 The following sub-sections provide a description of water resources surveys carried out since submission of the main ES, including surface water and groundwater.

2.2 Surface water surveys

2.2.1 Between June and August 2014 Water Framework Directive (WFD) surveys covering ecology, groundwater, surface water and hydromorphology were carried out on the River Blythe waterbody (from Temple Balsall to Patrick Bridge, and from Patrick Bridge to River Tame). The results are contained in SES and AP2 ES, Appendix WR-001-000, Annex A.

2.3 Groundwater surveys

2.3.1 The following WFD surveys were undertaken:

- in July 2014 WFD surveys covering ecology, groundwater, surface water and hydromorphology were carried out on the Tame Anker Mease - Secondary Combined groundwater body; and
- in August 2014 WFD surveys covering ecology, groundwater, surface water and hydromorphology were carried out on the Tame Anker and Mease - PT Sandstone Nuneaton and Meriden groundwater body.

2.3.2 The results are contained in SES and AP2 ES, Appendix WR-001-000, Annex B.

3 Design changes within the existing limits of the original scheme

3.1.1 There is one design change within the existing limits of the original scheme with the potential to affect water resources in CFA23, summarised inTable 1.

Table 1: List of design changes within the existing limits of the original scheme

SES No.	Design change name
AP2-023-006	Agricultural land access across Shadow Brook

4 Site specific surface water assessments

4.1 Summary of assessment

4.1.1 Table 2 summarises new or different significant potential impacts and effects to surface water, as a result of the new baseline information. It also summarises corrections to Appendix WR-002-023 (Volume 5) within the main ES and the design change within the existing limits of the original scheme outlined in Section 3.

4.1.2 The table contains details of the assessment from the main ES, the AP1 ES (if applicable) and the SES for comparison so that changes can be readily identified.

Table 2: Summary of potential impacts to surface water

	Surface water feature / receptor	**Value of surface water feature**	**Design element**	**Magnitude of impact (no mitigation)**	**Potential impact to water resource**	**Avoidance and mitigation measures**	**Magnitude of remaining impact and effect**	**Other mitigation measures**	**Residual effect**	**Duration of effect**
Main ES	Shadow Brook	Very high	Shadow Brook underpass, and new footpath/ bridleway over brook.	Minor adverse	Disturbance during construction	Mitigation measures outlined in draft Code of Construction Practice (CoCP)	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (Temporary)
SES	Shadow Brook	Very high	Realignment of bridleway way and access track	Minor adverse	Disturbance during construction	Mitigation measures outlined in draft CoCP	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (Temporary)

Part 2 Additional Provision 2

5 Summary of changes outside the existing limits of the original scheme

5.1.1 There are three design changes outside the existing limits of the original scheme with the potential to affect water resources in CFA23, summarised in Table 3.

Table 3: Design changes outside the existing limits of the original scheme relevant to CFA23

Amendment No.	Design change name
AP2-023-001	Extension to the Kenilworth Greenway
AP2-023-005	Realignment of Diddington Lane
AP2-023-004	Extension of the River Blythe viaduct

6 Surface water assessment

6.1.1 Table 4 summarises the potential impacts and effects to surface water as a result of design changes outside the existing limits of the original scheme.

Table 4: Summary of potential impacts to surface water as a result of design changes outside the existing limits of the Bill

	Surface water feature / receptor	Value of surface water feature	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Main ES	Bayleys Brook	Very high	Balsall Common Viaduct, Lavender Hall Lane overbridge and embankment, and Marsh Farm viaduct.	Minor adverse	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Mitigation measures outlined in draft CoCP	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)
AP2 ES	Bayleys Brook Tributary	Very high	Extension to Kenilworth Greenway.	Minor adverse	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Mitigation measures outlined in draft CoCP	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)
AP2 ES	Bayleys Brook floodplain	High	Extension to Kenilworth Greenway.	Minor adverse	Potential for increased flood risk by displacing	Replacement floodplain storage required	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (permanent)

	Surface water feature / receptor	Value of surface water feature	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
					floodwaters.					
Main ES	Shadow Brook	Very high	Shadow Brook underpass, and new footpath/ bridleway over brook.	Minor adverse	Disturbance during construction	Mitigation measures outlined in draft CoCP	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)
AP2 ES	Shadow Brook	Very high	Realignment of Diddington Lane.	Minor adverse	Disturbance during construction	Mitigation measures outlined in draft CoCP	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)
AP2 ES	Shadow Brook	Very high	Realignment of Diddington Lane.	Minor adverse	Potential for reduction in water quality and changes to flow from road runoff.	Balancing ponds will be located adjacent to the realigned Diddington Lane. These will discharge to the Shadow Brook and improve water quality of road runoff.	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (permanent)
Main ES	River Blythe	Very high	River Blythe viaduct.	Minor adverse	Potential impact on water quality and receiving watercourse flow from run-off from	Mitigation measures outlined in draft CoCP	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)

	Surface water feature / receptor	Value of surface water feature	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
					construction areas.					
Main ES	River Blythe	Very high	River Blythe viaduct.	Minor adverse	Potential for reduction in water quality from track drainage.	Balancing ponds will be located adjacent to the route near the Patrick cutting and Diddington Lane embankment. These will discharge into the River Blythe and will improve the quality of track drainage water discharging into the river.	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (permanent)
AP2 ES	River Blythe	Very high	Extension of the River Blythe viaduct.	Moderate adverse	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Mitigation measures outlined in draft CoCP.	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)
Main	River Blythe	High	Construction phase activities	Minor	Potential for increased	Mitigation measures outlined	Negligible	None required	Negligible	Construction

	Surface water feature / receptor	Value of surface water feature	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
ES	floodplain		within floodplain.	adverse	flood risk by inadvertently displacing floodwaters.	in draft CoCP to include preparation of site specific flood risk management plans for those areas of the site at risk of flooding.	Neutral (not significant)		Neutral (not significant)	(temporary)
AP2 ES	River Blythe floodplain	High	Construction phase activities within floodplain.	Minor adverse	Potential for increased flood risk by inadvertently displacing floodwaters.	Mitigation measures outlined in draft CoCP to include preparation of site specific flood risk management plans for those areas of the site at risk of flooding.	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (temporary)
AP2 ES	River Blythe floodplain	High	Increased number of viaduct piers (though reduced extent of Patrick embankment compared to the original scheme).	Minor adverse	Potential for increased flood risk by displacing floodwaters (though risk reduced compared to the original scheme).	Replacement floodplain storage required.	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (permanent)

7 Groundwater assessment

7.1.1 Table 5 summarises the potential impacts to groundwater as a result of the design changes outside the existing limits of the original scheme.

Table 5: Summary of potential impacts to groundwater

	Groundwater receptor (and value)	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Main ES	Permeable Superficial Deposits and Mercia Mudstone/ Springs (Moderate)	Cuttings, Areas of 'Dig out and replace'.	Minor adverse (Not significant)	Temporary dewatering affecting groundwater levels and quality.	Draft CoCP Section 16 concerning waste water and groundwater best practice measures.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
AP2 ES	Permeable Superficial Deposits and Mercia Mudstone/ Springs (Moderate)	Realignment of Diddington Lane.	Minor adverse (Not significant)	Mobilisation of existing contamination from the historic landfill from rainfall recharge.	Draft CoCP Section 16 concerning waste water and groundwater best practice measures.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
AP2 ES	Shadow Brook (Very high)	Realignment of Diddington Lane.	Minor adverse (Significant)	Mobilisation of existing contamination from the historic landfill from rainfall recharge.	Draft CoCP Section 16 concerning waste water and groundwater best practice measures.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

	Groundwater receptor (and value)	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Main ES	River Blythe SSSI/ River Blythe (Very high)	All below ground construction sites and structures e.g. piling for River Blythe viaduct and River Blythe bypass underbridge.	Minor adverse (Significant)	Barriers of low permeability affecting groundwater levels and quality.	Draft CoCP Section 16 concerning waste water and groundwater best practice measures. Implement a regime of post construction monitoring of groundwater levels.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
AP2 ES	River Blythe SSSI/ River Blythe (Very high)	Extension of the River Blythe viaduct.	Minor adverse (Significant)	Barriers of low permeability affecting groundwater levels and quality.	Draft CoCP Section 16 concerning waste water and groundwater best practice measures. Implement a regime of post construction monitoring of groundwater levels.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

Appendix WR-003-023

Environmental topic:	Water resources and flood risk assessment	WR
Appendix name:	Flood risk assessment	003
Community forum area:	Balsall Common and Hampton-in-Arden	023

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1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

1.1.1 The water resources and flood risk assessment appendices of the main ES comprise six parts. The first of these is a route-wide appendix (Volume 5: Appendix WR-001-000).

1.1.2 Additional specific appendices for each community forum area are also provided. For the Balsall Common and Hampton-in-Arden area (CFA23) these are:

- a water resources assessment (Volume 5: Appendix WR-002-023);
- a flood risk assessment (i.e. this appendix);
- a hydrology report for the River Blythe catchment (Volume 5: Appendix WR-004-016)
- a hydraulic modelling report for the River Blythe and Bayleys Brook (Volume 5: Appendix WR-004-017); and
- a hydraulic modelling report Bayleys Brook (at Marsh Farm and Lavender Hall Lane), the River Blythe Bypass, Shadow Brook and Hollywell Brook (Volume 5: Appendix WR-004-018).

1.1.3 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5 water resources map book of the main ES.

1.1.4 This FRA assesses flood risk from the Proposed Scheme including amendments made during AP2 as outlined in Table 1 .

Table 1: Summary of amendments in CFA23

Name of amendment	Description of the original scheme	Description of the AP2 revised scheme
Extension of the River Blythe viaduct (AP2-023-004)	The Hs2 route would cross the B4102 Meriden Road, via the B4102 Meriden Road underbridge, and continue on the Patrick embankment for approximately 260m before crossing the River Blythe and associated floodplain on the River Blythe viaduct which would be approximately 150m in length. A floodplain replacement storage area would be provided adjacent to the River Blythe.	To facilitate access between land holdings, the River Blythe viaduct will be extended to approximately 480m long which will replace the section of Patrick embankment between the B4102 Meriden Road and the River Blythe, the B4102 Meriden Road underbridge, and a short section of the Patrick embankment to the south-east of the underbridge. An additional private means of access will be provided. An access track off the B4102 Meriden Road for a balancing pond will be realigned closer to the HS2 route and Footpath M230A will be realigned accordingly. An underground diversion of the existing overhead power line will be diverted on a slightly different alignment under the viaduct to that reported in the main ES. The B4102 Meriden Road underbridge satellite compound will be renamed the River Blythe satellite compound and will be

Name of amendment	Description of the original scheme	Description of the AP2 revised scheme
		operational for approximately 12 months longer. Material stockpiles to the south-west of the HS2 route will be reduced in size and reconfigured which will require a minor realignment of the haul road.
Realignment of Diddington Lane (AP2-023-005)	A section of Diddington Lane between north of the residential properties, to the south of Diddington Lane, and south of the access to Diddington Farm would be permanently closed to vehicular traffic with access being maintained for agricultural vehicles. The closed section of Diddington Lane would be reinstated as a bridleway, which would improve non-motorised user connectivity between the A45 Coventry Road, The Island Project School and Hampton-in-Arden. During construction, Diddington Lane would be used as a construction traffic route providing access to Shadow Brook underbridge satellite compound and construction activities associated with the B4102 Meriden Road underbridge. Pasture Farm accommodation overbridge would provide access to agricultural land.	To reduce the severance of agricultural land and disruption to agriculture, Diddington Lane will not be closed and instead will be realigned to the west of the route of the original scheme, crossing the route at Diddington cutting via a new bridge (Diddington Lane overbridge). Two new balancing ponds will be provided with associated access tracks. A bridge will be provided where the new road crosses Shadow Brook. Footpath M114 will be diverted along the existing Pasture Farm access road. Pasture Farm accommodation overbridge will no longer be required with access to Pasture Farm being provided from the realigned Diddington Lane. Shadow Brook underbridge satellite compound will be relocated as will the construction haul road and temporary material stockpiles.
Agricultural land access across Shadow Brook (AP2-023-006)	A section of Diddington Lane between north of the residential properties, to the south of Diddington Lane, and south of the access to Diddington Farm would be permanently closed to vehicular traffic with access being maintained for agricultural vehicles. The closed section of Diddington Lane would be reinstated as a bridleway, which would improve non-motorised user connectivity between the A45 Coventry Road, The Island Project School and Hampton-in-Arden. During construction, Diddington Lane would be used as a construction traffic route providing access to Shadow Brook underbridge satellite compound and construction activities associated with the B4102 Meriden Road underbridge.	To provide access to agricultural land, the proposed bridleway, created on the alignment of the closed section of Diddington Lane, and an access track to a balancing pond will be realigned parallel to the HS2 route and cross Shadow Brook approximately 20m further east than in the original scheme.

1.2 Scope of this assessment

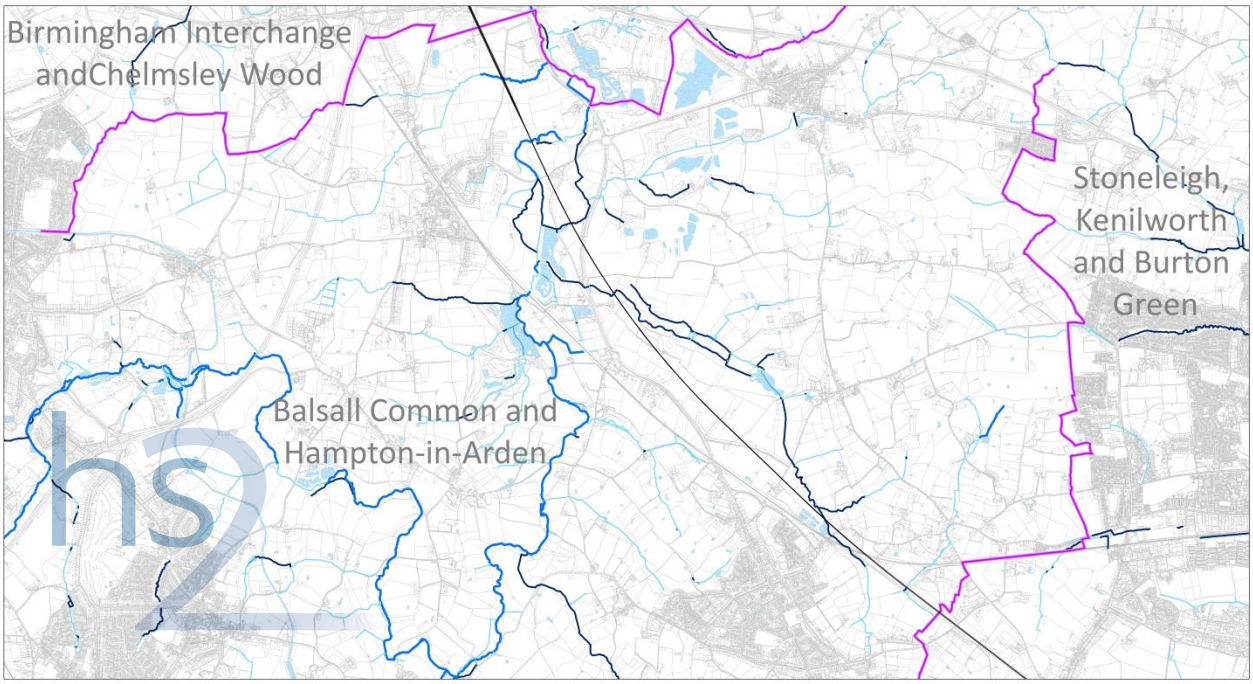
1.2.1 This flood risk assessment (FRA) considers the assessment of flood risk in the Balsall Common and Hampton-in-Arden CFA. This FRA is based on the Proposed Scheme as shown in mail ES Volume 2: Map book CT-06. Its purpose is to document how flood risk has been assessed and managed at this stage of the project's development so as to inform the hybrid Bill. It can be anticipated that the details of flood risk management will develop further as the project proceeds through later stages of design. The assessment has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF)[1], which aims to prevent inappropriate development in areas at risk of flooding and to ensure that, where development is necessary in areas at risk of flooding, it can occur without risk to the development or to third parties.

1.3 Location

1.3.1 This report focuses on CFA23 Balsall Common and Hampton-in-Arden. The area of consideration is shown in Figure 1.

1. Department for Communities and Local Government (2012) *National Planning Policy Framework*

Figure 1: Balsall Common and Hampton-in-Arden CFA23



Legend

River network

River Type

- Main river
- Ordinary watercourse (secondary)
- Ordinary watercourse (tertiary)
- Lake / Reservoir
- Canal
- Canal tunnel
- Underground river
- Route centre line
- Community forum area boundary
- Water body

0 1 2 4 6 8 Kilometers

2 Flood risk assessment methodology

2.1.1 The aim of this FRA is to assess the risk of all forms of flooding to and from the development. A risk-based methodology has been adopted through the application of the source-pathway-receptor (SPR) model.

2.2 Source-pathway-receptor model

2.2.1 Flood risk is assessed using the source-pathway-receptor model. In this model, individual sources of flooding within the study area are identified. The primary source of flooding is rainfall, which is a direct source in the short-term (surface water flooding) and can lead to flooding from watercourses (river flooding) and overloaded man-made collection systems (sewer flooding) in the short or medium term. Stored rainfall, either naturally in below ground aquifers and natural lakes or artificially in impounded reservoirs and canals can lead to flooding when the storage capacity of the system is exceeded. A final source of flooding arises from tidal effects and storm surges caused by low pressure systems over the sea.

2.2.2 The identification of the flooding source and pathway is based on a review of local conditions and consideration of the effects of climate change (CC).

2.2.3 For there to be a risk of flooding at an individual receptor there must be a pathway linking it to the source of flooding. The pathways within the study area are assessed by reviewing national datasets that show the spatial distribution of flood risk. Taking this into account, the associated magnitude of risk is then categorised.

2.2.4 Receptors include people, properties, businesses, infrastructure, the built and the natural environment which is within the range of the flood source, and is connected to the source of flooding by a pathway. The Proposed Scheme includes all associated temporary and permanent infrastructure.

2.2.5 This FRA presents baseline (current day) flood risk and post-development flood risk as a result of the Proposed Scheme. Areas of interest are identified through comparison of the national spatial datasets with the design drawings. Where a risk is identified, mitigation is proposed in line with recommendations in the NPPF.

2.2.6 Existing development within the study area is identified using Ordnance Survey (OS) mapping information and a high level assessment has been undertaken to identify receptors that are within or in close proximity to an area of flood risk via pathways. The vulnerability of each receptor is classified using Table 2 of the NPPF Technical Guidance Document[2].

2.2.7 The assessment then considers the vulnerability of the receptor with reference to the flood risk category of the source using Table 3 of the NPPF Technical Guidance Document and assesses whether the Proposed Scheme has any potential to influence or alter the risk of flooding to each receptor. The Proposed Scheme is committed to ensuring that there is no adverse effect on the risk of flooding to third party receptors, and therefore, where such potential exists, mitigation is proposed based on further analysis.

2.Department for Communities and Local Government (2012) *National Planning Policy Framework Technical Guidance*

2.2.8 The FRA has been written to demonstrate the relative change in flood risk as a result of the Proposed Scheme. Whilst all change in risk status is highlighted, the focus of this document is on the change in risk status to identified local receptors, particularly existing infrastructure.

2.3 Flood risk categories

2.3.1 The level of flood risk is categorised by assessing the design elements against the datasets for each source. A matrix showing the flood risk category associated with each flooding source is presented in Table 2.

Table 2: Flood risk category matrix for all flooding sources

Source of flooding	Flood risk category				
	No risk	**Low**	**Medium**	**High**	**Very high**
Watercourse[3]	-	Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Surface water / overland flow[4]	No FMfSW	FMfSW <0.3m for 1 in 200 year event	FMfSW >0.3m for 1 in 200 year event and FMfSW <0.3m for 1 in 30 year event	FMfSW >0.3m for 1 in 30 year event	-
Groundwater[5]	-	Very low-low	Moderate	High-very high	-
Drainage and sewer systems[6]	No sewer in vicinity of site	Surcharge point >20m from site and no pathways	Surcharge point within 20m of site and restricted pathways	Sewer network crosses site and pathways exist	-
Artificial sources[7]	Outside of inundation mapping / no pathway exists	Within inundation mapping / pathway exists	-	-	-

2.4 Exclusions and limitations

2.4.1 Temporary works have not been assessed unless they are of a significant scale compared with the post-construction scheme or are subject to or pose a significant flood risk or change in risk.

2.4.2 The assessment has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF)[8], which aims to prevent inappropriate development in areas at risk of flooding and to ensure that, where development is necessary in areas at risk of flooding, it is safe without increasing flood risk elsewhere.

3. River flood risk taken from the Environment Agency Flood Zone mapping or hydraulic modelling carried out for this FRA.

4. Surface water flood risk taken from the Environment Agency Flood Maps for Surface Water (FMfSW).

5. Groundwater flood risk taken from local flood risk assessment reports.

6. Identified using the Severn Trent Water's assets network.

7. Risk from reservoir flooding identified using the Environment Agency Reservoir Inundation mapping, canal flooding taken from identifying proximity of the Proposed Scheme to canals from Ordnance Survey mapping.

8. Department for Communities and Local Government (2012) *National Planning Policy Framework*.

2.4.3 No existing hydraulic models existed within this area, and a number of discrete hydraulic models were constructed. These are detailed in the accompanying hydraulic modelling reports (Volume 5: Appendices WR-004-017 and WR-004-018). The models and flood extents should only be viewed in the context of assessing flood risk related to the Proposed Scheme.

2.4.4 This FRA (and accompanying appendices) and the associated hydraulic models will require updating as the design develops and a greater level of detailed data (e.g. topographical survey) become available.

3 Design criteria

3.1 Source of design criteria

3.1.1 This FRA has taken account of the following documents:

- NPPF;
- Highways Agency Design Manual for Roads and Bridges (1992)[9];
- National Sustainable Drainage Systems (SuDS) Working Group Interim Code of Practice (2009)[10];
- Water Resources and Flood Risk Technical Note: Flood Risk Assessment (see Volume 5, Appendix CT-001-000/2 Scoping and methodology report addendum); and
- CIRIA Report C689 - Culvert Design and Operation Guide (2010)[11].

3.1.2 The key design criteria applied to the project are summarised below.

3.2 Summary of principal design criteria

Flood risk to third parties

3.2.1 The design has set out to avoid significant increases in flood risk to third parties, as a result of the Proposed Scheme up to and including the 1% Annual Exceedence Probability (AEP) flood event plus an appropriate allowance for climate change (cc) which has been abbreviated to 1% AEP+CC within this report.

Climate change

3.2.2 Climate change allowance is in accordance with NPPF.

3.2.3 Increases in peak rainfall intensity and peak river flow as a result of climate change have been allowed for as per the period 2085 to 2115 as defined in Table 5 of the Technical guidance to the NPPF and shown in Table 3 below.

Table 3: Appropriate climate change allowance figures for rainfall intensity and peak river flow (extract from Table 5 in Technical Guidance of the NPPF)

Parameter	1990 - 2025	2025 - 2055	2055 - 2085	2085 - 2115
Peak rainfall intensity.	+5%	+10%	+20%	+30%
Peak river flow.	+10%	+20%		

9. Highways Agency, (1992), *Design Manual for Roads and Bridges for trunk roads.*

10. National Sustainable Drainage Systems (SuDS) Working Group (2009). *SuDS Interim Code of Practice.*

11. CIRIA Report C689 (2010). *Culvert Design and Operation Guide.*

3.2.4 There is one departure to this; a 30% increase in flow in ungauged catchments has been used in order to account for uncertainty in flow calculations. This approach has been applied only when assessing culverts on small watercourses where no hydraulic modelling has been undertaken.

Freeboard at bridges

3.2.5 A minimum of 600mm freeboard above the 1% AEP+CC flood event has been allowed to the soffit of all bridges and viaducts. On main rivers, where possible, a freeboard of 1000mm has been allowed.

Freeboard at culverts

3.2.6 The freeboard provided between the 1% AEP+CC water level and the soffit of any proposed culvert is a minimum of 300mm for ordinary watercourses and 600mm for main rivers. The exception to this is where new structures are sized to match existing.

Flood protection to the Proposed Scheme rail infrastructure

3.2.7 The Proposed Scheme rail infrastructure (including the track drainage systems) will be designed to be protected against inundation in the 0.1% AEP flood event for both river and surface water flooding. This will be achieved through ensuring either a of 1m between the rail level and the 0.1% AEP flood level, or by providing flood protection with a freeboard of at least 300mm above the 0.1% AEP flood level.

Attenuation of surface run-off

3.2.8 All drainage will be attenuated in order that peak surface run off from the Proposed Scheme in the events up to the 1% AEP+CC peak rainfall event is no greater than the existing current day baseline run-off under the same peak rainfall event.

4 Data sources

4.1.1 The following data sources have been referred to in the compilation of this document:

- Environment Agency web site; http://www.environment-agency.gov.uk/;
- reservoir flood mapping[12];
- generalised river flood mapping and flood zone mapping[13];
- Solihull Metropolitan Borough Council (SMBC) Level 1 Strategic Flood Risk Assessment (SFRA)[14];
- SMBC Preliminary Flood Risk Assessment (PFRA)[15];
- historic flooding records[16];
- flood map for surface water (FMfSW)[17];
- topographic survey (200mm grid resolution laser interferometry detection and ranging (LiDAR) survey, in digital terrain model and digital surface model format) and associated aerial photography;
- as built and historic drawings and land drainage records from Network Rail (NR), BCC & others;
- evidence gathered from site visits (including photographs);
- online photographic & mapping resources (Google maps, Bing maps etc);
- Ordnance Survey 1: 10,000; 1:25,000 and 1:50,000 mapping;
- publicly available planning applications from recent developments within the area of interest;
- sewer network data from Severn Trent Water Plc (STW)[18];
- British Geological Survey (BGS) mapping;
- geotechnical desk studies; and
- Powell et al (2000)[19]: Geology of the Birmingham area.

12.Environment Agency, (2012), *Lakes and reservoirs GIS layer.*

13.Environment Agency, (2012), Flo*od zone mapping GIS layer.*

14.Halcrow, (2008). *Solihull Metropolitan Borough Council (SMBC) Level 1 Strategic Flood Risk Assessment.*

15.WSP, (2011), *Solihull Metropolitan Borough Council Preliminary Flood Risk Assessment.*

16.Environment Agency, (2012), *Midlands Historical 1992 and 2007 flood event GIS layers.*

17.Environment Agency, (2012), *Midlands Flood Map for Surface water GIS layers.*

18.Severn Trent Water, (2012), *Utilities GIS Data.*

19. Powell, JH, Glover, BW, and Waters, CN., (2000),. *Geology of the Birmingham area.* Memoir of the British Geological Survey, Sheet 168 (England and Wales).

5 The proposed development

5.1.1 The route of the Proposed Scheme through the Balsall Common and Hampton-in-Arden area will be approximately 7.8km in length, commencing north-west of Waste Lane (see main ES Volume 2: Map CT-06-100, E6), adjacent to the Kenilworth Greenway and then proceeding towards the existing Rugby to Birmingham line, crossing it south-east of Berkswell station.

5.1.2 Continuing north-east of Berkswell station the route will cross Truggist Lane, Bayleys Brook, Lavender Hall Lane and several public rights of way including the Millennium Way and the Heart of England Way (Footpath M214).

5.1.3 The route will then continue broadly parallel to the A452 Kenilworth Road which it will cross in close proximity to Marsh Lane Nature Reserve. It will then cross over the B4102 Meriden Road, the River Blythe and Diddington Lane and leave this area south-east of the A45 Coventry Road, near to Pasture Farm.

5.2 Design elements

5.2.1 To facilitate the Proposed Scheme the following design elements are required:

- high speed rail lines;
- overhead electrification gantries;
- signals;
- sections of route and side road diversions on embankment;
- sections of route and side road diversions in cutting;
- viaducts and overbridges spanning urban areas, rural land, highways, railways, watercourses and canals;
- bridges under existing urban areas, rail and highway infrastructure;
- flood relief culverts;
- culverts for existing watercourses;
- river diversions; and
- drainage infrastructure.

5.2.2 Within CFA23 the following elements have direct relevance to the assessment of flood risk:

- culvert crossing from Beechwood Farm;
- Balsall Common viaduct over Bayleys Brook;
- diverted Lavender Hall Lane Culvert crossing of Bayleys Brook;
- Marsh Farm viaduct crossing Bayleys Brook;
- bridleway M218 diversion crossing of Bayleys Brook;
- A452 Kenilworth Road diversion crossing of Bayleys Brook;
- culvert crossing of River Blythe tributary;
- A452 Kenilworth Road culvert crossing of Horn Brook adjacent to Marsh Lane;

- River Blythe viaduct;
- Shadow Brook underbridge to accommodate realigned Diddington Lane;
- Shadow Brook underbridge to accommodate the Proposed Scheme;
- A culvert over the Shadow Brook required to accommodate an access track required to allow access to Packington Estates land (Packington Estates field access culvert) and
- surface water drainage.

6 Existing flood risk

6.1 River flood risk

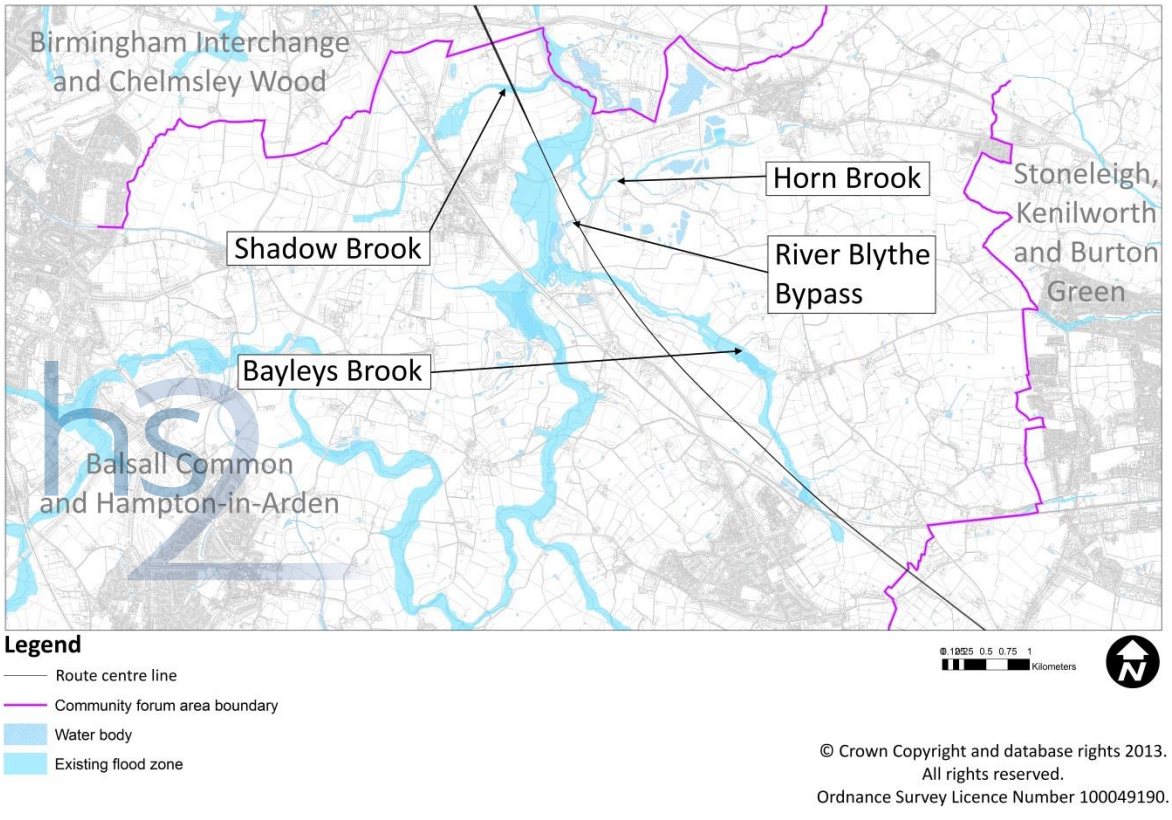
6.1.1 River flood risk is the risk of flooding posed by rivers and streams. The river flood risk within CFA23 is dictated by the risk posed by the River Blythe and its tributaries; Shadow Brook, Bayleys Brook, Horn Brook and smaller un-named tributaries.

River Blythe catchment

6.1.2 The River Blythe is a major tributary of the River Tame and drains parts of North Warwickshire, Solihull and the surrounding rural areas. It has a total catchment of 131km^2 (as taken from the Flood Estimation Handbook (FEH) CD Rom[20]) upstream of the proposed route crossing. It is a Main River and as such is operated and maintained by the Environment Agency. The river reach in proximity to the Proposed Scheme is designated as a Site of Special Scientific Interest (SSSI).

6.1.3 In order to establish the existing flood risk posed by the River Blythe to the land located along and adjacent to the Proposed Scheme reference has initially been made to the existing Flood Zone mapping available from the Environment Agency and shown in Figure 2.

Figure 2: Existing Flood Zone Mapping for the River Blythe and Tributaries (Environment Agency 2012)



20. Centre for Ecology and Hydrology, 1999, *Flood Estimation Handbook (FEH)*

6.1.4 The flood zone mapping indicates that a section of the route and associated infrastructure may be at high risk from inundation from the River Blythe and its tributaries, being partly located in Flood Zone 3a. This indicates that it is at high risk from inundation (during a flood event with a 1% AEP).

6.1.5 In order to fully understand the existing risk posed by the river catchment and to be able to evaluate the impact of the Proposed Scheme on the hydraulic behaviour of the Blythe Catchment, a number of discrete hydraulic models have been created using either fully two dimensional models or one dimensional steady state models. The Environment Agency does not have an existing model of the Blythe catchment.

6.1.6 Hydraulic models were created for each watercourse crossing where the 1% AEP+ 20% CC exceeded 3m^3/s. Simplified culvert calculations based on C689 were used to assess the post development flood risk impact of smaller watercourses.

6.1.7 The details of the activities undertaken to produce baseline hydraulic models are documented in the modelling reports in main ES Volume 5: Appendix WR-004-017 and WR-004-018, with the hydrological assessment detailed in Volume 5: Appendix WR-004-016.

6.1.8 The hydraulic models have been used to determine baseline water levels along the sections of river channel and on the floodplain for the following flood events:

- 50%;
- 10%;
- 5%;
- 2%;
- 1%;
- 1% + 20% CC;
- 1% + 30% CC (in culverts); and
- 0.1% AEP.

6.1.9 The proposed crossings in the River Blythe catchment are described in the following chapters along with the flood extents and levels derived from the baseline models.

River Blythe

6.1.10 The proposed route crosses the River Blythe to the north of the B4102 Meriden Road and west of the A452 Kenilworth Road.

6.1.11 A preliminary hydrological investigation of the River Blythe has been undertaken in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream the proposed route crossing point. The hydrology report is included in Volume 5: Appendix WR-004-016.

6.1.12 Due to the watercourse's specific out-of-bank flow patterns a fully two dimensional TUFLOW model has been constructed to assess peak water levels and flood flow paths for a range of flood events for both the baseline and post development scenarios. The details of the model build are discussed in the modelling report included in main ES Volume 5: Appendix WR-004-017.

6.1.13 The flows taken forward to the hydraulic analysis are shown in Table 4 below.

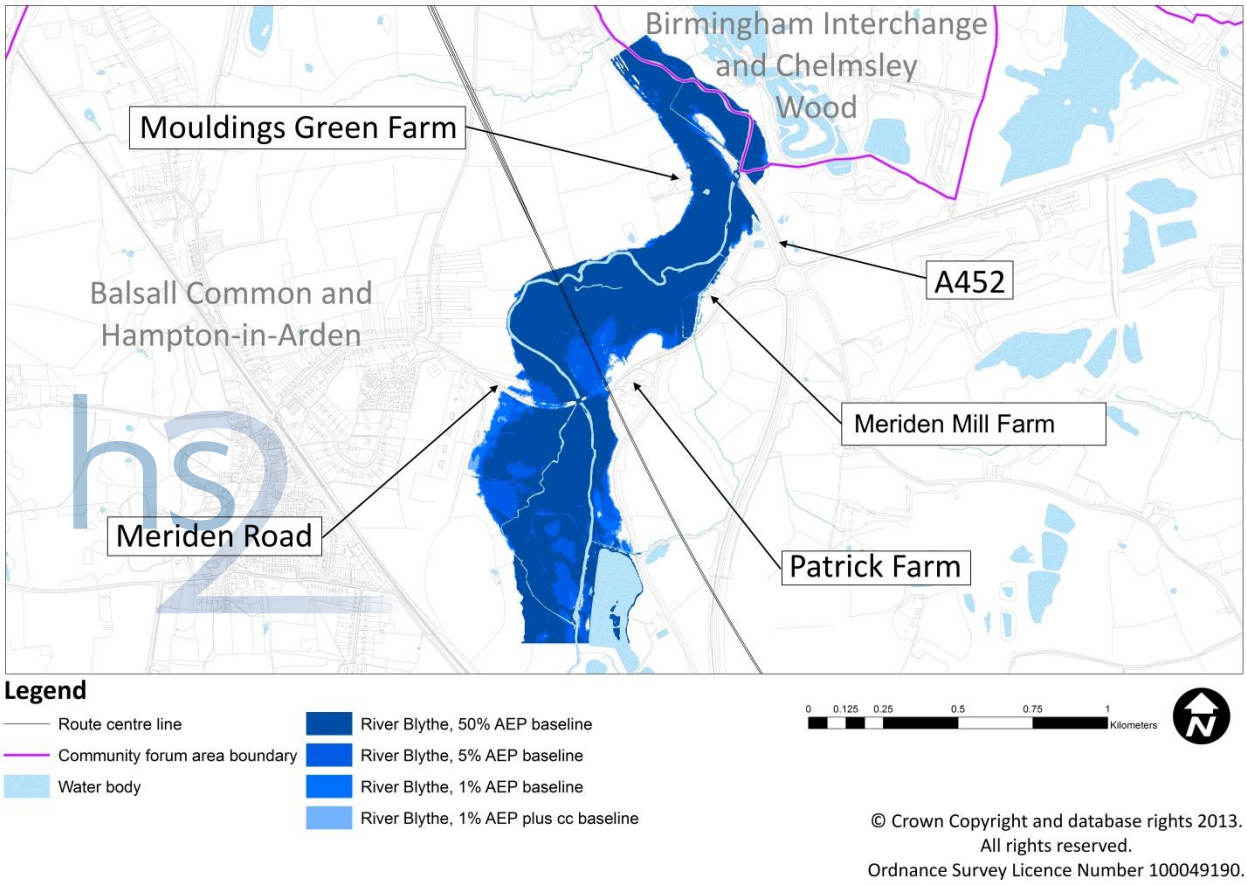
Table 4: River Blythe peak flood calculations using the revitalised flood hydrograph (ReFH)[21] method

AEP	Flow (m^3/s)
50%	23.74
10%	34.77
5%	39.21
2%	46.2
1%	52.66
1% plus CC	63.19
0.1%	86.07

6.1.14 The flooding extents for the 1% AEP plus CC generated by the baseline model are shown in main ES Volume 5: Map book WR-05. Figure 3 shows in more detail the baseline flood extents for key return periods.

Figure 3: Flooding extents for the River Blythe from baseline modelling

21. Kjeldsen, T.R., (2007), Supplementary Report N. 1, *The revitalised FSR/FEH rainfall-runoff method*, Centre for Ecology & Hydrology.



6.1.15 The results of the baseline modelling indicate that the location of the route is affected by river flood risk.

6.1.16 The flood extents predicted by the baseline model provide indicative definition of the floodplain, particularly at B4102 Meriden Road. The B4102 Meriden Road is a minor road which provides a link from Hampton-in-Arden to the A452 Kenilworth Road. The hydraulic modelling indicates that B4102 Meriden Road is overtopped in the baseline case. This is event from events in excess of the 10% AEO event. At the 10% AEP event, there is a limited amount of flooding to the east of the existing Meriden Road bridge. The model does not show overtopping of the bridge under events up to the 1% AEP plus CC due to the topography of the bridge's road deck.

6.1.17 Other flood receptors in the vicinity of the route include Patrick Farm, Meriden Mill Farm and Mouldings Green Farm all located on the east side of the River Blythe viaduct. Both floodplains of the River Blythe in this area are occupied by agricultural land. The eastern side of Hampton-in-Arden is located west (upstream) of the River Blythe viaduct. The A452 crosses the River Blythe downstream of the proposed route crossing.

6.1.18 Meriden Mill Farm and Mouldings Green Farm are within the modelled extents of the 50% AEP floodplain. Patrick Farm is outside of the modelled flood extents. The 1% AEP+ CC does not extend into Hampton-in-Arden. The A542 Kenilworth Road is predicted to flood for a 5% AEP.

Shadow Brook

6.1.19 Shadow Brook is a tributary of the River Blythe and is a Main River. The Brook flows in a north-easterly direction to the north of Hampton-in-Arden, joining the River Blythe immediately to the east of the A452 Kenilworth Road. The catchment area is approximately 4.3km^2 and is semi-rural in nature.

6.1.20 The route crosses Shadow Brook over Diddington Lane. At this location, there is an existing culvert which conveys Shadow Brook beneath Diddington Lane.

6.1.21 Due to the watercourse's relatively linear, uniform floodplain at the proposed route location a 1D steady state model (HEC-RAS) of Shadow Brook was considered sufficient for assessing peak water levels for the range of flood events for both the baseline and post development scenarios. The details of the model build are discussed in the modelling report included in main ES Volume 5: Appendix WR-004-018.

6.1.22 A preliminary hydrological investigation has been undertaken in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream the proposed route crossing point. The hydrology report is included in the appendices. The flows taken forward to the hydraulic analysis are shown in Table 5.

Table 5: Shadow Brook peak flow calculation results using ReFH

AEP	Flow (m^3/s)
50%	1.46
20%	1.93
10%	2.31
5%	2.69
2%	3.29
1%	3.83
1% AEP+20%	4.59
0.1%	6.86

6.1.23 The flooding extents for a selection of flood events up to the 1% AEP+ CC event generated by the baseline model are shown on in Figure 4. The flood extents generated by the 5% and 1% plus CC AEP are shown in full in main ES Volume 5: Map book WR-05 and WR-06. Water levels at key locations for the full range of return periods are provided in Table 6.

Figure 4: Flooding extents for the 1% AEP plus 20% CC for Shadow Brook from baseline modelling

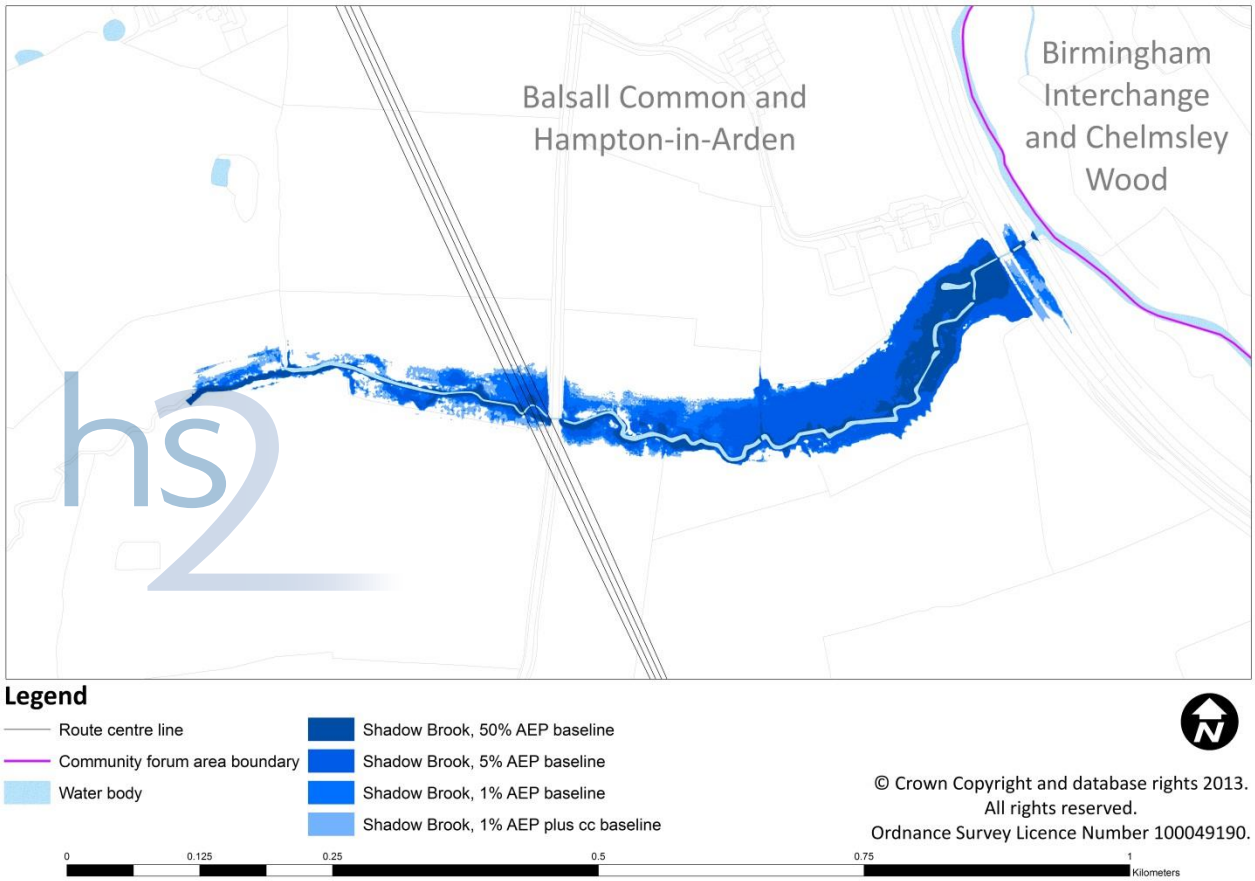


Table 6: Shadow Brook flood levels (mAOD) (for cross-section locations see Volume 5: Appendix WR-004-018 Section 3)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Downstream of Shadow Brook underbridge, cross-section 626	84.853	84.997	85.059	85.141	85.213	85.312
Upstream of Shadow Brook underbridge, cross-section 713	84.96	85.114	85.176	85.259	85.326	85.413
150m Upstream of Shadow Brook underbridge, cross-section 859	85.285	85.458	85.499	85.563	85.615	85.682

6.1.24 The results of the baseline modelling confirm that the location of the route is affected by river flood risk.

6.1.25 The flooding extents from the baseline model are broadly consistent in shape with the Environment Agency flood zone mapping data but the modelled flood extents are considerably narrower in the upstream reach and offset from the Environment Agency's flood zone mapping due to inconsistencies with the simplified terrain data used to derive the mapping.

6.1.26 The key flood receptors in the vicinity of the development are agricultural land located both upstream and downstream of the existing Diddington Lane crossing, a wooded area located on the left bank and Diddington Hall which is elevated above the floodplain on the left bank of the watercourse. While Diddington Hall itself is outside of the floodplain the access to the hall is only marginally above the 1% AEP plus CC flood level.

6.1.27 The A452 Kenilworth Road may be at risk of overtopping during extreme flood events; however, the levels predicted by the model are based on assumed culvert dimensions. Further survey information on the A452 Kenilworth Road culvert in the vicinity of Diddington Farm would be required to accurately assess the over topping risk.

Bayleys Brook at Balsall Common viaduct

6.1.28 Bayleys Brook is a tributary of the River Blythe and is an Ordinary Watercourse for which Solihull Metropolitan Borough Council (SMBC) are the Lead Local Flood Authority. The brook originates to the east of Balsall Common and flows in a north-westerly direction, where it flows parallel to the A452 Kenilworth Road. The brook confluences with the River Blythe to the south east of Hampton-in-Arden, approximately 200m after crossing the A452 Kenilworth Road and Marsh Lane. The catchment area is approximately 11.3km^2 and is predominantly rural, with small urban contributions from Balsall Common and Berkswell. The brook bisects a Site of Special Scientific Interest (SSSI) (Berkswell Marsh) along its route.

6.1.29 The proposed route runs parallel to Bayleys Brook and crosses the brook in two separate locations at Marsh Farm and Balsall Common. There will be two further crossings of Bayleys Brook for a diversion of the A452 Kenilworth Road at Marsh Farm and at Lavender Hall Lane.

6.1.30 Due to the skew angle of the Balsall Common viaduct a fully two dimensional model of Bayleys Brook has been constructed using TUFLOW to assess peak water levels and flood flow paths for a range of flood events for both the baseline and post development scenarios. The details of the model build are discussed in Volume 5: Appendix WR-004-017.

6.1.31 A preliminary hydrological investigation has been undertaken of Bayleys Brook in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream the proposed route crossing point. The hydrology report is included in main ES Volume 5: Appendix WR-004-016.

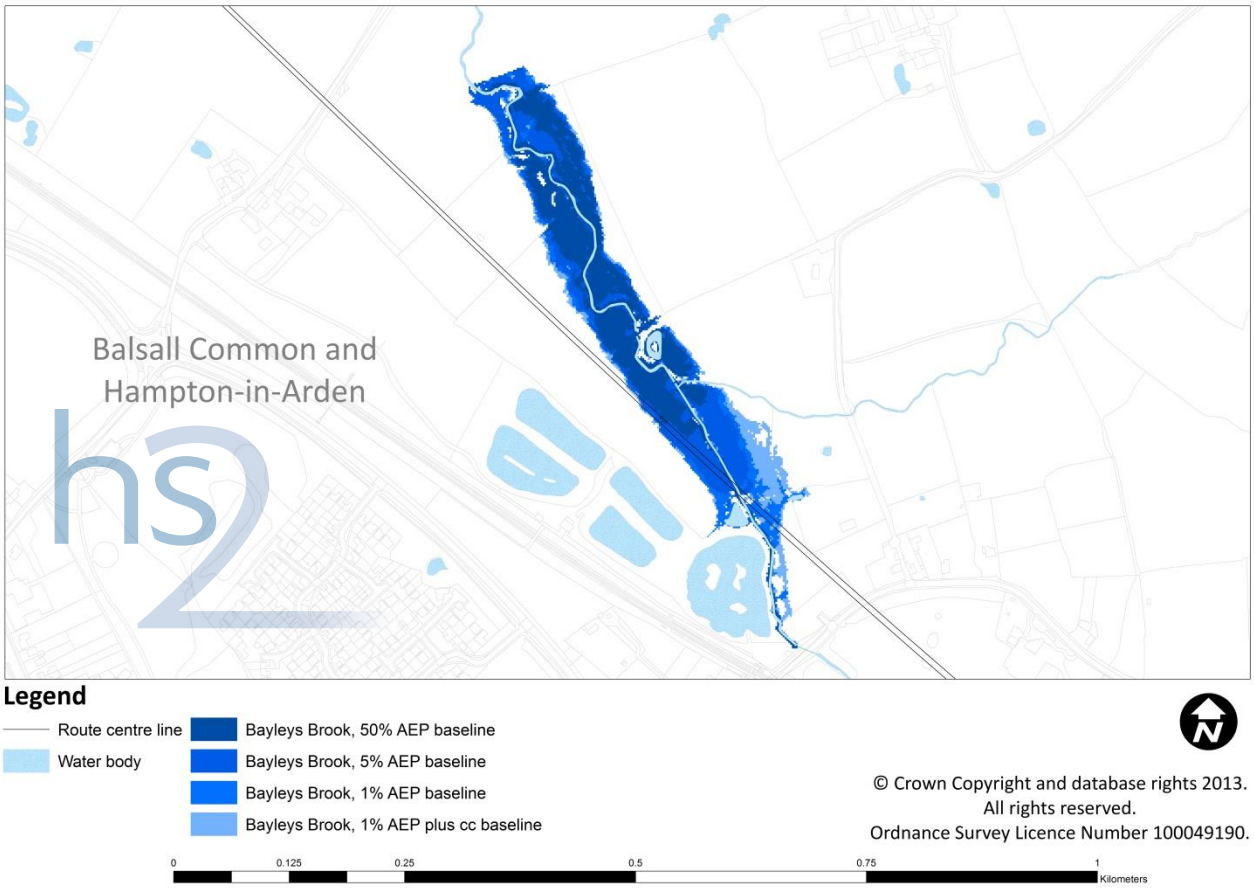
6.1.32 The flows taken forward to the hydraulic analysis are shown in Table 7 below.

Table 7: Bayleys Brook peak flow calculation results using ReFH

AEP	**Flow (m^3/s)**
50%	1.64
20%	2.16
10%	2.56
5%	2.98
2%	3.62
1%	4.20
1% AEP + CC	5.04
0.1%	7.46

6.1.33 The flooding extents for a range of return periods up to the 1% AEP + CC generated by the baseline models are shown on in Figure 5. The flood extents are provided in main ES Volume 5: Map book WR-05 and WR-06 for the 1% AEP plus CC and the 5% AEP events.

Figure 5: Flooding extents for the 1% AEP + 20% CC for Bayleys Brook from baseline modelling



6.1.34 The results of the baseline modelling indicate that the location of the proposed route is affected by river flood risk.

6.1.35 The flooding extents from the baseline model are broadly consistent with the Environment Agency's flood zone mapping. The notable exception is the lack of flooding within the pond to the west, and a smaller extent to the east of Bayleys Brook. This is due to the differences in the quality of digital terrain models used; where the Environment Agency's flood zone mapping data did not include the embankments surrounding the pond area.

6.1.36 Key flood risk receptors are the upstream Truggist Lane, agricultural land, Lavender Hall Farm and fisheries located on the western bank of the watercourse. The fisheries are shown to be outside of the 1% AEP + CC flood extent as they are bounded by a high ridge on their eastern boundary. The fisheries could still be susceptible to inundation from flood water through any outfalls discharging into Bayleys Brook.

6.1.37 The model extent does not reach upstream to Truggist Lane and the baseline flood risk to this receptor is not directly assessed. Any backwater affect from the proposed development and resultant increase in flood risk is discussed in the post development section of this report.

6.1.38 It is noted from the Environment Agency flood mapping that Truggist Lane may suffer from flooding and there is a low spot in vertical alignment of the highway as it passes beneath the rail line. Interrogation of the topography at and upstream of the road crossing would support the likelihood that any overtopping of Truggist Lane would most likely flow towards the low point of the road. Berkswell Station is located off Truggist Lane to the south west of the proposed development. The railway line itself is demonstrated to be outside of the 1% AEP floodplain extent for the model extents. The railway may be at risk of flooding upstream of Truggist Lane.

Bayleys Brook at Marsh Farm crossing

6.1.39 A one dimensional steady state model (HEC-RAS) was considered sufficient for assessing peak water levels for the range of flood events for both the baseline and post development scenarios for this crossing. The details of the model build are discussed in the modelling report included in main ES Volume 5: Appendix WR-004-018.

6.1.40 A preliminary hydrological investigation has been undertaken in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream of the proposed route crossing point. The hydrology report is included in main ES Volume 5: Appendix WR-004-016.

6.1.41 The flows taken forward for hydraulic analysis are shown in Table 8 below.

Table 8: Bayleys Brook (Marsh Farm) peak flow calculation results using ReFH

AEP	Flow (m^3/s)
50%	2.27
20%	2.94
10%	3.46
5%	3.99
2%	4.82
1%	5.56
1% AEP+ CC	6.67
0.1%	9.73

6.1.42 The flooding extents for a range of return periods up to the 1% AEP + CC generated by the baseline models are shown on in Figure 6. The flood extents are provided in Volume 5: Map book WR-05 and WR-06 for the 1% AEP plus CC and the 5% AEP events. While water levels at key locations for the full range of return periods are provided in Table 9.

Figure 6: Flooding extents for the 1% AEP plus CC for Bayleys Brook from baseline modelling

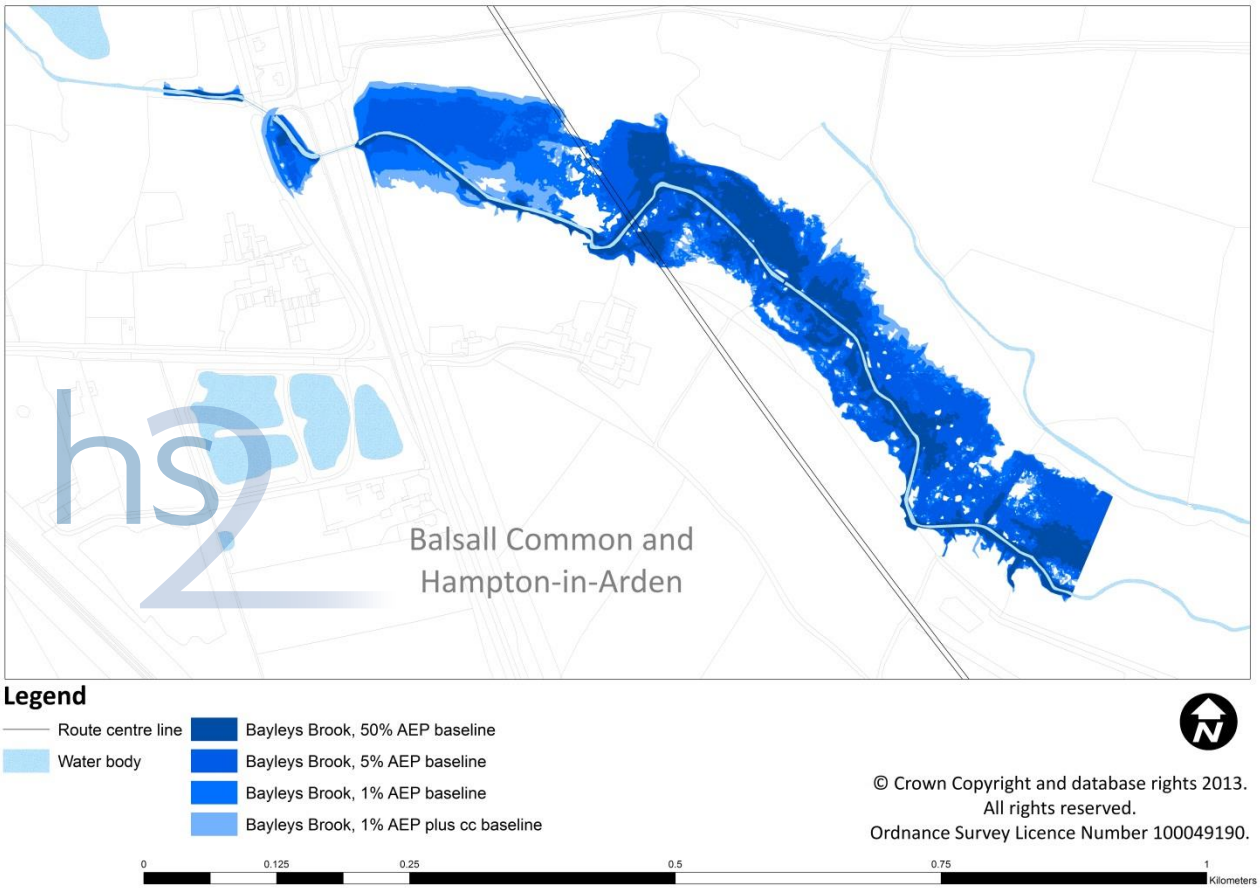


Table 9: Bayleys Brook flood levels (mAOD) at Marsh Farm (for cross-section locations see Volume 5: Appendix WR-004-018 Section 6)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Upstream of Marsh Lane, model cross-section 6	88.804	88.935	89.026	89.112	89.377	89.534
A452 & Bridleway Diversion – upstream of A452, model cross-section 8	89.605	89.672	89.704	89.707	89.741	89.843
Upstream, model cross-section 8.4	90.521	90.594	90.645	90.676	90.71	90.734
Upstream, model cross-section 11	90.788	90.842	90.875	90.903	90.938	90.968
Parallel to route – Baseline, model cross-section 12	90.996	91.035	91.061	91.086	91.12	91.151

6.1.43 Key flood risk receptors associated with Marsh Farm are Mercote Lodge and Marsh Farm Cottage which are located upstream of the A452 Kenilworth Road, both are elevated above the 1% AEP plus CC floodplain. Berkswell Marsh SSSI is located approximately 500m upstream of the proposed route crossing but is within the baseline floodplain. As such any changes to the hydrological operation of the watercourse could adversely impact on the SSSI. Mercote Lodge is located downstream of Marsh Lane and while it is identified as being outside of the 1% AEP plus CC flood extent it may be at risk of flooding via any drainage outfall connections. It should also be noted that there is uncertainty regarding the flood modelling due to absence of channel survey data.

6.1.44 Following analysis using the one dimensional model the floodplain was noted to split from the channel with divided flow. A two dimensional model may be required for future analysis to improve the accuracy of the modelling results in conjunction with further survey work.

6.1.45 Environment Agency river network GIS data notes a possible culvert from a tributary of the Bayleys Brook to the River Blythe Bypass Channel, this is shown in main ES Volume 5: Map WR-01-040. The culvert is denoted as assumed in the Environment Agency data and the presence of this culvert is currently unconfirmed. The flows that would pass through this culvert have been included in the flood modelling and assessment for Bayleys Brook at the Marsh Farm viaduct. The existence of this culvert will be confirmed during the detailed design stage and should a diversion be required this will developed in consultation with the Environment Agency and Lead Local Flood Authority.

Lavender Hall Lane

6.1.46 Due to the watercourse's relatively linear, uniform floodplain at the proposed route location a one dimensional steady state model (HEC-RAS) was considered sufficient for assessing peak water levels for the range of flood events for both the baseline and post development scenarios. The details of the model build are discussed in the modelling report included in main ES Volume 5: Appendix WR-004-018.

6.1.47 A preliminary hydrological investigation has been undertaken in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream of the proposed route crossing point. The hydrology report is included in main ES Volume 5: Appendix WR-004-016.

6.1.48 The flows taken forward to the hydraulic analysis are shown in Table 10 below. Climate change has been included as a 30% increase on the 1% AEP flows as the proposed structure is a culvert.

Table 10: Bayleys Brook peak flow calculation results using ReFH

AEP	Flow (m^3/s)
50%	1.8
20%	2.4
10%	2.8
5%	3.2

AEP	Flow (m^3/s)
2%	3.9
1%	4.6
1% AEP+20%	5.5
1% AEP+30%	5.9
0.1%	8.1

6.1.49 The flooding extents for a range of flood events up to the 1% AEP plus 30% CC generated by the baseline models are shown on in Figure 7. The flood extents for the 5% AEP and 1% AEP plus CC are included in main ES Volume 5: Map book WR-05 and WR-06. Water levels at key locations for the full range of return periods are provided in Table 11.

Figure 7: Flood extents for the 1% AEP plus 30% CC for Bayleys Brook from baseline modelling

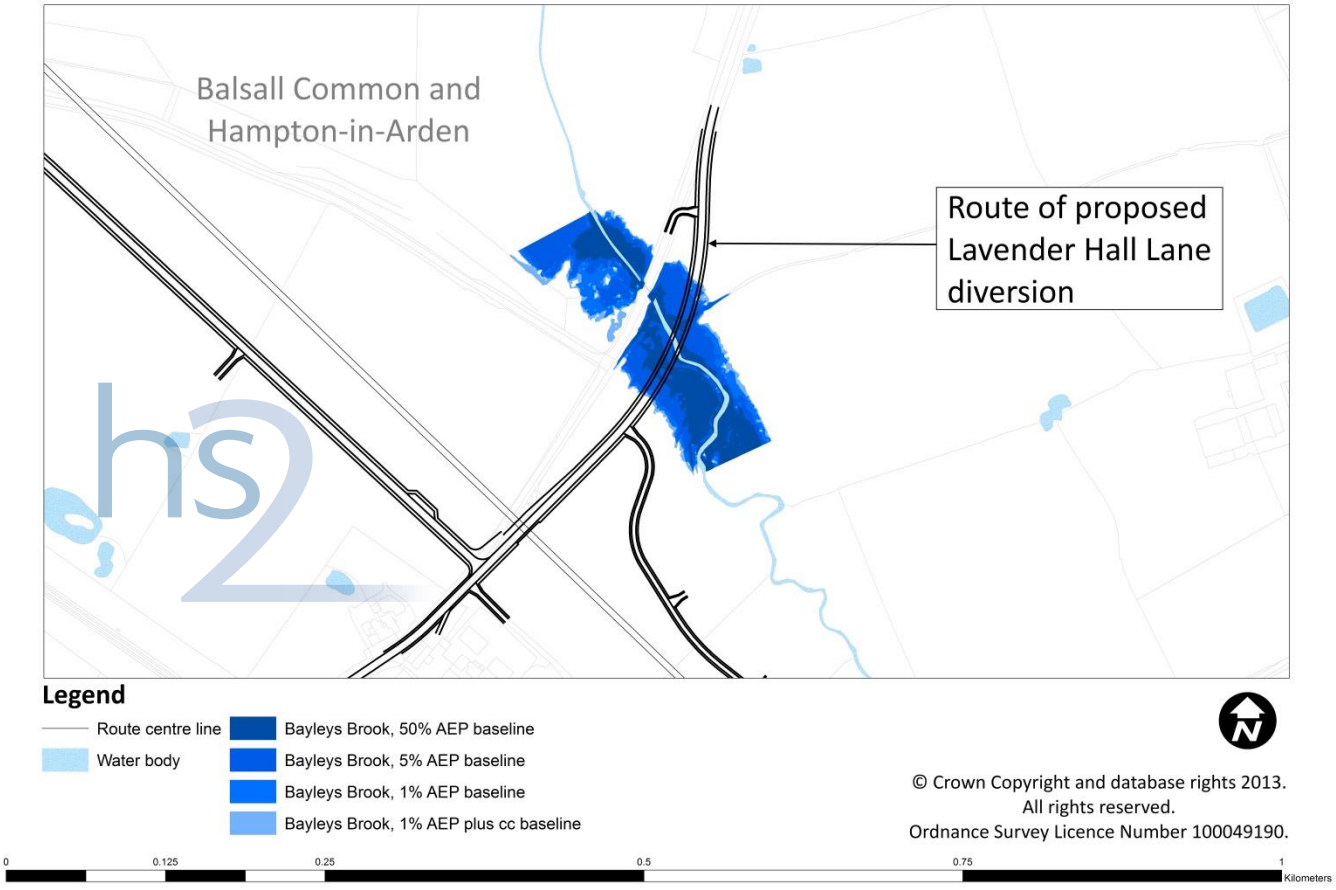


Table 11: Bayleys Brook flood levels (mAOD) at Lavender Hall Lane (for cross-section locations see Volume 5: Appendix WR-004-018 Section 5)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
A452 Diversion downstream of Lavender Hall Lane (model cross-section 4)	102.05	102.198	102.302	102.405	102.412	102.448
Upstream of Lavender Hall Lane diversion (model cross-section 5)	102.445	102.481	102.479	102.517	102.55	102.603

6.1.50 The results of the baseline modelling confirm the extent to which Lavender Hall Lane is currently affected by river flood risk.

6.1.51 The flooding extents from the baseline model are broadly consistent with the flood zone mapping data although the upstream position aligns more accurately with the main channel position.

6.1.52 The existing Lavender Hall Lane is predicted to over top for events exceeding the 10% AEP. Park Lane is also located downstream of the Lavender Hall Lane but is not predicted to flood up to the 1% AEP plus 30% CC. Other receptors in the vicinity of the Lavender Hall Lane crossing are agricultural land located either side of the crossing and Park Lane Spinney located immediately downstream on the left bank.

River Blythe bypass (River Blythe tributary)

6.1.53 The River Blythe bypass is a watercourse that diverges from a larger channel (Horn Brook) which originates to the east of the A452 Kenilworth Road. The divergence occurs immediately downstream of the road crossing with the majority of flow being conveyed by the Horn Brook which flows in a northerly direction towards the River Blythe. The River Blythe bypass is a secondary channel which conveys a smaller proportion of flow in a south-westerly direction while also functioning as a land drain. The hydraulic model splits the flow between the Horn Brook and River Blythe Bypass, with less than 20% of the catchment flow discharging to the Blythe Bypass.

6.1.54 The watercourse confluences with the River Blythe approximately 320m downstream of the route. The catchment area is approximately 11.3km^2 and is predominantly rural. It is an Ordinary Watercourse for which SMBC are the Local Flood Authority.

6.1.55 Due to the watercourse's relatively linear, uniform floodplain at the proposed route location a one dimensional steady state model (HEC-RAS) was considered sufficient for assessing peak water levels for the range of flood events for both the baseline and post development scenarios. The details of the model build are discussed in the modelling report included in main ES Volume 5: Appendix WR-004-018.

6.1.56 A preliminary hydrological investigation has been undertaken in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream the proposed route crossing point. The hydrology report is included in the main ES Volume 5: Appendix WR-004-016.

6.1.57 The flows taken forward to the hydraulic analysis are shown in Table 12 below.

Table 12: River Blythe bypass peak flow calculation results using ReFH

AEP	Total Flow (m^3/s)
50%	1.52
20%	1.99
10%	2.36
5%	2.75
2%	3.35
1%	3.90
1% AEP+20%	4.68
0.1%	7.05

6.1.58 The flooding extents for a range of return periods up to the 1% AEP + CC generated by the baseline models are shown on in Figure 8. The flood extents are provided in Volume 5: Map book WR-05 and WR-06 for the 1% AEP plus CC and the 5% AEP events. While water levels at key locations for the full range of return periods are provided in Table 13.

Figure 8: Flooding extents for the 1% AEP plus 20% CC for River Blythe Bypass from baseline modelling

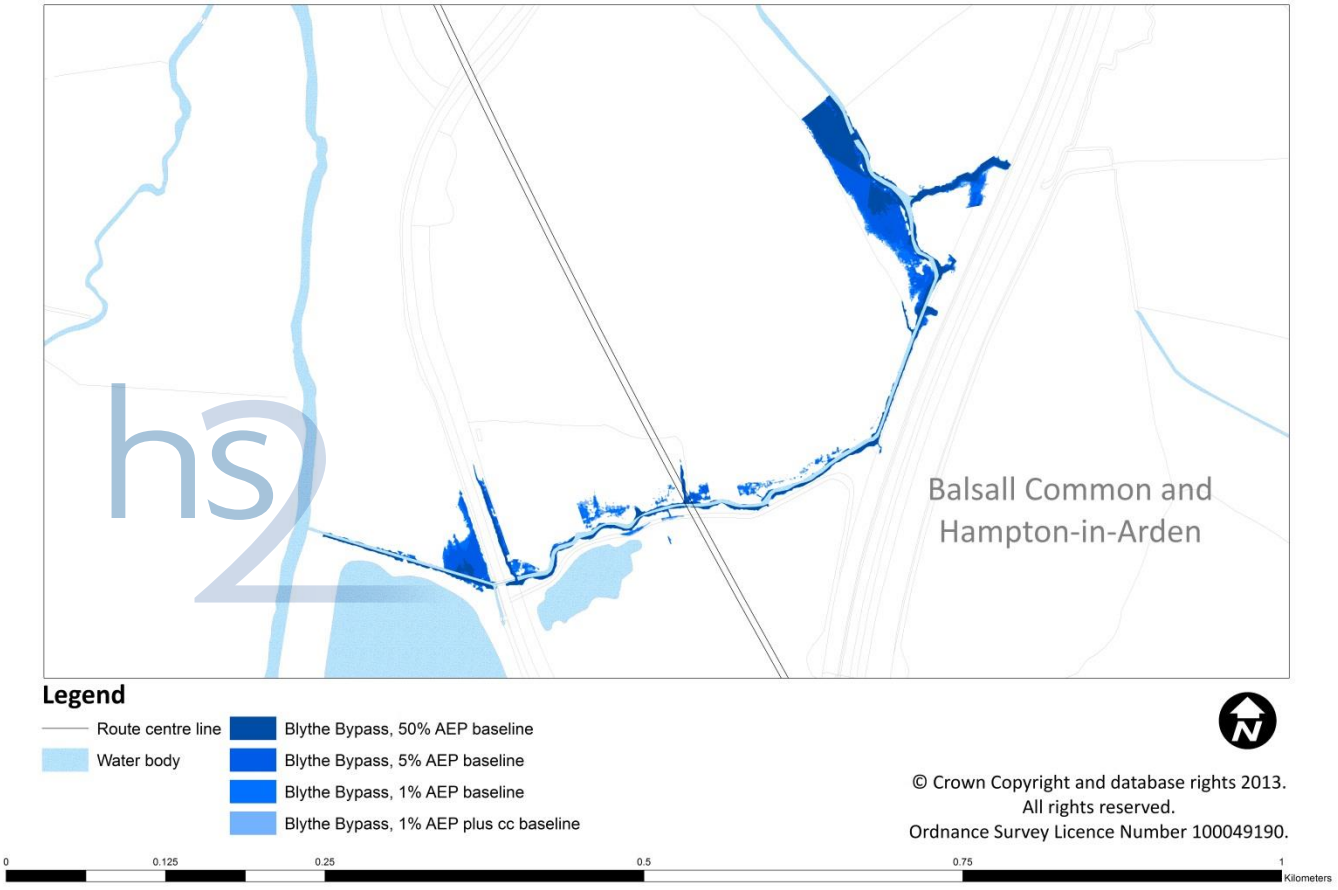


Table 13: River Blythe Bypass flood levels (m) at Blythe Bypass culvert (for cross-section locations see Volume 5: Appendix WR-004-018 Section 7)

	AEP					
Proposed scheme feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1%plus CC**
Downstream of River Blythe Bypass culvert, model cross-section 311	86.161	86.229	86.269	86.355	86.39	86.423
Downstream of River Blythe Bypass culvert, model cross-section 355	86.222	86.327	86.376	86.407	86.438	86.471

6.1.59 The results of the baseline modelling confirm the extent to which the route is affected by river flood risk.

6.1.60 The flooding extents from the baseline model are generally consistent with the Environment Agency flood zone mapping data at the proposed route crossing, showing a significant backwater extent from the River Blythe extending beyond the River Blythe bypass culvert.

6.1.61 Flood risk receptors are primarily agricultural land although the A452 Kenilworth Road is crosses the Blythe Bypass channel upstream of the Proposed Scheme and will be diverted as part of the Proposed Scheme.

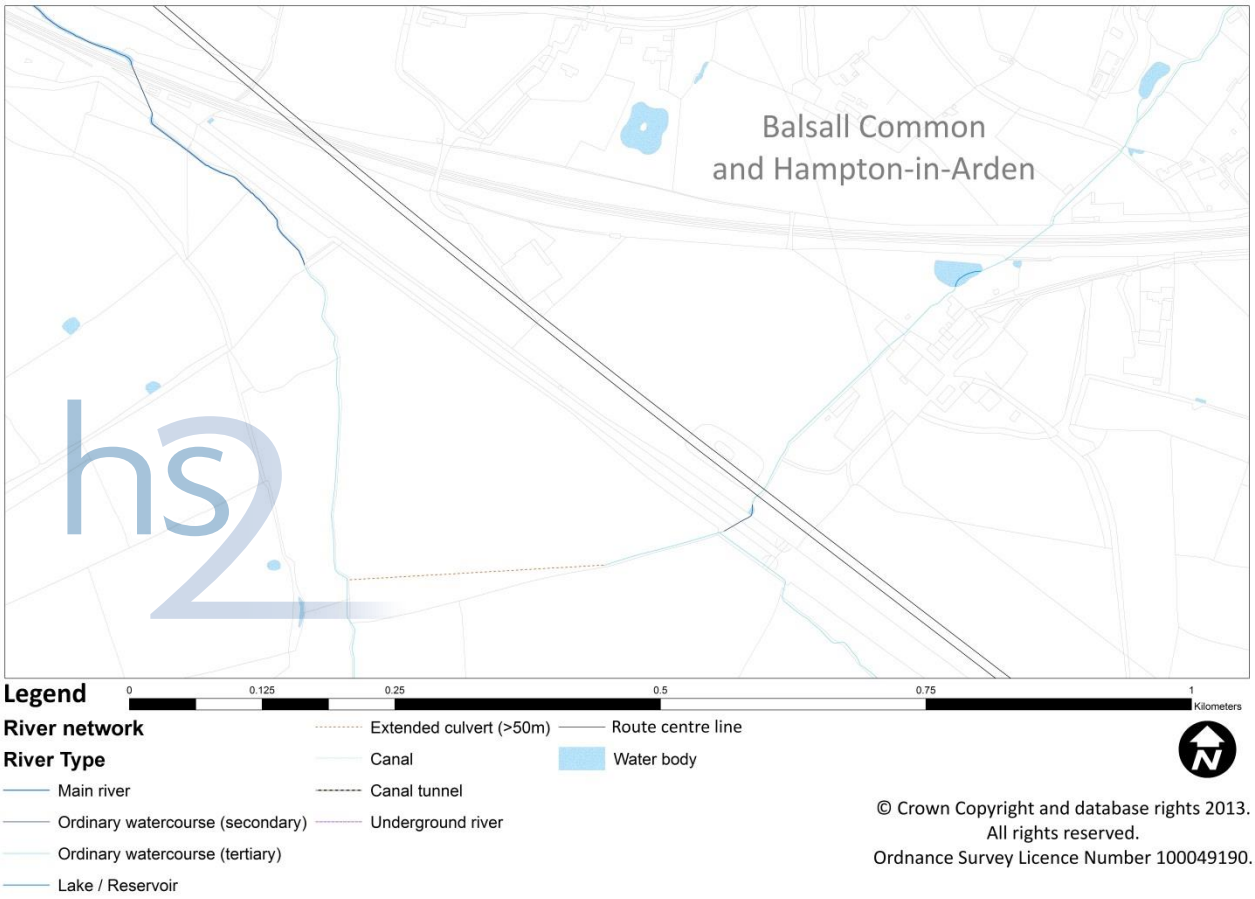
Other tributaries

6.1.62 There is one minor watercourse that also crosses the proposed route north-west of Beechwood Farm underpass. The location of this watercourse is shown in Figure 9.

6.1.63 There is an un-named watercourse that is a small tributary of Bayleys Brook and drains a predominantly rural catchment of 2.9km^2. There is an existing culvert located downstream of the Proposed Scheme which passes beneath an abandoned railway embankment (now part of the Kenilworth Greenway). There is no floodplain identified on the Environment Agency flood zone mapping.

6.1.64 A preliminary hydrological investigation has been undertaken in order to understand the magnitude of flows generated by the catchment up to a point a short distance downstream the proposed route crossing point. The hydrology report is included in main ES Volume 5: Appendix WR-004-016.

Figure 9: Watercourse crossing at Beechwood Farm



6.1.65 The flows taken forward to the hydraulic analysis are shown in Table 14.

Table 14: Peak flow calculation results using ReFH

AEP	Peak flow (m^3/s)
50%	0.9
20%	1.18
10%	1.40
5%	1.63
2%	1.98
1%	2.30
1% AEP+20%	2.76
1% AEP+30%	2.99
0.1%	4.10

6.1.66 Detailed baseline flood mapping has not been established for this smaller watercourse but the potential impact of the development on flood risk and the risk to the development has been assessed using the culvert analysis method described in CIRIA Report C689. The flood risk management of these smaller watercourses is discussed in Section 8.

6.2 Surface water flooding

6.2.1 This section is an examination of the existing flood risk posed by rainfall hitting the ground surface. This is often referred to as surface water. In this section it is examined in two ways (i) in terms of the risk posed in the event of failure or exceedance of existing drainage systems, and (ii) in terms of examining the pathways exploited by water flowing over the ground.

6.2.2 This can manifest itself as ponding or surface water flow when flows cannot enter a drainage system because the capacity is exceeded. Flooding can also occur when the surface water flow pathway reaches a receptor. This is also referred to as surface water flood risk.

6.2.3 Flood risk is assessed by examining existing surface water flow routes and reviewing the potential risk posed by the existing systems in place designed to manage surface water.

Drainage systems

6.2.4 The proposed route commences north-west of Waste Lane (see main ES Volume 2: Map CT-06-100, E6), adjacent to the Kenilworth Greenway and then proceeding towards the existing Rugby to Birmingham line, crossing it south-east of Berkswell station.

6.2.5 Continuing north-east of Berkswell station the route will cross Truggist Lane, Bayleys Brook, Lavender Hall Lane and several PRoW including the Millennium Way and the Heart of England Way (Footpath M214).

6.2.6 The route will then continue broadly parallel to the A452 Kenilworth Road which it will cross in close proximity to Marsh Lane Nature Reserve. It will then cross over the B4102 Meriden Road, the River Blythe and Diddington Lane and leave this area south-east of the A45 Coventry Road, near to Pasture Farm.

6.2.7 Due to the semi-rural location, there are only localised sewer networks through this area. The majority of the drainage systems will be the responsibility of Severn Trent Water and SMBC for highway drainage.

Route wide within CFA23

6.2.8 The existing public sewer networks owned by Severn Trent Water within the catchments affected have been interrogated and there are no significant interactions between the Proposed Scheme and the existing sewerage network within the Balsall Common and Hampton-in-Arden area. Highway drainage and some private drainage may be encountered along the route but no records are available to inform this flood risk assessment.

Surface water flow flood risk

6.2.9 The assessment of the existing flood risk posed by existing surface water flow routes has been based on the following:

- an investigation of existing topography using contours generated from LiDAR survey data;
- examining the Environment Agency's surface water flood mapping; and
- documenting any reported instances of flooding from the SMBC's SFRA and PFRA.

6.2.10 The proposed route crosses a number of natural drainage paths which form valleys in the topography. Consequently local surface water routes are towards the proposed route in number of localities. The general direction of surface water flow is shown in Annex A. These plans do not take into account the influence of infrastructure such as roads where any surface water flow could be intercepted by artificial drainage.

6.2.11 The Environment Agency's surface water flood mapping has also been examined and is shown in drawing series main ES Volume 5: Maps WR-01-039 and WR-01-040. These have been compiled by the Environment Agency using a simple ground model to indicate where surface water would be expected to flow or pond during the 0.5% AEP rainfall event. The mapping provides an indication of flooding greater than 0.1m depth and flooding greater than 0.3m deep. This data does have limitations but illustrates areas that may be at risk and where a more detailed study may be required as the design develops.

6.2.12 The data set primarily identifies flooding along watercourse floodplains which is addressed separately as part of this flood risk assessment. However, there are a number of significant features that would be expected to accumulate significant depths of water during rainfall events. The data set has been used to identify the following locations along or in close proximity of the propose route where surface water flow may be a flood risk consideration:

- ponding to the north east of Kenilworth Greenway (elevated on embankment;
- ponding adjacent to the existing railway embankment west of Carol Green;
- ponding of surface water at a low point in topography formed by the embanked A452 Kenilworth Road; and
- ponding of water behind the embanked A45 Coventry Road (south of Birmingham interchange station).

6.2.13 The PFRA reports a single historic flood event within 500m of the proposed route, located to the east of Berkswell Station, approximately 50m from the route. Surface water drainage will be designed for the scheme, and provided all mitigations measures identified are included there is no significant increase in flood risk identified.

6.3 Groundwater

6.3.1 Groundwater flood risk within the Balsall Common and Hampton-in-Arden area has been qualitatively assessed based on hazard identification and evaluation using the conceptual understanding of the ground conditions along the route as informed by geotechnical desk studies. The assessment of baseline groundwater flood risk is based on the presence or otherwise of an aquifer and the relative depth to groundwater level, as well as historical information on the occurrence of groundwater flooding incidents.

Baseline description

6.3.2 The following sections present details of the ground conditions along the route within the Balsall Common and Hampton-in-Arden area and a literature review of historical groundwater flooding incidents from the SMBC SFRAs.

Geology

6.3.3 The solid and superficial geology of the route corridor is presented below.

Solid geology

6.3.4 The geological structure of the Balsall Common and Hampton-in-Arden area comprises Triassic deposits (Mercia Mudstone group) forming part of the Knowle Basin, overlain by glacial and alluvial superficial deposits. At Lavender Hall Lane overbridge the route will cross the Meriden fault, which trends north to south and forms the western margin of the Warwickshire coalfield. South-east of this location, the geological structure comprises the uppermost part of the carboniferous Warwickshire group (Tile Hill Mudstone formation) overlain by alluvial superficial deposits. At depth the productive coal measures which include the Warwickshire thick coal are present.

6.3.5 Carboniferous Tile Hill Mudstone is present beneath the route in the Balsall Common and Hampton-in-Arden area from the start of the section at Burton Green to the western boundary fault at about Lavender Hall Lane. North-west of this fault the bedrock geology is the Triassic Mercia Mudstone Group for the remainder of the section. Near the Marsh Farm viaduct, a fault associated with an outcrop of Bromsgrove Sandstone just to the east intersects the proposed route. Around Diddington Lane there is a 150m wide outcrop of Arden Sandstone, which includes beds of sandstone and mudstone.

Superficial geology

6.3.6 In terms of superficial geology, the area of the route within the Balsall Common and Hampton-in-Arden area is characterised by widespread glacial deposits dating from the Mid Pleistocene. These comprise Glaciofluviual deposits, Glaciolacustrine deposits and Glacial Till.

6.3.7 The Glaciofluvial deposits are generally sands and gravels, forming large plateaux. These are locally up to approximately 25m thick and have been quarried in the area. One significant area extends from Lavender Hall Lane to Patrick Farm.

6.3.8 A small outlier of Glaciofluvial deposits is also present from near the Pasture Farm overbridge to near the A45 Coventry Road service road overbridge around Diddington Hill, just south of the A45 Stonebridge Highway.

6.3.9 Glaciolacustrine deposits, typically laminated clays and silts, are only mapped near Birmingham Business Park from the M42 motorway underbridge northward. Whilst this is mostly outside the extents of this area (CFA23), Glaciolacustrine clays were also identified in some historic boreholes as noted in the following sections.

6.3.10 The Glacial Till has been largely eroded but occurs beneath the proposed route between the Heart of England Way bridge and the Sixteen Acre Wood bridge.

6.3.11 A thin covering of Head deposits is present on valley sides and slopes in the area, locally up to several metres thick. This is not shown on the BGS mapping but was identified in a number of the historic boreholes.

6.3.12 Narrow channels of Alluvium are present close to stream courses, overlying the glacial deposits. The River Blythe valley contains more mature river deposits where the route will cross it between the River Blythe overbridge and near the River Blythe viaduct including River Terrace deposits and a wider channel of Alluvium.

6.3.13 Made Ground occurs at various locations throughout the route within this study area. It is mainly associated with highway earthworks and landscaping around developments, but has also been used for land raise and backfill to gravel pits.

6.3.14 Superficial glacial deposits resulting from several phases of glaciations during the Anglian and probably Wolstonian glacial periods, between approximately 400,000 and 200,000 years ago, are present beneath much of the route within the study area. Due to erosion after the last glacial phase, the cover of glacial material is discontinuous in places. During the last (Devensian) glacial period, that finished approximately 10,000 years ago, glacial ice did not reach this area, but periglacial permafrost conditions prevailed across the region.

6.3.15 Most of the glacial deposits beneath the route within the study area are sands and gravels formed during a glacial retreat phase by southward flowing melt water. These glacial sands and gravels form an extensive, but now dissected spread, beneath the axis of the River Blythe valley and form a significant local aggregate resource. They vary widely in lithology from fine grained silty sands to coarse poorly sorted boulder gravel. They are generally 5m-10m thick but can be up to 15m thick.

Hydrogeology

6.3.16 The strata have been classified using the Environment Agency aquifer classification framework[22] which is consistent with The Water Environment (EU Water Framework Directive (2000) [23]) England and Wales) Regulations. (2003). Statutory Instrument 2003 Mo. 3242. The aquifer designations for each stratum are summarised in Table 15.

22. Environment Agency, (2013). *Aquifer Classification Framework* [online], [Accessed 05-02-2013]. Available from: http://www.environment-agency.gov.uk/homeandleisure/117020.aspx.

23. Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy, European Council.

Table 15: Aquifer designations for geological units in CFA23

Geological Unit	Aquifer Designation
Alluvium	Secondary A
Head	Secondary Undifferentiated
River Terrace Deposits	Secondary A
Glacial Till	Unproductive
Glaciofluvial Deposits and Glacioacustrine Deposits	Secondary A
Mercia Mudstone	Secondary B
Arden Sandstone	Secondary A
Bromsgrove Sandstone (Sherwood Sandstone Group)	Principal
Tile Hill Mudstone (Warwickshire Group)	Principal

6.3.17 The Aquifer Designation is as follows:

- Secondary A Aquifers are considered to consist of variable permeability layers capable of supporting water supplies at a local scale.
- Secondary B Aquifers are predominantly of lower permeability and may locally store groundwater due to localised features such as thin fissures, thin permeable horizons and weathering.
- Principal Aquifers are highly inter-granular and/or fractured and the permeability is such that they are able to support water supply and river base flow at a strategic scale.

6.3.18 No Groundwater Source Protection Zones (SPZ) are located along or within 250m of the proposed route as shown in main ES, Volume 5: Map WR-02-23 groundwater baseline.

6.3.19 The valley bottom of a tributary to the River Blythe at the Marsh Farm viaduct was noted to be poorly drained during the walkover. There may be a diffuse discharge of groundwater into this valley bottom from an inlier of Sherwood Sandstone to Berkswell Marsh SSSI as well as from the superficial sand and gravel deposits.

Historical occurrence of groundwater flooding

6.3.20 SMBC's SFRA identifies a number of historical flooding events due to a combination of surface water and river flooding. However there are no known problems with flooding from groundwater within 1km of the route centre line within the Solihull Metropolitan Borough.

Current groundwater flood risk

6.3.21 The superficial deposits along the CFA23 route are mainly free draining sands and gravels. The River Terrace deposits, Glaciofluvial deposits and Arden Sandstone are designated as Secondary A aquifers.

6.3.22 Groundwater strikes from available borehole logs and monitoring instrumentation show that water strikes predominate from near the Shadow Brook underbridge to the northern limit of CFA23, in the area of the Glaciofluvial outcrop. To the south of the area, groundwater is poorly recorded in the borehole logs, but near surface water levels can be expected in the River Blythe floodplain and the southern Glaciofluvial outcrop. The Bromsgrove Sandstone (Sherwood Sandstone Group) is designated a Principal aquifer but is not intersected by the proposed route.

6.3.23 Although there are areas of permeable superficial deposits associated with rivers and watercourses where relatively shallow groundwater levels are expected, the current level of groundwater flood risk is considered low, this is supported by information that there are no reported historical groundwater flooding incidents on record.

6.4 Artificial sources / infrastructure failure

6.4.1 Artificial sources of flood risk describe a mechanism whereby the source of flooding would be failure of infrastructure used to impound (reservoir), retain (dam) or convey water (water pipeline).

6.4.2 In CFA23 flooding is a realistic possibility from the failure of the following infrastructure:

- surface water sewerage systems;
- foul water sewerage systems;
- water supply pipe networks; and
- reservoir failure.

6.4.3 The nearest canal to the CFA23 proposed route and infrastructure is the Grand Union Canal which follows a general north to south route some 3.6km to the west of the route centre line at its closest point. The canal is predominantly in cutting or grade and is not considered to pose a significant flood risk to the Proposed Scheme.

Water supply network

6.4.4 Water mains and water distribution infrastructure are a potential source of flood risk in the event of a failure. This section identifies significant water mains within the network and their position relative to the proposed route for the baseline condition.

6.4.5 Significance of the water main is based on diameter and pressure. It is assumed that the majority of small diameter pipes within the network are of low risk as the rate at which water escapes will be low. Where the risk is not considered to be low the utility is presented in Figure 10 and Figure 11.

Figure 10: Balsall Common water mains

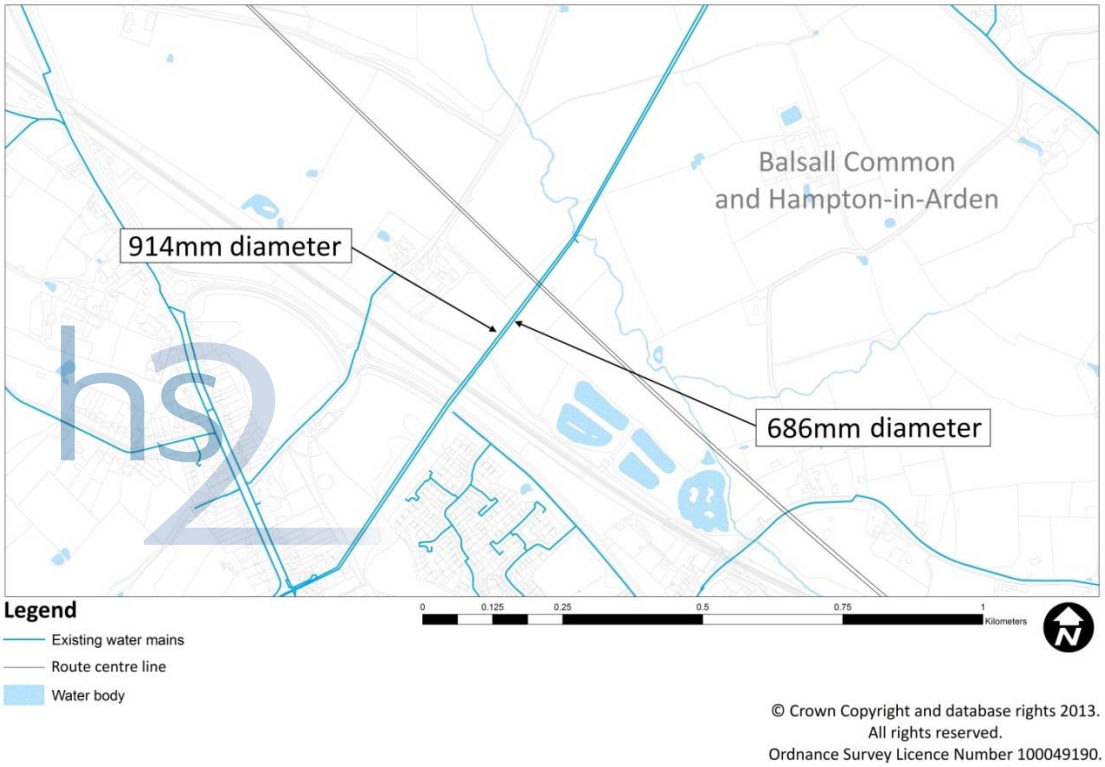
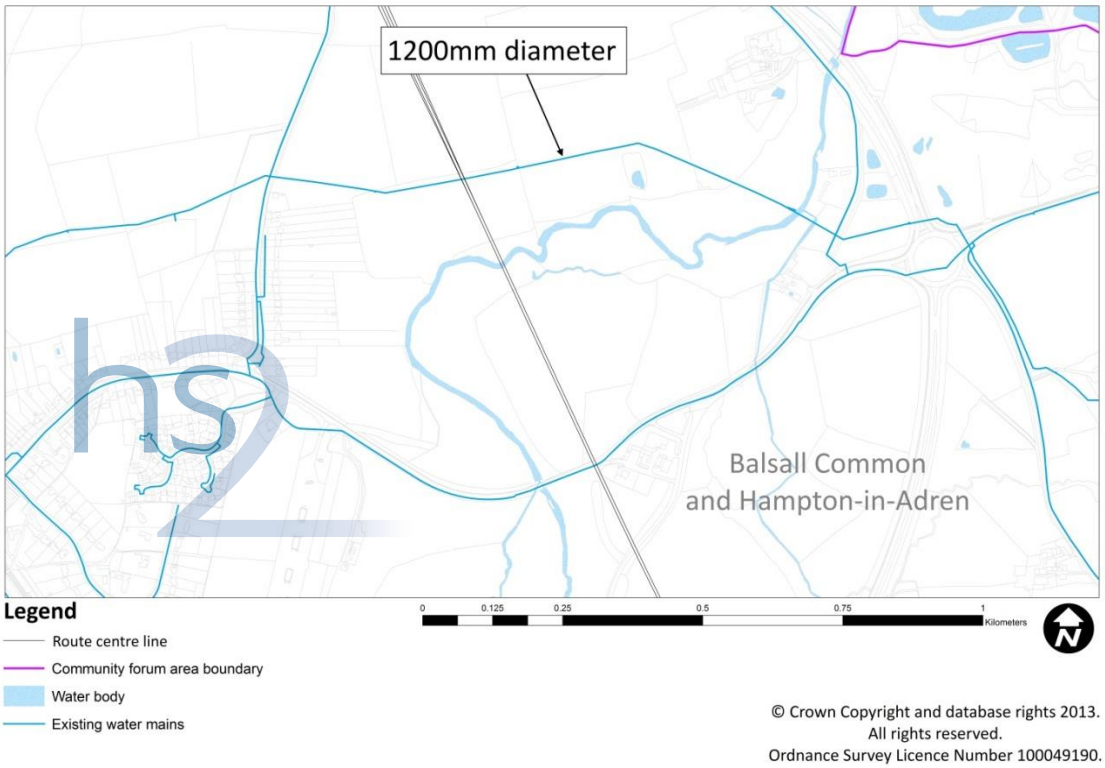


Figure 11: Blythe Valley water mains



6.4.6 An assessment of how existing water supply infrastructure interacts with the Proposed Scheme has been undertaken.

Reservoir failure

6.4.7 The probability of flooding occurring from the failure of a reservoir or large water body created by impoundment of water, by a dam or other retaining structure is extremely low. The Environment Agency's website reports that there has been no loss of life due to reservoir failure in the UK since 1925. All large water bodies across the UK have to be maintained and monitored to a very high standard under the Reservoir Act 1975[24]. This requires regular inspection of any water body designated a reservoir by a nominated engineer. However if a reservoir does fail the impact is likely to be severe and far reaching. It is a requirement of NPPF and The Flood and Water Management Act 2010[25] to evaluate the implications of reservoir failure on all proposed development even if the likelihood is very low. The Flood and Water Management Act 2010 proposes to change the capacity threshold at which reservoirs are regulated from 25,000m^3 to 10,000m^3. Secondary legislation which has yet to be enacted is required to enforce this change.

6.4.8 Although impounded water bodies with a capacity less than 10,000m^3 are not within the Reservoir Safety Act, they may still pose a significant flood risk and such water bodies are discussed in this chapter where appropriate.

6.4.9 The Environment Agency's Reservoir Inundation mapping for the Warwickshire area has been compared to the route within the study area.

6.4.10 There are three water bodies that are identified on the Environment Agency Reservoir Inundation maps as posing a flood risk to the River Blythe catchment in the vicinity of the proposed route. These are listed below:

- Earlswood lakes (including Engine Pool, Windmill Pool and Terry's Pool) located approximately 12km South West of the proposed route. These reservoirs are owned and maintained by the Canal Trust and are feeder reservoirs for the Stratford Upon Avon Canal. The flood pathway from these lakes would convey water along the River Blythe channel to the River Blythe viaduct approximately 26km downstream from the lakes;
- Meriden No. 1 and Meriden No. 2 Service Reservoirs are located approximately 4.2km from the proposed route. These reservoirs are owned and maintained by the Severn Trent Water. The flood pathway from the reservoirs would convey water through the village of Meriden and into the watercourse referred to as the River Blythe bypass in this report; and
- Geary's Level and Molands lakes, Packington, which are located less than 1km from the route and in close proximity to the Meriden Road. The lakes are owned and maintained by the Packington Estate Enterprises Ltd. The River Blythe is situated between the lakes and any proposed route infrastructure.

24. Reservoir Safety Act, (1975), London, Her Majesty's Stationary Office.

25. The Flood and Water Management Act, (2010), London, Her Majesty's Stationary Office.

6.4.11 The Environment Agency's Reservoir inundation food mapping shows the largest area that might be flooded if a reservoir were to fail. In most areas in vicinity to the River Blythe crossing the extent of inundation would be less extensive than the 1% AEP flood event as identified by the Environment Agency's Flood Mapping. However, the Environment Agency's data provided does not indicate flood depths, flow velocities or the time taken for onset of flooding after a breach takes place.

6.4.12 The mapping indicates that in the event of a catastrophic failure of any of the reservoirs in the Blythe catchment listed above the flood waters would flow down the rivers channels and extend out across the floodplain of both river systems.

6.4.13 In addition to the water bodies described above there are a number of smaller lakes and ponds which could pose a flood risk to the proposed route but which are not included in the reservoir mapping.

6.5 Summary of baseline flood risk

Table 16: Summary of baseline flood risk for all sources of flooding in CFA23

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
Rivers	River Blythe	Low to Very High Flood Zone 1 – 3b	Proposed Scheme including River Blythe viaduct, Patrick embankment and Diddington Lane embankment	The route runs in close proximity and crosses the River Blythe and so crosses all flood zones. Proposed Scheme set at above 0.1% AEP flood level plus appropriate freeboard. As such the Proposed Scheme is at low risk from the River Blythe.
	Shadow Brook	Low to Very High Flood Zone 1 – 3b	Proposed Scheme including Shadow Brook underbridge and embankments	The route runs in close proximity and crosses Shadow Brook and so crosses all flood zones. Proposed Scheme set at above 0.1% AEP flood level plus appropriate freeboard. As such the Proposed Scheme is at low risk from Shadow Brook.

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
	Horn Brook / River Blythe Bypass	Low to Very High Flood Zone 1 – 3b	Proposed Scheme including River Blythe Bypass culvert and embankments	The route runs in close proximity and crosses The River Blythe Bypass and so crosses all flood zones. Proposed Scheme set at above 0.1% AEP flood level plus appropriate freeboard. As such the Proposed Scheme is at low risk from the River Blythe Bypass
		Low to Very High Flood Zone 1 – 3b	A452 Kenilworth Road Diversion	The highway route runs in close proximity and crosses The Horn Brook and so crosses all flood zones. The level of the road is above the 1% +CC modelled flood levels plus the minimum freeboard requirements and as such is at low risk from the Horn Brook
	Bayleys Brook	Low to Very High Flood Zone 1 – 3b	Proposed Scheme, Balsall Common viaduct, Marsh Farm viaduct, Lavender Hall Lane culvert and embankments	The route runs in close proximity and crosses Bayleys Brook in two locations and so crosses all flood zones. Proposed Scheme set at above 0.1% AEP flood level plus appropriate freeboard. As such the Proposed Scheme is at low risk from Bayleys Brook.
			Truggist Lane and Birmingham to Rugby Line	Balsall Comon viaduct will convey flow up to 1% AEP plus climate change and replacement floodplain storage has been provided. No significant increase in flood risk.

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
	Unnamed Tributary	High	Proposed Scheme in cutting	Watercourse diversion appropriately sized and local protection to Proposed Scheme will be provided.
Surface water	Proposed Scheme drainage systems	Low	Land adjacent to receiving watercourses	Proposed Scheme drainage will be attenuated to pre-development greenfield/brownfield run-off rates within balancing ponds prior to discharge.
	Lavender Hall Lane and Park Lane diversion	Low	Land adjacent to Bayleys Brook.	Additional run-off from diversions will be attenuated to pre-development greenfield/brownfield run-off rates within balancing ponds prior to discharge.
	A452 Kenilworth Road	Low	Land adjacent to Horn Brook	No increase in paved area as a result of diversion so no significant increase in flood risk.
Artificial sources	Waterbodies contributing to the River Blythe and Horn Brook catchment. Earlswood lakes, Meriden No. 1 and Meriden No. 2 Service Reservoirs, Geary's Level and Molands lakes	Low - pathway exists within existing 1% AEP river flood flow	Proposed Scheme (embanked and viaducts)	Rail level set at >1m above 0.1% river flood level

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
Groundwater	Superficial deposits overlying the Tile Hill Mudstone from Lavender Hall Lane overbridge to the Heart of England Way bridge	Medium -high High groundwater levels within Secondary A Aquifer	Park Hall Cutting	No historical incidents of groundwater flooding
Groundwater	Superficial deposits overlying the Mercia Mudstone at Pasture Farm overbridge	Medium -high High groundwater levels within Secondary A Aquifer	Diddington Cutting	No historical incidents of groundwater flooding
Surface water	Kenilworth Greenway	Low	Beechwood embankment	Rail level is >1m above 0.1% AEP
Surface water	Rugby to Birmingham line	Low	Proposed Scheme	Rail level is >1m above 0.1% AEP
Surface water	A452 Kenilworth Road	Low	Diverted A452	The road is embankment and a culvert provided to allow passage of surface water flow.

Source of flooding	Location of flooding source	Flood risk category	Elements at risk	Assessment of risk
Surface water	A45 Coventry Road	Low	Proposed Scheme (Diddington Cutting)	Additional run-off from increased paved areas attenuated to greenfield run-off rates within balancing ponds prior to discharge to minor unnamed watercourse

7 Flood risk management measures

7.1.1 The purpose of this FRA is to demonstrate the flood risk impact of the Proposed Scheme within CFA23.

7.1.2 In this study area, the Proposed Scheme does result in some increases in flood depth and extent in some locations, however the FRA demonstrates that this does not significantly increase flood risk elsewhere and that the Proposed Scheme can be implemented without putting proposed infrastructure at risk of flooding.

7.1.3 In the first instance the risk of flooding from rivers and streams has been assessed and the water level generated by the 0.1% AEP river flood events has been calculated, with an allowance for blockage of existing culverts and bridges. The rail level will be set a minimum of 1m above this level, or a flood protection structure will be provided.

7.1.4 To do this a number of physical mitigation measures have had to be included in the design to either safeguard adjacent land users or the Proposed Scheme and associated infrastructure. These physical measures are described below.

7.1.5 Flood alleviation culverts will be provided at Lavender Hall embankment.

7.1.6 Partial replacement floodplain storage will be provided at Lavender Hall embankment, Lavender Hall Lane, Marsh Farm viaduct, River Blythe viaduct and Shadow Brook underbridge.

7.1.7 Surface water management across CFA23 will be provided to collect and convey surface water away from the Proposed Scheme and adjacent third party land vulnerable to flooding (water sensitive properties and infrastructure) up to the 0.1% AEP rainfall event. To achieve this on site flows will be strictly regulated by implementing attenuation storage and off site receptors will be considered in the event of rainfall events that exceed the design standard.

8 Post-development flood risk assessment

8.1 River flood risk

River Blythe

8.1.1 The key design elements with potential river flood risk considerations associated with the River Blythe catchment are:

- a viaduct crossing of the River Blythe;
- modifications to Stonebridge Island adjacent to the River Blythe; and
- a new junction on the A452 Kenilworth Road diversion adjacent to the River Blythe.

River Blythe viaduct crossing

8.1.2 The route crosses the River Blythe channel and floodplain between B4102 Meriden Road and the A452 Kenilworth Road, approximately parallel to the route of the A452 Kenilworth Road. The route will cross the floodplain on a 19 span, approximately 480m long viaduct.

8.1.3 The River Blythe viaduct has been incorporated into the baseline river hydraulic model of the River Blythe to produce a post-development model. The full range of flood events (50%, 20%, 10%, 2%, 1% and 1% plus climate change) have been simulated within this model to determine the impact caused by the Proposed Scheme on the performance of the River Blythe for a range of flood conditions.

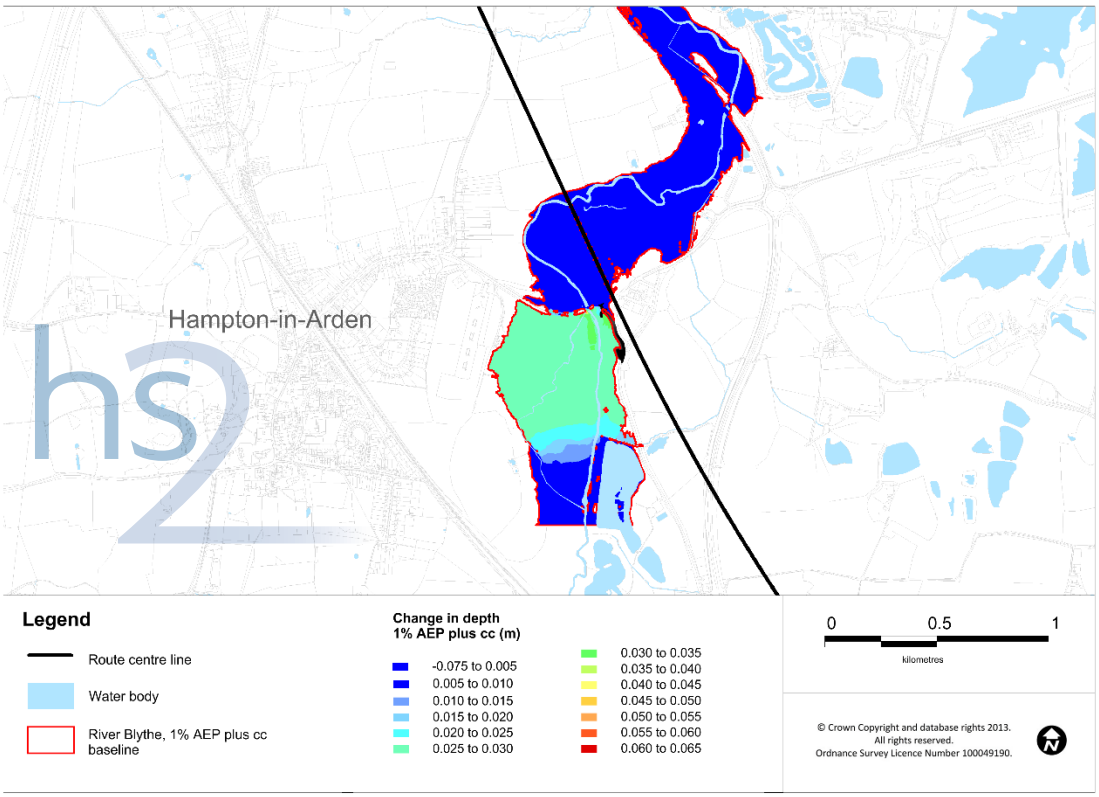
8.1.4 The River Blythe viaduct has been modelled with 17 clear spans of ~24.3m, one partially obstructed span to the north to represent the abutment of the Diddington Lane embankment, and one clear span of 24.9m to the south crossing Meriden Road. Each pier has been modelled as a 3m wide pier due to the grid size.

8.1.5 The impact of the Proposed Scheme on the River Blythe flood levels and flooded extents for the 1% AEP plus CC event is discussed in detail. The impact on lower return period flood events are only discussed if the nature of the Proposed Scheme infrastructure may increase flood risk during less extreme events but not cause a significant impact at the 1% AEP plus CC event.

8.1.6 The 0.1% AEP flood level is referenced to determine the risk to the Proposed Scheme only.

8.1.7 The change in flood depths between the post-development and baseline models are shown in Figure 12 for the 1% AEP plus CC. Where there is less than 1mm increase in flood depth between baseline and post development, this has not been shown. Where there is a depth increase greater than 60mm this has also been removed as these are due to changes in flood extent, i.e. areas of new flooding, which can be seen on Volume 5: Map book WR-05.

Figure 12: Flooding extents for the River Blythe post-development model with change to peak water level – 1% AEP + CC



8.1.8 Upstream of the B4102 Meriden Road, there will be an increase in flood levels (typically 30mm or less at the 1% AEP plus CC event on agricultural land and a marginal increase to flood extent (0.2% of the baseline flood extents) due to the Proposed Scheme. This land already floods under current baseline conditions and the Proposed Scheme will not change the frequency or the duration of flooding at this location.

8.1.9 Downstream of the B4102 Meriden Road, between this and the Proposed Scheme, there is negligible increase (typically 2mm or less, but up to a maximum of 5mm) in flood level or extent for the majority of the floodplain at the 1% AEP plus climate change event.

There is a localised increase in flood level, up to 30mm at the 1% AEP plus climate change event for an isolated region north west of the B4102 Meriden Road. There are also increases in flood extent associated with this isolated region (approximately 0.02% of the baseline flood extents) around the perimeter of the baseline flood extent. It is believed this is due to a topographical low spot and if the depiction of the flow characteristics around this low spot were refined it is likely that this impact would be reduced.

There are also localised increases on the upstream side of the piers on the right hand floodplain caused by flow path obstruction. These localised increases are replicated at lower return periods but do not exceed 20mm – there is no change to flood frequency or duration.

8.1.10 The B4102 Meriden Road has increased flood levels typically 30mm or less (but in a few isolated locations there are increases of up to 60mm) for the 1% AEP plus CC simulation and small increases in flood extent. A few marginal increases in flood extent at the perimeter of the baseline flood extent is also predicted.

This road is flooded in the baseline to levels of approximately 300mm at the 1% AEP plus CC event. The increase in flooding does not alter the hazard classification[26] of the road under flood events. The depth and velocity of baseline flooding predicted by the model for the 1% AEP plus CC event corresponds with a hazard rating of "danger to most", the changes to flood depth and velocities as a result of the scheme is insufficient to cause a change in this hazard rating. There is no significant change to flood duration or frequency.

8.1.11 Downstream of the Proposed Scheme there is no change in flood depths or extent up to the 1% AEP plus CC.

8.1.12 Typical changes in depths have been recorded in Table 17.

Table 17: Typical changes in depth from the River Blythe post-development model

Location	Typical change in depth (mm)
Between B4102 Meriden Road and the Proposed Scheme	0
B4102 Meriden Road	30
Upstream of B4102 Meriden Road	30

8.1.13 The post development model predicts a minor increase in peak flows immediately downstream of the route at the A452 Kenilworth Road crossing for the 50%, 10%, 5% and 1% AEP plus CC events with the increase being a maximum 0.014m^3/s or 0.06% (for the 50% AEP peak flow).

8.1.14 The flood risk receptors identified as being inundated for the baseline conditions (section 6.1.17) do not show any increase in flood risk or extent for any return period event.

8.1.15 The rail level of the Proposed Scheme will be designed to be protected from the 0.1% AEP, which includes simulated blockage of the downstream bridge and viaduct. Along the River Blythe viaduct the lowest top of rail level is ~94m AOD, 8m above the 0.1% AEP flood level of 85.88m (including blockage analysis).

8.1.16 The Proposed Scheme will result in lost flood storage as a result of the proposed access track embankment and viaduct piers which encroach on the 1% AEP + CC floodplain. All modelling results assume that this lost flood storage will not be entirely replaced; however, the Proposed Scheme includes an area of partial replacement floodplain storage to be located adjacent to the watercourse on the left bank. The requirement for which will be confirmed at detailed design in consultation with the Environment Agency.

8.1.17 The Proposed Scheme includes the closure of Diddington Lane, which is an alternative to Meriden Road for accessing Hampton-in-Arden. The closure of Diddington Lane has the potential to impact on emergency access and egress routes during flood events as Meriden Road, in baseline and post-development, may be impassable at certain flood events. Alternative access routes are available. During the detailed design stage consultation will be held with the Environment Agency and the LLFA to agree suitable flood warning and evacuation plans to mitigate this closure and ensure that emergency access routes are maintained.

[26] DEFRA, (2005) Flood risk assessment guidance for new development, Phase 2, R&D Technical report FD2302/TR2, Defra - Flood Management Division

Stonebridge island modifications (A45 / A452)

8.1.18 The Stonebridge Island modifications will include revised filter lanes onto the A45 Coventry Road.

8.1.19 The location is beyond the limits of the River Blythe model created to assess the impact of River Blythe viaduct and the potential flood risk impact has been assessed by comparing the Environment Agency's flood zone mapping with earthwork profiles to determine whether any loss of flood storage and change to flood flows could occur.

8.1.20 The assessment indicates that the earthworks will be generally outside of the floodplain extents even allowing for an additional factor of safety applied to flood levels to account for uncertainty in the derivation of levels. However, part of the existing A452 Kenilworth Road slip road will be within the Environment Agency's Flood Zone 3 extent due to a low point in the vertical alignment. There is no significant change to flood risk in this area.

Shadow Brook

Shadow Brook underbridge crossing

8.1.21 The Proposed Scheme impacts the Shadow Brook and its associated floodplain at three locations as described. (i) A realignment of Diddington Lane will require an underbridge located approximately 200m to the west of the existing Diddington Lane; (ii) The route of the Proposed Scheme will cross the Shadow Brook via a bridge located in the vicinity of the existing Diddington Lane; and (iii) an access track required to allow vehicular access to Packington Estates land will require the Shadow Brook to be culverted downstream of the existing Diddington Lane.

8.1.22 The design of the Shadow Brook crossing required by the realigned Diddington Lane has been based on water levels generated by the baseline hydraulic model of the Shadow Brook for the 1% AEP + CC at the location of the proposed crossing. A water level of 85.68m AOD has been compared to the existing topography of the proposed crossing point, the resulting floodplain extent is variable, ranging from approximately 6m to 12m. In order to prevent floodplain impingement, which prevents changes to flood risk it is proposed to provide a bridge structure that spans over the existing floodplain.

8.1.23 To ensure that there is consistency in the design between the Diddington Lane crossing and the Proposed Scheme crossing of the Shadow Brook it is proposed to provide a bridge with a width of 13.5m. This means that the existing floodplain is left totally undisturbed. This prevents any changes in hydraulic performance of the Shadow Brook at this location and also prevents the river channel from being disturbed which has ecological and biodiversity benefits.

8.1.24 The design of the Proposed Scheme underbridge at Shadow Bridge and the Packington Estates field access culvert over Shadow Brook have been incorporated into the baseline river hydraulic model of the Shadow Brook to produce a post-development model. The full range of flood events has been simulated within this model to assess changes in flood risk.

8.1.25 Flood maps for the 5% AEP and 1% AEP plus CC events are provided in main ES Volume 5: Map book WR-05 and WR-06.

8.1.26 The relative changes in water level between the baseline model and the post-development model are presented in Table 18.

Table 18: Shadow Brook proposed flood levels (m) (for cross-section locations see Volume 5: Appendix WR-004-018 Section 3)

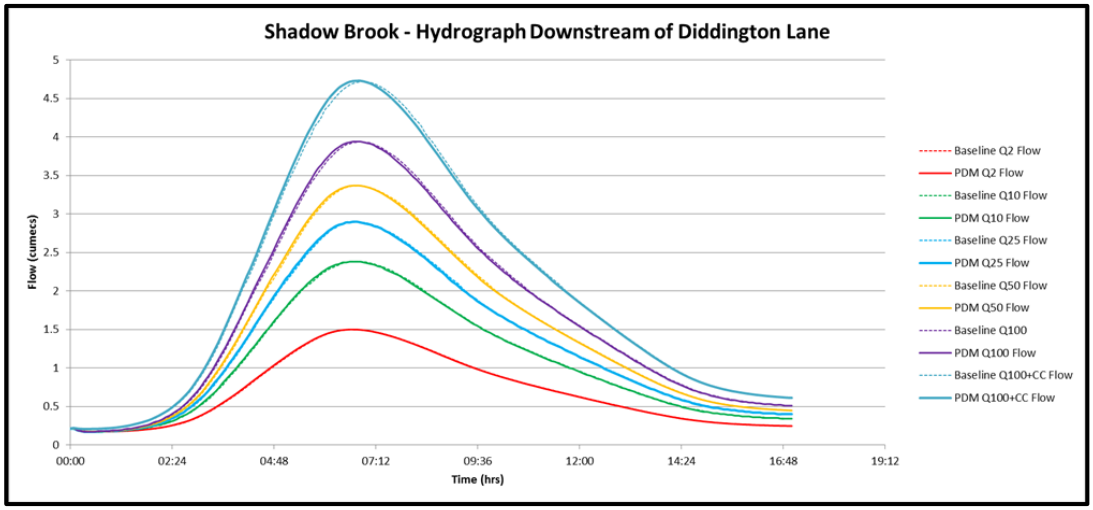
	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Baseline at model cross-section 713	84.96	85.114	85.176	85.259	85.326	85.413
Post-development upstream of Proposed Scheme underbridge n at model cross-section 713	84.96	85.110	85.171	85.253	85.321	85.412
Change	0	-0.004	-0.005	-0.006	-0.004	-0.001
Baseline at model cross-section 607	84.647	84.795	84.841	84.874	84.910	84.954
Post-development upstream of Proposed Packington Estates field access culvert cross-section 607	84.591	84.740	84.787	84.801	84.830	84.856
Change	-0.056	-0.055	-0.054	-0.073	-0.08	-0.098

8.1.27 The post-development model indicates a decrease in flood levels upstream of the Proposed Scheme underbridge for all modelled storm event.

8.1.28 A one dimensional unsteady state model has been created to assess the potential downstream impacts associated with the removal of the existing Diddington Lane culvert. The modelling approach is based on a single duration hydrograph assessment for selected return periods. The duration is based on the ReFH recommended storm duration.

8.1.29 Figure 13 identifies the comparative change in flow immediately downstream of Diddington Lane. For the 1% AEP plus CC flow there is a minor <1% increase in downstream flows as a result of the development with the removal of the Diddington Lane culvert and road profile.

Figure 13: Baseline and post-development hydrographs for Shadow Brook



8.1.30 With the incorporation of the Packington Estates field access culvert the risk posed by an additional pass forward of flow is reduced. The proposed culvert replaces the throttling effect caused by the Diddington Lane bridge. Although the hydraulics of the culvert cause a localised reduction in upstream water levels, the water levels at the downstream end of the culvert indicate a return to a level that almost matches the baseline.

8.1.31 Flood protection to the Proposed Scheme is assessed in relation to the 0.1% AEP. Proposed route alignment top of rail level at this location is approximately 92.75m AOD, 6.798m above the 0.1% AEP flood level of 85.952m which includes simulated blockage of the downstream bridge and viaduct.

8.1.32 There will be a loss of floodplain storage as a result of the embankment encroaching on the 1% AEP plus CC floodplain and the Packington Estates field access. The 1D modelling approach adopted for this crossing cannot accurately not take account of the lost flood storage, however, an area of replacement floodplain storage has been identified which will be located adjacent to the watercourse on a level for level basis. The requirement for this will be confirmed at detailed design in consultation with the Environment Agency.

Bayleys Brook

8.1.33 The route and associated highway diversions will cross Bayleys Brook at the following locations:

- Balsall Common viaduct;
- Lavender Hall Lane diversion;
- Marsh Farm viaduct; and
- A452 Kenilworth Road and the M218 bridleway diversion.

8.1.34 Individual models have been created at each location to assess the flood risk impacts and each crossing point is discussed separately in the following sections.

Balsall Common viaduct crossing

8.1.35 The route will cross Bayleys Brook and associated floodplain between Lavender Hall Lane and Truggist Lane. The route will cross the watercourse via a 250m long viaduct (Balsall Common viaduct) which will be constructed with 25m spans and approximately 2m wide piers. A localised brook diversion is required to convey the channel between piers because of the angle that the viaduct crosses the watercourse. There will be embankment to the west.

8.1.36 The Balsall Common viaduct has been incorporated into the baseline hydraulic model of Bayleys Brook to produce a post-development model. This model only considers three of the spans directly adjacent to the watercourse as the baseline flood extent modelled did not show flooding towards Truggist lane.

8.1.37 The post-development flood extents for a range of events up to the 1% AEP plus CC are shown in Figure 14 and the post development change in depth for the 1% AEP plus CC is shown in Figure 15.

8.1.38 Flood mapping (see main ES Volume 5: Map book WR-05 and WR-06) shows increases in flood extent around the perimeter of the baseline floodplain, this is approximately equal to 8% of the area of the baseline flood extent at the 1% plus CC event. There are very localised increases of up to 270mm for the 1% AEP plus CC event due to ponding of water against the western embankment and around piers. There are also increases in flood depths to the adjacent agricultural land downstream of up to 150mm, but this decreases to no significant change within 300m downstream of the route. There is a small increase in flood extents to north around the perimeter of the baseline floodplain. The backwater effect of the increase (less than 20mm) extends no more than 130m upstream and does not reach to Truggist Lane. These have been summarised in Table 19.

8.1.39 The post development model predicts a minor decrease in peak flows immediately upstream of the proposed route of up to 2.0% for the 1% AEP plus climate change simulation. The increase is reduced to a negligible change at the downstream boundary condition. The typical change in peak flows for the range of return periods is ±1%.

8.1.40 The flood risk receptors identified as at risk of flooding for the baseline conditions do not demonstrate any noticeable increase in flood level for the range of return periods assessed. Localised upstream increases at piers and within the main channel are evident but these increases do not extend to the outer extremes of the floodplain.

8.1.41 The rail track will be protected from the 0.1% AEP event, which includes simulated blockage of the downstream bridge and viaduct. Along the Balsall Common viaduct the lowest proposed route alignment top of rail level is 112.170m AOD, 6.3m above the 0.1% AEP flood level of 105.84m (including blockage).

8.1.42 The Proposed Scheme will encroach on the 1% AEP plus climate change flood extent due to the Lavender Hall embankment and viaduct piers which. All modelling results assume that this lost flood storage will not be replaced; however, the Proposed Scheme will include an area of replacement floodplain storage which will be located adjacent to the watercourse. The requirement for this will be confirmed at detailed design in consultation with the Environment Agency.

Figure 14: Balsall Common viaduct post development flood map 1% AEP + 20% CC

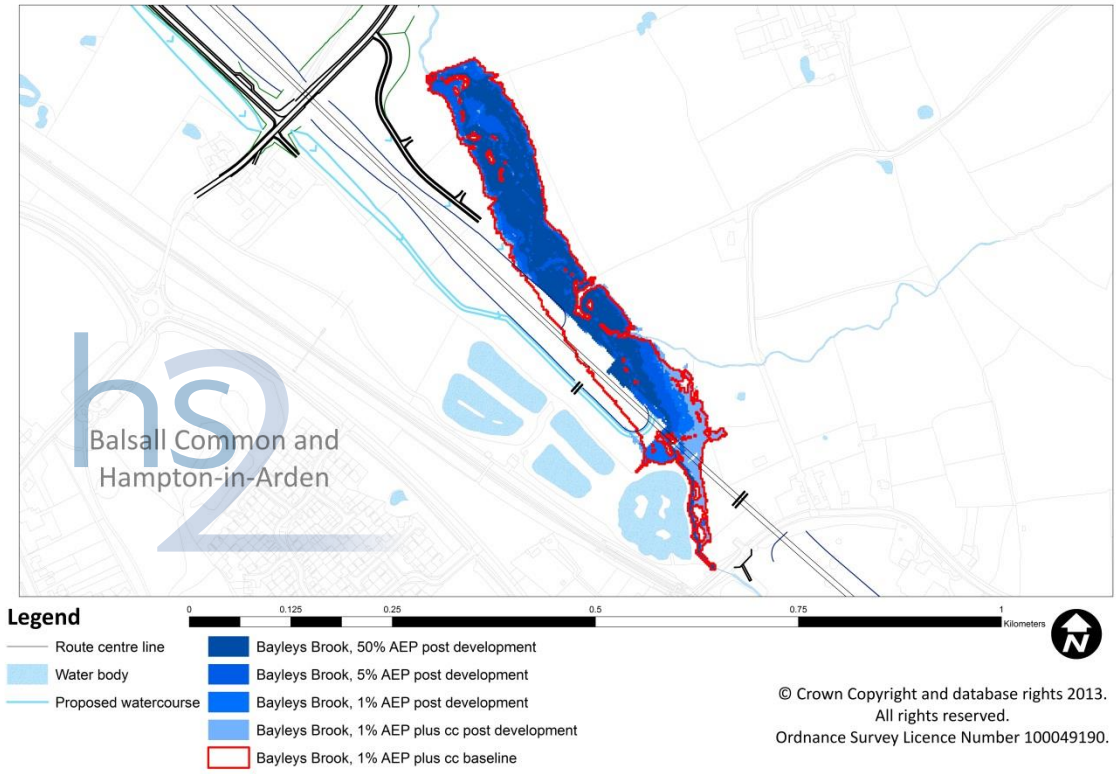


Figure 15: Balsall Common change in depth plan 1% AEP + 20% CC

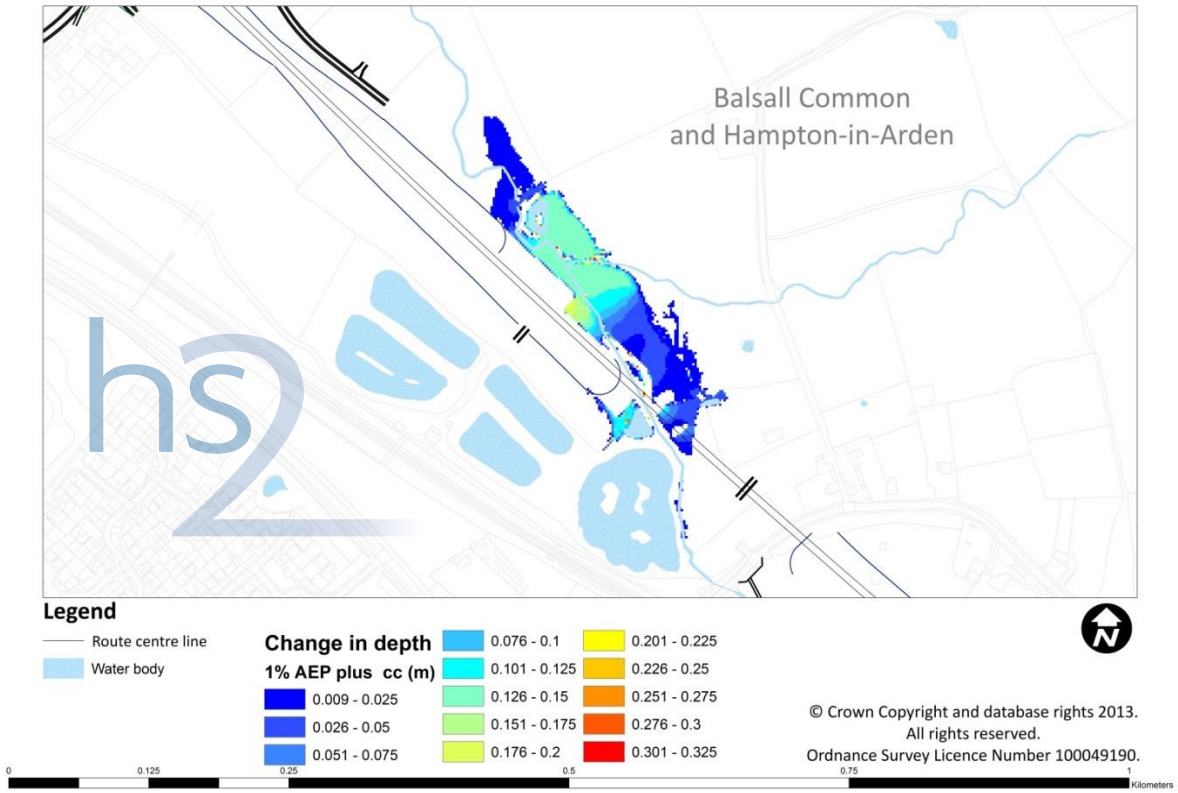


Table 19: Typical changes in depth on Bayleys Brook from the post development model

Location	Typical change in depth (mm)
At proposed route	270
Downstream	150
End of model extent	0

Marsh Farm viaduct crossing

8.1.43 The route will cross Bayleys Brook at Marsh Farm to the east of the A452 Kenilworth Road. The route will cross the watercourse via a 144m viaduct structure which will span the wide marshy floodplain.

8.1.44 The Marsh Farm viaduct has been incorporated into the baseline river hydraulic model of the Bayleys Brook to produce a post-development model. The proposed A452 Kenilworth Road diversion is also included. The full range of flood events have been simulated within this model to determine the impact caused by the Proposed Scheme on the performance of Bayleys Brook at Marsh Farm.

8.1.45 The post development model flood extents for the 5% AEP and 1% AEP plus CC are included in main ES Volume 5: Map book WR-05 and WR-06. The flood extents for a range of return periods are shown in Figure 16.

8.1.46 The relative changes in water level between the baseline model and the post-development model are presented in Table 20.

Figure 16: Marsh Farm viaduct post development flood map

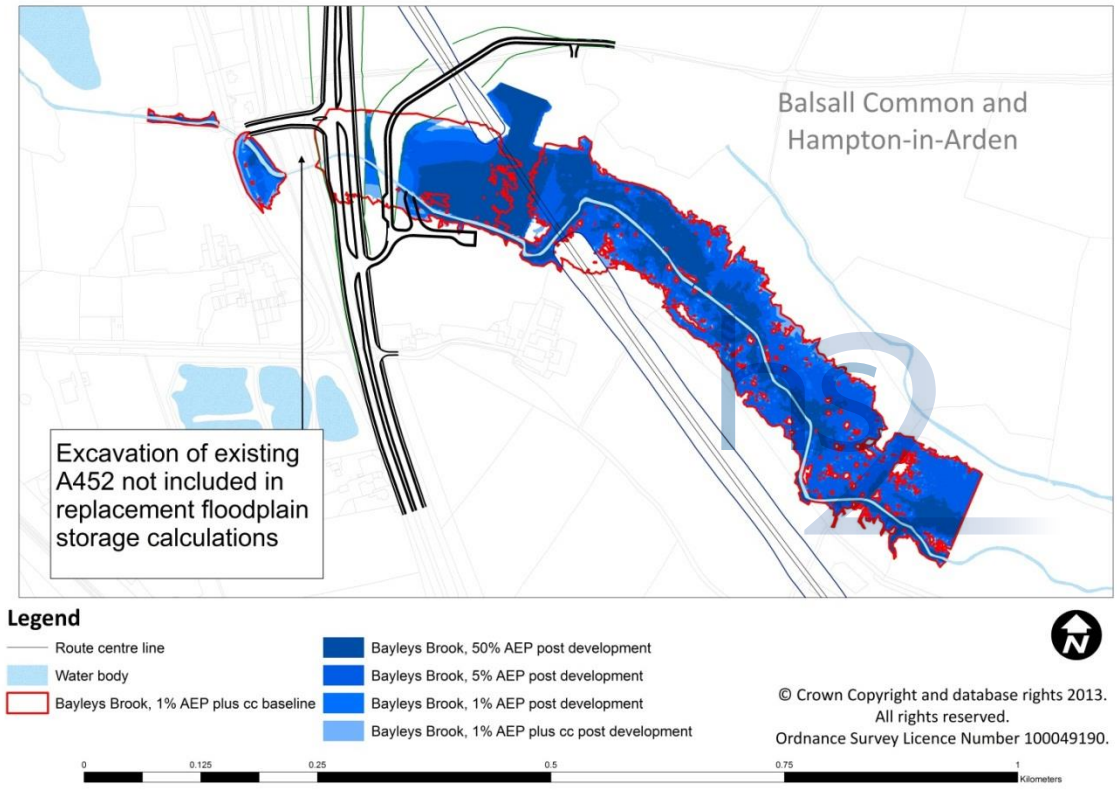


Table 20: Marsh Farm viaduct crossing Bayleys Brook flood levels (m) (for cross-section locations see Volume 5: Appendix WR-004-018 Section 6)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Downstream cross-section 8.2 – baseline	89.744	89.828	89.858	89.895	89.937	90.058
Downstream cross-section 8.2 – post-development	89.708	89.815	89.855	89.921	89.991	90.106
Cross-section 8.2 - change	-0.036	-0.013	-0.003	0.026	0.054	0.048
Upstream cross-section 8.4 – baseline	90.521	90.594	90.645	90.676	90.71	90.734
Upstream cross-section 8.4 – post-development	90.521	90.59	90.642	90.673	90.712	90.74
Cross-section 8.4 - change	0.000	-0.004	-0.003	-0.003	0.002	0.006
Upstream cross-section 11 – baseline	90.788	90.842	90.875	90.903	90.938	90.968
Upstream cross-section 11 – post development	90.788	90.842	90.875	90.903	90.938	90.968
Cross-section 11 – change	0.000	0.000	0.000	0.000	0.000	0.000
Adjacent to alignment cross-section 12 - Baseline	90.996	91.035	91.061	91.086	91.12	91.151
Adjacent to alignment cross-section 12 – post-development	90.996	91.035	91.061	91.086	91.12	91.151

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Cross-section 14 – change	0.000	0.000	0.000	0.000	0.000	0.000

8.1.47 In the vicinity of the Marsh Farm viaduct crossing the post-development model indicates a localised increase in flood levels and extents on existing agricultural land under 1% AEP plus CC event. The viaduct is of sufficient length to ensure a negligible change in the upstream flood risk. There is a localised predicted increase in flood levels on agricultural land located between Marsh Farm viaduct and A452 Kenilworth Road occurring for the 2%, 1% and 1% AEP plus CC flood events, which at the 1% AEP event is 54mm. The predicted flooding occurs at a single cross section and is attributed to the change in downstream flood levels where the new A452 culvert capacity is increased, reducing upstream flood levels.

8.1.48 In this location proposed route alignment top of rail is 94.71m AOD, 3.79m above the 0.1% AEP flood level of 90.92m which includes simulated blockage of the downstream bridge and viaduct.

8.1.49 The Proposed Scheme development will result in lost flood storage as a result of the embankment encroaching on the 1% AEP plus 20% CC floodplain. The 1D modelling approach adopted for this crossing cannot accurately take account of the lost flood storage, however, an area of replacement floodplain storage is proposed to be located adjacent to the watercourse on a level for level basis. The requirement for this will be confirmed at detailed design in consultation with the Environment Agency.

A452 Kenilworth Road and bridleway diversion

8.1.50 The proposed A452 Kenilworth Road and Bridleway diversion crosses the Bayleys Brook immediately east (upstream) of the existing A452 Kenilworth Road which will be removed. The existing A452 Kenilworth Road and culvert are excavated out to provide additional capacity within the downstream network where there is a flood risk posed to the adjacent Mercote Lodge. The proposed culvert is modelled as a single 4.8m span structure, 85m in length. In practice the culvert can be separated into two separate structures with a considerably reduced length to maximise the extent of open watercourse and minimise lost floodplain storage.

8.1.51 The proposed road diversion and culvert have been incorporated into the baseline hydraulic model of the Bayleys Brook to produce a post-development model. The proposed A452 Kenilworth Road diversion is also included. The full range of flood events up to the 1% AEP plus CC have been simulated within this model to determine the impact on the performance of the Bayleys Brook.

8.1.52 Flood extents for the 5% AEP and the 1% AEP plus CC are in main ES Volume 5: Map book WR-05 and WR-06. The flood extents for a range of return periods are shown in Figure 16.

8.1.53 The relative changes in water level between the baseline model and the post-development model are presented in Table 21.

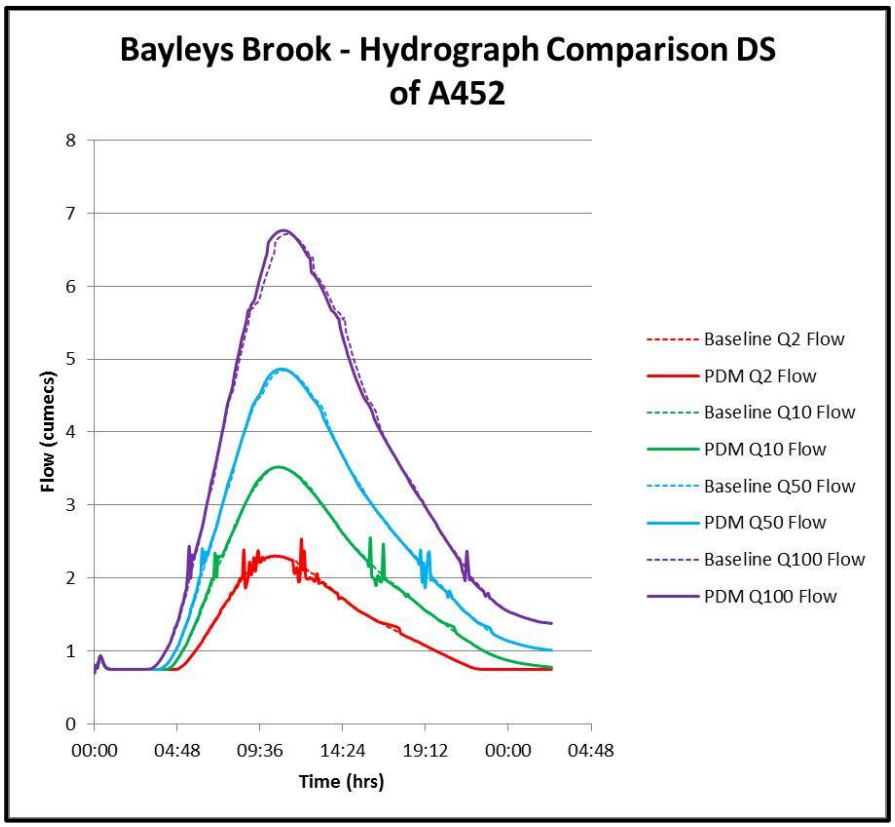
Table 21: A452 Kenilworth Road and Bridleway post-development flood levels (m) (for cross-section locations see Volume 5: Appendix WR-004-018 Section 6)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Upstream of Marsh Lane – baseline cross-section 6	88.804	88.935	89.026	89.112	89.377	89.534
Upstream of Marsh Lane – post-development cross-section 6	88.804	88.935	89.027	89.113	89.377	89.534
Cross-section 6 - change	0.000	0.000	0.001	0.001	0.000	0.000
A452 & Bridleway Diversion - upstream A452 baseline cross-section 8	89.605	89.672	89.704	89.707	89.741	89.843
A452 & Bridleway Diversion - upstream A452 post-development cross-section 8	89.443	89.498	89.551	89.609	89.735	89.849
Cross-section 8 – change	-0.162	-0.174	-0.153	-0.098	-0.006	0.006

8.1.54 The flood extents and flood levels indicate a significant reduction in flood levels upstream of the culvert structure of up to 175mm at lower return period flood events. The reduction results from an increase in culvert capacity.

8.1.55 The one dimensional models have been run in an unsteady state to provide an initial assessment of the potential downstream impacts associated with the increase in culvert capacity. The modelling approach is not documented in the modelling reports but includes a single duration hydrograph assessment for selected return periods. The duration is based on the ReFH recommended storm duration and further tests to determine the critical duration storm will be required as the design develops and detailed data becomes available. The hydraulic model does not represent the loss of storage due to the proposed route embankments or the associated replacement floodplain storage area. The graph below identifies the comparative change in flow downstream of the proposed culvert for a selection of return periods.

Figure 17: Hydrographs (baseline and post development) comparison downstream of the A452 Kenilworth Road



8.1.56 For the 1% AEP plus CC flow there is a predicted <1% (<0.1m^3/s) increase in downstream flows as a result of the removal of the railway culvert and embankment. At the 50% AEP event the change in flow is negligible apart from a model instability error in the post development model.

8.1.57 The unsteady state model predicts only a minor increase in flood level (<10mm) downstream of the A452 Kenilworth Road culvert. This is primarily due to the influence of the Marsh Lane culvert on flood levels on the downstream side of the A452 Kenilworth Road.

8.1.58 Notwithstanding the above it is noted that further development of the hydraulic model is required as part of the detailed design to confirm the potential impact on downstream flows analysed as part of the initial assessment.

8.1.59 The Proposed Scheme will include embankment which will encroach on the 1% AEP plus CC floodplain, and reduce the available floodplain storage. The one dimensional modelling approach adopted for this crossing cannot accurately take account of the lost flood storage; however, an area of replacement floodplain storage is proposed to be located adjacent to the watercourse on a level for level basis which provides storage in combination with the channel diversion.

Lavender Hall Lane diversion

8.1.60 The proposed Lavender Hall Lane diversion will cross the Bayleys Brook channel and floodplain immediately upstream of the existing Lavender Hall Lane. The proposed road alignment will be elevated above the floodplain on embankment and will cross the proposed route via an over bridge to the south-west of the Bayleys Brook crossing. Bayleys Brook will be conveyed beneath the Lavender Hall Lane diversion through a central 5.5m span, 50m long culvert with two 2m span flood relief culverts provided to convey extreme flood flows without increasing upstream flood levels. The existing Lavender Hall Lane will be retained as a private access and the existing culvert will be retained.

8.1.61 The proposed road alignment and culverts have been incorporated into the one dimensional baseline hydraulic model of the Bayleys Brook to produce a post-development. The full range of flood events has been simulated within this model to assess changes in flood risk.

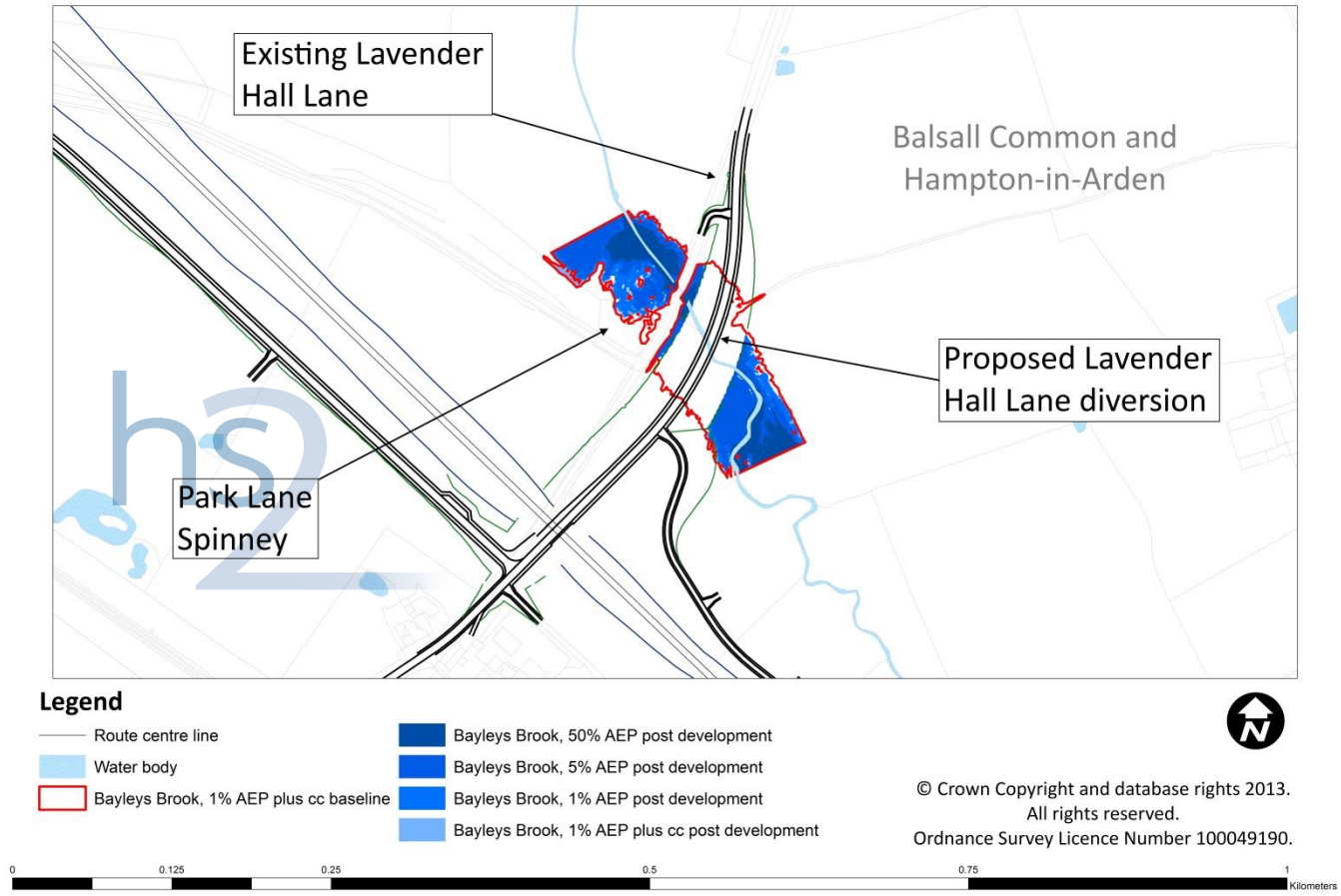
8.1.62 The post-development flood extents for the 5% AEP and 1% AEP plus CC are provided in main ES Volume 5: Map book WR-05 and WR-06. A range of modelled flood extents for the post-development case are provided in Figure 18.

8.1.63 The relative changes in water level between the baseline model and the post-development model are presented in Table 22.

Table 22: Bayleys Brook, Lavender Hall Lane - proposed flood levels (m) (for cross-section locations see Volume 5: Appendix WR-004-018 Section 5)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1%plus CC**
Upstream of Lavender Hall Lane cross-section 4	102.05	102.198	102.302	102.405	102.412	102.448
Upstream of Lavender Hall Lane post development cross-section 4	102.044	102.212	102.315	102.422	102.434	102.467
Change	-0.006	0.014	0.013	0.017	0.022	0.019
Upstream of Lavender Hall Lane cross-section 5	102.445	102.481	102.479	102.517	102.55	102.603
Upstream of Lavender Hall Lane post development cross-section 5	102.451	102.487	102.501	102.552	102.585	102.641
Change	0.006	0.006	0.022	0.035	0.035	0.038

Figure 18: Lavender Hall Lane post-development flood mapping



8.1.64 Upstream of the proposed A452 Kenilworth Road diversion for all return periods apart from the 50% AEP event, the mapping and flood levels indicate an increase in depth of up to 40mm on agricultural land that already flood under baseline conditions, and no increase in extents. The increase is greater for the higher return periods and diminishes under more frequent events where the inflows are lower. The Proposed Scheme will result in lost flood storage as a result of the embankment located within the floodplain. The one dimensional modelling approach adopted for this crossing cannot accurately take account of the lost flood storage; however, an area of replacement floodplain storage is proposed to be located adjacent to the watercourse on a level for level basis.

River Blythe Bypass

River Blythe Bypass viaduct

8.1.65 The route will cross the River Blythe Bypass channel and floodplain. The alignment will be elevated above the floodplain and a culvert will be provided to provide a flow route beneath the Blythe Bypass embankment.

8.1.66 The River Blythe Bypass culvert has been incorporated into the baseline hydraulic model of the River Blythe Bypass to produce a post-development model. The full range of flood events has been simulated within this model to assess changes in flood risk.

8.1.67 The post development flood extents are provided in Volume 5: Map book WR-05 and WR-06. A range of flood extents from the post development model are shown in Figure 19. The accompanying modelling report (Volume 5: Appendix WR-004-018) shows the flood outline to the east of the A452 Kenilworth Road this has been omitted from Figure 19 and the flood maps main ES Volume 5: Map book WR-05 and WR-06. DTM in this area was not of sufficient quality to generate accurate mapping.

8.1.68 The relative changes in water level between the baseline model and the post-development model are presented in Table 23.

Figure 19: River Blythe Bypass post-development flood extents

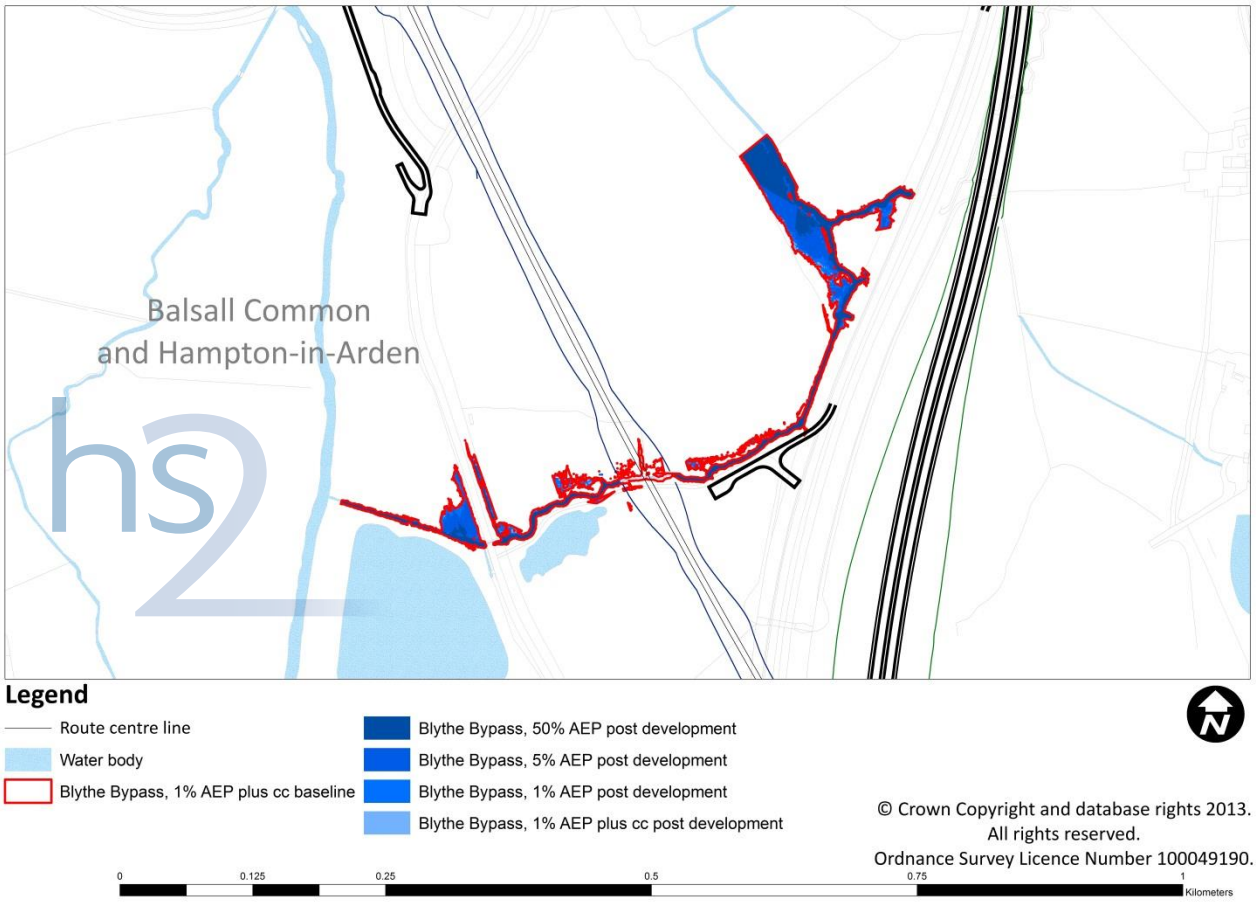


Table 23: River Blythe Bypass post development flood levels (m)

	AEP					
Proposed Scheme Feature	**50%**	**10%**	**5%**	**2%**	**1%**	**1% plus CC**
Upstream baseline cross-section 355	86.222	86.327	86.376	86.407	86.438	86.471
Upstream post-development cross-section 355	86.222	86.323	86.373	86.404	86.437	86.47
Change	0	-0.004	-0.003	-0.003	-0.001	-0.001

8.1.69 The post-development model indicates a negligible increase in flood levels upstream of the River Blythe Bypass culvert for all return periods. Where there is an increase in floodplain extent, the impact is negligible with no significant impact on flood receptors.

8.1.70 The proposed alignment is to be protected from the 0.1% AEP, which includes simulated blockage of the downstream bridge and viaduct. Along the River Blythe Bypass viaduct the lowest proposed route alignment top of rail level is approximately 92m AOD, 4.79m above the 0.1% AEP flood level of 87.284m.

Other tributaries

Post development assessment method

8.1.71 The post-development assessment for the small tributary (Figure 20) has been undertaken using the CIRIA guide C689.

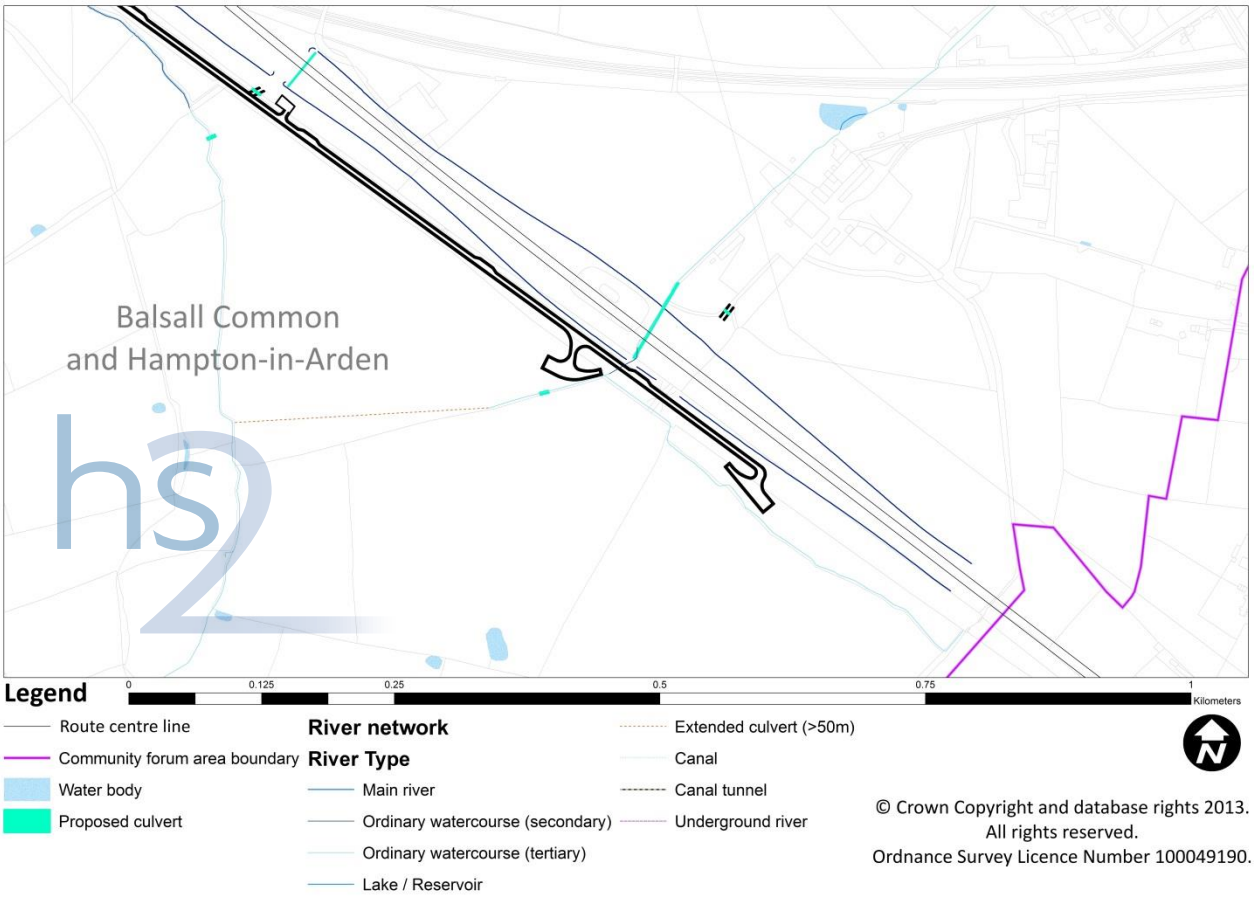
8.1.72 The approach calculates the culvert dimension required to convey the 1% AEP flood flow including a 30% allowance for climate change. The culvert is designed to convey the flood flow while maintaining a minimum 600mm freeboard to soffit. By providing a culvert sufficiently sized to convey the 1% AEP flood flow the impact on upstream flood level increases is controlled.

8.1.73 The culvert method does not take account of a backwater affect from downstream structures. The method is used to primarily assess the conveyance capacity of the culvert

8.1.74 No allowance has been made for the installation of trash screens or security gratings on culverts.

8.1.75 The predicted upstream flood level derived using the culvert assessment methods are shown below along with a description of the development proposals.

Figure 20: Watercourse crossing at Beechwood Farm



8.1.76 This un-named watercourse will be crossed by the route perpendicular to the channel. There is an existing culvert located downstream of the proposed route crossing which passes beneath an abandoned railway embankment (now part of the Kenilworth Greenway).

8.1.77 A 4m span x 2.7m deep box culvert (Beechwood culvert) will convey the watercourse beneath the Proposed Scheme. The resultant upstream flood level is predicted to be 112.85m AOD. In comparison, the upstream Beechwood Farm development is located at an elevation of at least 113.00m AOD. The Beechwood Farm accommodation underpass will be constructed alongside the culvert which will be located at an elevation approximately equal to the 1% AEP flood level using CIRIA Report C689. The underpass will operate as an informal flood relief culvert. The culvert calculations ignore the potential attenuating effect of the existing Rugby to Derby Line culvert upstream of Beechwood embankment. Therefore, there is no significant flood risk predicted to Beechwood Farm up to the 1% AEP plus CC event.

8.2 Surface water and sewerage flood risk

Proposed Scheme drainage

8.2.2 Surface water run-off from the Proposed Scheme will be attenuated to balance peak run-off rates and volumes to pre-development levels for a range of return periods up to the 1% AEP (+30% allowance for climate change). Based on the available information at this time and due to high groundwater levels, it is deemed unlikely that infiltration techniques will be a viable method of surface water disposal in this section of the route, therefore within this study area all the Proposed Scheme rail drainage systems will discharge to watercourses.

8.2.3 Drainage interception and conveyance designs will utilise a combination of piped track drainage and open channels which will convey drainage flows to balancing ponds while protecting the route from flooding up to the 0.1% AEP year storm event.

8.2.4 Ponds are the preferred method of flow attenuation due to the linear nature of the project and the requirement to control run-off at managed discharge points (design drawings are shown in main ES Volume 2: Map book CT-06).

8.2.5 The Proposed Scheme drainage catchments are listed in Table 24 and shown in Annex A of this report.

Table 24: Proposed Scheme drainage catchments and outfalls

Linear km of route drained	Receiving watercourse	Watercourse status	Greenfield peak discharge rate Q100 (l/s/ha)*	Outfall number
0.430	Unnamed	Ordinary	2.60-12.55	O-1479
0.350	Unnamed	Ordinary	2.86 - 12.55	O-1483
0.500	Bayleys Brook	Ordinary	3.29 - 12.55	O-1492
3.340	Bayleys Brook	Ordinary	2.60 - 12.55	O-1526
0.950	River Blythe Bypass	Ordinary	2.60 - 12.55	O-1534
0.880	River Blythe	Main	2.60 - 12.55	O-1538
0.650	Shadow Brook	Ordinary	2.60 - 12.55	O-1549
0.660	Shadow Brook	Ordinary	2.60 - 12.55	O-1552

*Greenfield peak discharge Q100 rate is derived from QBAR estimation for rural catchments, Institute of Hydrology Report 124 (1993)[27]. Attenuation volumes have been provisionally sized on the lower value and further site investigation will be required to confirm actual discharge rates at the detailed design stage.

27. Marshall, D.W.C. and Bayliss, A.C., (1993), *Flood Estimation for Small Catchments report number 124*, Natural Environment Research Council.

Highway drainage

8.2.6 Throughout the study area, the route requires the diversion or replacement of a number of existing public highways. The associated highway drainage systems will be reconfigured or replaced.

8.2.7 Drainage of reconfigured highways will aim to replicate the existing highway drainage strategy and outfalls. Where the paved area of the highway has been increased, highway run-off will be collected from an area equivalent to the additional paved surface and attenuated to balance peak run-off rates and volumes to pre-development levels for a range of return periods up to 1% AEP (+30% allowance for climate change). It is deemed unlikely that infiltration techniques will be a viable method of surface water disposal in this section of the route.

8.2.8 Ponds are the preferred method of flow attenuation due to the linear nature of the project and the requirement to control run-off at managed discharge points (design drawings are shown in main ES Volume 2: Map book CT-06).

8.2.9 The highway drainage catchments are listed in Table 25 below and shown in Annex A of this report.

Table 25: Highway drainage catchments and outfalls

Existing area of highway drained (ha)	**Proposed area of highway drained (ha)**	**Net change in highway drained (ha)**	**Receiving watercourse**	**Greenfield peak discharge rate Q100 (l/s/ha)***	**Outfall No.**
0.825	1.164	+0.339	Bayleys Brook	10.18 - 12.55	O-1500
1.489	1.728	+0.239	Bayleys Brook	No attenuation proposed as decrease in overall impermeable area	O-1527
2.123	1.732	-0.391	Unnamed watercourse		O-1535
0.547	0.420	-0.127	River Blythe	-	O-1542
	0.361	+0.361	River Blythe	10.18 - 12.55	O-1556
2.739	2.515	-0.224	River Blythe	-	O-1557
	0.308	+0.308	River Blythe	11.97 - 12.55	O-1559

*Greenfield peak discharge Q100 rate is derived from QBAR estimation for rural catchments, Institute of Hydrology Report 124 (1993)[28]. Attenuation volumes have been provisionally sized on the lower value and further site investigation will be required to confirm actual discharge rates at the detailed design stage.

28. Marshall, D.W.C. and Bayliss, A.C., (1993), *Flood Estimation for Small Catchments report number 124*, Natural Environment Research Council.

Surface water flow catchments

8.2.10 The route will introduce a continuous linear feature that will have the potential to interrupt and divert existing drainage catchments and surface water flow paths.

8.2.11 Where the route is on embankment or in cutting (including retained cutting) and the adjacent land falls towards the route (or there are existing urban drainage systems that may divert flows towards the route), a cut off drainage system and threshold protection measures will be provided to intercept the flows from external catchments and divert them to the nearest crossing point of the route, typically a bridge or culvert conveying a watercourse under the route.

8.2.12 Intercepted flows in the study area will be conveyed via grass lined ditches to outfall to a watercourse at a location as close to existing flow path as possible. The grass lined ditch will be graded to provide slow time of travel, so that time of entry to the watercourse will not be increased significantly, thereby minimising any effect on the watercourse.

8.2.13 The design assesses catchments and surface water flow paths in the baseline and post-development case to ensure no increase in flood risk to adjacent properties and receptors upstream or downstream of the Proposed Scheme.

8.2.14 An initial assessment of surface water flow catchments which will be modified as a result of the Proposed Scheme are shown in the figures presented in Annex A of this report. Where catchment flow paths are intersected by the Proposed Scheme, the design, where possible, will replicate existing catchment distributions and minimise alterations to surface water flow paths from their existing routes. Where this is not possible, a safe and secure route for drainage systems and surface water flows has been identified such that there will be no increased flood risk to properties or businesses. Flows will be intercepted using cut-off ditches and conveyed to a suitable outfall location as indicated on main ES Volume 2: Map book CT-06.

8.2.15 Catchments with notable issues are described in more detail in the following sections.

Sub-catchment 1A

8.2.16 The route will cross the line of existing flow paths to a channel running along Kenilworth Greenway. These flows will be intercepted within a cut-off ditch along the toe of the proposed embankment and conveyed in a similar manner as existing to an unnamed watercourse, approximately 50m upstream of current location with negligible impacts. The area is identified as susceptible to surface water ponding by the Environment Agency surface water flood maps but the provision of a drainage ditch at the toe of the Beechwood embankment will improve drainage in this area.

Sub-catchment 2D

8.2.17 This catchment is to west of the Rugby to Birmingham Line and naturally drains towards Bayleys Brook. This natural flow path is bisected due to the Proposed Scheme. In order to intercept and convey the run-off, a cut-off ditch will be provided to run from the high point southwards to outfall to Bayleys Brook. This cut-off ditch will protect the Proposed Scheme and the re-aligned Park Lane from surface water flooding, whilst also providing storage attenuation for the highway run-off (see Table 25 outfall O-1500).

8.2.18 In the baseline case, surface water flow would discharge to Bayleys Brook over a length of approximately 600m. Due to the Proposed Scheme this will result in the flow being introduced to Bayleys Brook at a point location. As flows will be attenuated within the cut-off ditch, the effects of the slightly altered flow path will be negligible subject to the correct implementation of all mitigation measures.

Sub-catchment 3A

8.2.19 A long, relatively thin surface water flow catchment will be intercepted by Park Lane cutting and Sixteen Acre Wood embankment along with a local drainage channel. In order to protect the cutting from surface water flows, a cut-off ditch will be provided to run along the west side of the route in order to provide a gravity outfall to Bayleys Brook. The cut-off ditch will be naturally lined and profiled in order to provide storage and attenuation of flows along its length.

8.2.20 The collected surface water flows, and land drainage ditch will discharge to Bayleys Brook up to 1.5km downstream of existing discharge locations. This will slightly decrease flows within Bayleys Brook along this location, but due to the relatively small intercepted catchment, the flood risk impact is deemed to be negligible.

Sub-catchment 4A

8.2.21 The existing flow paths cross the line of re-aligned A452 Kenilworth Road where a low point in the topography is identified as being a large at risk of ponding from surface water flow on the Environment Agency's surface water mapping. The area of surface water identified on the surface water mapping may be overestimated as there is likely to be a means of draining the area into the drainage channel on the opposite side of the A452 Kenilworth Road.

8.2.22 For post-development flows will be intercepted by a ditch at the toe of proposed Kenilworth Road embankment and conveyed to outfall close to the existing outfall location with negligible impacts.

Sub-catchment 5A

8.2.23 Surface water flows will be collected in cut-off ditch along toe of highway embankment and the Proposed Scheme to outfall to River Blythe similar to existing flow paths with negligible impacts.

Sub-catchment 5B

8.2.24 Surface water flows will be collected in cut-off ditch along toe of highway embankment and the Proposed Scheme to outfall to Shadow Brook similar to existing flow paths with negligible impacts.

Sub-catchment 5C

8.2.25 Surface water flows will be collected in cut-off ditch located along toe of proposed highway embankment to outfall to River Blythe similar to existing flow paths with negligible impacts.

Sub-catchment 5D

8.2.26 Flow paths will cross line of proposed B4102 Meriden Road/ Diddington Lane diversion. Surface water flows to be intercepted by cut-off ditch and conveyed through embankment in culvert to outfall to River Blythe at similar location to existing with negligible impacts.

Sub-catchment 5E and 5F

8.2.27 The Proposed Scheme will run parallel with existing surface water flow paths. A cut-off drainage ditch will be provided along toe of Proposed Scheme's embankment in order to collect any localised surface water drainage flows, and convey northwards to existing outfall location to Shadow Brook with negligible impacts.

Sub-catchment 6A

8.2.28 Surface water flows to be collected in cut-off ditch along toe of railway embankment to outfall to Shadow Brook similar to existing flow paths with negligible impacts.

Sub-catchment 6B

8.2.29 Flow paths which will cross the line of the Proposed Scheme will be intercepted by cut-off ditch and conveyed northwards to outfall to Hollywell Brook approximately 300m upstream of existing with negligible impact due to relatively small catchment area.

8.3 Groundwater

8.3.1 It is assumed that the principal mechanism by which Proposed Scheme will increase groundwater flood risk, is where impermeable structures (e.g. lined tunnels and pile walls) act as a barrier to groundwater flow and have the potential to cause a rise in groundwater level with mounding in the vicinity of these structures. Other changes to the groundwater environment such as through drained cuttings are not assumed to increase the groundwater flood risk as the drainage design will take account of groundwater flows entering the cutting.

8.3.2 To assess the possible changes to groundwater levels and flows, and the associated change in groundwater flood risk, a high level assessment of the groundwater conditions along the route has been undertaken to understand where the Proposed Scheme is likely to interact with groundwater (i.e. it is on an aquifer and within the proximity of groundwater levels).

8.3.3 This qualitative assessment has reviewed areas which have the potential to impact on groundwater flood risk and are discussed in Section 6.3.8. Further field data collection and analytical or numerical modelling will be required to quantify this change.

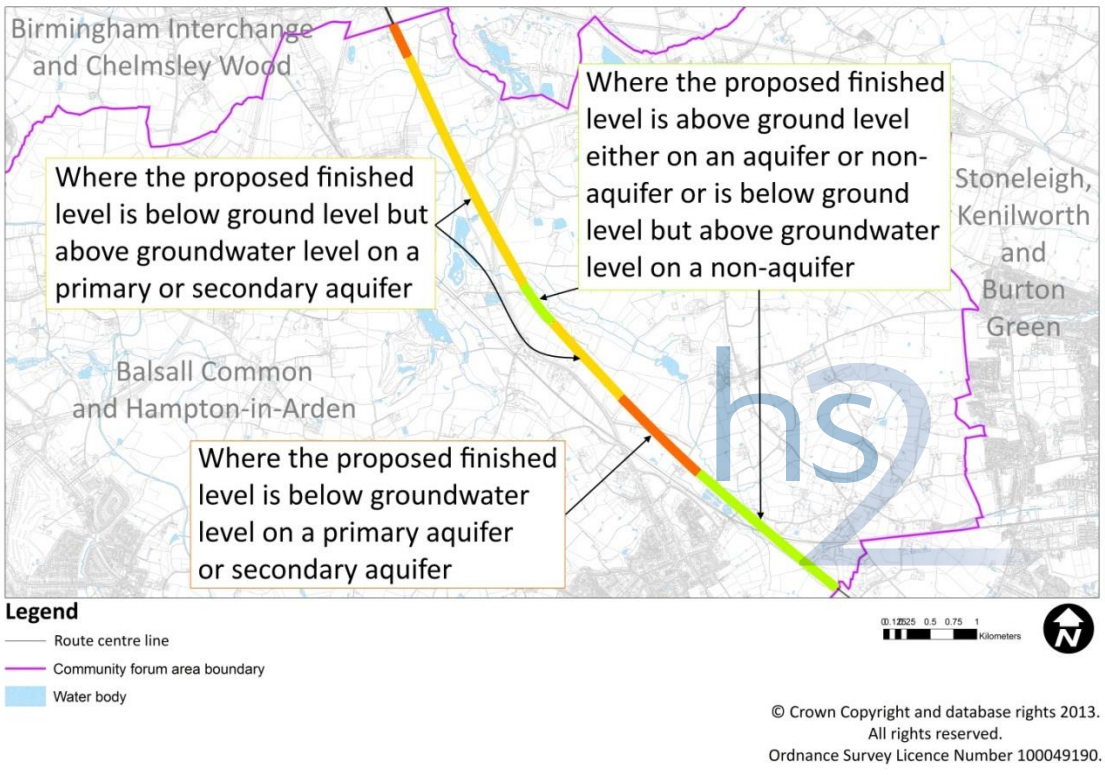
8.3.4 Table 26 shows the criteria used to identify areas where changes to the level of groundwater flood risk along the route corridor may occur from the introduction of Proposed Scheme infrastructure.

Table 26: Criteria to identify areas where changes to groundwater flood risk may occur

Low	Where the proposed finished level is above ground level either on an aquifer or non-aquifer or is below ground level but above groundwater level on a non-aquifer
Medium	Where the proposed finished level is below ground level but above groundwater level on a primary or secondary aquifer
High	Where the proposed finished level is below groundwater level on a primary or secondary aquifer

8.3.5 Information presented in Table 27 and summarised in Figure 21, illustrate the areas within CFA23 where there is greater potential for changes to groundwater flood risk post to the development and elsewhere.

Figure 21: Areas of greater potential for changes to groundwater flood risk within CFA23



8.3.6 The main areas where groundwater flood risk may be increased is where the Proposed Scheme will be within an aquifer and below groundwater level, and even then it depends on the nature of the infrastructure and how much of a barrier to groundwater flow it will create.

8.3.7 Two main sections have been identified as being below assumed groundwater level within the aquifer. Between Lavender Hill and the Heart of England Way, the route will be in the Park Lane cutting, the route will cut through the superficial deposits which are classified as a Secondary aquifer, and below the assumed groundwater level. However, the design will not include any significant impermeable barriers to groundwater flow and a small number of piles are proposed. Drainage systems will be provided, and so the additional groundwater flood risk is considered low.

8.3.8 Between the Pasture Farm accommodation overbridge and the East Way Loop underbridge (Diddington cutting), the route will cut through the top of the Mercia Mudstone, the top weathered zone can sometimes be water bearing and water strikes have been recorded in local borehole logs. However the design will include drainage systems, and there will not be any significant impermeable barriers to groundwater flow, pile foundations for the bridges are proposed, which would not significantly change the groundwater flood risk. Drainage systems will be provided.

Table 27: Summary of the conditions along the route corridor and areas where the groundwater flood risk may change

Approximate grid reference	Title	Existing Ground Level (mOD)	Proposed level (mOD)	Assumed groundwater level(mOD)	Aquifer Classification (Superficial)	Aquifer Classification (Solid Geology)	Superficial Geology	Solid Geology (approximate depth, m) at reference borehole	Reference borehole	Distance to reference borehole BH (m)	Assumed ground level (mOD) at reference borehole	Assumed depth to groundwater level (m) at reference borehole
SP2510 7671	Beachwood Underpass	112.6	120.7		Secondary A	Principal	Absent, though Alluvium near stream nearby	The Hill Mudstone (0)	Geol. map only		113	
SP2490 7701	Footpath Underpass 148+750	112.9	120.5	111.9		Principal	Absent	The Hill Mudstone/Sandstone band (0)	Geol. map only		114	1
SP2479 7717	Carol Green Rail Underbridge	110.9	120.2	109.9		Principal	Absent	The Hill Mudstone (0)	Geol. map only		111	1
SP2456 7752	Balsall Common viaduct	109.3	117.5	watercourse level	Secondary A	Principal	Alluvium close to stream approx. 100m each side	The Hill Mudstone (0 - 5)	Geol. map only		104-108	watercourse level
SP2399 7813	Lavender Hall Lane Overbridge	108.1	107.5	107.1	Secondary A	Principal	Absent but Glaciofluvial deposits nearby	The Hill Mudstone (0)	Geol. map only		108	1
SP2351 7859	Heart of England Way Bridge	113.3	102.9	112.3 assume perched in till	Secondary A	Secondary B	Till overlying Glaciofluvial deposits	Mercia Mudstone (5)	Geol. map only		113	1 assume perched in Till
SP2301 7920	Sixteen Acre Wood Bridge	108.7	101.3	98.7	Secondary A	Secondary B	Glaciofluvial deposits (sand/gravel)	Mercia Mudstone (20)	SP27NW38	260	108	10

Approximate grid reference	Title	Existing Ground Level (mOD)	Proposed level (mOD)	Assumed groundwater level(mOD)	Aquifer Classification (Superficial)	Aquifer Classification (Solid Geology)	Superficial Geology	Solid Geology (approximate depth, m) at reference borehole	Reference borehole	Distance to reference borehole BH (m)	Assumed ground level (mOD) at reference borehole	Assumed depth to groundwater level (m) at reference borehole
SP2236 8006	Marsh Farm viaduct	92	96.3	watercourse level	Secondary A	Secondary B	Alluvium over Glaciofluvial deposits (sand/gravel), possible seam of glacial clay	Mercia Mudstone (9)	SP28SW336	150	+91.3 at BH	watercourse level
SP2216 8028	Mercote Mill Farm Overbridge	92.6	93.4	84.6	Secondary A	Secondary B	Glaciofluvial deposits (sand/gravel)	Mercia Mudstone (10)	SP28SW336	200	94	8
SP2200 8053	A452 Kenilworth Road OB	91.5	91.9	88.5	Secondary A	Secondary B	Glaciofluvial deposits (sand/gravel)	Mercia Mudstone (5)	SP28SW333	400-600	92	3
SP2138 8186	River Blythe Bypass Overbridge	89.1	91.9	watercourse level	Secondary A	Secondary B	Alluvium (sand/gravel)	Mercia Mudstone (5)	SP28SW333	150	86-89	watercourse level
SP2164 8140	River Blythe viaduct	85.8	93.2	watercourse level	Secondary A	Principal	Alluvium (gravel/clay, peat and gravelly sand) 50m each side of watercourse. River Terrace deposits across rest of floodplain	Mercia Mudstone/Bromsgrove Sandstone (5?)	SP28SW73, SW28SW167		84-89	watercourse level
SP2123 8212	Diddington Lane OB	90.3	93			Secondary B	Absent	Mercia Mudstone (0)	Geol. map only		89	

Approximate grid reference	Title	Existing Ground Level (mOD)	Proposed level (mOD)	Assumed groundwater level(mOD)	Aquifer Classification (Superficial)	Aquifer Classification (Solid Geology)	Superficial Geology	Solid Geology (approximate depth, m) at reference borehole	Reference borehole	Distance to reference borehole BH (m)	Assumed ground level (mOD) at reference borehole	Assumed depth to groundwater level (m) at reference borehole
SP2106 8229	Shadow Brook viaduct	85.6	92.2	watercourse level	Secondary A	Secondary B	Alluvium - likely to be clay, sand and gravel	Mercia Mudstone (0 - 4)	Geol. map only		85-88.5	watercourse level
SP2094 8249	Pasture Farm Overbridge	98.8	90.5	97.8	Secondary A	Secondary B	Glaciofluvial deposits (sand/gravel)	Mercia Mudstone (3)	SP28SW327	120	98.5	1

8.4 Artificial sources / infrastructure

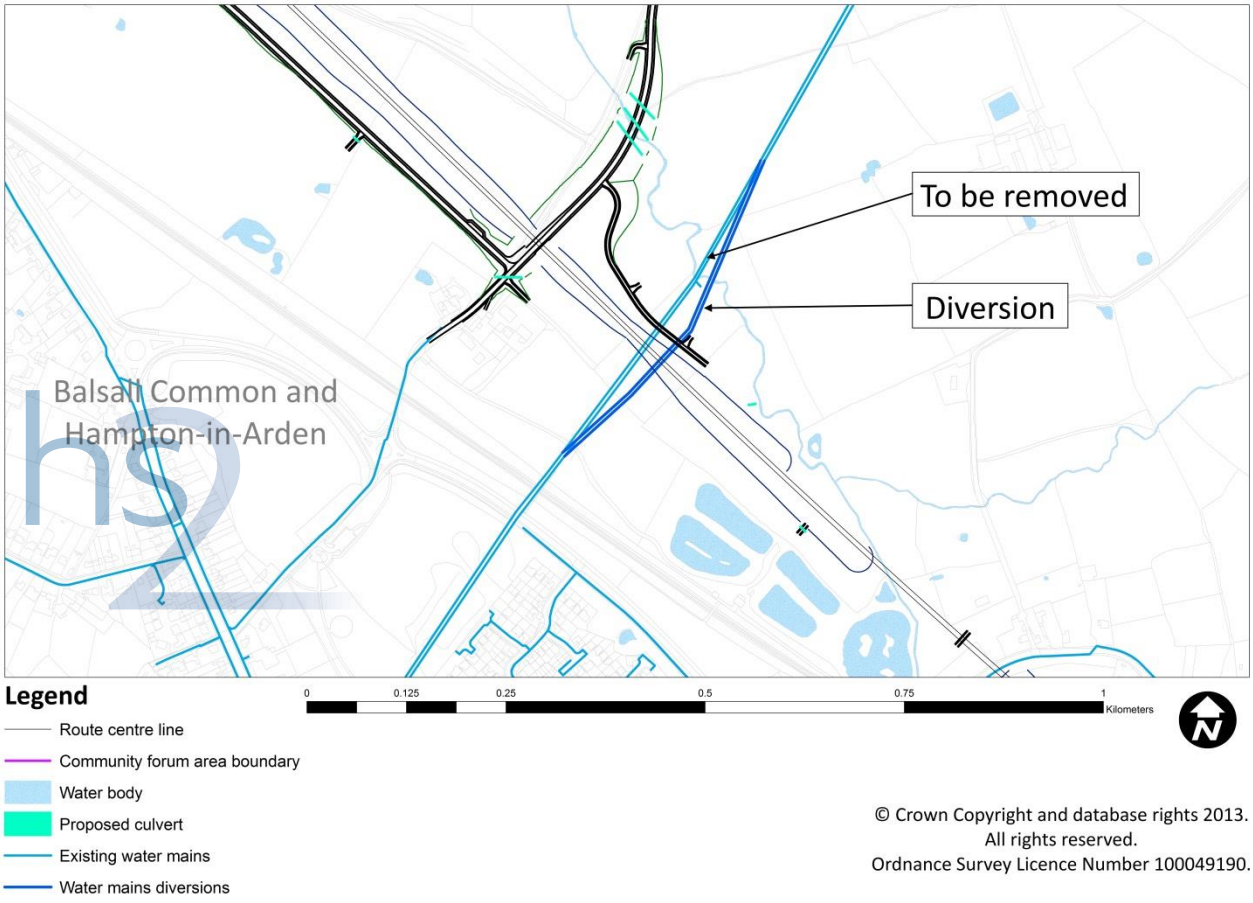
Water supply network

8.4.1 Overland flow has been adopted as a term in this section to distinguish it from surface water flooding i.e. where the capacity of the drainage system is exceeded. Overland flow in this section refers to flow over the surface which is caused by infrastructure failure.

8.4.2 Assets are mapped and where appropriate the potential overland flow paths inspected by interrogation of topographic data. The extent of overland flow from a pipe failure will depend on discharge rate which is in turn influenced by a number of factors including water main diameter, pressure, depth and upstream water source. Given the limited data available and complexity in accurately assessing overland flow routes this FRA is limited to identification of potential flow paths only.

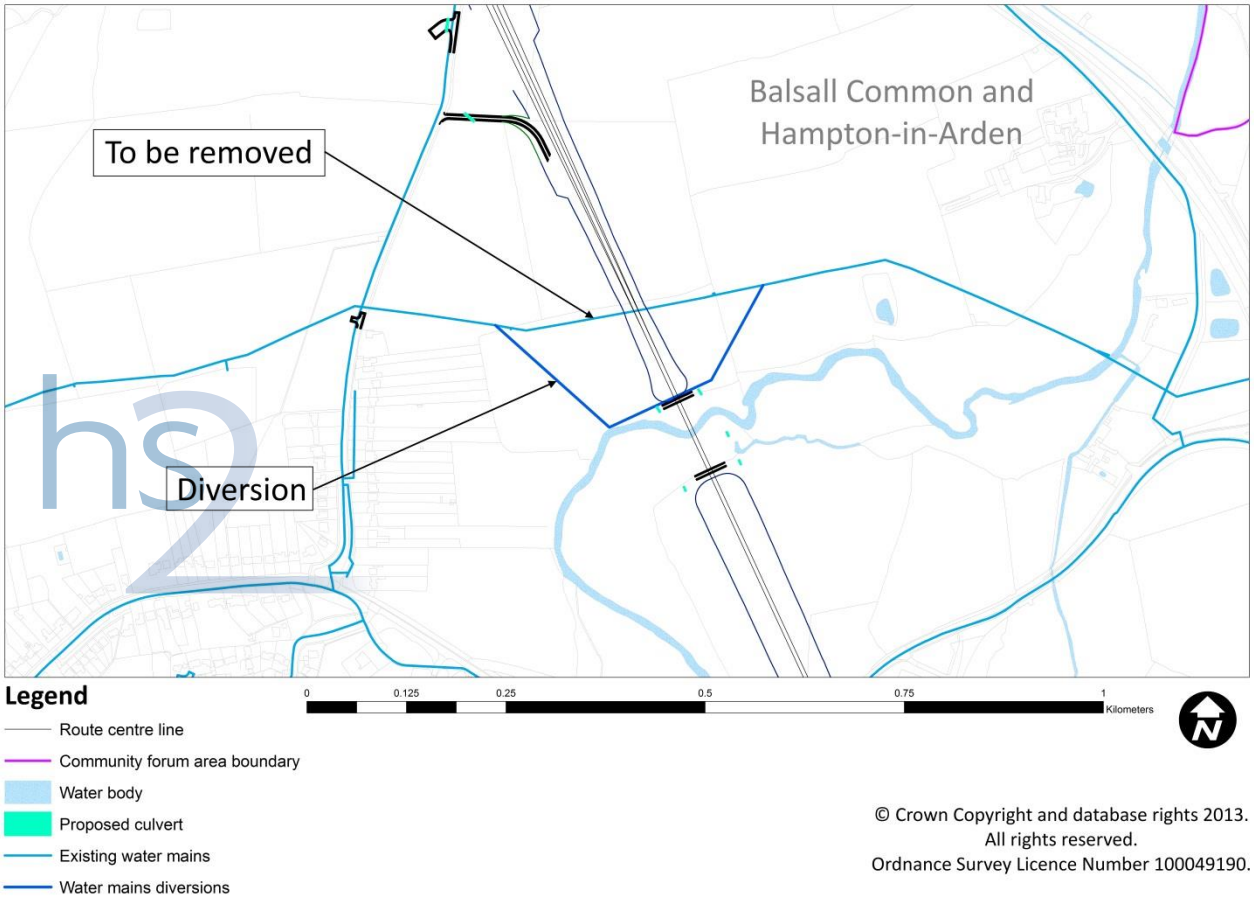
8.4.3 Where existing or diverted water mains and water distribution infrastructure have been judged to offer a potential source of flood risk from an upstream catchment an assessment of potential surface water flow routes have been made of the risk associated with this source.

Figure 22: Balsall Common diversion



8.4.4 Two existing water mains at Balsall Common will be diverted to avoid the proposed route and cross under the viaduct. Local topography suggests that in the event of failure, water will be received by Bayleys Brook and the proposed surface water cut-off ditches at the toe of proposed route embankments. No resulting surface water interface with either the Proposed Scheme or local buildings is anticipated east of the proposed works and embankment drainage would collect any run-off from the west.

Figure 23: Blythe Valley diversion



8.4.5 The existing 1200mm diameter water main at Blythe Valley will be diverted to avoid the proposed route and cross under the viaduct. A further diversion of an existing water main <200mm in diameter is also proposed through this viaduct from Meriden Road and is indicated on Figure 23. Local topography suggests that in the event of failure, water would be received by the River Blythe. No resulting surface water interface with either the Proposed Scheme or local buildings is anticipated east of the proposed works and land drainage would collect any runoff from west of Meriden Road / Diddington Lane diversion.

Reservoirs/large water bodies

8.4.6 The proposed overland flow routes associated with reservoir failure have been compared to the Proposed Scheme. The overland flow routes are discussed in the following sections in relation to the reservoir sources and the Proposed Scheme development.

Earlswood lakes

8.4.7 The flood pathway from these lakes will convey water along the River Blythe channel to the River Blythe viaduct approximately 26km downstream from the lakes. The Environment Agency's reservoir flood inundation mapping indicates a floodplain which appears no more extensive than the predicted 1% AEP plus CC flood map. It is assumed that the river modelling of the River Blythe viaduct provides adequate assessment of risk posed to the Proposed Scheme from failure of these reservoirs. Further assessment is recommended in the form of a review of the asset owners Reservoir Emergency Plan which may contain more accurate assessment of downstream flood risk and proposals for flood warnings.

Meriden Service reservoirs

8.4.8 The flood pathway from these reservoirs will convey water through the River Blythe Bypass channel, beneath the diverted A452 Kenilworth Road and northwards into the River Blythe. A proportion of the flow may be conveyed along the Bypass channel and beneath the route on Blythe Bypass viaduct. The floodplain extent from these reservoirs is less than that predicted for a 1% AEP event on the Environment Agency's Flood Mapping. It is assumed that the river modelling of the River Blythe viaduct provides adequate assessment of risk posed to the Proposed Scheme from failure of these reservoirs.

8.4.9 Further assessment is recommended in the form of a review of the asset owners Reservoir Emergency Plan which may contain more accurate assessment of downstream flood risk and proposals for flood warnings.

Geary's Level and Molands lakes

8.4.10 The flood pathway from these reservoirs would convey water directly to the River Blythe without passing through any of the Proposed Scheme. However, the proximity of the reservoirs to the Blythe may result in flood risk impact to the proposed new B4102 Meriden Road diversion junction located on the A452 Kenilworth Road. The floodplain extent from the reservoir failure mapping is similar in extent to the Environment Agency's flood mapping and while baseline modelling undertaken for the Blythe Bypass indicates an increase in flood extent at the same location it is assumed that the reservoir flood extent would not be significantly greater than the 1% AEP plus CC event. It is therefore assumed that the river modelling of the River Blythe viaduct provides adequate assessment of risk posed to the Proposed Scheme from failure of these reservoirs.

8.4.11 Further assessment is recommended in the form of a review of the asset owners Reservoir Emergency Plan which may contain more accurate assessment of downstream flood risk and proposals for flood warnings.

8.5 Summary of potential impacts on flood risk

8.5.1 Reference should be made to the flood maps provided in main ES Volume 5: Map book WR-05. A summary of main receptors is provided in Table 28.

Table 28: Summary of potential flood risk impacts in CFA23

Receptor	Vulnerability Classification	Pathway	Impacts
General Proposed Scheme		Rivers	The route is located on embankment and viaduct. Embanked sections are in Flood Zone 1 and as such will not cause a significant increase in flood risk. Where the route spans Flood Zones 2 and 3 viaducts will be employed or replacement floodplain storage will be provided and following implementation of all mitigation measures no significant increase in flood risk is identified.
		Surface water and drainage systems	Cuttings will be protected from surface water flooding by cut-off ditches and flood protection mound.
		Groundwater	Proposed Scheme will be in cutting north of Balsall Common. Groundwater seepage is not envisaged to be significant. Groundwater will be intercepted by Proposed Scheme rail drainage system.
		Artificial Bodies	Flood waters released by the failure of the artificial water bodies identified in this CFA would flow along the River Rea and River Tame. There would not be any increased risk of flooding from artificial sources caused by the Proposed Scheme
River Blythe			
B4102 Meriden Road	Less vulnerable	River FZ3b	Increase (typically 30mm) in existing flooding on B4102 Meriden Road. No change in hazard rating.
Meriden Mill Farm	More vulnerable	River FZ3b	No change in flood risk
A452 Kenilworth Road	More vulnerable	River FZ3b	No change in flood risk
Mouldings Green Farm	More vulnerable	River FZ3b	No change in flood risk
Agricultural Land	Less vulnerable	River FZ3b	Increase in existing flooding of between 20 to 60mm with a localised area of increase up to 170mm immediately upstream of the Proposed Scheme over agricultural land. Minor increase in extents.
SSSI		River	No significant impact.
Shadow Brook			

Receptor	Vulnerability Classification	Pathway	Impacts
Diddington Lane	Less vulnerable	River FZ3b	Existing Diddington Lane to be stopped and removed and replaced with an access track and new culvert downstream of Proposed Scheme bridge over Shadow Brook. New culvert reduces water levels by 98mm upstream of new culvert. Diddington Lane itself is to be realigned and Shadow Brook spanned by new bridge. No change to water levels at this crossing
A452 Kenilworth Road	More vulnerable	River FZ3a	Minor increase in flow at theA452Kenilworth Road but no resultant increase in flood levels.
Agricultural Land	Less vulnerable	River FZ3b	1mm reduction in flood levels upstream of the Proposed Scheme bridge crossing of Shadow Brook.
Bayleys Brook – Balsall Common			
Agricultural Land	Less vulnerable	River FZ3b	Localised increases in downstream flood level up to 150mm with minimal increase in floodplain extent
Lavender Hill Fisheries	Less vulnerable	Above River FZ3a	No significant change in flood risk
Truggist Lane	Less vulnerable	Model not extended to assess flood risk to Truggist Lane	There is no increase in flood level at the upstream model extent which is located downstream of Truggist Lane
Bayleys Brook – Marsh Farm			
A452 Kenilworth Road	More vulnerable	Above FZ3a flood levels	No change in flood risk
Marsh Lane	Less vulnerable	Above FZ3a flood levels	Less than 10mm increase in downstream flood levels
Berkswell Marsh SSSI	Water compatible	River FZ3b	No change in flood risk
Mercote Lodge	More vulnerable	Marginally Outside of River FZ3a	Less than 10mm increase in downstream flood levels
Agricultural Land	Less Vulnerable	River FZ3	Localised increase in depths immediately downstream of the Proposed Scheme.
Bayleys Brook – Lavender Hall Lane			
Lavender Hall Lane	Less vulnerable	Above River FZ3a levels	Slight increase in flood levels upstream of the Lavender Hall Lane crossing. The road level will be higher and level of flood protection to Lavender Hall Lane is increased.
Agricultural Land	Less vulnerable	River FZ3b	Minor, localised increase (approximately 40mm) in flood levels upstream of Lavender Hall Lane
Horn Book / River Blythe Tributary			
Marsh Lane	Less vulnerable	Above FZ3a flood levels	No change in flood risk

Receptor	Vulnerability Classification	Pathway	Impacts
Agricultural Land	Less vulnerable	River FZ3b	No change in flood risk
A452 Kenilworth Road	More vulnerable	Above River FZ3a levels	No change in flood risk, road levels are increased
Superficial deposits overlying the Tile Hill Mudstone and Mercia Mudstone from Lavender Hall Lane overbridge to the Heart of England Way bridge.	Less vulnerable	Groundwater	Rail level along route is below groundwater levels, with mitigation provided by drainage systems.
Superficial deposits overlying the Mercia Mudstone at Pasture Farm overbridge	Less vulnerable	Groundwater	Rail level along route is below groundwater levels, with mitigation provided by drainage systems.
Birmingham to Rugby Line	Essential infrastructure	Bayleys Brook	No change in flood risk. Balsall Common viaduct will be sized appropriately and replacement floodplain storage will be provided.
Truggist Lane	Less vulnerable	Bayleys Brook	No change in flood risk. Balsall Common viaduct will be sized appropriately and replacement floodplain storage will be provided.
Lavender Hall Lane diversion	Less vulnerable	Bayleys Brook	Elevation of Lavender Hall Lane will be raised to pass over Proposed Scheme. Flood alleviation culverts and replacement floodplain storage will be provided.
Kenilworth Road diversion	More vulnerable	Horn Brook	Elevation of Kenilworth Road will be raised to pass over Proposed Scheme. Replacement floodplain storage will be provided.

9 Conclusion

9.1.1 This FRA accounts for the flood risk considerations caused by construction of the Proposed Scheme within CFA23 to the proposed route and third parties.

9.1.2 In order to fully understand the existing risk posed by the River catchment and to be able to evaluate the impact of the Proposed Scheme infrastructure on the hydraulic behaviour of the Blythe Catchment a number of discrete hydraulic models have been created using either fully two dimensional (TUFLOW) models or one dimensional steady state models (HEC-RAS). The Environment Agency does not have an existing model of the Blythe catchment.

9.1.3 Hydraulic models were created for each watercourse crossing where the 1% AEP+ 20% CC exceeded $3m^3/s$. Simplified culvert calculations based on C689 were used to assess the post development flood risk impact of smaller watercourses.

9.1.4 The Proposed Scheme infrastructure proposals have been incorporated into the baseline river models in order for the impact of the proposals on flood risk to be determined.

9.1.5 The Proposed Scheme will be designed to be resilient up to and including the 0.1% AEP storm event. This will be achieved by either setting the rail level at 1m above the 0.1% AEP flood level or by protecting the route using flood defence structures set at a level that is equivalent to 300mm above the 0.1% return AEP flood level.

9.1.6 The surface water management strategy for CFA23 ensures run-off generated by rain water falling onto the Proposed Scheme is collected, attenuated and discharged at a controlled rate. The strategy is designed to manage discharges generated by rain storm events with a 1% AEP plus a 30% increase in rainfall intensity to allow for changes in rainfall patterns due to climate change.

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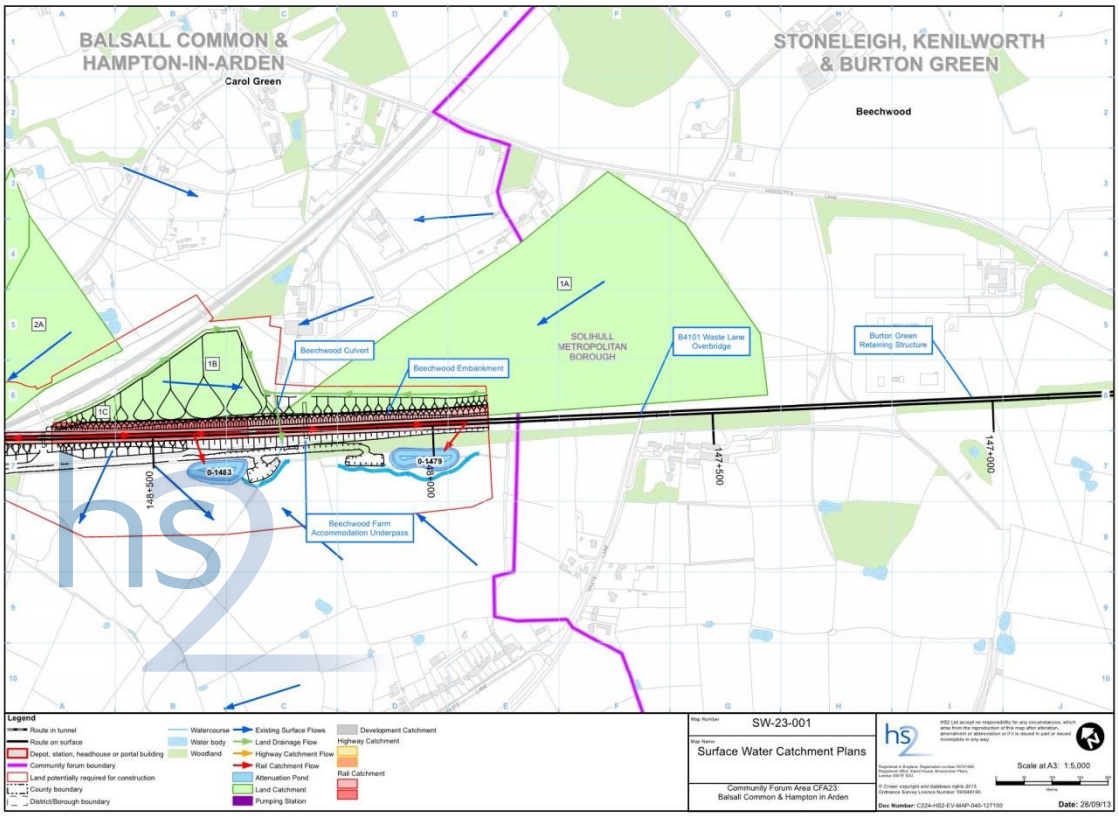
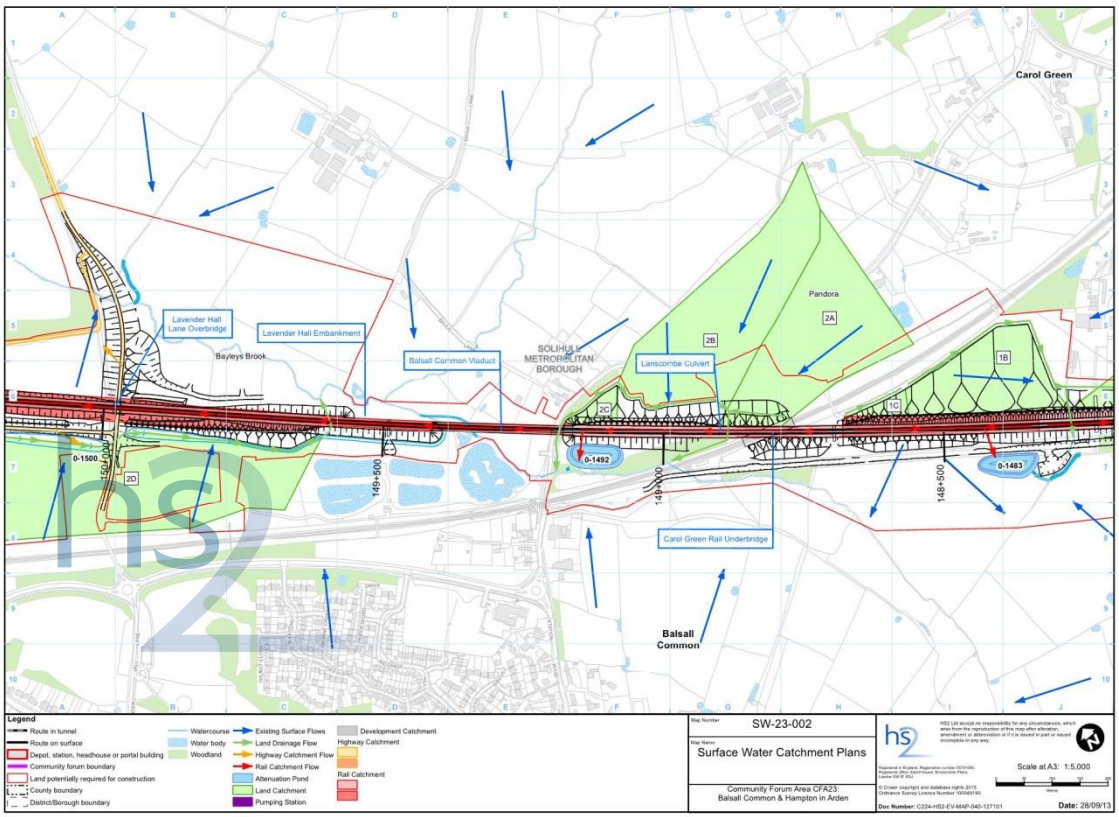
11 Annex A

11.1 Surface water catchment flow figures


BALSALL COMMON &
HAMPTON-IN-ARDEN
Carol Green
STONELEIGH, KENILWORTH
& BURTON GREEN
Beechwood
SOLIHULL
METROPOLITAN
BOROUGH
Beechwood Culvert
Beechwood Embankment
B4101 Waste Lane
Overbridge
Burton Green
Retaining Structure
Beechwood Farm
Accommodation Underpass
1A
1B
1C
2A
0-1483
0-1479
148+500
148+000
147+500
147+000
Legend
Route in tunnel
Route on surface
Depot, station, headhouse or portal building
Community forum boundary
Land potentially required for construction
County boundary
District/Borough boundary
Watercourse
Water body
Woodland
Existing Surface Flows
Land Drainage Flow
Highway Catchment Flow
Rail Catchment Flow
Attenuation Pond
Land Catchment
Pumping Station
Development Catchment
Highway Catchment
Rail Catchment
Map Number
SW-23-001
Map Name
Surface Water Catchment Plans
Community Forum Area CFA23:
Balsall Common & Hampton in Arden
Scale at A3: 1:5,000
Doc Number: C224-HS2-EV-MAP-040-127100
Date: 28/09/13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Lane Overbridge
Lavender Hall Embankment
Bayleys Brook
Balsall Common Viaduct
SOLIHULL
METROPOLITAN
BOROUGH
Lanscombe Culvert
Pandora
2A
2B
2C
2D
1B
1C
0-1500
0-1492
0-1483
149+500
149+000
148+500
Carol Green Rail Underbridge
Balsall
Common
Legend
Route in tunnel
Route on surface
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Land potentially required for construction
County boundary
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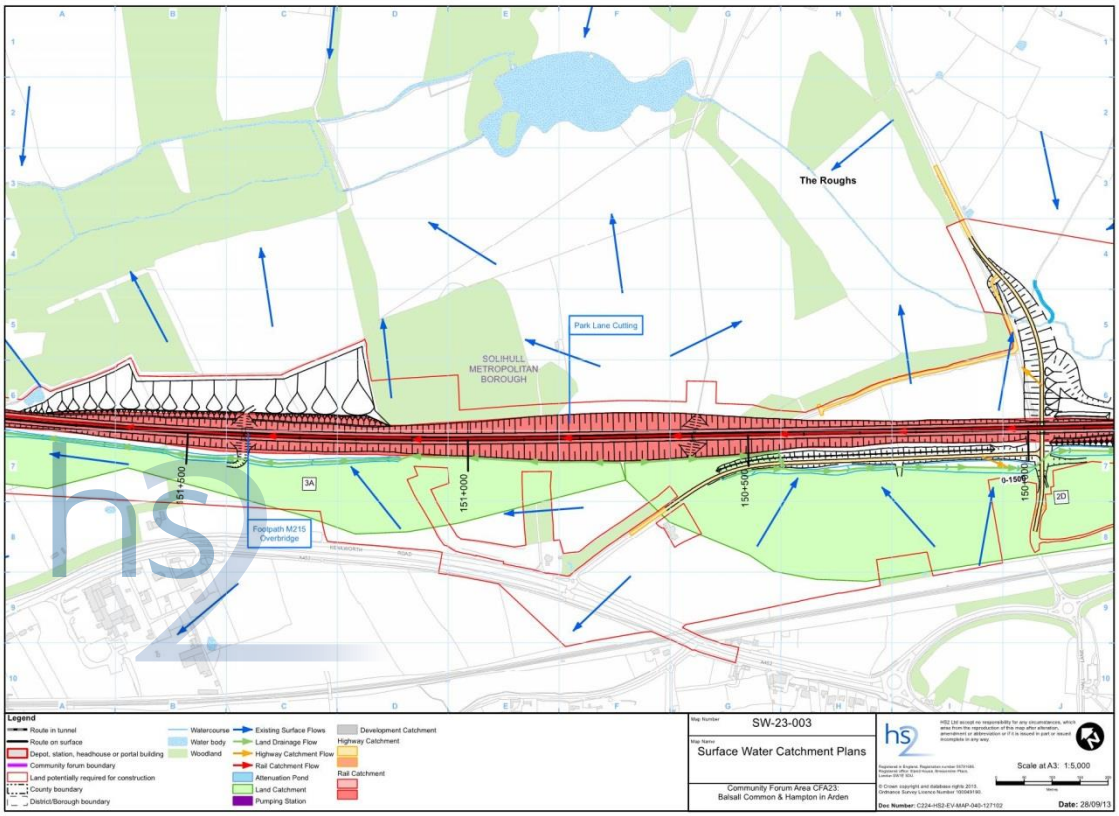
Date: 28/09/13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Footpath M215 Overbridge
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2D
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151+000
150+500
150+000
0-1500
Legend
Route in tunnel
Route on surface
Depot, station, headhouse or portal building
Community forum boundary
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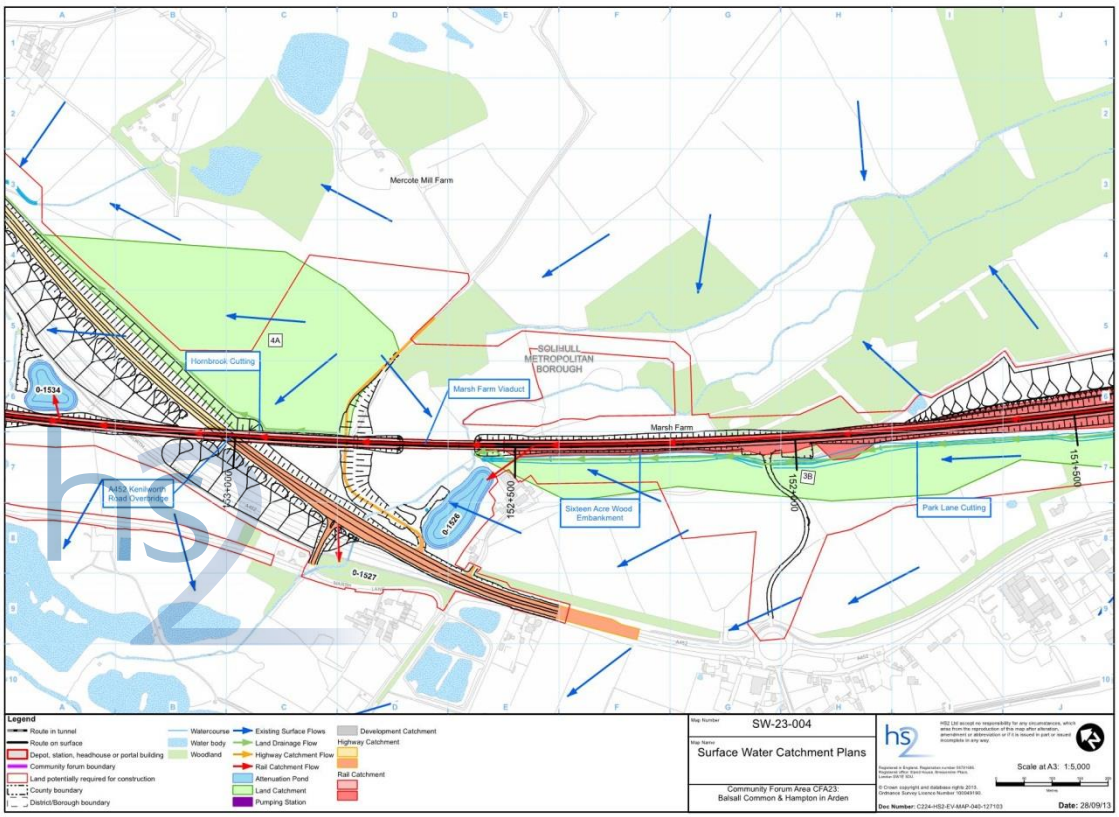
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Marsh Farm
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152+500
0-1526
0-1527
Sixteen Acre Wood Embankment
3B
152+000
151+500
Park Lane Cutting
Legend
Route in tunnel
Route on surface
Depot, station, headhouse or portal building
Community forum boundary
Land potentially required for construction
County boundary
District/Borough boundary
Watercourse
Water body
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Attenuation Pond
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Development Catchment
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Map Name
Surface Water Catchment Plans
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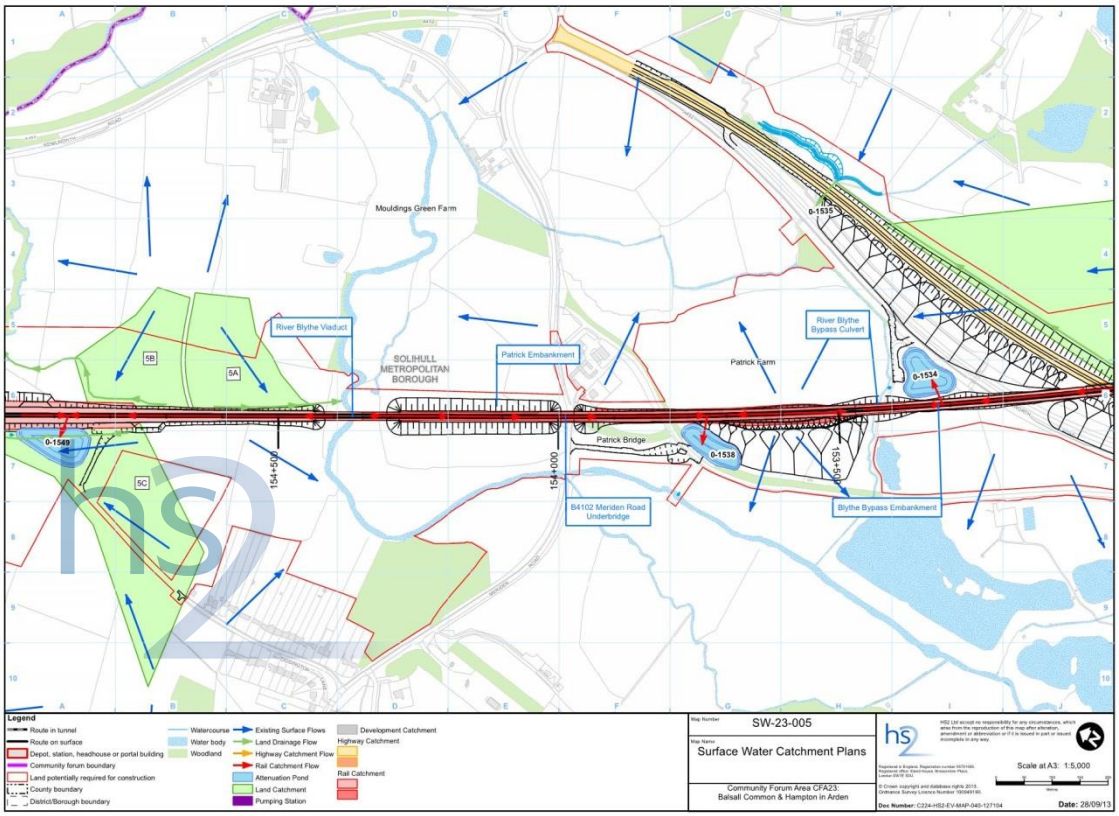
Date: 28/09/13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Patrick Embankment
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Route on surface
Depot, station, headhouse or portal building
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Rail Catchment
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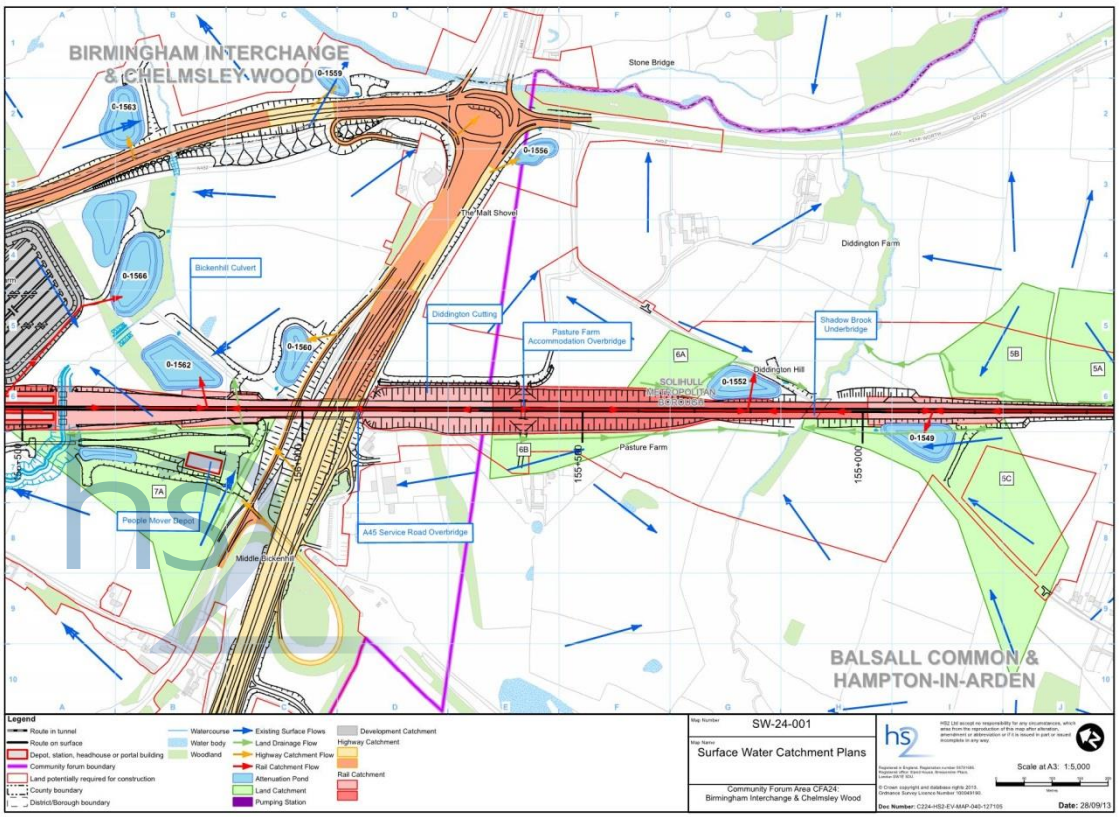
BIRMINGHAM INTERCHANGE & CHELMSLEY WOOD
Stone Bridge
The Malt Shovel
Diddington Farm
Bickenhill Culvert
Diddington Cutting
Pasture Farm Accommodation Overbridge
Shadow Brook Underbridge
Diddington Hill
Pasture Farm
People Mover Depot
A45 Service Road Overbridge
Middle Bickenhill
BALSALL COMMON & HAMPTON-IN-ARDEN
0-1559
0-1563
0-1556
0-1566
0-1560
0-1562
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6A
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7A
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Route on surface
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Attenuation Pond
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Development Catchment
Highway Catchment
Rail Catchment
Map Number
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Surface Water Catchment Plans
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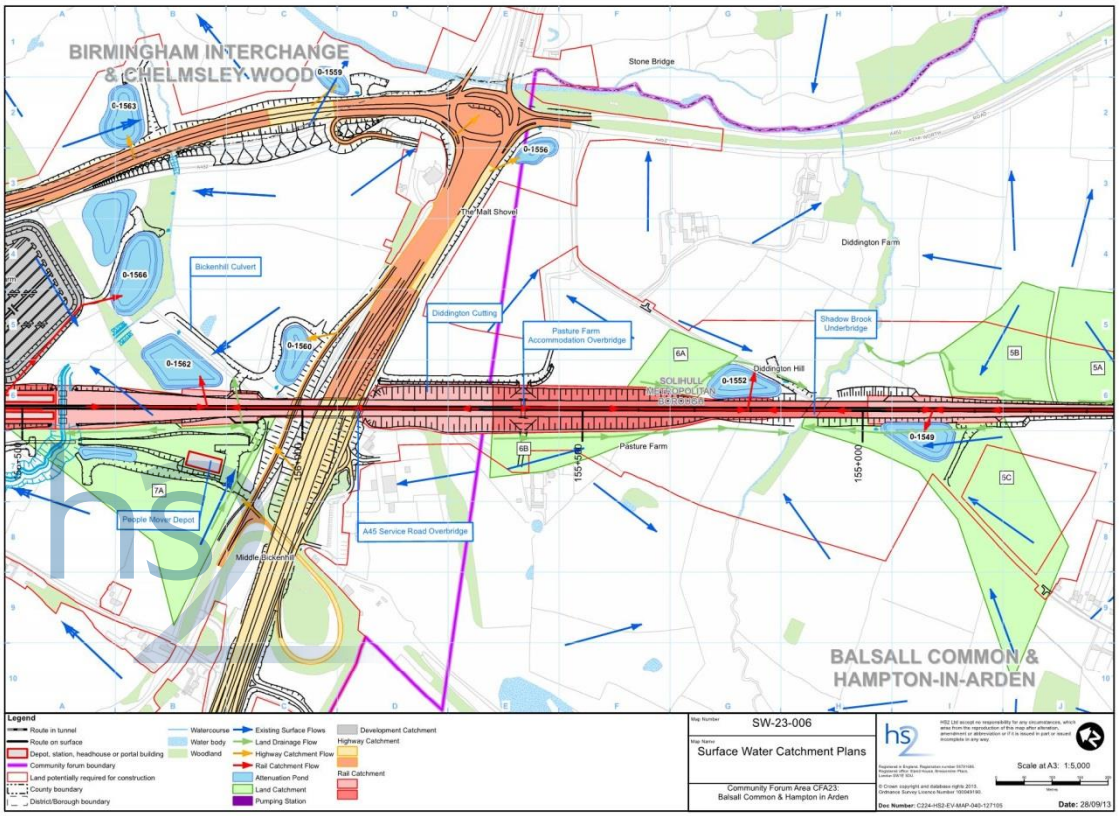
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Diddington Hill
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Pasture Farm
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People Mover Depot
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Rail Catchment Flow
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Land Catchment
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Highway Catchment
Rail Catchment
Map Number SW-23-006
Map Name Surface Water Catchment Plans
Community Forum Area CFA23: Balsall Common & Hampton in Arden
Scale at A3: 1:5,000
Date: 28/09/13

HIGH SPEED RAIL (LONDON - WEST MIDLANDS)

Supplementary Environmental Statement and Additional Provision 2 Environmental Statement

Volume 5 | CFA24 | Birmingham Interchange and Chemlsley Wood

Environmental topic:	Air quality	AQ
Appendix name:	Data appendix	001
Community forum area:	Birmingham Interchange and Chelmsley Wood	024

Contents

List of tables

1 Introduction

1.1 Structure of this air quality assessment appendix

1.1.1 This appendix provides an update to Appendix AQ-001-024 from the main Environmental Statement (ES) (Volume 5, Appendix AQ-001-024). This update should be read in conjunction with Appendix AQ-001-024 from the main ES.

1.1.2 This appendix is structured as follows:

- Baseline air quality data (Section 2); and
- Air quality assessment - road traffic (Section 3).

1.1.3 Maps referred to throughout this air quality appendix are contained in the Volume 5 Air Quality map book, within this Supplementary Environmental Statement (SES) and Additional Provision 2 ES (AP2 ES).

1.2 Scope of this assessment

1.2.1 This air quality assessment considers changes to local air quality as a result of:

- corrections to Appendix AQ-001-024 from the main ES;
- changes to the design or construction assumptions which do not require changes to the Bill;
- changes to the design of the scheme that are outside the existing limits of the Bill (i.e. AP2 amendments); and
- updates to traffic models.

Methodology, data sources and design criteria

1.2.2 The assessment scope, key assumptions and limitations for air quality are set out in Volume 1, the Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001 -000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2) of the main ES as amended by the SMR Addendum 2 (Volume 5: Appendix CT-001 -000/3 of the SES and AP2 ES), which was produced to specifically amend and advance the SMR for AP2. The SMR Addendum 2 focuses on updates and refinements to: the establishment of the baseline and definition of the survey; the scope of the air quality assessment; and the assessment methodology.

2 Baseline air quality data

2.1 Existing air quality

2.1.1 The combined impact of the SES and AP2 revised scheme will lead to an increase in the change in vehicle movements on some road links when compared with the original scheme, during the construction phase. On some of these road links, the change will exceed the screening criteria and further assessment of local air quality impacts is required.

2.1.2 To undertake this assessment, additional baseline information was required.

Background pollutant concentrations

2.1.3 The background concentrations used in the assessment are shown in Table 2. Background concentrations are below the national air quality objective values at the additional receptors considered in this assessment.

3 Air quality assessment - road traffic

3.1 Overall assessment approach

3.1.1 The overall assessment approach remains the same as described in Appendix AQ-001-024 of the main ES. Where changes to this aproach have been employed, these are detailed in section 3.2.

3.2 Model inputs and verification

Model parameters for detailed assessment

3.2.1 ADMS-Roads was used for the detailed assessment. A surface roughness length of 1.5m, meteorological site surface roughness length of 0.2m, minimum Monin Obukhov length of 100m and latitude of 52.5 degrees were used in the detailed assessment. All other parameters were model default settings. Meteorological data from the Birmingham Elmdon monitoring site was used.

Model verification

3.2.2 There is no baseline data within community forum area (CFA)24 to inform model verification. In the absence of such data, this assessment has made the assumption that no bias adjustment is required. This is in line with the performance of models in other neighboring CFAs, where model verification has been possible.

3.3 Construction traffic

3.3.1 Construction traffic data used in this assessment are detailed in SES and AP2 ES Volume 5 Appendix TR-001-000. Scenarios assessed were without the original scheme and with the SES and AP2 revised scheme (months 30, 35 and 44 of the construction period). The maximum change in months 30, 35 and 44 has been assessed for each of the receptors.

Receptors assessed

3.3.2 The additional receptors located within this area are listed in Table 1. The impact of the combined SES and AP2 revised scheme has been considered at these locations.

Table 1: Modelled receptors (construction phase)

Receptor	Description/location	Ordnance Survey (OS) coordinates	Scenarios assessed with the scheme
25-14	Common Farm	420049,284909	Month 30
25-15	Park Farm	420653,284051	Month 44
25-16	Cottage (Kennels)	420807,283108	Month 44
25-17	Myrtle Cottage	420249,283172	Month 35
25-18	217 Old Station Road	419813,282857	Month 35

Receptor	Description/location	Ordnance Survey (OS) coordinates	Scenarios assessed with the scheme
25-19	Coleshill and Bannerly Pools Site of Special Scientific Interest (SSSI)	419748, 285923	Month 44

Background concentrations

3.3.3 The background concentrations used in the assessment are shown in Table 2 and Table 3, and obtained from the Defra maps for 2017 and Air Pollution Information System website.

Table 2: Background 2017 concentrations at assessed receptor grid squares

Receptor (or zone of receptors)	Concentrations (µg/m³)		
	NOx	NO2	PM10
420500,284500	32.1	21.4	17.2
420500,283500	32.1	21.4	17.2
419500,282500	28.4	19.3	17.9

Table 3: Background 2017 concentrations at assessed receptor areas

Receptor (or zone of receptors)	Concentrations (µg/m³) and Deposition Rates		
	NOx	Nutrient nitrogen deposition (kg N Ha/yr)	Acid nitrogen deposition (Keq Ha/yr)
Coleshill and Bannerly Pools SSSI	43.5	37.6	2.7

Detailed modelling results

3.3.4 This section provides the summary of the modelled pollutant concentrations for the assessed receptors. The magnitude of change and impact descriptor are also derived following the Environmental Protection UK (EPUK) methodology.

Table 4: Summary of ADMS-Roads annual mean NO2 results (construction phase)

Receptor	Concentrations (µg/m³)		Change in concentrations (µg/m³)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with SES and AP2 revised scheme			
25-14	23.9	24.1	0.1	Imperceptible	Negligible
25-15	23.0	23.1	0.1	Imperceptible	Negligible
25-16	22.4	24.4	2	Medium	Negligible

Receptor	Concentrations (µg/m³)		Change in concentrations (µg/m³)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with SES and AP2 revised scheme			
25-17	23.9	25.1	1.2	Small	Negligible
25-18	35.2	35.7	0.5	Small	Negligible

Table 5: Summary of ADMS-Roads annual mean PM10 results (construction phase)

Receptor	Concentrations (µg/m³)		Change in concentrations (µg/m³)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with SES and AP2 revised scheme			
25-14	17.7	17.8	0.1	Imperceptible	Negligible
25-15	17.6	17.6	<0.1	Imperceptible	Negligible
25-16	18.6	19.0	0.4	Small	Negligible
25-17	18.7	19.0	0.3	Imperceptible	Negligible
25-18	19.6	19.7	0.1	Imperceptible	Negligible

Table 6: Summary of ADMS-Roads annual mean NOx results (construction phase)

Receptor	Concentrations (µg/m³)		Change in concentrations (µg/m³)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with SES and AP2 revised scheme			
25-19	86.4	86.9	0.5	Small	Slight Adverse

Table 7: Summary of ADMS-Roads annual mean Nutrient Nitrogen Deposition results (construction phase)

Receptor	Deposition Rate (kg N ha/yr)		Change in Deposition Rate (kg N ha/yr)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with SES and AP2 revised scheme			
25-19	40.3	40.3	<0.1	Imperceptible	Negligible

Table 8: Summary of ADMS-Roads annual mean Acid Nitrogen Deposition results (construction phase)

Receptor	Deposition Rate (keq ha/yr)		Change in Deposition Rate (keq N ha/yr)	Magnitude of change	Impact descriptor
	2017 without original scheme	2017 with SES and AP2 revised scheme			
25-19	4.0	4.0	<0.1	Imperceptible	Negligible

Assessment of significance

3.3.5 The impact at the worst affected receptor for changes to annual mean NO2 concentrations will be medium. Where total pollutant concentrations are below the national air quality objective value, this equates to a negligble effect on local air quality, which is not significant. Small to imperceptible changes to PM10 will also have a negligible effect, which is not significant.

3.3.6 The impact on annual mean NOx concentrations at the worst affected Coleshill and Bannerly Pools SSSI will be small. Total NOx concentrations at this SSSI will be in exceedance of the national air quality objective value for this pollutant in both baseline and construction phase scenarios.

3.3.7 The impact on annual nutrient nitrogen and acid nitrogen deposition rates will be imperceptible at the Coleshill and Bannerly Pools SSSI.

3.3.8 Air Quality effects at human health receptors arising from changes to traffic associated with the construction of the proposed scheme will be insignificant, as pollutant concentrations will be well below the relevant air quality standards and the impact descriptor at all receptors will be negligible. Effects at the ecological receptors will also be insignficant, as the construction phase only results small to imperceptible increases of the pollutants concerned.

Environmental topic:	Community	CM
Appendix name:	Community assessment	001
Community forum area:	Birmingham Interchange and Chelmsley Wood	24

Contents

List of tables

1 Introduction

1.1.1 This appendix provides an update to the Appendix CM-001-024 Community assessment from the main Environmental Statement (ES) as a result of design change SES-024-001 and SES-024-002, assessed as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with Appendix CM-001-024 Community assessment from the main ES.

1.1.2 This appendix is structured as follows:

- Part 1: Supplementary Environmental Statement
  - community impact assessment record sheets - construction.

Part 1: Supplementary Environmental Statement

2 Community impact assessment record sheets - construction

2.1 National Motorcycle Museum

Table 1: National Motorcycle Museum community impact assessment record sheet

Resource name	National Motorcycle Museum
Community forum area (CFA)	CFA24 – Birmingham Interchange and Chelmsley Wood
Resource type	Recreation
Resource description/profile	The National Motorcycle Museum is a popular visitor attraction, providing conference and meeting facilities as well as event space. The museum is located off the A45 Coventry Road/M42 junction 6 roundabout (known as M42 junction 6 roundabout) in Bickenhill.
Assessment year	Construction phase (2017+)
Impact 1: temporary loss of land	Impact: the National Motorcycle Museum site is partially within an area of land required to construct the original scheme. As part of the original scheme, the adjacent M42 junction 6 roundabout would require improvement works, including widening of the roundabout and entry/exit roads. This would include the construction of a segregated left turn lane for M42 southbound traffic on the roundabout, which will require an area of land within the museum's car park. The original scheme would result in the loss of approximately 55 car parking spaces (20% of the total car parking spaces) for up to one year and six months during the construction period. The museum currently provides approximately 274 car park spaces and requires the full capacity of the car park to accommodate a range of large events on a regular basis. The proposed change will mean that some of the improvements to the road network in the vicinity of the National Motorcycle Museum, to mitigate the impact of the scheme, will no longer be required, including the segregated left turn lane to the M42 southbound roundabout exit, which is now replaced by widening of the existing A45 Coventry Road westbound slip to M42 Junction 6 from three lanes to four; widening of the off slip roundabout entry and part of the widening of the roundabout circulatory carriageway. The temporary loss of parking will remain as reported in the main ES. Duration of impact: approximately one year and six months.
Assessment of magnitude	Medium: the loss of parking will compromise the ability of the resource to accommodate major events.
Relevant receptors	Users of the museum and ancillary facilities.
Assessment of sensitivty of receptor (s) to impact	Medium: the National Motorcycle Museum provides the following facilities: museum, fully licensed restaurant, gift shop, conference and banqueting facilities, training and seminar rooms, and a wedding venue. The museum currently provides 274 car parking spaces and requires the full capacity of the car park to accommodate a range of large events on a regular basis. There is no convenient alternative parking provision for

Resource name	National Motorcycle Museum
	visitors.
Significance rating of effect	Moderate adverse significant: the temporary loss of car parking is likely to impact upon the functioning of the National Motorcycle Museum. The magnitude of this effect is unchanged from that reported in the main ES.
Proposed mitigation options for significant effects	No further mitigation proposed.
Residual effects significance rating	Moderate adverse significant: the temporary loss of car parking is likely to impact upon the functioning of the National Motorcycle Museum. The magnitude of this effect is unchanged from that reported in the main ES.
Impact: 2: permanent loss of land	Impact: the original scheme included the widening of the A45 Coventry Road and the construction of a segregated left turn lane for M42 southbound traffic off the M42 junction 6 roundabout. This would require the permanent loss of some areas of the National Motorcycle Museum including the existing access point, a grassed area to provide a replacement access from the A45 Service Road, approximately 45 car parking spaces and the grass verge to the north of the museum. The proposed change will mean that some of the improvements to the road network in the vicinity of the National Motorcycle Museum will no longer be required. The proposed change will include the widening of the A45 Coventry Road westbound off slip roundabout entry from three lanes to four, widening of the off slip roundabout entry and part of the widening of the roundabout circulatory carriageway. Although a small area of land at the National Motorcycle Museum will be required permanently, this will not lead to any loss of parking and the existing access to the museum will remain in its existing location, albeit with minor modifications. Duration of impact: permanent.
Assessment of magnitude	Negligible: the museum will not be required to close and can continue to be used for its intended purpose without any significant inconvenience to the users.
Relevant receptors	Users of the museum and ancillary facilities.
Assessment of sensitivity of receptors (s) to impact	Medium: the National Motorcycle Museum provides the following facilities: museum, fully licensed restaurant, gift shop, conference and banqueting facilities, training and seminar rooms, and a wedding venue. The museum currently provides 274 car parking spaces and requires the full capacity of the car park to accommodate a range of large events on a regular basis. There is no convenient alternative parking provision for visitors.
Significance rating of effect	Negligible adverse not significant: the permanent loss of land at the National Motorcycle Museum is not likely to impact upon the functioning of the facility.

Resource name	National Motorcycle Museum
	The magnitude of the effect is reduced so that the effect is no longer significant.
Proposed mitigation options for significant effects	No further mitigation proposed.
Residual effects significance rating	Negligible adverse not significant: the permanent loss of land at the National Motorcycle Museum is not likely to impact upon the functioning of the facility. The magnitude of the effect is reduced so that the effect is no longer significant.

2.2 Heath Park

Table 2: Heath Park community impact assessment record sheet

Resource name	Heath Park
CFA	CFA24 – Birmingham Interchange and Chelmsley Wood
Resource type	Open space
Resource description/profile	Heath Park provides a triangular area of public open space, approximately 8.0ha, running adjacent to Yorkminster Drive in Chelmsley Wood. The southern end of the park provides two full sized seasonal grassed football pitches, whilst the northern extent is densely vegetated. The accessible area of the park (excluding the densely vegetated areas, the pylon and a landscape bund), is approximately 3.8ha. Alongside Yorkminster Drive is a steep landscaped embankment, which adds to the screening the park provides between residential properties and the M6 motorway. There are two pylons located within the park.
Assessment year	Construction phase (2017+)
Impact 1: temporary loss of land	Impact: within Heath Park, the original scheme required an area of land approximately 3.9ha (49% of the total park) during the construction period. The land would be required for the location of the Coleshill Heath Road underbridge satellite construction compound at the southern extent of the park, and utility works in the centre of the park. The satellite construction compound is required for works associated with lowering Coleshill Heath Road, the construction of the route on Pool Wood embankment and the M6 motorway box structure, for approximately two years and six months. Utility works would include the removal of an overhead electricity power on the eastern boundary of Heath Park and works to a second overhead power line further north in the park. It is expected that these utility works would take place in advance of the mobilisation of the satellite construction compound, for approximately one year. The construction works would result in the temporary loss of parkland and one senior playing pitch. The remaining area of parkland would provide sufficient space to realign one playing pitch during the football season. The proposed change will provide 3.3ha of alternative open space at Coleshill Heath Road prior to the works commencing at Heath Park. Duration of impact: approximately three years and six months.

Resource name	Heath Park
Assessment of magnitude	Medium: the park will be partially closed and unusable for a proportion of its intended purposes, however there will be nearby alternative open space available. The net loss of parkland in the area will be reduced to 0.6ha.
Relevant receptors	Users of the park and pitches.
Assessment of sensitivity of receptors (s) to impact	Medium: the park is relatively well used by walkers and dog walkers (see Section 3 main ES appendix CM-001-024– Open space survey/public rights of way survey results), plus football matches during the summer season. The Solihull Playing Pitch Strategy[1] reports that the playing pitches are of 'good' quality, with capacity for two matches per week. The Strategy reports that 1-2 matches are currently played at Heath Park per week. The nearest alternative site is Bluebell Recreation Ground; however pitches at this site are played beyond capacity. There are limited alternative areas of public open space within Chelmsley Wood.
Significance rating of effect	Moderate adverse significant: part of the function of the park will be lost temporarily. The magnitude of this effect is reduced from major to moderate although the effect is still significant.
Proposed mitigation options for significant effects	The following measures were proposed in the main ES to mitigate the significant effect identified. It was the intention to work with Solihull Metropolitan Borough Council (SMBC) to put in place the following measures: - reconfiguration of the existing playing pitch layout at Heath Park and Bluebell Recreation Ground to provide an additional playing pitch during the football season and improvement to the pedestrian access to Heath Park and Bluebell Recreation Ground.
Residual effects significance rating	Moderate adverse significant: part of the function of the park will be lost temporarily. The magnitude of this effect is reduced from major to moderate although the effect is still significant.
Impact 2: permanent loss of land	Impact: the original scheme required approximately 0.9ha of land (11% of the total park) permanently for the construction and operation of Pool Wood embankment to carry the route of the scheme across Coleshill Heath Road and onto the M6 motorway box structure. Approximately 450m^2 of additional accessible parkland will be created through the removal of the existing pylon to the north of the grass pitches. The proposed change will provide 3.3ha of alternative open space at Coleshill Heath Road prior to the works commencing at Heath Park. This will result in a net gain of 2.4ha of open space within the community. Duration of impact: permanent.
Assessment of magnitude	Beneficial: there will be a permanent net gain in open space within the

[1] Solihull Metropolitan Borough Council (2012), Final Playing Pitch Strategy. SMBC

Resource name	Heath Park
	community.
Relevant receptors	Users of the park and pitches.
Assessment of sensitivity of receptor(s) to impact	Medium: the park is relatively well used by walkers and dog walkers (see Section 3 main ES appendix CM-001-024– Open space survey/public rights of way survey results), plus football matches during the summer season. The Solihull Playing Pitch Strategy[2] reports that the playing pitches are of 'good' quality, with capacity for two matches per week. The Strategy reports that 1-2 matches are currently played at Heath Park per week. The nearest alternative site is Bluebell Recreation Ground; however pitches at this site are played beyond capacity. There are limited alternative areas of public open space within Chelmsley Wood.
Significance rating of effect	Beneficial: there will be a permanent net gain in open space within the community. The significant adverse effect is removed, and the overall effect becomes beneficial for the community.
Proposed mitigation options for significant effects	The following measures were proposed in the main ES to mitigate the significant effect identified. It was the intention to work with SMBC to put in place the following measures: - reconfiguration of the existing playing pitch layout at Heath Park and Bluebell Recreation Ground to provide an additional playing pitch during the football season and improvement to the pedestrian access to Heath Park and Bluebell Recreation Ground; and
Residual effect significance rating	The provision of 3.3ha of open space will result in a net increase in open space which will be a benefit to the community of Chelmsley Wood and surrounding communities. There will be no residual significant effect. The significant adverse effect is removed, and the overall effect becomes beneficial for the community.

[2] Solihull Metropolitan Borough Council, (2012), Final Playing Pitch Strategy. SMBC

Environmental topic:	Sound, noise and vibration	SV
Appendix name:	Construction assessment report	003
Community forum area:	Birmingham Interchange and Chelmsley Wood	024

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1 Introduction

1.1.1 This appendix provides an update to Appendix SV-003-024 construction assessment report for community forum area (CFA) 24 from the main Environmental Statement (ES) as a result of design change SES-024-001, and combined effects of amendments in this CFA due to changes in traffic flows, as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with Appendix SV-003-024 Construction assessment report from the main ES.

2 Scope, assumptions and limitations

2.1 Changes of relevance to this assessment

2.1.1 SES-024-001 relates to amendments to the road network at the M42 junction 6 and associated slip roads. Changes in traffic flows occur in this CFA due to combined effects of amendments in this CFA.

3 Effects arising during construction

3.1 Avoidance and mitigation measures

3.1.1 These are unchanged from those set out in the main ES, Volume 2, Birmingham Interchange and Chelmsley Wood (CFA Report 24), Section 11.

3.2 Quantitative identification of impacts and effects

Ground-bourne vibration

3.2.1 SES-024-001 results in the removal of an entry in the main ES, Volume 5, Appendix, SV-003-024 Table 1: Assessment of construction induced ground-bourne vibration at residential receptors. With the SES, the residential property represented by assessment location 722000 is no longer in close proximity to any works identified as a potentially significant source of ground-bourne vibration. Therefore, the entry in the results table for this assessment location is removed.

Airbourne sound: direct impacts and effects

3.2.2 Table 1 sets out the changes to the main ES, Volume 5, Appendix, SV-003-024, Sound, Noise and Vibration Assessment for the relevant assessment locations for SES-024-001. Explanation of the information within all these tables is provided in Appendix SV-001-000 and Appendix SV-003-026 (Volume 5 of the main ES).

Table 1: Assessment of construction noise at residential and non-residential receptors (SES-024-001)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L^{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 07:00-19:00	Evening 19:00-23:00	Night 23:00-07:00											
100515	Caretakers Flat, National Motorcycle Museum, A45 Coventry Road Bickenhill, Solihull	55/62 [B]	52/58 [C]	52/58 [C]	Day: Road construction; Eve: Road construction; Night: Road construction.	NA	1	R	T	H	-	N	-	-	
100515	National Motorcycle Museum, A45 Coventry Road, Bickenhill, Solihull	55/62	52/58	-	Day: Road construction; Eve: Road construction.	B	1	G 3	T	H	-	N	-	-	
722000	Old Station Road, Hampton-In-Arden, Solihull	55/67 [B]	45/48 [C]	44/48 [C]	Day: Vegetation clearance; Eve: Road construction; Night: Road construction.	NA	1	R	T	H	-	N	-	-	

Airbourne sound: indirect effects

3.2.3 Table 2 sets out the changes to the main ES, Volume 5, Appendix, SV-003-024, Construction assessment, Sound, noise and vibration. Explanation of the information within this table is provided in the main ES Volume 5, CFA 24.

Table 2: Assessment of construction traffic noise levels

Road name	Link	Future baseline sound level (dB)	Future baseline sound level + construction traffic (dB) quarter 4 2018	Future baseline sound level + construction traffic (dB) quarter 1 2019	Future baseline sound level + construction traffic (dB) quarter 4 2019	Change (dB) quarter 4 2018	Change (dB) quarter 1 2019	Change (dB) quarter 4 2019	Significant effect
		Daytime L^{pAeq},16hr 07:00-23:00 free-field	Daytime L^{pAeq},16hr 07:00-23:00 free-field	Daytime L^{pAeq},16hr 07:00-23:00 free-field	Daytime L^{pAeq},16hr 07:00-23:00 free-field				
Section of the eastbound off sliproad from the M6 junction 6 to East Way, adjacent to the A45 Coventry Road	61	51.3	55.1	54.4	54.7	+3.8	+3.1	+3.4	
Section of East Way to the east of Middle Bickenhill Lane	62	55.5	58.6	57.8	58.3	+3.1	+2.3	+2.8	

3.3 Assessment of significance of effects

Residential receptors: direct effects- individual dwellings

SES-024-001

3.3.1 The changes to the works at the M42 junction 6 roundabout and associated slip roads under the SES scheme, notably a reduction in construction works, will alter the construction sound, noise and vibration assessment as it is reported in the main ES.

3.3.2 The closest receptors include the National Motorcycle Museum, which contains a caretakers flat, and an individual residential property at the northern end of Old Station Road, Hampton in Arden, immediately adjacent to the M42 junction 6 roundabout.

3.3.3 The proposed change will affect the construction sound, noise and vibration assessment of these works. The main change will be a reduction in the physical extent of these works.

3.3.4 At the National Motorcycle Museum, including caretakers flat, only very slight changes in the construction noise levels are predicted (maximum change 1dB) due to the proposed change. The works to the A45 Coventry Road will be largely unchanged past the museum. No change to the predicted construction vibration impact at the museum is anticipated. Therefore, a significant effect is not identified.

3.3.5 At the individual property at the northern end of Old Station Road, the proposed change will result in a reduction in the typical and highest daytime monthly construction noise levels (6dB and 10dB respectively). This will be due to the removal of the works in close proximity to the property. As a result of these predicted reduced construction noise levels, the daytime construction noise impact screening criterion will no longer be exceeded and the daytime noise insulation trigger level for residential properties will also no longer be exceeded. In addition, the exceedance of the daytime vibration screening criterion at the property will also be removed. The proposed change will not give rise to a new or different significant effect.

Non-residential receptors- direct effects

SES-024-001

3.3.6 The changes to the works at the M42 junction 6 roundabout and associated slip roads under the SES scheme, notably a reduction in construction works, will alter the construction sound, noise and vibration assessment as it is reported in the main ES.

3.3.7 The closest receptors include the National Motorcycle Museum.

3.3.8 The proposed change will affect the construction sound, noise and vibration assessment of these works. The main change is a reduction in the physical extent of these works.

3.3.9 At the National Motorcycle Museum, only very slight changes in the construction noise levels are predicted (maximum change 1dB) due to the proposed change. The works to the A45 Coventry Road are largely unchanged past the museum. No change to the predicted construction vibration impact at the museum is anticipated. Therefore, a significant effect is not identified.

Residential receptors: indirect effects

3.3.10 No noise-sensitive receptors are located on the affected section of East Way, a single residential building at the southern end of Middle Bickenhill Lane is located approximately 35m from the affected section of the eastbound off-slip road, from the M6 junction 6 to East Way. Traffic flows and traffic noise levels along these links, in the future baseline scenario and the three construction traffic scenarios, are all low. Overall, noise levels in the vicinity of both links are dominated by traffic on the adjacent A45 Coventry Road dual carriageway, which has much higher traffic flows. This is demonstrated by the baseline sound monitoring in this area. Therefore, the change in traffic flows on these two minor roads will not significantly affect overall traffic noise levels in the area. On this basis, no significant effect due to construction traffic noise has been identified on these two links.

HIGH SPEED RAIL (LONDON - WEST MIDLANDS)

Supplementary Environmental Statement and Additional Provision 2 Environmental Statement

Volume 5 | CFA26 | Washwood Heath to Curzon Street

Environmental topic:	Community	CM
Appendix name:	Community assessment	001
Community forum area:	Washwood Heath to Curzon Street	26

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1 Introduction

1.1.1 This appendix provides an update to the Appendix CM-001-026 Community assessment from the main Environmental Statement (ES) as a result of design change SES-026-001 and corrections, assessed as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2ES). This update should be read in conjunction with Appendix CM-001-026 Community assessment from the main ES.

1.1.2 This appendix is structured as follows:

- Part 1: Supplementary Environmental Statement
  - Community impact assessment record sheets - construction; and
  - Community impact assessment record sheets - operation.
- Part 2: Additional Provision 2 Environmental Statement
  - Community impact assessment record sheets - construction; and
  - Community impact assessment record sheets - operation.

Part 1: Supplementary Environmental Statement

2 Corrections to the main ES

2.1.1 Since submission of the Bill, the need for a number of corrections in the contents of the main ES has been identified. Table 1Table 1 provides a list of those instances where there has been a need to correct the Volume 5 Appendix CM-001-026 because of the potential to alter the significance of environmental effects reported in the main ES or a factual inaccuracy relating to significant effects has been identified. The table gives the location of the correction in the main ES, the reason for the correction, replicates the text from the main ES, where applicable provides revised text, and identifies whether the correction changes a significant effect reported in the main ES. Where relevant, these corrections have been taken into account in the technical assessments contained within Section 3 of this SES.

Table 1: Corrections to the main ES

Reference in the main ES	Reason for correction	Text in the main ES CM-001-026	Revised text	Change to significant effects
Community Table 27, 2.28, Volume 5, Community Forum Area (CFA)26	Incorrect land requirement calculations at Eastside City Park.	Impact 1:permanent loss of land: 'Impact: an area of Eastside City Park, approximately 8500m^2 (27% of the total park area) will be removed permanently. The majority of this area (approximately 6900m^2) will be developed as the Curzon Promenade, a large area of public realm to the north of the proposed Curzon Street station, and will integrate with Eastside City Park. The remainder of the removed parkland, approximately 1400m^2, is required for the realignment of New Canal Street to the west of the Woodman public house. The realignment is required to protect the Grade I listed wall associated with the former Curzon Street Station building. The realigned road will be lined with planting to integrate the road with Eastside City Park. In addition a small area will be required for the Curzon Street station footprint. Impact 2: 'Impact: within	Impact 1:permanent loss of land: 'Impact: an area of Eastside City Park, approximately 8000m^2 (25% of the total park area) will be removed permanently. The majority of this area (approximately 6800m^2) will be developed as the Curzon Promenade, a large area of public realm to the north of the proposed Curzon Street station, and will integrate with Eastside City Park. The remainder of the removed parkland, approximately 1200m2, is required for the realignment of New Canal Street to the west of the Woodman public house. The realignment is required to protect the Grade I listed wall associated with the former Curzon Street Station building. The realigned road will be lined with planting to integrate the road with Eastside City Park. In addition a small area will be required for the Curzon Street station footprint. Impact 2: 'Impact: within	No. The area of land lost temporarily increases from 36% of the park to 41% of the park. As reported in the main ES, the public square area and a grassed area south of the square will be required for the construction and operation of the schemeThe effect on users of the park will remain major adverse, and therefore significant. The permanent area lost will be reduced slightly, however this will not change the magnitude of the effect.

Reference in the main ES	Reason for correction	Text in the main ES CM-001-026	Revised text	Change to significant effects
		Eastside City Park, a public square area and a grassed area south of the square will be required for the construction and operation of the Proposed Scheme. This includes approximately 11,500m2 of the park (36% of the total park), which will be removed for approximately five years during the construction period. The land will be used for the construction of Curzon Street station, including a number of utility diversions, and will be bound by a temporary fence of 2.4m high. Part of this land (approximately 3000m2) will be required for the construction period only, following which it will be reinstated as Eastside City Park. The remaining 8500m2 will be lost permanently (see permanent effects). The long-term loss of the public square and nearby grass areas will impair the overall function of the park, particularly as the area provides a pedestrian link to the city centre.	Eastside City Park, a public square area and a grassed area south of the square will be required for the construction and operation of the Proposed Scheme. This includes approximately 13,300m2 of the park (41% of the total park), which will be removed for approximately five years during the construction period. The land will be used for the construction of Curzon Street station, including a number of utility diversions, and will be bound by a temporary fence of 2.4m high. Part of this land (approximately 5,300m2) will be required for the construction period only, following which it will be reinstated as Eastside City Park. The remaining 8000m2 will be lost permanently (see permanent effects). The long-term loss of the public square and nearby grass areas will impair the overall function of the park, particularly as the area provides a pedestrian link to the city centre.	

3 Community impact assessment record sheets - construction

3.1 Residential properties on Bordesley Street

Table 2: Residential properties on Bordesley Street community impact assessment record sheet

Resource name	Residential properties on Bordesley Street
CFA	CFA26 – Washwood Heath to Curzon Street
Resource type	Residential

Resource name	**Residential properties on Bordesley Street**
Resource description/profile	There is a row of 11 three to four storey Victorian terraced properties located along Bordesley Street in Digbeth, approximately 200m south-east of Birmingham Moor Street station. Three of the properties at the end of the row sit above shop fronts or cafes. One of the properties provides supported accommodation for vulnerable adults. The properties are located in an industrial area and the general character of the area is historic, classic industrial.
Assessment year	Construction phase (2017+)
Impact: temporary significant noise and visual effects	Impact: a group of 11 residential properties (some of which may be split into flats) at the northern end of Bordesley Street will be located adjacent to construction traffic routes and utility works associated with the proposed Curzon Street station to the north. These works will result in the following significant environmental effects: Noise: the construction of Curzon Street station will result in significant noise effects, in particular due to nearby utility diversions for approximately five years. Visual: significant visual effects are expected; in particular cranes and other high level activities associated with the construction of the southern elevation and roof of the proposed Curzon Street station will be visible above the intervening buildings and the Rugby to Birmingham line. Properties that face New Bartholomew Street and the four storey properties at the southern end of the row will experience more direct views. Duration of impact: approximately five years.
Assessment of magnitude	Medium: two significant residual other environmental effects.
Relevant receptors	Residents of these properties
Assessment of sensitivity of receptors (s) to impact	High: all residential properties and their occupiers are identified as being highly sensitive.
Significance rating of effect	Major adverse significant: change to amenity, character and residents' enjoyment of the properties as a result of the combination of noise and visual effects. The magnitude of this effect is unchanged from that reported in the main ES, however the contributing effects are changed.
Proposed mitigation options for significant effects	No further mitigation proposed.
Residual effects significance rating	Major adverse significant: change to amenity, character and residents' enjoyment of the properties as a result of the combination of noise and visual effects. The magnitude of this effect is unchanged from that reported in the main ES, however the contributing effects are changed.

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Environmental Statement

4 Community impact assessment record sheets - construction

4.1 Masjid Ali Project Mosque

Table 3: Masjid Ali Project Mosque community impact assessment record sheet

Resource name	**Masjid Ali Project Mosque**
CFA	CFA26 – Washwood Heath to Curzon Street
Resource type	Place of worship
Resource description/profile	The Masjid Ali Mosque is located on Aston Church Road on the corner with Arley Road within the Saltley area. The mosque provides prayer facilities for approximately 100 people, with separate male and female halls which are used as multi-purpose areas including youth activities.
Assessment year	Construction phase (2017+)
Impact: temporary significant noise and visual effects	Impact: the original scheme included the demolition and replacement of the existing Aston Church Road Overbridge, to the west of the mosque. Utility diversions would be required within proximity to the mosque. The replacement Aston Church Road overbridge would be a three-span structure, crossing the existing Birmingham and Derby line, the route and the depot access lines. There would be three nearby satellite compounds associated with these works as well as the construction of the B4114Saltley viaduct and multiple demolitions within Saltley Business Park. The proposed improvement of the Aston Church Road/Arley Road junction (AP-026-001) will move the road works further from the mosque. All other works in the vicinity will remain as described in the main ES. These works result in the following significant environmental effects: Noise: no significant effect. HGV traffic: there will be several construction traffic routes within proximity to the mosque, this includes will include the Aston Church Road, Arley Road, Washwood Heath Road and Adderley Road. These will provide access to the construction sites including Saltley Business Park. This will result in a significant increase in HGVs passing the mosque.
Assessment of magnitude	No effect: one significant residual other environmental effects.
Relevant receptors	Users of the mosque
Assessment of sensitivity of receptors (s) to impact	High: this is a place of worship, with prayer times throught the day, and is therefore considered highly sensitve to noise and traffic disturbance.
Significance rating of effect	No effect. The significant effect on the mosque is removed.
Proposed mitigation options for significant effects	No further mitigation proposed
Residual effects significance rating	No effect.

Resource name	Masjid Ali Project Mosque
	The significant effect on the mosque is removed.

4.2 Residential properties on Vauxhall Grove and Northumberland Street

Table 4: Residential properties on Vauxhall Grove and Northumberland Street community impact assessment record sheet

Resource name	Vauxhall Grove and Northumberland Street
CFA	CFA26 – Washwood Heath to Curzon Street
Resource type	Residential
Resource description/profile	There is a group of 20 residential properties, comprising two blocks of flats at the southern-most end of Northumberland Street and the upper stories of the opposite two blocks of flats at the southern-most end of Vauxhall Grove. The flats, which represent typical post-war architectural styles, form part of a small residential community in this location and directly border the elevated railway tracks of the Birmingham and Bushbury line. The two blocks fronting Vauxhall Grove face St Vincent's School whereas the properties on Northumberland Street face the large side wall of Safeside at the West Midlands Fire Service Headquarters site. Overall, the properties reside within an area of mixed neighbourhood character. The group of properties is defined by the railway to the south, Northumberland Street to the west and Vauxhall Grove to the east.
Assessment year	Construction phase (2017+)
Impact: temporary significant noise and visual effects	Impact: the construction site boundary for the scheme is located in close proximity to 20 residential properties at the southern end of Vauxhall Grove and Northumberland Street, particularly at the south-western corner of Northumberland Street and the Birmingham and Bushbury line viaduct. Construction activities include those associated with Curzon Street No. 2 viaduct, the Curzon Street No. 2 viaduct satellite compound and the demolition of buildings to the south of the existing Birmingham and Bushbury line. In addition the reconfiguration of Freightliner Terminal Depot (AP-026-006) will be located in proximity to the residential properties. These works will result in the following significant environmental effects: Noise: these works will result in significant noise effects during the daytime for approximately one year and one month in total and significant noise effects during the night-time for approximately five months due to the construction of the viaduct deck. Visual: significant visual effects are expected from the upper stories of the block of flats fronting Vauxhall Grove and the block of flats on Northumberland Street including un-obscured views of construction activities associated with the Curzon Street No.2 viaduct. In particular, the residents of flats fronting Northumberland Street will experience direct and close views in the immediate foreground of 2.4m high fencing that will surround the construction working area as well as the proposed vehicle turning head at the southern end of the street. Furthermore, due to the location of two site entrances off Northumberland Street, it will be possible to view construction traffic. Significant night-time visual effects are expected of the lighting associated with the proposed Curzon Street No. 2 viaduct, which will be much brighter than the existing street lighting and will be in areas of the view which are currently not directly lit. Duration of effect: approximately one year and one month during the daytime and five months at night-time in total.

Resource name	Vauxhall Grove and Northumberland Street
Assessment of magnitude	Medium: two significant residual other environmental effects.
Relevant receptors	Residents of these properties
Assessment of sensitivity of receptors (s) to impact	High: all residential properties and their occupiers are identified as being highly sensitive.
Significance rating of effect	Major adverse significant: change to amenity, character and residents' enjoyment of the properties as a result of the combination of noise and visual effects for approximately one year and one month during the daytime and five months at night-time in total The magnitude of this effect is unchanged from that reported in the main ES, however the duration is extended.
Proposed mitigation options for significant effects	No further mitigation proposed
Residual effects significance rating	Major adverse significant: change to amenity, character and residents' enjoyment of the properties as a result of the combination of noise and visual effects approximately one year and one month during the daytime and five months at night-time in total. The magnitude of this effect is unchanged from that reported in the main ES, however the duration is extended.

4.3 West Midlands Fire Service

Table 5: West Midlands Fire Service community impact assessment record sheet

Resource name	West Midlands Fire Service
CFA	CFA26 – Washwood Heath to Curzon Street
Resource type	Community
Resource description/profile	The West Midlands Fire Service Headquarters is a recently constructed purpose built facility (2008). The site comprises office space, a fire control centre, parking and an ambulance dispatch facility. The site is situated off the B4132 Vauxhall Road, approximately 1km east of Birmingham city centre. The Fire Control Centre, which receives emergency 999 calls, is based on site and serves the West Midlands and Staffordshire. The centre is operated 24 hours a day by staff on shifts of 12 to 14 hours. The facility has a minimum of 301 staff based in the headquarters building and up to 500 when fully staffed. Visitor parking is provided to the front of the building and staff parking to the rear. This includes parking within the service yard to the rear and an off-site car park off St James' Place. The rear parking area also includes a permanent ambulance location with a charging facility. The ambulance can provide a quick response service 24 hours a day throughout the year. The offsite parking area on St James Street provides an additional 150 car parking spaces for staff, split between ground level, undercroft parking, and upper level parking. The West Midlands Fire Service also have a ten year rental lease on four units within the viaduct arches to the rear of the site, which are used as storage and workshop space.

Resource name	West Midlands Fire Service
	Additional emergency fire response capacity operates from the site when required, usually once or twice a month.
Assessment year	Construction phase (2017+)
Impact: temporary loss of land	Impact:as part of the original scheme, the route on viaduct (Curzon Street No.2 viaduct) would pass through the service yard to the rear of the West Midlands Fire Service Headquarters building and also through the off-site staff car park (Curzon Street No.3 viaduct) adjacent. This would result in the loss of access to the service yard, including the undercroft parking area, and the off-site car park for approximately five years during the construction period. Works would take place on approximately 1460m2 of the service yard at the main site, and approximately 1556m^2 at the off-site car park. Construction works would include; the erection of temporary fencing approximately 2.4m high around the area of works, a temporary haul route to the south of the service yard and off-site car park linking the A4540 Lawley Middleway to Northumberland Road and the demolition of the existing decked car park structure at the off-site car park. The amendment will require the same areas of the headquarters site to be taken to construction the Curzon Street No.2 viaduct. Additionally, the amendment will provide phased car parking, ensuring that there are the same number of car parking spaces available as at present, during each phase of construction. The loss of access to four Network Rail owned arches and other existing infrastructure such as water tanks will remain. The loss of four loading bays will additionally remain as the original scheme. Duration of impact: approximately five years
Assessment of magnitude	Negligible: the West Midlands Fire Service Headquarters will be able to continue with the majority of its functions, however some functions will be impaired due to the loss of the rail arches, loading bays and other infrastructure.
Relevant receptors	Members of the public served by the emergency service provision, plus between 301-500 staff in total.
Assessment of sensitivity of receptors (s) to impact	High: the car park areas are required for staff operating the Fire Control Centre. Nearby parking is required for these staff due to 24 hour shift working. There are currently no alternative car parks nearby. The viaduct arches are used by the West Midlands Fire Service. The service yard includes the ambulance dispatch facility and other infrastructure, which is required to provide an emergency response from the location.
Significance rating of effect	Minor adverse, not significant: due to the removal of infrastructure and facilities necessary to support emergency responses. The magnitude of this effect is reduced so that the effect is no longer significant.
Proposed mitigation options for significant effects	No further mitigation proposed
Residual effects significance rating	Minor adverse, not significant: due to the removal of infrastructure and facilities necessary to support emergency responses. The magnitude of this effect is reduced so that the effect is no longer significant.

Environmental topic:	Cultural heritage	CH
Appendix name:	Impact assessment table	003
Community forum area:	Washwood Heath to Curzon Street	26

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1 Introduction

1.1.1 This appendix provides an update to Appendix CH-003-026 Cultural heritage impact assessment to the main Environmental Statement (ES) as a result of corrections assessed as part of the Supplementary Environmental Statement (SES). This update should be read in conjunction with Appendix CH-003-026 Cultural heritage impact assessment from the main ES.

2 Corrections to the main ES

2.1.1 Since submission of the Bill, the need for a number of corrections in the contents of the main ES has been identified. Table 1 provides a list of those instances where there has been a need to correct the Volume 5 Appendix CH-003-026 because of the potential to alter the significance of environmental effects reported in the main ES or a factual inaccuracy relating to significant effects has been identified. The table gives the location of the correction in the main ES, the reason for the correction, replicates the text from the main ES, where applicable provides revised text, and identifies whether the correction changes a significant effect reported in the main ES.

Table 1: Corrections to the main ES

Reference in the main ES	Reason for correction	Text in the main ES CH-003-026	Revised text	Change to significant effects
Cultural Heritage Unique identifier WCS077, Volume 5, community forum area (CFA) 26 of the main ES	Reference is made to a locally listed public urinal on Banbury Street, which would be lost to the scheme, resulting in a major adverse and significant effect. While the urinal remains on the local list, it is no longer in existence, and was not present at the time of the submission of the main ES.	Name: Public urinal, Banbury Street Designation(s): Local listed building Value: Moderate Construction impact - nature of impact including mitigation: The structure is built within th fabric of the former buildings at the corner of Banbury Stree and New Canal Street. The structure will be removed as part of the Proposed Scheme resulting in a permanent effect. Construction impact - scale of impact: High adverse Construction impact - effect: Major adverse Operational impact - nature of impact including mitigation: the asset will be removed during construction.	Unique identifier WCS077 to be deleted.	Yes Removal of a significant effect as no longer in existence.

Reference in the main ES	Reason for correction	Text in the main ES CH-003-026	Revised text	Change to significant effects
		Operational impact - scale of impact: No change Operational impact - effect: Neutral		

Environmental topic:	Sound, noise and vibration	SV
Appendix name:	Construction assessment report	003
Community forum area:	Washwood Heath to Curzon Street	026

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1 Introduction

1.1.1 This appendix provides an update to Appendix SV-003-026 construction assessment report for community forum area (CFA) 26 from the main Environmental Statement (ES) as a result of design changes AP2-026-001, AP2-026-006, and AP2-026-007, as part of the Supplementary Environmental Statement (SES) and the Additional Provision 2 Environmental Statement (AP2 ES). This update should be read in conjunction with Appendix SV-003-026 Construction assessment report from the main ES.

2 Scope, assumptions and limitations

2.1 Changes of relevance to this assessment

2.1.1 AP2-026-001 relates to the improvement of Aston Church Road/Arley Road junction.

2.1.2 AP2-026-006 relates to additional land required for the reconfiguration of Freightliner Terminal Depot and the provision of rail sidings.

2.1.3 AP2-026-007 relates to additional land required for replacement car parking at West Midlands Fire Service headquarters.

3 Effects arising during construction

3.1 Avoidance and mitigation measures

3.1.1 These are unchanged from those set out in the main ES, Volume 2, Washwood Heath to Curzon Street (CFA Report 26), Section 11.

3.2 Quantitative identification of impacts and effects

Airbourne sound: direct impacts and effects

3.2.1 Table 1 sets out the changes to the main ES, Volume 5, Appendix, SV-003-026, Sound, Noise and Vibration Assessment for the relevant assessment locations for AP2-026-001.

3.2.2 Table 2 sets out the changes to the main ES, Volume 5, Appendix, SV-003-026, Sound, Noise and Vibration Assessment for the relevant assessment locations for AP2-026-006.

3.2.3 Table 3 sets out the changes to the main ES, Volume 5, Appendix, SV-003-026, Sound, Noise and Vibration Assessment for the relevant assessment locations for AP2-026-007.

3.2.4 Explanation of the information within all these tables is provided in Appendix SV-001-000 and Appendix SV-003-026 (Volume 5 of the main ES).

Table 1: Assessment of construction noise at non-residential receptors (AP2-026-001)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 0700-1900	Evening 1900-2300	Night 2300-0700											
700511	Masjid Ali Project Mosque, Aston Church Road, Birmingham	66/75	43/49	-	Day: road construction; Eve: conventional rail track recovery Washwood Heath depot	B	1	G3	T	H	-	N	-	-	
700511	Industrial unit, Arley Road, Birmingham	66/75	-	-	Day: road construction	B	2	G5	T	H	-	N	-	-	

Table 2: Assessment of construction noise at residential and non-residential receptors (AP2-026-006)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 0700-1900	Evening 1900-2300	Night 2300-0700											
50326	Nechells Business Centre (north), Dollman Street, Birmingham	66/75	-	-	Day: fencing	B	9	G5	T	H	-	N	-	-	
700507	Birmingham City Council Museum Collection, Dollman Street,	65/74	50/52	-	Day: demolition; Eve: conventional rail track laying Duddeston Mill Road	B	1	G3	S	-	-	Y	D 37	-	CSV26-N04

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 0700-1900	Evening 1900-2300	Night 2300-0700											
	Birmingham														
51904	Industrial units, Erskine Street, Birmingham	67/80	-	-	Day: demolition	B	4	G5	T	H	-	N	D 2	-	CSV26-No5
51535	Commercial units, Garrison Street North, Garrison Street, Birmingham	60/69	-	-	Day: demolition	B	5	G5	T	-	-	N	-	-	
36358	Mill Burn Way, Birmingham	51/56 [A]	<40/40 [C]	43/48 [C]	Day: demolition; Eve: conventional rail track laying Duddeston Mill Road; Night: Curzon street no.3 viaduct deck	NA	143	R	T	-	-	N	-	-	
51868	St. Vincent's De Paul School, Vauxhall Grove, Birmingham	55/64	44/46	-	Day: demolition; Eve: conventional rail track laying Duddeston Mill Road	B	1	G4	T	-	-	N	D 2	-	*
51814	Northumberland Street, Birmingham	62/72 [A]	43/45 [B]	57/64 [C]	Day: demolition; Eve: conventional rail track laying Duddeston Mill Road; Night: Curzon street no.2 viaduct deck	S	51	R	T	-	-	Y	D 13; N 5	NI	CSV26-C04
37938	Safeside at Eastside, Vauxhall Road,	62/78	43/45	-	Day: fencing; Eve: conventional rail track	B	1	G4	T	-	-	Y	D 10	-	CSV26-No6

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 0700-1900	Evening 1900-2300	Night 2300-0700											
	Birmingham				laying Duddeston Mill Road										

Table 3: Assessment of construction noise at residential and non-residential receptors (AP2-026-007)

Assessment location		Impact criteria				Significance criteria									Significant effect
ID	Area represented	Typical/highest monthly outdoor L_{pAeq} [dB]			Construction activity resulting in highest forecast noise levels	Type of effect	Number of impacts represented	Type of receptor	Receptor design	Existing environment	Unique feature	Combined impact	Impact duration [months]	Mitigation effect	
		Day 0700-1900	Evening 1900-2300	Night 2300-0700											
52220	Vauxhall Road, Birmingham	63/69 [C]	<40/40 [C]	52/59 [C]	**Day: demolition; Eve: conventional rail track laying Duddeston Mill Road; Night: Curzon street no.3 viaduct deck**	**S**	32	R	T	-	-	N	N 5	NI	CSV26-C05
52220	Gordon Franks Training, Vauxhall Road, Birmingham	63/69	<40/40	-	**Day: demolition; Eve: conventional rail track laying Duddeston Mill Road**	**B**	1	G4	T	-	-	N	D 2	-	*
700505	West Midlands Fire Service offices, and Commercial Units, St James' Place, Birmingham	68/77	-	-	Day: site clearance	B	2	G5	T	-	-	Y	D 5	-	CSV26-N05

3.3 Assessment of significance of effects

Residential receptors: direct effects - communities

AP2-026-001

3.3.1 The proposed amendment involving the improvement of Aston Church Road/Arley Road junction will not give rise to a new or different significant effect.

AP2-026-006

3.3.2 The reconfiguration of the Freightliner Terminal Depot and provision of rail sidings will introduce an area of new construction works not considered in the original scheme. The closest residential receptors to the south are located to the south of Garrison Street (Mill Burn Way), beyond the intervening commercial units. The closest residential properties to the north are on Northumberland Street.

3.3.3 In the main ES the residential properties on Northumberland Street were forecast to experience night-time noise levels higher than the noise insulation trigger levels as defined in the draft CoCP. Adverse noise effects during the day in the vicinity of these residential properties were considered significant. No significant construction noise or vibration effects were identified at the residential properties south of Garrison Street (Mill Burn Way).

3.3.4 At the residential properties to the south of Garrison Street (Mill Burn Way), construction works associated with the proposed amendment will result in a minimal change to the predicted construction noise levels as these properties are shielded from the works by intervening commercial units. The typical daytime monthly construction noise level is predicted to increase by 1dB to 51dB, and the highest monthly levels by 2dB to 56dB. Such levels are below the impact screening criterion and a significant effect is not identified

3.3.5 At the residential properties on Northumberland Street the typical and highest daytime monthly construction noise levels will be comparable to the original scheme, as reported in the main ES. Typical and highest monthly daytime levels are predicted to increase by 1 dB (to 62 dB and 72 dB respectively). An increase in the daytime impact duration of four months to 13 months is also predicted. The increases are due to the reconfiguration of the Freightliner Terminal Depot. No change to the night time construction noise levels, and the exceedance of the noise insulation trigger level, is anticipated as no night time works are proposed as part of the reconfiguration of the Freightliner Terminal Depot. The significant effects reported in the main ES remain.

AP2-026-007

3.3.6 The replacement car parking at West Midlands Fire Service headquarters will affect the programming of construction activities in this area. The timing of the demolition works in this area will be changed slightly from the original scheme and the demolition of the existing car park is to be carried out in two separate stages. A small number of additional construction activities will be introduced, consisting of the construction of the various phases of temporary car parking and the final permanent car park.

3.3.7 The closest residential receptors to the proposed amendment are the residential properties on Vauxhall Road to the north. A significant night time construction noise effect was reported in the main ES, at the residential properties on Vauxhall Road due to night time construction works at Curzon Street no. 3 viaduct. These properties would qualify for noise insulation.

3.3.8 A slight increase in the typical and highest daytime monthly construction noise levels of 1 dB (to 63 dB and 69 dB respectively), is predicted at the residential properties on Vauxhall Road. This will be due to a combination of factors, including the change in the programming of demolition activities at the Curzon Street No.2 viaduct satellite compound, combined with a slight contribution from the temporary car parking works. However, the daytime noise impact screening criteria is not exceeded. No change to the night-time construction noise levels is anticipated. Therefore, there will be no change to the significant effect identified in the main ES at these properties

Non-residential receptors - direct effects

AP2-026-001

3.3.9 In the main ES a significant effect from construction noise at the Masjid Ali Project Mosque was reported. An exceedance of the relevant impact screening criterion was also reported at the adjacent commercial units, although a significant effect was not identified.

3.3.10 The realignment of Aston Church Road/Arley Road junction will relocate the road construction and utility diversion construction activities slightly further away from the Masjid Ali Project Mosque and adjacent commercial units. The highest monthly construction noise level at these receptors will be reduced by 2 dB to 75dB, and the relevant impact screening criteria will not be exceeded. The proposed amendment will result in the removal of the significant adverse noise effect at the mosque reported in the main ES.

AP2-026-006

3.3.11 The reconfiguration of the Freightliner Terminal Depot and provision of rail sidings will introduce an area of new construction works that was not considered in the original scheme. The closest non-residential receptors include Nechells Business Centre, the Birmingham City Council Museum Collection Centre, industrial units on Erskine Street, St Vincent's school, Safeside educational facility (incorporating a 999 call centre), and commercial units on Garrison Street.

3.3.12 The main ES reported significant construction noise effects at the Birmingham City Council Museum Collection Centre, industrial units on Erskine Street and Safeside. The significant construction noise effect at the Birmingham City Council Museum Collection Centre was combined with a significant construction vibration effect. At St Vincent's school, an exceedance of the impact screening criterion was predicted of 1 dB for 1 month. Based on the magnitude and duration of the impact, a significant effect was not identified. No significant construction noise or vibration effects were identified at Nechells Business Centre and commercial units on Garrison Street and residential properties south of Garrison Street (Mill Burn Way).

3.3.13 At Nechells Business Centre, typical monthly construction noise levels are predicted to be increased by 1 dB to 66 dB, and the highest monthly level by 2 dB to 75 dB. As in

the main ES, the impact screening criterion is not exceeded and a significant effect is not identified.

3.3.14 At the industrial units on Erskine Street, typical and highest monthly daytime levels are predicted to be increased by 2dB and 1dB respectively (to 67dB and 80dB). The significant effect reported in the main ES remains.

3.3.15 Larger increases in both the typical (by 5 dB to 60 dB) and highest (by 7 dB to 69 dB) monthly construction noise levels are predicted at the commercial units at Garrison Street. Under the original scheme these units were remote from any construction works, but with the proposed amendment works will be in close proximity to the units, resulting in the increased predicted construction noise levels. The impact screening criterion is not exceeded and a significant effect is not anticipated at these units.

3.3.16 At St. Vincent's school, the typical monthly construction noise levels are predicted to increase by 2 dB to 55 dB and the highest monthly level by 1 dB to 64 dB, an increase in the impact duration of one month, to two months, is also predicted. The increases will be due to the addition of the Freightliner works in this area. However, as reported in the main ES, based on the magnitude and duration of the impact a significant effect is not identified at the school.

3.3.17 At the Birmingham City Council Museum Collection Centre, the typical daytime monthly construction noise level will increase slightly by 2 dB to 65 dB due to construction activities associated with the proposed amendment; an increase of 4 dB to 74 dB is predicted in the highest monthly construction noise level. Demolition works will be the source of the highest monthly construction noise level. The duration of the impact will also increase from 30 to 36 months. The significant construction noise effect reported in the main ES remains.

3.3.18 Vibration adverse effects were reported in the main ES at the Birmingham City Council Museum Collection Centre for short periods of time when vibro-compaction of structural earthworks, associated with the Curzon Street no. 1 viaduct, are at their closest approach. No change to this effect from that reported in the main ES is anticipated due to the proposed amendment.

3.3.19 At Safeside the reconfiguration of the Freightliner Terminal Depot increases the typical daytime monthly construction noise levels by 1 dB to 62 dB, no change to the highest monthly construction noise levels is anticipated. The duration of the impact will increase from four months to 10 months. The significant effect reported in the main ES remains.

3.3.20 The proposed amendment will give rise to a different significant effect at Birmingham City Council Museum Collection Centre, industrial units on Erskine Street and Safeside.

AP2-026-007

3.3.21 The replacement car parking at West Midlands Fire Service headquarters will affect the programming of construction activities in this area. The timing of the demolition works in this area will change slightly from the original scheme and the demolition of the existing car park will be carried out in two separate stages. A small number of additional construction activities will be introduced, consisting of the construction of the various phases of temporary car parking and the final permanent car park.

3.3.22 The closest non-residential receptors include the West Midlands Fire Service headquarters to the east and Gordon Franks Training to the north. A combined construction noise and vibration significant effect was reported in the main ES at the West Midlands Fire Service headquarters. A significant effect was not identified at Gordon Franks Training in the main ES.

3.3.23 The proposed amendment has no effect on the typical and highest monthly construction noise and vibration levels reported in the main ES for the West Midlands Fire Service headquarters. The significant construction noise and vibration effect identified in the main ES remains and is unchanged by the proposed amendment

3.3.24 At Gordon Franks Training, the typical and highest daytime monthly construction noise levels are predicted to increase by 1 dB (to 63 dB and 69 dB respectively), compared to the original scheme. An exceedance of the impact screening criterion for educational buildings of 1 dB is predicted for two months. This is due to a combination of factors including, the change in the programming of demolition activities at the Curzon Street No.2 viaduct satellite compound, combined with a slight contribution from the temporary car parking works. Based on the limited magnitude and duration of the exceedance a significant effect on occupants at Gordon Franks Training has not been identified. This is unchanged from the main ES.

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