

HIGH SPEED RAIL (LONDON - WEST MIDLANDS)

Supplementary Environmental Statement 3 and
Additional Provision 4 Environmental Statement
Volume 3 | Route-wide effects

October 2015

SES3 and AP4 ES 3.3



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Department for Transport

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Structure of the HS₂ Supplementary Environmental Statement 3 and Additional Provision 4 Environmental Statement

The Supplementary Environmental Statement 3 (SES₃) and Additional Provision 4 Environmental Statement (AP₄ ES) comprise:

- non-technical summary (NTS). This provides a summary in non-technical language of the SES₃ (Part 1) and the AP₄ ES (Part 2) and of any likely significant environmental effects, both beneficial and adverse, which are new or different to those reported in the High Speed Two (HS₂) Phase One Environmental Statement (ES) submitted to Parliament in November 2013 in support of the hybrid Bill ('the Bill') for Phase One of HS₂ (referred to as 'the main ES') as updated by the subsequent SESs and AP ES documents;
- Volume 1: introduction to the SES₃ and AP₄ ES. This introduces the supplementary environmental information and design changes included within the SES₃ and amendments, which have resulted in the need to amend the Bill, within the AP₄ ES. It also explains any changes to the scope, methodology, assumptions and limitations required for the environmental assessment;
- Volume 2: community forum area (CFA) reports and map books. These describe the supplementary environmental information and design changes included within the SES₃ (Part 1) and amendments within the AP₄ ES (Part 2). Any new or different likely significant environmental effects arising from these changes and amendments in each CFA, compared to those reported in the main ES, as updated by SES and SES₂ documents (and SES₃ for the AP₄ amendments) are reported. The AP₁, AP₂ and AP₃ amendments are also taken into account where relevant. In addition, the main local alternatives that have been considered are described, where relevant;
- Volume 3: route-wide effects. This reports new or different likely significant route-wide effects arising from the supplementary environmental information and design changes included within the SES₃ (Part 1) and amendments within the AP₄ ES (Part 2) compared to those reported in the main ES as updated by SES and SES₂ (and SES₃ for the AP₄ amendments). The AP₁, AP₂ and AP₃ amendments are also taken into account where relevant;
- Volume 4: off-route effects. This reports new or different likely significant off-route effects arising from the supplementary environmental information included within the SES₃ and an amendment within the AP₄ ES compared to those reported in the main ES as updated by SES and SES₂ (and SES₃ for the AP₄ amendment). The AP₁, AP₂ and AP₃ amendments are also taken into account where relevant;

SES₃ and AP₄ ES Volume 3 – Route-wide effects

- Volume 5: appendices and map books. This contains environmental information and associated maps in support of the other volumes of the SES₃ and AP₄ ES; and
- glossary of terms and list of abbreviations. This contains any new or different terms and abbreviations used throughout the SES and AP ES reports, additional to those included in the main ES.

1 Introduction

1.1 Background to High Speed Two

1.1.1 The hybrid Bill for high speed rail between London and the West Midlands ('the Bill') was submitted to Parliament together with an Environmental Statement (ES) in November 2013 ('the main ES'). If enacted by Parliament, the Bill will provide the powers to construct, operate and maintain Phase One of High Speed Two (HS₂). This phase of HS₂ will provide a new north-south railway between London, Birmingham and the West Midlands. Phase Two of HS₂ will comprise new lines between the West Midlands, Leeds and Manchester, completing what is known as the 'Y network'. Phase Two is not the subject of this document.

1.1.2 Since the deposit of the Bill, the need for a number of amendments (i.e. changes that require amendments to the Bill) to the scheme have been identified. These have been promoted in Parliament through the following three Additional Provisions (APs), which were each accompanied by AP ESs:

- AP₁: deposited in Parliament in September 2014. This focused on CFAs 7 (Colne Valley) to 26 (Washwood Heath to Curzon Street);
- AP₂: deposited in Parliament in July 2015. This focused on CFAs 4 (Kilburn (Brent) to Old Oak Common) to 26 (Washwood Heath to Curzon Street); and
- AP₃: deposited in Parliament in September 2015. This focused on CFAs 1 (Euston station and approach) to 3 (Primrose Hill to Kilburn (Camden)).

1.1.3 Any new or different significant effects that were likely to result from changes to the design which do not require amendments to the Bill; changes to construction assumptions, new environmental baseline information and corrections to the main ES were reported in Supplementary Environmental Statements (SESs). These were deposited alongside the AP₂ ES and the AP₃ ES:

- the SES (submitted alongside the AP₂ ES) focused on CFAs 4 (Kilburn (Brent) to Old Oak Common) to 26 (Washwood Heath to Curzon Street); and
- the SES₂ (submitted alongside the AP₃ ES) focused on CFAs 1 (Euston station and approach) to 5 (Northolt Corridor).

1.2 Introduction to the SES₂ and AP₃ ES for High Speed Two

1.2.1 Since submission of the SES₂ and AP₃ ES, the need for a number of further amendments has been identified in CFAs 4 (Kilburn (Brent) to Old Oak Common) to 26 (Washwood Heath to Curzon Street), including a 2.6km extension northwards of the Chiltern tunnel in CFA₉ (Central Chilterns). The need for an amendment has also been identified in the Langley area (a location away from the route of the scheme). These amendments are being promoted via AP₄. The associated AP₄ ES describes these amendments and reports the associated likely significant environmental effects.

1.2.2 In addition to these amendments, there are also a number of design changes in CFAs 4 (Kilburn (Brent) to Old Oak Common) to 26 (Washwood Heath to Curzon Street) that do not require amendments to the Bill. Environmental information not previously available for the assessment has also become available (including changes to

construction assumptions) and the need for a number of corrections to the main ES and subsequent SESs and AP ESs has been identified. Any new or different significant effects that are likely to result from these changes are reported in a third SES ('SES₃').

- 1.2.3 These additional amendments and design changes have arisen through the High Speed Rail (London – West Midlands) Select Committee ('the Select Committee') process, ongoing discussions with petitioners and key stakeholders, and as a result of design refinements.
- 1.2.4 A formal consultation will be undertaken on the SES₃ and the AP₄ ES. There will also be a petitioning period for those directly and specially affected by the changes. Any petitions against these changes will be heard by the Select Committee in due course.
- 1.2.5 A description of the design changes and amendments within CFAs 4 to 26 is provided in Section 1.3 of Volume 1. Section 1.3 in Volume 1 also highlights any changes to construction assumptions.
- 1.2.6 As this SES₃ and AP₄ ES provides an update to the previously published main ES, AP₁ ES, SES and AP₂ ES, and SES₂ and AP₃ ES it should be read in conjunction with them.

1.3 Terminology used to describe the scheme

- 1.3.1 In order to differentiate between the original scheme assessed as part of the main ES and subsequent changes, the following terms Table 1 are used throughout the SES₃ and the AP₄ ES.

Table 1: Scheme descriptions

Scheme name	Definition	Relevant CFAs
the original scheme	the Bill scheme submitted to Parliament in November 2013, which was assessed in the main ES	1 to 26
the AP ₁ revised scheme	the original scheme as amended by the AP submitted in September 2014	7 to 26
the SES scheme	the original scheme with the design changes described in the SES submitted in July 2015	4 to 26
the AP ₂ revised scheme	the SES scheme as amended by the AP ₂ submitted in July 2015	4 to 26
the SES ₂ scheme	the original scheme as updated by the SES scheme, with the design changes described in the SES ₂ submitted in September 2015	1 to 5 (i.e. this applies in the London area only)
the AP ₃ revised scheme	the SES ₂ scheme as amended by the AP ₃ submitted in September 2015	1 to 5 (i.e. this applies in the London area only)
the SES ₃ scheme	the SES ₂ scheme with the design changes described in the SES ₃ submitted in October 2015	4 to 26
the AP ₄ revised scheme	the SES ₃ scheme as amended by the AP ₄ submitted in October 2015	4 to 26

- 1.3.2 The following terms are also used to differentiate between design changes included in the SES₃ and those included in the AP₄ ES:
- 'SES₃ design changes' – changes to the scheme reported in the SES₃ that do not require amendments to the Bill; and
 - 'AP₄ amendments' – changes to the scheme reported in the AP₄ ES that require amendments to the Bill.

1.4 Scope of this report

- 1.4.1 Route-wide effects are those considered to be appropriately assessed at a geographical scale greater than that presented within the Volume 2, CFA reports. A formal scoping process has been undertaken for the SES₃ design changes and AP₄ amendments in order to determine whether there is potential for the design changes or amendments to give rise to new or different significant route-wide environmental effects compared with those reported in Volume 3 of the main ES and where relevant the AP₁ ES, SES and AP₂ ES and the SES₂ and AP₃ ES.
- 1.4.2 These new or different route-wide effects, are reported in the SES₃ (Part 1) or AP₄ ES (Part 2) of this document, depending on whether they arise from SES₃ design changes or AP₄ amendments. Parts 1 and 2 are divided into environmental topics which are presented in the same order as reported in Volume 3 of the main ES.
- 1.4.3 In addition to describing the new or different likely significant route-wide effects as a result of the AP₄ amendments, Part 2 also takes account of the impacts of the SES₃ changes reported in Part 1.
- 1.4.4 Some environmental topics have been scoped out of the route-wide assessment, since their effects are localised in extent and have no potential to cause significant route-wide effects. These environmental topics are: air quality, community, landscape and visual assessment, and sound, noise and vibration. Whilst there could be the potential for new or different significant route-wide effects for land quality, following the scoping process it was determined that there was no potential for new or different significant route-wide effects as a consequence of the SES₃ changes or AP₄ amendments and this topic is not reported in this volume.
- 1.4.5 The climate, and waste and material resources assessments are reported at a route-wide level in this volume rather than within the Volume 2, CFA reports. This follows the approach taken in the main ES.
- 1.4.6 Route-wide effects potentially include those that occur where new works are introduced in the Chilterns Area of Outstanding Natural Beauty (AONB) and where there is potential for new in-combination effects for agriculture, forestry and soils, and ecology. These are reported in this document.
- 1.4.7 Given that the methodology for each environmental topic assesses effects in a different way appropriate to that topic, the approach to route-wide effects varies between environmental topics. The extent and basis of the route-wide assessments is explained in each of the environmental topic sections in Volume 3 of the main ES. The Scope and Methodology Report (SMR) (Volume 5: CT-001-000/1 of the main ES); the SMR Addendum (Volume 5: CT-001-000/2 of the main ES); the SMR Addendum 3

(Volume 5: CT-001-000/4 of the SES₂ and AP₃ ES); and the SMR Addendum 4 (Volume 5: CT-001-000/5 of this SES₃ and AP₄ ES) should also be referred to.

- 1.4.8 The standard measures that will be used to mitigate likely significant adverse environmental effects during the construction and operation of the scheme are described in the main ES, Volume 1, Section 9 and the draft Code of Construction Practice (CoCP)¹ submitted in support of the Bill. Implementation of these measures has been assumed in this SES₃ and AP₄ ES.
- 1.4.9 Following the approach taken for the main ES, committed developments are considered within the assessments but only referred to if there is the potential for new or different significant cumulative effects.

1.5 Structure of this report

1.5.1 The report is structured as follows:

- Section 1: Introduction;

Part 1: Supplementary Environmental Statement 3

- Section 2: Chilterns AONB;
- Section 3: Agriculture, forestry and soils;
- Section 4: Climate;
- Section 5: Cultural heritage;
- Section 6: Ecology;
- Section 7: Socio-economics;
- Section 8: Traffic and transport;
- Section 9: Waste and material resources;
- Section 10: Water resources and flood risk assessment;
- Section 11: Phase One and Phase Two combined impacts;

Part 2: Additional Provision 4 Environmental Statement

- Sections 12–21: the environmental topics are listed as per Sections 2–11 in Part 1 of this report; and
- Section 22: References.

¹ HS2 Ltd (2013), Draft Code of Construction Practice.

Part 1: Supplementary Environmental Statement 3

2 Chilterns Area of Outstanding Natural Beauty

2.1 Introduction

- 2.1.1 Volume 3 of the main ES included an assessment of effects on the special landscape qualities of the Chilterns AONB.
- 2.1.2 Volume 3 of the AP₁ ES and the SES and AP₂ ES reported that the design changes and amendments were not of sufficient scale to give rise to any new or different likely significant environmental effects on the special landscape qualities of the AONB. It was therefore concluded that none of the design changes or amendments would result in any changes in the assessment of effects on the Chilterns AONB as presented in Volume 3 of the main ES.
- 2.1.3 An assessment of the Chilterns AONB was not included within Volume 3 of the SES₂ and AP₃ ES because the SES₂ changes and AP₃ amendments were limited to CFAs 1 to 5 and would not lead to new or different significant effects on the AONB.

2.2 Changes to the assessment of effects

- 2.2.1 It is considered that the SES₃ design changes are not of sufficient scale to give rise to any new or different effects on the special landscape qualities of the AONB.

3 Agriculture, forestry and soils

3.1 Introduction

- 3.1.1 Volume 3 of the main ES provided an assessment of the route-wide impacts and likely significant effects on agriculture, forestry and soils arising from the construction of the original scheme. Since it is considered that during operation there will be no significant route-wide effects for agriculture, forestry and soils, operational effects are not considered further.
- 3.1.2 Volume 3 of the AP₁ ES, and the SES and AP₂ ES reported that the SES design changes or AP₁ and AP₂ amendments were not of sufficient scale to result in any new or different significant route-wide effects during construction.
- 3.1.3 Agriculture, forestry and soils was not included within Volume 3 of the SES₂ and AP₃ ES because the SES₂ changes and AP₃ amendments were limited to CFAs 1 to 5 and would not lead to any new or different significant effects.

3.2 Changes to the assessment of effects

- 3.2.1 The SES₃ design changes are not of sufficient scale to result in any new or different significant route-wide effects during construction.

4 Climate

4.1 Introduction

- 4.1.1 Volume 3 of the main ES reported the assessment of the greenhouse gas (GHG) emissions of the original scheme during construction and operation.
- 4.1.2 Volume 3 of the AP1 ES reported that the potential impact of the AP1 amendments on the carbon footprint would be negligible and therefore did not warrant any further assessment.
- 4.1.3 Volume 3 of the SES and AP2 ES reported that the SES design changes would have a negligible impact on the carbon footprint reported in Volume 3 of the main ES. The AP2 revised scheme was reported to lead to an increase in construction GHG emissions, however the overall conclusions of the assessment remain as in Volume 3 of the main ES.
- 4.1.4 Volume 3 of the SES2 and AP3 ES reported that the SES2 design changes would lead to an increase in construction GHG emissions; however, there would be a negligible increase in operational GHG emissions. None of the AP3 amendments were considered to materially impact the original scheme's carbon footprint and therefore no further assessment was carried out. The overall conclusions of the climate assessment for the AP3 revised scheme remain as reported in Volume 3 of the main ES.

4.2 Changes to the assessment of effects

- 4.2.1 A scoping assessment was undertaken to determine if the SES3 design changes would be likely to result in a material difference to the GHG emissions of the original scheme (see Section 1.3 in Volume 1 for the full list of SES3 design changes).
- 4.2.2 The methodology for determining which SES3 design changes are material to GHG emissions comprises quantitative and qualitative assessments. See the Appendix CL-002-000 (Volume 5 of this SES3 and AP4 ES) for a more detailed description of the process.
- 4.2.3 The SES3 design changes were reviewed both individually and as a group following this approach. The potential GHG emissions impact of the SES3 design changes have been considered in the context of the GHG emissions of the original scheme, to determine whether each change is considered to be potentially material or not.
- 4.2.4 The outcome of this scoping assessment identified that none of the SES3 design changes would materially impact the original scheme's carbon footprint, therefore no further assessment was carried out.
- 4.2.5 For further detail on the scoping outcomes see Appendix CL-002-000 (Volume 5 of this SES3 and AP4 ES).

5 Cultural Heritage

- 5.1.1 Volume 3 of the main ES reported that the original scheme would not have a direct physical effect on any World Heritage Site and would not require the demolition of any Grade I or Grade II* listed building. Since the submission of the main ES, the war

memorial at Euston Square Gardens, that was due to be removed as a result of the construction of the original scheme, has been regraded from a Grade II to Grade II*.

- 5.1.2 Volume 3 of the main ES also reported that across the entire route of the original scheme, a number of designated assets would be significantly affected through direct physical impact.
- 5.1.3 The changes and amendments reported in the AP₁ ES and the SES and AP₂ ES were not considered to require an assessment of heritage assets at a route-wide level and this topic was scoped out.
- 5.1.4 Volume 3 of the SES₂ and AP₃ ES reported that no new heritage assets would be affected as a result of the SES₂ design changes and AP₃ amendments.
- 5.1.5 There are no new designated assets significantly affected through direct physical impact as a result of the SES₃ scheme. As reported in the SES₂ and AP₃ ES, the following heritage assets are directly affected:
- heritage assets comprising:
 - one registered battlefield;
 - one scheduled monument;
 - one Grade II* listed building entry;
 - 17 Grade II listed buildings entries; and
 - alteration to a curtilage wall to a Grade I listed building; and
 - historic landscape assets comprising:
 - two Grade II* registered parks and gardens;
 - 81 lengths of historic hedgerow; and
 - 37 areas of ancient woodland².

6 Ecology

6.1 Introduction

- 6.1.1 Volume 3 of the main ES described the likely significant effects on ecological resources that will occur at a route-wide level as a consequence of the construction and operation of the original scheme. The route-wide assessment addressed significant effects at the regional and national level, and in combination effects not discussed within Volume 2 of the main ES.
- 6.1.2 Volume 3 of the AP₁ ES reported that the AP₁ amendments led to only minor changes in the ecological effects reported in the main ES. These changes were not of sufficient scale to generate new or different significant effects at a route-wide level.

² Volume 3 of the main ES reported 19 ancient woodland sites were directly affected by the original scheme. Since publication of the main ES, four additional woodlands have been added to the ancient woodland inventory and three additional sites have been identified that were previously considered as a single ancient woodland area. In addition a further 11 woodland sites were identified as likely to be added to the ancient woodland inventory and therefore are assumed to be ancient. Please refer to Section 6 for further information.

- 6.1.3 Part 1 of Volume 3 of the SES and AP₂ ES reported new and different significant adverse effects as a consequence of changes relating to designated sites, the ancient woodland inventory, areas that have been identified as likely to be added to the ancient woodland inventory, and additional data relating to bat populations at Waddesdon and Quainton (CFA₁₂), Calvert, Steeple Claydon, Twyford and Chetwode (CFA₁₃), and Radstone (CFA₁₄).
- 6.1.4 Part 1 of Volume 3 of the SES₂ and AP₃ ES reported a different significant adverse effect on ecological networks due to the removal of the HS₁–HS₂ Link.
- 6.1.5 This section of the SES₃ and AP₄ ES identifies any new or different significant effects on ecological resources to those reported in Volume 3 of the main ES, and where relevant updated by the SES and/or SES₂, as a consequence of SES₃ changes. It also considers the SES₃ scheme with any relevant AP₁, AP₂ and AP₃ amendments to identify the potential for new or different cumulative effects at the route-wide level. Consideration is given to the potential for impacts on species, habitats and sites designated on the basis of their importance for nature conservation.

6.2 Changes to the assessment of effects

Designated sites

- 6.2.1 The SES₃ changes will not result in any new or different likely significant effects on statutory sites or non-statutory designated sites.

Habitats

- 6.2.2 The SES₃ design change at Ranston Covert and Battlesford Wood (CFA 7, Colne Valley) will result in a 1.6ha decrease in the extent of ancient woodland losses, as a consequence of the SES₃ scheme. Compared to the SES₂ scheme, ancient woodland losses arising from the SES₃ scheme would therefore reduce by 1.6ha to a total of 42.9ha (see Table 2). The total number of ancient woodland sites affected under the SES₃ scheme would remain at 37, unchanged from that reported in Part 1 of the SES and AP₂ ES. The SES₃ design change will therefore result in a different permanent adverse residual effect on an irreplaceable resource. However, the effect remains significant at the national level.

SES₃ and AP₄ ES Volume 3 – Route-wide effects

Table 2: Summary of ancient woodland losses due to HS₂ Phase One within the original scheme and SES scheme iterations

Scheme iteration	Approximate extent of ancient woodland losses (ha)	Approximate extent of woodland loss (ha)
Original scheme	32	310
SES scheme	44.5 ³	310
SES ₂ scheme	44.5	310
SES ₃ scheme	42.9	308

6.2.3 The SES₃ design change at Ranston Covert and Battlesford Wood (CFA7) also results in an approximately 2.2ha decrease in the overall extent of woodland loss (including the 1.6ha of ancient woodland discussed above). This reduces the overall expected loss of woodland habitats reported in Part 1 of the SES and AP₂ ES to approximately 308ha.

Protected and/or notable species

6.2.4 The SES₃ design changes and new baseline included within the scope of the assessment are not expected to result in any new or different significant effects on protected and/or notable species receptors that are of relevance at the route-wide level.

6.3 Cumulative effects

6.3.1 This section of the report considers the SES₃ scheme in combination with all relevant AP₁, AP₂ and AP₃ amendments to identify the potential for new or different route-wide level effects to those reported in the relevant Volume 3 ES chapters⁴.

6.3.2 The number of Local Wildlife Sites (LWS) affected by the SES₃ scheme in combination with all relevant AP₁, AP₂ and AP₃ amendments is 90, with 62 of these subject to significant effects on site integrity. Therefore, the assessment of cumulative effects on ecological networks reported within the 'Cumulative effects' section of Volume 3; Part 1, Section 4 of the SES₂ and AP₃ ES is unchanged.

6.3.3 The SES₃ scheme will result in the loss of 42.9ha of ancient woodland with a total of 37 sites affected.

6.3.4 Assuming that all AP₁, AP₂ and AP₃ amendments are accepted by Parliament, then the total ancient woodland losses as a consequence of the scheme would be 42.2ha (see Table 2). However, the total number of ancient woodlands affected would remain unchanged at 37. This would be a 0.7ha reduction in ancient woodland losses compared to the SES₃ scheme. This is a different effect, but the adverse effect remains significant at the national level.

³ Due to the formal changes to Natural England's ancient woodland inventory, and the identification of additional woodlands that are likely to be added to the inventory Part 1 of the SES and AP₂ ES reported a 12.5ha increase in the extent of ancient woodland affected by the scheme. However, there was no increase in the extent of woodland habitat lost as a consequence of the scheme.

⁴ i.e. Volume 3 of the main ES; Volume 3 of the AP₁ ES; Volume 3 Part 2 of the SES and AP₂ ES; or Volume 3 Part 2 of SES₂ and AP₃ ES.

6.3.5 Table 3 provides a comparison between habitat losses resulting from the SES₃ scheme and those which will occur if all relevant AP₁, AP₂ and AP₃ amendments are approved. The total loss of broadleaved woodland would reduce by just over 13ha compared to the SES₃ scheme. In addition there would be a slight reduction in the losses of neutral grassland and hedgerow habitat compared to the SES₃ scheme (see Table 3).

Table 3: Comparison of habitat losses resulting from the SES₃ scheme and those resulting from the SES₃ scheme in combination with the AP₁, AP₂ and AP₃ amendments

Scheme iteration	Approximate extent of ancient woodland (ha)	Approximate extent of broadleaved woodland (including ancient woodland) (ha)	Approximate extent of neutral grassland (ha)	Approximate extent of hedgerow (km)
SES ₃ scheme	42.9	308	170	490
Cumulative: SES ₃ scheme plus the AP ₁ , AP ₂ and AP ₃ amendments	42.2	295	170 ⁵	483

7 Socio-economics

7.1 Introduction

7.1.1 Direct and indirect socio-economic effects of the original scheme were reported in the main ES at a route-wide and CFA level. The assessment in Volume 3 of the main ES considered:

- route-wide construction employment created (direct and indirect);
- employment in businesses directly and indirectly affected by construction;
- operational employment; and
- operational effects on existing business employment.

7.1.2 Volume 3 of the AP₁ ES, the SES and AP₂ ES and the SES₂ and AP₃ ES reported that the design changes and amendments would not generate new or different significant effects at a route-wide level for socio-economics.

7.2 Changes to the assessment of effects

7.2.1 The changes as a result of the SES₃ scheme are not considered to result in any new or different significant route-wide effects.

⁵ The net result of AP₁ and AP₂ changes would result in a slight decrease in the extent of neutral grassland losses that is not evident due to rounding.

8 Traffic and transport

8.1 Introduction

- 8.1.1 Volume 3 of the main ES provided an overview of the approach to and conclusions from the route-wide traffic and transport assessment of the original scheme. It considered the impacts that may occur over a wide area due to changes in travel patterns.
- 8.1.2 Volume 3 of the AP₁ ES reported that the AP₁ amendments would not generate any new or different significant effects at a route-wide level for traffic and transport.
- 8.1.3 The SES changes in volume 3 of the SES and AP₂ ES resulted in minor local changes, which did not generate any new or different significant route-wide effects. The AP₂ amendments would not generate new or different significant effects at a route-wide level for traffic and transport.
- 8.1.4 Volume 3 of the SES₂ and the AP₃ ES reported that the SES₂ design changes and AP₃ amendments would not generate any new or different significant effects at a route-wide level for traffic and transport.

8.2 Changes to the assessment of effects

- 8.2.1 The changes as a result of the SES₃ scheme are not considered to result in any new or different significant route-wide effects for traffic and transport.

9 Waste and material resources

9.1 Introduction

- 9.1.1 Volume 3 of the main ES presented a route-wide assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that would be generated by the construction and operation of the original scheme.
- 9.1.2 The waste and material resources topic was scoped out of Volume 3 of the AP₁ ES as the AP₁ amendments would not give rise to issues that would be of importance to the consideration of new or different likely significant environmental route-wide effects with regards to waste and material resources.
- 9.1.3 Volume 3 of the SES and AP₂ ES reported that the SES design changes would not generate new or different likely significant route-wide effects. It further reported that the construction of the AP₂ revised scheme would lead to an increase in the total quantity of inert waste and that the resultant effect associated with the off-site disposal of this waste would be minor adverse, compared to negligible as reported in the main ES. The total quantities of non-hazardous and hazardous waste associated with the construction of the AP₂ revised scheme were greater than those reported in the main ES, however the level of significance remained as reported in the main ES.
- 9.1.4 Volume 3 of the SES₂ and AP₃ ES reported that the SES₂ design changes and AP₃ amendments would not result in any new or different likely significant route-wide effects.

9.2 Changes to the assessment of effects

- 9.2.1 There are no SES₃ design changes considered to give rise to issues that would be of importance to the consideration of waste and material resources on a route-wide basis. The changes as a result of the SES₃ scheme are therefore not considered to result in any new or different likely significant environmental route-wide effects.

10 Water resources and flood risk assessment

10.1 Introduction

- 10.1.1 Volume 3 of the main ES presented the significant route-wide effects on surface water and groundwater resources and flood risk. It concluded that, with the exception of the Mid-Chilterns Chalk groundwater body, there were no likely significant regional or route-wide, temporary or permanent adverse effects on water resources and flood risk as a result of the construction process or the operation and maintenance of the original scheme.

- 10.1.2 Volume 3 of the main ES also included a route-wide Water Framework Directive (WFD) compliance assessment for the water bodies potentially affected by the original scheme. The compliance assessment considered whether any of the scheme elements would result in a breach of WFD objectives, the two main WFD objectives being:

- ensuring a scheme element does not result in deterioration in the current WFD status or potential for any water body; and
- ensuring a scheme element does not prevent a failing water body from attainment of good WFD status or potential in the future.

- 10.1.3 A water resources and flood risk assessment and WFD compliance assessment were not included within Volume 3 of the AP₁ ES as the AP₁ amendments were not considered likely to generate new or different significant route-wide effects or affect WFD water bodies at the catchment scale.

- 10.1.4 A water resources and flood risk assessment was not included within Volume 3 of the SES and AP₂ ES as the SES design changes and AP₂ amendments were not considered likely to generate new or different significant route-wide effects. Compliance with the WFD was considered in Volume 3 of the SES and AP₂ ES. The assessment concluded that, as for the original scheme, there would be no breach of the WFD as a result of the SES design changes and AP₂ amendments.

- 10.1.5 A water resources and flood risk assessment and WFD compliance assessment were not included within Volume 3 of the SES₂ and AP₃ ES as the SES₂ changes and AP₃ amendments were not considered likely to generate new or different significant route-wide effects or affect WFD water bodies at the catchment scale.

10.2 Changes to the assessment of effects

- 10.2.1 A scoping exercise determined that the SES₃ design changes did not have the potential to give rise to new or different significant route-wide effects in terms of

water resources and flood risk. The scoping exercise also determined that the SES₃ design changes would not affect WFD water bodies at the catchment scale.

- 10.2.2 It is concluded that, as for the original scheme and AP₂ revised scheme, there will be no breach of the WFD as a result of the SES₃ design changes.

11 Phase One and Phase Two combined impacts

11.1 Introduction

- 11.1.1 Volume 3 of the main ES presented a tabulated summary of the potential total impacts of both Phase One (the original scheme) and Phase Two on a range of environmental receptors. Phase Two of HS₂ will comprise new lines between the West Midlands, Leeds and Manchester, completing what is known as the 'Y network'. Impacts of the original scheme were based on design data and assessments undertaken as part of the Environmental Impact Assessment or assessments prepared in support of the January 2012 updated Appraisal of Sustainability report for Phase One. The Phase Two data was taken from the Phase Two Sustainability Statement, published in July 2013.

- 11.1.2 Volume 3 of the AP₁ ES, the SES and AP₂ ES and the SES₂ and AP₃ ES reported that the design changes and amendments would result in very minor or negligible changes to the figures given in the main ES.

11.2 Summary of changes to combined impacts

- 11.2.1 The SES₃ design changes will result in very minor or negligible changes to the combined impact figures given in Volume 3 of the main ES.

Part 2: Additional Provision 4 Environmental Statement

12 Chilterns Area of Outstanding Natural Beauty

12.1 Introduction

12.1.1 Volume 3 of the main ES, the AP₁ ES and the SES and AP₂ ES included an assessment of effects on the special landscape qualities of the Chilterns AONB.

12.1.2 Section 2 in Part 1 of this volume reports that the SES₃ design changes are not of sufficient scale to give rise to any new or different effects on the special landscape qualities of the AONB.

12.2 Background

12.2.1 The assessment of effects set out in the Volume 3 of the main ES addresses the natural beauty and special landscape qualities of the Chilterns AONB (referred to as the AONB) as referenced in the Chilterns AONB Management Plan 2008–2013⁶. Since the publication of the main ES, the Chilterns AONB Management Plan has been reviewed and republished to cover the period between 2014 and 2019. The Chilterns AONB Management Plan 2014–2019⁷ largely replicates the 2008–2013 version, with small changes in total areas of downland, woodland and registered commons. These changes are summarised in Volume 3 of the SES and AP₂ ES.

12.3 Description of the AP₄ amendment

12.3.1 The only AP₄ amendment with the potential to generate new or different significant effects on the Chilterns AONB is the extension to the Chiltern tunnel from Mantle's Wood portal to South Heath green tunnel north portal (AP₄-009-001). A detailed assessment of the effects on individual landscape character areas within the AONB is provided in the individual CFA reports:

- Chalfonts and Amersham (Volume 2, CFA report 8);
- Central Chilterns (Volume 2, CFA report 9); and
- Dunsmore, Wendover and Halton (Volume 2, CFA report 10).

12.3.2 The impacts on the special landscape qualities of the AONB during construction are described in this section.

12.3.3 The amendment incorporates the following elements:

- changes to the Chalfont St Peter, Chalfont St Giles and Little Missenden ventilation shafts and auto-transformer stations included in the original scheme;

⁶ The Chilterns Conservation Board (2008), Management Plan 2008–2013: A Framework for Action.

⁷ The Chilterns Conservation Board (2014), Management Plan 2014–2019: A Framework for Action.

- extension of the bored tunnel by approximately 2.6km, relocation of the Chiltern tunnel north portal and incorporation of landscape earthworks and planting around the new north portal to integrate the feature into the surrounding landform;
- a new ventilation shaft adjacent to B485 Chesham Road;
- a temporary construction access road connecting the Chiltern tunnel north portal to the A413 at the A413/A4128 Link Road roundabout at Great Missenden; and
- a revised location for the South Heath mid-point auto-transformer station.

12.3.4 The ventilation shafts and auto-transformer stations, the South Heath midpoint auto-transformer station, remodelled landscape earthworks and planting will remain within the limits of land required for the original scheme. The extension of the bored tunnel will not require the surface elements of the original scheme between Mantle's Wood and Frith Hill, west of South Heath with the exception of a new ventilation shaft and auto-transformer at B485 Chesham Road and a revised location for the South Heath mid-point auto-transformer station just north of Leather Lane.

12.3.5 The AP4 revised scheme requires a wider and deeper portal at the northern end of the Chiltern tunnel compared to the South Heath green tunnel portal, which was part of the original scheme in this location. This will accommodate sufficient space for the extraction of tunnel boring machines, a 550m² hardstanding allowing for the maintenance and emergency access and egress from the tunnel and associated portal buildings and substations. The porous portal hood for the revised Chiltern tunnel north portal is approximately 200m in length. Planting and landscape earthworks will provide mitigation to integrate the revised north portal into the landscape and to provide visual screening for residents of South Heath, Frith Hill and other scattered properties including Bury Farm on Potter Row. The noise barriers within the original scheme would have been 3m high and positioned at the bottom of the cutting along the eastern side only. The AP4 revised scheme will include 3m high noise barriers, located at the top of the cutting on the eastern side of the route, extending 1.4km from the new portal to Leather Lane (CFAg). The barriers will be integrated with the landscape earthworks and landscape planting.

12.3.6 The AP4 revised scheme will reduce the total permanent area of land required to operate the scheme in this area by approximately 40ha compared to that presented in the original scheme.

12.4 Assessment of effects during construction

12.4.1 The main ES reported that during construction the changes in the immediate vicinity of the route would be at considerable variance with the landscape character and special landscape qualities of the AONB, resulting in substantial local impacts and a major adverse effect locally to the Misbourne Valley. However, given that changes to the character and appearance of the landscape would be temporary and limited to the landscape in the vicinity of the Misbourne Valley, there would be a moderate adverse effect on the AONB as a whole during construction.

- 12.4.2 The AP₄ revised scheme will reduce the total amount of land temporarily required within the AONB by 62ha during construction. This compares to the approximately 250ha reported as a result of the original scheme. The specific impacts on the special landscape qualities and landscape character of the AONB during construction of relevance to this amendment are described below.

Steep chalk escarpment

- 12.4.3 The chalk escarpment will not be directly affected by the AP₄ amendment. The main ES reported that the construction activity associated with the original scheme would temporarily affect the characteristic long distance views from Coombe Hill, Bacombe Hill and Boddington Hill. In comparison with the original scheme, the AP₄ revised scheme will reduce the construction activity in the area of South Heath, approximately 6km away, but the effects associated with the remainder of the route would be as set out in the original scheme.

Flower-rich downland

- 12.4.4 The main area of flower-rich downland close to the route is located on Bacombe Hill and Coombe Hill and will not be directly affected by the AP₄ amendment. The original scheme did not directly affect the flower-rich downland, however, the main ES reported that construction activities will be visible from isolated open areas at Coombe Hill and Bacombe Hill temporarily affecting the setting of these distinctive areas. Although the AP₄ revised scheme will reduce the construction activity in the area of South Heath, the effects will be as set out for the original scheme.

Woodlands

- 12.4.5 The AP₄ revised scheme will result in the loss of approximately 0.7ha of ancient woodland at Jones' Hill Wood. This is 0.3ha less than the loss reported in the main ES (the original scheme would have resulted in the loss of 1ha of ancient woodland at Jones' Hill Wood). The AP₄ revised scheme will avoid the loss of ancient woodland at Mantle's Wood, Farthings Wood and of woodland at Hedgemoor. An area of approximately 0.25ha of ancient woodland at Sibley's Coppice is shown as falling within the land required for the scheme. However, no works will be undertaken within this area in order to avoid any impacts on the ancient woodland present.
- 12.4.6 The AP₄ revised scheme avoids all but a small loss (approximately 0.7ha, equivalent to approximately 0.007%) of all ancient woodland in the AONB and will not therefore noticeably affect this special quality.

Commons, heaths and greens

- 12.4.7 The AP₄ revised scheme and the original scheme will not result in the loss of commons, heaths and greens.

Historic settlement and environment

- 12.4.8 Construction activity between Hyde Heath and South Heath will no longer occur in the AP₄ revised scheme. In comparison with the original scheme, this will avoid the demolition of several properties along Frith Hill, Kings Lane and Hyde Lane to facilitate construction; the setting of Shardeloes and Missenden Abbey registered parks and gardens will be unaffected; and the construction activity associated with the

new Chesham Road ventilation shaft adjacent to the B485 Chesham Lane will be smaller in scale than that of the original scheme. North of South Heath, the AP4 revised scheme is the same as the original scheme so that the impacts on the setting of settlement at Wendover and the loss of historic features through the removal of approximately 150m of Grim’s Ditch, small areas of sunken lanes at Leather Lane and Bowood Lane again remain as reported in the main ES.

- 12.4.9 The AP4 revised scheme represents an improvement over the original scheme through the reduced construction activity and temporary land take between Hyde Heath and South Heath.

Network of Public Rights of Way and ancient routes

- 12.4.10 The AP4 revised scheme will require a temporary Public Rights of Way (PRoW) diversion (Public footpath GMI/33/3, GMI/33/2) at the Chesham Road ventilation shaft. However, both temporary PRoW diversions between Mantle’s Wood and Frith Hill set out in the original scheme will no longer be required. North of Frith Hill, Footpath GMI/13, diverted to the north in the original scheme, will be temporarily diverted south around the Chiltern tunnel north portal.
- 12.4.11 In comparison with the original scheme, the AP4 amendment will reduce the number of PRoW directly affected between Hyde Heath and South Heath, but the temporary realignment of the Icknield Way Path and the Ridgeway National Trail south-west of Wendover will remain. Overall, the AP4 amendment will represent a localised improvement compared to the original scheme.

Chalk streams

- 12.4.12 In the AP4 revised scheme, Little Missenden ventilation shaft will be deepened by approximately 3m compared to the original scheme. Whilst construction activity in this location may affect the enjoyment of this landscape feature, the overall character of chalk streams would remain unaffected.

Tranquil valleys

- 12.4.13 The AP4 revised scheme will avoid the enclosed and tranquil Mantle’s Wood valley. However, as proposed in the original scheme, the construction activity will be apparent at the Chalfont St Giles ventilation shaft in the tranquil valley fold to the north-west of Chalfont St Giles. Additionally, the character of the dry valley coombe at Wendover Dean will be affected by the presence of construction activities associated with the Wendover Dean viaduct. Overall, the AP4 revised scheme will represent an improvement over the original scheme.

Farmland

- 12.4.14 The AP4 revised scheme will result in an overall net reduction in the land required across CFA8, CFA 9 and CFA 10 of approximately 62ha, from 250ha in the original scheme to 188ha.

Summary of effects during construction

- 12.4.15 The extension of the Chiltern tunnel will give rise to a different significant effect locally in the Misbourne valley as the area directly affected by above-ground works will be reduced by approximately one third. Ancient woodland at Mantle’s Wood,

Farthings Wood and Sibley's Coppice will not be removed, as would be the case for the original scheme. This will change the level of significance of effects on the Misbourne Valley reported in the main ES from major adverse to moderate adverse.

- 12.4.16 For the AONB as a whole, the amendment will not give rise to new or different significant effects during construction. This will not change the level of significance of the effects reported in the main ES.

12.5 Assessment of effects during operation

- 12.5.1 The main ES reported a major adverse effect locally to the Misbourne Valley between year one and 15 of operation, reducing to moderate adverse in year 60.

- 12.5.2 Taking into account the AONB as a whole, the partial alteration to the special landscape qualities will be confined to one of the valleys within the whole of the AONB. A moderate adverse effect was reported during year one and 15 of operation. By year 60 of operation, the mitigation planting will have matured and effects will reduce such that it is not considered to be significant.

- 12.5.3 The AP4 revised scheme will reduce the total permanent area of land required within the AONB by approximately 40ha during operation compared to the original scheme. The specific effects on the special landscape qualities and landscape character of the AONB during operation of relevance to this amendment are described below.

Steep chalk escarpment

- 12.5.4 The escarpment will not be directly affected by the AP4 revised scheme. However, during year 1 of operation, there will be indirect effects on the setting of parts of the steep chalk escarpment due to the visibility of the Chiltern tunnel north portal near Frith Hill and ventilation shafts in the lower lying landscape. By year 15 and 60, mitigation planting will have matured to provide greater landscape integration. In comparison with the original scheme, the AP4 revised scheme will reduce the visibility of the above ground infrastructure in the area of South Heath, approximately 6km away, but the effects associated with the remainder of the route would be as set out in the main ES.

Flower-rich downland

- 12.5.5 The main area of flower-rich downland close to the route is located on Bacombe Hill and Coombe Hill and will not be directly affected by the AP4 amendment or by the original scheme. The main ES reported that the original scheme will be a minimal impact on the setting of the landscapes on the chalk escarpment during year one of operation and will not perceptibly alter the character of the flower-rich downland by year 15 and beyond to year 60. Due to the distance that the AP4 revised scheme elements will be from the downland at Bacombe Hill and Coombe Hill the AP4 revised scheme will not alter the assessment in the main ES.

Woodlands

- 12.5.6 The AP4 revised scheme will retain the ancient woodland at Mantle's Wood, Farthings Wood, Sibley's Coppice and woodland at Hedgemoor that would have been lost with the original scheme. By year 15 and 60 of operation, the mitigation planting will be well established, strengthening the wooded character of the AONB. In comparison

with the original scheme, the retention of the ancient woodland, in particular that at Sibley's Coppice, Mantle's Wood and Jones' Hill Wood, will avoid altering the historic landscape and character of the Misbourne Valley in year one and beyond to years 15 and 60.

Commons, heaths and greens

- 12.5.7 The AP4 revised scheme and original scheme will not result in the loss of commons, heaths and greens.

Historic settlement and environment

- 12.5.8 The AP4 revised scheme will introduce an additional built element into the landscape, the new Chesham Road vent shaft off the B485 Chesham Lane. In comparison with the original scheme, this will be substantially smaller in scale than the above-ground elements associated with the original scheme and will avoid the loss of features between Hyde Heath and South Heath including built elements and vegetation. However, the impacts in relation to the Little Missenden ventilation shaft, the route alignment at Wendover, removal of approximately 150m of Grim's Ditch and small areas of sunken lanes at Leather Lane and Bowood Lane remain as reported for the original scheme. Overall the AP4 revised scheme will be an improvement when compared to the original scheme but adverse effects remain.

Network of PRow and ancient routes

- 12.5.9 The permanent PRow diversions between Mantle's Wood and Frith Hill as set out in the original scheme will no longer be required in the AP4 revised scheme. North of Frith Hill, Footpath GMI/13, diverted to the north to Footpath GMI/12 overbridge in the original scheme, will be permanently diverted south around the Chiltern tunnel north portal via a new access track. On the east side of the route, it will continue on its original alignment through Jenkin's Wood before joining with Potter Row. A permanent PRow diversion of GMI/2 (AP4-009-002) will amend this footpath so that on the western side of the route it will be diverted to the west of the mitigation planting and not along the top of the cutting as in the original scheme.
- 12.5.10 In comparison with the original scheme, the AP4 amendment will reduce the number of PRow directly affected between Hyde Heath and South Heath, but the temporary realignment of the Icknield Way Path and the Ridgeway National Trail south-west of Wendover will remain. Overall, the AP4 revised scheme will represent a localised improvement compared to the original scheme in year one. Direct effects will remain as reported in year one in years 15 and 60.

Chalk streams

- 12.5.11 In the AP4 revised scheme the Little Missenden ventilation shaft will be deepened by approximately 3m compared to the original scheme but the above ground elements will be unchanged from the original scheme.

Tranquil valleys

- 12.5.12 The AP4 revised scheme will avoid the enclosed and tranquil Mantle's Wood valley representing an improvement compared to the original scheme. However, the viaduct crossing the dry valley coombe at Wendover Dean and the presence of the Chalfont St

Giles ventilation shaft in the tranquil valley fold to the north-west of Chalfont St Giles will locally alter the character of the valleys and the impacts will be as reported in the main ES.

Farmland

- 12.5.13 The route of the AP₄ revised scheme will traverse a predominantly arable landscape with a varied field pattern interspersed with areas of woodland. The amendment will result in an overall net reduction in the land required across CFA8, CFA 9 and CFA 10 from approximately 210ha in the original scheme to 170ha for the AP₄ revised scheme.

Summary of effects during operation

- 12.5.14 In summary, during operation of the AP₄ revised scheme, there will be a reduced permanent loss of key characteristics that contribute to the special landscape qualities of the AONB in the Misbourne Valley including farmland, ancient woodland (limited to 0.7ha of Jones Hill Wood as reported in the main ES) and local style properties relative to the original scheme. The proposed extension of the Chiltern tunnel, will give rise to a different significant effect locally in the Misbourne valley. This amendment will change the level of significance of the effects reported in the main ES in the Misbourne Valley from major adverse to a moderate adverse effect in year one and 15 and remaining as moderate adverse in year 60 of operation.
- 12.5.15 The amendment will avoid the Mantles Wood area of the Misbourne Valley, representing an improvement compared to the original scheme. However, overall, the extension of the Chiltern tunnel will not give rise to a new or different significant effect on the AONB as a whole and will not change the level of significance of the effects reported in the main ES.

13 Agriculture, forestry and soils

13.1 Introduction

- 13.1.1 Volume 3 of the main ES provided an assessment of the route-wide impacts and likely significant effects on agriculture, forestry and soils arising from the original scheme. Since it is considered that during operation there will be no significant route-wide effects for agriculture, forestry and soils, operational effects are not considered further. Section 3 in Part 1 of this volume reports that the SES₃ design changes will not generate any new or different significant route-wide effects.

13.2 Changes to the assessment of effects

- 13.2.1 The construction of the SES scheme will require a total of approximately 4,800ha⁸ of agricultural land, comprising approximately 2,500ha of Best and Most Versatile (BMV) agricultural land in Grade 2 and Subgrade 3a, and 2,300ha of lower quality land in Subgrade 3b and Grade 4.
- 13.2.2 Following construction, the land required temporarily will be reinstated to its pre-existing agricultural condition by following good practice guidance on the sustainable use of soils, as set out in the draft CoCP (main ES, Volume 5: Appendix CT-003-000).

⁸ Total land required is rounded to the nearest 100ha

This will assist in minimising soil degradation, such that soils will continue to provide a varied range of important services and functions such as food production, carbon storage and climate regulation, water storage and filtration, flood management and support for biodiversity. Following construction and restoration to agricultural land, the SES scheme will permanently require approximately 2,800ha of agricultural land, of which 1,500ha is BMV land and 1,300ha is lower quality land. The SES scheme will also require an area of approximately 250ha of forestry land permanently, which will be offset by the replanting of approximately 650ha of woodland for landscape mitigation and ecological habitat creation or replacement.

- 13.2.3 Following construction of the AP₄ revised scheme, the area of land that will change permanently from agricultural use will decrease from the SES scheme by 45ha to approximately 2,750ha. Most of the reduction will involve land in Subgrade 3b. Approximately 17ha less forestry land will be required by the AP₄ revised scheme. These changes are not sufficient in scale to result in any new or different significant route-wide effects on agricultural and forestry land from the SES scheme.
- 13.2.4 Taking into account the AP₄ revised scheme cumulatively with the AP₁ and AP₂ amendments (none of the AP₃ amendments would affect agricultural land), will not result in any new or different significant route-wide effects on agricultural and forestry land.

14 Climate

14.1 Introduction

- 14.1.1 Volume 3 of the main ES reported the assessment of the GHG emissions of the original scheme during construction and operation. Construction GHG emissions in the main ES were reported at 5,590,000 tonnes carbon dioxide equivalent (tCO₂e)⁹ under the central scenario (Scenario A)¹⁰, and 5,300,000 tCO₂e under a stretch scenario (Scenario B)¹¹.
- 14.1.2 Section 4 in Part 1 of this volume reports that, of the subsequent SES, SES₂ and SES₃ design changes, only the SES₂ design changes materially impact the original scheme's carbon footprint. Construction GHG emissions were recalculated in SES₂ to take account of the revised scheme for the Euston station and approach area and the removal of the HS₁–HS₂ link, and were reported at 5,815,000 tCO₂e (Scenario A) and 5,460,000 tCO₂e (Scenario B). The SES₂ scheme forms the baseline against which the AP₄ revised scheme is assessed.

14.2 Scope, assumptions and limitations

- 14.2.1 A scoping exercise identified which of the AP₄ amendments are considered to be potentially material from a GHG emissions perspective. For further detail on the scoping methodology applied see part 1, Section 2.2 of this document.

⁹ Tonnes carbon dioxide equivalent is a metric used to compare the emissions from various greenhouse gases based on their global warming potential.

¹⁰ The construction carbon footprint is presented as a range based on two scenarios. Scenario A is a central figure based on the likely improvements in the carbon efficiency within the construction industry by 2020. For further information see Section 5.1 of Volume 3 of the main ES.

¹¹ The construction carbon footprint is presented as a range based on the two scenarios. Scenario B is a "stretch" figure assuming that the construction industry is able to implement its research on carbon efficiency. For further information see Section 5.1 of Volume 3 of the main ES.

- 14.2.2 The scoping exercise identified a single AP₄ amendment with the potential to materially impact the original scheme’s construction carbon footprint; the extension of the Chiltern Tunnel from Mantle’s Wood portal to South Heath Green Tunnel North portal and associated works.
- 14.2.3 The impact that the AP₄ amendments have on GHG emissions from the operation of HS2 has also been reviewed as part of the scoping exercise both individually and collectively. None of the AP₄ amendments were identified to have material impacts on operational GHG emissions¹².
- 14.2.4 Refer to Appendix CL-002-000 (Volume 5 of this SES₃ and AP₄ ES) for the complete summary of the scoping exercise.

14.3 Carbon footprint methodology

- 14.3.1 The methodology used to assess GHG emissions remains unchanged from the main ES. No changes have been made to the underlying assumptions of the carbon footprint methodology (e.g. carbon factors adopted, the density and weight of construction material, or transport vehicles assumed for logistics). Further details are provided in Appendix CL-002-000 (Volume 5 of this SES₃ and AP₄ ES).

14.4 Greenhouse gas implications of the AP₄ amendments

- 14.4.1 The extension of the Chiltern tunnel compared to the SES₂ scheme increases construction GHG emissions by 105,000 tCO₂e (Scenario A) and 100,000 tCO₂e (Scenario B)¹³. This is equivalent to a 1.8% increase for both Scenario A and Scenario B and therefore the AP₄ revised scheme construction emissions are 5,920,000 tCO₂e (Scenario A) and 5,560,000 tCO₂e (Scenario B).
- 14.4.2 Assuming that the AP₂ amendments are accepted by Parliament, the cumulative impact on construction GHG emissions would be an increase of 310,000 tCO₂e (Scenario A) and 295,000 tCO₂e (Scenario B) compared to the SES₂ scheme. This is equivalent to a 5.3% and 5.4% increase for Scenarios A and B, respectively. No potentially material AP₁ or AP₃ amendments were identified and therefore do not form part of the cumulative assessment.
- 14.4.3 Table 4 summarises the change in GHG emissions as a result of the AP₄ revised scheme.

Table 4 HS2 construction emissions (tCO₂e) comparison¹⁴

Scheme iteration	Scenario A	Scenario B
SES ₂ scheme	5,815,000	5,460,000
AP ₄ revised scheme	5,920,000	5,560,000

¹² Operational GHG emissions include mode shift outcomes.

¹³ These figures also include GHG emissions associated with changes in the movement of materials as a result of the extension of the Chiltern Tunnel.

¹⁴ Figures presented in this table have been rounded and thus cumulative totals between different scheme revisions may not tally.

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Difference (tCO ₂ e)	105,000	100,000
Difference (%)	1.8%	1.8%
Cumulative: AP ₄ revised scheme including AP ₂ amendments	6,125,000	5,755,000
Difference (tCO ₂ e)	310,000	295,000
Difference (%)	5.3%	5.4%

14.4.4 For reference, compared to the main ES, the AP₄ revised scheme increases emissions by 5.9% (Scenario A) and 4.9% (Scenario B), whilst the AP₄ revised scheme including AP₂ amendments represents a 9.6% (Scenario A) and 8.6% (Scenario B) increase.

14.5 Conclusions

14.5.1 The impact of the AP₄ amendments on the SES₂ scheme is considered to be minor, increasing construction GHG emissions by 1.8% for Scenarios A and B.

14.5.2 The AP₄ amendments are considered to have a negligible effect on the operation of the scheme and therefore the GHG benefits associated with AP₄ revised scheme remain as reported in the main ES.

14.5.3 The main contributions to HS₂'s construction GHG emissions remain the same (i.e. bridges and viaducts, tunnels, stations and track).

14.5.4 In combination with the AP₂ revised scheme (including SES₂ design changes), the AP₄ amendments increase the scheme's construction GHG emissions by between 5.3% (Scenario A) and 5.4% (Scenario B).

14.5.5 The overall conclusions from this assessment remain the same as in Volume 3 of the main ES.

15 Cultural Heritage

15.1.1 Section 5 in Part 1 of this volume reports that no new heritage assets would be affected as a result of the SES₃ design changes.

15.1.2 One length of historic hedgerow will no longer be affected as a result of the AP₄ amendments in comparison with the SES₃ scheme. In total, there will be 80 lengths of historic hedgerow directly affected by the AP₄ revised scheme.

15.1.3 The AP₄ amendments will ensure that five previously affected ancient woodland areas under the SES₃ scheme will no longer be affected. The total number of ancient woodland areas affected by the AP₄ revised scheme will be 32.

15.1.4 There are no further changes to the list of affected heritage assets in Section 5 in Part 1 of this volume as a result of the AP₄ amendments.

16 Ecology

16.1 Introduction

- 16.1.1 Volume 3 of the main ES described the likely significant effects on ecological resources that will occur on a route-wide level as a consequence of the construction and operation of the original scheme. The route-wide assessment addressed significant effects at the regional and national level, and in combination effects not discussed within Volume 2 of the main ES.
- 16.1.2 This section of the report identifies any new or different significant effects on ecological resources due to the AP₄ amendments, compared to those reported for the SES₃ scheme (see Section 6 in Part 1 of this volume). The assessment presented in this section of the report also considers the AP₄ revised scheme in combination with any relevant AP₁, AP₂ and AP₃ amendments to identify the potential for any new or different cumulative effects at the route-wide level. Consideration is given to the potential for impacts on species, habitats and sites designated on the basis of their importance for nature conservation.

16.2 Changes to the assessment of effects

Designated sites

- 16.2.1 The main ES identified that Phase One of HS₂ London-West Midlands would result in habitat loss and/or fragmentation of two statutory designated sites, namely the Mid-Colne Valley Site of Special Scientific Interest (SSSI) and Helmdon Disused Railway SSSI. Each of these SSSIs is of national value for nature conservation.
- 16.2.2 The AP₄ revised scheme will increase the number of SSSI affected by the scheme to three, through habitat loss and fragmentation at Frays Farm Meadows SSSI, near Denham, Hillingdon (AP₄-006-004 – CFA7 Colne Valley). HS₂ Ltd will work with relevant landowners, Natural England and London Wildlife Trust to develop appropriate mitigation and/or compensation to address this new significant effect.
- 16.2.3 In addition, the realignment of the Stamford Brook sewer (AP₄-004-002) in CFA₄ (Kilburn (Brent) to Old Oak Common) will result in the temporary loss of approximately 0.5ha of Wormwood Scrubs Local Nature Reserve (LNR)¹⁵. No significant effect on site integrity is anticipated, and affected habitats will be reinstated on the completion of works.
- 16.2.4 As a consequence of these amendments (i.e. AP₄-006-004 and AP₄-004-002), the AP₄ revised scheme will result in habitat loss and/or fragmentation from a total of four statutory designated sites for nature conservation (three SSSI and one LNR). In comparison the SES₃ scheme affects two statutory designated sites (two SSSI).
- 16.2.5 The extension of the Chilterns bored tunnel (AP₄-009-001) means that habitat loss and/or fragmentation at three LWS identified in the main ES (Mantle's Wood LWS; Hedgemoor and Farthings Wood LWS; Sibley's Coppice LWS) will not occur as the tunnel will now pass beneath these sites.

¹⁵A separate section of the LNR is within the land required for the SES₃ scheme. However, previously no construction works were proposed within the LNR, the areas were included solely to allow the provision of ecological mitigation.

- 16.2.6 Other proposed AP₄ amendments will result in habitat loss and/or fragmentation from three additional LWS previously located outside of the land required for the SES₃ scheme, namely: Wormwood Scrubs Park Site of Borough Importance Grade I (SBI.I), River Brent at Hanger Lane Grade II SBI, and Old Oak Common Sidings Birch Woods SBI.I.
- 16.2.7 The SES₃ scheme would result in habitat loss and/or fragmentation from a total of 89 LWS, 61 of which would be subject to impacts likely to result in effects on the integrity of the site. Overall there is no change in these numbers in the AP₄ revised scheme. However, as described above, the individual LWS concerned have changed.
- 16.2.8 Part 1 of the SES₂ and AP₃ ES reported that prior to mitigation there is the potential for the adverse effects on the LWS identified in the Volume 2 CFA reports to result in additional significant adverse effects on the networks of which they form a part. Prior to mitigation the AP₄ revised scheme will result in a different adverse effect on the ecological networks of which the LWS forms a part as the location of the LWS affected has changed. However, this does not affect the route-wide effects on ecological networks described in Part 1 of the SES₂ and AP₃ ES, which, following the implementation of proposed mitigation and compensation, are still not expected to be significant.

Habitats

- 16.2.9 The SES₃ scheme would result in the loss of a total of 42.9ha of ancient woodland with a total of 37 ancient (or likely ancient) woodlands directly affected. This is identified as a permanent adverse residual effect on an irreplaceable resource, which is significant at the national level.
- 16.2.10 Four proposed AP₄ amendments result in changes in the extent of ancient woodland required for the construction of the AP₄ revised scheme:
- extension of the Chilterns bored tunnel (AP₄-009-001): reduces the area of ancient woodland required for the construction of the scheme in the CFA₉, Central Chilterns area by approximately 9.2ha. The loss of ancient woodland at Mantle's Wood (6.2ha), Sibley's Coppice (2.5ha) and Farthings Wood (0.5ha) reported in the main ES will not occur in the AP₄ revised scheme;
 - additional land required for an overbridge and reconfiguration works at Calvert Landfill waste transfer sidings (AP₄-013-002): requires the removal of an additional 300m² of ancient woodland from the unnamed woodland to the west of the HS₂ route to allow the provision of a new overbridge;
 - Stoneleigh Park amendments (AP₄-018-002): reduces by approximately 0.4ha the land required from an unnamed area of ancient woodland south of the B4115 Ashow Road in Stoneleigh; and
 - provision of overhead line diversion at Park Hall nature reserve (AP₄-025-001): provides an alternative alignment overhead line diversion that will avoid the loss of the 2.8ha of ancient woodland at Parkhill Wood and Langley Hill Wood. These woodlands are no longer directly affected under the AP₄ revised scheme.

- 16.2.11 Overall, the AP₄ revised scheme will result in the loss of approximately 30.5ha of ancient woodland, a reduction of approximately 12.4ha compared to the SES₃ scheme. The number of ancient woodland sites directly affected by the AP₄ revised scheme will reduce to 32. In addition, AP₄ amendments are likely to result in indirect effects on Pinnocks Wood (CFA7) where a temporary haul road is located adjacent to the woodland, and the unnamed 0.2ha parcel of ancient woodland that is isolated by the Calvert waste transfer sidings amendment (AP₄-013-002). Overall this is a different significant effect to that reported in Part 1 of the SES and AP₂ ES (see Table 5). However, it remains a permanent adverse residual effect on an irreplaceable resource, which is significant at the national level.
- 16.2.12 Ancient woodland losses under the AP₄ revised scheme are therefore approximately 1.5ha less than was reported in the main ES.
- 16.2.13 Table 5 provides a comparison between habitat losses for key habitat types resulting from the SES₃ scheme and those resulting from the AP₄ revised scheme. The AP₄ amendments would reduce the loss of broadleaved woodland by approximately 15ha. In addition they reduce the loss of neutral grassland and hedgerows by 3ha and 4km respectively.

Table 5: Comparison of habitat losses resulting from the SES₃ scheme and those resulting from the AP₄ revised scheme

Scheme iteration	Approximate extent of ancient woodland (ha)	Approximate extent of broadleaved woodland (including ancient woodland) (ha)	Approximate extent of neutral grassland (ha)	Approximate extent of hedgerow (km)
SES ₃ scheme	42.9	308	170	490
AP ₄ revised scheme	30.5	293	167	486

Protected and/or notable species

- 16.2.14 The AP₄ amendments are not expected to result in new or different likely significant effects on protected and/or notable species which would be relevant at the route-wide level.

Cumulative effects

- 16.2.15 This section of the report considers the AP₄ revised scheme in combination with all relevant AP₁, AP₂ and AP₃ amendments to identify the potential for new or different route-wide level effects to those reported in the relevant Volume 3 ES chapters¹⁶.
- 16.2.16 AP₂ amendment (AP₂-014-006¹⁷) results in a different significant effect on Helmdon Disused Railway SSSI. However, in combination with the AP₄ revised scheme the number of statutory sites for nature conservation directly affected remains four (three SSSI and one LNR).
- 16.2.17 The number of LWSs affected by the AP₄ revised scheme in combination with all relevant AP₁, AP₂ and AP₃ amendments is 91, with 61 of these subject to significant

¹⁶ i.e. Volume 3 of the main ES; Volume 3 of the AP₁ ES; Volume 3 Part 2 of the SES and AP₂ ES; or Volume 3 Part 2 of SES₂ and AP₃ ES.

¹⁷ Amendment AP₂-014-006 provides a green bridge at Helmdon Disused Railway SSSI in order to facilitate the safe passage of bats, in particular Natterer's bat across the railway.

effects on site integrity¹⁸. This results in a different significant adverse effect on the ecological networks of which the LWS forms a part, due to the changes in the number and location of LWS affected. However following the implementation of proposed mitigation and compensation, route-wide level effects on ecological networks are still not expected to be significant.

- 16.2.18 The total ancient woodland losses as a result of the AP₄ revised scheme in combination with all previous amendments will reduce by 0.4ha to a total of 30.1ha (compared to 30.5ha for the AP₄ revised scheme, see Table 6). The total number of ancient woodlands directly affected will remain at 32. The number indirectly affected will remain at two. This will result in a different permanent adverse residual effect on an irreplaceable resource. However, the effect remains significant at the national level.
- 16.2.19 Table 6 provides a comparison between habitat losses resulting from the AP₄ revised scheme and those which will occur if all relevant AP₁, AP₂ and AP₃ amendments are approved, on key habitats. In relation to broadleaved woodland the AP₄ revised scheme will result in the loss of approximately 293ha of broadleaved woodland. Assuming that all the AP₁, AP₂ and AP₃ amendments are accepted by Parliament then the total loss of broadleaved woodland would reduce to approximately 280ha. This is a reduction of just over 13ha compared to the AP₄ revised scheme.
- 16.2.20 In combination with the AP₄ revised scheme, proposed AP₁, AP₂ and AP₃ amendments will result in slight reductions in the total losses of neutral grassland and hedgerow habitat compared to the AP₄ revised scheme (see Table 6).

Table 6: Comparison between habitat losses resulting from the AP₄ revised scheme and the AP₄ revised scheme in combination with the AP₁, AP₂ and AP₃ amendments

Habitat type	Approximate extent of ancient woodland (ha)	Approximate extent of broadleaved woodland (including ancient woodland) (ha)	Approximate extent of neutral grassland (ha)	Approximate extent of hedgerow (km)
AP ₄ revised scheme	30.5	293	167	486
Cumulative: AP ₄ revised scheme plus the AP ₁ , AP ₂ and AP ₃ amendments	30.1	280	167 ¹⁹	479

- 16.2.21 No other new or different likely significant effects relevant at a route-wide level are expected as a consequence of AP₄ amendments occurring in combination with AP₁, AP₂ or AP₃ amendments.

¹⁸ AP₂ amendment AP₂-021-004 reports a precautionary adverse effect on the Moor Covert and Pool SBI. Therefore increasing the number of LWS subject to significant effects on site integrity to 63.

¹⁹ The net result of AP₁ and AP₂ changes would result in a slight decrease in the extent of neutral grassland losses that is not evident due to rounding.

17 Socio-economics

17.1 Introduction

17.1.1 Volume 3 of the main ES presented a route-wide assessment of the direct and indirect socio-economic effects. Section 7 in Part 1 of this volume reports that none of the subsequent SES, SES₂ and SES₃ design changes will generate any new or different significant route-wide effects for socio-economics.

17.2 Changes to the assessment of effects

17.2.1 The AP₄ amendments will have minimal impacts on total numbers of existing employment affected by construction and total numbers of construction employment created. Whilst the employment figures given in Volume 3 of the main ES may change to a very small degree, any such change is considered to be negligible and will not change the conclusions of the assessment.

17.2.2 None of the amendments proposed as part of the AP₄ revised scheme have been identified to result in any new or different significant route-wide effects.

18 Traffic and transport

18.1 Introduction

18.1.1 Volume 3 of the main ES provided an overview of the approach to and conclusions from the route-wide traffic and transport assessment. Section 8 in Part 1 of this volume reports that none of the subsequent SES, SES₂ and SES₃ design changes would generate any new or different significant route-wide effects.

18.2 Changes to the assessment of effects

18.2.1 None of the amendments proposed as part of the AP₄ revised scheme have been identified as likely to result in any new or different significant route-wide effects for traffic and transport.

19 Waste and material resources

19.1 Introduction

19.1.1 Volume 3 of the main ES presented a route-wide assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that will be generated by the construction and operation of the original scheme. Section 9 in Part 1 of this volume reports that the SES₃ design changes would not generate any new or different significant route-wide effects on waste and material resources.

19.1.2 This section presents the route-wide assessment of the likely significant environmental effects associated with the off-site disposal to landfill of solid waste that will be generated by the construction and operation of the AP₄ revised scheme. The AP₄ revised scheme takes the SES₃ design changes into account in the valuation of quantities of solid waste generated.

- 19.1.3 Excavated material data pertaining to the AP₁, AP₂ and AP₃ amendments have also been included within this route-wide assessment for the AP₄ revised scheme. This is therefore a cumulative assessment assuming all the amendments are accepted by Parliament and constitutes a worst-case scenario.
- 19.1.4 Where AP₄ amendments have not resulted in changes to the quantities of construction, demolition, worker accommodation site or operational waste quantities, the assessment uses the quantities reported for the AP₃ revised scheme in the SES₂ and AP₃ ES. Where no new data was reported in the SES₂ and AP₃ ES the assessment uses the quantities reported for the AP₂ revised scheme in the SES and AP₂ ES. Where no new data has been reported since the main ES, the AP₄ assessment uses the data reported for the original scheme in the main ES.
- 19.1.5 This assessment considers:
- the types and quantity of waste that will be generated;
 - the quantity of waste that will require off-site disposal to landfill; and
 - the availability of off-site landfill disposal capacity.
- 19.1.6 This assessment primarily considers the impacts of waste. Consideration of material resources in this assessment is limited to the beneficial reuse of excavated material arising from the construction of the AP₄ revised scheme. Only if excavated material is not required or is unsuitable for the construction of the AP₄ revised scheme, will it be considered waste.
- 19.1.7 An overview of the types and quantities of waste that will be generated within each CFA where potentially significant effects have been identified is presented within Appendix WM-001-000 (Volume 5 of this SES₃ and AP₄ ES).

19.2 Policy framework

- 19.2.1 A summary of the policy framework provided in the main ES was updated in the SES and AP₂ ES. The policy framework for this SES₃ and AP₄ ES is unchanged from that reported in the SES and AP₂ ES.

19.3 Scope, assumptions and limitations

- 19.3.1 The assessment assumptions and limitations remain unchanged from those described in the main ES, as set out in Volume 3, Section 14.3.

19.4 Assessment methodology

- 19.4.1 The assessment methodology remains unchanged from that described in the main ES, as set out in Volume 3, Section 14.4.
- 19.4.2 The consequences of the AP₄ amendments on waste generation from construction and operation have been quantitatively assessed for each CFA, and then amalgamated for the AP₄ revised scheme as a whole.

19.5 Environmental baseline

Waste arisings and management

- 19.5.1 Since submitting the main ES, the format in which the Department for Environment, Food & Rural Affairs and the Environment Agency publish national and regional waste data has changed, preventing a direct update of the baseline conditions. A revision of the methodology used to set the baseline would prevent a direct comparison of the SES₃ and AP₄ ES with the main ES.
- 19.5.2 Therefore, baseline arisings and management of construction, demolition and excavation waste (CDEW), and commercial and industrial (C&I) waste during operation, remain unchanged from that described and assessed in Volume 3 of the main ES as was the case for the SES and AP₂ ES waste and material resources assessment.

Waste infrastructure

- 19.5.3 Following submission of the Bill, revised data has been published by the Environment Agency on the waste infrastructure capacity within each of the counties and former regional planning areas through which the AP₄ revised scheme will pass. This was updated for the SES and AP₂ ES (Volume 3, Section 19.5) and continues to be used to inform the baseline and future baseline used in this assessment.

19.6 Assessment of effects during construction

Avoidance and mitigation measures

- 19.6.1 The provision of mitigation measures during construction is unchanged from that described in Volume 3 of the main ES with the exception of sustainable placement mitigation measures.
- 19.6.2 The main ES reported that three sustainable placement areas (SPAs) have been selected on the basis of their suitability for the on-site disposal of surplus excavated material to avoid causing environmental effects²⁰ that would otherwise be associated with the off-site disposal of that material.
- 19.6.3 It was reported in Part 1 of the SES and AP₂ ES that SPA₂ near Hunt's Green Farm at South Heath, (which was planned for the on-site placement of approximately 1,928,002 tonnes of surplus excavated material) would no longer be used. In addition, an AP₄ amendment (AP₄-006-002) proposes to reduce the quantity of surplus excavated material to be disposed of at the Harvil Road SPA₁ from 2,884,487 tonnes, as reported in the main ES, to 2,737,140 tonnes.
- 19.6.4 The SPAs are shown in Table 7. The on-site placement for disposal of surplus excavated material will reduce the quantity of inert surplus excavated material to be disposed off-site to landfill by approximately 4,781,611 tonnes (6,856,960 tonnes reported in Volume 3 of the main ES).

²⁰ Primarily transportation effects and the associated environmental effects of noise, air quality and climate change.

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Table 7: Sustainable placement areas for the AP4 revised scheme

Sustainable placement area reference	Quantity (tonnes)	Regional area	Sustainable placement area	Map references
SPA1	2,737,140	Greater London (CFA6)	Harvil Road	CT-06-019a-L1 CT-06-019a-R1
SPA2	0	South East (CFA10)	South Heath	Removed from the AP4 revised scheme as shown on CT-06-035
SPA3	2,044,471	South East (CFA13)	Calvert	CT-06-055
Total	4,781,611	-	-	-

- 19.6.5 Other environmental controls previously described in Volume 3 of the main ES will apply to the management of CDEW and worker accommodation site waste generated during construction of the AP4 revised scheme.

Assessment of impacts and effects

Waste forecast

Excavated material quantities

- 19.6.6 Table 8 presents a route-wide summary of the revised forecast excavated material quantities for the AP4 revised scheme (including the SES3 design changes). This is based on the calculated figures for the integrated earthworks design and reflects the balance of excavated material across the AP4 revised scheme. A detailed excavated material quantity forecast is provided in Appendix WM-001-000 (Volume 5 of this SES3 and AP4 ES), which contains changes that have been considered potentially significant (i.e. for CFA4 and CFA9), and a complete set of excavated material quantity forecast for all CFAs is included in Annex 1 of Appendix WM-001-000. For the purpose of this assessment, it has been assumed as a worst-case scenario that all of this material will be disposed off-site to landfill.

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Table 8: Forecast excavated material quantities for the original scheme, the AP2 revised scheme and the AP4 revised scheme, 2017 to 2025

Excavated material management methods	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes) ²¹	Total quantity AP4 revised scheme (tonnes) ²²	Proportion of AP4 revised scheme total
Quantity of excavated material reused for engineering and environmental mitigation earthworks (including all topsoil and agricultural subsoil)	116,649,579	111,235,950	112,274,011	86%
Quantity of surplus excavated material for sustainable placement	6,856,960	4,928,958	4,781,611	4%
Quantity of surplus excavated material for off-site disposal to landfill	4,492,557	12,220,286	13,482,996	10%
Total	127,999,096	128,385,194	130,538,618	100%

- 19.6.7 The AP4 revised scheme will generate approximately 130,538,618 tonnes of excavated material during the period 2017 to 2025. This represents a 2% (2,539,522 tonnes) increase on the quantities reported for the original scheme, and 1.7% (2,153,424 tonnes) increase on the quantities reported for the AP2 revised scheme.
- 19.6.8 The majority of the increased quantity of excavated material generated by the AP4 revised scheme, when compared with the AP2 revised scheme, results from earthworks changes in CFA20, comprising predominantly of the Kingsbury Road Railhead, the Marston Farm cutting, and the Curdworth cutting.
- 19.6.9 Table 8 shows that 86% (112,274,011 tonnes) of the excavated material generated by the AP4 revised scheme will be reused to satisfy the necessary engineering and environmental mitigation earthworks quantities required on a route-wide basis. This represents a slight decrease from 91% (116,649,579 tonnes) reported in Volume 3 of the main ES, and 87% (111,235,950 tonnes) reported in Volume 3 of the SES and AP2 ES.
- 19.6.10 The majority of the reduction in on-site re-use affecting the quantity of fill material required by the AP4 revised scheme results from:
- The extension of tunnelling in CFA9 and CFA10; and
 - The changes to the earthworks design of embankments in CFA20.
- 19.6.11 The means of classification and classes of excavated material suitable for use as engineering fill material and for environmental mitigation earthworks remains unchanged from Volume 3 of the main ES.
- 19.6.12 The estimated quantity of surplus excavated material that will not be reused within the construction of the AP4 revised scheme will be approximately 14% (18,264,607

²¹ References to the AP2 revised scheme include changes resulting from the AP1 revised scheme throughout the waste and material resources assessment.

²² References to the AP4 revised scheme include changes resulting from the AP1, AP2 and AP3 revised schemes throughout the waste and material resources assessment.

tonnes) of the overall excavated material that will be generated on a route-wide basis. This will comprise:

- approximately 4,781,611 tonnes of surplus excavated material that will be managed via sustainable placement; and
- approximately 13,482,996 tonnes of surplus excavated material that will require off-site disposal to landfill.

19.6.13 The quantity of surplus excavated material that will be disposed off-site to each class of landfill, unless used for other purposes is shown in Table 9.

Table 9: Quantity of surplus excavated material requiring off-site disposal to landfill (by class of landfill) original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Class of landfill	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes)	Total quantity AP4 revised scheme (tonnes)	Proportion of AP4 revised scheme total
Quantity of surplus excavated material for off-site disposal to inert waste landfill	3,760,937	11,311,251	12,573,420	93%
Quantity of surplus excavated material for off-site disposal to non-hazardous waste landfill	394,329	439,498	439,498	3%
Quantity of surplus excavated material for off-site disposal to hazardous waste landfill	337,291	469,537	470,078	4%
Total	4,492,557	12,220,287	13,482,996	100%

Surplus excavated material for off-site disposal to inert waste landfill

19.6.14 Table 9 shows that, as in Volume 3 of the main ES, the majority (approximately 93%) of surplus excavated material requiring off-site disposal to landfill for the AP4 revised scheme will be inert in nature. This represents an increase of 9% compared with 84% (3,760,937 tonnes) reported in Volume 3 of the main ES for the original scheme, and an increase of 1% compared with 92% (11,311,251 tonnes) reported in Volume 3 of the SES and AP2 ES for the AP2 revised scheme.

19.6.15 The AP4 revised scheme noticeably increases the overall total quantity of surplus excavated material requiring off-site disposal to landfill by approximately three times (8,990,439 tonnes) compared to the main ES. The AP4 revised scheme shows a 10% (1,262,709 tonne) increase in surplus excavated material requiring off-site disposal to landfill compared to the AP2 revised scheme.

19.6.16 The majority of the increase in surplus excavated material requiring off-site disposal to landfill compared to the main ES, derives from the reduction in volume of SPAs and the lowered vertical alignment around the A38 in CFA22 as reported in the SES and AP2 ES.

19.6.17 Opportunities may arise at the time of construction to provide inert surplus excavated material for off-site reuse in other construction projects, thereby increasing the diversion of this material from landfill.

Surplus excavated material for off-site disposal to non-hazardous waste landfill

- 19.6.18 Surplus excavated material that will require off-site disposal to non-hazardous waste landfill represents the quantity of Unacceptable Class U1B material²³ that will be generated by the AP4 revised scheme and has increased to approximately 439,498 tonnes. This quantity represents an 11% increase when compared to the original scheme (394,329 tonnes), and remains unchanged from the AP2 revised scheme.
- 19.6.19 This material will not be suitable either for reuse within the AP4 revised scheme or sustainable placement (without treatment) due to its chemical properties.

Surplus excavated material for off-site disposal to hazardous waste landfill

- 19.6.20 Surplus excavated material that will require off-site disposal to hazardous waste landfill represents the quantity of Unacceptable Class U2 material²⁴ that will be generated by the AP4 revised scheme, which has increased to approximately 470,078 tonnes. This quantity represents a 39% increase when compared to the original scheme (337,291 tonnes) and a 0.1% increase when compared to the AP2 revised scheme (469,537 tonnes).
- 19.6.21 Unacceptable Class U2 material will be unsuitable for reuse within the AP4 revised scheme and for sustainable placement due to its hazardous nature.

Demolition material and waste quantities

- 19.6.22 Table 10 presents a summary of the forecast demolition material and waste quantities for the AP4 revised scheme. A regional and route-wide summary is shown to indicate where along the route demolition materials will be generated and managed²⁵. A detailed demolition material and waste quantity forecast is provided in Appendix WM-001-000 Annex 1 (Volume 5 of this SES3 and AP4 ES).
- 19.6.23 The AP4 revised scheme will generate approximately 1,727,876 tonnes of demolition material during the overall construction period from 2017 to 2025. This represents an 8% (126,135 tonne) increase on the quantities reported for the original scheme, and a 2% (31,082 tonne) increase on the quantities reported for the AP2 revised scheme.

²³ Unacceptable material Class U1B is 'chemically' unsuitable as defined in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 2(ii)(a); http://www.standardsforhighways.co.uk/mchw/vol1/pdfs/series_o600.pdf; Accessed 04 September 15.

²⁴ Unacceptable material Class U2 'hazardous waste', as described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i); http://www.standardsforhighways.co.uk/mchw/vol1/pdfs/series_o600.pdf; Accessed 04 September 15.

²⁵ It has been assumed that demolition materials will be largely managed within the region in which they will be generated.

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Table 10: Forecast demolition material and waste quantities (by region) for the original scheme, AP₂ revised scheme and AP₄ revised scheme, 2017 to 2025

Regional area	Total quantity original scheme (tonnes)	Total quantity AP ₂ revised scheme (tonnes)	Total quantity AP ₄ revised scheme (tonnes)	Quantity diverted from landfill original scheme (tonnes)	Quantity diverted from landfill AP ₂ revised scheme (tonnes)	Quantity diverted from landfill AP ₄ revised scheme (tonnes)	Quantity for off-site disposal to landfill original scheme (tonnes)	Quantity for off-site disposal to landfill AP ₂ revised scheme (tonnes)	Quantity for off-site disposal to landfill AP ₄ revised scheme (tonnes)
Greater London	601,112	692,464	722,610	541,001	623,218	650,349	60,111	69,246	72,261
South East	74,510	77,010	70,354	67,059	69,309	63,318	7,451	7,701	7,035
East of England	2,478	2,478	2,217	2,230	2,230	1,996	248	248	222
East Midlands	44,308	44,451	44,416	39,877	40,006	39,974	4,431	4,445	4,442
West Midlands	879,333	880,391	888,279	791,399	792,352	799,451	87,934	88,039	88,828
Total	1,601,741	1,696,794	1,727,876	1,441,566	1,527,114	1,555,088	160,175	169,679	172,788

19.6.24 The quantity of demolition material that will be diverted from landfill via reuse, recycling and recovery is based on a landfill diversion rate of 90%, as stated in Volume 3 of the main ES.

19.6.25 It has been assumed, as a reasonable worst-case scenario for the purpose of this assessment, that the remaining 10% of demolition material that will be generated will be disposed of off-site to landfill. The quantity of demolition waste that will require off-site disposal to landfill during the overall construction period of 2017 to 2025 will be approximately 172,788 tonnes. The class of landfill to which demolition waste will be sent for disposal is shown in Table 11.

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Table 11: Quantity of demolition waste requiring off-site disposal to landfill (by class of landfill), original scheme, AP₂ revised scheme and AP₄ revised scheme, 2017 to 2025

Class of landfill	Total Quantity original scheme (tonnes)	Total quantity AP ₂ revised scheme (tonnes)	Total quantity AP ₄ revised scheme (tonnes)	Proportion of AP ₄ revised scheme total
Quantity of demolition waste for off-site disposal to inert waste landfill	0	0	0	0%
Quantity of demolition waste for off-site disposal to non-hazardous waste landfill	96,105	101,808	103,673	60%
Quantity of demolition waste for off-site disposal to hazardous waste landfill	64,070	67,872	69,115	40%
Total	160,175	169,679	172,788	100%

- 19.6.26 For the purpose of this assessment, it has been assumed that 60% of the quantity of demolition waste requiring off-site disposal to landfill will be non-hazardous waste and 40% will be hazardous waste, as stated in Volume 3 of the main ES.

Construction waste quantities

- 19.6.27 Table 12 presents a summary of the forecast construction waste quantities for the AP₄ revised scheme. A regional and route-wide summary is shown to provide an indication of where along the route construction waste will be generated and managed²⁶. A detailed construction waste quantity forecast is provided in Appendix WM-001-000 (Volume 5 of this SES₃ and AP₄ ES).
- 19.6.28 Using the waste forecast methodology described in Volume 3 of the main ES, the AP₄ revised scheme will generate approximately 3,084,948 tonnes of construction waste during the overall construction period of 2017 to 2025. This represents an approximately 13% (357,130 tonne) increase over the quantity reported for the original scheme in Volume 3 of the main ES, and a 7% (202,897 tonne) increase over the quantity reported for the AP₂ revised scheme in Volume 3 of the SES and AP₂ ES.
- 19.6.29 The majority of the increase in the forecast of construction waste to be generated between the AP₂ revised scheme and the AP₄ revised scheme (approximately 87%) can be attributed to the revised design of the Euston station and approaches, which was assessed in the SES₂ and AP₃ ES.

²⁶ It has been assumed that construction waste will be largely managed within the region in which it will be generated.

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Table 12: Forecast construction waste quantities (by region) original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Regional area	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes)	Total quantity AP4 revised scheme (tonnes)	Quantity diverted from landfill original scheme (tonnes)	Quantity diverted from landfill AP2 revised scheme (tonnes)	Quantity diverted from landfill AP4 revised scheme (tonnes)	Quantity for off-site disposal to landfill original scheme (tonnes)	Quantity for off-site disposal to landfill AP2 revised scheme (tonnes)	Quantity for off-site disposal to landfill AP4 revised scheme (tonnes)
Greater London	1,315,930	1,388,482	1,525,649	1,184,337	1,249,633	1,373,085	131,593	138,848	152,565
South East	470,119	491,067	506,448	423,107	441,960	455,803	47,102	49,107	50,645
East of England	15,035	112	14,891	13,531	101	13,402	1,504	11	1,489
East Midlands	126,292	114,056	128,825	113,663	102,650	115,943	12,629	11,406	12,883
West Midlands	800,442	888,334	909,134	720,398	799,501	818,221	80,044	88,833	90,913
Total	2,727,818	2,882,051	3,084,948 ²⁷	2,455,036	2,593,845	2,776,453 ²⁷	272,782	288,205	308,495

- 19.6.30 The quantity of construction waste that will be diverted from landfill via reuse, recycling and recovery is based on a landfill diversion rate of 90%, as stated in Volume 3 of the main ES.
- 19.6.31 It has been assumed, as a reasonable worst-case scenario for the purpose of this assessment that the remaining 10% of construction waste that will be generated will be disposed of off-site to landfill. The quantity of construction waste that will require off-site disposal to landfill during the overall construction period of 2017 to 2025 will be approximately 308,495 tonnes.
- 19.6.32 It has been assumed for the purpose of this assessment that all of the construction waste requiring off-site disposal to landfill will be sent to non-hazardous waste landfill, as stated in Volume 3 of the main ES.

Worker accommodation site waste

- 19.6.33 Table 13 presents a summary of the forecast worker accommodation site waste quantities for the AP4 revised scheme. A regional and route-wide summary is shown to provide an indication of where along the route worker accommodation site waste will be generated and managed²⁸. A detailed worker accommodation site waste

²⁷ Numbers may not sum to totals due to rounding.

²⁸ It has been assumed that worker accommodation site waste will be largely managed within the region in which it will be generated.

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quantity forecast is provided in the Appendix WM-001-000 Annex 1 (Volume 5 of this SES3 and AP4 ES).

- 19.6.34 Using the waste forecast methodology described in the main ES, the AP4 revised scheme will generate approximately 1,792 tonnes of worker accommodation site waste during the overall construction period of 2017 to 2025. Worker accommodation site waste will be managed as C&I waste. This represents approximately a 7% (125 tonne) decrease in waste compared with the quantity reported for the original scheme in Volume 3 of the main ES, and a 5% (94 tonne) decrease in waste compared with the quantity reported for the AP2 revised scheme in Volume 3 of the SES and AP2 ES.

Table 13: Forecast worker accommodation site waste quantities (by region) original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Regional area	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes)	Total quantity AP4 revised scheme (tonnes)	Quantity diverted from landfill original scheme (tonnes)	Quantity diverted from landfill AP2 revised scheme (tonnes)	Quantity diverted from landfill AP4 revised scheme (tonnes)	Quantity for off-site disposal to landfill original scheme (tonnes)	Quantity for off-site disposal to landfill AP2 revised scheme (tonnes)	Quantity for off-site disposal to landfill AP4 revised scheme (tonnes)
Greater London	134	134	127	67	67	64	67	67	64
South East	708	708	621	354	354	310	354	354	310
East of England	71	71	67	36	36	33	35	36	33
East Midlands	281	281	276	140	141	138	141	141	138
West Midlands	723	692	701	361	346	350	362	346	350
Total	1,917	1,886	1,792	958	943	896	959	943	896

- 19.6.35 The quantity of worker accommodation site waste that will be diverted from landfill via re-use, recycling and recovery is based on a landfill diversion rate of 50%. Waste generated by occupants of worker accommodation sites will be similar in composition to household waste. As such, this rate has been selected based on a review undertaken in the preparation of the main ES, of national household waste targets for England and Wales and took into account the most recently published performance data for household waste and local authority collected waste in England (i.e. for the year 2011/12).
- 19.6.36 It has been assumed, as a reasonable worst-case scenario for the purpose of this assessment that the remaining 50% of worker accommodation site waste will be disposed of off-site to landfill. The quantity of worker accommodation site waste that

will require off-site disposal to landfill during the overall construction period of 2017 to 2025 will be approximately 896 tonnes.

- 19.6.37 It has been assumed for the purpose of this assessment that all of the worker accommodation site waste requiring off-site disposal to landfill will be sent to non-hazardous waste landfill.

Impact of construction on future baseline waste arisings

Construction, demolition and excavation waste

- 19.6.38 Table 14 provides a summary of material and waste quantities that will be generated by excavation, demolition and construction of the AP4 revised scheme during the period 2017 to 2025.

Table 14: Summary of material and waste quantities that will be generated by excavation, demolition and construction of the original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Source		Total quantity of material (tonnes)	Quantity diverted from landfill (tonnes)	Quantity of surplus excavated material for sustainable placement (tonnes)	Quantity for off-site disposal to landfill (tonnes)
Excavation	Original scheme	127,999,096	116,649,579	6,856,960	4,492,557
	AP2 revised scheme	128,385,194	111,235,950	4,928,957	12,220,286
	AP4 revised scheme	130,538,618	112,274,011	4,781,611	13,482,996
Demolition	Original scheme	1,601,741	1,441,566	0	160,175
	AP2 revised scheme	1,696,794	1,527,114	0	169,679
	AP4 revised scheme	1,727,876	1,555,088	0	172,788
Construction	Original scheme	2,727,818	2,455,036	0	272,782
	AP2 revised scheme	2,882,051	2,593,845	0	288,205
	AP4 revised scheme	3,084,948	2,776,453	0	308,495
Total	Original scheme	132,328,655	120,546,181	6,856,960	4,925,514
	AP2 revised scheme	132,964,038	115,356,910	4,928,957	12,678,171
	AP4 revised scheme	135,351,442	116,605,553 ²⁷	4,781,611	13,964,278 ²⁷
Proportion	Original scheme	100%	91%	5%	4%
	AP2 revised scheme	100%	87%	4%	10%

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Source	Total quantity of material (tonnes)	Quantity diverted from landfill (tonnes)	Quantity of surplus excavated material for sustainable placement (tonnes)	Quantity for off-site disposal to landfill (tonnes)
AP ₄ revised scheme	100%	86%	4%	10%

- 19.6.39 Table 14 shows that the AP₄ revised scheme will generate approximately 135,351,442 tonnes of excavated material, demolition material and construction waste during the period 2017 to 2025. This represents an approximately 2% (3,022,787 tonne) increase on the excavated material, demolition material and construction waste reported for the original scheme, and a 1.8% (2,387,404 tonne) increase on the quantity reported for the AP₂ revised scheme.
- 19.6.40 Approximately 86% (116,605,553 tonnes) of the total quantity will be diverted from landfill via re-use, recycling and recovery. This represents approximately a 5% decrease on the percentage reported for the original scheme, and a 1% decrease from that reported for the AP₂ revised scheme.
- 19.6.41 The impact of this material and waste generation and its off-site disposal to landfill is shown in Table 15 as the percentage difference between future baseline CDEW arisings with and without the AP₄ revised scheme.
- 19.6.42 Future baseline CDEW arisings are presented as the total quantity projected to be generated during the period 2017 to 2025. The portion expected to be landfilled is included in the assessment of the future baseline landfill capacity, and is expected to be partially offset by future increases in capacity. This is to provide a direct comparison with the total quantity of excavated material, demolition material and construction waste that will be generated during construction of the AP₄ revised scheme.

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Table 15: Impact of material and waste quantities that will be generated by excavation, demolition and construction of the original scheme, AP₂ revised scheme and AP₄ revised scheme, 2017 to 2025

Future baseline scenario with and without the AP ₄ revised scheme		National		Regional ²⁹	
		CDEW arisings (tonnes)	CDEW arisings to landfill (tonnes)	CDEW arisings (tonnes)	CDEW arisings to landfill (tonnes)
Future baseline waste arisings 2017 to 2025		696,378,870 ³⁰	178,547,319 ³¹	481,410,000 ³²	140,553,000 ³³
Forecast material and waste arisings 2017 to 2025	Original scheme	132,328,655	4,925,514	132,328,655	4,925,514
	AP ₂ revised scheme	132,964,038	12,678,171	132,964,038	12,678,171
	AP ₄ revised scheme	135,351,442	13,964,278	135,351,442	13,964,278
Future baseline waste arisings 2017 to 2025 with the scheme	Original scheme	828,707,525	183,472,833	613,738,655	145,478,514
	AP ₂ revised scheme	829,342,908	191,225,490	614,374,038	153,231,171
	AP ₄ revised scheme	831,730,312	192,511,597	616,761,442	154,517,278
Increase in future baseline waste arisings with the scheme	Original scheme	19%	3%	27%	4%
	AP ₂ revised scheme	19%	7%	28%	9%
	AP ₄ revised scheme	19%	8%	28%	10%

19.6.43 Table 15 shows that the total quantity of excavated material, demolition material and construction waste generated by the AP₄ revised scheme will be equivalent to approximately 19% of national and 28% of regional future baseline CDEW arisings during the period 2017 to 2025. These represent negligible changes from the increases reported for the original scheme.

19.6.44 The total quantity of surplus excavated material, demolition waste and construction waste generated by the AP₄ revised scheme that will require off-site disposal to landfill will be equivalent to approximately 8% of national, and 10% of regional future baseline CDEW arisings to landfill during that time. This represents a 5% increase over the national change reported for the original scheme, and a 1% increase over the national change reported for the AP₂ revised scheme. In addition, it represents a 6% increase over the regional change reported for the original scheme, and a 1% increase over the regional change reported for the AP₂ revised scheme.

²⁹ Based on future baseline CDEW arisings and CDEW to landfill for the aggregated five regions.

³⁰ Based on annual projections of 77,375,430 tonnes nationally as set out in the main ES, Volume 3, Section 14.5.

³¹ Based on an annual projection of 19,838,591 tonnes nationally as set out in the main ES, Volume 3, Section 14.5.

³² Based on an annual projection of 53,490,000 tonnes for the aggregated five regions as set out in the main ES, Volume 3, Section 14.5.

³³ Based on an annual projection of 15,617,000 tonnes for the aggregated five regions as set out in the main ES, Volume 3, Section 14.5.

Worker accommodation site waste

- 19.6.45 The total quantity of worker accommodation site waste that will be generated during the overall construction period of 2017 to 2025 is shown in Table 16 (along with the quantity that will be diverted from landfill via reuse, recycling and recovery and the quantity that will require off-site disposal to landfill).
- 19.6.46 The impact of worker accommodation site waste generation and off-site disposal to landfill is shown in Table 16 as the percentage difference between future baseline C&I waste arisings with and without the AP4 revised scheme.
- 19.6.47 Future baseline C&I waste arisings are presented as the total quantity projected to be generated during the period 2017 to 2025. This is to provide a direct comparison with the total quantity of C&I waste that will be generated during construction of the AP4 revised scheme.

Table 16: Impact of C&I waste arisings generated for the original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Future baseline scenario with and without the AP4 revised scheme		National		Regional ³⁴	
		C&I waste arisings (tonnes)	C&I waste arisings to landfill (tonnes)	C&I waste arisings (tonnes)	C&I waste arisings to landfill (tonnes)
Future baseline waste arisings 2017 to 2025		431,352,000 ³⁵	101,520,000 ³⁶	244,107,000 ³⁷	56,718,000 ³⁸
Forecast material and waste arisings 2017 to 2025	Original scheme	1,917	959	1,917	959
	AP2 revised scheme	1,886	943	1,886	943
	AP4 revised scheme	1,792	896	1,792	896
Future baseline waste arisings 2017 to 2025 with the scheme	Original scheme	431,353,917	101,520,959	244,108,917	56,718,959
	AP2 revised scheme	431,353,886	101,520,943	244,108,886	56,718,943
	AP4 revised scheme	431,353,792	101,520,896	244,108,792	56,718,896
Increase in future baseline waste arisings with the scheme	Original scheme	0.00%	0.00%	0.00%	0.00%
	AP2 revised scheme	0.0004%	0.0009%	0.0008%	0.0017%
	AP4 revised scheme	0.0004%	0.0009%	0.0007%	0.0016%

- 19.6.48 Table 16 shows that the total quantity of worker accommodation site waste generated by the AP4 revised scheme will be equivalent to less than 0.1% of national and regional future baseline C&I waste arisings during the period 2017 to 2025. These

³⁴ Based on future baseline C&I waste arisings and C&I waste to landfill for the aggregated five regions.

³⁵ Based on an annual projection of 47,928,000 tonnes nationally as set out in the main ES, Volume 3, Section 14.5.

³⁶ Based on an annual projection of 11,280,000 tonnes nationally as set out in the main ES, Volume 3, Section 14.5.

³⁷ Based on an annual projection of 27,123,000 tonnes for the aggregated five regions as set out in the main ES, Volume 3, Section 14.5.

³⁸ Based on an annual projection of 6,302,000 tonnes for the aggregated five regions as set out in the main ES, Volume 3, Section 14.5.

represent negligible changes from the increases reported for the original scheme and for the AP2 revised scheme.

- 19.6.49 The total quantity of worker accommodation site waste that will require off-site disposal to landfill will be equivalent to less than 0.1% of national and regional future baseline C&I waste arisings to landfill during that time. These represent negligible changes from the increases reported for the original scheme and for the AP2 revised scheme.

Likely significant environmental effects

Inert waste landfill capacity

- 19.6.50 Subject to waste acceptance criteria set out in the Landfill Directive³⁹ and the Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills⁴⁰, the total quantity of inert waste (i.e. surplus excavated material) that will require off-site disposal to landfill during the construction period 2017 to 2025 is approximately 12,573,420 tonnes (see Table 17). This represents an increase of approximately three times (8,812,483 tonnes) the quantity reported for the original scheme, and an increase of 11% (1,262,169 tonnes) over the quantity reported for the AP2 revised scheme. Inert waste will account for approximately 90% of the total CDEW requiring off-site disposal to landfill.

Table 17: Quantity of waste requiring off-site disposal to inert waste landfill for the original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Waste source	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes)	Total quantity AP4 revised scheme (tonnes)	Proportion of AP4 revised scheme quantity
Excavation	3,760,937	11,311,251	12,573,420	100%
Demolition	0	0	0	0%
Construction	0	0	0	0%
Worker accommodation sites	0	0	0	0%
Total	3,760,937	11,311,251	12,573,420	100%

- 19.6.51 Off-site disposal of inert surplus excavated material to landfill will result in an overall reduction of inert waste landfill capacity of 12,573,420 tonnes throughout the nine-year construction period.

³⁹ Council of the European Union; *Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:NOT>; Accessed 6 May 2015.

⁴⁰ Commission of the European Communities; *Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills Pursuant to Article 16 and Annex II of Directive 1999/31/EC on the Landfill of Waste (COM/2002/0512 Final)*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52002PC0512:EN:NOT>; Accessed 6 May 2015.

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- 19.6.52 This will be equivalent to an 11% reduction in inert waste landfill capacity across the aggregated five regions according to the amount of capacity projected to be available at the end of construction in 2025 (approximately 119 million tonnes)⁴¹.
- 19.6.53 Further to this, Table 18 shows that the majority (approximately 97%) of inert surplus excavated material will be disposed off-site to inert waste landfill in the South East.

Table 18: Locations (by regional and local area) for the off-site disposal to landfill of inert surplus excavated material, 2017 to 2025

Regional area for off-site disposal to landfill	Local area for off-site disposal to landfill	Quantity (tonnes)	Proportion
Greater London	N/A	0.00	0%
South East	Surrey, Buckinghamshire	12,143,374	97%
East of England	Hertfordshire	0.00	0%
East Midlands	Northamptonshire	430,046	3%
West Midlands	Warwickshire	0.00	0%
Total	-	12,573,420	100%

- 19.6.54 On this basis, it is considered that there will be sufficient inert waste landfill capacity available in the aggregated five regions to accept the forecast quantity of inert surplus excavated material for off-site disposal to landfill.
- 19.6.55 Furthermore, the draw-down of inert waste landfill capacity as a result of the AP₄ revised scheme will occur over a period of several years, starting initially with enabling works followed by earthworks such as tunnelling. It is unlikely that the AP₄ revised scheme will draw-down projected capacity to an extent where there is an immediate, significant need for additional inert waste landfill capacity to be made available in the aggregated five regions.
- 19.6.56 As reported for the AP₂ revised scheme in Volume 3 of the SES and AP₂ ES, the constant rate of surplus excavated material generation has been assumed for the five year period of the earthworks construction phase instead of the entire nine year construction phase assumed in Volume 3 of the main ES. The total quantity of inert surplus excavated material requiring off-site disposal to landfill will be approximately 2,514,684 tonnes per annum. This constitutes an increase of 2,096,802 tonnes over the quantity reported for the original scheme (i.e. 417,882 tonnes per annum), and an increase of 252,434 tonnes over the quantity reported for the AP₂ revised scheme (i.e. 2,262,250 tonnes per annum).
- 19.6.57 Significance criteria for inert waste landfill capacity, appended to Section 16 of the SMR Addendum (Volume 5: Appendix CT-001-000/2 of the main ES)⁴², state that a regional-scale reduction in inert waste landfill capacity of between 2,000,000 to

⁴¹ Figure 1 in Section 19.5 of Volume 3 of the AP₂ ES shows that by the end of the construction period in 2025, there will be approximately 119 million tonnes of inert waste landfill capacity remaining in the aggregated five regions through which the AP₄ revised scheme will pass.

⁴² Rationale for landfill significance criteria technical note appended to Section 16 of HS₂ Ltd (November 2013) Scope and methodology report addendum (CT-001-000/2), issued as part of Volume 5 of the main ES.

10,000,000 tonnes per annum may be judged to be important in the regional planning context, for example, where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.

- 19.6.58 In accordance with these significance criteria, the likely significant environmental effects associated with the off-site disposal to landfill of inert surplus excavated material generated by construction of the AP4 revised scheme is expected to be moderate adverse, this increases from a minor adverse assessment for the original scheme in Volume 3 of the main ES, and remains unchanged from the moderate adverse assessment for the AP2 revised scheme in Volume 3 of the SES and AP2 ES.

Non-hazardous waste landfill capacity

- 19.6.59 Subject to waste acceptance criteria set out in the Landfill Directive⁴³ and the Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills, the total quantity of non-hazardous waste that will require off-site disposal to landfill during the construction period 2017 to 2025 is approximately 852,562 tonnes (see Table 19). This represents an increase of 11.6% (88,387 tonnes) over the quantity reported for the original scheme in Volume 3 of the main ES, and an increase of 2.7% (22,108 tonnes) over the quantity reported for the AP2 revised scheme in Volume 3 of the SES and AP2 ES.
- 19.6.60 The majority (approximately 52%) will comprise of surplus excavated material of Unacceptable Class U1B material. Other quantities of non-hazardous waste will be generated by demolition and construction activities and by occupants of worker accommodation sites.

Table 19: Quantity of waste requiring off-site disposal to non-hazardous waste landfill for the original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Waste source	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes)	Total quantity AP4 revised scheme (tonnes)	Proportion of AP2 revised scheme quantity
Excavation	394,329	439,498	439,498	52%
Demolition	96,105	101,808	103,673	12%
Construction	272,782	288,205	308,495	36%
Worker accommodation sites	959	943	896	0%
Total	764,175	830,454	852,562	100%

⁴³ Council of the European Union; Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:NOT>; Accessed 6 May 2015.

- 19.6.61 Off-site disposal of non-hazardous surplus excavated material, demolition, construction and worker accommodation site waste will result in an overall reduction of non-hazardous waste landfill capacity of 852,562 tonnes throughout the nine-year construction period.
- 19.6.62 This will be equivalent to a 0.8% reduction in non-hazardous waste landfill capacity across the aggregated five regions according to the amount of capacity projected to be available at the end of construction in 2025 (approximately 104 million tonnes)⁴⁴.
- 19.6.63 On this basis, it is considered that there will be sufficient non-hazardous waste landfill capacity available in the aggregated five regions to accept the forecast quantity of non-hazardous surplus excavated material, demolition, construction and worker accommodation site waste for off-site disposal to landfill.
- 19.6.64 Table 19 shows that non-hazardous waste will be generated by a range of construction activities that will occur throughout the nine-year duration of construction of the AP₄ revised scheme. As such, the nine-year period will be assumed in this case instead of the five-year period assumed for inert waste landfill capacity assessed above.
- 19.6.65 Consequently, the draw-down of non-hazardous waste landfill capacity as a result of the AP₄ revised scheme will occur over a period of several years and is unlikely to draw-down projected capacity to an extent where there is an immediate, substantial need for additional non-hazardous waste landfill capacity to be made available in these areas.
- 19.6.66 Assuming a fairly constant rate of waste generation throughout the nine-year construction period, the total quantity of non-hazardous waste requiring off-site disposal to landfill will be approximately 94,729 tonnes per annum, an increase of approximately 12% over the quantity reported for the original scheme (84,908 tonnes per annum), and an increase of approximately 3% over the quantity reported for the AP₂ revised scheme (92,273 tonnes per annum).
- 19.6.67 Significance criteria for non-hazardous waste landfill capacity, which is appended to Section 16 of the SMR Addendum (Volume 5: Appendix CT-001-000/2 of the main ES)⁴⁵, state that a regional-scale reduction in non-hazardous waste landfill capacity of between 50,000 tonnes and 250,000 tonnes per annum may be judged to be important in the regional planning context.
- 19.6.68 According to the significance criteria applicable to non-hazardous waste landfill capacity, the likely significant environmental effects associated with the off-site disposal to landfill of non-hazardous surplus excavated material, construction, demolition and worker accommodation site waste generated by the AP₄ revised scheme, remain unchanged from the assessment of the original scheme and the AP₂ revised scheme, and will be moderate adverse.

⁴⁴ Figure 2 in Section 19.5 of Volume 3 of the SES and AP₂ ES shows that by the end of the construction period in 2025, there will be approximately 104 million tonnes of non-hazardous waste landfill capacity remaining in the aggregated five regions through which the AP₄ revised scheme will pass.

⁴⁵ Rationale for landfill significance criteria technical note appended to Section 16 of HS₂ Ltd (November 2013) Scope and methodology report addendum (CT-001-000/2), issued as part of Volume 5 of the main ES.

Hazardous waste landfill capacity

19.6.69 Subject to waste acceptance criteria set out in the Landfill Directive⁴⁶ and the *Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills*⁴⁷, the total quantity of hazardous waste requiring off-site disposal to landfill during the construction period 2017 to 2025 is approximately 539,193 tonnes (see Table 20). This represents an increase of 34% (137,832 tonnes) over the quantity reported for the original scheme, and an increase of 0.3% (1,784 tonnes) over the quantity reported for the AP2 revised scheme.

Table 20: Quantity of waste requiring off-site disposal to hazardous waste landfill for the original scheme, AP2 revised scheme and AP4 revised scheme, 2017 to 2025

Waste source	Total quantity original scheme (tonnes)	Total quantity AP2 revised scheme (tonnes)	Total quantity AP4 revised scheme (tonnes)	Proportion of AP2 revised scheme quantity
Excavation	337,291	469,537	470,078	87%
Demolition	64,070	67,872	69,115	13%
Construction	0	0	0	0%
Worker accommodation sites	0	0	0	0%
Total	401,361	537,409	539,193	100%

19.6.70 Off-site disposal of hazardous surplus excavated material and demolition waste will result in an overall reduction of hazardous waste landfill capacity of 539,193 tonnes throughout the nine-year construction period.

19.6.71 This will be equivalent to a 49% reduction in hazardous waste landfill capacity across the aggregated five regions according to the amount of capacity projected to be available at the end of construction in 2025 (approximately 1.1 million tonnes)⁴⁸.

19.6.72 Table 20 shows that the majority (approximately 87%) of the hazardous waste landfill capacity requirement will be for hazardous surplus excavated material (i.e. Unacceptable Material Class U2) requiring off-site disposal to landfill (approximately 470,078 tonnes).

19.6.73 As a conservative assumption, the hazardous waste will be generated predominantly within the first two years of construction (i.e. 2017 and 2018) associated with excavation and management of contaminated land, and will thus be equivalent to a 25% reduction in hazardous waste landfill capacity across the aggregated five regions according to the amount of capacity projected to be available at the end of 2018 (approximately 1.9 million tonnes).

⁴⁶ Council of the European Union; *Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:NOT>; Accessed 6 May 2015.

⁴⁷ Commission of the European Communities; *Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills Pursuant to Article 16 and Annex II of Directive 1999/31/EC on the Landfill of Waste (COM/2002/0512 Final)*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52002PC0512:EN:NOT>; Accessed 6 May 2015.

⁴⁸ Figure 3 in Section 19.5 of Volume 3 of the SES and AP2 ES shows that by the end of the construction period in 2025, there will be approximately 1.1 million tonnes of hazardous waste landfill capacity remaining in the aggregated five regions through which the AP4 revised scheme will pass.

- 19.6.74 Hazardous surplus excavated material will be generated predominantly in the South East (approximately 306,215 tonnes, or 65% of all hazardous surplus excavated material generated)⁴⁹ and the West Midlands (approximately 115,151 tonnes, or 24% of all hazardous surplus excavated material generated)⁵⁰, where the majority of hazardous waste landfill capacity is projected to be available.
- 19.6.75 Significance criteria for hazardous waste landfill capacity, which is appended to Section 16 of the SMR Addendum (Volume 5: Appendix CT-001-000/2 of the main ES)⁵¹, state that a regional-scale reduction in hazardous waste landfill capacity of between 20,000 tonnes and 100,000 tonnes per annum may be judged to be important in the regional planning context.
- 19.6.76 According to the significance criteria applicable to hazardous waste landfill capacity, the likely significant environmental effects associated with the off-site disposal to landfill of hazardous surplus excavated material and demolition waste generated by the AP4 revised scheme, remain unchanged from the assessments of the original scheme and AP2 revised scheme, and will be major adverse.

Other mitigation measures

- 19.6.77 The other mitigation measures described in Volume 3 of the main ES remain applicable to the AP4 revised scheme.
- 19.6.78 As shown in Table 21, excavation and earthworks activities will be responsible for the majority (97%) of waste requiring off-site disposal to landfill. Of this quantity, approximately 12,573,420 tonnes (or 93% of the total quantity of surplus excavated material requiring off-site disposal to landfill – see Table 9) will be inert in nature. This represents the greatest opportunity for further diversion from landfill through provision for use in other construction projects.
- 19.6.79 Work is being undertaken to identify opportunities for the beneficial off-site reuse of surplus excavated material (e.g. flood protection schemes) with the aim of achieving a landfill diversion rate of 90% for excavated material.

⁴⁹ 164,639 at HEx depot Langley off-route, 22,163 tonnes in CFA11 (Stoke Mandeville and Aylesbury), 14,772 tonnes in CFA13 (Calvert, Steeple Claydon, Twyford and Chetwode) and 104,640 tonnes in CFA14 (Newton Purcell to Brackley - South East region only).

⁵⁰ 1,593 tonnes in CFA23 (Balsall Common and Hampden-in-Arden), 2,372 tonnes in CFA24 (Birmingham Interchange and Chelmsley Wood), 2,126 tonnes in CFA25 (Castle Bromwich and Bromford) and 108,445 tonnes in CFA26 (Washwood Heath to Curzon Street).

⁵¹ Rationale for landfill significance criteria technical note appended to Section 16 of HS2 Ltd (November 2013) Scope and methodology report addendum (CT-001-000/2), issued as part of Volume 5 of the main ES.

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Table 21: Quantity of waste for off-site disposal to landfill by waste type for the original scheme, AP₂ revised scheme and AP₄ revised scheme, 2017 to 2025

Waste source	Quantity for off-site disposal to landfill original scheme (tonnes)	Quantity for off-site disposal to landfill AP ₂ revised scheme (tonnes)	Quantity for off-site disposal to landfill AP ₄ revised scheme (tonnes)	Proportion of AP ₄ revised scheme quantity
Excavation	4,492,557	12,220,286	13,482,996	97%
Demolition	160,175	169,679	172,788	1%
Construction	272,782	288,205	308,495	2%
Worker accommodation sites	959	943	896	0%
Total	4,926,473	12,679,114	13,965,174	100%

- 19.6.80 In some local areas along the route of the AP₄ revised scheme⁵², the use of inert surplus excavated material is also favoured by waste planning authorities for restoration purposes, for example, to restore landfill sites and former mineral workings. Whilst still classed as a landfill disposal activity, this is likely to provide further opportunities for the off-site management of inert surplus excavated material.
- 19.6.81 Some of the non-hazardous waste generated by the construction of the AP₄ revised scheme will also be suitable for energy recovery (i.e. incineration). This will reduce reliance on non-hazardous waste landfill capacity.
- 19.6.82 A reasonable worst-case approach has been taken in determining the quantity of hazardous waste for off-site disposal to landfill. However, detailed chemical sampling and laboratory analysis, as part of future ground investigation works, may allow the hazardous waste to be reclassified as non-hazardous waste. This will reduce reliance on hazardous waste landfill capacity.
- 19.6.83 It is likely that a large proportion of the hazardous demolition waste and hazardous surplus excavated material will comprise asbestos containing materials. This material could be disposed of at non-hazardous landfill sites within a separate cell for Stable Non-reactive Hazardous Waste (SNRHW)⁵³ provided it meets SNRHW acceptance criteria in accordance with the Landfill Directive⁵⁴, and the Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills. This will reduce reliance on hazardous waste landfill capacity and will reduce the likely significant effect associated with the off-site disposal to landfill of hazardous

⁵² For example, Policy 1.3 (Construction, Demolition and Excavation Waste) of the *Staffordshire and Stoke-on-Trent Local Waste Plan 2010-2026* favours the use of inert waste for restoration purposes.

⁵³ A non-hazardous waste landfill with a SNRHW cell allows for hazardous waste that has been stabilised and thus has a low leaching potential to be deposited in cells with a standard of containment consistent with non-hazardous wastes and in accordance with Council Decision 2003/33/EC (Council Decision of 19 December 2002 Establishing Criteria and Procedures for the Acceptance of Waste at Landfills Pursuant to Article 16 of Annex II to Directive 1999/31/EC). For further details, see Environment Agency; *Waste Acceptance at Landfills: Guidance on Waste Acceptance Procedures and Criteria*, November 2010; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296422/geho1110btew-e-e.pdf; Accessed 6 May 2015.

⁵⁴ Council of the European Union; *Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:NOT>; Accessed 6 May 2015.

surplus excavated material and demolition waste generated by the AP4 revised scheme, from major adverse to moderate adverse.

Summary of likely residual significant effects

- 19.6.84 On the basis of the other mitigation measures proposed, the likely residual significant effects from construction will be:
- minor adverse in relation to inert waste landfill capacity;
 - moderate adverse in relation to non-hazardous waste landfill capacity; and
 - moderate adverse in relation to hazardous waste landfill capacity.

Cumulative effects

General

- 19.6.85 A qualitative assessment has been undertaken to establish the cumulative effects associated with the off-site disposal to landfill of solid waste that will be generated by the construction of the AP4 revised scheme and other developments along its route.
- 19.6.86 The cumulative effects assessment takes into account developments that are assumed to be delivered at the same time as the construction of the AP4 revised scheme (i.e. 2017 to 2025), as they will have a simultaneous requirement for landfill disposal capacity of solid waste. A list of developments that have been taken into account in the cumulative effects assessment is provided in Appendix WM-002-000 (Volume 5 of this SES3 and AP4 ES).
- 19.6.87 The majority of the committed developments are of insufficient scale to result in significant cumulative effects. However, three developments (Thames Tideway Tunnel, Crossrail 1 and the Northern Line Extension) were identified in Volume 3 of the SES and AP2 ES, which remain committed and are of potential significance in terms of activities and scale. The nature and scale of these significant committed developments remains unchanged from the description reported in Section 19.6 of Volume 3 of the SES and AP2 ES.

Cumulative assessment

- 19.6.88 Considering the potential for waste generation, opportunities to divert waste from landfill and the amount of inert, non-hazardous and hazardous waste landfill capacity projected to be available in the aggregated five regions at the end of construction in 2025⁵⁵, it has been assessed that the cumulative effects, without mitigation measures applied to the major schemes identified, are as set out below:
- moderate adverse in relation to inert waste landfill capacity;
 - moderate adverse in relation to non-hazardous waste landfill capacity; and
 - major adverse in relation to hazardous waste landfill capacity.
- 19.6.89 Mitigation measures provided for these major schemes will reduce the magnitude of the cumulative effects.

⁵⁵ Approximately 119 million tonnes of inert waste landfill, 105 million tonnes of non-hazardous waste landfill and 1.1 million tonnes of hazardous landfill.

19.7 Assessment of effects during operation

- 19.7.1 The operation of the AP₄ revised scheme will not give rise to new or different significant environmental route-wide effects during operation.

20 Water resources and flood risk assessment

20.1 Introduction

- 20.1.1 Volume 3 of the main ES presented the significant route-wide effects on surface water and groundwater resources and flood risk. It concluded that, with the exception of the Mid-Chilterns Chalk groundwater body, there are no likely significant regional or route-wide, temporary or permanent adverse effects on water resources and flood risk as a result of the construction process or the operation and maintenance of the original scheme. Section 10 in Part 1 of this volume reports that the SES₃ design changes would not generate any new or different significant route-wide effects on water resources and flood risk.
- 20.1.2 Volume 3 of the main ES also included a route-wide WFD compliance assessment for the water bodies potentially affected by the original scheme. The main ES route-wide WFD compliance assessment concluded that, whilst there are potential risks of deterioration, with further development of avoidance measures and generic mitigation through detailed design, there would be no breach in WFD objectives as a result of the original scheme. Section 10 in Part 1 of this volume reports that there would be no breach of the WFD as a result of the SES₃ design changes.

20.2 Changes to the assessment of effects

- 20.2.1 A scoping exercise determined that the AP₄ amendments did not have the potential to give rise to new or different significant route-wide effects in terms of water resources and flood risk. The scoping exercise, however, did determine that there was potential for the AP₄ amendments to impact on WFD compliance. The focus of the AP₄ revised scheme assessment is therefore on WFD compliance and the details of the assessment are reported in Volume 5 Appendix WR-001-000 of the SES₃ and AP₄ ES.

Change in potential risks to water body status

Surface water

- 20.2.2 There are ten AP₄ amendments that have the potential to affect eight surface water bodies. All of these water bodies would have been potentially affected by the original scheme and the subsequent SES schemes and AP revised schemes.
- 20.2.3 All of the eight surface water bodies potentially affected by AP₄ amendments remain at the same overall level of risk of deterioration as for the SES and AP₂ ES: three remain at amber risk (adverse widespread or prolonged potential effect); three remain at yellow risk (localised/temporary adverse effect); one at green (no impact), and one at blue (minor/localised beneficial).

- 20.2.4 The assessment of the AP₄ revised scheme concluded that there is no change in the conclusion that there will be no breach in WFD objectives.

Groundwater

- 20.2.5 There are seven AP₄ amendments that have the potential to affect five groundwater bodies. All of these groundwater bodies would be potentially affected by the original scheme and subsequent SES schemes and AP revised schemes.
- 20.2.6 There are no changes to the risks assessed for the five groundwater bodies potentially affected by the AP₄ revised scheme in comparison to the original scheme, SES scheme, AP₂ revised scheme and SES₃ scheme and therefore there is no change to the conclusion in the main ES that there will be no breach in WFD compliance as a result of the AP₄ revised scheme.

WFD Compliance

- 20.2.7 As stated in the Volume 3 of the main ES and the SES and AP₂ ES, the WFD assessment has been undertaken on a precautionary basis given that the baseline data was not available for all the affected water bodies and tributaries, and that the design of mitigation measures is at an outline stage.
- 20.2.8 The WFD assessment provides an indication of the likely compliance of the scheme at the time the assessment was prepared. It is based on the AP₄ revised scheme design, incorporated mitigation measures and on the current status of 61 surface water bodies and 16 groundwater bodies. The assessment assumes key avoidance and mitigation measures as presented in the main ES are in place such as, ensuring that engineering design retains an adequate 'buffer' around sites, habitats or features of ecological value, sufficient to ensure their continued ecological functionality (see Section 2.5 of Appendix WR-001-000 of the main ES for a full list).
- 20.2.9 The assessment concluded that, as for the original scheme, there will be no breach of the WFD as a result of the AP₄ amendments.

21 Phase One and Phase Two combined impacts

21.1 Introduction

- 21.1.1 Volume 3 of the main ES presented a tabulated summary of the potential total impacts of both Phase One (the original scheme) and Phase Two on a range of environmental receptors. Section 11 in Part 1 of this volume reports that the SES₃ design changes would result in very minor or negligible changes to the figures in the main ES.

21.2 Summary of changes to combined impacts

- 21.2.1 Table 22 presents a summary of the potential total impacts of Phase One (the original scheme, AP₂ revised scheme, AP₃ revised scheme and AP₄ revised schemes) and Phase Two on a range of environmental receptors. Impacts of the Phase One, original scheme, were based on design data and assessments undertaken as part of the main ES or assessments prepared in support of the January 2012 updated AoS Report for

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Phase One⁵⁶. The data for the AP₂, AP₃ and AP₄ revised schemes is taken from the corresponding SES and AP₂ ES, SES₂ and AP₃ ES and SES₃ and AP₄ ES. The Phase Two data is taken from the Phase Two Sustainability Statement⁵⁷.

⁵⁶ Booz & Co. Temple (2012), High Speed Two London to West Midlands Appraisal of Sustainability - Post Consultation Route Refinements.

⁵⁷ Temple ERM (2013), High Speed Rail: Consultation on the route from the West Midlands to Manchester, Leeds and beyond Sustainability Statement Volume 1: main report of the Appraisal of Sustainability.

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Table 22: Combined impacts of Phase One (original scheme, AP₂ revised scheme, AP₃ revised scheme and AP₄ revised scheme) and Phase Two

	Phase One				Phase Two (Phase Two Manchester and Phase Two Leeds)	Overall Total (Phase One AP ₄ revised scheme and Phase Two)
	Original scheme	AP ₂ revised scheme ⁵⁸	AP ₃ revised scheme ⁵⁹	AP ₄ revised scheme ⁶⁰		
Route characteristics (km)						
Total	225.5 ⁶¹	216.0 ⁶²	216.0 ⁶²	216.0 ⁶³	335.2	551.2
At grade	0.1	0 ⁶⁴	0 ⁶⁴	0 ⁶⁴	24.1	24.1
Tunnel	53.4	47.9 ⁶⁴	47.9 ⁶⁴	49.4 ⁶⁴	27.3	76.7
Cutting	73.8	76.0 ⁶⁴	76.0 ⁶⁴	74.7 ⁶⁴	130.9	205.6
Viaduct	18.5	16.4 ⁶⁴	16.4 ⁶⁴	16.3 ⁶⁴	47.0	63.3
Embankment	65.2	62.6 ⁶⁴	62.6 ⁶⁴	62.6 ⁶⁴	105.9	168.5
Property and settlements						
Demolitions (residential)	339 dwellings ^{65,66} (265 buildings)	335 dwellings (248 buildings)	333 dwellings (246 buildings)	326 dwellings (218 buildings)	278	604
Demolitions ⁶⁷ (community)	21 community facilities ⁶⁸	21 ⁶⁹ community facilities	20 community facilities	19 community facilities	4	23
Demolitions (commercial/retail)	404 units (312 buildings) ⁷⁰	408 units (312 buildings)	368 units (295 buildings)	371 units (308 buildings)	227	609
Demolitions (manufacturing/industrial)					11	
Total demolitions	600 buildings ^{71,72}	582 buildings	560 buildings	545 buildings	520	1,065

⁵⁸ The AP₂ revised scheme assumes that the AP₁ amendments have been implemented.

⁵⁹ The AP₃ revised scheme assumes that the AP₁ and AP₂ amendments have been implemented.

⁶⁰ The AP₄ revised scheme assumes that the AP₁, AP₂ and AP₃ amendments have been implemented.

⁶¹ This total includes another 14.5km attributed to retaining walls and stations.

⁶² This total includes another 13.1km attributed to retaining walls and stations. This total includes the removal of the HS₁-HS₂ Link.

⁶³ This total includes another 13.0km attributed to retaining walls and stations. This total includes the removal of the HS₁-HS₂ Link.

⁶⁴ This total includes the removal of the HS₁-HS₂ Link.

⁶⁵ This figure excludes student accommodation at Curzon Street on the basis that this is a commercially operated business for short term lets (and is included as two buildings under commercial/retail demolitions).

⁶⁶ This figure excludes future baseline (i.e. committed residential development not currently completed).

⁶⁷ This total includes the community facilities that are demolished and not re-provided.

⁶⁸ This figure is provided for the number of community resources (i.e. a cluster of buildings providing a single resource is reported as a single demolition). This figure does not include the demolition of buildings which will not prevent the continued operation of a community resource (e.g. outbuildings or other ancillary structures), however these are included under total demolitions.

⁶⁹ Two community facilities are being re-provided: Burton Green Community Hall and Wendover Cricket Ground.

⁷⁰ This figure includes some properties which also provide community resources, e.g. public house, local services.

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	Phase One				Phase Two (Phase Two Manchester and Phase Two Leeds)	Overall Total (Phase One AP4 revised scheme and Phase Two)
	Original scheme	AP2 revised scheme ⁵⁸	AP3 revised scheme ⁵⁹	AP4 revised scheme ⁶⁰		
(including residential)						
Employment and housing						
Permanent jobs created	2,200 ⁷³	2,200 ⁷³	2,200 ⁷³	2,200 ⁷³	1,400	3,100 ⁷⁴
Construction jobs created	14,600 ⁷⁵	14,600 ⁷⁵	14,600 ⁷⁵	14,600 ⁷⁵	10,000	24,600
Jobs supported ⁷⁶	30,000 ⁷⁷	30,000 ⁷⁷	30,000 ⁷⁷	30,000 ⁷⁷	48,700-70,300	78,700-100,300
Houses supported	5,620 ⁷⁷	5,620 ⁷⁷	5,620 ⁷⁷	5,620 ⁷⁷	5,200-7,600	10,820-13,200
Jobs displaced	8,430 ⁷⁸	8,510 ⁷⁹	7,900 ⁸⁰	7,950 ⁸¹	4,800	12,750
Noise						
People affected by noise (WebTAG annoyance) (mitigated scheme)	~623 ⁸²	~623 ⁸²	~556	~541	~1,600 ⁸³	~2,141
People affected by noise (WebTAG annoyance) per km	~2.9 ⁸²	~2.9 ⁸²	~2.8	~2.7	~4.8	~3.9
Landscape						
AONB crossed at	8.9	8.9	8.9	7.6	0	7.6

⁷¹ This total includes the total number of residential, community, commercial/retail/manufacturing/industrial & miscellaneous buildings.

⁷² This number is different to that published in the Phase Two Sustainability Statement (which was based on data in the Draft Environmental Statement) as there have been some changes to the design and more detailed knowledge of other buildings not previously referenced (e.g. outbuildings).

⁷³ Indicative direct operational employment figure which has been estimated to the nearest 100 jobs.

⁷⁴ Figures are not additive as some jobs associated with classic compatible services for Phase One will transfer to Phase Two.

⁷⁵ Number reported as an approximate equivalent of permanent full time construction jobs.

⁷⁶ Figures account for jobs displaced.

⁷⁷ Booz & Co. Temple (2012), *High Speed 2 London to West Midlands Appraisal of Sustainability - Post Consultation Route Refinements*.

⁷⁸ Jobs displaced comprise jobs relocated elsewhere in the UK economy and jobs lost, due to land being acquired for the construction and operation of the original scheme.

⁷⁹ Jobs displaced comprise jobs relocated elsewhere in the UK economy and jobs lost, due to land being acquired for the construction and operation of the AP2 revised scheme.

⁸⁰ Jobs displaced comprise jobs relocated elsewhere in the UK economy and jobs lost, due to land being acquired for the construction and operation of the AP3 revised scheme.

⁸¹ Jobs displaced comprise jobs relocated elsewhere in the UK economy and jobs lost, due to land being acquired for the construction and operation of the AP4 revised scheme.

⁸² The main ES reported that approximately 525 people will be affected by noise due to the original scheme. A number of areas were omitted from this calculation including Euston and the HS1-HS2 Link. The updated figure provided in the table accounts for these omitted areas.

⁸³ Figure rounded in Phase Two Sustainability Statement, July 2013.

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	Phase One				Phase Two (Phase Two Manchester and Phase Two Leeds)	Overall Total (Phase One AP4 revised scheme and Phase Two)
	Original scheme	AP2 revised scheme ⁵⁸	AP3 revised scheme ⁵⁹	AP4 revised scheme ⁶⁰		
surface (km)						
Cultural heritage						
Scheduled Monuments directly affected	1	1	1	1	1	2
Registered Battlefields directly affected	1	1	1	1	0	1
Grade I & II* structures directly affected	1 ⁸⁴	1 ⁸⁴	2 ⁸⁵	2 ⁸⁵	0	2
Grade II structures directly affected	18	18	17 ⁸⁶	17 ⁸⁶	8	25
Registered parks and gardens directly affected	2	2	2	2	0	2
Conservation Areas directly affected	2	2	2	2	8	10
Biodiversity and wildlife						
Natura 2000 sites affected	0	0	0	0	0	0
SSSIs directly affected	2	2	2	3 ⁸⁷	13	16
Habitats of Principal Importance directly affected	41	41	41	41	62	n/a ⁸⁸
Ancient	37 ⁸⁹	37 ⁸⁹	37 ⁸⁹	32 ⁹⁰	14	46

⁸⁴ This comprises the alteration to a curtilage wall to a Grade 1 Listed building.

⁸⁵ This figure includes the removal of the war memorial at Euston Square Gardens that has been re-graded from a Grade II to Grade II* since the submission of the main ES.

⁸⁶ This figure includes the removal of the war memorial at Euston Square Gardens that has been re-graded from a Grade II to Grade II* since the submission of the main ES.

⁸⁷ Additional SSSI affected as a result of the AP4 scheme is the Frays Farm Meadows SSSI.

⁸⁸ Phase One and Phase Two will affect many of the same Habitats of Principal Importance types therefore these figures are not additive.

⁸⁹ Volume 3 of the main ES reported 19 ancient woodland sites were directly affected by the original scheme. Since publication of the main ES, four additional woodlands have been added to the ancient woodland inventory and three additional sites have been identified that were previously

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	Phase One				Phase Two (Phase Two Manchester and Phase Two Leeds)	Overall Total (Phase One AP ₄ revised scheme and Phase Two)
	Original scheme	AP ₂ revised scheme ⁵⁸	AP ₃ revised scheme ⁵⁹	AP ₄ revised scheme ⁶⁰		
Woodlands directly affected						
Water resources and flood risk						
Major rivers diverted	7	8 ⁹¹	8	8	5	13
Route through Flood Zone 3 (km)	12.0	12.0	12.0	12.0	28.5	40.5
Station/depot occupation of Flood Zone 3 (ha)	2.1	2.1	2.1	2.1	23.6	25.7
Cutting or tunnel through SPZ 1 or 2 (km)	8.1	8.1	8.1	6.7	1.7	8.4
Land use resources						
Active landfills crossed	0	0	0	0	5	5
Grade 1 and 2 agricultural land (km)	22.0	22.0	22.0	22.0	50.8	72.8
Waste and material resources						
Excavated material (million m ³)	62.2 ⁹²	62.4 ⁹²	62.6 ⁹²	63.4 ⁹²	29.00	92.4
Concrete (million tonnes)	13.62	13.04 ⁹³	13.04 ⁹⁴	13.04 ⁹⁵	6.77	19.81
Steel (million tonnes)	1.36	1.30 ⁹³	1.30 ⁹⁴	1.30 ⁹⁵	0.73	2.03

considered as a single ancient woodland area. In addition a further 11 woodland sites were identified as likely to be added to the ancient woodland inventory and therefore are assumed to be ancient.

⁹⁰ AP₄ amendments will ensure that no loss of ancient woodland occurs at Mantle's Wood; Sibley's Coppice; Farthing's Wood; Parkhill Wood and Langley Hill Wood.

⁹¹ The additional river diverted as a result of the AP₂ revised scheme from the original scheme is Mare Brook.

⁹² This figure is the total quantity of excavated material that will be generated from the construction of Phase One. This includes excavated material that will be reused in the construction process as well as surplus excavated material that will be made available for use off-site or disposed of on or off-site.

⁹³ This total reflects the reduced length of the AP₂ scheme as a pro-rata of the original scheme.

⁹⁴ This total reflects the reduced length of the AP₃ scheme as a pro-rata of the original scheme.

⁹⁵ This total reflects the reduced length of the AP₄ scheme as a pro-rata of the original scheme.

22 References

Booz & Co. Temple (2012), High Speed 2 London to West Midlands Appraisal of Sustainability - Post Consultation Route Refinements

Commission of the European Communities; *Proposal for a Council Decision Establishing Criteria and Procedures for the Acceptance of Waste at Landfills Pursuant to Article 16 and Annex II of Directive 1999/31/EC on the Landfill of Waste (COM/2002/0512 Final)*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52002PC0512:EN:NOT>; Accessed 6 May 2015.

Council of the European Union; *Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste*; <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:NOT>; Accessed 6 May 2015.

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