HS2

No net loss in biodiversity calculation – methodology and results

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1.1 Background

1.1.1 High Speed Two Limited (HS2 Ltd) is seeking to achieve the goal of Phase 2a (West Midlands to Crewe route) of High Speed Two (HS2) ('the scheme') resulting in no net loss in biodiversity at a route-wide level. Phase One of HS2 was the UK's first infrastructure scheme of national significance to adopt the goal of seeking to achieve no net loss in biodiversity. Phase 2a of HS2 has adopted the same goal.

1.1.2 In order to gauge progress towards its goal of no net loss in consultation with Defra and Natural England, HS2 Ltd developed a modified version of the Defra pilot biodiversity offsetting metric[i] ('the HS2 metric'). The HS2 metric uses habitats as a proxy for considering losses and gains as measured in 'biodiversity units'.

1.1.3 The HS2 metric has not been used to define the level of compensation that has been included in the scheme. The HS2 metric has been used as an 'accounting tool' and applied to the habitats present pre- and post-construction of the scheme to compare the losses and gains in biodiversity units as a consequence of the scheme. This accounting process has been referred to as the 'no net loss calculation'.

1.1.4 The assessment of biodiversity losses and gains using the HS2 metric applies a different set of criteria to those considered within the Environmental Statements (ES) for the scheme, which in line with requirements of the Environmental Impact Assessment (EIA) Regulations focus on the likely significant effects of the scheme. In contrast, the HS2 metric focuses on the overall biodiversity losses and gains in replaceable habitats for the scheme, including those which are not significant even when considered cumulatively. The goal of seeking to achieve no net loss may require the provision of habitat creation above and beyond that required to mitigate the significant effects identified within the ES.

1.1.5 The challenge of realising HS2 Ltd's current biodiversity policy should not be underestimated, particularly in light of the additional commitments made by HS2 Ltd to reduce impacts on the agricultural holdings of affected landowners and land managers. Whilst the National Planning Policy Framework recognises that the planning system should seek to minimise impacts on biodiversity, it also recognises that any development also needs to protect the best and most versatile agricultural land. The use of land for environmental mitigation needs to strike a balance between maximising the mitigation opportunities and minimising the impacts upon valuable agricultural land and/or farming operations. Landowners will frequently petition against environmental mitigation if this is considered to threaten the viability of their

interests and, in those instances, HS2 Ltd may need to reconsider the mitigation proposals.

1.1.6 In January 2016 HS2 Ltd published the interim results of its no net loss in biodiversity calculation for Phase One of HS2. The report included details of minor amendments to the methodology set out in the November 2013 Environmental Statement. Natural England subsequently undertook a review of HS2's Ltd interim report, publishing the results of its review in November 2016[ii] which included a range of recommendations for modifications to the HS2 approach.

1.1.7 HS2 Ltd worked with Natural England to agree a number of changes to the HS2 metric in light of the review recommendations. The no net loss calculation for Phase 2a of HS2 has been undertaken in accordance with the revised metric, which is described in Section 5 of this report and supersedes the methodology described in the Phase 2a Scope and Methodology Report Addendum Technical Note[iii].

1.1.8 In line with a recommendation of the Natural England review, areas of irreplaceable habitat[1] are not included within the calculation. Therefore, all ancient woodland affected by the scheme (both ancient semi-natural woodland and plantation on ancient woodland) has been removed from the HS2 no net loss calculation. Neither ancient woodland affected by the scheme, nor the compensation being provided in response to adverse effects on ancient woodland, generate any biodiversity units in the updated calculation. An area based comparison of ancient woodland losses and associated compensatory measures is reported separately within HS2's ancient woodland strategy[xv].

1.1.9 The outcome of the calculation for Phase 2a of HS2 is at this stage interim, as detailed design of the scheme is yet to be completed. It is anticipated that subsequent iterations of the calculation will be used to track HS2 Ltd's progress towards the goal of seeking to achieve no net loss as the design of the scheme is developed and finalised and the conclusions to this report are developed and implemented.

1.2 Outputs of the current calculation

1.2.1 The no net loss calculation for Phase 2a of HS2 has been undertaken based on the original scheme submitted to Parliament in July 2017, as amended by SES1 and AP1 ES submitted in March 2018 and SES2 and AP2 ES submitted in February 2019 ('the

[1] i.e. those habitats which cannot be adequately recreated when lost, as opposed to replaceable habitats which are those that can be adequately recreated within compensatory habitat creation. The only instances of habitat loss within Phase 2a of HS2 which HS2 Ltd considers to be irreplaceable relate to ancient woodland.

Scheme') and relevant Undertakings and Assurances on the HS2 Undertakings and Assurances register as published in July 2018.

1.2.2 The HS2 metric calculates losses and gains in replaceable habitats for most habitats as area based features (measured in 'area based biodiversity units'), and as linear features for hedgerows and watercourses (measured in 'hedgerow biodiversity units' and 'watercourse biodiversity units' respectively). The no net loss calculation for replaceable habitats, therefore, results in three separate conclusions, one for area based features, one for hedgerow linear based calculations, and one for the watercourse linear based calculations.

1.2.3 At the route wide level for area based features the no net loss calculation for replaceable habitats suggest that the scheme will result in approximately a 17% reduction (approximately 1342 units) in the number of area-based biodiversity units generated by replaceable habitats post-construction.

1.2.4 For linear features the calculation currently indicates a significant reduction[2] in watercourse biodiversity units (approximately 38%) and a significant gain in hedgerow biodiversity units post-construction (approximately 20%).

1.2.5 For high distinctiveness grasslands and moderate and high distinctiveness 'other habitats'[3] the results are positive, indicating that area based biodiversity units generated by habitats of these types post-construction will exceed those associated with the habitats currently present. There is a large reduction in the number of area-based biodiversity units generated by low and moderate distinctiveness grasslands (approximately 1442 units) and 'other habitats' of low distinctiveness (approximately 974 units) post-construction. These losses are due to a large reduction in the extent of arable farmland and pasture, and will be partly offset by expected gains in area-based biodiversity units generated by grassland habitats.

1.2.6 For woodland habitats the calculation indicates that post-construction, habitats of high distinctiveness will generate approximately 445 less area based biodiversity units.

1.2.7 It should be noted that the reported reductions in area based biodiversity units are not the result of reductions in absolute area of habitats from pre-construction to post-construction. In fact, following establishment of newly created habitats, HS2 Phase 2a will result in a significant increase in the overall extent of habitats of

[2] This result is a worst-case estimate that reflects the fact that no newly created ditches are afforded biodiversity units as 'watercourses' within the post-construction calculation. This is because current design data does not clearly distinguish those ditches that are likely to contain flowing water. The output of the calculation is likely to improve significantly as the project progresses through detailed design as the ditches that can reasonably be described as watercourses are confirmed and therefore allocated biodiversity units.

[3] 'Other habitats' are all habitats that are not categories of woodland or grassland, including arable land.

principal importance[4] as listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act, 2006. This is expected to include net increases of approximately 173ha of habitat of principal importance grasslands and approximately 126ha of habitat of principal importance woodlands.

1.3 Next steps

1.3.1 The outputs of the current calculation show that the goal of demonstrating no net loss in relation to replaceable habitats has yet to be achieved. However, HS2 Ltd reaffirms its commitment to continue to work towards achieving this goal as the project progresses through detailed design and construction, and into the operational stage.

1.3.2 In considering the outputs of the calculation it is important to take into account the context within which this work has been undertaken.

1.3.3 HS2 Ltd has made significant investments in developing a methodology to transparently allow the wider biodiversity performance of the scheme to be measured. In doing so it has sought to promote the importance of no net loss initiatives and encourage major development schemes to ensure due consideration of the overall biodiversity impact of a scheme, rather than simply addressing the significant effects identified within the statutory EIA process.

1.3.4 Demonstrating that the goal of seeking no net loss in relation to replaceable habitats has been met remains an ongoing target. However, there remain many good opportunities to improve the overall balance of biodiversity units generated by Phase 2a of HS2 during detailed design, construction and operation. Key opportunities being explored for reducing the current shortfalls include the following:

- **reducing the scale of habitat loss:** the current calculation is based on the precautionary assumption that all habitat within the land required will be lost. In practice it will be possible to retain some habitats. For example, it will be possible to retain the majority of habitats within the land required for the Grid Supply Point Connection at Parkgate (7.7km in length); and by retaining hedgerows in areas required temporarily during construction. In accordance with the draft Code of Construction Practice[5] and the Environmental Minimum Requirements

[4] The list of habitats of principal importance for England was derived from the United Kingdom Biodiversity Action Plan (UK BAP), list of Priority Habitats. It includes all UK BAP Priority Habitats relevant to England.

[5] Section 9.1 of the draft CoCP includes the requirement that 'the contractors will, where it is reasonably practicable reduce any habitat loss within the land required for the Proposed Scheme by keeping the working area to the minimum required for construction of the Proposed Scheme.'

during detailed design and construction, the project will continue to seek to avoid or further reduce the impacts of the Scheme;

- **enhancing the ecological value of landscape led planting:** the calculation currently assumes areas of landscape led woodland planting will achieve only a moderate distinctiveness score (4 x weighting). Where it does not compromise the landscape function of these areas, there is an opportunity to establish woodland with the same species composition as the woodland habitat creation areas that have a primary purpose for ecology. The adoption of this measure would allow such areas to achieve high distinctiveness (6 x weighting). The commitment to ongoing management of these landscape led areas of woodland planting would also be increased to equal that of the woodland habitat creation areas with a primary purpose for ecology. This would increase the area-based biodiversity units generated by landscape led woodland planting and would contribute towards addressing the current shortfall in relation to habitats of high distinctiveness; and
- **additional habitat creation/enhancement opportunities:** HS2 Ltd is reviewing additional options for habitat creation and enhancement on land within the scheme, opportunities on land acquired by HS2 Ltd that is not required for the operation of the Scheme[6], and opportunities at third party sites. Any additional habitat creation proposals will need to balance other requirements for land, such as its value for agriculture.

1.3.5 Within this context, it is considered that it remains feasible for HS2 Ltd to achieve its goal of seeking no net loss in biodiversity for replaceable habitats. To do so it will be necessary to address the current route wide deficit in:

- area-based biodiversity units;
- area-based biodiversity units associated with woodland habitats of high and moderate distinctiveness;
- area-based biodiversity units associated with grassland habitats of moderate distinctiveness; and
- watercourse biodiversity units.

1.3.6 It will also be necessary to provide further detail to stakeholders to formalise the commitment to management and ongoing monitoring in order to secure compensation measures in the long term.

1.3.7 HS2 Ltd will require its contractors to track progress against the no net loss calculation and report on this at regular intervals during detailed design and construction, with the aim of demonstrating progress towards this goal.

[6] For example, where land required for the scheme has 'blighted' the operation of a farm holding resulting in HS2 Ltd purchasing a larger area than is required for the construction and operation of the required scheme as part of a compensation settlement.

1.3.8 The calculation does not include consideration of biodiversity benefits that may be generated by any additional funding that HS2 Ltd has provided on HS2 Phase 2a (e.g. through the Cheshire East environment and landscape enhancement fund, the funding for additional enhancement measures within the remit of the Trent-Sow Parklands and Cannock Chase AONB HS2 Group and the Phase 2a Woodland Fund), totalling £4.35 million. An additional £5 million of the HS2 Community and Environment and Business and Local Economy Fund was made available for Phase 2a, which could also realise local or strategic environmental benefits.

1.3.9 The calculation also does not include any of the woodland habitat creation that is included within the Scheme as partial compensation for losses of ancient woodland, as recommended by Natural England.

2 Abbreviations, acronyms and descriptions

Table 1: Abbreviations, acronyms and descriptions

Abbreviation/Acronym	Description
AONB	Area of Outstanding Natural Beauty
AP	Additional Provision
BOA	Biodiversity Opportunity Area
ha	hectare
km	kilometre
m	metre
CA	Community Area
Defra	Department for Environment, Food and Rural Affairs
ES	Environmental Statement
EIA	Environmental Impact Assessment
EMR	Environmental Minimum Requirements
ERG	Ecology Review Group
FEP	Farm Environment Plan
GIS	Geographical Information System
HLS	Higher Level Stewardship
HS2WF	HS2 Woodland Fund
IHS	Integrated Habitat System
LNR	Local Nature Reserve
LWS	Local Wildlife Site
NIA	Nature Improvement Area
NNL	No net loss
NPPF	National Planning Policy Framework
NVC	National Vegetation Classification
PAWS	Plantations on ancient woodland sites
QA	Quality assurance
SES	Supplementary Environmental Statement
SSSI	Site of Special Scientific Interest
SINC	Site of Importance for Nature Conservation
SES	Supplementary Environmental Statement
SMR	Scope and Methodology Report

3 Introduction

3.1 Background to High Speed Two

3.1.1 High Speed Two (HS2) is the Government's proposal for a new, high speed north-south railway. The proposal is being taken forward in phases: Phase One will connect London with Birmingham and the West Midlands. Phase 2a will extend the route to Crewe. Phase 2b will extend the route to Manchester, Leeds and beyond.

3.1.2 The hybrid Bill for HS2 Phase 2a between the West Midlands and Crewe ('the Bill') was submitted to Parliament together with an Environmental Statement (ES) in July 2017. Following deposit of the Bill, the need for a variety of changes to the Scheme arose through the High Speed Rail (West Midlands - Crewe) Select Committee process, on-going discussions with petitioners and key stakeholders, and as a result of design refinements.

3.1.3 Those changes which did not require an amendment to the Bill (e.g. changes to construction assumptions, new environmental baseline information and corrections to the main ES) were reported in two Supplementary Environmental Statements (SES). Changes to the Scheme that required amendments to the Bill were promoted in Parliament through two Additional Provisions (AP), which were each accompanied by an ES.

3.1.4 The no net loss calculation for Phase 2a of HS2 has been undertaken based on the original scheme submitted to Parliament in July 2017, as amended by SES1 and AP1 ES submitted in March 2018 and SES2 and AP2 ES submitted in February 2019 ('the Scheme') and relevant Undertakings and Assurances on the HS2 Undertakings and Assurances register as published in July 2018.

3.1.5 The hybrid Bill for Phase 2a of the project is anticipated to be granted Royal Assent in late 2019. Royal Assent would provide powers to construct, operate and maintain Phase 2a of HS2.

3.2 Background to HS2's no net loss calculation

3.2.1 The UK Government is committed to enhancing biodiversity[7] in the UK within a generation as part of its 25 Year Environment Plan[iv], which aims to embed the principle of environmental net gain into new development including infrastructure. A public consultation on biodiversity net gain was held between December 2018 and February 2019. The consultation sought views on proposals to make biodiversity net gain mandatory for developments when granting planning permission, and it

[7] The variety of life in the world or in a particular habitat or ecosystem.

included a summary of the proposed updated 'Defra Biodiversity Metric 2.0'[v]. Defra are currently processing the results of the consultation and preparing a government response.

3.2.2 Until any outcomes of the consultation are implemented, there remains no statutory requirement under existing policy or guidance for individual projects to deliver no net loss in biodiversity, or net gain in biodiversity. HS2 Ltd has adopted the objective of seeking to achieve no net loss in biodiversity on Phase 2a of the project as a non-statutory objective, which represents a significant commitment for a major infrastructure project.

3.2.3 In July 2017 HS2 Ltd submitted the Environmental Statement for Phase 2a of HS2 ('the main ES'). The main ES was accompanied by a Technical Note (Main ES Volume 5: Environmental Impact Assessment Scope and Methodology Report Addendum Annex E (CT-001-002))[iii] covering the methodology to be used in the no net loss in biodiversity calculation. The methodology was based on the original Defra metric[vi] for calculating biodiversity values in its biodiversity offsetting pilot project, and its development included consultation with both Defra and Natural England. The methodology set out in this report now supersedes the methodology contained within the technical note.

3.2.4 The HS2 biodiversity metric was not devised to define the level of compensation that needed to be provided in support of HS2 Phase 2a, and has not been used for this purpose. It has been developed as an accounting tool to compare the losses and gains in biodiversity identified within the main ES and subsequent AP ESs, and measure progress towards the project objective of seeking to achieve no net loss in biodiversity. This accounting process has been referred to as the 'no net loss calculation'. Further details regarding the approach adopted for Phase 2a of HS2, and the differences to a standard 'biodiversity offsetting' approach are provided in Section 4.

3.2.5 In January 2016 HS2 Ltd published the interim results of its no net loss in biodiversity calculation for HS2 Phase One. The report included details of minor amendments to the methodology set out in the November 2013 Environmental Statement and interim results.

3.2.6 Following publication of the January 2016 report and concerns raised by petitioners, the House of Commons HS2 Select Committee recommended that an independent review was undertaken 'to review the different net loss metrics and publish its findings'. The Department for Transport (DfT) subsequently asked Natural England, the statutory nature conservation advisor to undertake this review.

3.2.7 Natural England published the results of the no net loss review for Hs2 Phase One in November 2016[vii] which included a range of recommendations for modifications to the HS2 approach. HS2 Ltd subsequently issued a response to Natural England's report identifying how it intended to respond to the recommendations of the review (see Appendix A). Following on from this response HS2 Ltd has continued to liaise with Natural England in updating its methodology and associated calculation.

3.2.8 The no net loss calculation for Phase 2a of HS2 has been undertaken in accordance with the revised HS2 metric, which is described in Section 5 of this report.

3.3 Aims of this report

3.3.1 This report and the associated calculation have the following key aims:

- to clearly set out HS2 Ltd's seeking no net loss in biodiversity objective;
- to explain the novel methodology that has been utilised to assess the losses and gains in biodiversity as a consequence of Phase 2a of HS2, and the similarities and differences from the Defra biodiversity offsetting metric;
- to provide a clear and transparent explanation of the methodology followed in undertaking the calculation;
- to demonstrate the rationale for the methods utilised and the benefits and limitations of the approach adopted;
- to provide a meaningful comparison of the losses and gains in biodiversity that are likely to occur as a consequence of Phase 2a of HS2;
- to provide comment on progress made towards the goal of seeking to achieve no net loss, actions that would be required in order to meet the objective of no net loss in biodiversity; and identify at a high level potential opportunities for addressing any remaining deficit; and
- to provide a baseline for the no net loss calculation against which future iterations can be compared going forward.

4 Role of the HS2 no net loss calculation

4.1 Introduction

4.1.1 This chapter provides background information relating to the development of the HS2 biodiversity metric, the underlying policy context, and the process followed in devising the HS2 biodiversity metric.

4.2 Policy context

4.2.1 The NNL objective stems from a number of international and national policy sources. The European Union (EU) Biodiversity Strategy[viii] states that to avoid a net loss of biodiversity and ecosystem services, damages resulting from human activities must be balanced by at least equivalent gains. The England Biodiversity 2020 strategy[ix] similarly requires progression from a position of net biodiversity loss to net gain, by supporting healthy, well-functioning ecosystems and coherent ecological networks. The UK Government's 25 Year Environment Plan[iv], endorses the principle of net gain, and makes a commitment to strengthening existing requirements for net gain for biodiversity in national planning policy. This was implemented through updates to the National Planning Policy Framework[x] (NPPF) in 2019.

4.2.2 Until any outcomes of the biodiversity net gain consultation are implemented, there remains no statutory requirement under existing policy or guidance for individual projects to deliver no net loss in biodiversity, or net gain in biodiversity.

4.2.3 HS2 Environmental Policy[xi] provides a framework for environmental protection and management for HS2 and its operations. The policy includes the principle that HS2 'will seek to achieve no net loss for biodiversity, reducing impacts on species and creating and enhancing habitats'. Inclusion of this principle within the policy acknowledged the increasing importance of the 'no net loss' concept within planning policy and seeks to encourage the measurement (and comparison of) all losses and gains in biodiversity.

4.2.4 HS2 Ltd recognises the Government's aspiration to achieve environmental net gains as set out in the 25 Year Environment Plan and is supportive of this policy where possible. The environmental plan is still in an early stage and HS2 Ltd will continue to review its approach in light of the development of the plan.

4.2.5 The criteria for no net loss and net gain concepts are different to those considered within the main ES and subsequent AP ESs, which in line with requirements of the

EIA Regulations focused on the likely significant effects of the Scheme. In contrast the seeking no net loss in biodiversity objective focuses on the overall biodiversity losses and gains of the Scheme including those which are not significant even when considered cumulatively. For example, the cumulative value of some low quality habitats, the loss of which would not be considered 'significant' in EIA terms.

4.2.6 Based on the recommendations of the Natural England review of the HS2 Phase One metric in November 2016, ancient woodland habitats have been removed from the HS2 no net loss calculation in order to make it clear that ancient woodland losses are irreplaceable. Losses of ancient woodland and associated compensation are reported separately[xv] in order to demonstrate that the Scheme has provided an appropriate package of compensation measures in response to those losses that cannot be reasonably avoided. Therefore, ancient woodland and associated compensation measures are considered to fall outside of the scope of the HS2 no net loss calculation. The 'no net loss' calculation for HS2 Phase 2a therefore only considers losses and gains in 'replaceable' habitats[8].

4.2.7 Within the HS2 biodiversity objective, 'no net loss' would be considered to be achieved where the losses in biodiversity from replaceable habitats as a consequence of the Scheme are balanced, or exceeded, by the biodiversity gains that would be provided by compensation measures.

4.2.8 The objective involves comparison of the biodiversity value of the habitats present prior to construction, with those following the completion of construction, when all compensation measures will have been established. The use of the term 'net' reflects the fact that biodiversity losses will occur, both during construction and post-construction until such a point that new habitats establish there is likely to be a reduction in the biodiversity supported by the habitats in the vicinity of the Scheme. In addition biodiversity losses and gains may not be perfectly balanced with regard to the time, space or type of biodiversity impacted[9,xii].

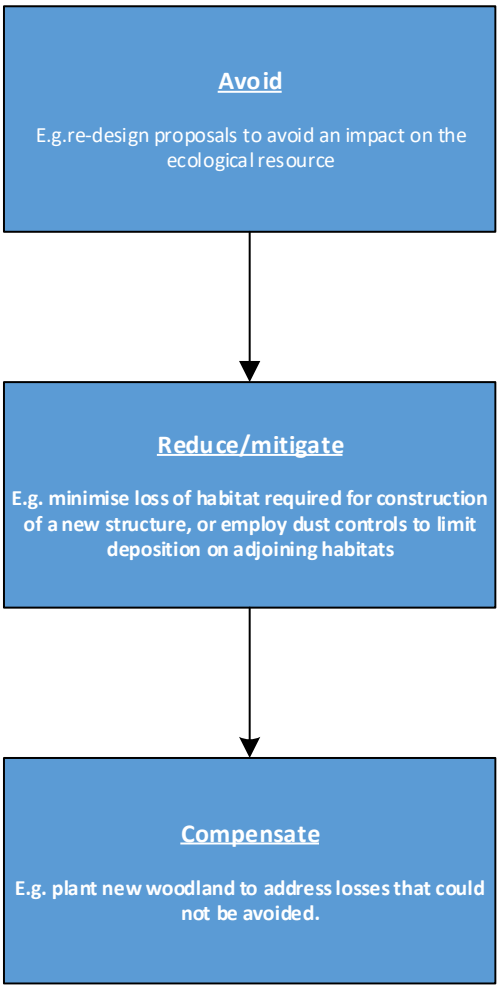
4.3 Mitigation hierarchy

4.3.1 In seeking to minimise the effects of the Scheme on biodiversity, the 'mitigation hierarchy' outlined in Figure 1 has been implemented.

[8] i.e. those habitats which can be adequately recreated when lost. The only instances of habitat loss within Phase 2a of HS2 which HS2 Ltd considers to be irreplaceable relate to ancient woodland. Ancient woodland and associated areas of compensation are therefore excluded from the scope of the no net loss calculation.

[9] i.e. there may be a lag time between impacts occurring and the provision of suitable replacement habitat; impacts and compensation may be provided at different locations; and may not exactly replicate the habitats lost.

Figure 1: Mitigation hierarchy



4.3.2 The application of the 'mitigation hierarchy' is a requirement of the NPPF, and it is widely regarded as a best practice approach to managing potential impacts on biodiversity.

4.3.3 According to the mitigation hierarchy, efforts should be made in the first instance to try and avoid an impact. For example, through amending the design to avoid impacts on a feature of interest. Where the impact cannot be avoided, efforts should be made to mitigate (i.e. reduce the impact or effect). For example, through limiting the extent of habitat lost or by limiting the duration over which an impact would occur.

4.3.4 Where after the application of avoidance and mitigation measures, there is still likely to be a significant residual impact, then compensation (e.g. creation of new habitat or management to enhance existing habitat) should be provided to a level sufficient to balance (or 'offset') the impacts.

4.3.5 The use of biodiversity offsetting metrics is associated with the final step in the mitigation hierarchy 'compensation'. The use of a metric provides a formal means by

which to compare the losses that will occur (after avoidance and mitigation have been considered), with the gains provided by compensation. As such the use of a metric can form part of the application of the standard mitigation hierarchy, but should not in any way change the application of the earlier stages in the hierarchy.

4.4 Development of HS2 compensation proposals

4.4.1 The main ES and subsequent AP ESs document the avoidance, mitigation and compensation measures that have been incorporated into the Scheme. This approach was undertaken following due consideration of the mitigation hierarchy, as summarised in Figure 1 and set out in further detail within the 'Ecological Principles of Mitigation' Technical Note (Main ES Volume 5: Environmental Impact Assessment Scope and Methodology Report Addendum Annex E (CT-001-002))[iii].

4.4.2 The Scheme has been designed, where reasonably practicable, to avoid impacts on sensitive ecological receptors. However, given the scale of the Scheme, and a series of sometimes conflicting environmental constraints, there are locations where impacts on ecological receptors cannot be reasonably avoided.

4.4.3 Where the potential for significant adverse ecological effects was identified, feedback has been provided to the design team and the scope for avoiding or reducing the impacts (i.e. mitigation) has been considered. This process has been driven by collaborative working between the HS2 Ltd engineering, design and environmental teams and has been informed by the consultation and engagement process associated with the main ES, and subsequent AP ESs.

4.4.4 Where avoidance and mitigation measures are not considered sufficient to address the effects of the Scheme then compensation, in the form of habitat creation, or the enhancement of retained habitat has been proposed.

4.4.5 The compensation measures provided for in the hybrid Bill in response to adverse effects on habitat and species as a consequence of the Scheme were determined as part of the ecological impact assessment reported within the ES.

4.4.6 The measures included were determined according to professional judgement, the approach taken in all major UK infrastructure projects to date in determining appropriate compensation. The compensation requirements for individual impacts were considered on a 'site by site' basis, before consolidating this into a suitable compensation strategy for the wider local area (e.g. consolidating the creation of new woodland in one area to address losses of two separate areas of broadleaved woodland). This process did not involve the use of a biodiversity offsetting metric or other loss to gain ratios.

4.4.7 This approach reflects HS2 Ltd's view that for a Scheme of the scale and complexity of HS2 there is no currently available metric (or other loss/gain ratio) sufficiently well-developed to substitute for a detailed ecological impact assessment that is based upon the professional judgement of experienced ecologists.

4.4.8 The approach to determining the level of compensation included within the hybrid Bill for HS2 Phase 2a has therefore been no different to that traditionally used by all major UK infrastructure projects over the last 30 years.

4.5 Biodiversity metrics

Introduction to biodiversity metrics

4.5.1 Biodiversity in its entirety is impossible to measure so biodiversity metrics utilise a 'metric' to represent, and provide a measure of, overall biodiversity[xiii]. Biodiversity offsetting metrics are surrogates, or combinations of measurements, that together provide a method of measuring biodiversity value in 'biodiversity units'.

4.5.2 Biodiversity offsets are conservation activities designed to deliver biodiversity benefits in compensation for losses, in a measurable way[xiv]. Offsetting methodologies compare the losses resulting from the impact of a development with the gains achieved through the provision of compensation or offsets, thus aiming to provide a transparent mechanism by which the impacts of a development can be quantified, and an appropriate level of compensation agreed.

4.5.3 Through providing measurable outcomes, biodiversity offsetting methodologies also allow the potential to establish a market based system whereby an offset provider can generate 'biodiversity units' through habitat creation or restoration, that can be traded and used to offset a deficit created by another project.

4.5.4 A biodiversity metric operates on the principle of applying scores to each of the various elements of biodiversity value, and then undertaking a multiplication sum using each of those scores (see below), in order to produce a number that represents biodiversity value. The value is normally referred to in terms of biodiversity units.

4.5.5 A habitat based biodiversity offsetting metric uses habitat type as a measure of overall biodiversity. It allows impacts on one habitat type to be compared with those involving a habitat of a different type and/or quality.

4.5.6 Metrics cannot fully account for all aspects of biodiversity value, but can provide a broad mechanism for comparing losses and gains in biodiversity. Their application in the UK is not yet either mandatory or standard practice. Where utilised to date they

have been used to quantify the number of biodiversity units that need to be created in order to compensate for losses that cannot be avoided or mitigated. In turn the area of a particular habitat type needed to obtain the required number of compensatory biodiversity units can then be calculated.

4.5.7 As detailed in Section 4.4, the level of compensation included within the hybrid Bill for Phase 2a of HS2 has been determined based on professional judgement, rather than any metric or other loss/gain ratio.

Use of a biodiversity metric in HS2 Ltd's no net loss calculation

4.5.8 Having determined the level of compensation provision to be included within the Bill, an 'accounting tool' was required to gauge in broad terms progress towards the objective of seeking to achieve no net loss in biodiversity. HS2 Ltd has utilised a bespoke method, incorporating the use of a modified version of the Defra pilot metric ('the HS2 metric' - See Section 5), to calculate and compare the likely losses and gains in biodiversity of replaceable habitats that will occur as a consequence of Phase 2a of HS2.

4.5.9 This differs from the conventional application of a biodiversity offsetting metric as within Phase 2a of HS2 it was not used to determine the level of compensation provision that was reported in the main ES and subsequent AP ESs.

4.5.10 The use of a biodiversity metric in Phase 2a of HS2, provides a means for undertaking a broad comparison between the overall biodiversity value of all habitats present prior to construction, and the likely biodiversity value of all habitats that will be present post-construction once all compensation measures have been implemented and are established.

4.5.11 To date, a biodiversity metric has not been utilised in such a way (i.e. solely as an accounting method) in the UK. In the absence of an 'off the shelf' solution HS2 Ltd has invested considerable time and effort in developing modifications to the Defra pilot metric to make it suitable for this purpose.

4.5.12 It is important to note that the calculation seeks to provide a broad comparison of losses and gains pre- and post-construction, rather than acting to determine compensation requirements or to inform an impact assessment. Approached in this context, it represents an appropriate method for ensuring the concept of no net loss has been given due consideration.

4.5.13 Undertaking the calculation across the 58km route of Phase 2a of HS2 has involved ecologists scoring of over 51,866 area based features and 11,889 linear features, against a series of criteria set out in the HS2 metric. This has been a major

undertaking and is among the most complex examples of any such calculation utilising a biodiversity metric (including those used to define compensation requirements) to be undertaken in the UK, alongside HS2 Phase One.

4.5.14 In committing to the goal of seeking to achieve no net loss, HS2 Ltd have adopted a goal that may require the provision of habitat creation above and beyond that required to mitigate the significant effects identified within the ES.

5 HS2 metric

5.1 Introduction

5.1.1 The no net loss calculation for Phase 2a of HS2 has been undertaken in accordance with the metric described below.

5.2 Irreplaceable habitats

5.2.1 In line with the recommendation of the Natural England review, all ancient woodland affected by the Scheme (both ancient semi-natural woodland and plantation on ancient woodland) has been removed from the HS2 no net loss calculation. Therefore, neither ancient woodland affected by the Scheme, nor the compensation being provided in responses to adverse effects on ancient woodland generate any biodiversity units in the updated calculation.

5.2.2 All areas of ancient woodland affected by the Scheme and compensation associated with losses of ancient woodland have been labelled within the GIS database, to indicate why they have been excluded from the calculation.

5.2.3 Losses of ancient woodland as a consequence of the Scheme, and the associated compensatory measures to be provided by HS2 Ltd in response to these losses will not be compared utilising a metric. An area based comparison is reported separately within HS2's ancient woodland strategy[xv].

5.2.4 There are no other area based or linear habitat types within the Scheme that are considered to be irreplaceable.

5.3 Sites of Special Scientific Interest (SSS1s)

5.3.1 There are no SSSIs within the land required for the Scheme.

5.4 Habitat management and monitoring

5.4.1 In predicting the biodiversity value that can be achieved through creating new habitats, or management to improve the condition of existing ones, it is assumed that the biodiversity value of habitats created or enhanced as part of the Scheme will be secured through a commitment to long-term management and monitoring.

5.4.2 HS2 Ltd has set out indicative commitments to the management and monitoring of ecology led habitat creation in support of HS2 Phase 2a, during the period of

establishment within Information Paper E2: Ecology[xvi]. A summary of current assumptions is provided in Table 2 below.

Table 2: Indicative management, monitoring and maintenance durations during establishment for habitats to be created within the Scheme

Habitat type	Generic duration of monitoring and management during establishment	Comments
Woodland (including screening planting)	10-50 years	• Duration of 10 years for areas provided for primary purpose of landscaping; • Duration of up to 50 years during establishment for those areas that are created specifically for ecological mitigation/ compensation. The 50-year period would be provided for all locations where the translocation of ancient woodland soils is proposed.
Grasslands	5-15 years	• Areas of grassland with the primary purpose of landscaping are likely to fall under a 5 year regime; • Majority of grassland provided as compensation for losses is likely to be subject to a 15-year regime.
Hedgerows	5-10 years	• Hedgerows provided specifically for ecological purposes (e.g. to provide connectivity between other areas of planting, or those translocated due to their ecological value) may be subject to a regime of up to 10 years; • Majority of hedgerows will be subject to a 5-year regime.
Watercourses	5 years	• A standard duration is likely to be applied to all habitats of this type.
Ponds	5 years	• A standard duration is likely to be applied to all habitats of this type.

5.4.3 In addition the draft Environmental Memorandum for HS2 Phase 2a[xvii] states at paragraph 4.8.5 that: "The nominated undertaker will maintain or make provision to maintain and monitor any new or managed habitat for a sufficient period to ensure that the objectives of the proposals for nature conservation and protection of the historic environment are achieved."

5.4.4 The duration, exact nature and frequency of maintenance, management and monitoring works for individual locations will be developed during detailed design. Such management is likely to be delivered through a combination of mechanisms, including:

- legal agreements with existing landowners;
- legal agreements with other interested stakeholders (e.g. local wildlife trusts); and
- retention by the Nominated Undertaker and/or future Operator.

5.4.5 In line with current HS2 Ltd commitments, the no net loss calculation assumes that habitat creation or enhancement with a primary ecology function is likely to be subject to a longer term commitment to management and monitoring than those areas that have primarily been provided for landscape and visual reasons. At present a ten year commitment to ongoing management has been made in relation to areas of landscape led planting. On that basis the calculation adopts a precautionary approach in relation to landscape planting (i.e. areas of tree planting), assuming at present that such areas of planting are only likely to achieve 'moderate' distinctiveness (4 x weighting).

5.5 Revised scope of the HS2 metric

5.5.1 The HS2 no net loss calculation seeks to consider the losses and gains in biodiversity for replaceable habitats within the land required for the Scheme.

5.5.2 The HS2 metric calculates losses and gains in replaceable habitats for most habitats as area based features (measured in 'area based biodiversity units'), and as linear features for hedgerows and watercourses (measured in 'hedgerow biodiversity units' and 'watercourse biodiversity units' respectively).

5.5.3 The no net loss calculation for replaceable habitats, therefore, results in three separate conclusions, one for area based features, one for hedgerow linear based calculations, and one for the watercourse linear based calculations. The units for these three aspects are not interchangeable or relatable, and therefore the goal of seeking to achieve no-net loss relates to each of these separate elements of the calculation.

5.5.4 In each case the biodiversity units generated by all replaceable habitats affected by the development (see Section 6.1) are calculated for the habitats currently present (pre-construction) and those that will be present once the Scheme has been constructed and created habitats have established (post-construction).

5.6 Formula utilised to calculate biodiversity units

Area based features

5.6.1 With the exception of ancient woodland (excluded from the calculation), hedgerows and watercourses (considered as linear features), losses and gains in biodiversity are compared within the HS2 no net loss calculation based on biodiversity units calculated taking into consideration the area of each habitat type present (area-based biodiversity units).

5.6.2 Each habitat parcel which within the scope of the calculation (i.e. meeting at least one of the criteria identified in Section 6.1) has been allocated a weighted score on the basis of each of the following criteria:

- habitat distinctiveness (see Section 5.7); and
- habitat condition (See Section 5.8).

5.6.3 In the pre-construction calculation the outputs of the above scored factors are multiplied by the area (ha) of the habitat parcel concerned in order to derive the total number of area based biodiversity units as follows:

Pre-construction biodiversity units (area based feature) = habitat distinctiveness x habitat condition x area

5.6.4 In the post-construction calculation the outputs of the factors utilised in the pre-construction calculation are also multiplied by a series of 'risk multipliers' in order to calculate the total number of biodiversity units generated as follows:

Post-construction biodiversity units (area based feature) = habitat distinctiveness x habitat condition x difficulty to create x time to target condition x area

5.6.5 The total number of area-based biodiversity units generated by features pre-construction will subsequently be compared with the number of area-based biodiversity units generated by habitat parcels present post-construction in order to predict the change in biodiversity units as a consequence of the Scheme.

Change in biodiversity units as a result of the Scheme (area based features) = total post-construction biodiversity units generated by all area based features - total pre-construction biodiversity units generated by all area based features

5.6.6 A positive overall result from the calculation would indicate that once established the areas of habitat to be created or restored as part of the Scheme are likely to generate more biodiversity units than those lost as a consequence of the Scheme. A negative overall result would indicate that the habitats to be created or restored are likely to generate fewer biodiversity units than the habitats currently present. A zero result indicates for those habitats a situation of no net loss in biodiversity.

Linear features – hedgerows and watercourses

5.6.7 Hedgerows and watercourses are considered as linear features and each form a separate accounting element in the overall calculation.

5.6.8 Due to the unique nature of both habitat types, losses of each habitat will only be directly compared with gains achieved through provision of the same habitat (e.g. pre-construction hedgerow biodiversity units will only be compared with post-construction hedgerow biodiversity units).

5.6.9 The scope of the calculations for linear features incorporates all hedgerows and water courses within the same spatial extents described in Section 5.6.2.

5.6.10 Distinctiveness is not used within the biodiversity units calculation for hedgerows and watercourses as in both cases it is likely that the vast majority of features present both pre- and post-construction are likely to meet the respective habitat of principal importance definitions which are both broad ranging. As a consequence, scoring all pre-construction hedgerows on the basis of their distinctiveness was not a worthwhile exercise. Given that all hedgerows to be created as part of the Scheme will be targeted at creating habitats of high distinctiveness (i.e. those that would meet habitat of principal importance definitions), it is not considered in the post-construction calculation.

5.6.11 For hedgerows and watercourses the number of biodiversity units is calculated taking into account the length of the feature (m), and the condition of the feature. as follows:

Pre-construction biodiversity units (linear feature) = length (m) x habitat condition

Post-construction biodiversity units (linear feature) = length (m) x habitat condition x difficulty to create x time to target condition

5.6.12 For both watercourses and hedgerows the overall change in biodiversity units for each habitat type has been calculated as follows:

Change in biodiversity units (linear feature) = post-construction biodiversity units - pre-construction biodiversity units

5.7 Habitat distinctiveness

5.7.1 All area based features considered in the calculation (ancient woodland and associated compensation are excluded from the calculation) have been scored against a four category scale, based on the distinctiveness of the habitat type concerned (see Table 3). Distinctiveness includes parameters such as species

richness, diversity, rarity (at local, regional, national and international scales) and the degree to which a habitat supports species rarely found in other habitats[xviii].

5.7.2 Irreplaceable habitats are no longer scored within the metric and therefore the 'very high' (8 x weighting) distinctiveness category utilised previously in the HS2 metric has been removed. The distinctiveness categories used in the HS2 metric are therefore unchanged from those used in the Defra metric.

5.7.3 Table 3 provides a high level guide to those habitat types that fall into each habitat category based on the guidance provided in support of the Defra metric.

Table 3: Habitat distinctiveness categories utilised in the HS2 metric

Distinctiveness	Habitats types included	Weighting
High	Habitats of principal importance i.e. those which meet the criteria[xix] to qualify as habitats of principal importance.	6
Moderate	Semi-natural habitats that do not fall within the scope of habitats of principal importance definitions, including: all areas of woodland and semi-natural grassland that do not qualify as a habitat of principal importance e.g. non-native coniferous plantation or species poor semi-improved grassland), uncultivated field margins; road verge and railway embankments (excluding those that are intensively managed).	4
Low	Habitats including: improved grassland; arable fields (excluding any uncultivated margins); built up areas; domestic gardens, regularly disturbed bare ground (e.g. quarry floor, landfill sites etc.); intensively managed verges associated with transport corridors.	2
None	Habitat that are of no or negligible value for biodiversity e.g. roads and other hardstanding, transport corridors (without associated verges), landfill sites, spoil heaps.	0

5.8 Habitat condition

5.8.1 With the exception of watercourses (which are dealt with as linear feature and are subject to separate metric rules), all pre-construction habitat features were allocated a condition score category with reference to the Higher Level Stewardship Farm Environment Plan (FEP) Manual[xx] utilised within the Defra metric.

5.8.2 The condition scale is basic and, where it was applicable, habitat survey notes were utilised to allocate a condition score to each habitat parcel (see Table 4 below). Where all of the stated criteria are met then a condition assessment category of

good (or A rating) is given. Where one of the criteria is missed or failed then a moderate (B rating) was given, and where two or more criteria are failed/missed then a poor condition (C rating) is allocated.

Table 4: Habitat condition categories utilised in the HS2 metric

Condition score	HLS condition assessment category	Framework for those habitats which are not covered by HLS condition assessment
3	A rating	Good
2	B rating	Moderate
1 (N.B. a condition score of 1 will be applied to all habitats of low distinctiveness).	C rating	Poor
NULL	Utilised for all area based features allocated a distinctiveness score of null.	

5.8.3 The FEP Manual guidance does not cover all habitat types that fall within the scope of the calculation, and where the guidance provided no relevant criteria then professional judgement has been applied to allocate a condition score against the three point scale.

5.8.4 Within the HS2 metric all habitats identified as being of low habitat distinctiveness are automatically allocated a condition weighting of 1. This is a variation from the Defra metric and reflects the view that for habitats of low distinctiveness the condition of the habitat has negligible influence on the overall value of that habitat type.

5.8.5 The HS2 metric adopts a precautionary approach in relation to the scoring of target condition for created habitats. It is the intention of HS2 Ltd that all habitats created with the primary function of providing ecological mitigation or compensation will be managed in the long term with the aim of achieving 'high' condition (3 x weighting). Table 5 indicates those habitat types to which this commitment applies, and further details regarding current commitments in relation to management are provided in Section 5.4.

5.8.6 However, habitats of both high distinctiveness and high condition will be the most difficult to create, and are likely to take many years to achieve both of these criteria. As a consequence, in the first instance a more precautionary approach to the initial scoring of the biodiversity units generated by newly created habitats within the post-construction calculation was considered appropriate. Thus, within the post-construction calculation the combination of high distinctiveness and high condition has not been utilised as a target within the HS2 metric.

Table 5: Summary of HS2 post-construction habitat creation categories with a commitment to obtain 'high' condition score criteria

Post construction habitat category	FEP habitat condition score HS2 have committed to achieve	FEP habitat condition score used within the HS2 NNL calculation	Content of habitat category
K1.4 Ecological Mitigation Pond	3	2	All ponds created with the primary purpose of providing ecological mitigation/compensation
K2.1 Woodland Habitat Creation	3	2	All woodland created with the primary purpose of providing ecological mitigation/compensation
K2.2. Wetland Habitat Creation	3	2	All wetland habitat creation with the primary purpose of providing ecological mitigation/compensation
K2.3 Grassland Habitat Creation	3	2	All grassland habitats created with the primary purpose of providing ecological mitigation/compensation

5.8.7 For all habitats except hedgerows, a rule has been implemented whereby the proposed ecological habitat creation will only be scored as being of moderate condition (2 x weighting). This rule has been implemented to ensure that the targeted condition scores remain realistic to achieve. Given that there is a commitment that management will continue until a high condition is achieved, this means that in the future there is the potential for the habitats created as a consequence of Phase 2a of HS2 to eventually generate more area-based biodiversity units than are claimed within the current calculation.

5.8.8 For hedgerows only, it has been considered acceptable to target habitat created at both high distinctiveness and high condition scores. The hedgerow definition for habitat of principal importance is broad, and the vast majority of hedgerows would fall within the scope of the definition.

5.8.9 Assuming best practice methods are implemented there is considered to be a high likelihood that the required criteria to qualify as an 'A condition' hedgerow (2m in height, 1.5m in width and gaps of no more than 10% of the hedgerow length) will be met within ten years of planting. Within its response to Natural England's review of the no net loss calculation HS2 has committed to providing case study examples of hedgerow creation in support of development schemes.

5.8.10 Based on HS2's Ltd's consultants experience of creating hedgerow habitats, and the FEP criteria for an 'A rating', i.e. highest condition score available) it is realistic to expect that new hedgerows can reliably be expected to achieve both high distinctiveness (6 x weighting) and high condition (3 x weighting). Therefore, it is

considered allowable to target new hedgerow creation at high condition (3 x weighting) within the HS2 calculation.

5.8.11 Watercourses are considered as linear features and therefore all running water habitat polygons are afforded a zero value for all fields within the pre-construction polygons feature class.

5.9 Risk multipliers

Difficulty of recreation

5.9.1 The HS2 metric utilises the same difficulty of recreation 'multiplier' categories utilised within the Defra metric (see Table 6). However, in order to simplify their application within a GIS database the Defra metric values have been converted to their respective decimal equivalents (to an accuracy of two decimal places) so that the various scored values utilised in the calculation can be readily multiplied to generate the overall number of biodiversity units generated (see Section 5.6 for details of the formula utilised).

Table 6: Multipliers utilised for difficulty to recreate/restore within the HS2 metric

Difficulty of recreation/restoration	Multiplier	Examples of habitats falling into this category[10]	
		Recreation	Restoration
High	0.33	Wet heath; upland flushes, fens and swamps; purple moor grass and rush pastures.[11]	Wet heath.
Medium	0.67	Lowland mixed deciduous woodland; wet woodland; lowland calcareous grassland; lowland beech and yew woodland; wood pasture and parkland; lowland dry acid grassland; lowland fens, lowland heathland; lowland meadows; eutrophic standing waters.	Eutrophic standing waters; lowland heathland; lowland raised bog; purple moor grass and rush pastures.
Low	1.00	Arable field margins; coastal and floodplain grazing marsh; hedgerows; open mosaic on previously developed land; ponds; traditional orchards.	Hedgerows; watercourses, lowland beech and yew woodland; lowland calcareous grassland; lowland dry acid grassland; lowland fens; lowland meadows; lowland mixed deciduous woodland; ponds; open mosaic on previously

[10] Note that the listing of a habitat type in this table does not necessarily mean that that habitat type is present within the scope of the HS2 Phase One no net loss calculation. Both habitats present within the scope of the Phase One calculation, and others that could fall within this category are listed.

[11] Covers only the variants of those habitat types which are considered replaceable. Irreplaceable habitats are not considered in the no net loss calculation for replaceable habitats.

Difficulty of recreation/restoration	Multiplier	Examples of habitats falling into this category[10]	
		Recreation	Restoration
			developed ground; reedbeds; wet woodland.

Time to target condition

5.9.2 Table 7 details the time to target condition categories and associated decimal multipliers utilised most commonly for each habitat type within the HS2 metric. The time to target condition values shown are based on the time required to achieve a condition score of 2 (moderate) for high and medium distinctiveness habitats, and condition 1 for low distinctiveness habitats. This approach accords with the cap on the condition target for newly created habitats (see Section 5.8.7) that has been applied in the HS2 methodology. The figures in Table 7 should not be used for achieving a habitat condition score of 3 as the timescales involved to achieve the relevant criteria for these habitats would be considerably longer than those stated.

5.9.3 In some instances the multiplier applied in the HS2 calculation may differ from the standard value indicated in Table 7 for the habitat type concerned. Such changes have only been applied where there is sound ecological justification to deviate from the values shown. The multiplier used for individual habitat polygons and polylines can be identified by querying the geodatabase data which will be made available via the data.gov.uk website.

Table 7: Time to target condition multipliers utilised most commonly for habitats within the HS2 metric

Years to target condition	Multiplier	Habitat types for which this multiplier is normally applied
0	1.00	Arable fields, buildings, bare ground, standing water, quarry. A multiplier of 1 is also used for any areas of habitat within the land identified as required for the scheme that are to be retained, and will not be affected by HS2 works[12]
1	0.97	Improved grassland, ephemeral/short perennial; introduced shrub,
2	0.93	Other tall herb and fen - ruderal, amenity grassland, other grassed areas (including some areas of public realm and engineered earthworks).

[12] Note that for areas of land utilised temporarily it is assumed that habitats will be lost and then recreated with the same time to target condition values applied as are utilised elsewhere. Further clarification is provided in Section 6.8.

Years to target condition	Multiplier	Habitat types for which this multiplier is normally applied
5	0.84	Scattered scrub; open mosaic habitat on previously developed ground; ponds; replacement floodplain storage, engineering earthworks[13], other habitat (Phase 1 category), bracken - scattered, bracken – continuous; poor semi-improved grassland and neutral grassland – semi-improved grassland[14].
10	0.71	Grasslands to be created as ecology compensation; hedgerows; woodland planting with a primary landscape function, dense scrub.
15	0.60	Young heathland/acid grassland mosaic.
20	0.50	Not utilised.
25	0.42	Not utilised.
30	0.36	Not utilised.
32 or above	0.33	Woodland created for primary ecological purpose; and mature heathland.

5.9.4 The HS2 metric utilises those categories from the Defra metric (0, 5, 10, 15, 20, 25, 30 and 32+yrs). In addition, several extra categories (1 year and 2 years) have been included to deal with low quality habitats. A list of time to target condition values used for low distinctiveness habitats is provided in Section 6.5.

5.9.5 Time to target condition multiplier values have been derived from the 3.5% discounting rate figures set out in the Treasury Green Book[xxi]. Values have in each case been rounded to two decimal places which is considered an appropriate level of detail for the calculation, and in line with that used for other multipliers in the calculation (e.g. difficulty of creation/restoration).

5.9.6 Within the HS2 calculation the time to target condition multiplier provides an adjustment of the number of biodiversity units generated based on the time that habits will take to establish following habitat creation, e.g. planting and or physical formation. Currently it is not practicable to attempt to include within the calculation the full temporal complexity of the losses and gains in biodiversity that will occur during the construction period.

[13] Time to target condition for engineering earthworks will differ dependent on the treatment of these areas. A precautionary approach has been adopted.

[14] Note that in the post-construction calculation these habitat categories are only utilised where areas of land subject to temporary use are scheduled to be returned to their previous habitat type. They are therefore in general utilised within the HS2 calculation where pasture fields (of limited biodiversity value) are assumed to be destroyed due to construction works, and then are to be recreated following completion of works.

5.9.7 During construction those areas of new habitat creation that have a primary role of providing ecology led mitigation and compensation, will be created prior to, or during the early stages of main construction works. As construction will not commence at the same time across the route, this will mean that some new habitats will be created before the impacts occur (in some cases several years), some will be created after the impacts occur due to complexities of the works programme. It is not currently practicable to consider all such factors within the calculation, and consideration of this level of complexity is unlikely to be desirable or reliable.

5.9.8 The time to target condition multiplier is also applied for areas of land that are due to be used temporarily during construction works. In such areas it is assumed that habitats currently present will be lost, with the same habitat type recreated following completion of construction. As efforts have been made to avoid temporary works in areas of high biodiversity value, the areas where temporary works are scheduled to occur are largely of limited value. In particular temporary works will affect large areas of pasture classified under the Phase 1 habitat survey methodology as poor semi-improved grassland and neutral grassland – semi-improved. For these areas, a time to target condition multiplier of 0.84 (5 years) is appropriate to fully establish a grassland habitat of similar biodiversity value. For areas of new grassland creation with the primary purpose of ecological compensation the calculation utilises a 0.71 time to target condition multiplier (10 years).

6 Undertaking the calculation

6.1 Scope of the calculation

6.1.1 The scope of the calculation incorporates areas of replaceable habitat located within the extent of the land required for the construction and/or operation of the Scheme[15].

6.1.2 The no net loss calculation considers replaceable habitats only and therefore excludes ancient woodland and land associated with the provision of compensation for impacts on ancient woodland. Ancient woodland and associated compensation provision do not generate biodiversity units within the no net loss calculation and a simple area based comparison will be provided in the Ancient Woodland Strategy. For clarity all areas of ancient woodland and associated compensation are marked clearly within the no net loss data so that it is clear the areas that have been excluded from the calculation scoring, and why.

6.2 Data sources

6.2.1 Table 8 below provides a summary of the key data sources that have been used in undertaking the no net loss calculation.

Table 8: Summary of key data sources utilised in the no net loss calculation

Data type	Data types utilised	Source(s)
Scheme design	GIS layers derived from the AP2 revised scheme[16] CAD Model for the following map series included within the SES2 and AP2 ES: CT-05: Construction Phase; CT-06 Proposed Scheme.	HS2 Ltd
Existing habitats	Phase 1 habitat survey[17] and National Vegetation Classification (NVC) data[18]	Surveys undertaken by HS2 Ltd
	Priority Habitat Inventory[xxii]	data.gov.uk website
	Habitat inventories (and relevant data from third parties)	Local Environmental Records Centres (LERC) Planning applications for nearby developments.

[15] The land required for the construction of the scheme is defined as the combined extent of all areas of land required either temporarily during construction or permanently during operation.

[16] The SES2 and AP2 ES GIS layers represent the scheme design i.e. original scheme as amended by the AP1 revised scheme and AP2 revised scheme.

[17] A habitat classification and field survey technique to record semi-natural vegetation and other wildlife habitats.

[18] The National Vegetation Classification (NVC) is a system for categorising the plant communities of Britain. In habitats with the potential to be of greater ecological value, an NVC survey has been undertaken according to the approved NVC survey methodology to allow the habitats present to be categorised.

Data type	Data types utilised	Source(s)
	Aerial photography of the route alignment	HS2 Ltd
Ancient woodland inventory	Location of ancient woodlands	Natural England via data.gov.uk website[xxiii]
	Review of historic mapping undertaken in support of main ES and SES2 and AP2 ES.	HS2 Ltd
Statutory designated sites	GIS Shapefiles for statutory designated sites	Multi Agency Geographical Information for the Countryside (MAGIC) website
Non-statutory designated sites	Details obtained through Local Environmental Records Centre (LERC) data searches	LERC
Guidance on allocating habitat condition scores	Higher Level Stewardship - Farm Environment Plan Manual[xx]	Natural England
Location and extent of proposed habitat creation	GIS layers derived from SES2 and AP2 CAD Model for the CT-06 Proposed Scheme map series included within the SES2 and AP2 ES. HS2 Phase 1 habitat data layer (derived from data sources above) utilised to confirm habitat type for all areas where land is required only temporarily[xx]	HS2 Ltd

6.3 GIS schema

6.3.1 The no net loss calculation has been undertaken within a Geographical Information System (GIS) using ArcGIS software.

6.3.2 The recording of all data in support of the calculation has been produced in accordance with a standardised geodatabase schema to ensure consistency in presentation of outputs.

6.3.3 The geodatabase contains five feature classes[19] as follows:

- pre-construction polygons (i.e. parcels of habitat with a defined spatial area): this is used for all pre-construction parcels of habitat that are dealt with in the calculation as area based features;
- post-construction polygons: this is used for all post-construction parcels of habitat that are dealt with in the calculation as area based features;
- pre-construction polylines (i.e. linear features with no defined area): this is used for hedgerows and watercourses present pre-construction which are considered within the methodology as linear-based features;

[19] A collection of geographic features with the same geometry type.

- post-construction polylines: this is used for hedgerows and watercourses present post-construction which are considered within the methodology as linear-based features; and
- land use polygons: this is used to provide a high level indication of the land use for each parcel of land included in the calculation. Further details on the land use categories utilised and how data within the land use layer has been derived are provided within Section 6.7.

6.3.4 A description of the various data fields utilised and summary of the feature classes to which they apply is provided in Appendix B.

6.3.5 Each habitat polygon or polyline has been populated by HS2 Ltd's consultants with the appropriate multipliers, allowing the area (ha) or length (m) of the feature and the selected multipliers to be used to automatically calculate the number of biodiversity units generated by each feature. The GIS data are then queried in order to ascertain the total number of biodiversity units generated pre- and post-construction.

6.3.6 Where a field in the GIS schema is not utilised in the calculation for a particular feature the cell is marked 'null'. For example, for hedgerows the distinctiveness score is not utilised and therefore is always marked as 'null' This approach has been utilised in order to retain the numerical functionality of the GIS layers, such that it is possible for stakeholders to undertake their own numerical analysis of the outputs. Null values have been actively allocated and do not indicate an absence of data.

6.3.7 For the scoring of distinctiveness values an entry of zero i.e. '0' indicates that the distinctiveness value has been considered against the provided guidance and has been actively scored as falling within this category. For example, where an area of road or hardstanding occurs this will have its distinctiveness weighting recorded as 0, as this is a defined score that has been actively allocated.

6.3.8 Where the distinctiveness value has been allocated a score of zero, all other scoring fields (i.e. habitat condition, difficulty of restoration, and time to target condition) have been populated with a 'null' value to reflect the fact that these criteria have not been actively scored, on the basis that the overall biodiversity units will in any event always be zero (as to calculate the biodiversity units these other fields would be multiplied by the distinctiveness score of '0').

6.4 Calculating the pre-construction biodiversity units

6.4.1 The HS2 Phase 1 habitat type GIS dataset was utilised as the basis for creating the pre-construction polygons and pre-construction polylines feature classes.

6.4.2 Habitat polygons within the Phase 1 habitats GIS dataset were isolated and used to form the basis for the pre-construction polylines feature class. The attribute fields set out in the HS2 schema (see Appendix E) were then applied to create an unpopulated structure for housing the data required for each habitat polygon to inform the calculation.

6.4.3 A similar process was then followed to isolate all hedgerow and running water features from the Phase 1 habitat data set (the only features considered in the linear calculations) and form the basis for the pre-construction polylines feature class.

6.4.4 The following section of the report provides details of the process followed to populate the 'pre-construction polygons' and 'pre-construction polylines' feature classes. Note that further details of the scoring criteria used within the HS2 metric are provided in Section 5.

6.4.5 While the metric prescribes rules and guidance to inform this process the application of the metric has also required the application of the professional judgement of experienced ecologists in scoring the various habitat attributes appropriately to ensure a meaningful and reliable outcome.

6.4.6 The scoring of habitat distinctiveness within the pre-construction polygons feature class[20] has predominately been based upon Phase 1 habitat survey and National Vegetation Classification (NVC) data reported in the main ES, and updated Phase 1 habitat survey data reported in SES1 and AP1 ES and SES2 and AP2 ES, and displayed in Map Series EC-02 and EC-10 (Background Information and Data Ecology Map Books).

6.4.7 Due to access restrictions, field survey information is not available for all land due to be affected by the Scheme. During the production of the main ES an exercise was undertaken to record the Phase 1 habitat type for all habitat areas within or adjacent to the Scheme. Where field survey data were not available, gaps were infilled using both aerial photograph analysis and data from available habitat inventories (e.g. Priority Habitat Inventory[xxii]. The output of this exercise was the EC-02 Map Series that formed part of the ecology map books within the Background Information and Data that accompanied the main ES.

[20] Habitat distinctiveness is not utilised within the HS2 metric for linear features (i.e. hedgerows and watercourses).

6.4.8 Where additional survey and desk study information has become available since publication of the main ES, this information has been used to update the Phase 1 habitat data presented in the EC-02 Map Series.

6.4.9 The guidance provided in Appendix C has been used to aid the translation of Phase 1 habitat survey categories to the relevant distinctiveness weighting.

6.4.10 For those Phase 1 habitat categories where all occurrences of that habitat type are afforded the same distinctiveness weighting, an automated process has been used to populate the database with the relevant value. Where there is more than one potential distinctiveness weighting, route section ecologists have utilised the available data to allocate the most appropriate weighting based on the available information[21].

6.4.11 Where robust data from Phase 1 habitat surveys or National Vegetation Classification (NVC) surveys undertaken in support of the Scheme are available, that information has been utilised as the primary basis for deciding the relevant distinctiveness weighting and has taken precedence over other third party data. Therefore, for example if the area has been identified within the Priority Habitat Inventory[22] as likely to qualify as priority habitat, but field survey has demonstrated otherwise, then the distinctiveness rating has been allocated on the basis of the latter HS2 Ltd field survey information.

6.4.12 Phase 1 habitat categories which are recorded as point data (e.g. scattered scrub or individual trees) have been considered in allocating the distinctiveness weighting of the underlying habitat polygon. Therefore, where the presence of a point data of a particular category was considered to add to the distinctiveness rating of the underlying habitat type (e.g. the presence of the scattered scrub within an area of ephemeral/short perennials) then the distinctiveness rating of the underlying habitat type polygon has been adjusted manually to account for this.

6.4.13 Where no HS2 specific survey has been possible due to access constraints, or a survey is sub-optimal (e.g. access restricted or timing of survey lies outside best practice guidance) then third party data (e.g. Priority Habitat Inventory) and aerial photography have been utilised to allocate the distinctiveness weighting, and a

[21] HS2 surveys are ongoing as land becomes accessible, as a general guide data that was obtained before the end of March 2018 has been considered within the calculation.

[22] Priority Habitats are those that were identified as being most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP). The UK BAP has now been superseded. However, the same criteria were used to define habitats of principal importance under Section 41 of the Natural Environment and Rural Communities (NERC) Act, 2006. Therefore an area identified as priority habitat under the UK BAP, also represents a habitat of principal importance. In most cases the extent of these areas has been established via aerial photograph interpretation only.

precautionary approach has been adopted. In these instances the following guidance was adhered to:

- habitat distinctiveness scores have been based primarily on the habitat type present. Statutory and non-statutory designations have not been used alone as the sole reason for adjusting the distinctiveness score, but have been considered as part of the available data;
- where the Natural England Priority Habitat Inventory data identifies that an area may represent a habitat of principal importance, a 'high' distinctiveness score (weighting x 6) has generally been allocated. Exceptions have only been made where there is clear evidence to suggest that this is not the case (e.g. where it is clear from aerial photographs that an area of habitat has recently been cleared for development);
- where interpretation of aerial photography suggests that an area not within the Natural England Priority Habitat Inventory data is likely to represent a habitat of principal importance (e.g. an area that appears to be broadleaved woodland from aerial photography would be assumed to represent lowland mixed deciduous woodland habitat of principal importance), a 'high' distinctiveness score (weighting x 6) has been allocated;
- a precautionary approach has been taken and where in doubt between categories, the higher distinctiveness category has been allocated; and
- data from interpretation of aerial photography were given priority over local habitat inventories where the photography provided more up to date data.

6.4.14 Distinctiveness scores are not used for the linear features considered in the pre-construction polylines features class calculation (see Section 5.6.10).

Habitat distinctiveness

Arable field margins

6.4.15 For all arable fields falling within the scope of the pre-development calculations a GIS query has been utilised to add a field margin of 1m width. These field margins have been allocated as moderate distinctiveness (4 x weighting).

6.4.16 Arable field margins are considered as part of the overall area-based biodiversity unit's aspect of the no net loss calculation.

Inland saltmarsh

6.4.17 An area of severely degraded inland saltmarsh occurs within the land required for the Scheme at Lionlodge Covert LWS. This habitat is agriculturally improved and as a result is recorded within the Phase 1 habitat mapping as species-poor semi-improved grassland. This habitat is a remnant of inland saltmarsh habitat, which is an unusual habitat type. In recognition, this area has been allocated as 'high' distinctiveness (6 x weighting).

Ponds and water bodies

6.4.18 For ponds, other standing water and canals the following assumptions have now been applied in relation to distinctiveness:

- if great crested newts, otters, water voles or white-clawed crayfish were present then the water body was considered to represent a habitat of principal importance and was assigned a high distinctiveness score (6 x weighting); and
- all other water bodies were assigned a moderate distinctiveness score (4 x weighting).

Watercourses

6.4.19 All habitat areas within both the pre-construction and post-construction mapping that relate to watercourses have, for the purposes of the area based features, been given a score of 'null' for all categories. This is to ensure that the total area of land covered by the calculation remains the same in the pre-and post-construction calculation, but that no area-based biodiversity units are generated (as watercourses are considered and scored as a linear unit).

Habitat condition

6.4.20 A habitat condition weighting of 1, 2, or 3 was attributed to each applicable feature in the pre-construction polygons feature classes in accordance with the metric rules set out in Section 5.8.

6.4.21 All habitats identified as being of low habitat distinctiveness were automatically allocated a condition weighting of 1, as described in Section 5.8.

6.4.22 The FEP Manual guidance does not cover all habitat types that fall within the scope of the calculation, and where the guidance provided no relevant criteria then professional judgement has been applied to allocate a condition score against the three point scale.

6.4.23 Where access has not been available for survey it was necessary to allocate a score based on a precautionary approach, informed by professional judgement:

- all habitats identified as being of 'low' habitat distinctiveness (2 x weighting) were automatically allocated a 'low' condition score (1 x weighting) (the same rule applies for those that have been surveyed);
- for all other areas as a general rule, in the absence of access to conduct a survey a moderate condition (2 x weighting) was assumed. A condition score of poor (1 x weighting) was allocated where there is a very clear justification based on the information available; and

- where access was not available for survey and there was reason to believe that an area was being actively managed to benefit nature conservation then a condition weighting of 3 has been allocated. This includes all habitat areas of high or moderate distinctiveness that occur within designated wildlife sites i.e. LWS and BAS, based on the precautionary assumption that they are managed for the benefit of nature conservation.

Broadleaved woodland plantation

6.4.24 In the absence of detailed guidance within the FEP Manual in relation to condition scoring of broadleaved woodland plantation, the FEP Manual guidance for T08 native semi-natural woodland were considered as part of the assessment of habitat condition for all surveyed areas.

Broadleaved parkland/scattered trees and mixed parkland scattered trees

6.4.25 In the absence of detailed guidance within the FEP Manual in relation to condition scoring of areas of broadleaved parkland/scattered trees (A3.1) and mixed parkland scattered trees (A3.3) the following criteria were developed and utilised:

- if an area was not surveyed it was assigned a condition weighting of moderate (x 2 weighting; and
- where areas were surveyed the following criteria were considered in the allocation of condition scores:
  - native tree species dominant;
  - mature trees are noted within the field survey results, i.e. mature, old, large trees etc.; and
  - presence of bat roost features are noted within the field survey results i.e. deadwood, cracks, broken limbs, holes, etc.

Scrub

6.4.26 A standard condition score of 'moderate' (2 x weighting) has been allocated to all habitat areas mapped as scrub (i.e. dense scrub or scattered scrub) that are afforded a distinctiveness of 'moderate' (4 x weighting) or above[23]. The Higher HLS FEP Manual[xx] was found to provide insufficient guidance to reliably distinguish between condition scoring categories.

Marshy grassland

6.4.27 The FEP Manual guidance for G07 purple moor-grass and rush pastures was considered as part of the allocation of habitat condition scoring for marshy grassland (B5) for all areas confirmed from survey data.

[23] Any scrub habitats of 'low' distinctiveness (2 x weighting) follow the rule that all habitats of 'low' distinctiveness are afforded a 'low' (1 x weighting) condition score.

Poor semi-improved grassland

6.4.28 In the absence of detailed guidance within the FEP Manual in relation to condition scoring of areas of poor semi-improved grassland (B6), the FEP Manual guidance for G06 lowland meadows were considered as part of the assessment of habitat condition for all surveyed areas. All of these areas failed at least two criteria of lowland meadow and as such were assigned a condition score of 'poor' (1 x weighting), which is considered to be appropriate for confirmed areas of this habitat type. In the absence of survey data, a 'moderate' condition (2 x weighting) was assumed on a precautionary basis.

Inland saltmarsh

6.4.29 The area of remnant inland saltmarsh at Lionlodge Covert LWS is agriculturally improved and not botanically diverse, with a single salt-tolerant species recorded from survey. As such this area is assigned a condition score of 'poor' (1 x weighting).

Ponds and water bodies

6.4.30 In the absence of detailed guidance within the FEP Manual in relation to condition scoring of ponds the following criteria were developed and utilised:

- if a pond was not surveyed it was assigned a condition weighting of moderate (x 2 weighting); and
- where ponds were surveyed and met one of the following criteria they were assigned a condition weighting of x 2, if they met two or more criteria they were assigned a condition weighting of x 1:
  - more than 500m from any other water body;
  - not within semi-natural habitat (i.e. if they are within hard standing, arable, pasture);
  - contain non-native (signal) crayfish.

Running water

6.4.31 In the absence of detailed guidance within the FEP Manual in relation to condition scoring of running water (G2) the following criteria were developed and utilised for condition scoring:

- in the absence of survey data, watercourses were allocated a condition score of 'moderate' (x 2 weighting); and
- Phase 2a river corridor survey data was utilised where available to assign condition scores to watercourses based on professional judgement.

6.5 Calculating the post-construction biodiversity units

6.5.1 The spatial data for the post-construction polylines and post-construction polygons feature classes were created from a combination of the AP2 design data polygons and data derived from the completed pre-construction feature classes.

6.5.2 AP2 design data (including extents of proposed habitat creation) were utilised to provide spatial data, and the intended land use (rail alignment; woodland habitat creation etc.) for the extent of the constructed Scheme (i.e. the features shown in the ES 'CT-06 Proposed Scheme' drawings).

6.5.3 As for the pre-construction feature classes the attribute fields set out in the HS2 schema (see Appendix E) were then applied to the spatial data to form an unpopulated structure for housing the data required for each habitat polygon to inform the calculation.

6.5.4 Land that is only required during the construction of the Scheme (i.e. is required only temporarily) does not feature within the AP2 design data used to inform the calculation. For the purposes of the calculation it is assumed that all areas within the land required for construction without design data (and therefore not attributed a land use within the 'CT-06 Proposed Scheme' drawings), represent areas that are required only during the construction of the Scheme.

6.5.5 It is assumed for the purposes of the post-construction calculation that all habitats within the land required for construction will be lost when these areas are cleared to enable construction. This represents a precautionary approach to the calculation as it is likely that as detailed design and construction progresses it will be possible to retain at least some of the habitats within areas required during construction only. For example, efforts will be made to retain hedgerows and where areas are proposed for storing material there will be some buffer areas of retained habitat.

6.5.6 Under the terms of the proposed Bill, once construction is complete the nominated undertaker will be required to return those areas only required during construction to a similar form to that currently present. Therefore, for all areas of land required during construction only, the calculation assumes that on completion of works these areas will be returned to the pre-construction conditions (i.e. of the same Phase 1 habitat type, distinctiveness and habitat condition). However, it is taken into consideration that for some habitats it will take time for the pre-construction condition to be achieved (see Table 7).

Habitat distinctiveness and habitat condition

6.5.7 All habitats that are being created for the primary purpose of ecological mitigation/compensation (i.e. those polygons identified on the CT-06 mapping as either wetland habitat creation, woodland habitat creation or grassland habitat

creation) will be targeted at creating habitats of principal importance listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act. These areas are afforded the following default habitat distinctiveness weightings in the post-construction feature classes:

- habitat distinctiveness = 'high' (6 x weighting); and
- habitat condition = 'moderate' (2 x weighting) (N.B. The rules of the HS2 metric set out a 'cap' limiting the condition rating used in the calculation to a moderate weighting).

6.5.8 As a general rule, where proposed ecological compensation included in the design (and shown on the CT-06 drawings[24]) is intended to represent a mosaic of habitats then the entire extent of those areas has been considered on the basis of the scores generated by the dominant habitat type. Based on the habitats present along the route of the Scheme this is considered likely to provide a precautionary view (e.g. grassland rides in an area identified in CT-06 drawings as woodland would likely be easier to create than the surrounding woodland); and areas shown as grassland are likely to be interspersed with habitats such as scrub, ruderals and open ground that will be easier to recreate thus generating more area-based biodiversity units.

6.5.9 For all other areas of non-ecology led planting/landscaping works that are due to occur within the areas of land required permanently for the Scheme, the semi-natural habitats created as part of the landscape design have been assumed as a default to achieve the following target multipliers:

- habitat distinctiveness = 'moderate' (4 x weighting); and
- habitat condition = 'moderate' (2 x weighting).

6.5.10 As set out in paragraph 6.5.6 it is assumed that all land required during construction only will be returned to a similar form to that currently present. Therefore, the habitat type, distinctiveness and condition data for these areas within the pre-construction dataset have been used to provide both the spatial extent of each habitat type and to populate the equivalent fields in the post-construction polygons and post-construction polylines feature classes.

Arable field margins

6.5.11 In areas of land required only during construction it is assumed that arable field margins will be reinstated post-construction and will be of the same extent, distinctiveness rating, and habitat condition as was present prior to construction.

[24] The CT-06 (Proposed Scheme) plans are included within the Volume 2 map books for the main ES and all subsequent ESs.

Reedbeds

6.5.12 Areas of reedbed that are not being specifically created for ecological benefit (e.g. where these have been included to provide filtration beds) are assumed not to fall within the habitat of principal importance definition. On a precautionary basis, they are considered to be of 'moderate' distinctiveness (4 x weighting) as their ecological value is likely to be limited by their functional role as filtration for railway drainage.

Hedgerows

6.5.13 For hedgerows, in line with the approach set out in Section 5.8 all hedgerows created or re-instated following construction will be targeted at creating diverse native hedgerows that meet the habitat of principal importance definition and are of 'high (3 x multiplier) condition.

6.5.14 For hedgerows, it has been assumed in the calculations that within the areas of temporary land-use, all hedgerows will be removed and then subsequently recreated post-construction in their previous locations. Therefore, previous Phase 1 habitat data has been utilised to indicate the likely locations at which habitats will be recreated. At all such locations it has been assumed that the hedgerow will be recreated and will achieve the same distinctiveness and condition scores as present pre-construction. However, it is acknowledged that due to field modifications and access requirements it is likely that at least some of the pre-construction hedgerows will not in reality be reinstated. On this basis a manual adjustment has been made to the post-construction calculation outputs, with a 10% reduction applied to the number of hedgerow units generated in areas of temporary land-use.

Risk multipliers

6.5.15 Time to target condition and difficulty of creation multipliers have been applied to the post-construction calculation in accordance with the criteria set out in Section 5.9.

6.5.16 Where HS2 Ltd has made a specific commitment within the ES or an assurance to landowners/stakeholders that an area of habitat located within the land required will be retained, then such areas are included within both the pre- and post-construction calculation, with all relevant risk multipliers set to a multiplier of 1.0. Therefore, retained features will score the same value within the pre- and post-construction calculations, and not affect the overall balance of biodiversity units in the calculation.

6.5.17 Risk multipliers have been applied to post-construction features in accordance with the guidance provided in Section 5.9. The most commonly used difficulty of creation and time to target condition multipliers utilised in the calculation for each key habitat type are shown in Table 9. However, it should be noted that at some

locations site specific adjustments have been applied where local conditions or habitat variations were considered to warrant this.

6.5.18 Risk multipliers have been applied both to areas of new habitat creation that form part of the mitigation/compensation strategy and to those areas required temporarily during construction where it is assumed existing habitats will be lost, and subsequently replaced with similar habitats prior to the return to the existing landowner.

6.5.19 The time to target condition values shown in Table 9 are based on the time required to achieve a condition score of 2 (moderate) for high and medium distinctiveness habitats, and condition 1 (poor) for low distinctiveness habitats. This approach accords with the cap on the condition target for newly created habitats (see paragraph 5.8.7) that has been applied in the HS2 methodology. The figures in Table 9 should not be used for achieving condition 3 habitats as the timescales involved to achieve condition 3 for many of these habitats would be considerably longer than those stated.

Table 9: Most commonly used risk multipliers for key habitat types within the HS2 calculation

Habitat category	Difficulty of creation multiplier	Time to target condition multiplier
Phase 1 Habitats (N.B. Phase 1 habitat categories are generally used in the post-construction calculation for those areas to be affected by construction only, where it is assumed existing habitats will be lost, and then recreated following construction)		
A1.1.1 Broad leaved - semi-natural woodland	0.67	0.33
A1.1.2 Broad leaved - plantation	0.67	0.71
A1.2.2 Coniferous woodland - plantation	0.67	0.71
A1.3.1 Mixed woodland - semi-natural	0.67	0.33
A1.3.2 Mixed woodland - plantation	0.67	0.71
A2. 1 Scrub - Dense scrub	1	0.71
A2.2 - Scrub - Scattered scrub	1	0.84
B1.1. - Acid grassland - unimproved	0.67	0.71
B1.2 - Acid grassland - semi-improved	0.67	0.71
B2.1 - Neutral grassland - unimproved	0.67	0.71
B2.2 - Neutral grassland - semi-improved	0.67	0.84[25]
B3.1 Calcareous grassland - unimproved	0.67	0.71

[25] A 0.84 time to target condition value is most commonly utilised for this habitat type, due to the high frequency of pasture fields of low biodiversity value that have been classified under this category.

Habitat category	Difficulty of creation multiplier	Time to target condition multiplier
B3.2 Calcareous grassland - semi-improved	0.67	0.71
B4 Improved grassland	1	0.97
B6 Poor semi-improved grassland	1	0.84
B5 Marsh/marshy grassland	0.67	0.71
AP2 design data habitat codes (N.B. These codes are used in the post construction calculation for areas of habitat to be created with the primary or joint primary purpose of ecological mitigation or compensation)		
K1.4 Ecological mitigation pond	1	0.84
K2.1 Woodland habitat creation	0.67	0.33
K2.3 Grassland habitat creation	0.67	0.71
K2.4 Landscape mitigation planting	0.67	0.71
K2.5 Hedgerow habitat creation	1	0.71
Other		
All retained habitat (i.e. area of habitat that are within the land required by the Scheme but will not be impacted by any works)	1	1

6.6 Removal of ancient woodland and associated compensatory habitat provision

6.6.1 In accordance with the recommendations of the Natural England review, an area based summary of losses of ancient woodland and compensation measures to be provided in response to these losses are provided in a separate ancient woodland strategy for HS2 Phase 2a.

6.6.2 Areas of ancient semi-natural woodland and plantation on ancient woodland (PAWS), and associated compensation measures have been isolated to prevent these features from generating biodiversity units in the calculation.

6.6.3 Information collated to inform the Environmental Statement and ancient woodland strategy has been used to identify the spatial extent of ancient woodland habitat that is likely to be affected by the Scheme, and associated compensation measures. These areas have been classified according to the following categories:

- areas within the proposed Bill where the Scheme will result in direct loss of ancient woodland;

- areas to be used for translocation of ancient woodland soils;
- areas of new planting to be provided in response to the loss of ancient woodland (excluding areas on ancient woodland soils);
- areas where HS2 Ltd will undertake enhancement of existing ancient woodland; and
- areas of ancient woodland within the area covered by the proposed Bill that will be retained.

6.6.4 Rather than removing the polygons for areas of ancient woodland and associated compensation from the no net loss geodatabase entirely, the spatial data generated in support of the ancient woodland strategy have been utilised to isolate the relevant areas in the pre- construction polygons and post-construction polygon feature classes and zero the biodiversity units generated by these polygons in the no net loss calculation.

6.6.5 The combined outer boundary of polygons within the ancient woodland habitat and compensation GIS feature class was used to split the relevant habitat polygons within the pre- and post-construction polygon layers.

6.6.6 For habitat polygons in pre-construction and post-construction polygon layers that coincided with the area covered by the ancient woodland habitat and compensation layer, a new field 'Precon_Used _in bio calc'/'Postcon_Used_in bio calc' was populated with the relevant code set out in Table 10.

Table 10: 'Used in biodiversity units' calculation codes

Used in Biodiversity Units Calculation Code	Description
BC1	Yes (area generates biodiversity units and is considered in the no net loss calculation).
BC2	No - Areas within the proposed Bill where the scheme will result in direct loss of ancient woodland
BC3	No - Areas within or outside of the proposed Bill where no direct loss of ancient woodland will occur, but the ES has identified the potential for significant indirect effects on ancient woodland
BC4	No - Areas to be used for translocation of ancient woodland soils
BC5	No - Areas of new planting to be provided in response to the loss of ancient woodland (excluding areas on ancient woodland soils)
BC6	No - Areas where HS2 Ltd will undertake enhancement of existing ancient woodland
BC7	No - Areas of ancient woodland within the area covered by the proposed Bill that will be retained
BC8	No - Area where HS2 Ltd will undertake enhancement of existing non-ancient woodland

6.6.7 For all ancient woodland and associated compensation within the pre-construction polygon and post-construction polygon feature classes (i.e. areas classified with a used in biodiversity calculation code of BC2 to BC8) all fields associated with the scoring criteria used in the no net loss calculation were set to <Null> (if they are a numeric field) or 'N/A' (if they are a text field).

6.6.8 Following the splitting process the area and biodiversity unit fields in the pre-construction and post-construction polygon feature classes were updated to take account of the changes resulting from this process.

6.6.9 No changes have been made to the polylines feature classes and linear features within areas of ancient woodland will continue to form part of the respective hedgerow and watercourse calculations.

6.7 Land use category feature class

6.7.1 To aid interpretation of the data by third parties, a new 'land use category' GIS feature class has been created. This feature class provides a high level indication of why each area of land is included within the land required for the Scheme, utilising the following categories:

- habitat within the Scheme boundary that will be retained;
- habitat required during construction only;
- habitat required permanently for the operation of the Scheme;
- habitat required for mitigation/compensation - joint primary purpose landscape and ecology;
- habitat required for mitigation/compensation - primary purpose ecology; and
- habitat required for mitigation/compensation - primary purpose landscape.

6.7.2 The new layer has been created based on information contained within the AP2 design data utilised to create the CT-05 Construction Phase and CT-06 post construction drawings, and that contained within the post-construction polygon layer.

Step 1

6.7.3 For each route section a copy of the post-construction polygon layer was made and the attribute field Land_Use_Cat (see Appendix C) was added (all values for that attribute field were blank at this stage).

Step 2

6.7.4 Route consultants then undertook a review of Scheme drawings, and assurances made with the ES, and subsequently to landowners, in order to identify those area within the limits of Bill where a commitment has been made to retain habitats located within the land required for the Scheme.

6.7.5 These areas were labelled within the land use feature class as 'Habitat within the Scheme boundary that will be retained'.

Step 3

6.7.6 A comparison of the CT-06 polygon design data extents and the AP2 Scheme was then undertaken. All polygons located within areas that are included in the CT-05 data, but are not included within the data covered by CT-06 data should be labelled in the Land_Use_Cat field as 'Habitat required during construction only'.

Step 4

6.7.7 Based on the guidance provided in Table 11, the data within the post-construction polygon layer were utilised to populate the land use category attribute field for areas that form part of the ecology and landscape mitigation package.

Table 11: Land use categories utilised in the land use category feature class

Land use category	Post-construction habitat distinctiveness codes used to create the layer
Habitat required permanently for the operation of the Scheme	All polygons listed with a K4 or K5 code within the 'Habitat description' attribute field
Habitat required for mitigation/compensation - joint primary purpose landscape and ecology	All polygons with habitat description code of K2.4 Landscape mitigation planting; or K2.6 Grassed areas and a post-construction distinctiveness rating of 6
Habitat required for mitigation/compensation - primary purpose ecology	All polygons with habitat description code of: K2.1 Woodland habitat creation; K2.2 Woodland habitat; K2.3 Grassland habitat creation. K2.4 Ecological mitigation pond.
Habitat required for mitigation/compensation - primary purpose landscape	Habitat description code of K2.4 Landscape mitigation planting; and a post-construction distinctiveness rating of 4.

Step 5

6.7.8 All remaining polygons without a land use category entry were at this stage populated with the entry 'Other land required for the construction and operation of the Proposed Scheme'. This habitat category covers the remaining elements of the constructed Scheme and principally includes elements such as the engineered earthworks and cutting faces.

6.7.9 As a check, the location of all such polygons was at this stage compared with the CT-06 layer data. All such polygons should fall within the extent of the CT-06 data.

Step 6

6.7.10 Once the land use layer had been populated, all attribute fields except the land use category field and those that are a mandatory HS2 Ltd requirement were deleted.

6.8 Assumptions and limitations – route-wide

Assumptions

6.8.1 As a general rule it has been assumed that those features located within the land required for the Scheme but outside of the areas shown in the CT-06 plans are required temporarily for construction only. While such areas are only required temporarily, as a worst case scenario it is assumed that all habitats within these areas will be lost when the areas are cleared prior to construction, and subsequently reinstated in accordance with HS2 Ltd's commitment to return these areas to landowners in a similar form and condition to that present prior to construction.

6.8.2 The calculation applies difficulty of creation and time to target condition multipliers for all habitats, including those within land used temporarily. This approach represents a worst case approach for land used temporarily because in some cases it may be possible to retain and restore these habitats (as opposed to their loss and re-creation as assumed within the calculation). In these instances it is likely that habitats will reach target condition sooner than the time period assigned within the calculation, in which case they would generate more biodiversity units than currently assumed.

6.8.3 With the exception of enhancement of ancient woodland (which is excluded from the calculation), the calculation assumes that pre-construction habitats within habitat creation areas are lost, prior to post-construction habitat creation. This is a precautionary approach and in reality there are likely to be a number of habitat creation locations where it will be practicable and ecologically preferable to enhance existing habitat to reach the target habitat type and condition. This will be determined as part of the detailed mitigation design and would be reflected in subsequent iterations of the calculation.

6.8.4 In addition it has been assumed that:

- the requirements of individual species issues will be addressed through compliance with the existing legislative and policy framework that applies to these species; and
- all areas of land shown in the CT-06 drawings as landscaped earthworks which do not show specific detail of proposed landscaping (e.g. tree planting on the earthwork) will return to their previous land use.

6.8.5 An exception has been made in relation to replacement floodplain storage areas, which appear on the CT-06 drawings, but it has in general been assumed that these areas will be reinstated to their preconstruction habitat type.

6.8.6 Where HS2 Ltd has made formal assurances[26] that compulsory purchase powers included in the Bill will not be exercised; the calculation assumes that habitats within these areas are to be retained. Retained areas of habitat have been scored with the same 'distinctiveness' and 'habitat condition' weightings in both the pre- and post-construction aspects of the calculation. In addition risk multipliers of 1 have been used for 'time to target condition' and 'difficulty of restoration'. Therefore, such areas score the same biodiversity units in both the pre- and post-construction elements of the calculation and do not affect the overall balance of biodiversity units.

Limitations

6.8.7 It is not possible to measure biodiversity in its entirety and therefore the no net loss calculation utilises a habitat based metric to provide a broad indication of the likely biodiversity value of each area of land required for the Scheme. It has not been possible to access all land to undertake survey, therefore as set out in the methodology in some areas the scoring has been influenced by data from pre-existing surveys and interpretation of aerial photography.

6.8.8 Detailed landscape design is yet to be undertaken. As a consequence the AP2 design only includes broad categories for habitats to be created (e.g. grassland habitat creation) that features in the post-construction calculation. These categories limit the ability to provide detailed comparisons with the more detailed Phase 1 habitat categories that are available for habitats present pre-construction. Phase 1 habitat categories are only available in the post-construction calculation for those locations where land is required on a temporary basis only, and therefore they will be returned to their original habitat type following construction.

6.8.9 In line with the worst-case scenario assumed in the main ES, the calculation assumes that all hedgerows within areas required temporarily for the construction of the Scheme will be removed and following completion of construction re-created on their existing alignments. However, in practice the final layout of re-created hedgerows will be adjusted to accommodate the reconfiguration of field boundaries, and revised access requirements. In the absence of detailed design the hedgerow data cannot be edited to reflect these changes. An adjustment has been applied to limit the impact on the calculation as set out in Section 7.2.

[26] These are unilateral commitments given directly to Petitioners or affected parties which do not have the status of legally binding contracts enforceable by the courts, but are made binding on the project by being included on the Register of Undertakings and Assurances. Enforcement is through the Secretary of State.

6.8.10 There is a difference of approximately 0.9ha in the total area of the pre-construction and post-construction habitat polygons. The discrepancy represents approximately 0.03% of the total area and is created by tiny gaps between mapped features within the GIS layers. Given the very small scale of this discrepancy it will create a negligible difference in area-based biodiversity units and therefore is not a significant constraint to the calculation.

6.8.11 It is acknowledged that both the pre- and post-construction calculations do not overtly acknowledge the biodiversity units that may be generated by roadside verges. This is a consequence of both the scale of the initial Phase 1 habitat survey mapping, and the level of detail currently available through the CT-06 drawings. However, it is likely that in many cases the road diversion routes included within the Scheme will be longer in extent than those which are currently present. As such even when risk multipliers are considered, the overall effect of this element on the wider calculation is likely to be minimal.

6.8.12 The land use feature class has been produced specifically in support of the updated no net loss calculation. It has been generated utilising a series of existing data sets and given that this was not the intended purpose for any of these data sets there is potential for some errors in the land use categories allocated. However, it should be noted that the accuracy of the land use categories allocated has no impact on the accuracy of the no net loss calculation output given that it has no effect on the number of biodiversity units allocated.

6.9 Quality assurance process

6.9.1 A quality audit on data outputs has been undertaken on all elements of the calculation, which has focused on ensuring that:

- the scoring of features within the calculation has been informed by the most suitable available baseline information and sound professional judgement; and
- scoring has been undertaken consistently and in accordance with the prescribed metric.

6.9.2 As part of the final QA process, a further detailed technical review of pre-construction and post-construction data polygon and polyline data covering a minimum of 10% of the total route alignment was undertaken to check that the scoring methodology has been implemented accurately and consistently.

6.9.3 The review was undertaken by an ecologist familiar with the methodology, but who had not been involved in undertaking the scoring for the selected areas identified. The scope of the reviews included the following:

- undertaking peer review of the application of the metric to ensure consistency within route section, and verification of professional judgements;
- undertaking numerical queries on the GIS database to check for potential outputs that are contrary to the 'rules' set out in the prescribed methodology. For example, have time to target condition and difficulty of recreating values been prescribed in line with the methodology;
- comparing scored distinctiveness values with available data from habitat inventories, including the Natural England Priority Habitat Inventory data set;
- have route section specific assumptions and limitations been documented; and
- undertaking GIS data checks to confirm data conforms with the requirements of the HS2 GIS schema.

6.9.4 Following the completion of the 10% QA check of the habitat polygons and polylines data all changes identified as being required from review of this subsection of the data were actioned and applied across the entire data set.

6.9.5 A standard spreadsheet of final QA checks was also undertaken. These checks focused on identifying any potential non-conformities with rules or default values utilised with the calculation, and ensuring justifications for any exceptions were documented. The QA checks undertaken are set out in Appendix F. Exceptions to these rules were reviewed and justifications provided where deviations were considered justified.

6.9.6 Once the data had passed the various QA checks set out in Appendix F, a spatial QA tool was run on the GIS dataset. This is an automated series of checks of the spatial aspects of the GIS data which identifies issues such as where there is overlap between the habitat polygons in the GIS database.

6.10 Accessing the data

6.10.1 In order to enable third party scrutiny of the no net loss calculation, it is intended that the GIS data will be shared with relevant stakeholders.

6.10.2 The non-GIS format of the data has been provided in a spreadsheet format. This is a direct extract from the GIS data.

6.10.3 An explanation of key fields used within the GIS database is provided in Appendix E.

6.10.4 Several of the other data sets that have underpinned the calculation (e.g. HS2 Phase 1 habitat data) are also updated periodically at the data.gov.uk site. A summary of the data sources utilised in the no net loss calculation in each route section is provided in Table 8.

7 Results

7.1 Route-wide summary of calculation outputs

7.1.1 Table 12 and Table 13 respectively provide a summary of the no net loss calculation outputs for habitat polygons (area-based features) and polylines (linear-based features) at a route-wide level. These totals are derived from the data contained within the GIS data. In each case the comparison between the pre and post-construction totals gives an indication of progress towards the goal of no net loss in biodiversity in relation to replaceable habitats.

7.1.2 For habitat polygons (area based features), Table 12 shows the number of area-based biodiversity units sub-divided by habitat types and distinctiveness weightings in order to aid comparison of how the biodiversity units are distributed.

7.1.3 Table 13 provides a summary at the route-wide level of the calculation outputs for hedgerows and watercourses, which are both considered within the metric as linear features. It should be noted that the methodology for calculating the number of biodiversity units differs between hedgerows and watercourses, and so units are not interchangeable.

Table 12: Route-wide summary of area-based biodiversity units generated pre- and post-construction

Habitat polygons (Area-based biodiversity units)							
Pre-construction			Post-construction			Summary	
Habitat category (distinctiveness weighting)	Area (ha)	Area-based biodiversity units generated	Habitat category (distinctiveness weighting)	Area (ha)	Area-based biodiversity units generated	Net change in area-based biodiversity units	Net change in area (ha)
Woodland & scrub (6)	80.14	987.03	Woodland & scrub (6)	205.86	542.22	-444.81	125.72
Woodland & scrub (4)	42.25	317.53	Woodland & scrub (4)	23.43	92.57	-224.96	-18.82
Woodland & Scrub (2)	6.27	12.54	Woodland & Scrub (2)	4.32	7.25	-5.29	-1.96
Woodland & Scrub (0)	0.00	0.00	Woodland & Scrub (0)	0.00	0.00	0.00	0.00
Woodland & Scrub (NULL)	30.58	0.00	Woodland & Scrub (NULL)	95.58	0.00	0.00	65.00
Grassland (6)	45.86	460.77	Grassland (6)	218.42	1228.09	767.32	172.57
Grassland (4)	260.90	1536.47	Grassland (4)	130.97	596.78	-939.69	-129.93

Habitat polygons (Area-based biodiversity units)							
Grassland (2)	831.77	1663.54	Grassland (2)	623.68	1161.40	-502.13	-208.09
Grassland (0)	0.00	0.00	Grassland (0)	0.00	0.00	0.00	0.00
Grassland (NULL)	39.16	0.00	Grassland (NULL)	3.45	0.00	0.00	-35.71
Other habitats (6)	5.82	71.90	Other habitats (6)	69.46	448.16	376.26	63.64
Other habitats (4)	9.62	76.57	Other habitats (4)	166.14	682.58	606.01	156.51
Other habitats (2)	1380.13	2760.26	Other habitats (2)	898.62	1785.79	-974.47	-481.51
Other habitats (0)	205.73	0.00	Other habitats (0)	409.98	0.00	0.00	204.25
Other habitats (NULL)	40.34	0.00	Other habitats (NULL)	127.76	0.00	0.00	87.42
TOTALS	2978.57	7886.61		2973	6544.84		-0.91
Route-wide net change in area-based biodiversity units						-1341.76	

Table 13: Route-wide summary of biodiversity units generated pre- and post-construction (linear features)

Polylines (Linear based features)						
Pre-construction			Post-construction			Summary
Habitat type	Length (m)	Biodiversity units generated	Habitat type	Length (m)	Biodiversity units generated	Net change in Biodiversity Units
Hedgerow	234180.00	499228.91	Hedgerow	300766.46	629866.78	130637.87
Watercourse	22604.94	46660.71	Watercourse	14039.95	28860.18	-17800.53

7.2 Discussion of calculation outputs

Area-based features

7.2.1 Each row in Table 12 reports the change in area and area-based biodiversity units that are expected as a consequence of Phase 2a of HS2 for a particular habitat category (e.g. woodland), and distinctiveness ban (e.g. high distinctiveness - 6 x weighting).

7.2.2 A summary of the habitat types included in each of the habitat categories utilised for results analysis is provided as Appendix G.

7.2.3 The granularity of the habitat categories utilised for the purpose of comparing the pre- and post-construction calculations is constrained by the broad-level habitat categories utilised within the Scheme design data (e.g. woodland habitat creation, grassland habitat creation). Therefore, for example it is not possible at this stage of the project to provide a clear comparison of the area-based biodiversity units generated by specific Phase 1 habitat types (e.g. B2.1 Neutral grassland - unimproved) before and after construction for the entire Scheme. Phase 1 habitat type data is only available for the post-construction calculation where the areas concerned are either retained or are only required during construction[27].

7.2.4 A more detailed breakdown of the calculation outputs will be possible in subsequent iterations of the calculation once both the detailed engineering design, and in particular the detailed landscape design of the Scheme is finalised.

7.2.5 A commentary in relation to the key habitat types is provided below, and (as far as current data allows) further details of the composition of pre-construction and post-construction habitats is provided in the following sections.

Woodland and scrub (overview)

7.2.6 The woodland and scrub habitats created post-construction (all distinctiveness categories) are expected to generate approximately 675 fewer area-based biodiversity units than the woodland and scrub habitats currently present, with approximately a 51% reduction in the number of biodiversity units present. There is a reduction in the biodiversity units at all distinctiveness categories and so the results do not show a 'trading down' between categories, i.e. there is not a surplus of units at a lower distinctiveness category that is providing an offset for a deficit at a higher distinctiveness category.

7.2.7 A breakdown of the area of woodland and scrub habitat types sub-divided by habitat distinctiveness category is provided in Table 14.

[27] Areas of land required only during construction are assumed to be reinstated to the same Phase 1 habitat type as was present in that location prior to construction.

Table 14: Breakdown of woodland and scrub habitats by habitat distinctiveness score

Habitat type	Pre-construction distinctiveness score				Post-construction distinctiveness score			
	High (6 x weighting) (ha)	Moderate (4 x weighting (ha)	Low (2 x weighting) (ha)	Total (ha)	High (6 x weighting) (ha)	Moderate (4 x weighting) (ha)	Low (2 x weighting) (ha)	Total (ha)
A1.1.1 Broadleaved woodland – unimproved	78.19	0.00	0.00	78.19	47.63	0.00	0.00	47.63
A1.1.2 Broadleaved woodland – plantation	0.00	15.77	0.00	15.77	0.00	8.51	0.00	8.51
A1.2.2 Coniferous woodland - plantation	0.00	3.71	0.00	3.71	0.00	2.73	0.00	2.73
A1.3.1 Mixed woodland – unimproved	1.95	2.12	0.00	4.07	1.02	1.26	0.00	2.27
A1.3.2 Mixed woodland - semi-improved	0.00	3.90	0.00	3.90	0.00	1.80	0.00	1.80
A2. 1 Scrub - dense/continuous;	0.00	11.97	0.00	11.97	0.00	7.79	0.00	7.79
A2.2. Scrub - scattered	0.00	0.00	6.27	6.27	0.00	0.00	4.32	4.32
A3.1 Parkland/scattered trees - Broad-leaved	0.00	4.75	0.00	4.75	0.00	1.32	0.00	1.32
A3.2 Parkland/scattered trees – Coniferous	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A3.3 Parkland/scattered trees – Mixed	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02
K2.1 Woodland habitat creation	0.00	0.00	0.00	0.00	157.21	0.00	0.00	157.21
K2. 4 Landscape mitigation planting (scrub/woodland)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Woodland and scrub pre-construction total (ha)			128.66	Woodland and scrub post-construction total (ha)			233.60

Woodland and scrub (high distinctiveness - 6 x weighting)

7.2.8 A breakdown of the extent of individual habitat types within this category is provided in Table 14.

7.2.9 Prior to construction the land required for the Scheme includes approximately 80ha of woodland habitat of 'high distinctiveness' (6 x weighting) (i.e. woodland habitat that qualifies as habitat of principal importance under Section 41 of the Natural

Environment and Rural Communities Act, 2006). Post-construction there will be approximately 206ha of woodland habitat of 'high distinctiveness' (6 x weighting), a net increase in area of approximately 126ha.

7.2.10 However, based on the risk multipliers applied within the area-based biodiversity units calculation there will be a reduction of approximately 445 biodiversity units in the number of area-based biodiversity units generated by 'high distinctiveness' woodland.

Woodland and scrub (moderate distinctiveness - 4 x weighting)

7.2.11 A breakdown of the extent of individual habitat types within this category is provided in Table 14.

7.2.12 Prior to construction the land required for the Scheme includes approximately 42ha of woodland and scrub habitats of moderate distinctiveness (4 x weighting).

7.2.13 Post-construction there will be approximately 23ha of woodland and scrub habitat of moderate distinctiveness (4 x weighting). This represents a net reduction of approximately 19ha. This does not include 122ha of woodland and scrub planting that has been proposed with the primary function of providing landscape and visual mitigation, or aiding the landscape integrating the Scheme (K2.4 Landscape Mitigation Planting), which is accounted for within the 'other habitat' categories within the calculation.

7.2.14 For moderate distinctiveness woodland and scrub habitats there is anticipated to be a net reduction of approximately 225 area-based biodiversity units.

Woodland and scrub (low distinctiveness - 2 x weighting)

7.2.15 Prior to construction the land required for the Scheme includes approximately 6ha of woodland and scrub habitats of low distinctiveness (2 x weighting).

7.2.16 Post-construction there will be approximately 4ha of woodland and scrub habitats of low distinctiveness (2 x weighting). This represents a net reduction of approximately 2ha.

7.2.17 A breakdown of the extent of individual habitat types within this category is provided in Table 14. Low distinctiveness woodland and scrub habitats are anticipated to produce approximately 5 fewer area-based biodiversity units within the post-construction calculation.

Grassland (overview)

7.2.18 The Scheme is expected to result in a 'trading up' across the grassland distinctiveness categories, with reductions in moderate (4 x weighting) and low distinctiveness (2 x weighting) areas of grassland accompanied by a significant increase in both the extent and area-based biodiversity units generated by habitats of high distinctiveness (6 x weighting).

7.2.19 Overall, there is expected to be a net reduction of approximately 675 biodiversity units generated by grassland habitats established post-construction (equivalent to approximately an 18% loss in grassland area-based biodiversity units).

7.2.20 A breakdown of the area of grassland habitats sub-divided by habitat distinctiveness category is provided in Table 15. As discussed for woodland habitats, the granularity of the post-construction data is limited by the broad habitat categories that are used within the current design data.

Table 15: Breakdown of grassland habitats by habitat distinctiveness score

Habitat type	Pre-construction distinctiveness score				Post-construction distinctiveness score			
	High (6 x weighting) (ha)	Moderate (4 x weighting (ha)	Low (2 x weighting) (ha)	Total (ha)	High (6 x weighting) (ha)	Moderate (4 x weighting) (ha)	Low (2 x weighting) (ha)	Total (ha)
B1.1 Acid grassland - Unimproved	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B1.2 Acid grassland - Semi-improved	0.21	0.00	0.00	0.21	0.02	0.00	0.00	0.02
B2.1 Neutral grassland - Unimproved	3.17	0.00	0.00	3.17	0.15	0.00	0.00	0.15
B2.2 Neutral grassland - Semi-improved	30.49	63.07	0.00	93.55	7.25	26.42	0.00	33.67
B3.1 Calcareous grassland - unimproved	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B3.2 Calcareous grassland - semi-improved.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B4 Improved grassland	0.81	0.00	786.87	787.68	0.00	0.00	417.34	417.34
B5 Marsh/marshy grassland	9.65	2.37	0.00	12.02	3.42	0.81	0.00	4.22
B6 Poor semi-improved grassland	1.53	195.46	0.00	196.99	4.83	103.74	0.00	108.57

Habitat type	Pre-construction distinctiveness score				Post-construction distinctiveness score			
	High (6 x weighting) (ha)	Moderate (4 x weighting (ha)	Low (2 x weighting) (ha)	Total (ha)	High (6 x weighting) (ha)	Moderate (4 x weighting) (ha)	Low (2 x weighting) (ha)	Total (ha)
J1.2 Cultivated/disturbed ground - Amenity grassland	0.00	0.00	44.90	44.90	0.00	0.00	28.44	28.44
K2.3 Grassland Habitat Creation	0.00	0.00	0.00	0.00	202.75	0.00	0.00	202.75
K2.6 Grassed Areas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K5.3 Engineering earthworks	0.00	0.00	0.00	0.00	0.00	0.00	177.90	177.90
	Grassland pre-construction total (ha)			1138.52	Grassland post-construction total (ha)			973.06

Grassland (high distinctiveness - 6 x weighting)

7.2.21 A breakdown of the extent of individual habitat types within this category is provided in Table 15.

7.2.22 Prior to construction approximately 44.5ha of grassland habitat of 'high distinctiveness' (6 x weighting) (i.e. grassland habitats that meet the habitat of principal importance definitions for grassland habitats) are located within the land required for the Scheme. This total excludes the 1.5ha of grassland of high distinctiveness which comprises poor semi-improved grassland that has been uplifted due to the presence of remnant inland saltmarsh habitat. This is not included in the total because this is not a habitat of principal importance.

7.2.23 Post-construction there will be approximately 218ha of grassland habitats of high distinctiveness (6 x weighting), an increase of approximately 173.5ha.

7.2.24 This translates into a net gain of approximately 767 biodiversity units generated by grasslands that are likely to meet habitat of principal importance definitions. In contrast there is a significant reduction in both the extent and number of area-based biodiversity units generated by grassland habitats of moderate and low distinctiveness post-construction.

Grassland (moderate distinctiveness - 4 x weighting)

7.2.25 A breakdown of the extent of individual habitat types within this category is provided in Table 15.

7.2.26 Prior to construction approximately 261ha of grassland habitat of 'moderate distinctiveness' (4 x weighting) are located within the land required for the Scheme. Post-construction there will be approximately 131ha, a reduction of approximately 130ha.

7.2.27 Moderate distinctiveness grasslands are anticipated to produce approximately 940 fewer area-based biodiversity units in the post-construction calculation (c.f. pre-construction).

Grassland (low distinctiveness - 2 x weighting)

7.2.28 A breakdown of the extent of individual habitat types within this category is provided in Table 15.

7.2.29 Prior to construction approximately 832ha of grassland habitat of 'low distinctiveness' (2 x weighting) are located within the land required for the Scheme. Post-construction there will be 623ha, a reduction of approximately 209ha. This translates to grassland habitats of low distinctiveness generating approximately 502 fewer biodiversity units in the post-construction calculation.

Other habitats (overview)

7.2.30 Collectively across all habitat distinctiveness bands 'other habitat' types are expected to generate approximately a net gain of 8 area-based biodiversity units within the post-construction calculation (approximately 0.3% increase on that present pre-construction).

7.2.31 There is a reduction of 974 biodiversity units generated by 'other habitats of low distinctiveness 2 x weighting). This includes a reduction of approximately 521ha in the extent of arable farmland. However, the Scheme is expected to result in a 'trading up' across 'other habitat' of high (6 x weighting) and moderate (4 x weighting) distinctiveness. In both cases the extent and number of area-based biodiversity units generated are expected to increase.

7.2.32 An area based breakdown of key 'other habitats' sub-divided by habitat distinctiveness categories is provided in Table 16. As discussed for woodland habitats, the granularity of the post-construction data is limited by the broad habitat categories that are used within the current design data.

Table 16: Breakdown of selected 'other habitat' by habitat distinctiveness score

Habitat type	Pre-construction distinctiveness score				Post-construction distinctiveness score			
	High (6 x weighting) (ha)	Moderate (4 x weighting (ha)	Low (2 x weighting) (ha)	Total (ha)	High (6 x weighting) (ha)	Moderate (4 x weighting) (ha)	Low (2 x weighting) (ha)	Total (ha)
C1.1 - Bracken - continuous	0.00	0.00	1.90	1.90	0.00	0.00	0.66	0.66
C1.2 - Bracken - scattered	0.00	0.00	0.04	0.04	0.00	0.00	0.04	0.04
C3.1 - Other tall herb and fern - ruderal	0.00	0.00	7.32	7.32	0.00	0.00	3.46	3.46
F2.2 - Marginal and inundation - inundation vegetation	0.05	0.00	0.00	0.05	0.05	0.00	0.00	0.05
G1 - Standing water	4.96	8.91	0.00	13.88	3.28	6.00	0.00	9.28
G1.1 - Standing water - eutrophic	0.04	0.40	0.00	0.44	0.00	0.27	0.00	0.27
G1.2 - Standing water - mesotrophic	0.10	0.21	0.00	0.31	0.10	0.16	0.00	0.26
J1.1 - Cultivated/disturbed land - arable	0.67	0.00	1352 .70	1353.3 7	0.00	0.00	832.17	832.17
J1.3 - Cultivated/disturbed land - ephemeral/short perennial	0.00	0.10	0.00	0.10	0.00	0.10	0.00	0.10
J1.4 - Introduced shrub	0.00	0.00	0.30	0.30	0.00	0.00	0.15	0.15
J2.8 - Earth bank	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.02
J3.6 - Buildings	0.00	0.00	5.30	5.30	0.00	0.00	3.90	3.90
J4 - Bare ground	0.00	0.00	10.2 0	10.20	0.00	0.00	3.72	3.72
J5 - Other habitat	0.00	0.00	2.04	2.04	0.00	0.00	2.00	2.00
K1.2 - Balancing pond	0.00	0.00	0.00	0.00	0.00	37.49	0.00	37.49
K1.4 - Ecological mitigation pond	0.00	0.00	0.00	0.00	7.73	0.00	0.00	7.73
K2.2 - Wetland habitat creation	0.00	0.00	0.00	0.00	58.31	0.00	0.00	58.31
K2.4 - Landscape mitigation planting (primary purpose = landscape & visual)	0.00	0.00	0.00	0.00	0.00	122.1 1	0.00	122.11
K2.6 - Grassed areas (primary purpose = landscape & visual)	0.00	0.00	0.00	0.00	0.00	0.00	45.30	45.30
K4.2 - Depot, station, headhouse or portal building	0.00	0.00	0.00	0.00	0.00	0.00	1.79	1.79
K4.4 - Electricity substation	0.00	0.00	0.00	0.00	0.00	0.00	5.40	5.40
	Other habitats pre-construction total (ha)			1395.5 8	Other habitats post-construction total (ha)			1134.22

Other habitats (high distinctiveness - 6 x weighting)

7.2.33 A breakdown of the extent of individual habitat types within this category is provided in Table 16.

7.2.34 Prior to construction the land required for the Scheme contains approximately 6ha of 'other habitat' that qualifies as habitat of principal importance (i.e. a 'high' distinctiveness score - weighting x 6) which includes:

- approximately 0.1ha of marginal and inundation vegetation;
- approximately 5.1ha of standing water; and
- approximately 0.7ha of arable, which is an area of Traditional Orchard habitat of principal importance that was mapped as arable from interpretation of aerial photographs.

7.2.35 Post-construction there will be approximately 69ha of 'other habitat' that qualifies as habitat of principal importance. This is an increase of approximately 63ha from the 6ha of 'high distinctiveness' habitat present prior to construction. This translates to an increase of approximately 376 area-based biodiversity units.

7.2.36 The 'other habitat' of 'high distinctiveness' (6 x weighting) created by HS2 Ltd will include significant areas of pond (approximately 8ha), and wetland (approximately 58ha).

Other habitats (moderate distinctiveness - 4 x weighting)

7.2.37 A breakdown of the extent of individual habitat types within this category is provided in Table 16.

7.2.38 Prior to construction the land required for the Scheme contains approximately 10ha of 'other habitats' of moderate distinctiveness. This includes approximately 9ha of standing water, 0.4ha of standing water – eutrophic, 0.2ha standing water - mesotrophic and 0.1ha of cultivated/disturbed land - ephemeral/short perennials.

7.2.39 It is anticipated there will be a net gain of approximately 157ha of 'moderate distinctiveness' (4 x weighting) 'other habitats' post-construction. This translates to an increase of approximately 606 area-based biodiversity units. This is largely driven by the inclusion within this category of 122ha of woodland and scrub planting that has been proposed with the primary function of providing landscape and visual mitigation, or aiding the landscape integrating the Scheme (K2.4 Landscape Mitigation Planting).

Other habitats (low distinctiveness - 2 x weighting)

7.2.40 A breakdown of the extent of individual habitat types within this category is provided in Table 16.

7.2.41 'Other habitats' of low distinctiveness occupy an area of approximately 1380ha pre-construction, but only 899ha post-construction. Therefore, there is expected to be a net reduction in their extent of approximately 481ha. This habitat group includes arable fields, improved grassland and areas of amenity grassland.

7.2.42 There will be a net loss of approximately 974 area-based biodiversity units due to the loss of 'other habitats' of 'low distinctiveness' (2 x weighting).

Linear-based features

Hedgerows

7.2.43 Table 13 sets out the outputs of the pre- and post-construction calculations for hedgerows. The calculation shows that there is approximately 234km of hedgerow which are present prior to construction. Assuming the creation of hedgerows identified within the AP2 design, and the re-creation of all hedgerows in areas of temporary land-use, then approximately 301km of hedgerow are likely to be present post-construction. This equates to a net increase of approximately 130,638 hedgerow biodiversity units.

7.2.44 However, in line with the precautionary approach adopted for the rest of the assessment a further manual adjustment to the calculation outputs has been applied to gain a worst-case estimate for the potential change in hedgerow biodiversity units.

7.2.45 The Scheme contains large areas of land that will be used temporarily and then returned to landowners after construction. For the purposes of the calculation reported in Table 17 it has been assumed that all hedgerows within areas required temporarily will be reinstated on their existing alignments. In practice it is likely that there will be at least a proportion of these hedgerows that will not be reinstated in order to accommodate the reconfiguration of field boundaries, and to accommodate revised access requirements.

7.2.46 Based on a visual review of the post-construction dataset to study the arrangement of hedgerows in areas of permanent and temporary land-use it is estimated that reconfigurations could result in approximately a 10% reduction in the length of hedgerow currently estimated in the post-construction calculation. Taking this into account a broad adjustment has been made to the likely number of hedgerow

biodiversity units generated post-construction, through applying a 10% reduction to the number of hedgerow units generated in those areas of temporary land take due to reconfiguration of field boundaries.

7.2.47 The adjustment is set out in Table 17, and reduces the net increase in hedgerow biodiversity units to approximately 100,372 units. This represents an increase of approximately 20% on the biodiversity units generated by hedgerows present prior to construction.

Table 17: Adjustment to hedgerow biodiversity units to take into account likely reconfiguration of hedgerows in areas of temporary land-use

Pre-construction hedgerow biodiversity units (based on metric output – see Table 13)	Post-construction hedgerow biodiversity units generated (based on metric output – see Table 13)	Adjusted Post-construction hedgerow biodiversity units (10% reduction from metric output applied)	Adjusted net change in biodiversity units
499228.91	629866.78	599600.56	100371.65

Watercourses

7.2.48 Table 13 sets out the outputs of the pre- and post-construction calculations for watercourses. There will be approximately 8.6km decrease in the length of watercourses due to the Scheme. This translates to a net reduction of approximately 17,801 watercourse biodiversity units. This represents a decrease of approximately 38% from the biodiversity units generated by watercourses present prior to construction. This is discussed in Section 8.3.

8 Discussion and conclusions

8.1 Introduction

8.1.1 The HS2 metric calculates losses and gains in replaceable habitats for both area based features, and linear features (hedgerows and watercourses only). The no net loss calculation for replaceable habitats, therefore, results in three separate conclusions, one for the area based features and one for each of the length based calculations.

8.1.2 In considering the outputs of HS2 Ltd's no net loss calculation, it is important to understand the context within which this work has been undertaken. HS2 Phase 2a is the UK's second major linear infrastructure Scheme of national significance to adopt the objective of seeking to achieve no net loss in biodiversity, with HS2 Phase One being the first. In order to gauge progress towards this goal, it has adopted an accounting mechanism which utilises a biodiversity metric to allow the losses and gains in biodiversity as a consequence of the Scheme to be compared.

8.1.3 Undertaking such a calculation is not currently a statutory requirement, although it is likely to become mandatory for planning applications following a Defra consultation on net gain between December 2018 and February 2019. HS2 Ltd have voluntarily adopted such an approach for Phase 2a of HS2 in order to proactively acknowledge the importance of no net loss (and net gain) initiatives and seek to ensure that Phase 2a of HS2 plays its role in contributing to the UK Government's policy goal of halting biodiversity decline.

8.1.4 HS2 Ltd has made significant investments in developing a methodology to transparently allow the wider biodiversity performance of the Scheme to be measured. In doing so it has sought to promote the importance of no net loss initiatives and encourage major development Schemes to ensure due consideration of the overall biodiversity impact of a Scheme, rather than simply addressing the significant effects identified within the statutory EIA process.

8.1.5 The outputs of the current iteration of the no net loss calculation provide an indication of HS2 Ltd's current progress towards the goal of seeking no net loss in biodiversity in relation to replaceable habitats. These outputs should not be considered the final answer. The calculation will continue to evolve during the lifetime of the project, and HS2 Ltd intends to undertake further updates as the project progress (see Section 8.5). As set out in Section 8.4 there are significant reasons to suggest that the overall goal of seeking to achieve no net loss in relation to replaceable habitats can be achieved.

8.1.6 Given that HS2 is the first major UK infrastructure project to adopt the use of a biodiversity metric based accounting approach, it is perhaps unsurprising that the method adopted has generated much debate. HS2 Ltd will continue to discuss their approach with Natural England in order to achieve further developments to the methodology for subsequent phases of the project, where timescales and data collection requirements allow.

8.2 Area based features

Route-wide calculation

8.2.1 As described within the main ES, SES1 and AP1 ES, and SES2 and AP2 ES, published in support of Phase 2a of HS2, the mitigation measures included in the Bill are sufficient to address the significant adverse effects of the Scheme on replaceable habitats. Overall, HS2 Phase 2a is likely to result in significant increases in the overall extent of habitats achieving habitat of principal importance status, including net increases of approximately 173ha of habitat of principal importance grasslands and approximately 126ha of habitat of principal importance woodlands.

8.2.2 At the route wide level the results of the area-based aspects of the no net loss calculation for replaceable habitats, which is the largest component, currently suggests that the Scheme will result in approximately a 17 % reduction in the number of area based biodiversity units generated by replaceable habitats.

8.2.3 As set out within international standards (e.g. IUCN Policy of Biodiversity Offsets[xxiv]) in order for the project to have achieved the overall goal of achieving no net loss in biodiversity it is necessary that the biodiversity losses as a consequence of the project are addressed through compensatory provision that is either ecologically equivalent or of higher conservation priority (i.e. 'like for like or better').

8.2.4 Within the HS2 metric this equates to a requirement that the area-based biodiversity units for a particular habitat type and distinctiveness band (e.g. woodland of high distinctiveness) within the pre-construction calculation are balanced by units within the post-construction calculation generated by habitats of similar type and of equal or higher distinctiveness category.

8.2.5 At present there is a significant reduction in the area based biodiversity units generated by woodlands of high distinctiveness (approximately 445 area based units). There will be approximately 206ha of woodland and scrub habitats of high distinctiveness created as part of HS2, but currently there will be a 'downgrading' with less area-based biodiversity units being created by woodland habitat of high distinctiveness post-construction. There will also be an approximately 19ha decrease

and approximately 225 area based biodiversity units decrease in relation to moderate distinctiveness woodland and scrub habitats.

8.2.6 In relation to grassland the calculation indicates a positive outcome for grassland areas of high distinctiveness with approximately 218ha of 'high' distinctiveness grassland to be created and a net gain of over 767 area based biodiversity units anticipated. These area-based biodiversity unit gains in relation to high distinctiveness grassland, do not exceed the losses in relation to moderate and low distinctiveness grasslands, thus showing that grassland compensation at this stage does not meet the 'like for like or better' criteria.

8.2.7 For 'other habitats' the calculation predicts a positive outcome, with an overall increase in the number of area based biodiversity units generated by 'other habitats' (an increase of approximately 8 biodiversity units). There is a 'trading up' across moderate and high distinctiveness 'other habitats', which show net increases in area-based biodiversity units post-construction that outweigh the reduction in units generated by low distinctiveness 'other habitats'. However, as the 'other habitats' category includes a diverse range of habitat types, and there are difficulties in drawing detailed comparisons between losses and gains for each of these individual habitat types it is not possible at this stage to demonstrate that ecological equivalence has been achieved for all such habitats.

8.3 Linear based features

Hedgerows

8.3.1 The adjusted outputs of the current calculation (Table 17) in relation to hedgerows are precautionary and show that based on the design information available at this stage there is predicted to be a net increase in the biodiversity value of hedgerow habitats of approximately 100,372 hedgerow biodiversity units as a consequence of the Scheme. Furthermore, due to the precautionary approach adopted in the calculation (see Section 7) this is considered to be a worst-case estimate. The extent of post-construction hedgerow habitat is expected to increase further in subsequent iterations of the calculation due to the retention of hedgerows within areas of temporary landtake[28].

Watercourses

8.3.2 In relation to watercourses the calculation predicts a loss in watercourse biodiversity units, of approximately 17,801 once the Scheme has been constructed. This result in part reflects the fact that newly created ditches are excluded from the features

[28] The current iteration of the calculation assumes that all hedgerows within areas of temporary landtake are lost and then reinstated. Where hedgerows are retained these features will generate the same biodiversity units in both the pre and post-construction, thus reducing the overall deficit in hedgerow biodiversity units.

included in the post-construction calculation. These features are not afforded biodiversity units within the calculation as current design data does not clearly distinguish those ditches that are likely to regularly hold water. Due to the precautionary approach adopted in the calculation (see Section 7) this is considered to be a worst-case estimate. As the project progresses through detailed design it will be possible to distinguish new 'ditches' that are likely to support regular flows, and should therefore be included within the post-construction calculation as watercourses. Furthermore, the units generated by post-construction watercourse habitat is expected to increase in subsequent iterations of the calculation due to the retention of small watercourses within areas of temporary landtake.

8.4 Progressing towards the goal of achieving no net loss

8.4.1 The outputs of the current calculation show that the goal of seeking to achieve no net loss in relation to replaceable habitats has yet to be achieved. However, progress towards this goal has been made, and HS2 Ltd reaffirms its commitment to continue to work towards achieving this goal as the project progresses through detailed design and construction, and into the period of operation.

8.4.2 In order to robustly demonstrate that the seeking no net loss objective for replaceable habitats has been achieved, it will be necessary to reduce the deficit in:

a. area-based biodiversity units (i.e. ensure that when all replaceable habitats are considered the post-construction calculation generates the same or greater biodiversity units than those habitats present pre-construction);
b. area-based biodiversity units associated with woodland habitats of high distinctiveness (i.e. ensure that high distinctiveness woodland habitat generates the same or greater biodiversity units than those high distinctiveness woodland habitats present pre-construction,
c. area-based biodiversity units associated with woodland habitats of moderate distinctiveness (i.e. ensure that moderate distinctiveness woodland habitat generates the same or greater biodiversity units than those moderate distinctiveness woodland habitats present pre-construction, or that any shortfall in units from moderate distinctiveness woodland is outweighed by a greater increase in high distinctiveness woodland);
d. area-based biodiversity units associated with grassland habitats of moderate distinctiveness (i.e. ensure that moderate distinctiveness grassland habitat generates the same or greater biodiversity units than those moderate distinctiveness grassland habitats present pre-construction, or that any shortfall in units from moderate distinctiveness grassland is outweighed by a greater increase in high distinctiveness grassland); and

e. watercourse biodiversity units (i.e. ensure that the watercourses present post-construction generate more biodiversity units than those present pre-construction).

8.4.3 It will also be necessary to provide further detail to stakeholders to formalise the management and ongoing monitoring process that will be implemented by HS2 Ltd to ensure that the compensatory habitat creation and enhancement proposed will achieve the distinctiveness and condition criteria targeted, and be maintained in the long term.

8.4.4 Demonstrating that the goal of seeking no net loss in relation to replaceable habitats has been met remains a challenging target. However, given the precautionary assumptions adopted in the current calculation (e.g. that all habitats within areas of temporary land-use will be lost) there remain many opportunities to improve the overall balance of biodiversity units generated by Phase 2a of HS2 as detailed design, construction and operation progresses. A summary of key opportunities is provided in the following sections.

8.4.5 Within this context, it is considered that it remains feasible for HS2 Ltd to achieve its goal. Given that the Scheme will continue to evolve during detailed design and construction the process of reaching this goal will be an iterative one. As set out in Section 8.5 it is the intention of HS2 Ltd to repeat the calculation at appropriate intervals during detailed design and construction, and monitor progress towards targeted habitat distinctiveness and condition scores into the period of operation, with the aim of demonstrating ongoing progress towards this goal.

Precautionary assumptions (reducing scale of habitat loss)

8.4.6 The no net loss calculation for replaceable habitats is at this stage based on precautionary assumptions. It currently assumes that all habitats within the land identified as required temporarily for the construction of the Scheme will be removed. Due to the application of risk multipliers in the calculation this means that for each area of habitat lost it will normally require a larger habitat area in order to create a similar number of area-based biodiversity units to those associated with the habitats lost.

8.4.7 In practice not all habitat areas currently identified as required temporarily during construction will need to be removed. In addition, in accordance with the draft Code of Construction Practice and the Environmental Minimum Requirements during

detailed design and construction the project will continue to seek to avoid or further reduce the impacts of the Scheme[29].

8.4.8 A number of key opportunities for reducing extent of land required during construction are as follows:

- service diversions and new connections: the current calculation as a general rule assumes that the entire corridor allocated for works within the Bill powers would be subject to habitat loss, and subsequent reinstatement. However, with respect to overhead line diversions it is likely that the majority of the habitats along these corridors can be retained, and land is only required to allow flexibility in routing, to allow lowering and re-stringing of cables or to provide an access route re-stringing. Similarly, with respect to new overhead line power connections, it is likely that the majority of the habitats in such corridors can be retained, and land is only required to allow flexibility in routing and localised construction works for new pylons and associated access routes. This applies particularly to the Grid Supply Point Connection at Parkgate which is 7.7km in length;
- widening of local roads: in many rural locations it is necessary for sections of local roads to be widened to enable access for construction traffic. In such scenarios the land covered by the proposed Bill often includes the hedgerows on either side of the road, therefore the no net loss calculation will have assumed both hedgerows will be lost due to the Scheme. However, where other constraints allow it is more likely that during detailed design the decision will be taken to retain one hedgerow and provide all of the necessary widening to one side of the existing carriageway, thus allowing one of the roadside hedgerows to be retained;
- gradient of cuttings: the preliminary design utilised in the CT-06 plans utilises conservative gradients for all of the proposed cuttings. It is likely that during detailed design the contractor will seek to increase some cutting gradients which may reduce the area of land required during both construction and operation, both through reduction in land required for the cutting itself, and an accompanying reduction in the land required for the local placement of surplus excavated material. Any such refinements will need to take into account any implications for ecological mitigation; and
- hedgerow and watercourse retention: the no net loss calculation currently assumes that all hedgerows and watercourses within areas of temporary landtake will be removed and replaced prior to the completion of works. While the full extent to which hedgerows and watercourses can be retained is yet to be confirmed it is likely that a high proportion of hedgerows and watercourses

[29] Section 9.1 of the draft CoCP includes the requirement that 'the contractors will, where it is reasonably practicable reduce any habitat loss within the land required for the Proposed Scheme by keeping the working area to the minimum required for construction of the Proposed Scheme.'

within areas of temporary landtake may be retained, with losses confined to those sections where access routes are required.

8.4.9 Given the precautionary approach adopted in the current calculation it is appropriate to assume that as detailed design progresses the area of land where habitats are assumed to be lost as a consequence of the Scheme will reduce. Retained habitats would no longer be afforded a risk multiplier in the calculation (the multipliers reduce the biodiversity units available to deal with inherent risks of creating new habitats), thus the post-construction biodiversity units would increase.

8.4.10 Reductions in the land required are therefore likely to deliver significant reductions in the current route wide deficits for both area based features and for watercourses as detailed design progresses.

8.4.11 The HS2 metric has also adopted a precautionary approach in relation to the scoring of target condition for created habitats. It is the intention of HS2 Ltd that all habitat created with the primary function of providing ecological mitigation or compensation will be managed in the long term with the aim of achieving 'high' condition (3 x weighting) (see Table 5). However, in order to acknowledge the difficulty of reaching this goal, the HS2 metric only utilises the units that would be achieved if habitats achieve 'moderate' habitat condition (2 x weighting) in the post-construction element of the calculation. Therefore, if appropriate management continues in the long term it is likely that the number of biodiversity units that will eventually be achieved will exceed those currently stated (although these would not be claimed in the HS2 calculation).

Enhancing ecological value of landscape led planting

8.4.12 It is currently assumed that the constructed Scheme will include a total of over 122ha of landscape led mitigation planting (i.e. woodland and scrub habitats) of moderate distinctiveness (4 x weighting). These areas of planting are currently assumed to achieve moderate distinctiveness within the current calculation and areas of woodland planting with a primary landscape function are currently subject to a 10year commitment for ongoing aftercare/management. A commitment of up to 50 years applies for areas with a primary ecological function. However, in reality some of these parcels of woodland are contiguous and would be most appropriately managed in the long term as a single management unit.

8.4.13 Where it does not compromise the landscape function of landscape led planting areas, there is an opportunity to establish woodland with the same species composition as the woodland habitat creation areas that have a primary purpose for ecology. This measure in addition to increasing the duration of the management commitment for landscape led mitigation planting areas would allow the full ecological value of these areas of habitat to be achieved. Thus, with such a

commitment it would be realistic to target additional areas of woodland and scrub planting at achieving habitat of high distinctiveness (i.e. habitat of principal importance).

8.4.14 If such a commitment were applied to certain areas of woodland planting currently identified as having a primary landscape function it would be possible to increase the area based biodiversity units generated by post-construction habitats. Through upgrading some of these areas to high distinctiveness there is the potential to reduce the current shortfall in area-based biodiversity units in relation to high distinctiveness woodland habitats.

Additional habitat creation/habitat enhancement opportunities

8.4.15 In order to address the current deficit in area-based biodiversity units, and in particular the current 'down trading' in relation to high distinctiveness woodland, further habitat creation/enhancement is likely to be required.

8.4.16 HS2 Ltd has commenced a study to assess additional habitat creation and enhancement opportunities.

8.4.17 In terms of land within the Scheme, a high-level assessment is being undertaken with engineers and GIS to identify areas where the design of the Scheme (and the standards which govern the design) could reasonably be amended to increase habitat provisions.

8.4.18 As part of this study the following broad options are being considered for land outside of the Scheme:

- habitat creation and/or management/enhancement opportunities on land acquired by HS2 Ltd, that is not required for the operation of the Scheme; and
- habitat creation and/or management/enhancement opportunities at selected third party sites put forward by stakeholders.

8.4.19 The above options would have the potential to contribute additional biodiversity units post-construction through either large scale habitat creation projects in a small number of locations, and/or smaller scale third party led projects (e.g. support for third party woodland projects, or habitat creation/enhancements). A combination of these approaches is likely to provide the best opportunity to ensure that biodiversity benefits are delivered across the Scheme area.

8.4.20 Further data gathering and consultation with stakeholders will be required to confirm potential constraints to delivery associated with each shortlisted option and the number of biodiversity units that can ultimately be delivered at each of these sites.

Ongoing management and monitoring

8.4.21 HS2 Ltd's indicative periods for the management and monitoring of habitats are set out within the HS2 Information Paper E2: Ecology[xvi]. These currently cover the period up to establishment only. However, in line with no net loss principles it is intended to secure the biodiversity benefits of the Scheme in the long-term.

8.4.22 As set out in Section 5.4 the duration, exact nature and frequency of maintenance, management and monitoring works for individual locations will be developed during detailed design.

8.4.23 Long term management is likely to be delivered through a combination of mechanisms, including legal agreements and associated payments to landowners.

8.4.24 Positive obligations requiring landowners to undertake ongoing management of created habitats are not currently enshrined in existing UK legislation. However, the High Speed Rail (West Midlands - Crewe) Bill includes in Clause 48 the ability to impose conditions on the land released by the undertaker, including a positive obligation relating to the 'carrying out, maintenance, protection or enhancement of relevant environmental works…'. This is to ensure the maintenance of mitigation measures, upgrades to the mitigation if required and prohibition on uses of the land where such uses would detrimentally affect the measures in place. The clause binds successors in title into any covenant agreed with previous landowners.

8.4.25 The inclusion within the Bill of such a measure is a demonstration of HS2 Ltd's intention to ensure that the biodiversity benefits delivered by the habitat mitigation and compensation measures are secured in the long-term.

8.5 Next steps

Ancient woodland

8.5.1 While not the focus of this report it should be noted that as part of its overall approach to addressing the biodiversity impacts of the Scheme HS2 Ltd has published a summary of the losses of that will occur at each ancient woodland affected by Phase 2a, and the associated compensation measures proposed in response to these losses. As HS2 Ltd has acknowledged throughout the ES, all ancient woodland habitats are irreplaceable.

Future iterations of the no net loss calculation

8.5.2 HS2 Ltd intends to re-calculate the no net loss in biodiversity metric for replaceable habitats at appropriate intervals during detailed design and construction and is committed to monitoring progress towards habitat targets into the period of operation of the Scheme.

8.5.3 HS2 will consider the use of updates contained within the revised Defra Biodiversity Metric 2.0 (due for publication in 2019) within an updated HS2 metric for application in support of HS2 Phase 2b, dependent on the programme.

8.5.4 The project continues to seek to ensure that habitat compensation is provided to ensure habitats created are of similar or higher quality than those lost. Given that the Scheme will result in some significant changes in the type and quality of habitats present (e.g. reduction in arable habitats but large increase in grassland habitats) ongoing discussions with Natural England will also consider the resultant landscape scale implications for key individual species or species groups.

8.5.5 Inputs from the Ecology Review Group (ERG)[30] will also be sought in future relating to the project's no net loss objective for replaceable habitats where such issues fall within the Terms of Reference of the ERG.

[30] The Promoter will require the nominated undertaker to establish an Ecology Review Group to provide independent advice on the monitoring of ecological mitigation and compensation measures.

9 Summary of conclusions

9.1.1 At the route wide level the no net loss calculation for all replaceable habitats suggests that the Scheme will result in approximately a 17% reduction (approximately 1342 fewer units) in the number of area-based biodiversity units. In addition, the calculation predicts a significant reduction of approximately 445 area based biodiversity units generated by woodland habitats of high distinctiveness.

9.1.2 For linear features the no net loss calculation currently shows a reduction in biodiversity units for watercourse features (approximately 38%), and an increase in hedgerow biodiversity units generated by hedgerows post-construction (approximately 20%).

9.1.3 Demonstrating that the goal of seeking no net loss in relation to replaceable habitats has been met remains a challenging target. However, progress towards this goal has been made and HS2 Ltd reaffirms its commitment to continue to seek to achieve no net loss in biodiversity as the project progresses. There are opportunities to improve the overall balance of biodiversity units generated by Phase 2a of HS2 during detailed design, construction and operation, including:

- **further reducing the scale of habitat loss:** the current calculations are based on the precautionary assumption that all habitat within the land required will be lost. In practice it will be possible to retain some habitats;
- **enhancing the ecological value of landscape led planting:** establishing landscape led planting with similar native species composition and ongoing management commitments to ecology led woodland habitat creation, would allow an increased number of area-based biodiversity units to be generated by existing planting; and
- **additional habitat creation/enhancement opportunities:** HS2 Ltd is assessing opportunities for additional habitat creation and enhancement. This process is considering opportunities on land acquired by HS2 that is not required for the operation of the Scheme and opportunities at third party sites.

9.1.4 The calculation does not include consideration of biodiversity benefits that may be generated by any additional funding that HS2 Ltd has provided on HS2 Phase 2a (e.g. through the Cheshire East environment and landscape enhancement fund, the funding for additional enhancement measures within the remit of the Trent-Sow Parklands and Cannock Chase AONB HS2 Group and the Phase 2a Woodland Fund), totalling £4.35 million. An additional £5 million of the HS2 Community and Environment and Business and Local Economy Fund was made available for Phase 2a, which could also realise local or strategic environmental benefits.

9.1.5 Within this context, it is considered that it remains feasible for HS2 Ltd to achieve its goal of seeking no net loss in biodiversity for replaceable habitats. HS2 Ltd intends to re-calculate the output of the no net loss calculation for replaceable habitats at appropriate intervals during detailed design and construction and monitor progress towards habitat targets into the period of operation of the Scheme, with the aim of demonstrating progress towards this goal.

Appendix A – HS2 Ltd response to Natural England's review of the no net loss in biodiversity metric

Table 18: HS2 Ltd response to Natural England's review of the No Net Loss of biodiversity metric

Natural England recommendation	HS2 Ltd response
Irreplaceable habitats and designated sites	
It is recommended that irreplaceable habitats and protected areas, notably ancient woodland and Sites of Special Scientific Interest (SSSIs), are taken out of the HS2 NNL metric as their inclusion gives the impression of tradability for non-tradable biodiversity resources. It is right to quantify all biodiversity losses arising from the project but in these instances losses should not be accounted for using a metric methodology. A separate recognition of these losses, that considers and makes explicit compensation, would be more appropriate.	We agree with this recommendation and will remove ancient woodland from the metric, so ancient woodland losses can be accounted for through a non-metric approach. In order to clearly communicate the unavoidable losses of ancient woodland and how these are compensated for HS2 Ltd will publish an Ancient Woodland Strategy that clearly identifies the impacts on ancient woodlands and the planned compensation for these impacts outlined. However, the logic of treating SSSI habitat separately from the calculation is not clear, given that the metric has been used only as a way of valuing each habitat, and not as a way of justifying their replacement. Measures to compensate for loss of land within SSSIs have been developed in consultation with Natural England and will be discussed further with them at the detailed design stage.
Enhancement of existing ancient woodland habitat	
Restoring existing ancient woodland habitat to compensate for woodland losses is consistent with established conservation practice. It is recommended that ancient woodland enhancement is documented in a separate report, and HS2 Ltd provide certainty on management sustainability and the design and monitoring of condition targets.	We agree with this recommendation. Our Ancient Woodland strategy will outline the proposed compensation arrangements for each ancient woodland impacted, which will include measures to restore existing ancient woodland where appropriate.
Position in an ecological network	
The aspiration to incorporate the spatial context of a habitat within its wider network, as part of the HS2 metric, is commendable. However, the current means of adding a connectivity factor is overly simplistic, and there is a risk that the multiplier adds bias by favouring a narrow set of criteria whilst other valid criteria are not incorporated. It is recommended that the 'position in an ecological network' multiplier is removed from the HS2 metric. It is recommended that Natural England coordinates the development of a new spatial multiplier that is better grounded in the growing body of scientific and	HS2 original response to Natural England: HS2 Ltd agree that Natural England should coordinate the development of a more sophisticated multiplier that takes account of the growing body of scientific literature. HS2 Ltd are willing to work with Natural England to support this. Natural England highlight the importance of the spatial context of habitat within its wider network, therefore, until the new multiplier has been developed, HS2 Ltd will continue to use the existing multiplier so habitat connectivity can be recognised

Natural England recommendation	HS2 Ltd response
expert knowledge on ecological connectivity, and which would be applicable to small developments as well as large infrastructure projects.	Update: Following further discussions with Natural England HS2 have subsequently agreed to remove the existing ecological position in the network multiplier for the Phase One no net loss calculation)..
Target condition and scoring of hedgerows post-construction	
It is recommended that HS2 Ltd should maintain the separate hedgerow accounting line in the NNL metric, and concluded that it is reasonable for HS2 Ltd to assume that a 'good' condition can be achieved for newly created hedgerows. It is recommended that HS2 Ltd assess the distinctiveness of hedgerows pre and post construction in line with current practice in place in Warwickshire. It is recommended that Natural England coordinates the development of an updated multiplier model for hedgerow condition in light of improved understanding of hedgerow management and experiences of applying the metric in the Defra pilot areas.	HS2 Ltd agrees to maintain the separate hedgerow accounting line. HS2 Ltd also agrees to the principle of assessing the distinctiveness of hedgerows pre- and post- construction; but this will require extensive field analysis which will not be available for the next calculation of the metric due before Royal Assent. We welcome Natural England's offer to coordinate the development of an updated multiplier for hedgerow condition, and will integrate the updated multiplier into the metric once it is available.
Time to Target Condition	
The HS2 metric is more optimistic than the Defra metric, in terms of the predicted time to achieve a target condition. It is recommended that the professional expertise of the consultant ecologists should be backed up by published evidence to justify the time to target condition values. The time to target condition in the Defra metric cannot be consistently applied in a metric calculation due to the wide variance in the lower and upper limits of the time to reach target condition. It is recommended that an independent group develops a set of values to use for different habitats being created, restored or enhanced that could add to the existing guidance on biodiversity metrics. Natural England would be willing to coordinate this group. It is recommended that an indication of which habitat types are expected to achieve a good condition weighting within the project period is placed in the public domain.	HS2 Ltd will publish the professional advice and evidence used to determine the target time to condition and an indication of which habitat types are expected to achieve a good condition weighting within the project period. We support the efforts of Natural England to coordinate an independent group to undertake further work on the 'time to target condition' multiplier for future use of NNL metrics.
Temporary Land Use	
It is recommended that options to account for construction timescales within the metric are explored to determine how the HS2 impact arising from temporary land use can be accounted for, and that more information is provided on the construction phase and temporary land use. Furthermore, it is recommended that the scoring of low distinctiveness habitats that will be temporarily lost during construction is included in the calculation, in order to fully record biodiversity losses and gains. In	While at this stage precise construction timescales are not known we will explore with Natural England and the Ecology Review Group options for how the impacts arising from temporary land take can be more effectively incorporated into the metric in the future. We agree that more can be done to score low distinctiveness habitats and the metric will be revised to take account of this.

Natural England recommendation	HS2 Ltd response
recognition of the fact that some low distinctiveness habitats will not take five years to create (the lowest time to target condition normally applied), whilst others will take five years, HS2 Ltd should consider whether to assume an average that uses a smaller multiplier, or to further separate out the habitat types in order to allocate a more realistic time to target condition.	
Understanding the HS2 NNL metric	
HS2 is a large and complex project, and as such, Natural England have made recommendations on how HS2 Ltd could more clearly communicate No Net Loss on a project of this scale. It is recommended: That there is clarity of objectives, both in terms of what NNL is and the purpose of the HS2 NNL metric. This will reduce confusion over what does and does not inform compensation provision. That the NNL methodology is more clearly explained so that it can be more readily understood and repeated by a third-party. It needs to be clear how and why changes have been made to the Defra metric with sensitivity analysis and examples used to illustrate where ever possible. That the reporting of the calculations is more transparent, so that results can be easily understood and links made from the Environmental Statement to the NNL calculation	We agree with these recommendations. Prior to Royal Assent of the Hybrid Bill, HS2 Ltd will provide an update to the methodology to ensure that it clearly explains the purpose and objectives of the NNL metric, and the metric is set out in a way that it can be easily understood.
That the HS2 NNL metric calculation is re-run on an iterative basis over the lifetime of the Project based on further detailed information as the Scheme design and implementation progress.	HS2 Ltd agrees with this recommendation and will re-calculate the metric over the life time of the project at regular intervals. HS2 Ltd will work with Natural England and the forthcoming Ecology Review Group to determine how regularly the metric should be re-run.
That independent quality assurance is built into the future development of the HS2 NNL metric.	In response to this recommendation, HS2 Ltd will continue to involve stakeholders throughout the application of the No Net Loss metric. This will be achieved through the independent Ecology Review Group, who will review ecological monitoring data and future calculations of the No Net Loss metric.
Biodiversity opportunities	
We recommend that HS2 Ltd is more ambitious in its aspirations to compensate effectively for unavoidable losses of ancient woodland and to demonstrate that it recognises the importance of these irreplaceable habitats. For a project of this scale, it is the judgement of Natural England that HS2 Ltd should aim to create 30 hectares of new woodland for every hectare lost, where ancient woodland is to be replaced by new woods. There are a number of approaches that could be explored to realise that ambition. If that ambition	As DfT have outlined, we cannot accept this recommendation, as the report does not provide enough evidence for this to be implemented. We also believe that to use such a ratio would only be compatible with a metric approach, this would be inconsistent with Natural England's recommendation to remove ancient woodland from the metric and apply a non-metric approach for ancient woodland compensation. Defra have agreed to examine ancient

Natural England recommendation	HS2 Ltd response
proves legally impracticable to implement for Phase 1, it certainly should be implemented for Phase 2.	woodland compensation through their 25-Year Plan for the Environment.
It is recommended that HS2 Ltd considers augmenting delivery of compensation outside the 'Bill' area (particularly for ancient woodland), and should explore what opportunities such arrangements might offer for realising additional benefits as a result of HS2.	We accept that land outside the Bill limits could be looked at to augment the delivery of the No Net Loss objective. We are currently working with interested parties and looking at land which will be purchased through the company's property acquisition Schemes to find further options for habitat creation.
In light of the wide ranging issues that using the HS2 NNL metric as an accounting tool has presented, it is recommended that for Phase 2 of the Scheme a metric is applied for biodiversity offsetting purposes, i.e. a tool to inform compensation provision. It is considered that this would be beneficial for the natural environment, for reporting purposes and for HS2 Ltd. It is recommended that for Phase 2 the metric should be applied for the purpose of meeting a net gain objective, in order to fully accord with national policy, rather than simply aiming to achieve NNL.	The Phase One Environmental Statement seeks to mitigate and compensate for biodiversity losses and that is brought forward in a balanced way taking account of the full range of effects and mitigations that have to be accounted for through the assessment process and which is necessary to enable Parliament as decision maker in this instance to scrutinise proposals and ensure the view of those directly or specially affected are fairly heard. It must be recognised that there are practical limits to the extent to which the NNL metric can be used to drive compensation measures on a project the scale of HS2. The nature of a major project like HS2 is that the design of the railway will develop and mature right up to the point of construction. This design development process involves many changes at a local level that have the potential to affect biodiversity in a different way. To rerun the NNL metric for each change in order to derive the appropriate biodiversity response would be impractical. We recognise and support national policy which is to minimise 'impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures' (National Planning Policy Framework). We believe that our approach to NNL is consistent with this policy. The NNL metric at this early stage in the design of HS2 is based on cautious assumptions, for example it assumes that for land occupied temporarily, all biodiversity (such as hedgerows) is removed when in reality contractors would seek to avoid the need to remove all hedgerows. Similarly the metric assumes that all the land in the Bill is used, when HS2 Ltd has a policy to, as far as reasonably practicable, reduce land take. Therefore, the NNL metric at this early stage of the project is likely to reflect a pessimistic view of the biodiversity impacts of the project. (continued on next page)
	(continued from previous page) It also does not include any of the biodiversity benefits that may be generated by the funds that the project

Natural England recommendation	HS2 Ltd response
	has provided (for example, the Community and Environment Fund, HS2 Additional Mitigation Plan for the Colne Valley Regional Park Fund, Chilterns AONB Review Group Fund) or from the commitments in the Environmental Minimum Requirements to use reasonable endeavours to adopt mitigation measures that will further reduce any adverse environmental impacts caused by Phase One. These funds go above and beyond our No Net Loss commitment and could offer an opportunity to realise a net gain for replaceable habitats. The project to date has used a cautious assumption when developing its compensation measures, meaning that aiming for a net gain from the NNL metric at an early stage is likely to lead to a response that leads to excessive third party land take for replacement habitats. Due to the nature of the land the railway typically runs through, this land is most likely to be agricultural land. Whilst The National Planning Policy Framework recognises that the planning system should seek to minimise impacts on biodiversity, it also recognises that any development also needs to protect the best agricultural land, and therefore a balance must be struck. We believe that focusing on NNL at this early stage strikes the correct balance.

Appendix B – Comparison of the Defra metric and the HS2 metric

Table 19: Comparison of the Defra metric and HS2 metric

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
Role of the metric	The Defra metric was devised for use in an offsetting calculation where it is used to define the level of compensation provision. For HS2, the level of mitigation and compensation provision to be provided as part of the Scheme has been defined based on professional judgement and is set out in the ES.	HS2 has used a modified form of the Defra metric to create an 'accounting tool' to measure the overall losses and gains in biodiversity that are likely to occur as a consequence of the Scheme. Changes are in relation to terminology only. The overall calculation has been described as a 'no net loss calculation' and the calculation consists of a comparison of the units generated by the pre- and post-construction layers.	No fundamental changes to the Defra metric have been required to address this particular change in use. The metric continues to be used to equate habitat losses and gains into biodiversity units that can be readily compared	See Section 4
Habitat distinctiveness (general scoring categories)	Habitats are scored based on pre-assigned bands based on their distinctiveness, on a scale of 0, 2 (low), 4 (medium) or 6 (high).	Unchanged from the Defra metric[31].	Consideration of irreplaceable habitats within the HS2 calculation has been removed in response to the Natural England review. Therefore, method for scoring of habitat distinctiveness is now consistent between both metrics.	See Section 6.7

[31] Following the recommendations of the Natural England review the additional distinctiveness category of 'very high' (8 x weighting), included in the methodology that accompanied the November 2013 Environmental Statement has been removed. Therefore, the revised HS2 metric utilises the same distinctiveness categories as the Defra metric.

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
Translation of habitat survey data	The Defra metric utilises habitat codes with the Integrated Habitat System (IHS)[32] which are translated to distinctiveness scores.	Guidance has been provided to consultants undertaking the calculation on the translation of Phase 1 habitats into habitat distinctiveness scores (see Appendix A). However, where a Phase 1 category could fall into two or move distinctiveness score categories then review of available information alongside professional judgement has been used to allocate the distinctiveness scores.	Habitat data for Phase One of HS2 consists of Phase 1 habitat survey, and in selected areas data from National Vegetation Classification (NVC) surveys. Therefore, additional guidance was needed in order to standardise (as far as is possible) the translation of this data.	See Appendix C
Consideration of 'open mosaic on previously developed land' habitat of principal importance	The Defra metric is based on IHS habitat categories, which include a specific category for open mosaic on previously developed ground.	The HS2 metric utilises Phase 1 habitat categories, which do not include a bespoke category for the habitat type open mosaic habitat on previously developed ground. Individual components of this habitat type (e.g. scrub, bare ground) would each individually be allocated a lower distinctiveness score than the overall area meeting the habitat of principal importance definition. The distinctiveness score attributed to all Phase 1 habitat types that form part of an area that qualifies as the habitat of principal importance open mosaic habitat on previously developed land	Provision was needed in the HS2 metric for dealing with this habitat type, as it does not translate neatly to Phase 1 habitat codes, and therefore there was the potential for its value to be overlooked. It was felt particularly important to ensure this habitat type was given due consideration due to its potential presence within the vicinity of the route, in particular within the urban sections of the route in London and Birmingham;	No examples of this habitat type within Phase 2a Scheme

[32] This is an infrequently used habitat classification system which aligns with the UK Biodiversity Action Plan priority habitat descriptions set out within UK Biodiversity Action Plan; Habitat Descriptions BRIG (ed Ant Maddock) 2008 (updated Dec 2011). Available to download at http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
		have been increased to a 'high' distinctiveness score (6 x weighting), thus ensuring the value of these habitats is fully recognised within the calculation.		
Watercourses	Watercourses are dealt with as an area based unit within the Defra metric.	Watercourses are considered as a linear, rather than an area based measure within the HS2 metric.	Consultant ecologists highlighted that consideration of water courses within the area based aspect of the HS2 metric could result in some unrealistic outcomes if an area based metric (as used in the Defra metric) was used to compare losses and gain in biodiversity for watercourses. For example, the realignment of a sinuous section of watercourse, supporting a diverse range of habitat niches may as part of HS2 be replaced by a wider section of straight channel that would potentially increase the surface area of the watercourse. Under the Defra metric this could lead to the wide and straight section of channel generating more watercourse biodiversity units than a sinuous channel.	See paragraph 6.4.19
Habitat condition (general scoring approach)	All habitats within the area bases aspects of the calculation are scored based on their condition as either 1 (poor), 2 (moderate) or 3 (good) according to the guidance provided in the Higher Level Stewardship	The HS2 metric utilises the same general categories for scoring habitat condition i.e. either 1 (poor), 2 (moderate) or 3 (good) in accordance with the HLS FEP. However, professional judgement has been applied to allocate a score on the same scale where the FEP does not provide any condition scoring guidance. In addition, the following deviations to the Defra metric have been incorporated:	The HLS FEP was devised for use in farmland environments and does not contain any guidance for some habitat types, in particular those which occur in urban and sub-urban locations along the route of Phase One of HS2. Access has not been possible to some areas of the route. In the absence of survey data it has been assumed that any sites that are known to be actively managed are in good condition. Rationale in relation to amendments made in relation to scoring of low distinctiveness habitats and condition scoring cap are provided below in separate table rows.	See Section 5.8

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
	(HLS) Farm Environment Plan Manual (FEP)[33].	Method for condition scoring of low distinctiveness habitats (see separate table row below); All scrub habitats have been afforded a condition score of 2; where access was not available for survey, a precautionary approach has been adopted; and incorporation of a condition scoring 'cap' (see separate table row below).		
Scoring condition of low distinctiveness habitats	Utilises a variable condition score of 1 (poor), 2 (moderate) or 3 (good) based on HLS FEP guidance.	A change to the Defra metric has been implemented. All low distinctiveness habitats (i.e. those allocated a 2 x distinctiveness weighting) are allocated a condition weighting of 'poor' (1 x weighting).	Consultant ecologists highlighted that it was difficult in practice to accurately score the condition of habitats of low distinctiveness, and that there was concern that differences in the scoring of such habitats were having a disproportionate effect on the overall outcome of the metric. This view was reinforced by verbal feedback from the pilot studies provided by Natural England and Defra. The implemented change seeks to recognise that condition is likely to have very limited effect on the overall biodiversity value of habitats that are of intrinsically low distinctiveness, and ensure consistency in the scoring of these elements of the calculation.	See Section 5.8
Condition score 'cap'	Within the Defra metric there is no barrier to targeting habitat creation at this combination of scores, which	All habitats created for the purpose of ecological mitigation or compensation will be managed with the aim of	It was considered important to ensure that the post-construction targets for created habitats are realistic and can be achieved in a reasonable timescale.	See Section 5.8

[33] Natural England (2010), *Higher Level Stewardship – Farm Environment Plan (FEP) Manual – Technical guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features*. Natural England.

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
	is that which would generate the most biodiversity units.	achieving high distinctiveness habitats of high condition. However, in order to recognise that achieving this will be difficult and will take a long time to achieve the HS2 metric incorporates a rule that for habitats targeted at a 'high' distinctiveness score (6 x weighting), only a maximum target condition score of 'moderate' (2 x weighting) will be used within the current calculation.	In practice habitats of high distinctiveness and condition are the most difficult to create, and for some habitat types (e.g. woodland) it can take a particularly long period to achieve the criteria required to achieve high condition. The HS2 approach seeks to recognise that the target of creating high distinctiveness habitats of high condition is the most difficult to achieve, and for some habitat types may take many years to achieve. The approach adopted by HS2 acts to temper the biodiversity units generated by the habitats created, and as such represents a precautionary approach.	
Role of habitats in wider ecological networks	The Defra metric incorporates a spatial risk multiplier for habitat created that seeks to reward compensation provision in locations which are aligned with the wider goals of local offsetting strategies, or other recognised opportunities for ecological enhancement (e.g. biological opportunity areas). However, the Defra metric does not attempt to consider the importance of where habitat losses occur, and how these may impact on existing ecological networks.	The 'ecological position in the network' multiplier that was originally developed for inclusion within the HS2 metric has now been removed. The Defra spatial risk multiplier has not been reinstated as it is not considered suitable for a landscape scale Scheme such as HS2.	The Defra metric was developed primarily for application in small to medium sized projects, rather than application within a landscape scale Scheme such as Phase One of HS2.	-

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
Risk multipliers (general)	Utilises positive value 'risk multipliers' and divides the total number of biodiversity units by this figure to calculate the number of biodiversity units available once the risk multiplier has been applied.	Risk 'multipliers' utilised within the Defra metric have been converted to their equivalent decimal values (e.g. where the Defra metric divided biodiversity units by 10, the HS2 metric multiplies by 0.01). This is a presentational change only. There has been no change in the overall effect of the risk multipliers utilised.	This change was required in order to aid use of the metric as an accounting tool, and simplifies the biodiversity unit calculations within the geodatabase.	See Section5.9
Spatial risk multiplier	The Defra metric includes a spatial risk multiplier intended to manage risks associate with the location where the offset is provided.	The spatial risk multiplier is not utilised within the HS2 metric.	The spatial risk multiplier was not considered appropriate for application in HS2, as it focusses on provision in relation to locations identified as targets for conservation effort in existing offsetting strategies.	See Section 5.9
Time to target condition multiplier categories	The Defra metric includes a series of time to target condition risk multipliers from zero to 32+ years. These are applied to temper the number of biodiversity units generated by newly created habitats to reflect delivery risks. The Defra categories jump from zero years (risk multipliers =1), directly to five years (risk multiplier = 0.83).	The HS2 metric utilises the Defra metric time to target condition categories for the majority of habitat types. In response to the Natural England review HS2 have created bespoke time to target condition categories for some low distinctiveness habitats types. This aims to reflect that for such habitats there will be a short lag time until they reach target condition, however that in many cases this will take less than five years to achieve (the lowest category available within the Defra metric). The new time to target condition categories are used in addition to the	The Natural England review highlighted that a time to target condition should be allocated to habitats of low distinctiveness. Additional time to target condition categories were seen to be needed in order to more accurately reflect the short time to target condition periods that would apply for some habitat types (e.g. ephemeral/perennial communities).	See Section 5.9

Topic	Defra metric	HS2 metric	Rationale	Reference for further details of approach in HS2 metric
		categories utilised within the Defra metric		
Time to target condition	The Defra metric includes guidance on the time to target condition to be allocated for broad habitat types. However, in many cases a broad banding is provided (e.g. 10-50 years), rather than a specific value.	HS2 has created guidance to its consultants on the time to target condition categories from the Defra metric to be applied as the default for key habitat types. The guidance provides specific time to target condition values, or a narrow band of values than those included in the Defra metric guidance.	HS2 sought the advice of its consultant ecologists and devised additional guidance for the time to target condition values to be used in the calculation. The durations utilised are based on the time it is expected to take in order to achieve the relevant criteria within the HLS FEP guidance needed to reach the targeted condition value. This has been informed by professional experience of undertaking habitat creation Schemes, and the assumption that best practice measures will be implemented for Phase One of HS2.	See Table 9
Difficulty to create/restore multiplier	Utilises a series of set multipliers to account for the element of delivery risk dictated by the type of habitat being created/restored.	Unchanged within the HS2 metric.	The Defra metric difficulty multiplier was considered appropriate.	N/A
Consideration of individual species requirements	The Defra metric is a habitat based methodology. It does not deal explicitly with individual species. It is assumed that individual species issues will be addressed through compliance with the existing legislative and policy framework that applies to these species.	Unchanged within the HS2 metric.	Requirements in relation to protected species are set out within the ES, and will be provided in response to the existing legislative and policy framework.	N/A

Appendix C – Habitat distinctiveness scores for Phase 1 habitat survey categories

Table 20: Habitat distinctiveness scores for Phase 1 Habitat categories

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
A1.1.1	Broadleaved woodland - semi-natural	High	6	.
A1.1.2	Broadleaved woodland - plantation	Moderate	4	-
A1.2.1	Coniferous woodland - semi-natural	High	6	-
A1.2.2	Coniferous woodland - plantation	Moderate	4	-
A1.3.1	Mixed woodland - semi-natural	High/ moderate	6/4	Consider potential to split out areas of woodland that qualify as a habitat of principal importance, and validity of including as part of the underlying habitat of principal importance where the coniferous cover is less than 25%. Such areas could score a high distinctiveness rating. All others will score a moderate rating.
A1.3.2	Mixed woodland - plantation	High/moderate	6/4	High distinctiveness rating to be allocated to those sites which meet the criteria to qualify under habitat of principal importance type 'traditional orchard'. Moderate rating to be applied for all others.
A2.1	Scrub - dense/ continuous	Moderate	4	-
A2.2	Scrub - scattered	Low	2	This habitat type could have been created as either a polygon or point data. Only polygon data should be utilised within the assessment.
A3.1	Broadleaved parkland/ scattered trees	High/moderate	6/4	This habitat type only to be utilised where mapped as a polygon. High distinctiveness rating to be applied

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
				to habitats falling under the wood pasture and parkland habitat of principal importance type. Moderate rating to be applied in all other cases.
A3.2	Coniferous parkland/ scattered trees	Moderate	4	This habitat type only to be utilised where mapped as a polygon.
A3.3	Mixed parkland/ scattered trees	Moderate	4	This habitat type only to be utilised where mapped as a polygon.
A4.1	Broadleaved woodland - recently felled	Moderate	4	-
A4.2	Coniferous woodland - recently felled	Moderate	4	-
A4.3	Mixed woodland - recently felled	Moderate	4	
B1.1	Acid grassland - unimproved	High	6	-
B1.2	Acid grassland - semi-improved	High	6	-
B2.1	Neutral grassland - unimproved	High	6	-
B2.2	Neutral grassland - semi-improved	High/moderate	6/4	Split out those areas of grassland that fall within the lowland meadows habitat of principal importance type, and identify these as being of high distinctiveness. Moderate rating to be applied in all other cases.
B3.1	Calcareous grassland - unimproved	High	6	
B3.2	Calcareous grassland - semi-improved	High/moderate	6/4	Split out those areas falling under the definition of lowland calcareous grassland habitat of principal importance type. All other areas of grassland which contain elements of a calcareous sward should be considered to be of moderate distinctiveness.
B4	Improved grassland	Low	2	-
B5	Marsh/marshy grassland	High/moderate	6/4	Split out any areas that represent habitats of principal importance (in

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
				particular purple moor grass and rush pasture) and identify these as of high distinctiveness. All others should be considered to be of moderate distinctiveness.
B6	Poor semi-improved grassland	Moderate	4	-
C1.1	Bracken - continuous	Low	2	-
C1.2	Bracken - scattered	Low	2	Only those areas mapped as polygons should be used within the calculation.
C3.1	Other tall herb and fern - ruderal	Low	2	-
C3.2	Other tall herb and fern - non ruderal	Low	2	-
D1.1	Dry dwarf shrub heath - acid	High	6	-
D1.2	Dry dwarf shrub heath - basic	High	6	-
D2	Wet dwarf shrub heath	High	6	-
D5	Dry heath/acid grassland	High	6	-
D6	Wet heath/acid grassland	High	6	-
E2.1	Flush and spring - acid/neutral flush	High	6	-
E2.2	Flush and spring - basic flush	High	6	-
F1	Swamp	High/moderate	6/4	Identify those areas that qualify under the reedbed or purple moor grass and rush pasture habitat of principal importance definitions as being in the high category. Identify all others areas as being of moderate distinctiveness.
F2.1	Marginal and inundation - marginal vegetation	High/moderate	6/4	This Phase 1 category is defined as strips of emergent vegetation that are of less than 5m in width. Identify those areas that qualify under purple moor grass and rush pasture

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
				habitat of principal importance definitions as being of high distinctiveness.
F2.2	Marginal and inundation - inundation vegetation	High/moderate	6/4	Consider potential for this habitat to fall under any habitat of principal importance definition (considered unlikely). All other to be identified as moderate.
G1	Standing water	High/moderate	6/4	Habitats of principal importance should be identified as being of high distinctiveness. All other occurrences of this habitat type should be identified as being of moderate distinctiveness.
G1.1	Standing water - eutrophic	High/moderate	6/4	
G1.2	Standing water - mesotrophic	High/moderate	6/4	
G1.3	Standing water - oligotrophic	High/moderate	6/4	
G1.4	Standing water - dystrophic	High/moderate	6/4	
G1.5	Standing water - marl	High/moderate	6/4	
I1.1.1	Inland cliff - acid/neutral	High	6	-
I1.1.2	Inland cliff – basic	High	6	-
I1.4.1	Other exposure - acid/neutral	Moderate	4	-
I1.4.2	Other exposure - basic	Moderate	4	-
I1.5	Cave	Moderate	4	-
I2.1	Quarry	High/moderate/low/ none	6/4/2/0	Re-allocate these areas based on the habitats present and score accordingly.
I2.2	Spoil	None	0	-
I2.3	Mine	High/moderate/low/ none	6/4/2/0	Re-allocate these areas based on the habitats present and score accordingly.
I2.4	Refuse-tip	None	0	-
J1.1	Cultivated/ disturbed land - arable	Moderate/low	4/2	Where uncultivated field margins are present these areas should be split off and classified as of moderate distinctiveness. All other arable or un-vegetated ground should be

Phase 1 code	Habitat description	Distinctiveness	Weighting	Guidance
				classified as being of low distinctiveness.
J1.2	Cultivated/ disturbed land - amenity grassland	Low	2	-
J1.3	Cultivated/ disturbed land - ephemeral/ short perennial	High/moderate/low	6/4/2	Areas which form part of an open mosaic habitat on previously developed ground (a habitat of principal importance) should be identified as of high distinctiveness. Other stands should be classified as moderate or low distinctiveness based on the species present.
J1.4	Introduced shrub	Low	2	-
J2.8	Earth bank	Low	2	-
J3.4	Caravan site	High/moderate/low/none	6/4/2/0	Re-allocate these areas based on the habitats present and score accordingly.
J3.6	Buildings	Low	2	-
J4	Bare ground	Low	2	-
J5	Other habitat	High/moderate/low/none	6/4/2/0	Based on habitats and species present.
N/A	Roads and other hardstanding	Low	0	-

Appendix D – Default time to target condition multipliers for low distinctiveness habitats

Table 21: Summary of default time to target condition multipliers utilised for habitats of low distinctiveness

Habitat description	Revised time to target condition (years)	Revised time to target condition based on 3.5% discounting rate (multiplier)
A2.2 - Scrub - scattered	5	0.84
B1.2 - Acid grassland - semi-improved[34]	5	0.84
B4 - Improved grassland	1	0.97
C1.1 - Bracken - continuous	5	0.84
C1.2 - Bracken - scattered	5	0.84
C3.1 - Other tall herb and fern - ruderal	2	0.93
G1 - Standing water	0	1.00
I2.1 - Quarry	0	1.00
J1.1 - Cultivated/disturbed land - arable	0	1.00
J1.2 - Cultivated/disturbed land - amenity grassland	2	0.93
J1.3 - Cultivated/disturbed land - ephemeral/short perennial	1	0.97
J1.4 - Introduced shrub	1	0.97

[34] This habitat type would not normally be afforded a low distinctiveness score and therefore a comment should be added to justify the distinctiveness scoring for any such occurrence.

Habitat description	Revised time to target condition (years)	Revised time to target condition based on 3.5% discounting rate (multiplier)
J3.6 - Buildings	0	1.00
J4 - Bare ground	0	1.00
J5 - Other habitat	5	0.84
K1.3 - Replacement floodplain storage	5	0.84
K2.6 - Grassed areas	2	0.93
K4.2 - Depot, station, headhouse or portal building	0	1.00
K4.4 - Electricity substation	0	1.00
K5.2 - Public realm	0	1.00
K5.3 - Engineering earthworks[35]	5	0.83

[35] Time to target condition for engineering earthworks will differ dependent on the treatment of these areas. A precautionary approach has been adopted.

Appendix E – Description of key fields used within GIS schema

Table 22: Description of fields utilised within the HS2 no net loss GIS schema

Field Alias	Field Name	Field relevant to Pre or Post ?	Description
Ecology ID	Ecology_ID	Pre/Post	Unique alphanumeric identifier code for each feature in database. Internal reference only.
CFA	CFA	Pre/Post	Identifies Community Forum Area (CFA) in which habitat features is located.
Habitat description	Hab_Desc	Pre/Post	Coding to describe the allocated habitat type. Codes commencing with letters A to J relate to the standard Phase 1 habitat category codes. For further details refer to : JNCC (2010) *Handbook for Phase 1 habitat survey. A technique for environmental audit*. JNCC, Peterborough. Codes commencing with letter' K' relate to HS2 created categories utilised in the CT-06 Proposed Scheme model. Further details relating to these category names is provided within the data dictionaries provided within map book issued alongside the November 2013 ES e.g. Main ES Volume 2 CFA10 map book. Download at http://webarchive.nationalarchives.gov.uk/20140806172102/http://assets.dft.gov.uk/hs2-environmental-statement/volume-2/MB10_VOL2_CFA10_WATERMARKED.pdf
Source	Source	Pre/Post	Primary source that has been used to determine the extent of the feature.
Pre or post-construction	Pre_Post	Pre/Post	This field indicates if the feature is relevant to the pre-construction or post-construction element of the calculation.
Preconstruction biological units	PreCon_Bio_Units	Pre	This field documents the number of biodiversity units generated by the polygon/polyline in question. The formula utilised to calculate this output differs between polygons and for polyline features. For polygons Number of preconstruction biodiversity units generated by habitat polygon = PreCon_Distinct_Rate x PreCon_Hab_Cond x PreCon_Hab_Area. For watercourses and hedgerows: Number of pre-construction biodiversity units = PreCon Hab Length x PreCon Hab_Condition
Preconstruction distinctiveness rating	PreCon_Distinct_Rate	Pre	This field records the pre-construction habitat distinctiveness weighting allocated to the polygon/polyline in question. A weighting of 0, 2, 4, 6, or 8 has been utilised where the habitat distinctiveness is used as part of the biodiversity units calculation

Field Alias	Field Name	Field relevant to Pre or Post ?	Description
			for that particular feature. Scores have been allocated against the criteria set out in Appendix C. An entry of 'Null' is used where distinctiveness is not utilised in the biodiversity units for that particular habitat type (e.g. hedgerows).
Preconstruction distinctiveness rating comment	Distinct_Comment	Pre	Where appropriate this provides a text comment to explain the preconstruction distinctiveness score allocated. Where no comment is necessary the field is marked 'Null'
Preconstruction habitat area	PreCon_Hab_Area	Pre	For preconstruction polygon features this field shows the area of the polygon in hectares (ha) This field isn't used for the linear features.
Preconstruction Habitat condition	PreCon_Hab_Con	Pre	For pre-construction features this field records the habitat condition score allocated to the polygon/polyline in question. A weighting of 1, 2, or 3 has been utilised where habitat condition is used as part of the biodiversity units calculation for that particular feature. Scores have been allocated against the criteria set out in Section 5.8. An entry of 'Null' is used where distinctiveness is not utilised in the biodiversity units for that particular habitat type.
Preconstruction Habitat condition comment	Condition_Comment	Pre	Where appropriate this provides a text comment to explain the preconstruction habitat condition score allocated. Where no comment is necessary the field is marked 'Null'
Preconstruction habitat length	PreCon_Hab_Length	Pre	For polyline features this field records the length of the pre-construction feature in metres (m). This field isn't used for the polygon features.
Post-construction biological units	PostCon_Bio_Unit	Post	This field documents the number of biodiversity units generated by the polygon/polyline in question. The formula utilised to calculate this output differs between polygons and for polyline features. For polygons Number of post-construction biodiversity units generated by habitat polygon = PostCon_Distinct_Rate x PostCon_Hab_Cond x PostCon_Hab_Area x PostCon_Diff_Rating x PostCon_Time_TargCond For watercourses and hedgerows: Number of post-construction biodiversity units = PostCon_Hab_Length x PostCon_Hab_Cond x PostCon_Diff_Rating x PostCon_Time_TargCond
Post-construction difficulty rating	PostCon_Diff_Rating	Post	This field records the allocated difficultly of restoration multiplier used in for the feature in question. Values have been attributed according to the guidance set out in Table 9 and in Section 6.5. Where the difficult to restoration field is not used in the biodiversity units calculation for a feature the field is marked 'Null'
Post-construction	PostCon_Distinct_Rate	Post	This field records the post-construction habitat distinctiveness weighting allocated to the polygon/polyline in question.

Field Alias	Field Name	Field relevant to Pre or Post ?	Description
distinctiveness rating			A weighting of 0, 2, 4, 6, or 8 has been utilised where the habitat distinctiveness is used as part of the calculation for that particular feature class, and has been scored against the criteria set out in Appendix C. An entry of "Null' is used where distinctiveness is not utilised in the biodiversity units for that particular habitat type (e.g. hedgerows).
Post-construction distinctiveness rating comments	Distinct_Comment	Post	Where appropriate this provides a text comment to explain the post-construction habitat condition score allocated. Where no comment is necessary the field is marked 'Null'
Post-construction habitat area	PostCon_Hab_Area	Post	For post-construction polygon features this field shows the area of the polygon in hectares (ha) This field isn't used for linear features.
Post-construction habitat condition	PostCon_Hab_Cond	Post	For post-construction features this field records the habitat condition score allocated to the polygon/polyline in question. A weighting of 1, 2, or 3 has been utilised where habitat condition is used as part of the biodiversity units calculation for that particular feature. Scores have been allocated against the criteria set out in Section 5.8 An entry of 'Null' is used where distinctiveness is not utilised in the biodiversity units for that particular habitat type.
Post-construction habitat condition comment	Condition_Comment	Post	Where appropriate this provides a text comment to explain the post-construction habitat condition score allocated. Where no comment is necessary the field is marked 'Null'
Post-construction habitat length	PostCon_Hab_Length	Post	For polyline features this field records the length of the post-construction feature in metres (m). This field isn't used for polygon features.
Post-construction time to target condition	PostCon_Time_TargCond	Post	This field records the allocated time to target condition multiplier used in for the feature in question. Values have been attributed according to the guidance set out in Table 7 and in Section 5.9. Where the time to target condition is not used in the biodiversity units calculation for a feature the field is marked 'Null'
Shape_Length	Shape_Length	Pre/Post	For Linear features this field contains the length of the feature in metres N.B. This is an auto-generated field within ArcGIS and are not used directly in the calculation formula.
Shape_Length	Shape_Length	Pre/Post	For Polygon features this field contains the perimeter length of the feature in metres N.B. This is an auto-generated field within ArcGIS and are not used directly in the calculation formula.
Shape_Area	Shape_Area	Pre/Post	For Polygon features this field contains the area of the feature in metres^2

Field Alias	Field Name	Field relevant to Pre or Post ?	Description
			N.B. This is an auto-generated field within ArcGIS and are not used directly in the calculation formula.
PostCon_Used_in_bio_calc	Post	PostCon_Used_in_bio_calc	This field has been added to make it clear if a polygon feature generates biodiversity units within the no net loss calculation. It intends to allow those areas of ancient woodland and associated compensation which are not scored in the calculation to be readily identified. The field is populated based on is status within the no net loss calculation as follows: Yes (area generates biodiversity units and is considered in the no net loss calculation); No - areas within the Bill where the Proposed Scheme will result in direct loss of ancient woodland; No - areas within or outside of the Bill where no direct loss of ancient woodland will occur, but the ES has identified the potential for significant indirect effects on ancient woodland; No - areas to be used for translocation of ancient woodland soils; No - areas of new planting to be provided in response to the loss of ancient woodland (excluding areas on ancient woodland soils); No - areas where HS2 will undertake enhancement of existing ancient woodland; No -area of ancient woodland within the area covered by the Bill that will be retained; and No - areas where HS2 Ltd will undertake enhancement of existing non-ancient woodland.
PreCon_Used_in_bio_calc	Pre	PreCon_Used_in_bio_calc	This field has been added to make it clear if a polygon feature generates biodiversity units within the no net loss calculation. It intends to allow those areas of ancient woodland and associated compensation which are not scored in the calculation to be readily identified. The field is populated based on is status within the no net loss calculation using the categories described for PostCon_Used_in_bio_calc above.
Land_Use_Cat	N/A	Land_Use_Cat	This field is contains a simplified category allocated to indicate the reason why individual polygons are required for the Scheme. The field has been populated with one of the responses below based on information derived from a variety of data sources as described in Section 6.7. habitat required permanently for the operation of the Scheme; habitat within the Scheme boundary that will be retained; habitat required during construction only; habitat required for mitigation/compensation - joint primary purpose landscape and ecology; habitat required for mitigation/compensation - primary purpose ecology; and habitat required for mitigation/compensation - primary purpose landscape.

Appendix F – Final QA checks spreadsheets

Table 23: Final QA checks undertaken for polyline features

FINAL QA CHECKS - POLYLINES							
	POLYLINE REF.	Hedgerows, watercourse or both	Relevance of check (Pre-, post- or both)	Check	Guidance	PRE CONSTRUCTION (Result and details of remedial action taken)	POST CONSTRUCTION (Result and details of remedial action taken)
TOTALS PRIOR TO QA CHECKS	PLY-A1	Hedgerows	BOTH	Total length of hedgerows prior to QA check (m)	Total of all hedgerow lengths for layer in question.		
	PLY-B1	Hedgerows	BOTH	Total hedgerow biodiversity units prior to QA check	Total of all biodiversity units for hedgerow habitats in layer in question		
	PLY- C1	Watercourses only	BOTH	Total length of watercourses (m) prior to QA check	Total length of all watercourse features in layer in question.		
	PLY-D1	Watercourses only	BOTH	Total watercourse biodiversity units prior to QA check	Sum of all post-construction hedgerows		
						PRECONSTRUCTION	POSTCONSTRUCTION

				N.B. When making any updates as a consequence of the following QA checks always ensure that where scores are updated, the corresponding comments fields are also updated as appropriate to ensure that allocated scores and comments remain complimentary.		Findings of checks on database & action taken.	Findings of checks on database & action taken.
POLYLINE FINAL QA CHECKS	PLY-1	Hedgerow only	Post-construction	Check that risk multiplier fields (PostCon_Diff_Rating and PostCon_Time_TargCond) are enabled to deal with decimal point entries.	There was an error with this field in some of the previous submissions. Most entries in this field are decimal point entries.		
	PLY-2	Hedgerows & Watercourses	BOTH	Ensure that naming and attributes of all geodatabase fields match those in the template supplied	Check that all field names are identical to those used in the template to ensure the data from the four contract hours is compatible for merging.		

	PLY-3	Hedgerows & Watercourses	BOTH	Ensure that any linear features within the pre-and post-construction polyline layers that do not generate any biodiversity units (e.g. fences, dry ditches, scattered trees, earth banks) are removed from the GIS layer	Search pre- and post-construction layers for linear features where biodiversity units(PreCon-Bio-Units or PostCon_Bio_Units) = 0. Review entries and delete as appropriate.		
	PLY-4	Hedgerows & Watercourses	BOTH	Check that all cells are populated with an entry ? (Y/N)	Check for any cell that does not have a value or a null entered. Populate as appropriate.		
	PLY-5	Hedgerows only	Pre-construction	Check biodiversity units formula is correct for all hedgerow features	For hedgerows: Number of pre-construction biodiversity units = PreCon_Hab_Length x PreCon_Hab_Cond		N/A
	PLY-6	Watercourses only	Pre-construction	Check biodiversity units formula is correct for all watercourse features	For watercourses: Number of pre-construction biodiversity units = PreCon_Hab_Length x PreCon_Hab_Cond		N/A

	PLY-7	Hedgerows only	Post-construction	Check biodiversity units formula is correct for all cells	For hedgerows: Number of post-construction biodiversity units = PostCon_Hab_Length x PostCon_Hab_Cond x PostCon_Diff_Rating x PostCon_Time_Targ Cond	N/A	
	PLY-8	Watercourses only	Post-construction	Check biodiversity units formula is correct for all cells	For watercourses: Number of post-construction biodiversity units = PostCon_Hab_Length x PostCon_Hab_Cond	N/A	
	PLY-9	Hedgerows only	Post-construction	Do all hedgerow entries have 'time to target condition' value of 0.71 ?	Update 'PostCon_Time_Targ Cond' (time to target condition) value to 0.71 for all hedgerow features.	N/A	

	PLY-10	Hedgerows only	Post-construction	Check post-construction difficulty rating (PostCon_Diff_Rating) = 1 for all hedgerows in the post-construction layer.	There are a few exceptions along the route where historic hedgerows may warrant being given decimal multipliers. Where exceptions exist these must be discussed and justification for these occurrences provided.	N/A	
	PLY-11	Hedgerows & Watercourses	BOTH	1) Set distinctiveness (PreCon_Distinct_Rate/PostCon_Distinct_Rate) to 'null' for all entries (hedgerows and watercourses); 2) Update 'Distinctiveness comment' (Distinct_Comment) field to say 'Distinctiveness not used in calculation for linear features'.	Distinctiveness field is not used for the linear calculation		
	PLY-13[36]	Watercourses only	Post-construction only	Set post-construction difficulty (PostCon_Diff_Rating) to 'null'	Difficulty rating is not used in the post construction calculation for watercourses.	N/A	
	PLY-14	Watercourses only	Post-construction only	Set post-construction time to target condition (PostCon_Time_Targ_Cond) rating - to 'null' for all watercourses	Time to target condition is not used in the post-construction calculation for watercourses	N/A	

[36] Check PLY 12 was associated with checking ecological position in the network multipliers and therefore has been removed.

	PLY-15	BOTH	BOTH	Check that eB Document Link (is populated. If not then update.	This will need to be populated at a late stage and you will need to 'reserve' an eB document number and link location to allow this.		
	PLY-16			Ensure that biodiversity unit fields (PreCon_Bio_unit/PostCon_Bio-Unit) have been updated to take account of any changes taken to the			
TOTALS POST QA CHECKS	PLY-A2	Hedgerows	BOTH	Total length of hedgerows (m)	Total of all hedgerow lengths for layer in question.		
	PLY-B2	Hedgerows	BOTH	Total biodiversity units	Total of all biodiversity units for hedgerow habitats in layer in question		
	PLY-C2	Watercourses only	BOTH	Total length of watercourses(m)	Total length of all watercourse features in layer in question.		
	PLY- D2	Watercourses only	BOTH	Total Watercourse biodiversity units	Sum of all post-construction hedgerows		

Table 24: Final QA checks undertaken for polygon features

FINAL QA CHECKS - POLYGONS						
	POLYGON QUERY REF	Relevance of check (Pre-, post- or both)	Check	Guidance	PRE CONSTRUCTION (Result and any remedial action taken)	POST CONSTRUCTION (Result and any remedial action taken)
TOTALS PRIOR TO QA CHECKS	PLG-A1	BOTH	Total area of polygons (ha) within layer prior to QA checks ?	Total area of polygons (Ha) in pre-construction layer, and same for post-construction		
	PLG- B1	BOTH	Total area of polygons 'used in biodiversity calculation' ?	Undertake a query to select out only those polygon features where the 'used in biodiversity calculation' has been identified as a 'Yes'.		
	PLG- C1	BOTH	Total area of polygons not used in biodiversity calculation ?	Undertake a query to select out only those polygon features where the 'used in biodiversity calculation' is not identified as 'Yes'.		

	PLG-D1	BOTH	Of the areas not used in the biodiversity calculation what area (ha) falls into each of the following categories: 1) No - area within the Bill where the Proposed Scheme will result in direct loss of ancient woodland; 2) No - area within or outside of the Bill where the ES has identified the potential for significant adverse effects on ancient woodland; 3) No - area to be used for translocation of ancient woodland soils (& associated planting); 4) No - area to be used for new planting to be provided in response to the loss of ancient woodland (excluding areas on ancient woodland soils); 5) No - area where HS2 will undertake enhancement of existing ancient woodland. Do these figures agree with those in the ancient woodland strategy ?	Areas to answer questions 1) to 5) can be obtained by querying the 'used in the biodiversity calculation' field. The totals should be the same for the pre- and post-construction layers. However, please check each layer independently to verify this.		
	PLG-E1	BOTH	Total biodiversity units generated by all polygons within the layer?	Check number of biodiversity units in pre-construction layer and for post-construction layer.		
	PLG-F1	BOTH	Total biodiversity units generated by all polygons not used in the biodiversity calculation ?	Undertake a query to select out only those polygon features where the 'used in biodiversity calculation' is <u>not</u> identified as 'Yes'. Count biodiversity units		

				associated with these polygons.		
					PRECONSTRUCTION	POSTCONSTRUCTION
			N.B. When making any updates as a consequence of the following QA checks always ensure that where scores are updated, the corresponding comments fields are also updated as appropriate to ensure that allocated scores and comments remain complimentary.		Results of checks on merged database & action taken.	Results of checks on merged database
POLYGON FINAL QA CHECKS	PLG-1	BOTH	Ensure that naming and attributes of all geodatabase fields match those in the template supplied by HS2.	Check that all field names are identical to those used in the template to ensure the data from the four contract hours is compatible for merging.		
	PLG-2	Post-construction	Check that risk multiplier fields (PostCon_Time_TargCond and PostCon_Diff_Rating) are enabled to deal with decimal point entries.	There was an error with this field in some of the previous submissions. Most entries in this field are decimal point entries.	N/A	
	PLG-3	BOTH	Are all Cells Populated with an entry ? (Y/N)	Check for any cell that does not have a value or a null entered		
	PLG-4	BOTH	Identify any polygons that are still allocated a distinctiveness score of 8. For all such entries please submit details justifying why these habitats are considered 'irreplaceable' habitat.	Check for polygons attributed a distinctiveness score (PreCon_Distinct_Rating) of 8.		

	PLG-5	Pre-construction	Check biodiversity units formula is correct for all cells in pre-construction layer.	For polygons Number of preconstruction biodiversity units generated by habitat polygon = PreCon_Distinct_Rate x PreCon_Hab_Cond x PreCon_Hab_Area		N/A
	PLG-6	Post-construction	Check biodiversity units formula is correct for all cells in post-construction layer.	For polygons Number of post-construction biodiversity units generated by habitat polygon = PostCon_Distinct_Rate x PostCon_Hab_Cond x PostCon_Hab_Area x PostCon_Diff_Rating x PostCon_Time_TargCond	N/A	
	PLG-7	Post-construction	Check for consistency in the allocation of 'time to target condition' scores.	Filter polygons by time to target condition score (PostCon_Time_TargCond) allocated. For each score record the habitat types that have been allocated to this category. Check and justify any duplication of habitat types between time to target condition scores.	N/A	

	PLG-8	Post-construction	Check 'PostCon_Diff_Rating' field for any entries where difficulty rating = 0.75. If there are any then these should be amended to a value of 0.67.	This was an error in our original technical note picked up by Defra. Consultants were alerted previously so it should have been addressed.	N/A	
	PLG-9	BOTH	Check that the metric rules for scoring low distinctiveness habitats (i.e. distinctiveness score =2) have been implemented: Where distinctiveness score =2, habitat condition scores should always = 1. For those features where this error occurs also update the 'habitat condition' comment to read 'Habitat condition scored in line with standard guidance for low distinctiveness habitats'.	There is a default rule whereby if distinctiveness score of 2 then it gets a score of 1 for habitat condition. There were a significant numbers of errors against this rule in the last submission.		
	PLG-10	BOTH	List of the habitat types where time to target condition score = 1. Check this complies with updated time to target condition guidance.	Query 'PostCon_Time_TargCond' for all entries where score = 1.		
	PLG-11	BOTH	For all polygons where 'used in biodiversity calculation' field contains a 'Yes' response are there any polygons with distinctiveness values that have been scored 'null' ?	As distinctiveness is used in the polygon calculations it should always be allocated a score of 0, 2, 4, 6 or 8. .		

	PLG-12	BOTH	Check that all 1m arable field margins that have been added to the calculation have all been identified and scored as areas of 'poor semi-improved grassland' . All 1m assumed arable margins included in the calculation should be scored as poor semi-improved grassland (distinctiveness = 4; habitat condition = 2, difficulty rating + 1; time to target condition = 0.83)	1m clipped arable field boundaries can be identified by sorting data by the 'Source' field. They were scored inconsistently in the last submissions.		
	PLG-13	BOTH	For habitat types: Scrub - Dense/continuous scrub & Scrub - Scattered scrub only where distinctiveness = 4 or 6 then ' habitat condition' score should be set to value of '2'. Corresponding 'habitat condition' comments all to be updated to say 'Condition scored in accordance with methodology for scrub habitats'	This change is necessary to ensure that it tallies with the assumptions made for created scrub habitats.		
	PLG-14	BOTH	Identify all areas where habitat description' = 'J1.2 Amenity Grassland' and distinctiveness score is greater than 2. Review all such entries and amend distinctiveness score or ensure that an appropriate comment is added justifying score for all such entries.	Amenity grassland habitat would normally be expected to be of low distinctiveness. Query to check validity of any polygons of this habitat type that have been afforded a distinctiveness score (PreCon_Distinct_Rate or PostCon_Distinct_Rate) of greater than 2.		

	PLG-15		Removed as was relevant to position in the network multiplier which has now been removed.			
	PLG-16	Post-construction Only	Undertake a query to identify any post-construction polygons that are scored as either a) PostCon_Distinct_Rate = 6 and PostCon_Hab_Cond = 3; or b) PostCon_Distinct_Rate = 4) and PostCon_Hab_Cond = 3. List number of occurrences,. Check all such occurrences - this combination of values should not occur for any areas of new habitat creation. Identify number of such occurrences and update as appropriate, adding a comment to justify any exceptions (e.g. where habitat enhancement is proposed or habitat is within the Scheme but is to be retained)	The query identifies a combination of scores that should not apply for new habitat creation due to the metric rule that we will not claim high distinctiveness scores for newly created habitats.	N/A	

	PLG-17	BOTH	Where habitat distinctiveness (PreCon_Distinct_Rate or PostCon_Distinct_Rate) score = '0' then the following should be undertaken: 1) the following fields should all be updated so that they score 'null'; 'condition rating' (PreCon_Habt_Cond; PostCon_Hab_Cond); 'time to target condition (PostCon_Time_TargCond); 'Difficult of recreating' (PostCon_Diff_Rating); 2) for entries where habitat distinctiveness (PreCon_Distinct_Rate or PostCon_Distinct_Rate) = 0 update the comments in all comment fields for 'condition rating'; so that they are populated with the text 'Distinctiveness = 0. Therefore null value attributed as per standard guidance'.			
	PLG-18	BOTH	Check that eB Document Link is populated. If not then update.	This will need to be populated at a late stage and you will need to 'reserve' an eB document number and link location to allow this.		
	PL-19	BOTH	Ensure that biodiversity unit (PreCon_Bio_Unit /Post_Con_Bio_Unit) and area fields (PreCon_Hab_Area/PostCon_Hab_Area) have been updated to take account of any changes made to other fields during the QA checks above	Some problems were experienced in last submissions with these values not updating automatically.		
TOTALS FOLLOWING QA CHECKS	PLG-A2	BOTH	Total area of polygons (ha) within layer prior to QA checks ?	Total area of polygons (Ha) in pre-construction layer, and same for post-construction		

	PLG- B2	BOTH	Total area of polygons 'used in biodiversity calculation' ?	Undertake a query to select out only those polygon features where the 'used in biodiversity calculation' has been identified as a 'Yes'.		
	PLG- C2	BOTH	Total area of polygons <u>not</u> used in biodiversity calculation ?	Undertake a query to select out only those polygon features where the 'used in biodiversity calculation' is not identified as 'Yes'.		
	PLG-D2	BOTH	Of the areas not used in the biodiversity calculation what area (ha) falls into each of the following categories: 1) No - area within the Bill where the Proposed Scheme will result in direct loss of ancient woodland; 2) No - area within or outside of the Bill where the ES has identified the potential for significant adverse effects on ancient woodland; 3) No - area to be used for translocation of ancient woodland soils (& associated planting); 4) No - area to be used for new planting to be provided in response to the loss of ancient woodland (excluding areas on ancient woodland soils); 5) No - area where HS2 will undertake enhancement of existing ancient woodland. Do these figures agree with those in the ancient woodland strategy ?	Areas to answer questions 1) to 5) can be obtained by querying the 'used in the biodiversity calculation' field. The totals should be the same for the pre- and post-construction layers. However, please check each layer independently to verify this.		

	PLG-E2	BOTH	Total biodiversity units generated by all polygons within the layer?	Check number of biodiversity units in pre-construction layer and for post-construction layer.		
	PLG-F2	BOTH	Total biodiversity units generated by all polygons not used in the biodiversity calculation ?	Undertake a query to select out only those polygon features where the 'used in biodiversity calculation' is not identified as 'Yes'. Count biodiversity units associated with these polygons.		

Appendix G – Habitat categories used in polygon data analysis

Table 25: Habitat categories used in the data analysis

Habitat category used for data analysis	Phase 1 habitat categories and CT-06 Proposed Scheme codes that fall within habitat category
Woodland and scrub	A1.1.1 Woodland - Broad-leaved - Semi-natural A1.1.2 Woodland - Broad-leaved - Plantation A1.2.1 Woodland - Coniferous - Semi-natural A1.2.2 Woodland - Coniferous - Plantation A1.3.1 Woodland - Mixed - Semi-natural A1.3.2 Woodland - Mixed - Plantation A1.2.1 Scrub - Dense/continuous scrub A1.2.2 Scrub - Scattered scrub A1.3.1 Parkland/scattered trees - Broad-leaved A1.3.2 Parkland/scattered trees - Coniferous A1.3.3 Parkland/scattered trees - Mixed K2.1 Woodland habitat creation K2. 4 Landscape mitigation planting (scrub/woodland)
Grassland	B1.1.1 Acid grassland - Unimproved B1.1.2 Acid grassland - Semi-improved B1.2.1 Neutral grassland - Unimproved B1.2.2 Neutral grassland - Semi-improved B1.3.1 Calcareous grassland - unimproved B1.3.2 Calcareous grassland - semi-improved. B1.4 Improved grassland B1.5 Marsh/marshy grassland B1.6 Poor semi-improved grassland J1.2 Cultivated/disturbed ground - Amenity grassland K2.3 Grassland Habitat Creation K2.6 Grassed Areas K5.3 Engineering earthworks
Other habitat	All other Phase 1 (J codes) and CT-06 (K codes) habitat types not included within the woodland and grassland habitat categories above.

Appendix H – References

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