



High Speed Rail in the Chilterns Little Missenden to Wendover:

**An assessment of the non-market effects of the Proposed Scheme compared
to the Alternative Proposal**

**VOLUME 1
MAIN TEXT**



Project Ref: 25136/004 | FINAL Rev: 00 | Date: 28th November 2013





Document Control Sheet

Project Name: High Speed Rail in the Chilterns: Little Missenden to Wendover

Project Ref: 25136-004

Report Title: An assessment of the non-market effects of the Proposed Scheme compared to the Alternative Proposal

Doc Ref: VOLUME 1 – MAIN TEXT- FINAL

Date: 25th November 2013

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Recommended for acceptance	Executive Committee Meeting			25/11/2013
For and on behalf of the Chilterns Conservation Board				

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Preface

This report represents a major contribution to the debate on valuing the environment when assessing major developments. The Treasury Green Book and the Supplementary Guidance on Accounting for Environmental Impacts led the way starting in 2003. Subsequently the Natural Environmental White Paper (2012) and the publication of the National Ecosystem Assessment (2011) provided a firm intellectual base from which to develop an approach to evaluating environmental impacts in general and non-market effects in particular.

Most infrastructure programmes or projects impact on the urban or rural landscape in which they are placed and on the people within them. Linear, dispersed or single location programmes or projects all have impacts but in different ways. Linear ones for example will always impact more because the perimeter length in proportion to the whole is greater than in the case of those in a single location.

The impacts which are the subject of this report are those for which it is difficult to judge a market value because a market does not exist to buy and sell them. The impact on the population effected or displaced, or destroyed cultural heritage are examples of this. It is not possible to buy or sell the anxiety or distress caused, or the loss or visual harm of the nation's archaeological remains; but they do have a value to the individuals or to society at large.

The term used to describe this is non-market effects. During the last few years government has progressed with the recognition of this problem and begun to identify some of the tools in order to undertake the analysis and evaluation. This is a two-step process: analysis on a qualitative basis (kinds, scale and type of impact), and evaluation on a quantitative basis (monetary amount). This is the approach which has been adopted, and the main concern here is qualitative analysis thus forming the basis of a quantitative evaluation later.

The evaluation of non-market effects is now essential in the assessment of costs and benefits of infrastructure programmes and projects. To do otherwise would be to run counter to current thinking and the desirability of recognising the value of the environment. This current thinking is now well articulated by the Natural Capital Committee which reports to the Economic Affairs Committee of the Cabinet Office.

In preparing a report such as this it has been tempting to overwhelm the subject with too much detail and this has been resisted although when the quantitative evaluation is done there may be a call for a finer grain approach in areas such as tourism and biodiversity. The Chilterns Conservation Board is aware that this report puts forward a methodology which is applicable to any infrastructure project in any protected landscape. It has not accepted the role lightly. It has done so because government is considering the imposition of a major linear infrastructure project across the widest part Chilterns Area of Outstanding Natural Beauty. The basis of the argument put forward here is that the current government proposals militate rather than mitigate the impact. It is not the purpose of this report to pass judgement on either of these approaches but to draw attention in an evidence-based and disinterested way to the consequences of the government's approach in this case.

Ray Payne

Member Appointed by the Secretary of State
Chilterns Conservation Board

October 2013

Summary

This report was written in response to the Government's proposal to build a high speed rail line as a surface route across part of the Chilterns AONB.

In this report the Government proposal is referred to as the Proposed Scheme. An alternative engineering solution has been developed which takes the form of a continuous tunnel and is referred to in this report as the Alternative Proposal.

The designation of the protected landscape of the Chilterns AONB rests on the unique characteristics of its landscape. The design of the government's Proposed Scheme takes no account of the designated landscape of the Chilterns AONB or the protective provisions of Part IV of CROW 2000.

PBA was commissioned by Conserve the Chilterns & Countryside to carry out a study into the practicalities of extending the tunnel from the proposed current termination point at Mantle's Wood north of Little Missenden to the Chilterns AONB boundary north of Wendover. This study was published in October 2012 and HS2 Ltd was asked to comment on it.

The conclusion which they reached was that such a tunnel extension was a practical engineering solution although HS2 Ltd have decided not to pursue it because it is of the opinion that it will cost about **£330m** more than the Published Scheme. A previous estimate indicated only £65m difference and the basis of this new cost differential has not been confirmed.

Therefore it is felt that an evaluation of the non-market effects of the 11.6km of the Proposed Scheme is essential.

These non-market effects are those which materially impact on the quality of the landscape, archaeology and cultural assets, biodiversity, health and wellbeing and similar effects for which no market exists but the value of which must be taken into account in comparing the Proposed Scheme with alternatives.

This report provides a qualitative analysis of the comparative impacts of the Proposed Scheme versus the Alternative Proposal, on the landscape, biodiversity, geomorphology and archaeology of the Chilterns AONB. The report also compares the effect the Proposed Scheme versus the Alternative Proposal could have on the local and national economy through a consideration of the effects on agriculture, property, tourism and health and well-being.

The analysis undertaken to date has shown that the magnitude of non-market effects predicted in relation to the Proposed Route is on average **ten times greater** than with the Alternative Proposal summarised in these key points.

- The Proposed Scheme affects **55 sq.km** of the Chilterns AONB during construction and **45 sq.km** in operation. The Alternative Scheme affects **6 sq. km** of the Chilterns AONB during construction and operation.
- The Proposed Scheme would result in the loss of **13** historic sites. The Alternative Scheme affects **1** historic site.
- The Proposed Scheme removes **9.2 ha** of Ancient Woodland. The Alternative Proposal affects **0 ha** of Ancient Woodland.
- With the Proposed Scheme approximately **250 ha** of agricultural land is lost. With the Alternative Scheme approximately **20 ha** of agricultural land is lost.
- The Proposed scheme disrupts over **18** walking routes compared to **2** for the Alternative.

- The Proposed scheme will demolish or significantly affect **143** dwellings whereas the Alternative will only demolish **1**, which is lost in either proposal.

In conclusion, HS2 Limited's opinion of the cost differential between the Proposed Scheme and the Alternative Proposal is **£330m**. This figure is not accepted by Conserve the Chilterns and Countryside but the detailed information to check the figures has not been made available by HS2 Limited.

Even if the figure is £330m, our work has identified that the non-market effects of the Proposed Scheme are approximately ten times greater than that of the Alternative Proposal.

Given the duty of the Government under Section 85 of the Countryside and Rights of Way Act 2000 to have regard to the purpose of conserving and enhancing the natural beauty of Areas of Outstanding Natural Beauty, the scale of any cost differential between the Proposed Scheme and the Alternative Proposal has to be balanced against the Government's duty in section 85 and the non-market effects of both schemes, as set out in this document.

"The matters set out in this report lead to a conclusion that it would be perverse for the Government to proceed with the Proposed Scheme in preference to the Alternative Proposal having regard to its duty under CRow 2000 Section 85."

*Simon Ricketts
Partner, Joint UK Head of Real Estate, King & Wood Mallesons SJ Berwin*

1 Introduction

1.1 Background

- 1.1.1 The report has been prepared jointly by Peter Brett Associates LLP (PBA) and the Chilterns Conservation Board (the Board). The purpose of this association is to harness the skills, knowledge and expertise of both organisations and in particular to discharge the statutory duty of the Board to conserve and enhance the natural beauty of the Chilterns Area of Outstanding Natural Beauty (Chilterns AONB).
- 1.1.2 This report, and its predecessor *Response to the surface route draft Environmental Statement and a commentary on the proposed continuous tunnel* (PBA/CCB, July 2013), were written in response to the Government's proposal to build a high speed rail line as a surface route across part of the Chilterns AONB. In this report the Government proposal is referred to as the Proposed Scheme. An alternative engineering solution has been developed which takes the form of a continuous tunnel and is referred to in this report as the Alternative Proposal.
- 1.1.3 The authors are of the opinion that the long-term consequent changes to the environment after construction, and the temporal changes as a result of the construction process will generate considerable direct and indirect costs for society in general and local communities in particular. It is important that these environmental impacts should be properly assessed.
- 1.1.4 It is clear that the Chilterns AONB will be devalued by the construction of HS2; but it is unclear by how much. This report seeks to assess how much less the AONB would be devalued by the Alternative Proposal in comparison to the Proposed Scheme.

1.2 Earlier Studies

- 1.2.1 In the face of criticisms that the environmental impacts on the Chilterns AONB would be considerable and unacceptable, HS2 Ltd gave an undertaking to consider an investigation into the feasibility of extending the tunnel in the Proposed Scheme to the northern boundary of the Chilterns AONB.
- 1.2.2 The purpose of this extension would be to reduce considerably the negative environmental and economic impacts. It was expected there would be an additional cost for a longer tunnel compared with the published surface alignment and this proved to be the case.
- 1.2.3 PBA was commissioned by Conserve the Chilterns & Countryside to carry out a study into the practicalities of extending the tunnel from the proposed current termination point at Mantle's Wood north of Little Missenden to the Chilterns AONB boundary north of Wendover, based on the Published Scheme horizontal alignment. This study was published in October 2012 and HS2 Ltd was asked to comment on it. They commissioned its tunnelling Professional Services Contractor, Atkins, to do this and Atkins in turn has reported to HS2 Ltd.
- 1.2.4 The conclusion which they reached was that such a tunnel extension was a practical engineering solution although HS2 Ltd have decided not to pursue it because it is of the opinion that it will cost about **£330m** more than the Proposed Scheme. The Draft ES notes that:
- Whilst the extended (tunnel) options are feasible in engineering terms and would have an environmental benefit; there would be a financial cost in extending the bored tunnel.*
- 1.2.5 The additional cost now quoted by HS2 is greater than the previously considered difference in cost using previous information published by HS2 when considering the long tunnel option, which was calculated as £65m. The question as to why the costs have changed so much and why the previous reports are no longer valid, despite being the basis of scheme decisions, is unclear.

- 1.2.6 This has reinforced the Board's view that an evaluation of the non-market effects of the 11.6km of the Proposed Scheme from Little Missenden to Wendover is essential.
- 1.2.7 These non-market effects are those features of the Proposed Scheme which materially impact on the quality of the landscape, archaeology and cultural assets, biodiversity, health and wellbeing and similar effects. These are effects for which no market exists but the value of which must be taken into account in comparing the Proposed Scheme with alternatives.

1.3 Purpose of this Report

- 1.3.1 The purpose of this report is to provide an analysis of the non-market effects of the Proposed Scheme compared with the Alternative Proposal based on the information to hand.
- 1.3.2 This report is in the following six parts, which are to:
- Summarise the main features of the Proposed Scheme and the Alternative Proposal;
 - Review the status of the Chilterns AONB in an international and national context;
 - Review the current government position on non-market evaluation and background methodology;
 - Describe the methodology developed for this report;
 - Analyse the comparative data on the Misbourne Valley so as to be able to demonstrate its unique characteristics in both specific and generic terms;
 - Use this data and the refined engineering information to undertake a preliminary assessment of the non-market effects of the Proposed Scheme in comparison with the Alternative Proposal; and
 - Prepare the basis of a primary evaluation of non-market effects. This primary evaluation is not considered in this report, but some indicators are provided.

1.4 Description of the proposed scheme

- 1.4.1 HS2 is planned to be a Y-shaped rail network with stations in London, Birmingham, Leeds, Manchester, South Yorkshire and the East Midlands, linked by high speed trains running at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph)), and a maximum design speed of 400kph (250mph).
- 1.4.2 HS2 is proposed to be built in two phases. Phase One would involve the construction of a new railway line of approximately 230km (143 miles) between London and Birmingham that would become operational by 2026; with a connection to the West Coast Main Line (WCML) near Lichfield and to the existing HS1 line in London. The Phase One route is shown in Figure 1.1.
- 1.4.3 On opening, Phase One would run up to 14 trains per hour (tph). HS2 trains would be up to 400 metres (m) long with 1,100 seats during peak hours. Beyond the dedicated high speed track, these high speed trains would connect with and run on the existing West Coast Main Line to serve passengers beyond the HS2 network. A connection to HS1 would also allow some services to run to mainland Europe via the Channel Tunnel.

High Speed rail in the Chilterns

- 1.4.4 The published design of the Proposed Scheme as it crosses the Chilterns AONB is in a bored tunnel from the M25 to Mantle's Wood (ancient woodland) near Little Missenden. The

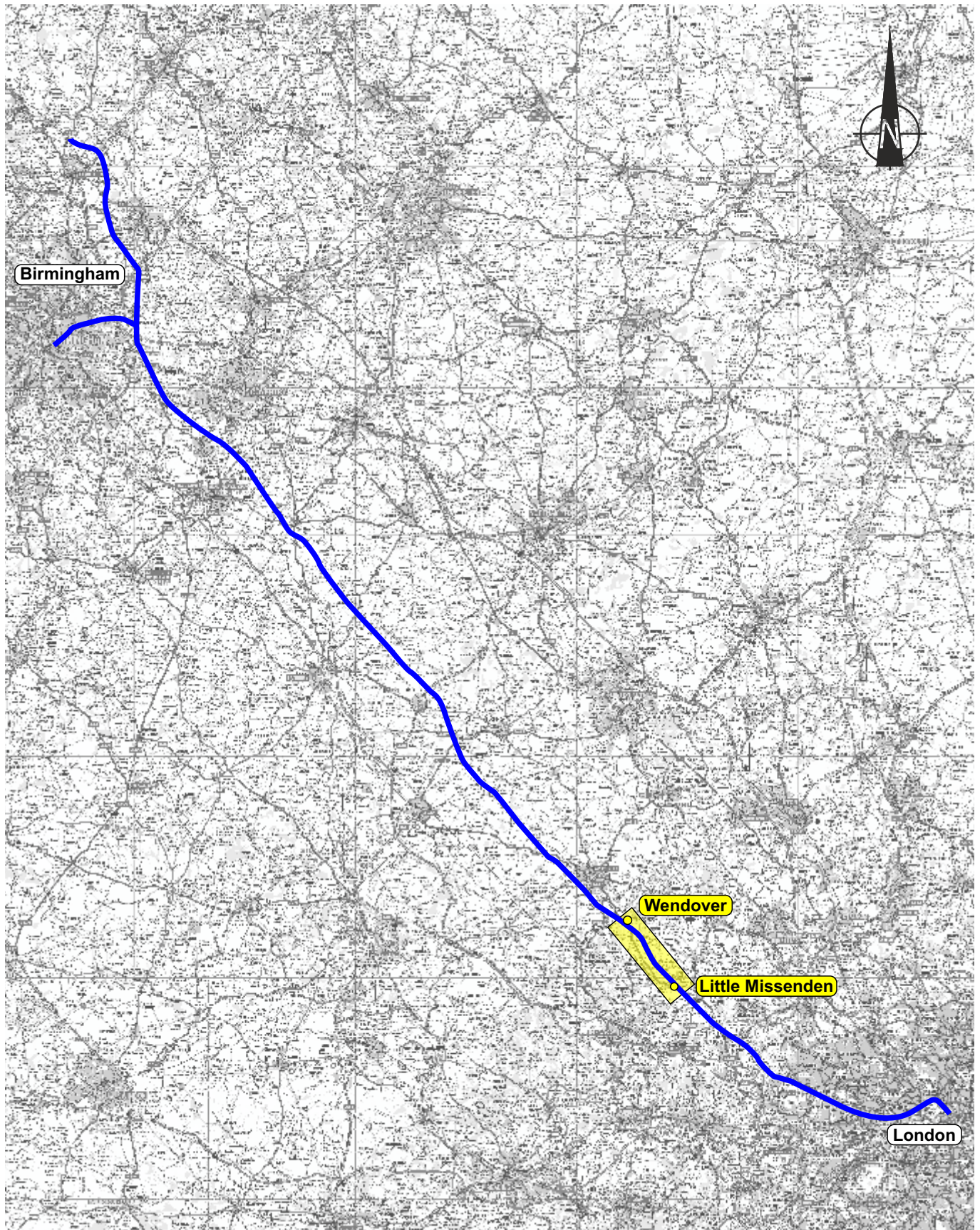
remainder has been designed as a surface route which is a combination of cuttings, embankments, ‘cut and cover’ concrete box tunnels and viaducts as shown in Figure 1.1.


- 1.4.5 As part of the Proposed Scheme, the material from the cuttings is to be used to form embankments in the usual way and a quantity of residual material is also to be placed alongside the railway in an attempt to mitigate noise and disguise the visual impact. The consequences of this are that the effects will be militated rather than mitigated. HS2 Ltd have also confirmed that an additional surplus quantity of material, totalling 800,000 cu.m (approx. 1.8 million tonnes (Mt)) will have to be “sustainably” disposed of in the locality. The location for disposal of this material is not yet defined or the effects understood.
- 1.4.6 It has been argued by both government and HS2 Ltd that the decision to have a bored tunnel from the M25 to Little Missenden is in recognition of the Chilterns nationally protected status as an AONB. This principle is supported. It does, however, raise the question why only one half of the Chilterns AONB is to be protected with a bored tunnel when the impacts on the remainder of the route in the Chilterns AONB are similar and in some respects worse. The Board is of the opinion that the principle should be applied equally to the whole AONB.
- 1.4.7 The Proposed Scheme is summarised in Table 1.1 below.

Table 1.1: The 2012 Post Consultation Route

Section	Chainage (km) *	Length (m)	Description
M25 to Mantles Wood	31.500 - 44.725	13,225	Twin- bored tunnel
Mantles Wood to Chesham Road	44.725 -46.250	1,525	Deep cutting
South Heath	46.250 - 47.330	1,080	Cut and cover (concrete box tunnels)
Potter Row to Durham Farm	47.330 - 50.450	3,120	Cutting
Durham Farm	50.450 - 51.150	700	500m viaduct and embankments
Wendover Dean	51.150 - 51.600	450	Cutting
Over A413 and Chiltern Line	51.600 - 53.750	2,150	500m viaduct and embankments
Wendover	53.750 - 55.030	1,280	Cut and Cover (concrete box tunnels)
Wendover to AONB boundary	55.030 - 56.200	1,170	Cutting

*Chainage is the distance in kilometres from London Euston Station (presented on drawings as km+m)





 Study Area



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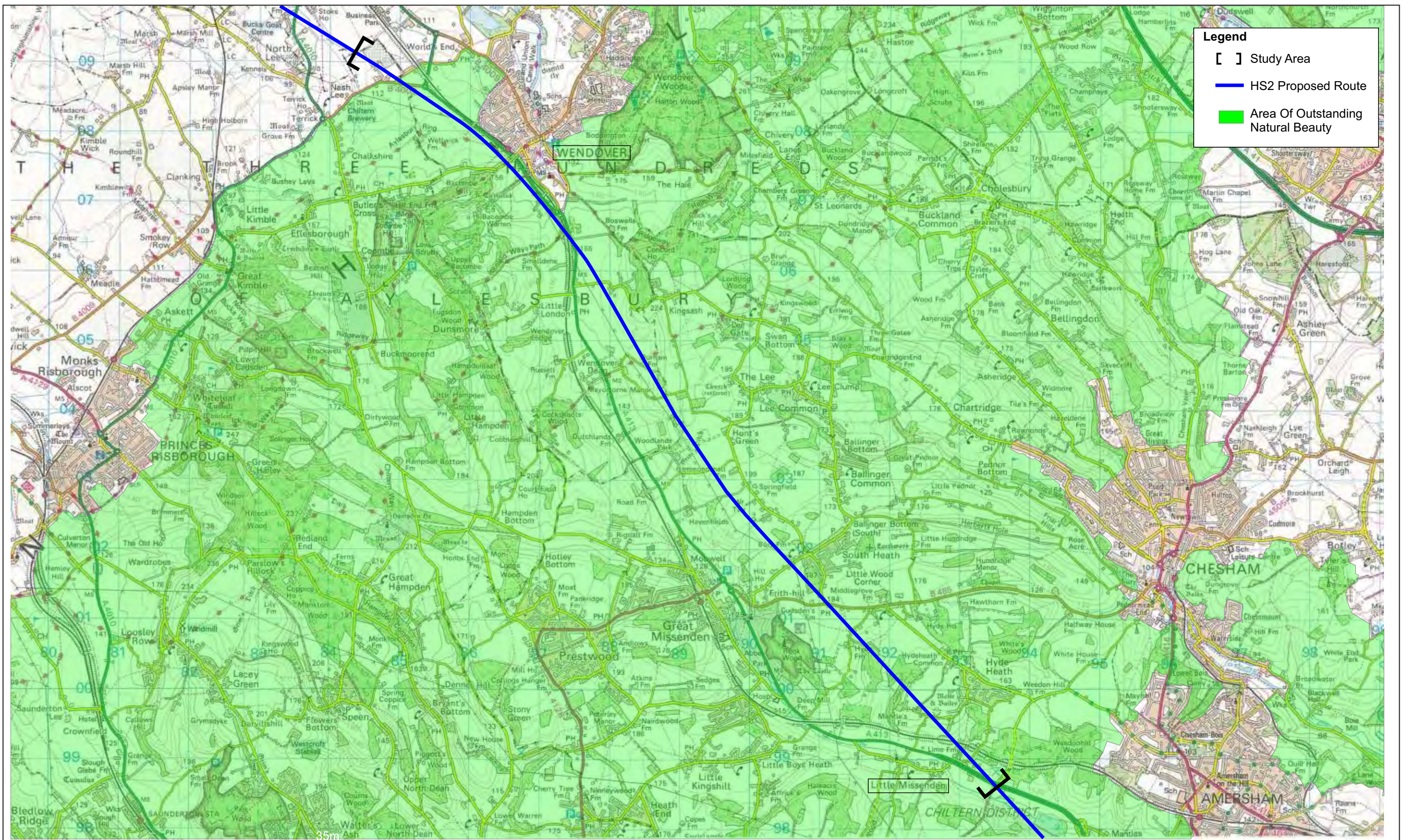
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HS2 IN THE CHILTERNS

HS2 Phase One Route

Date	17.10.2013
Scale	1:250 000
Drawn by	DC
Checked by	JH
Revision	-

FIGURE 1.1



Client


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HS2 in the Chilterns Assessment of Non-Market Effects

Study Area for Alternative Continuous Tunnel

Date	17.10.2013
Scale	1:50 000
Drawn by	DC
Checked by	JH
Revision	-

FIGURE 1.2

1.5 Description of the Alternative Proposal

- 1.5.1 The Alternative Proposal lies in two Community Forum Areas designated by HS2 Ltd, namely;
- The Central Chilterns; and
 - Dunsmore, Wendover and Halton.
- 1.5.2 It covers a section approximately 14.1km in length in the local authority districts of Chiltern, Wycombe and Aylesbury. It passes to the east of Little Missenden and Great Missenden and extends from the junction of the A413 with Mop End Lane in a north-westerly direction toward Leather Lane and northwards, to the west of Wendover.
- 1.5.3 The most desirable solution would be a fully bored tunnel from the M25 to the AONB boundary north of Wendover with no surface intervention apart from vents. This is the only solution to give acceptable protection to the Chilterns AONB, but a tunnel of this length is not currently permitted under the European safety legislation without additional infrastructure measures.
- 1.5.4 The European Technical Specification on Interoperability (TSI) 1 issued in 2008 has a major influence on the choice of tunnel design for the transit of the Chilterns. The TSI stipulates, inter alia, that any tunnel in excess of 20 kilometres in length requires a Special Safety Investigation to be undertaken that may lead to additional safety measures not included in the TSI to admit interoperable trains in an acceptable fire safety environment.
- 1.5.5 It was considered by HS2 Ltd that such a Special Safety Investigation could result in a significant delay to the project.
- 1.5.6 In the current alignment the distance from the tunnel entry point within the M25 to the edge of the Chilterns AONB north of Wendover is 24.5 kilometres. However, if a long tunnel is divided by a section in open air which is at least 500 metres long with suitable access and egress then the tunnels can be treated as two separate tunnels for the purposes of the TSI.
- 1.5.7 The TSI is currently being revised and the revised EU Decision should come into force in 2014. This may allow greater flexibility in the application of the TSI and could possibly remove the need for a gap. But for this report it has been assumed that the current TSI is applicable.
- 1.5.8 Evaluation of the options for the tunnel has for simplicity been confined to altering the vertical alignment only whilst retaining the horizontal alignment proposed in January 2012. In practice if a tunnel option is selected the horizontal alignment could also be altered.
- 1.5.9 Ideally the northern portal of the tunnel would be outside the Chilterns AONB, but the requirement for a maintenance loop to be located just north of the Chilterns AONB make this impossible. Instead the last section of the route would be in a concrete box tunnel. This would also permit the tracks to converge from the 19.6 metre separation of the track centrelines as they emerge from the bored tunnel to 5 metres for the maintenance loop.
- 1.5.10 In this report it has been assumed that the bored tunnel portals are located at chainage 54.535 and run directly into a concrete box tunnel to ch55.400 and the termination of the porous portal is at ch55.500.
- 1.5.11 It would be preferable for this portal to be located as far north as ch56.200, closer to the current boundary of the AONB, but engineering constraints may not make this feasible. The exact position and arrangement for these tunnel portals may need to be adjusted after further studies of the line geometry, hydrology, and geotechnical investigation and the consequent laboratory test results.
- 1.5.12 A temporary construction site near the tunnel boring machine (TBM) launch portal will be required for storage and screening. Approximately 100,000 to 150,000 square metres will be

needed plus an additional 30,000 square metres if a segment casting factory is necessary. An alternative might be for the segments to be brought in by rail from the casting factory located near the M25 portal.

- 1.5.13 With a continuous bore from Wendover through to Mantles Wood the complexity of constructing the concrete box tunnels adjoining Wendover and South Heath as envisaged in the Proposed Scheme would be avoided. There would also be no need for the viaducts at Wendover Dean and across the A413 and Chiltern Railways tracks.
- 1.5.14 The option described below has been adjusted from the original proposals made in October 2012 to take account of the recommendations contained in Atkins engineering review of the earlier proposals and are now dated June 2013 and reflects the description of Option C in the Draft ES CFA Books 9 & 10.
- 1.5.15 The Alternative Proposal with the intervention gap at Durham Farm is the focus of this report. The scheme with the intervention gap at Mantles Wood was discussed in *Response to the surface route draft Environmental Statement and a commentary on the proposed continuous tunnel* (PBA/CCB, July 2013).

1.6 Construction of the Alternative Proposal

- 1.6.1 The Alternative Proposal would require two pairs of (TBMs) working from opposite ends of the Chilterns AONB. One pair of TBMs would bore from inside the M25 to the Vent Shaft S4 adjacent to the A413 (Chainage 43.000) and another pair would start near the Chilterns AONB boundary north of Wendover driving to the same shaft.
- 1.6.2 A gap of 500 metres to comply with the TSI would be sited at Durham Farm, Wendover Dean, whereas under the current proposal there is to be a 500 metre long viaduct at this point. This is 19km from the M25 portal and therefore complies with the TSI.
- 1.6.3 The Alternative Proposal is summarised in Table 1.2 below:

Table 1.2: Summary of Alternative Proposal

Section	Chainage (km) *	Length (m)	Description
M25 to A413	31.500 to 43.000	11,500	Twin-bored tunnel
North side of A413	43.000	n/a	Enlarged vent shaft
A413 to Durham Farm	43.000 to 50.450	7,450	Twin-bored tunnel
Durham Farm	50.450 to 51.150	700	Intervention Gap
Durham Farm to Wendover	51.150 to 54.535	3,385	Twin-bored tunnel
Wendover towards B4009	54.535 to 55.400	865	Cut and cover tunnel (concrete box tunnels)

*Chainage is the distance in kilometres from London Euston Station (presented on drawings as km+m)

Waste Arisings

- 1.6.4 It is recognised that the Alternative Proposal is likely to generate a significant volume of waste arisings from the tunnelling.
- 1.6.5 For the section of tunnelling (ch 43.000 to ch 55.400) which would be bored from the Wendover end, it has been estimated there will be 3.2 Mt. of excavation arisings that will be

composed mainly of chalk. The likely tunnelling method used would mean the material would be removed from the bore as slurry and once at the reception facility the moisture content would be reduced through a combination of drying and introducing inert additives. The moisture reduction process is necessary in order to bring the chalk to a state where it is possible to transport by any mode. The options for transporting the excavation arisings from the reception facility would then be road, rail, or conveyor. An initial location for receipt of this material is considered to be Calvert, a direct distance of 20 - 25km and adjacent to the HS2 trace and Chiltern Line, where there are large voids available from former brickmaking activities and which is licenced to receive such material. It can also receive material both by road and rail.

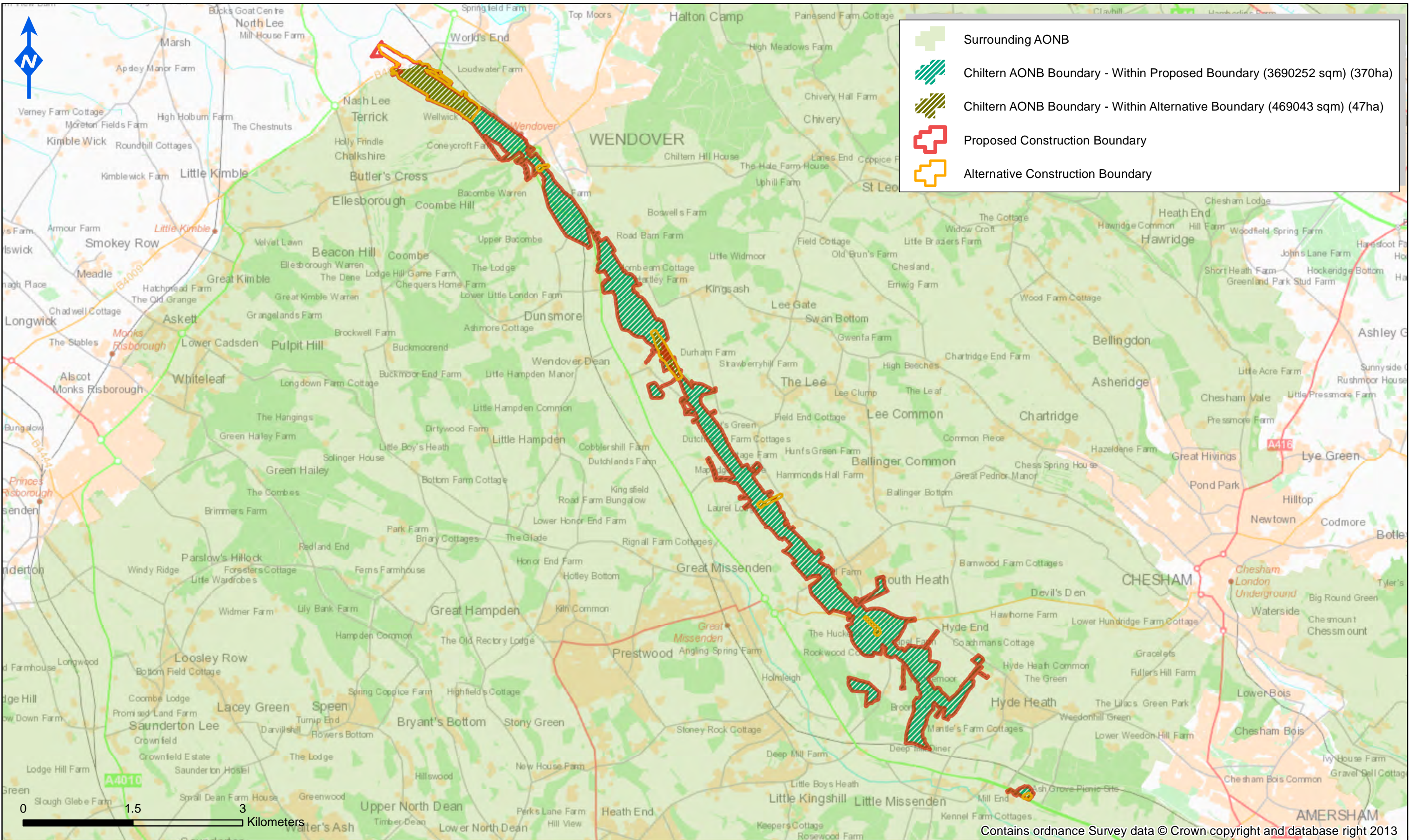
- 1.6.6 The rail freight terminal at Calvert is active and currently receives material for disposal as landfill from various locations by train. Some of this material is municipal waste which is moved in sealed containers and trans-shipped by overhead gantry cranes to off-road vehicles for the final stage of the journey. Calvert also receives spoil and other materials which can be contaminated or inert (and thus suitable for lining and capping landfill pits); these materials are moved in open-box wagons which are unloaded by mobile tracked grabs.
- 1.6.7 The Calvert terminal is thus well-suited to handle material from the tunnel site, having the equipment and staff able to unload it from open-box wagons.
- 1.6.8 The feasibility of using road or rail has been given a preliminary assessment and the conclusions are outlined below:
- Road offers a familiar and flexible solution for the transport of the excavation arisings;
 - The road operation will generate a very high number of trips. If all the arising were deposited at Calvert Landfill then all the trips are likely to have to pass through Aylesbury;
 - The UK rail freight industry is well-placed to move bulk solids of this nature;
 - Rail freight operating companies can offer competitive pricing to that of road transport and between themselves;
 - The characteristics of the proposed traffic flow (resource utilisation, predictability and duration) make it particularly attractive to rail freight operators;
 - The rail operation is likely to consist of a daily train of open-box wagons capable of operating between the rail terminal and Calvert at any time outside morning and evening peak hours;
 - A completely new rail facility would be required to load the material because there is no suitable existing siding;
 - Topography in the vicinity of the likely site for a rail facility is reasonably favourable but dwellings, public-footpaths and National Grid power-lines in close proximity must be taken into account when designing the facility and agreeing its operating hours;
 - The rail terminal at Calvert is suitable to receive bulk solid waste such as material from the tunnel but it can only accept open-box wagons at present; and
 - Preliminary estimates indicate road has a cost advantage of around £0.85/T, but the environmental saving of using rail far exceed those of using road.
- 1.6.9 It is estimated that in order to maintain suitable flow of spoil away from the tunnelling reception facility for the Alternative Proposal about 1,500 tonnes of arisings will have to be removed each day. To meet this target would require 92 lorry visits per day to site, equal to 184 one-

way trips. Assuming a lorry payload is 16t, it is estimated the transport would require 16 lorries, which would each have to make 6 trips per day.

- 1.6.10 The overall quantity of material to be disposed of under the Proposed Scheme has not been published but it should be noted that since the close of consultation on the draft ES, it has been announced that an additional 800,000 cu.m (approx. 1.7 million tonnes) of material has to be disposed of from the work in the Chilterns. This is apparently in addition to the material indicated in the draft ES as being used for regrading existing fields for visual and noise impact mitigation.

1.7 Operation of the Alternative Proposal

- 1.7.1 The Alternative Proposal will operate in the same way as the proposed scheme. The design speed is slightly reduced through bored tunnels to 320km/h and it is calculated that the additional tunnel length will add approximately 10-15 seconds to the journey time.



1.8 Comparison of area of land likely to be disturbed

1.8.1 A comparison of the area of land likely to be disturbed by the Proposed Scheme (surface route) with the Alternative Proposal (continuous tunnel) is illustrated in the Figures 1.4 and 1.5 below.

Figure 1.4: Comparison of the Disturbed Area along Route

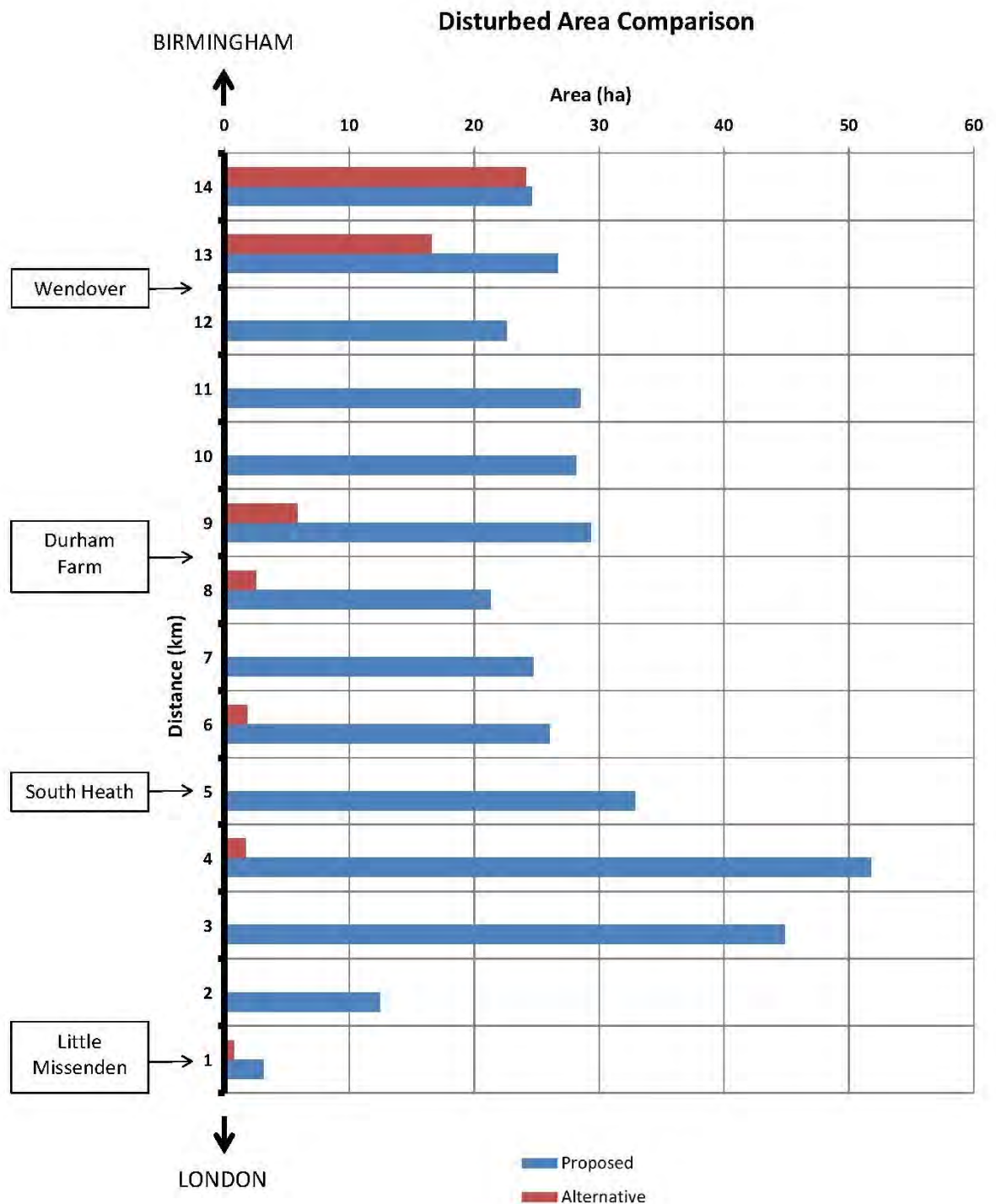
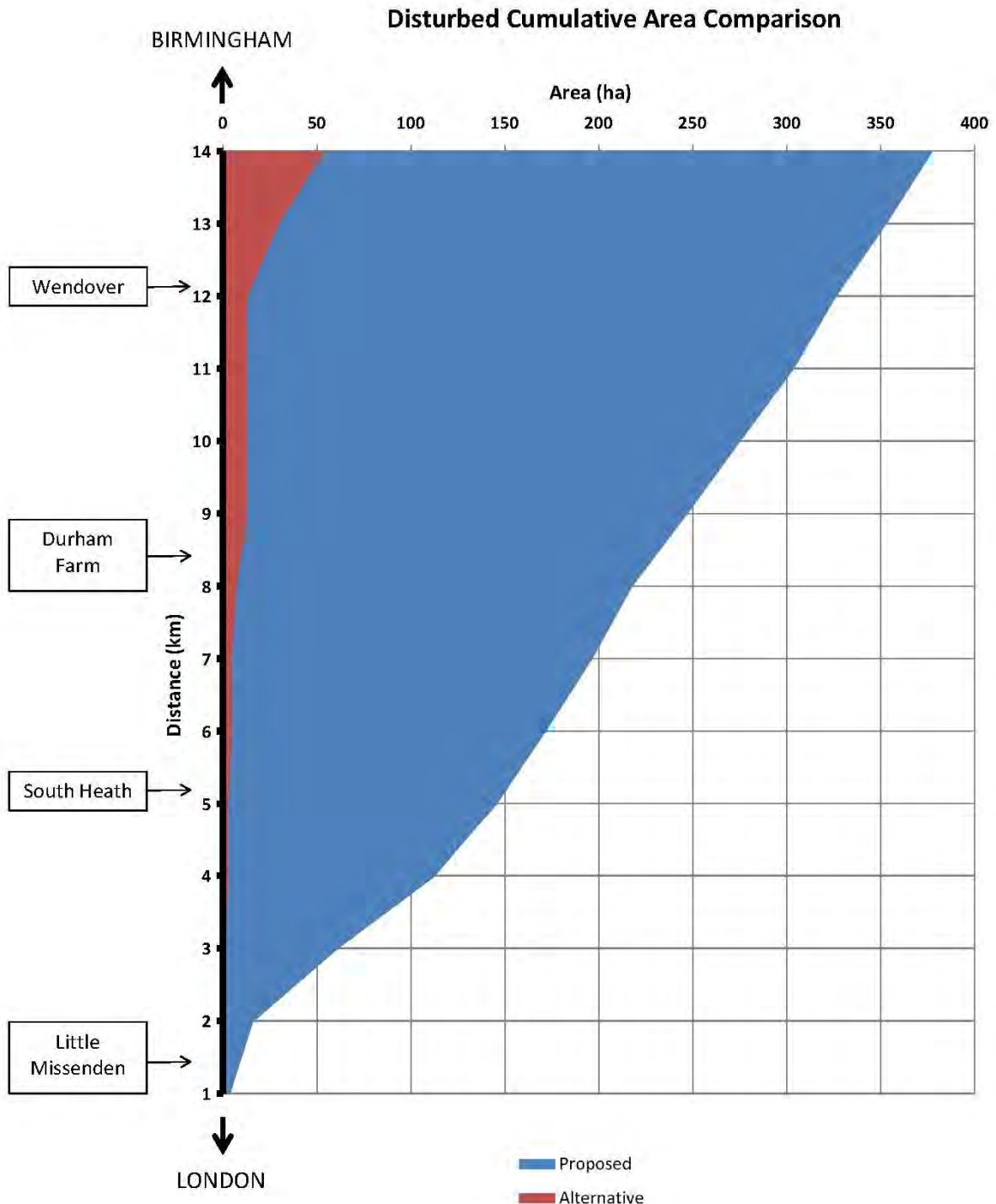


Figure 1.5: Comparison of the Cumulative Area of Disturbance



1.9 International Importance of the Chilterns AONB

- 1.9.1 The International Union for Conservation of Nature (IUCN) provides international recognition for the AONB designation, which it places in its Category V - Protected Landscapes and Seascapes. The IUCN has asked for renewed commitment to nature conservation from all AONB's. The National Association for AONB has prepared and has had accepted by IUCN, a Statement of Compliance for all AONBs. The Board has provided a Statement of Commitment to this Statement of Compliance and as a result the Chilterns AONB has retained its status as a Category V Protected Landscape.
- 1.9.2 This confers on the Chilterns AONB an international status to complement its national standing. Category V is also the same category in which the UK's National Parks and French Regional Nature Parks are placed; thus again blurring the distinction between the Chilterns AONB and a National Park.

1.10 National importance of the Chilterns AONB

- 1.10.1 There are three distinguishing features which separate a National Park from an AONB and for most AONBs there are significant differences. In the case of the Chilterns AONB, the distinguishing features are less clear. The features are technical criteria, desirability, designation and purpose.

Technical criteria

- 1.10.2 Natural beauty is not exhaustively defined in the legislation. It is also a very subjective characteristic of a landscape and ultimately involves a value judgment. In deciding whether an area has natural beauty and the designation National Park or AONB the following criteria have been adopted by Natural England
- Landscape quality;
 - Scenic quality;
 - Relative wildness;
 - Relative tranquillity;
 - Natural heritage features; and
 - Cultural heritage
- 1.10.3 The Chilterns AONB satisfied the technical criteria listed above. It should also be noted that the natural beauty required of a National Park is the same as that of the Chilterns AONB. It could also be argued that the National Park obligation to provide opportunities for open air recreation is not dissimilar to that of the Chilterns Conservation Board in intent if not in fact taking into account the 55m visits to the Chilterns AONB each year.

Desirability

- 1.10.4 Because a National Park designation brings with it more significant changes in the administration of the area by a National Park Authority, different thresholds apply. The implication of the word 'especially' in relation to National Parks is that the threshold of desirability for the designation of land as a National Park is higher than that for an AONB.

Designation

- 1.10.5 In recognition of the fact that National Parks and AONBs represent the highest level of landscape protection, areas have to be nationally significant in order to be designated. There should also be confidence that the mechanisms, powers and duties resulting from designation are necessary to ensure the delivery of National Parks and AONB purposes.
- 1.10.6 The Chilterns AONB and its Board achieved this level of confidence.

Purpose

- 1.10.7 National Parks and AONBs generally have different purposes. The Chilterns AONB is only one of two of these 33 AONBs to have the statutory purpose of promoting the understanding and enjoyment of the area's special qualities to the public. It has this additional purpose by virtue of section 87 of the CROW 2000.
- 1.10.8 Both designations also share the purpose of conserving and enhancing natural beauty, but for AONBs this does not expressly include the purpose of conserving and enhancing wildlife or cultural heritage. Natural England considers that 'cultural heritage' often contributes to the perception of natural beauty of the area and so forms part of the AONB purpose to the extent that this is the case.
- 1.10.9 The Chilterns AONB therefore satisfies the highest level of technical criteria, desirability, designation and purpose. It also reinforces the position that the government's Proposed Scheme fails to take account of the fact that the designation of the Chilterns AONB is similar to that of a National Park.

1.11 Legislation relating to the Board

- 1.11.1 The Chilterns Conservation Board has two statutory purposes under the Countryside and Rights Of Way Act 2000 (CROW) 2000. These are:
- to conserve and enhance the natural beauty of the AONB; and
 - To increase the understanding and enjoyment of the special qualities of the AONB.
- 1.11.2 The second of these statutory purposes is unique to only two of the 33 AONBs: the Chilterns AONB and the Cotswolds AONB. Only these two have statutorily appointed Boards and regulatory control and some Board members are appointed by the Secretary of State for the Environment.
- 1.11.3 In fulfilling these statutory purposes, the Board also has a duty to seek to foster the economic and social wellbeing of local communities within the Chilterns AONB. The other important aspect of CROW 2000 is the reference in section 85(1) to the 'General duty of public bodies etc.', In particular it requires that:
- 1.11.4 *In exercising or performing any functions in relation to, or so as to affect, land in an area on outstanding natural beauty, a relevant authority shall have regard to the purpose of conserving and enhancing the natural beauty of the area on outstanding natural beauty.*
- 1.11.5 The relevant authorities in this case include any Minister of the Crown which the Board has interpreted as including the Secretary of State for Transport. The Board understands that the interpretation of the duty to 'have regard' under section 85(1) of the CROW 2000 has not been tested in the courts although there have been two analogous situations in which Parliament have imposed a duty on public authorities to have regard to a particular factor in exercising the functions, and in relation to which the courts have addressed what is required in order to comply with that duty.

- 1.11.6 The National Parks and Access to the Countryside Act, 1949 (NPAC 1949) established the statutory framework for protected landscapes in England. This legislation has been amended and added to since then and land to be included in a National Park or AONB must now meet the statutory designation criteria that are described in the National Parks and Access to the Countryside Act 1949 (for National Parks) or the CROW 2000 in respect of AONBs. The other relevant legislation is the Natural Environment and Rural Communities Act, 2006 (NERC 2006).
- 1.11.7 Section 82(1) of CROW 2000 defines an AONB in England as an area that is not in a National Park but which appears to Natural England to be of such outstanding natural beauty that it is desirable that the protective provisions of Part IV of CROW 2000 should apply to it for the purpose of conserving and enhancing the area's natural beauty. Natural England concluded that the Chilterns satisfied the outstanding natural beauty test and by order designated the area as an AONB.
- 1.11.8 The design of the government's Proposed Scheme takes no account of the designated landscape of the Chilterns AONB or the protective provisions of Part IV of CROW 2000.

2 The current position of the government

2.1 Background

- 2.1.1 The published business case for HS2 is based on a combination of real costs and revenue together with a range of notional costs including a valuation of the time saved by running trains at a faster speed than classic rail or HS1. The case has not so far included the evaluation of non-market effects sometimes referred to as economic externalities. This is the value of natural systems to society which are largely unregistered by the free market or for which a market does not exist. For example costs have not been included for the reduced asset value arising from uncompensated property blight or the loss of trade for affected businesses. Similarly the business case does not include any indirect costs such as loss of tourist trade to the Chilterns due to reputational damage, inconvenience to local people, disruption to local transport services and provision of utilities, and the value of the landscape and cultural heritage.
- 2.1.2 This section begins with a review of the current Department for Transport (DfT) evaluation methodology, and continues with a discussion on alternatives which government supports, or in the case of the Natural Capital Committee, has been recommended to government.

2.2 The DfT evaluation methods for landscape

- 2.2.1 DfT used a methodology based on the current use of the land to be occupied by the railway. This methodology does not include any values for impacts on adjacent land, sites or features, nor does it value the setting or wider landscape.
- 2.2.2 Valuing the assessment of landscape impacts is a vital aspect of the comparative analysis of the various route options. The DfT's document "*The Economic Case for HS2: Value for Money Statement*", discusses Landscape Impacts and the results of its assessment in the following way:

The assessment of landscape impacts was carried out by the Department in line with standard value for money procedures and is based on the methodology outlined by the Department for Communities and Local Government in its document 'Valuing the External Benefits of Undeveloped Land' (DCLG, 2001). While the value of adverse landscape impacts is sensitive to the underlying analytical assumptions regarding land type and mitigation measures, the estimated disbenefit of £960m (2011 prices, 2011 present value) should be regarded as an upper limit to the impact as it is based on the route presented at consultation and does not take into account the route changes described in the 'Review of Possible Refinements to the Proposed HS2 London to West Midlands Route' (HS2 Ltd, Jan 2012)

- 2.2.3 This method of calculation resulted in a value of adverse landscape impacts at £4.4bn for the whole route and £0.96bn for the section from Amersham to the Chiltern northern edge. As the statement points out it does not take into account later route changes.
- 2.2.4 The transit route across the Chilterns AONB was subsequently changed to be in a tunnel from the M25 to Little Missenden. The DfT then carried out a separate analysis based on the this revised route, the Proposed Scheme, and concluded that the value of the adverse landscape impacts from Amersham to the Chiltern northern edge are £0.11bn, most of which is attributable to the Wendover area.
- 2.2.5 The methodology used in this later study is based on *Valuing the External benefits of Undeveloped Land* (Department for Community and Local Government, 2001). This methodology forms part of the guidance in *WebTAG Transport appraisal and the treasury Green Book*. This methodology, whilst technically correct:

- Is inappropriate for valuing an AONB, a SSSI or a National Park
 - Does not take account of the protected characteristics of these areas
 - Is limited by the narrow geographical bandwidth either side of the route
- 2.2.6 It is inappropriate because ¾ of the Proposed Scheme is valued mainly at the lowest possible land value. Virtually no recognition of the protected status of the Chilterns AONB has been acknowledged unlike the first preliminary landscape valuation that valued it at the highest non-urban value (natural and semi natural or rural forested), nearly **60 times** greater.
- 2.2.7 The methodology used by DfT and described above accurately implements the Department's current methodology but is limited in scope, spatial application, and in content. Clearly none of this represents a true or accurate assessment of a protected landscape. The valuation of intensive/extensive or agricultural land was based on two studies: one which was done in Canada and the other in Sweden. This represents the application of a fairly insensitive form of benefits transfer. The dangers of this approach have been highlighted in *Assessing Environmental Impact: Guidance* (Defra, 2013) in which the advice is:
- (Landscape) is an area where values cannot be easily transferred due to the locally specific nature of valuations*
- 2.2.8 The geographical band width used is confined to a strip 500m each side of the centre line of the route beyond which it assumes that there is no damage to the landscape or environment;
- 2.2.9 The approach adopted by government in this case seems to be based on an unsound technique (benefits transfer for landscape valuation), a remarkably small sample (only two), and samples based on substantial differences in cultural and physical and protected characteristics. In addition in *Economic Valuation with Stated Preference Techniques* (2002) this approach of transferring unadjusted estimates was described as hazardous whilst the Treasury Green Book advises care.
- 2.2.10 It is because of these doubts that a review has been carried out of the alternatives methodologies.

2.3 Supplementary Government thinking (Defra, June 2011)

UK National Ecosystem Assessment

- 2.3.1 The Forward to the *Synthesis of the key Findings* maintains that in the UK:

The UK National Ecosystem Assessment (UK NEA) provides a comprehensive overview of the state of the natural environment in the UK and a new way of estimating shows how we have under-valued our natural resources. Valuing them properly will enable better decision making, more certain investment, new avenues to wealth creation and jobs, and greater human well-being in changing times ahead.

The Natural Environment White Paper

- 2.3.2 The Natural Environment White Paper makes much the same point:

Most people rightly believe in the innate value of nature and our strong moral responsibility to protect it. But the value of nature to our economy and society, and to our personal wellbeing, is also clearer than ever. Science, economics and social research have broken new ground, demonstrating that, year by year, the erosion of our natural environment is losing us benefits and generating cost.

The work of the Natural Capital Committee

2.3.3 In addition there is the work being done by the Natural Capital Committee. This was one of the headline commitments in the Natural Environment White Paper. It is an independent advisory body to government and formally reports to the Economic Affairs Committee of the Cabinet Office. The Natural Capital Committee in its first State of Natural Capital Report one of its key messages is that *changes in natural capital should be properly valued and those values more effectively included in decision making processes*

2.3.4 In particular it made the point that:

- *Policy makers urgently need robust assessments of the economic value of changes in natural capital for use within appraisals. These valuations must be based on firm natural and social science evidence and be applicable to local conditions.*
- *A major challenge is to provide the valuations and decision tools required to implement existing guidance such as HM Treasury's 'Green Book' to an appropriate standard. Extensions to this guidance may also be required to address particular natural capital issues, such as situations where robust valuations are not likely to be available, or where irreversible losses to assets, such as wild species or habitats arise.*

It also recommended that:

- *Government undertakes a critical look at how cost-benefit analysis is being implemented with respect to natural capital to identify priority areas for improvements. While H.M. Treasury's 'Green Book' provides a good starting point for cost-benefit analysis, options to improve the treatment of natural capital within this guidance should be explored. This should include consideration of the appropriateness of physical (in-kind) compensation for certain forms of natural capital loss;*
- *An urgent programme is initiated to provide high quality evidence on the economic value of changes in natural capital to feed into cost-benefit analyses. The NCC will bring forward detailed proposals on this shortly; and*
- *Government, working with the NCC, explores the development of new 'decision-support tools' aimed at incorporating economic valuations of changes in natural capital within wider decision appraisals.*

Green Infrastructure – Valuation Tools Assessment

2.3.5 Natural England has recently published a report, drawing together the range of widely used tools and assessing them against research standards for natural science and economics. Its aim is to assist people in valuing green infrastructure using the best tool to suit them.

Applying an Ecosystem Services Framework to Transport Appraisal

2.3.6 This report was published by DfT in February 2013 and its purpose is to consider any gaps in the current assessment framework with particular regard to enabling the monetary evaluation of environmental services. It discusses the relevance of valuing agriculture, recreation, biodiversity and green belt land as part of the possible application of UK NEA ESS studies to transport. In its conclusions and recommendations it acknowledges that The ESS approach has a more formal relationship between environmental capital and the services it provides than WebTAG's environmental capital approach. This ESS categorisation is considered to be more complete than that of the environmental capital approach and therefore provide a more comprehensive approach. It also draws attention to the need for further research and testing on each ESS impact before it is possible to understand the potential significance of each to

the preparation of business cases. Paragraphs 13.1.1 to 13.1.3 of this report echo this point of view.

HM Treasury

2.3.7 HM Treasury has published two guidance documents in relation to the financial appraisal of all new policies, programmes and projects. These are:

- *The Green Book: Appraisal and Evaluation in Central Government; and*
- *Accounting for environmental impacts: Supplementary Green Book guidance (in conjunction with Defra)*

2.3.8 The Treasury Green Book constitutes binding guidance for departments and executive agencies. It also recognises that some departments, such as the DfT, and other departments and government agencies will have their own guidance and that in such cases these departments must ensure that their own manuals and guidelines are consistent with the principals of the Green Book, providing supplementary guidance on their specific areas.

2.3.9 The Green Book also touches upon the matter of valuing costs and benefits where there is no market value. It recognises that the valuation of non-market impacts is a challenging but important element of appraisal, and should be attempted wherever feasible. The Supplementary Green Book guidance is a mixture of guidance and recommendations. It provides more detailed guidance for use on policies that are designed to have one or more specific environmental effects as well as policies with a different focus that may have impacts on the environment. This is certainly the case with the government's Proposed Scheme. It extends the Green Book guidance by introducing the notion and importance of identifying environmental effects in the following way:

Although many aspects of our environment (air, water, landscape and marine) are protected from direct harm through regulation, growing pressures increase the need to consider the environment as a functioning system and that provides the essential services that underpin economic, social and personal well-being.

Apart from the things which we can sell (e.g. food and timber), the value of natural systems to society is largely unregistered by the free market, it is what economists refer to as an externality which means it may if ignored be unvalued in decision making and so be vulnerable to loss and degradation.

2.3.10 It also introduces four key steps in the process of valuing non-market impacts. These are:

- i. Identifying legal and biophysical constraints, risk and opportunities to achieve positive outcomes for the natural environment alongside the meeting of policy aims;
- ii. Identifying the aspects of the natural environment that will be affected by a policy or project and the changes in environmental effects or ecosystem services;
- iii. Taking forward a qualitative assessment to determine the range and nature of the environmental effects, using an ecosystem services framework for assessment where there are multiple environmental effects; and
- iv. Quantifying and valuing the changes in ecosystem services: putting a monetary or other value on the costs and benefits of environmental effects focussing exclusively on the changes brought about by a policy or project

2.3.11 These four steps form the basis of the methodology adopted in this report. Chapters 1, 2 and 3 respond to key step 1, and Chapters 4 to 15 address key step 2. Key step 3, qualitative analysis, is the subject of Chapter 15, and key step 4 is the subject of further work.

2.4 Summary

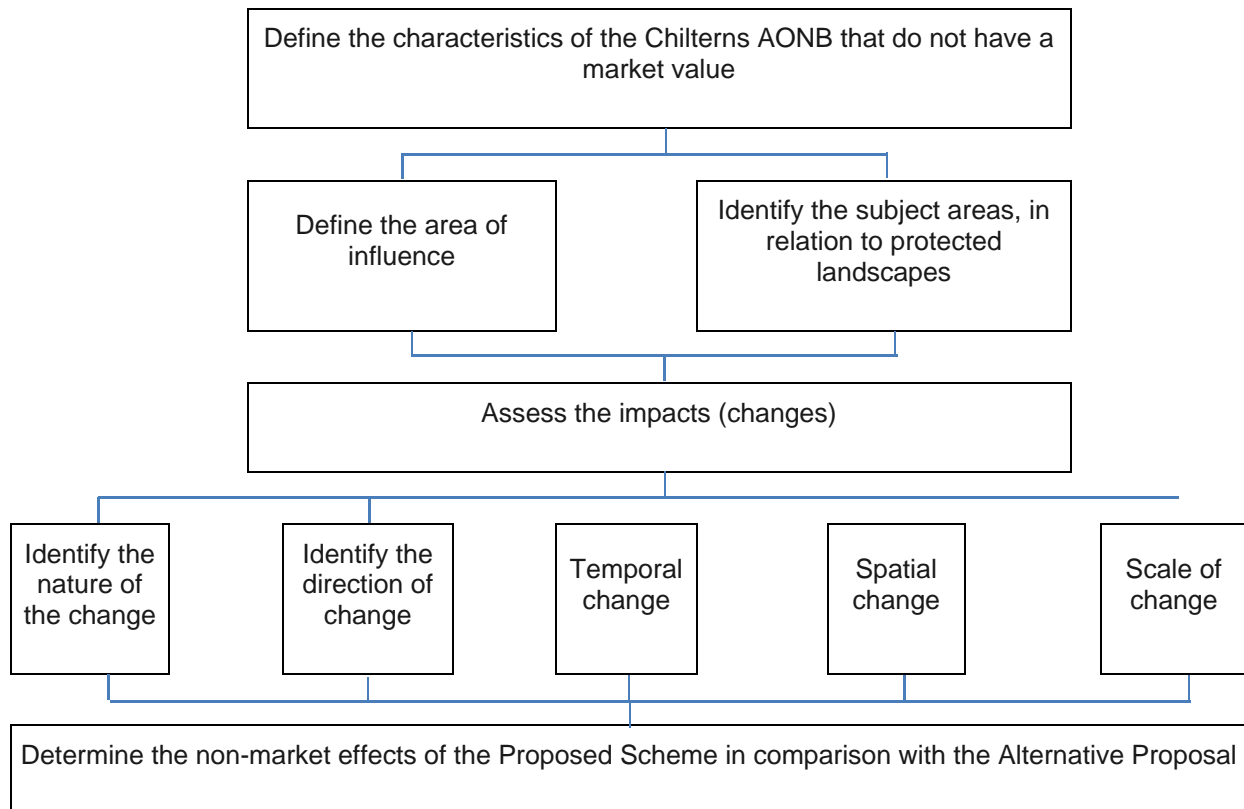
- 2.4.1 The assessment undertaken by HS2 to date has used a methodology “not –fit –for purpose”, especially in the context of a protected landscape.

3 The Assessment of Effects

3.1 The Method of Assessment

3.1.1 The following diagram illustrates the methodology used and the text follows this sequence.

Figure 3.1: Diagram illustrating the assessment process



3.1.2 We believe that a quantitative primary valuation should be undertaken based on the information in this report and other published guidance. PBA and the Board accept that this has not been done on this scale before for linear infrastructure projects in protected landscapes but as paragraph 1.3.1 points out, it is considered necessary that an evaluation of this kind is commissioned for HS2 which could then form a pilot for other infrastructure projects.

3.2 Primary effects

3.2.1 There are four primary effects which form the basis of assessing the non-market effects both generic to any landscape and specific to a protected landscape. They are:

- Physical and cultural: the effect on the landscape, amenity, enjoyment, tourism etc.;
- Social: the impact on employment and the local economy, health and wellbeing;
- Economic: the reduction in property values, uncompensated property blight; and
- Specific: the special consequences of these on the protected landscape of the Chilterns AONB

3.3 Definition of the Area of Influence

- 3.3.1 The Supplementary Green Book Guidance refers to the need to identify aspects of the natural environment that will be affected by a project and the changes in the environmental effects. This is referred to in paragraph 2.3.9(ii). In this report identification has been defined as the area of influence within the Chilterns AONB relates to the area either side of the route within which it:
- Can be seen;
 - Can be heard; and
 - Can be felt
- 3.3.2 These criteria have attached to them the modifier 'reasonable'. For example the route when viewed from a distance of 5km would not impose an economic impact compared with say 1km. In the same way it would be irrational to consider sound impact beyond the limit where it matched the ambient noise level. The argument against this is that if it can be seen, heard or felt to any degree then it must have an impact however remote. This is true in the sense that if it can be seen or heard then it has been built. In terms of evaluating non market effects this is a false argument because the test of remoteness renders the quantification of economic externalities to the point of zero well before the geographical limit of any distance.
- 3.3.3 This being the case then the two positions which the Board and others have adopted is intact: prevention of the construction of the route, and mitigation of the effects if it is built. Prevention implies that it will never occur and therefore it will never be seen or heard; mitigation must be designed to get the best solution possible by applying a pragmatic evidence based rigour to the analysis.
- 3.3.4 The label which has been given to this family of criteria for the purposes of establishing the boundary of the Area of Influence is horizontal or vertical proximity.
- 3.3.5 Horizontal or vertical proximity is either:
- The horizontal distance in the landscape from which the route is visible; or
 - The horizontal distance in the landscape from which the route is audible; and
 - Vertical proximity is the vertical distance from the route measured either vertically or at an angle to the vertical above which vibration from the route can be felt or observed.
- 3.3.6 These characteristics determine the geographical extent of the Area of Influence taking into account the reasonableness test described in paragraph 3.3.2.
- 3.3.7 The rule which has been adopted is that the limit of the boundary of the area of influence is whichever distance is the greater. For example there may be cases where the route cannot be heard but where it can be seen, and where it can be heard but not seen however there has to be a limiting factor and this is likely to be for vision rather than sound. For example a 10m high object viewed from a distance of 1000m will appear to be larger than the same 10m high object viewed from a distance of 2000m and so on.

3.4 The subject areas which have been considered

- 3.4.1 The subject areas are those topics which form the basis of the qualitative analysis. The Treasury Green Book referred to in paragraph 2.3.6 referred to some subject areas for consideration and that list has been modified and expanded to suit the circumstances and are considered appropriate to form the basis of the quantitative analysis.

- Landscape
- Biodiversity
- Geomorphology
- Archaeology
- Agriculture
- Tourism
- Property
- Health and wellbeing

3.4.2 These 8 subject areas have been chosen as representative of the key indicators for landscapes in general and protected landscapes in particular within the area of influence.

Table 4.1: Summary of the range of impacts within subject areas

Subject area	Range of impacts
Landscape	Horizontal and vertical proximity Topographic change Severance Loss Transient impact
Biodiversity	Topographic change Severance Loss Transient impact
Geomorphology	Topographic change
Archaeology	Topographic change Severance Loss
Agriculture	Topographic change Severance Loss Transient impact
Tourism	Horizontal and vertical proximity
Acquisition and use of property	Horizontal and vertical proximity
Health and wellbeing	Horizontal and vertical proximity Topographic change Severance Loss Transient impact

3.5 Evaluation of the effect of the identified impacts on the local and national economy

3.5.1 The following topic assessments identify where possible some examples of how the impacts could affect both the local and national economy and make some recommendations of how a comprehensive quantitative assessment of the non-market effects could be undertaken. This commentary on the potential effects draws on existing studies and valuations.

4 Landscape

4.1 Introduction

- 4.1.1 The full paper on Landscape is in Appendix A.
- 4.1.2 The designation of the protected landscape of the Chilterns AONB as set out in Sections 1.9-1.11, rests on the unique characteristics of its landscape. The Misbourne valley system represents not only a fine example of this landscape but also has the distinction of being different to the other four valley systems which cut through the north west facing scarp slope of the Chiltern Hills. Landscape quality and interest is often associated with landform which in turn is a function of the underlying geological structure. These are not the only defining characteristics.
- 4.1.3 The defining characteristics of the Misbourne Valley system are a result of the landform and human intervention. This intervention has left a strong cultural heritage in the valley. In common with many other landscapes it has produced a demand led pattern of farms, fields, settlements and tracks. In this particular case it has been demand led because of the demand for productive land which created land ownership arrangements and rights, common land enclosures and subsequently increasing mechanisation.
- 4.1.4 The value of this landscape is not only confined to its outward appearance. The rich variety of archaeology, much of which predates the medieval legacy of agricultural endeavour and ownership, which when taken together form a powerful attraction for residents and non-residents. This is demonstrated by the substantial tourist industry in the Chilterns AONB in general and in the Misbourne Valley in particular. This is described in Chapter 9.

4.2 The Cultural Landscape of the Misbourne Valley

Hilltops

- 4.2.1 The significance of the hill tops on each side of the Misbourne Valley system lies in the fact that the landscape evolved very slowly over a long time in areas where colonisation was piecemeal.

Valley floor

- 4.2.2 It was on the valley bottom where the land was flatter and the better soils were easier to farm, the major land re-organisations occurred. The first of these was in late Anglo Saxon and Medieval times in the creation of the strip fields and nucleated villages associated with the joint and co-operative working of the land.

4.3 Ancient and Planned Countryside

- 4.3.1 The late medieval landscape of the northern end of the Misbourne Valley south of Wendover was recorded in 1620 on one of a pair of maps relating to the Chequers estate. The subsequent changes that it underwent during later eighteenth century enclosure is recorded on a second pair of maps: an estate map of Wendover in 1794 which shows the old enclosures and common fields, and an enclosure map dated 1795 which shows the new allotments.

Access and development

- 4.3.2 The network of smaller lanes, tracks and holloways running up and along the valley sides is also clear by 1620 and today forms part of the labyrinth of single track lanes such as Leather Lane and Bowood Lane which are typical of the Misbourne Valley.

4.3.3 The Missenden Valley north of Little Missenden escaped the worst of the suburbanisation with Wendover and Great Missenden having comparatively modest growth, allowing them to maintain their village status. The current landscape on the modern OS maps still shows a dispersed settlement pattern on the valley sides and hill tops with grander houses, tiny hamlets and individual farmsteads remaining very much where they were located in 1620.

4.4 Effect on the local and national economy

4.4.1 By virtue of its designation it is unquestionable that the Chilterns AONB is of national significance, therefore by implication any loss, degradation or devaluation of the elements that make this landscape special will be significant at a national scale.

4.4.2 Further analysis is needed to establish what contribution does the Chilterns AONB make to the national and local economy and what proportion of this contribution is directly related to its landscape?

4.4.3 Another way to consider these effects is to pose the question – if the UK was to take out an insurance policy against the loss or damage to its protected landscapes what would the premium be? Would it be based on the cost of replacement? Or would the landscapes be deemed to be irreplaceable and therefore priceless?

4.4.4 As well as the individual topics discussed in later sections, the overall potential effect on the landscape can be considered in relation to visibility of the proposals, noting the time scale of the work and therefore its impact over the medium and long term. This can be defined as the Zone of Visual Impact during the construction and operation phases.

4.5 Comparison of effects

Table 4.1: Comparison of potential effects on landscape

Proposed Scheme effects	Alternative Proposal effects	Comment
Construction - 55 sq.km	Construction – 6 sq.km	The Alternative Proposal will have ~10 times less effect on the landscape throughout its life.
Operation – 45 sq.km	Operation – 6 sq.km	

5 Biodiversity

5.1 Introduction

Statutory sites

- 5.1.1 Within the Chilterns AONB there are 55 statutory sites and Wildlife Trust Reserves. The distribution is shown in Table 5.1.

Table 5.1: Statutory sites within the Chilterns AONB

Type	Number	Total Area Ha
National Nature Reserves	3	197
Sites of Special Scientific Interest	38	3,167
Wildlife Trust Reserves	14	182

- 5.1.2 Within or adjacent to the area of the Proposed Scheme there are the following SSSIs;

Table 5.2: Statutory sites within the Proposed Scheme area

Location	Type	Area Ha
The Lee	Geological SSSI	0.4
Coombe Hill	Biological SSSI (regional importance)	42.5
Ellesborough Warren	Biological SSSI (national importance)	35.2
Lodge Hill	Biological SSSI (national importance)	26.7

5.2 Biodiversity Opportunity Areas

- 5.2.1 Biodiversity Opportunity Areas (BOAs) are the most important areas for biodiversity in the country. BOAs represent a targeted landscape-scale approach to conserving biodiversity and the basis for an ecological network. BOAs identify where the greatest opportunities for habitat creation and restoration lie, enabling the efficient focusing of resources to where they will have the greatest positive conservation impact.
- 5.2.2 Traditionally, nature conservation has focused on protecting important sites. This approach has achieved a lot however it, alone, cannot sustain biodiversity in the long-term. Important sites are still fragmented and isolated from one another. In order to successfully conserve a viable natural environment, the physical factors such as the elimination or severance of habitats needs to be taken account of. These processes link sites to the wider landscape and affect the habitat found. The basis of this is landscape-scale conservation which reconciles protection of priority habitats and species with ecosystem functions. It allows the adoption of a more sustainable approach to custody of the countryside; ensuring biodiversity can adapt and thrive in the face of climate change. The application of this to the Misbourne Valley is a good example of this process in action. To achieve this, opportunities must be sought to expand, link and buffer sites.
- 5.2.3 It is accepted that BOAs do not represent a statutory designation. They indicate areas where there are substantial opportunities to make positive changes for biodiversity, and should be used to inform conservation strategies and place planning.
- 5.2.4 In addition it is recognised that their value is likely to increase with the introduction of Biodiversity Offsetting which is currently being promoted by Government (*Biodiversity Offsetting in England* a consultation document published on 5 September 2013, DEFRA).

The Board has reservations about the application of the biodiversity offsetting principle in protected landscapes and is responding to this consultation document.

5.3 Biodiversity Opportunity Areas within the Proposed Scheme area

5.3.1 These have been identified by the Buckinghamshire and Milton Keynes Biodiversity Partnership and include:

- Central Chilterns Chalk Rivers;
- Chess Valley Headlands;
- Chilterns Escarpment;
- Dunsmore Woodlands;
- Prestwood Local; and
- Wendover Woods

5.4 Effect on the local and national economy

5.4.1 Biodiversity has an intrinsic value of its own.

5.4.2 Biodiversity is also an essential part of the country’s natural capital, without which there would not be an economy. Essentially all wealth is generated through the harnessing of natural capital by human endeavour.

5.4.3 The value to the UK economy of Biological Opportunity Areas should not be overlooked. There is currently a proposal by the government to introduce Biodiversity Offsetting in England. This proposal would see a significant increase in the demand for, and therefore the value of, areas suitable and available for biological offsetting. Removing or devaluing the Biodiversity Opportunity Areas within the AONB effectively eliminates this potential income to the local economy. It also reduces the amount of available areas within the UK and consequently increases the value of the remaining areas which in turn will result in an increased cost to developers.

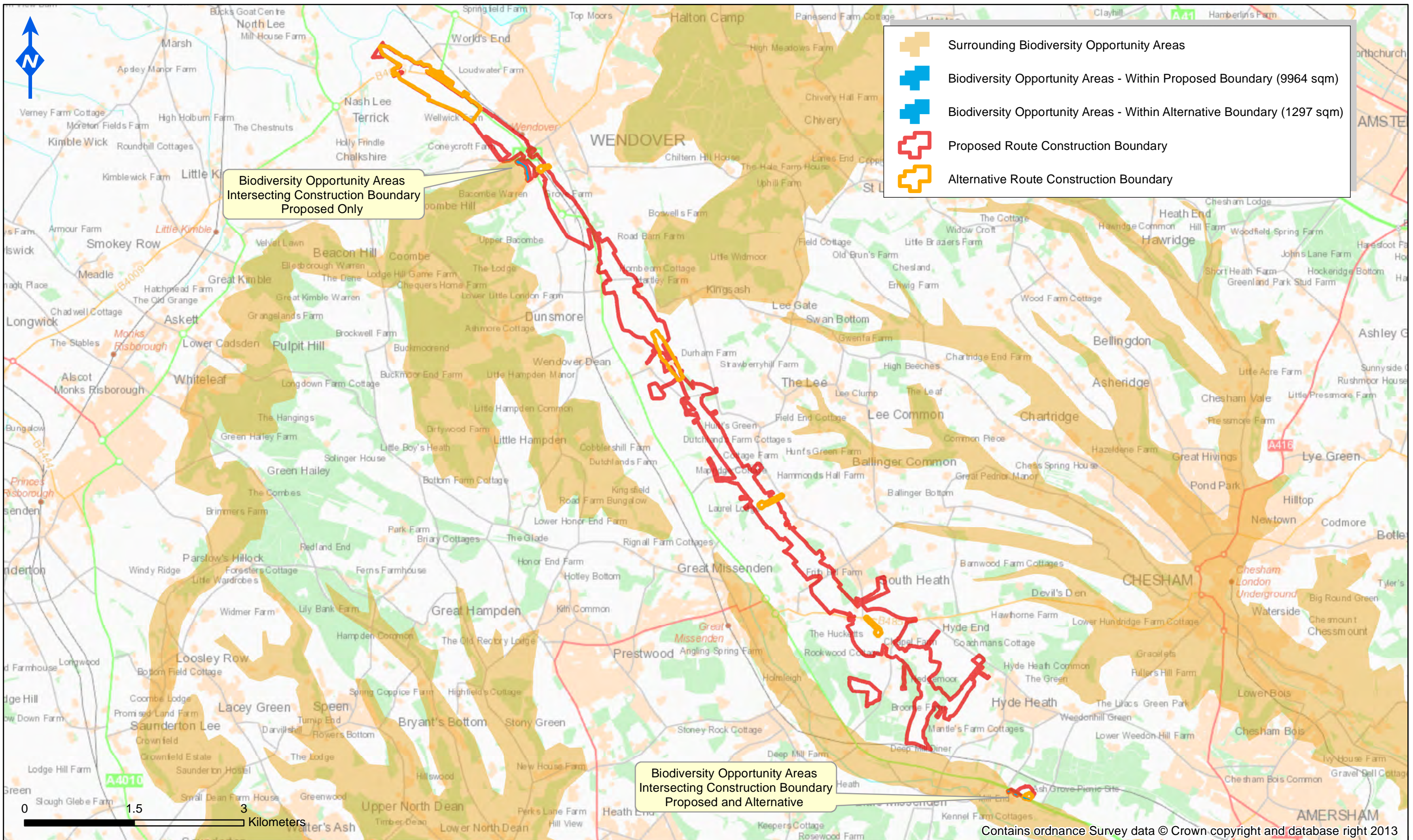
5.4.4 Ancient woodland is an important reservoir of biodiversity and helps to reduce the fragmentation of otherwise fragmented habitats. The effect of the Schemes on Ancient Woodland is identified in Section 7 but should also be considered under biodiversity.

Ancient woodland is important to more threatened species than any other habitat in the UK (Woodland Trust, 2000).

5.5 Comparison of effects

Table 5.3: Comparison of potential effects on biodiversity

Proposed Scheme effects	Alternative Proposal effects	Comment
1 ha of BOA	0.13ha of BOA	The Alternative Scheme affects only one location



HS2 in the Chilterns Assessment of Non-Market Effects
 Proposed vs Alternative
 Biodiversity Opportunity Areas Affected

Date	September / 2013
Scale	1 : 48,000 at A3
Drawn By	FS
Checked By	BB
Figure Number	Figure 5.1

6 Geomorphology

6.1 Introduction

- 6.1.1 The Chilterns AONB form part of a broad belt of chalk running across England. It extends from Goring, where the gap carved through the chalk by the River Thames separates the Chilterns AONB from the Berkshire Downs, to Hitchin and forms the Northern boundary of the Tertiary London Basin. The tilting of the chalk has produced a steep escarpment along the north western edge, overlooking the Jurassic clay vales of Oxford and Aylesbury. The dip slope to the south east is dissected by valleys most of which are dry and a few of which almost break through the escarpment to form easy routes across the hills.
- 6.1.2 The scarp slope is the most prominent feature of the Chilterns AONB and one of its outstanding characteristics. Topographically the Chilterns AONB have their highest summits close to the North West facing scarp slope. At its highest point the escarpment rises to 262m above sea level and about 180m above the adjoining Vale of Aylesbury.
- 6.1.3 This scarp is cut by five major valley systems. They are at:
- Goring;
 - Princes Risborough;
 - Wendover;
 - Tring; and
 - Luton
- 6.1.4 The Wendover Gap valley is primarily the subject of this report with the Princes Risborough and Tring valley systems used as reference valleys in the landscape section.
- 6.1.5 This chalk is frequently covered with Tertiary drift deposits comprising clay, sand and gravel. There is very little surface drainage on the chalk, but during the period of the last two glaciation periods, permanently frozen sub-soils allowed this to a far greater extent. River erosion has moulded the topography to the present land forms.
- 6.1.6 As a result the dip slope has been cut by many deep valleys, some with steep sides resembling the slopes of the escarpment. Although the narrow valleys steep sided, the Misbourne Valley is a notable exception to this, the drift covered plateau landscape is gentle and rounded and still often difficult to access other than on foot.
- 6.1.7 The Misbourne Valley system and other famous dry valleys such as those at Barton Hills were cut into the chalk by frost and water working together during a much colder, wetter period in the Ice Age. Chalk is normally a highly porous rock and the numerous fractures and pore spaces ensure water now permeates through the rock very efficiently to the water table. However, under tundra conditions the water in these pores and fractures becomes frozen and any melt-water is forced to flow over the surface. In this way, deep river channels can be cut down relatively rapidly. As soon as the climate ameliorated, the permanent frozen ground thawed, and the normal drainage system and porous nature of the Chalk was resumed.
- 6.1.8 Glacial streams cut the escarpment at the Wendover Gap on the Misbourne Valley system. The melt water from the Anglian ice sheet about 500,000 years ago flowed away in braided streams carrying vast quantities of sediment. The channels of braided streams shift constantly across the unconsolidated loose deposits. One of their characteristics is wide flat bottom valleys such as the Misbourne Valley.

- 6.1.9 They are common features throughout the Chalk of southern England, not just the Chilterns. The majority show the typical form of a water-cut valley, that is, fairly steep sides, an asymmetry in form and an overall v-shaped profile. The Misbourne Valley is an exception to this.
- 6.1.10 Chalk is chemically basic in its reaction whereas many of the superficial drift deposits referred to above are acidic. These drift deposits are partially or completely impermeable to water and are thus far wetter than chalk. This variation affects the soils developed in the Chilterns AONB and allows considerable variation in flora.

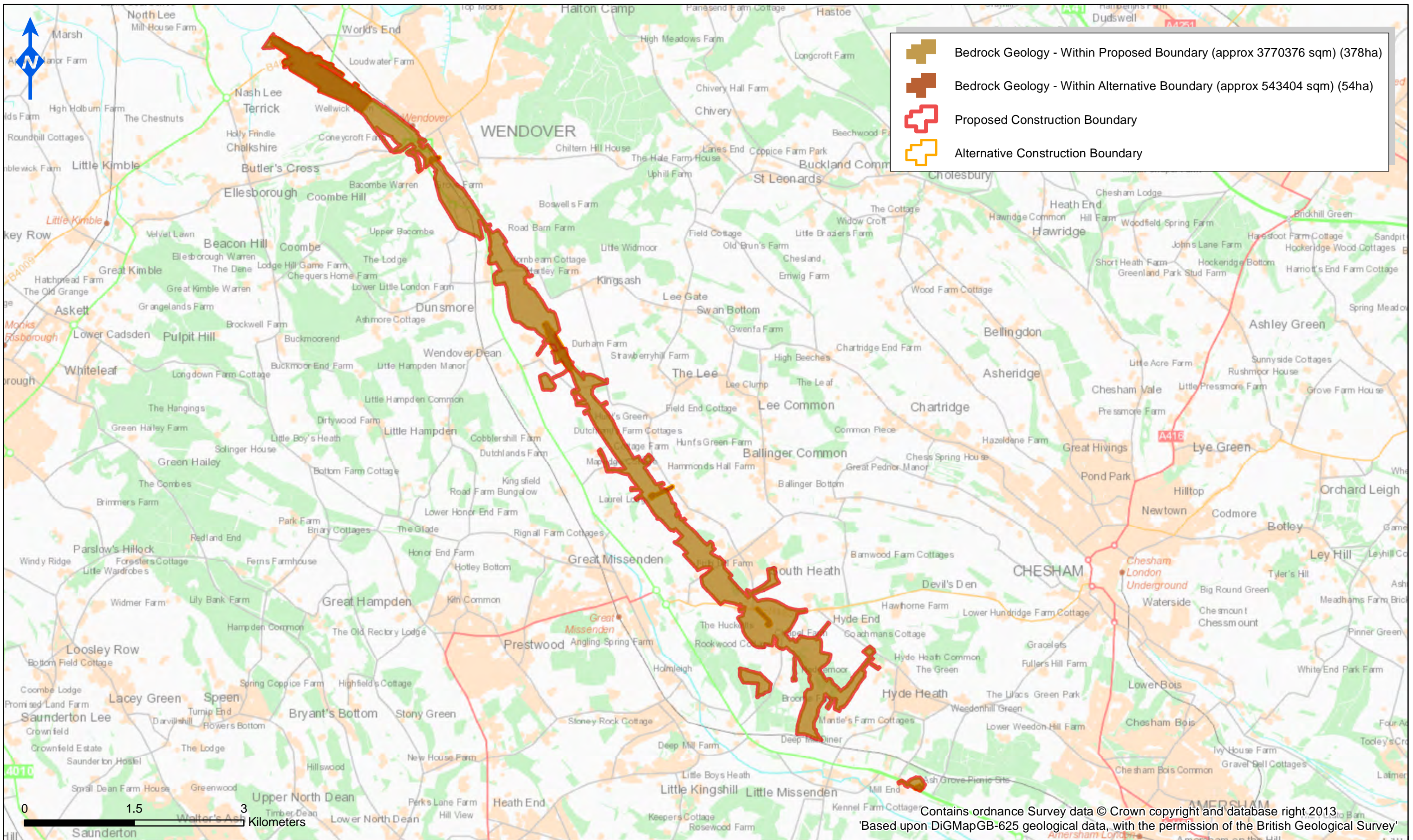
6.2 Effect on the local and national economy

- 6.2.1 The geology and subsequently the geomorphology of the AONB is part of what makes it a special landscape. Therefore devaluing the geology (i.e. exposing the bedrock and superficial geology) will have a direct impact on the value of the landscape in visual terms which could have a knock-on effect on its attractiveness to visitors and property owners.

6.3 Comparison of effects

Table 6.1: Comparison of potential effects on geomorphology

Proposed Scheme effects	Alternative Proposal effects	Comment
Area of bedrock geology exposed approx. 378 ha.	Area of bedrock geology exposed approx. 54 ha.	The Proposed Scheme exposes and therefore devalues significantly more geology than the Alternative.
Area of superficial geology exposed approx. 224 ha.	Area of superficial geology exposed approx. 38 ha.	

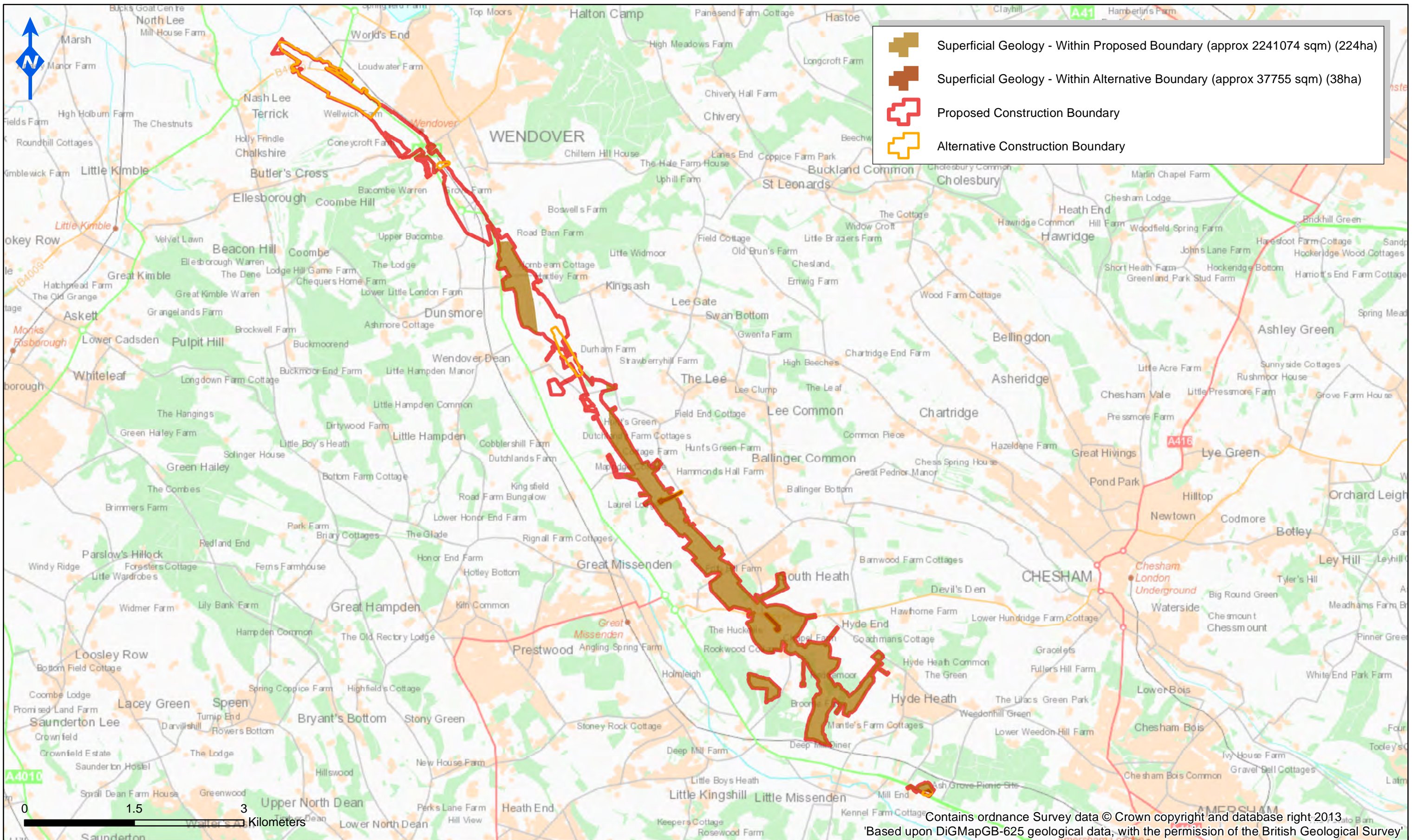


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HS2 in the Chilterns Assessment of Non-Market Effects
 Proposed vs Alternative
 Area of Bedrock Geology Exposed

Date	September / 2013
Scale	1 : 48,000 at A3
Drawn By	FS
Checked By	BB
Figure Number	Figure 6.1



HS2 in the Chilterns Assessment of Non-Market Effects
Proposed vs Alternative
Area of Superficial Geology Exposed

Date	September / 2013
Scale	1 : 48,000 at A3
Drawn By	FS
Checked By	BB
Figure Number	Figure 6.2

7 Archaeology

7.1 Introduction

- 7.1.1 The full paper on Archaeology is in Appendix B.
- 7.1.2 The land through which the Proposed Scheme is planned to pass is remarkably rich in important archaeological features and some are scheduled monuments. Many have ancient origins and are part of the history of Southern England; their presence enhances the natural wealth of this part of the Chilterns AONB.
- 7.1.3 In some cases the Proposed Scheme passes directly through these archaeological features. Other archaeological sites lay relatively nearby and are in danger of damage, and indeed complete loss, during the broader scale HS2 works. If they are demolished or damaged their loss is a national loss of heritage and not just a local misfortune. Those archaeological sites that are more distant from HS2 work site will inevitably lose their setting and in some cases accessibility cannot be ignored.
- 7.1.4 In order to provide a structured overview, sites of archaeological and historical interest are grouped into four categories which relate to their horizontal proximity with the route as follows:
- Category 1: eliminated, severed or within 200m of the route;
 - Category 2: between 200m and 500m of the route;
 - Category 3: between 500m and 700m of the route; and
 - Category 4: Between 700m and 1000m of the route

7.2 Sites which will be eliminated, severed or within 200m of the route

Motte and Bailey Castle

- 7.2.1 This monument includes a small motte and bailey castle, sited to overlook the natural valley routeway. This motte and bailey castle is unusual in its small size and survives well as a very complete example of this class of monument.

Bury Farmhouse

- 7.2.2 The Bury Farmhouse is a former 17th-century manor house and a field survey identified a medieval moat and fishpond.

Jenkins Wood earthworks

- 7.2.3 The Jenkins Wood earthwork is immediately adjacent to Bury Farm

Grim's Ditch

- 7.2.4 This is an Iron Age bank and ditch and is a scheduled monument. The earthwork can be identified for about 1 kilometre towards the existing Chiltern Line railway and onto Great Hampden.

7.3 Sites between 200m and 500m from the route

Potter Row

7.3.1 Potter Row is a lane running across the Chiltern Plateau and its entire length lies within an Archaeological Notification Area.

- Warren Cottage
- Hammonds Hall Farmhouse
- Park Farm

Bacombe Hill, Wendover

7.3.2 On the hill stand a number of Bronze Age features. These occupy a prominent position overlooking Wendover to the north east, the Vale of Aylesbury to the north and the upper part of the Misbourne valley to the south east.

7.4 Sites between 500m and 700m from the route

The Castle, Rook Wood

7.4.1 This is a nearly square enclosure which appears to be a medieval manorial stronghold.

Frith Hill

7.4.2 This is a medieval enclosure comprising a substantial semi-circular bank and ditch with an outer counterscarp bank.

7.5 Sites between 700m and 1000m from the route

The Old Church, the Lee

7.5.1 The Old Church of St John the Baptist was built and run by the monks of Missenden Abbey. Constructed around 1220 it was originally a 'Chapel of Ease'.

Boddington Hill Fort

7.5.2 This Late Bronze Age to Iron Age hill fort occupies the summit of a steep sided chalk spur.

7.6 Effect on the local and national economy

7.6.1 Once lost, the archaeological and historic sites (of national importance) could not be replaced. Their loss could be considered to devalue the AONB and make it less attractive to tourists/visitors this could have the effect of reducing income from tourism within both the local and national economy.

7.6.2 According to the Woodland Trust website www.woodlandtrust.org.uk

“Ancient woodland is one of our richest wildlife habitats. It's scarce and irreplaceable, covering less than 2 per cent of the UK.”

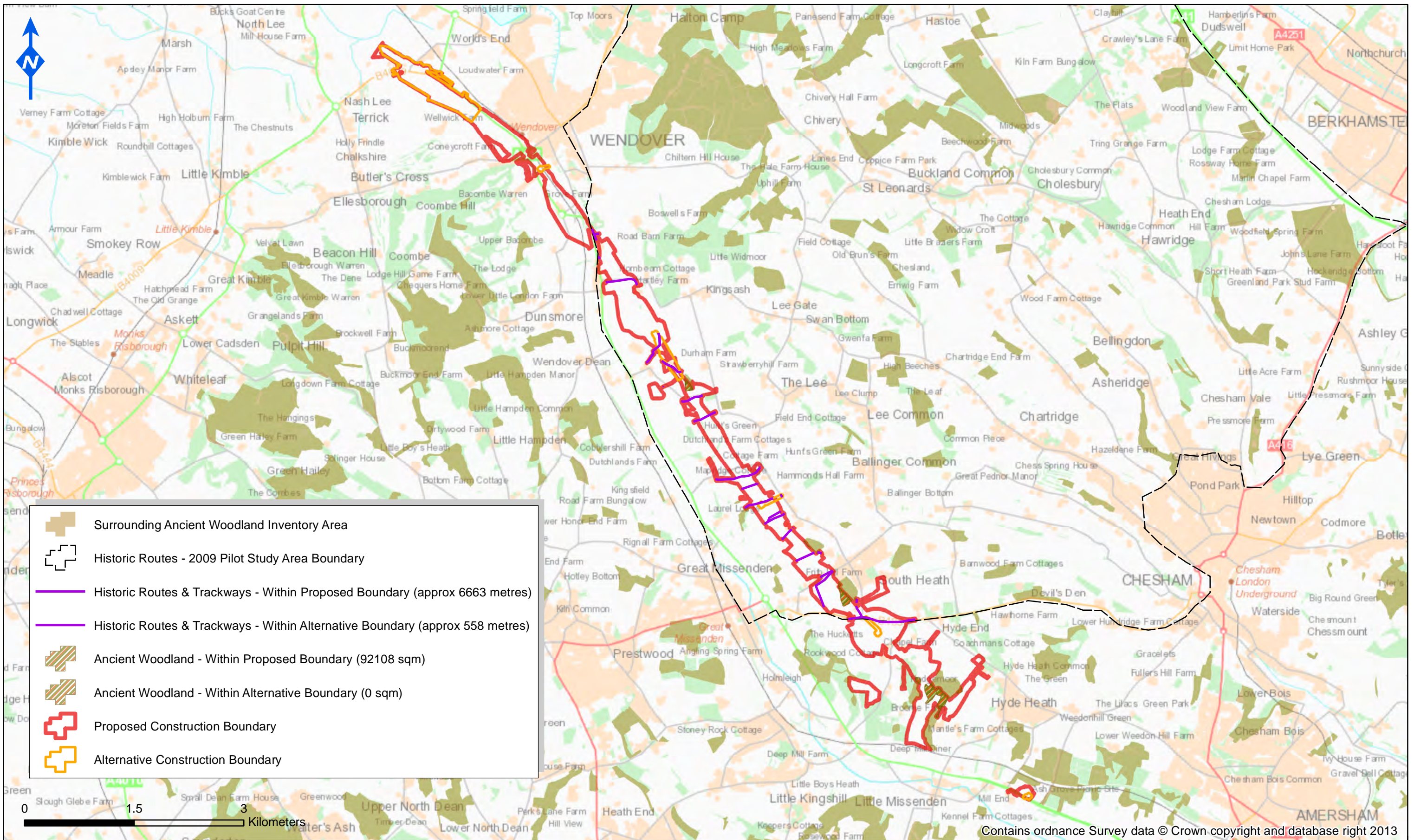
7.6.3 The proposed scheme will remove 9.2 ha of this already scarce resource.

- 7.6.4 If lost or damaged, in theory, the ancient woodlands could be replaced, (although this has proved unsuccessful where it has been attempted in relation to HS1).
- 7.6.5 The definition of an Ancient Woodland is land that has been continually wooded since at least 1600AD. Therefore it is not unreasonable to consider the cost of replanting, maintenance and protection for the next **400 years** to estimate its economic value.
- 7.6.6 A study entitled “The cost of restoring plantations on ancient woodland sites”, The Woodland Trust (2002), has been used to provide the cost of establishing an ancient woodland (£1,680 per ha) and the cost of maintaining a woodland (£400 hectare per year). The cost of maintaining woodland includes the control of invasive species, squirrel control, boundary fencing and insurance.
- 9.2 x £1680=**£15,456** (establishment)
- 9.2 x £400 x 400 = **£1,472,000** (maintenance)
- 7.6.7 Using these costs it can be estimated that the replacement of the area of ancient woodland removed by the Proposed Scheme would be approximately **£1.4 M**.

7.7 Comparison of effects

Table 7.1 Comparison of potential effects on archaeology and cultural heritage

Proposed Scheme effects	Alternative Proposal effects	Comment
4 historic sites lost or severely affected	0 historic sites lost or severely affected	The setting of Bacombe Hill will be altered by the scheme north of Wendover in either option.
9 historic sites degraded	1 historic sites degraded	
6.6km of ancient trackway lost	0.6km of ancient trackway lost	
9.2 ha of ancient woodland lost	0 ha of ancient woodland lost	



8 Agriculture

8.1 Introduction

8.1.1 Most of the protected landscapes of the Chilterns AONB agriculture forms one of the key land uses that have shaped the landscape in the past and continue to influence the nature and character of our countryside today. This is referred to in the Farming and Forestry section of the Chilterns AONB Management Plan 2008 – 2013 (currently under review). The influence of agriculture is not confined to what goes on within the fields but made a major contribution to the creation of the network of field patterns with associated hedgerows, woodland strips, ancient routeways and traditional farm buildings. The mosaic of farms, woodland, commons and rural settlements is an essential element of the character of the Chilterns AONB.

8.2 Land classification

8.2.1 Most of the Chilterns AONB in Buckinghamshire is in Grade 3: good to moderate quality agricultural land based on the standard agricultural land classification. It is only in the dry valley bottoms where there are deep, well drained loams that grade 2 and grade 1 land occurs. The slopes from the plateaus to valley bottoms will be graded as 3 or 4 according to the degree of slope. This does not apply to the Misbourne Valley which has comparatively gentle side slopes.

8.2.2 While such analysis has merit when looking at the national context, there is less value in identifying land class for individual farm businesses or when assessing the impact of the proposals on the Chilterns AONB. The exception is that it provides a measure of quality for land to be returned to agricultural use following the construction period.

8.2.3 The Grade 3 land classification is summarised below.

Grade 3 - good to moderate quality agricultural land

8.2.4 Land with moderate limitations to agricultural use which affects the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where more demanding crops are grown yields are generally lower or more variable than on land in Grades 1 and 2.

Subgrade 3a - good quality agricultural land

8.2.5 Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of a wide range of crops including cereals, grass, oilseed rape, potatoes, sugar beet and the less demanding horticultural crops.

Subgrade 3b - moderate quality agricultural land

8.2.6 Land capable of producing moderate yields of a narrow range of crops, principally cereals and grass or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the year.

8.3 Relevance to the Misbourne Valley

General

8.3.1 Much of the land farmed within the Misbourne Valley north of Amersham is under arable production. However, most farmed land optimises returns by taking advantage of diversification opportunities. Along the proposed route such activities include off road gallops, horse stabling, craft shows and commercial shoots. Many farms therefore rely on multiple business strands to maintain viability. It is therefore important not only to assess the impact of

the proposed scheme on individual strands but also the effect of any reduced profitability on the whole business.

- 8.3.2 Agricultural land is a finite resource. Each farm business is based on the particular total land area utilised. If one part is removed, it is not a simple case of buying more replacement land. Loss of part of a holding will affect the whole. It is therefore evident that the impact of the route on farm businesses and the farm management practised may extend far beyond the point where it can be seen, heard or felt.

Topography

- 8.3.3 The map books produced to support the draft Environmental Statement gave, for the first time, an indication of potential earthworks and landscaping outside the line of the route of the Proposed Scheme within cutting or on embankment. Within the Chilterns AONB north of the tunnel portal at Little Missenden, these additional earthworks cover an area of approximately 370 hectares. This is likely to extend even further with the announcement that space needs to be found to accommodate an additional 800,000 cu.m of arisings. At an average depth of 1m this would cover a further 80ha, taking the total area of land disturbed by the proposed scheme to 450 ha.
- 8.3.4 It has been suggested that at least a proportion of the land covered by these embankments will be returned to agriculture. However, changes in topography may well affect suitability for particular farm enterprises or use of certain farm machinery and there may also be an additional time period before soil structure is once again suitable. Given that the construction period will be over 7 years, it is likely that there will be potentially a further 5 years (total 12 years) before the land returns to a suitable condition.

Long-term disturbance

- 8.3.5 Because of the nature of the disposition of the field system in the Misbourne Valley and the relatively small landholdings, some belonging or rented out to much larger farms physical disturbance, that is severance or elimination of individual fields or portions of farm holdings will have a significant impact on individual farm enterprises and, therefore, on holding viability. Stock movement will be particularly affected by the physical barrier of the route. Even within the Misbourne Valley, stock is occasionally moved along roads. Such movement will be severely restricted during the construction period and may still be extremely difficult when the line is open.
- 8.3.6 Farm machinery is progressively getting larger to cope with the larger areas managed by individual farm businesses or under contract farming. Severance will result in isolated smaller blocks of land which may no longer be profitable to farm unless amalgamated with other areas. This would entail the loss of hedgerows and other field boundaries with resulting detrimental impacts for both wildlife and the landscape of the Chilterns AONB.
- 8.3.7 Restricted crossing points will either directly reduce farm business profitability or lead to a reduction in rent that can be secured from contract farming arrangements.
- 8.3.8 There is a case to be made which is that the loss of land to an agricultural business is the easiest area to assess. The draft ES placed considerable emphasis on standard agricultural land classification. It is estimated that the total area of land lost to agriculture within the Chilterns AONB north of Little Missenden will be in the region of 250 hectares. As well as the line, embankments and cuttings, this includes new structures, road realignments, drainage features and land for landscape planting. It does not include the potential 80ha need for the additional spoil to be “sustainably disposed of” in the locality which was not accounted for in the draft ES and which will be assumed to be returned to agricultural use.
- 8.3.9 As mentioned above, the impact of reduced income as a result of land loss will be an important consideration which has to be assessed for each farm business. Land loss within an

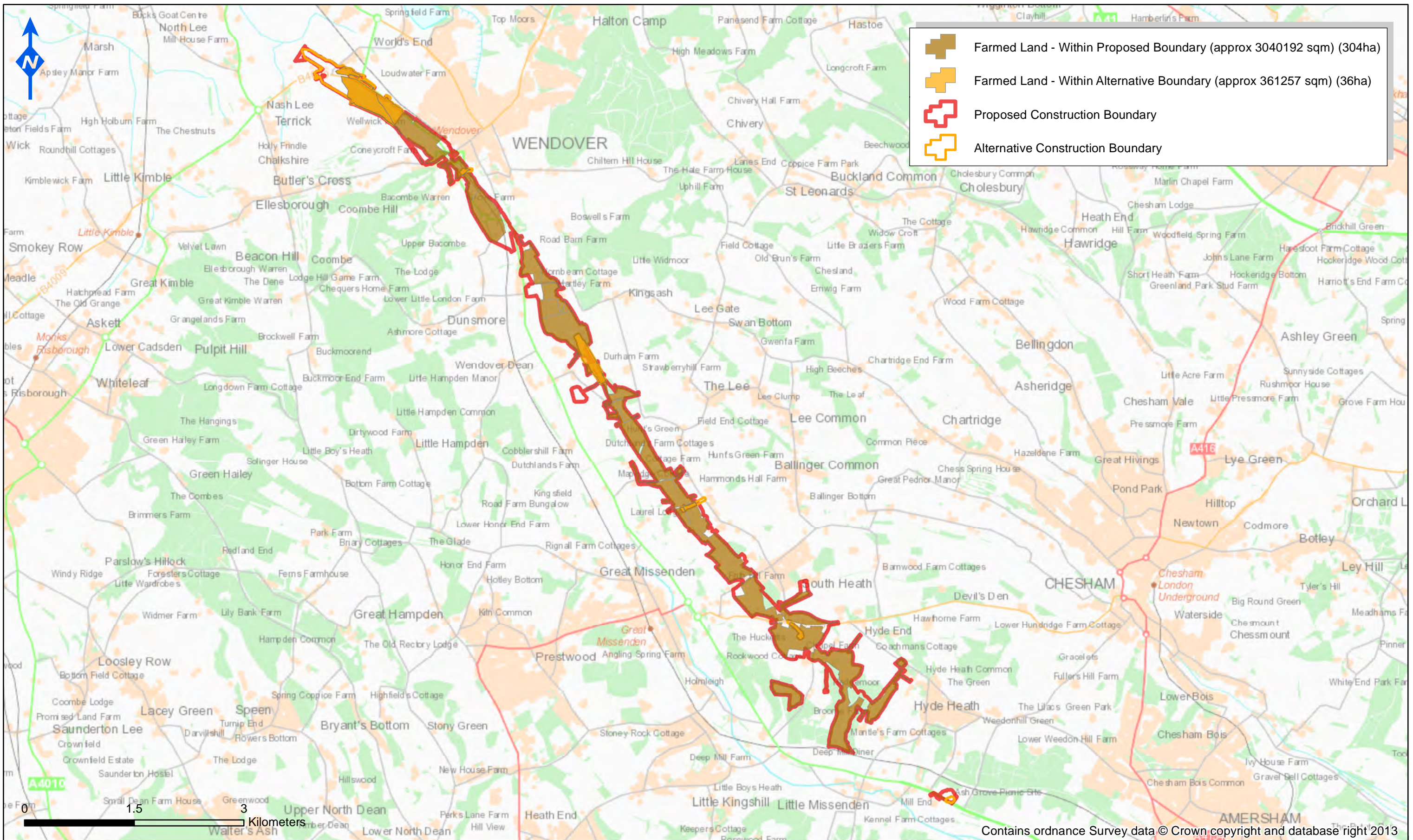
area may also affect individual contract farming businesses. Such businesses invest in large and expensive machinery related to the returns they can expect. Economies of scale are such that a reduction in land available could well affect profitability and potentially viability of such businesses. The remaining portions of fields may not be as usable for existing enterprises. This may require a switch to less profitable enterprise or may lead to further land being lost altogether to farming.

- 8.3.10 Individual farm enterprises can be very dependent on land area. Grazing animals require minimum areas of forage and also areas for conserving grass or other crops as hay or silage for the winter months. Purchasing feed is an expensive option that again can reduce profitability and viability.
- 8.3.11 Paragraph 8.2.1 identifies a number of diversification options for farmers. Additionally, redundant farm buildings are often let out to other businesses and return valuable income to the farm. Loss of land may not only directly affect such businesses but may also lead to a loss of full agricultural status for the holding which, in turn, might change the rateable status of the remaining buildings. This in turn could affect the profitability of businesses using these buildings and potentially reduce employment.
- 8.3.12 Initial proposals for landscape or mitigation planting were identified within the draft Environmental Statement map books. These proposals can represent additional loss of farmed land and lead to further severance and isolation of remaining land. Future management obligations, costs and ownership of these planted areas will also require full assessment.
- 8.3.13 Defining the transient impact to agriculture in terms of the land occupied during and for the purposes of construction would be far too limited. The implications of such time limited land loss are far greater than the loss of income from these areas during the construction period. Certain farm enterprises, particularly those involving stock, are very area specific. It may not be feasible to maintain flocks or herds during the construction period and, if numbers are reduced, it may take a number of years to build numbers up again. If pedigree status is involved, time and finance required may be considerable.
- 8.3.14 During construction, soils will be stripped and stockpiled. Soil structure is likely to be severely degraded and quality, including organic content, mineral and nutrient availability, substantially reduced. Compaction of land beneath stock piles and elsewhere will also require careful attention to return it to its former condition. Soil management and restoration has to be carefully planned to identify management requirements, responsibilities, costs and projected time periods before land can be returned to productive agricultural capability.

8.4 Comparison of effects

Table 8.1: Comparison of potential effects on agriculture

Proposed Scheme Effects	Alternative Proposal effects	Comment
<p>370 ha temporarily lost</p> <p>250 ha permanently lost</p>	<p>47 ha temporarily lost</p> <p>20 ha permanently lost</p>	<p>The permanent loss under the Alternative Proposal is predominantly at the section north of the Wendover Portal within the AONB</p>



HS2 in the Chilterns Assessment of Non-Market Effects

Proposed vs Alternative
Agricultural Land Affected

Date	September / 2013
Scale	1 : 48,000 at A3
Drawn By	FS
Checked By	BB
Figure Number	Figure 8.1

9 Tourism

9.1 Introduction

- 9.1.1 The full paper on Tourism is in Appendix C.
- 9.1.2 There are 55 million leisure visits to the Chilterns every year, making this one of the most popular protected landscapes in the world (*Chilterns AONB Visitor Survey 2007*). The Chilterns countryside is highly valued for the wide variety of recreational opportunities it offers, which includes walking, cycling and horse-riding, gliding, canoeing and bird watching.
- 9.1.3 The economic impacts of visits to the countryside are substantial, with an estimated £471.6 million of expenditure associated with leisure visits to Chilterns and an estimated 12,000 FTE jobs sustained. However it is not just the economic impacts which are important. The Chilterns AONB offers numerous non-monetary benefits which have far-reaching impacts on peoples' lives. It provides opportunities for learning and discovery, volunteering and participation in events and activities.
- 9.1.4 It is the landscape and scenery that provides the backdrop to this flourishing tourism industry. There are over 500 tourism businesses in the Chilterns and a Chilterns Tourism Network with 160 members. There is a dedicated Chilterns Tourism website www.visitchilterns.co.uk and there are many projects aimed at growing the rural tourism economy.

9.2 Visits to the Chilterns Countryside

- 9.2.1 It is evident from local authority surveys that the Chilterns countryside is visited and enjoyed by most of its residents. Usage of the Chilterns countryside by local residents varies from 81% in Buckinghamshire to over 90% in Oxfordshire. The Chilterns has an extensive rights of way network and is nationally recognised for its walking, with several promoted trails passing through the Chilterns, including the Ridgeway National Trail and the Thames Path national trail. The Misbourne Valley is also an important visitor destination, with high volumes of day visits from London and the urban areas adjacent to the Chilterns AONB. The excellent existing rail and London underground links make this the most visited protected landscape in England.
- 9.2.2 There are many promoted routes passing through the Misbourne Valley and these are some of the most heavily used routes due to their accessibility to London and other major towns in the South East. More than 200 walks and rides leaflets are featured on the Chilterns AONB website.

Health Walks Programmes

- 9.2.3 The number of health walk attendances in the Chilterns, (including repeat visits) is 42,000 (*Simply Walk, Hertfordshire Countryside Management Services, the Ramblers and Central Bedfordshire Council*).
- 9.2.4 There are 10 health walk programmes in the Misbourne Valley organised by Simply Walk, which generated 7,000 health walk attendances in 2012/13.

Walking, cycling, running groups – organised club events

- 9.2.5 The Misbourne Valley is used by a large number of groups for walking, cycling, geocaching, orienteering and other countryside-based activities. There are many affiliated clubs based in and around the Chilterns AONB, and it also attracts large numbers of groups from outside the area for day visits. For example:

9.3 Volunteering in the Chilterns countryside

9.3.1 Volunteering linked to the countryside is very strong in the Chilterns, with many different opportunities on offer with organisations such as the National Trust, Natural England and BBOWT. These volunteer programmes provide important health and social benefits to a wide cross-section of people, some of them with physical or mental health issues.

9.4 Chilterns Tourism

9.4.1 The Misbourne Valley is an important visitor destination in its own right, with a range of attractions, accommodation and festivals/events which bring people to the area. There are many promoted walking and cycling routes passing through the Misbourne Valley (including national trails) and these, in addition to the formal countryside sites such as Wendover Woods, attract large numbers of visitors.

9.5 Effect on the local and national economy

9.5.1 Tourism is the UK’s fifth largest industry with an annual economic impact of £115 billion (Deloitte and Oxford Economics, 2010). This makes attracting tourism and recreation an important element of local authority economic development plans.

9.5.2 It is estimated that walking in the English Countryside leads to £6,139 million of expenditure, with an economic impact between £1,473 and £2,763 million, and supporting between 180,559 and 245,560 F.T.E. jobs (Christie and Mathews, 2003).

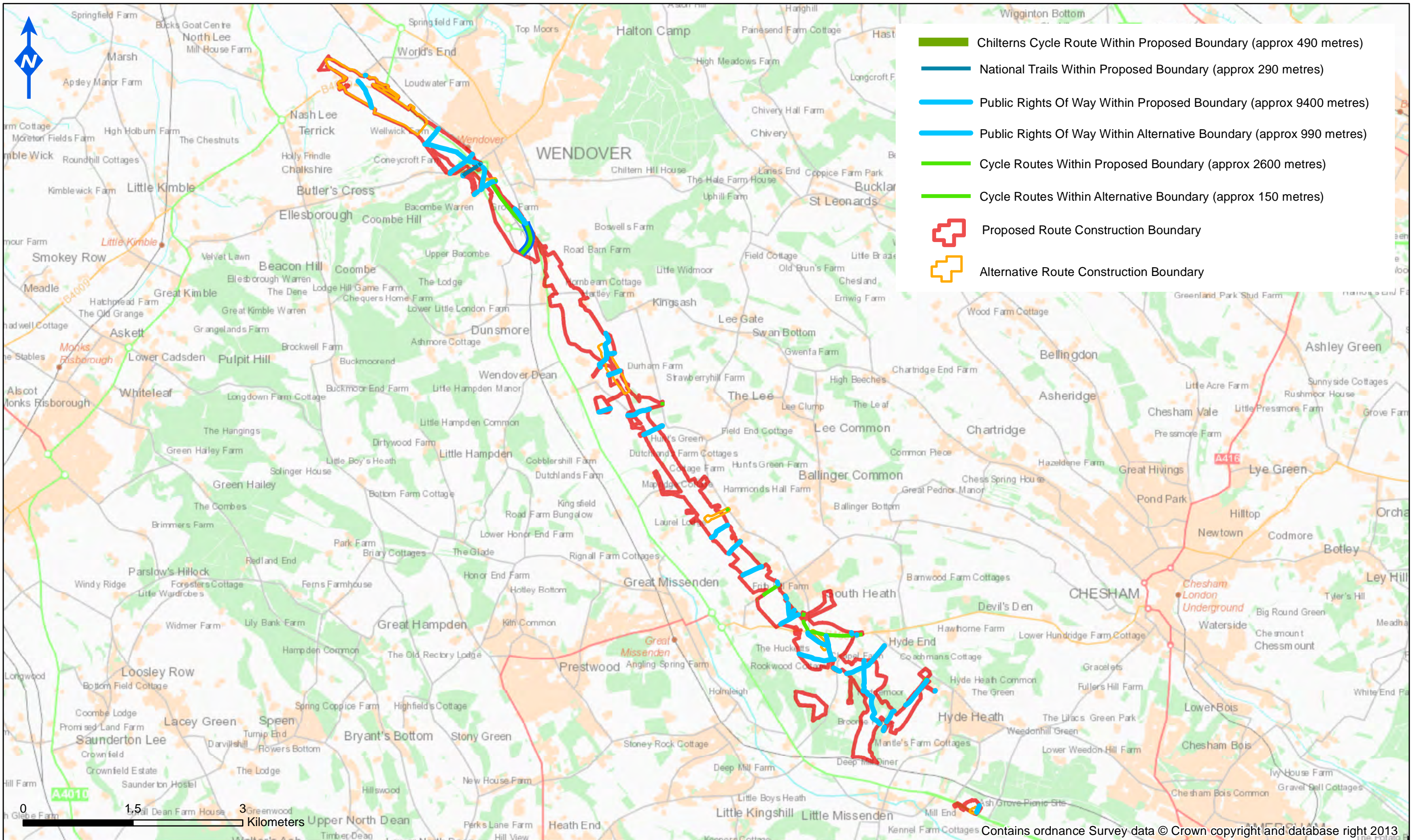
9.5.3 The Chiltern AONB Visitor Survey concluded that there were 55 million leisure visits to the Chilterns in 2007. The estimated economic impact of these visits has been calculated to be £471.6 million per annum. These visits help to sustain an estimated 12,000 FTE jobs.

9.5.4 The landscape accounts for 500 tourism businesses in the Chilterns with a Chilterns Tourism Network with 160 members.

9.6 Comparison of effects

Table 9.1: Comparison of potential effects on tourism

Proposed Scheme effects	Alternative Proposal effects	Comment
18 walking routes on ancient trackways disrupted/severed	2 walking routes on ancient trackways disrupted/severed	The two routes affected by the Alternative Proposal relate to the gap required at Durham Farm, where two paths cross the line.
9,400m of PRow affected	990m of PRow affected	Approximately 10 times the length of PRow are affected by the proposed scheme
2600m of cycle routes affected	150m of cycle routes affected	



10 Property

10.1 Introduction

10.1.1 The impact of the Proposed Scheme on property values, both land and buildings, is to a large extent a function of the distance of the property from the route in terms of visibility and sound. This has been referred to in section 5 as a function of proximity.

10.1.2 This raises the issue of compensated property loss and uncompensated property blight. Whilst both of these matters are very important they do not fall within the statutory duties and responsibilities of the Board.

10.2 Background

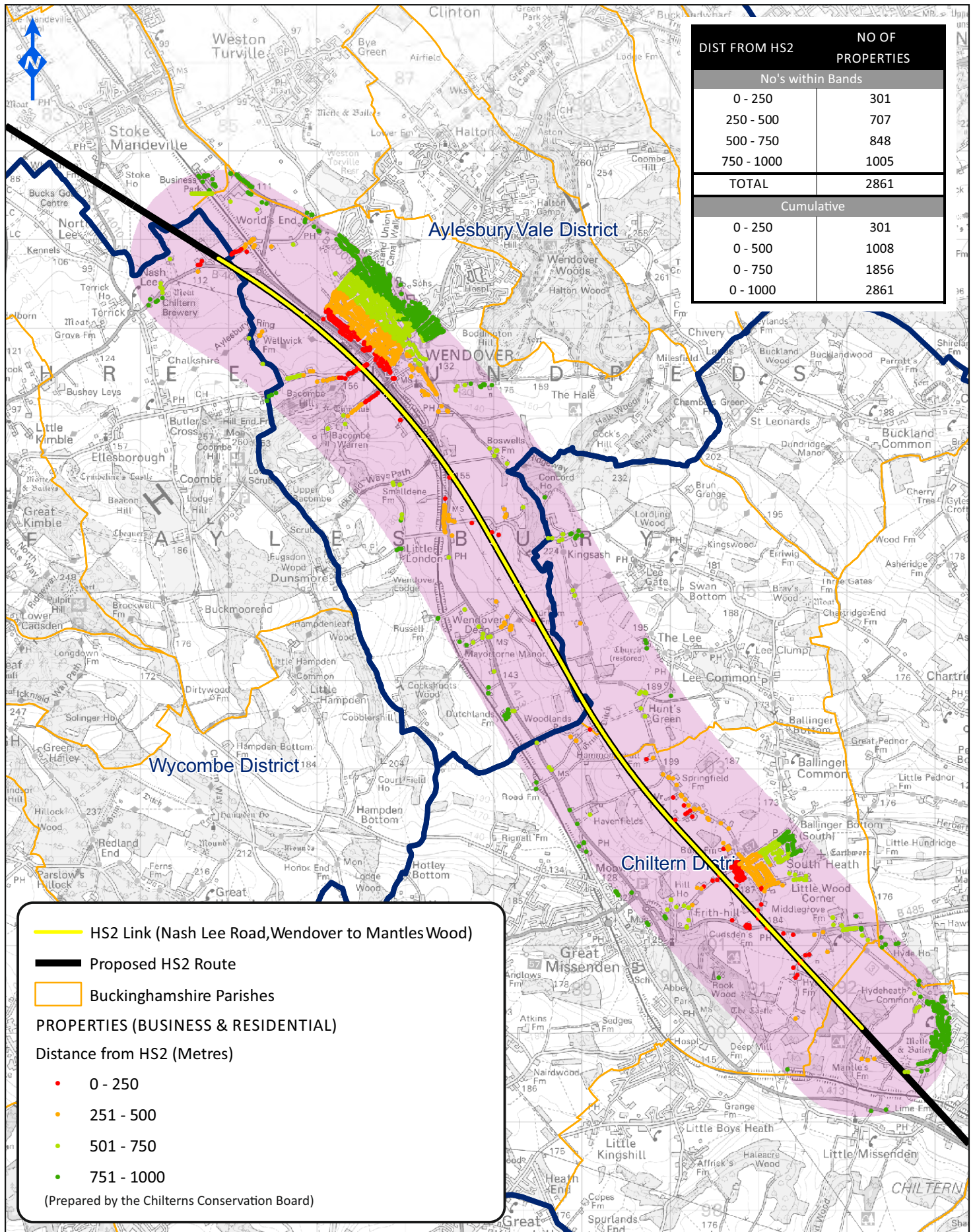
10.2.1 It is useful and not prejudicial to illustrate some of the features which will probably be taken into account at a later stage. The relationship of proximity and diminishing value has already been indicated and this is illustrated in Figure 10.1 by combining distance and the current view of HS2 Ltd of the propagation of sound from the Proposed Scheme.

10.2.2 Using this information it is possible to begin to take a view of the impact the proposed Scheme compared with the Alternative proposal will have on both market and non-market effects. Market effects being compensated property loss and non-market being uncompensated property blight. Table 10.1 below indicates the difference in effect on numbers of residential properties within 200m of the Proposed Scheme and the Alternative Proposal

10.3 Comparison of effects

Table 10.1: Comparison of potential effects on property

Proposed Scheme effects	Alternative Proposal effects	Comment
143 residential properties permanently affected (on or within 200m of the line in operation), with a further 39 residential properties affected during construction.	1 property affected	The single property affected in the Alternative Proposal is Durham Farm, the location of the intervention gap.



— HS2 Link (Nash Lee Road, Wendover to Mantles Wood)
— Proposed HS2 Route
 Buckinghamshire Parishes

PROPERTIES (BUSINESS & RESIDENTIAL)

Distance from HS2 (Metres)

- 0 - 250
- 251 - 500
- 501 - 750
- 751 - 1000

(Prepared by the Chilterns Conservation Board)



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**HS2 in the Chilterns Assessment of
 Non-Market Effects**
 Proposed vs Alternative
 Business and Residential Properties Affected

Date	25.11.2013
Scale	NTS
Drawn by	PR
Checked by	BB
Revision	-

Figure 10.1

11 Health and Well-Being

11.1 Background

11.1.1 Many local planning authorities now require a Health Impact Assessment (HIA) to be undertaken in relation to major developments. The purpose of undertaking an HIA is to identify the health determinants and the pathways which may be affected by a proposed development. Many recent large infrastructure projects have also undertaken HIAs including the Thames Tideway Tunnel and Crossrail.

11.1.2 We would recommend that a comprehensive HIA is undertaken in relation to HS2. This HIA should in particular take account of the impacts during the Planning phase as well as the Construction and Operational Phases. The nature of these impacts can be encapsulated under the term “worry” and could fall under three headings:

- Loss of familiarity
- Anxiety
- Lack of understanding

11.1.3 More detail on how this can affect health is described in Appendix D, but the overall cumulative effects of individual determinants are discussed below.

11.2 Determinants of Health

11.2.1 The following topics have been identified as potential determinants of human health, many of which as shown in the Draft ES are included in the EIA of HS2. However, it is the cumulative effect of changes to these determinants which should be considered together in an integrated way, in order to determine the effects on health and well-being.

- Water quality
- Access to open and green spaces and physical activity
- Air Quality
- Odour
- Noise and Vibration
- Transport and access to medical and/or social services
- Waste generation, transport and disposal
- Employment and business activities
- Housing and household wealth
- Flood risk
- Soil quality
- Personal safety and security

11.3 Noise

- 11.3.1 The impact on existing noise levels as a result of HS2 is included in the EIA and has been reported in the Draft ES.
- 11.3.2 Noise is broadly defined as any unwanted sound, and to some extent it is an inevitable consequence of living in a mature and vibrant society. Most noise is generated as a by-product of economic activity, from the production and consumption of goods and services, and in the case of the Proposed Scheme by the intermittent sound of high speed trains. In managing noise the aim should be to strike a balance between the demand for noise making goods and services and the detrimental effect that noise has on the population exposed. In this case the demand for high speed rail and the effect on the populations in and visiting a protected landscape.
- 11.3.3 Defra has recently reported that the social cost of environmental noise has been estimated at £7-10bn per annum. The Noise Policy Statement for England (NPSE) sets out the government's position and key responsibilities for the management of noise, which are to:
- Avoid significant adverse impacts on health and quality of life;
 - Mitigate and minimise adverse impacts on health and quality of life; and
 - Where possible, contribute to the improvement of health and quality of life
- 11.3.4 Exposure to noise can have a significant negative effect through impacts on amenity, health, productivity, and damage to the natural environment. To reflect these impacts in decision making the Interdepartmental Group on Costs and Benefits noise subject group (IGCB(N)) was established with the remit to develop a robust economic methodology to value noise. The IGCB(N) is made up of an interdisciplinary group of analysts from across most major government departments which looks to disseminate these methodologies for use in appraisal as best practice guidance across all UK government policies including transport.
- 11.3.5 According to a report by Natural England "Microeconomic Evidence for the Benefits of Investment in the Environment" Natural England Research Report NERR033 (2012),
- "...there is good evidence linking access to, and views of greenspace to improved physical and mental health outcomes. Logically this should lead to improved productivity and reduced worker absence. Additionally, there is suggestive evidence of a more immediate relationship between views of plants and nature and productivity"....*

11.4 Effect on the local and national economy

- 11.4.1 A deterioration of health and well-being in the population has a direct economic impact in the form of NHS expenditure; this effect on the economy is further exasperated if ill-health (whether it be physical or stress related), results in a reduced ability to work.
- 11.4.2 The Walking Works report by the Ramblers and Macmillan Cancer Support published in October 2013 examines the impact of inactivity on people's health and wellbeing. The report says that if everyone, in England alone, did the recommended 150 minutes of moderate physical exercise every week it would:
- Save 37,000 lives each year
 - Prevent 6,700 cases of breast cancer
 - Stop 4,700 people getting colorectal cancer
 - Lead to nearly 300,000 fewer cases of type 2 diabetes.

- 11.4.3 As outlined in Chapter 9 above, the Proposed Scheme results in the removal or disruption of at least 18 walking routes, reducing the opportunities for walking.
- 11.4.4 As a minimum, taking into consideration the number of properties directly affected by the scheme and ignoring properties and therefore people situated along construction access routes, assuming an average occupancy of 2.3 people (2011 Census; ONS), the number of people directly affected and most likely to suffer direct health effects from the scheme are therefore 330 for the Proposed Scheme; and 3 under the Alternative Scheme.

12 Comparison of effects

12.1 Introduction

12.1.1 The qualitative assessment of the change brought about by the Proposed Scheme compared with the Alternative Proposal describes:

- the nature of the change, that is a change in quantity, for example emissions or quality
- the direction of the change which will be either an increase or decrease in quantity, or an improvement or deterioration in quality
- the temporal nature of the change. That is a change that will occur immediately or gradually over time, for a limited period of time, for example the effects during the construction phase, or on a permanent basis
- the spatial nature of the change which refers to locations where the change will occur

12.2 Summary

12.2.1 Table 12.1 below summarises the comparison of effects between the Proposed and the Alternative.

Table 12.1: Comparison of potential effects - Proposed Scheme vs. Alternative Proposal

Subject Area	Proposed Scheme effects	Alternative Proposal effects
Landscape	55 sq.km in construction 45 sq.km in operation	6 sq.km in construction and operation
Biodiversity	1ha of BOA	0.13ha of BOA
Geomorphology	Area of bedrock geology exposed approx. 378 ha. Area of superficial geology exposed approx. 224 ha	Area of bedrock geology exposed approx. 54 ha. Area of superficial geology exposed approx. 38 ha
Archaeology	13 sites affected 6.6km of trackway 9.2ha of ancient woodland	1 site affected 0.6km of trackway 0ha of ancient woodland
Agriculture	370ha temporarily ± 250 ha permanently lost	47 ha temporarily ± 20 ha permanently lost
Tourism	18 + walking routes	2 + walking routes

Subject Area	Proposed Scheme effects	Alternative Proposal effects
	9,400m of PRow affected 2600m of cycle routes affected	990m of PRow affected 150m of cycle routes affected
Property	143 properties	1 property
Health and Wellbeing	330 people	3 people

13 Evaluation of non-market effects

13.1 Introduction

- 13.1.1 The primary purpose of this report is to provide a first indication of the evaluation of the non-market effects of the Proposed Scheme compared with to the Alternative Proposal. This is done in two ways. An evaluation is made of the known effects as a result of the qualitative assessment in *An assessment of the non-market effects of the proposed Scheme compared to the Alternative Proposal* (PBA/CCB, October 2013). This is followed by examining the application of a variation of the shadow pricing technique.
- 13.1.2 This is not an easy thing to do and the basis upon which such an evaluation should be based, that is a primary study, has not been done even on an initial or pilot basis. The results in this report therefore should be treated with caution and viewed as nothing more than an indication of the likely outcome of a primary study and the method of approach; an attempt has not been made to evaluate all of the effects. The report *An Introductory Guide to Valuing Ecosystem Services* (defra, 2007) made the same point by noting that *it is now necessary to determine the extent to which the ecosystem provides the service and how the policy options may impact on that provision. It can be very difficult to quantify the level of ecosystem services provided by each option.* This has been found to be the case here.
- 13.1.3 On the matter of a primary study this has been referred to in the DfT report *Applying an Ecosystem Services Framework to Transport Appraisal* in the following way:
- Where there is no relevant valuation study available in the existing literature that can be used to provide generic values in WebTAG and/or the cost-benefit analysis is seen to depend significantly on the scale of the environmental/ecosystem services effects, undertaking bespoke value transfer or a primary valuation study may be justified. This may be appropriate for transport projects of particular significance, or with particularly important environmental/ESS effects. Primary valuation studies can be costly and time consuming so it is something that should be undertaken only when it is proportionate and when the policy context demands it.*
- The imposition of a major infrastructure project on a protected landscape should be considered a proportionate response and in this case the policy context demands it.*
- 13.1.4 The methodology used by government is reviewed as a reference point and is considered. This is supported by two annexes the first of which contains a review of current government thinking on the problems and solutions of the evaluation of non-market effects, and the second is an extract from *Green Infrastructure Valuation Tools Assessment* which provides a strong case for using a primary study when making evaluations of non-market effects.

13.2 Current government valuation methodology

- 13.2.1 The current methodology used by government to evaluate the non-market effects is based on *Valuing the External benefits of Undeveloped Land* (Department for Community and Local Government, 2001). This methodology forms part of the guidance in *WebTAG Transport Appraisal* and the *Treasury Green Book*. For the purposes of making a comparative evaluation: of this:
- It is inappropriate for valuing an AONB, a SSSI or an National Park
 - It does not take account of the protected characteristics of these areas
 - It is limited by the narrow geographical bandwidth either side of the route

13.2.2 Many examples can be used to substantiate these claims. For example:

- The band width used is confined to a strip 500m each side of the centre line of the route beyond which it assumes that there is no damage to the landscape or environment;
- The equation used to calculate the reduction in land value (cost) = the unit land value * land area (ha) * line type mitigation * existing land state mitigation * distance mitigation. The unit land value is that contained in *Valuing the External Benefits of Undeveloped Land*, which in turn is a function of the landform typology; and
- For the section from Amersham to the Chiltern northern edge the classifications adopted, the resulting proportion of each classification which has been used, and the cost per hectare are shown in Table 13.1:

Table 13.1: Land classifications adopted and assigned value

Land classification	Assigned value £m/Ha	Proportion of the land classification adopted
Urban core	10.8	5%
Natural and semi natural or rural forested	1.3	14%
Agriculture extensive	0.63	4%
Intensive/extensive or agriculture intensive	0.02	76%

13.2.3 From Table 13.1 it can be seen that 76% of the surface route across the Chilterns AONB is valued mainly at the lowest possible land value. Virtually no recognition of its status has been acknowledged unlike the first preliminary landscape valuation that valued it at the highest non-urban value (natural and semi natural or rural forested), nearly 60 times greater.

13.2.4 The methodology used by DfT and described above seems to accurately implement the Department's current methodology, although there is some doubt about this, but it is limited in scope, spatial application, and in content. Clearly it is not a true or accurate assessment of a protected landscape. The valuation of intensive/extensive or agricultural land was based on two studies: one which was done in Canada and the other in Sweden. This represents the application of a fairly insensitive form of benefits transfer. The dangers of this approach have been highlighted in *Assessing Environmental Impact: Guidance* (Defra, 2013) in which the advice is:

(Landscape) is an area where values cannot be easily transferred due to the locally specific nature of valuations

13.2.5 The approach adopted by government in this case seems to be based on an unsound technique in these circumstances (benefits transfer for landscape valuation), a remarkably small sample (only two), and samples based on substantial differences in cultural and physical and protected characteristics. In addition in *Economic Valuation with Stated Preference Techniques* (2002) this approach of transferring unadjusted estimates was described as hazardous whilst the *Treasury Green Book* advises 'care' in such circumstances. The report *Applying Ecosystems Services Framework to Transport Appraisal* also provides the basis for the monetary valuation of environmental services which are a large part of the basis for the designation of an AONB .

13.3 Preliminary results of evaluation

13.3.1 In broad terms it can be said that under every measure the environmental impacts related to the Proposed Scheme are approximately 10 times greater in magnitude than those related to the Alternative Scheme.

13.3.2 Table 12.1 above presents a range of effects which it could be argued are all capable of financial evaluation. This would be true if a primary study based on original research was carried out. This is currently not the case and what follows is an attempt to move the evaluation forward with some reasoned assumptions the purpose of which is to provide a guide.

13.3.3 During the operation of the Proposed Scheme the line will be visible from an area of about 45 km² compared to about 6 km² for the Alternative proposal. In both of these cases the

diminution in landscape value of the effect of the line will have its maximum near the line and reduce to nothing at its furthest distance from it. These areas present the basis for a qualitative evaluation of the diminution of value of the landscape and the objects in it. This must be done on the basis of a primary study before the Alternative Proposal is discarded as a solution on the basis of cost.

13.4 Modified shadow pricing approach

- 13.4.1 This section is based on information provided by Bluespace Thinking Ltd.
- 13.4.2 A combination of derivatives of contingent valuation and shadow pricing could be used to indicate a minimum value loss attributable to HS2 passing through the northern part of the Chilterns AONB. Both are recognised valuation techniques which should be accepted as consistent with the *Treasury Green Book* and good valuation practice.
- 13.4.3 While it is very difficult to value the damage caused by HS2 it is easier to establish the minimum market value of alternative developments that may be considered to give a similar level of damage and which at that established value are not acceptable in the Chilterns AONB.
- 13.4.4 A reference case would be to theoretically permit a limited amount of, say, housing development along possibly 8km of the 10 km surface route section of the transit across the Chilterns AONB north of Little Missenden. If a residential road of similar density as the 0.65km length of Ballinger Rd, South Heath (east from the junction with Potter Row) were permitted the value of the HS2 route land, simply as building land, would be about **£200m**. As this development is unacceptable under the restrictions of the AONB it follows that from the perspective of society as a whole it values the unblemished landscape more highly.
- 13.4.5 It will be a matter of considered opinion whether the damage from this unacceptable development would be greater, less or the same as from HS2. Given it could be tailored to avoid ancient woodland, areas of special interest and be denser in certain less visible and less impactful locations it is probably at about the right level. Stated preferences techniques can be used to establish a level of theoretical development that would generally be considered to be similar in terms of damage to the AONB as HS2 taking into account both the construction and operating phases.
- 13.4.6 To this established minimum value can be added other aspects of environmental damage as defined in the Green Book and good environmental valuation practice. As an example, and as the Green Book points out, shutting quarrying in National Parks because of its impact was valued using contingent valuation techniques by the former DeTR at £10.52/extracted tonne. The HS2 Tunneling and earthworks are quarrying in terms of the environmental damage they will create. As noted previously the total quantity of excavated material has not yet been published but this could add over £60m to value of damage avoided by the Alternative Scheme.

14 Conclusion

- 14.1.1 In broad terms it can be said that under every measure the environmental impacts related to the Proposed Scheme are approximately 10 times greater in magnitude than those related to the Alternative Scheme.
- 14.1.2 In the case of the shadow pricing analysis described in Section 13.4 it is likely that the minimum open market value of 8km of the surface section using these techniques would come to between **£350-£500 million** and the land value about **£150m to £200m** thus making a good case for a tunnel.
- 14.1.3 This approach could be a bridge between those who see no value in Nature's beauty and those that see it as priceless but requires much more work to confirm these tentative results.
- 14.1.4 In conclusion, HS2 Limited's opinion of the cost differential between the Proposed Scheme and the Alternative Proposal is £330m. This figure is not accepted by Conserve the Chilterns and Countryside but the detailed information to check the figures has not been made available by HS2 Limited.
- 14.1.5 Even if the figure is £330m, our work has identified that the non-market effects of the Proposed Scheme are approximately ten times greater than that of the Alternative Proposal.
- 14.1.6 Given the duty of the Government under Section 85 of the Countryside and Rights of Way Act 2000 to have regard to the purpose of conserving and enhancing the natural beauty of Areas of Outstanding Natural Beauty, the scale of any cost differential between the Proposed Scheme and the Alternative Proposal has to be balanced against the Government's duty in section 85 and the non-market effects of both schemes, as set out in this document.

"The matters set out in this report lead to a conclusion that it would be perverse for the Government to proceed with the Proposed Scheme in preference to the Alternative Proposal having regard to its duty under CRow 2000 Section 85."

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Appendices A - D Volume 2