The Case for An Optimum HS2 Environmental Line Speed

in the Chilterns Area of Outstanding Natural Beauty

Summary

HS2 noise is a subject of grave concern. This is because of the projected very high speed and usage of the trains, and that relevant information on HS2's noise is apparently unavailable, unknown or outside the EU's Technical Specifications for Interoperability. Comparisons with other high speed lines, in particular HS1 and the TGV lines, are not relevant as the future use of HS2 will be very different.

Areas of Outstanding Natural Beauty (AONBs) are nationally importance resources designated for their natural beauty including tranquillity. The Government states in its 2011 Natural Environment White Paper that AONBs are "national treasures".

Half the proposed 20km HS2 route in the Chilterns AONB is on the surface. It is currently designed with a line speed of 400kph (250mph). If HS2 were to go ahead and a tunnelled route throughout the AONB not provided, it is proposed that the surface route is designed at a reduced optimum environmental line speed in the AONB. This would help mitigate the impact of the line in respect of a) noise and b) environmental impacts.

The inadequacy of the noise calculation method should be further explored and explained.

Introduction

1. HS2 noise is a subject of grave concern to a very wide section of the community. HS2 trains will travel up to 360kph (225mph) and will ultimately travel up to 400kph (250mph). The projected speeds of HS2 trains are the fastest in Europe, if not the world.[1] [2]

2. The Chilterns Area of Outstanding Natural Beauty (AONB) is a nationally important resource. The Government says in its 2011 Natural Environment White Paper that AONBs are "national treasures" i.e. highly valued and precious to the UK.

3. Given this, serious concerns have arisen over the impact of HS2 Ltd's recommended route on the Chilterns AONB:

[1] HS2 Ltd's Technical Seminars October 2010 Infrastructure and Technical Specification http://www.hs2.org.uk/assets/x/77048

[2] Gourvish, T. March 2010 The High Speed Rail Revolution: History and Prospects http://www.railwaysarchive.co.uk/documents/HS2_TheHighSpeedRailRevolutionHistoryAndProspects2010.pdf

a) HS2 will travel for more than 20kms in the AONB.

b) It will travel through the widest part of the AONB.

c) Half the route in the AONB will be on the surface.

4. If the government continues with its plans for HS2 – despite the poor BCR and the Major Project Authority's red/orange status for the scheme – what mitigation should be considered for the nationally designated AONB? A bored tunnel under the full length of the AONB is the favoured solution. If this is not accepted, what else could be done to reduce HS2's noise and environmental impacts?

5. The Countryside and Rights of Way Act (2000 s87) recognises the importance of understanding and enjoyment by the public of the special qualities of the area of outstanding natural beauty. HS2 Ltd has produced limited information on noise impacts on buildings and residents in the AONB. However, it is important the noise impacts of the scheme on visitors to the AONB are considered. How will impacts on visitors and AONB land be taken into account?

6. HS2 travels through scenic parts of the AONB easily accessible by public transport, bicycle and rights of way, the methods of access to AONBs favoured by the Government.[3] The area is one of just three such Gateways to the AONB recognised by the Department for Transport.[4] The socio-economic well-being of communities in the AONB should be fostered (Countryside and Rights of Way Act 2000, s87) while conserving the landscape and scenic beauty of the AONB.[5]

7. Given the concerns listed above, reducing the noise and environmental impact of HS2 on the AONB is of prime importance.

How Can Noise Impacts Be Best Reduced?

8. The means of attenuating noise are given below in sequence of efficiency:

   a) Reducing the speed of HS2 trains. As well as a direct reduction of source noise relating to speed, this option offers further opportunities for route design.

   b) Lowering the alignment.

   c) Erecting bunds and barriers.

[3] Natural Environment White Paper, The Natural Choice: Securing the Value of Nature, June 2011 paragraphs 4.35 http://www.defra.gov.uk/environment/natural/whitepaper/

[4] £1 Million Boost to Cycling Tourism http://www.chilternsaonb.org/news/90/19/1-million-boost-to-cycling-tourism.html

[5] National Planning Policy Framework 2012 paragraph 115 http://www.communities.gov.uk/documents/planningandbuilding/pdf/2116950.pdf

9. Given that reducing the line speed provides an opportunity to effectively reduce both noise and environmental impacts it is proposed that an optimum environmental line speed is designed for the HS2 route in the AONB.

Transport Select Committee

10. The Transport Select Committee raised concerns over HS2's noise and environmental impacts due to the very high speed of the trains (Inquiry Report November 2011). Both types of impacts will potentially be lessened with line speeds less than 400kph (250mph):

    "A very high speed line may have been given undue emphasis as a result of the particular appraisal method used as part of the economic case. It may be that a high-speed line operating at less than 250mph may offer greater opportunities for noise and environmental impact mitigation" (Conclusion and Recommendation 9). [6]

11. HS2 Ltd's remit was for a line speed of at least 186mph (300kph). At the 13 September 2011 Committee Inquiry, Chief Engineer Professor Andrew McNaughton said it was HS2 Ltd that had decided on the line speed of 400kph.[7]

Concerns over Noise from HS2 Ultra High Speed Trains

12. The usual line speed for high speed rail in Europe is 300kph (186mph).[8] HS1 (Channel Tunnel Rail Link) trains, for example, travel at a maximum of 300kph.

13. HS2 Ltd's Appraisal of Sustainability shows that noise levels increase with train speed (noise levels measured at 25m). It should be noted that at 300kph (186mph) and above, the gradient of the slope between noise level and train speed becomes steeper.[9]

14. The amount of available data above 320kph (200mph) is limited. There are concerns the relationship between noise level and train speed at higher speeds may not be linear.

---

[6] Transport Committee Tenth Report – High Speed Rail
http://www.publications.parliament.uk/pa/cm201012/cmselect/cmtran/1185/118511.htm

[7] Transport Select Committee Minutes of Evidence High Speed Rail 13 September 2011 Q437
http://www.publications.parliament.uk/pa/cm201012/cmselect/cmtran/1185/11091301.htm

[8] Gourvish, T. March 2010 The High Speed Rail Revolution: History and Prospects
http://www.railwaysarchive.co.uk/documents/HS2_TheHighSpeedRailRevolutionHistoryAndProspects2010.pdf

[9] HS2 London to West Midlands Appraisal of Sustainability Appendix 5 AoS Technical Reports page 45 Figure 4.
http://highspeedrail.dft.gov.uk/sites/highspeedrail.dft.gov.uk/files/hs2-aos-appendix05.pdf

15. Although HS2 trains will travel up to 360kph from the outset, the pass-by noise level above 350kph is not supplied.[10]

16. Although HS2 Ltd's Project Specification states the noise generated would be "in line with TSI requirement",[11] there are no TSIs for pass-by noise for trains travelling above 320kph (Table 1).[12] (TSI: Technical Specifications for Interoperability are EU Decisions.)

17. The 2008 TSI states that new trains - ordered after 1 January 2010 – should be quieter than rolling stock ordered before this date.[13] This is of direct benefit to communities affected by new and recently bought trains travelling at maximum operating speeds in Europe of 300kph or 320kph (Table 1).

18. Looking at Tables 1 and 2 it is of great concern that communities and visitors affected by HS2 will not benefit from the reduced amounts of noise that is intended in the EU's TSI. The pass-by noise of HS2 trains operating at 350kph will now apparently be noticeably/significantly greater than the pass-by noise of new trains operating at 300kph, on infrastructure such as HS1 for example (Tables 1 and 2, including note 3 below Table 2). Thus, rather than improving the environment with respect to noise, it seems the company's choice of ultra high speed will enable it to operate trains that exceed the current noise limits of new high speed trains operating within Europe.

19. HS2 Ltd states that as trains travel at 300kph and above, increasing amounts of aerodynamic noise are produced. [14] This is mostly high frequency noise. HS2's noise data does not include any information about the noise frequency levels the trains will produce.

20. Because high frequency aerodynamic noise will mostly be generated by the pantographs it will not be mitigated by 3m high barriers on level ground, and 2m high barriers on viaducts.[15] These are the barrier heights HS2 Ltd used for its noise

---

[10] FOI 10/032

[11] HS2 Project Specification page 10 http://www.hs2.org.uk/assets/x/85360

[12] 21 February 2008 Technical Specification for interoperability relating to the 'rolling stock' sub-system of the trans-European high-speed rail system paragraph 4.2.6.5.4 page 198 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:084:0132:0392:EN:PDF

[13] 21 February 2008 Technical Specification for interoperability relating to the 'rolling stock' sub-system of the trans-European high-speed rail system paragraph 7.1.5.3 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:084:0132:0392:EN:PDF

[14] HS2 London to West Midlands Appraisal of Sustainability Appendix 5 AoS Technical Reports page 40 Paragraph 2.2.1. http://highspeedrail.dft.gov.uk/sites/highspeedrail.dft.gov.uk/files/hs2-aos-appendix05.pdf

[15] HS2 London to West Midlands Appraisal of Sustainability Appendix 5 AoS Technical Reports page 50 Paragraph 6.3.5 http://highspeedrail.dft.gov.uk/sites/highspeedrail.dft.gov.uk/files/hs2-aos-appendix05.pdf

modelling purposes. HS2's contact wires - touched by the pantographs – are more than 5m high.

21. L_{Aeq} is the metric which has been used to assess the scheme's impact. However this metric, which is an 'average' of noise levels, fails to reflect the sharp rises in noise that affected communities and land will be subjected to. The noise level will be low in the intervening periods between each passing ultra high speed train. This effect is amplified due to the route not having been planned in an existing noise corridor between London and Birmingham. Given this, the impact of the scheme's noise has not been properly reflected in the Appraisal of Sustainability[16].

22. Concerns over HS2's noise impacts are compounded by predicted usage. There will be up to 18 HS2 trains *per hour* each way. This far exceeds the usage of routes by high speed trains in Europe. For example, there are on average 10 non-stop TGV trains *per day* each way between Paris and each of Lyons, Valence and Avignon on France's LGV Sud-Est. Thus, in contrast to TGV trains in France, noise from HS2 trains will impact on communities once every 100 seconds. Similarly, contrasting HS2 with HS1, the limit on the number of Eurostar trains in Kent is 4 trains per hour each way.[17]

23. If all other things were equal, and based upon frequency of trains only, exposure to HS2 would be 9 to 13dB $L_{Aeq,12hr}$ greater than exposure to the TGV, and 6 dB $L_{Aeq,12hr}$ greater than exposure to Eurostar. On the usual assumptions made with regard to exposure to noise, HS2 is roughly twice as great as the TGV exposure and significantly greater than HS1. This does not take into account further differences in exposure caused by differences in train speed.

24. HS2 Ltd's data relates only to the "off the shelf" (captive) fleet. In fact, more than 70% of HS2 trains will be the bespoke classic compatible fleet.[18] These will travel at the same speeds on HS2 infrastructure as the captive fleet, but unlike the latter, classic compatible trains will also be able to travel on the West Coast Main Line. Classic compatible trains have yet to be designed so that the noise levels they will produce are unknown.

    It is important that information on noise levels and noise frequency content of both fleets are validated.

[16] HS2 London to the West Midlands Appraisal of Sustainability Main Report Volume 2 Plans and Appraisal Framework February 2011.

[17] HS1 Section 1 Infrastructure Register page 12 paragraph 5.8.

[18] High Speed Rail London to the West Midlands and Beyond A Report to Government by High Speed Two Ltd pages 41 and 42.

HS2 Ltd's Response to the Transport Select Committee Report

25. HS2 Ltd carried out an appraisal of noise and environmental impacts of the recommended route designed with line speeds of 300kph and 360kph. The company compared the impacts with the Consultation 400kph line speed alignment.

26. In addition, along the Consultation route six route sections, or study areas, with reduced line speeds were designed. For three of the study areas impacts were examined at both 300kph and 360kph line speed alignments. For the remaining three study areas impacts were examined at a line speed alignment of only 360kph.

27. Predictably HS2 Ltd found that reducing the line speed lessens noise impacts (see note 4 - below Table 2).[19]

Characteristics of AONBs

28. Tranquillity, including peace and quiet, is an important characteristic of AONBs.[20] The importance of peace and quiet is emphasised in the Chilterns Conservation Board's Management Plans.[21] Such plans state the policy for management of an AONB and how this shall be carried out (Countryside and Rights of Way Act 2000) (s89).

29. Other characteristics of AONBs include landscape, scenic, wildness and natural and cultural heritage factors. Factors detracting from natural beauty include incongruous elements, built features and development.[22]

30. Of the UK's AONBs, the Chilterns is a particularly valuable resource in tranquillity and natural beauty provision:

    a) It is the only AONB between London and Birmingham.
    b) The AONB lies just 3 miles from Greater London.

[19] High Speed 2 London to West Midlands Appraisal of Sustainability – Route Corridor and Design Speed Review dated January 2012, issued April 2012 http://www.hs2.org.uk/assets/x/85354

[20] Guidance for Assessing Landscapes for Designation as National Park or Area of Outstanding Natural Beauty in England page 3 and Appendix 1 http://www.naturalengland.org.uk/Images/B1DesignationGuidanceMar11_tcm6-26242.pdf

[21] Chilterns Conservation Board Management Plans: Understanding and Enjoyment. http://www.chilternsaonb.org/uploads/files/ConservationBoard/ManagementPlan/Understanding_and_enjoyment.pdf

[22] Guidance for Assessing Landscapes for Designation as National Park or Area of Outstanding Natural Beauty in England Appendix 1 http://www.naturalengland.org.uk/Images/B1DesignationGuidanceMar11_tcm6-26242.pdf

What Mitigation Could a Lower Design Speed Provide in the AONB?

A. Noise Reduction

31. As noted, the most efficient means of attenuating noise is by reducing the speed of the trains. HS2's line speed is 400kph throughout the surface route in the AONB including the green tunnels. Lowering the line speed of the surface route to 300kph, for example, in the AONB would apparently result in a noticeable/significant reduction in HS2's pass-by noise. (Tables 1 and Table 2 including note 3).

32. A further means of reducing the effect of noise on communities is in their avoidance by route alignment. The population size of communities is taken into account when considering the noise impacts of different alignments.

B. Reduced Environmental Impacts

33. There are additional opportunities to avoid or reduce impacts because the alignment can be made more sinuous using lower speed alignments. Table 3 gives a list of major impacts - as the author sees it - of the surface route in the Chilterns AONB.

34. There are impacts not referred to in Table 3 that are unavoidable without the construction of a bored tunnel throughout the AONB. There are also impacts on isolated properties not referred to in Table 3.

What Has HS2 Ltd Done to Investigate Reducing the Line Speed in the AONB?

35. HS2 Ltd examined the effect of reducing the line speed to 360kph in the route section between South Heath and Wendover (Study Area 6). There were many benefits including avoiding Grim's Ditch; reducing the length of Wendover viaduct to 50% of its present length; reducing the maximum height of Wendover Dean viaduct from 17m to 6m and its length from 500m to 332m.

36. Although there were disadvantages to the 360kph alignment including moving the line too close to the London Road/Rocky Lane community, HS2 Ltd says it actually prefers the 360kph alignment to the 400kph Consultation alignment.[23] Despite this the company never pursued a lower speed alignment in the AONB.

37. HS2 Ltd did not examine reducing the line speed to 300kph in the route section between South Heath and Wendover because an initial review apparently showed

[23] Review of HS2 London to West Midlands Route Selection and Speed page 51 Paragraph 4.3.46. http://www.dft.gov.uk/publications/hs2-review-of-route-selection-and-speed/

"no additional benefits could be achieved" from lowering the line speed to this speed.[24]

This is questionable. Would there not be reduced noise impacts to communities, to individual houses, to the AONB and to its visitors from lowering the line speed to 300kph?

What should be done now?

38. Up to this point HS2 Ltd has given the indication that the noise results that have been published have been based upon the Calculation of Railway Noise procedures. This was based upon the 1995 publication and supplement and a further examination in 2007. This further work was concerned with amendments and corrections related to the rolling noise component of the train noise. The only other source of further noise that has been considered is fan noise and this was added in 1995 to allow for the consideration of the Eurostar fleet into the CRN procedure. This should not be confused with aerodynamic noise as the consideration of fan noise shows a reduction of noise output as the train increases in speed. Clearly this is not the case with aerodynamic noise and HS2 Ltd has stated that aerodynamic noise increases with train speed. It is fair to say that all noise sources arising from HS2 have not been considered up to this time.

    The Appraisal of Sustainability mentioned this point, almost in passing, by referring to extra research and measurement of HS1 noise and other sources. Ad hoc consideration may have been included in the limited noise prediction carried out to date but it is now essential that these fundamental matters are considered in much greater detail. The results should be then used to provide information on how the noise of the trains, and consequentially the noise exposure of an area, will change with vehicle speed. With this information a relevant line speed can be formulated that can be included in the mitigation plan for especially vulnerable areas such as AONBs.

39. It is proposed that alignments of various line speeds between 300kph and 400kph are now designed by HS2 Ltd in order to:

    a) Reduce the noise from HS2 trains so the AONB would be relatively more tranquil than under the current plans.

    b) Provide options for reducing environmental impacts (Table 3).

40. Numbers of demolitions, and noise data including the parameters used in the 2011 and 2012 Appraisals of Sustainability, should be supplied. Interim noise contour maps should also be supplied.

[24] Review of HS2 London to West Midlands Route Selection and Speed page 39 Paragraph 4.3.9. http://www.dft.gov.uk/publications/hs2-review-of-route-selection-and-speed/

41. The community forums concerned with the surface route in the AONB will consider the data and the alignments.

42. The forums should have the opportunity to make comparisons of alignments at several line speeds to reduce environmental impacts to help achieve an optimum environmental line speed in the AONB. These would include various options of alignments that – for example – do not avoid Grim's Ditch but reduce the height and length of the viaducts (Table 3). Such comparisons are not currently available from HS2 Ltd's single lowered line speed (360kph) alignment. There will need to be further combinations of reduced environmental impacts for the forums to consider (Table 3).

43. As noted, the Government has said the AONB is a "national treasure". Developing an optimum environmental line speed is the very least that should be offered that might go some way towards realising this value.

Marilyn Fletcher B.Sc. Ph.D.

Dr Fletcher is a biological researcher and a graduate of the University of Sheffield. After qualifying for her Ph.D. at the University of London, Dr Fletcher lectured to under-graduates at the university for 15 years. She also supervised post-graduate students for Ph.D. as well as carrying out her own research.

She is now an independent researcher specialising in the environment and sustainability.

Acknowledgements

The author would like to thank Professor Colin Waters for providing valuable technical advice on noise issues. His expertise has been immensely helpful in elucidating the potential noise impacts HS2 will present which will make it a very different scheme from HS1.

Professor Waters BSc (Eng) MSc C Eng MRAeS FIOA is principal of Colin Waters Acoustics and has professional consulting experience in this field for over 40 years. He has been a Director of Ove Arup and Partners Ltd with responsibility for environmental acoustics for that firm. He has carried out and directed major infrastructure environmental acoustics projects in both the national and international field. Professor Waters has advised the Chinese Civil Aviation Authority on associated airport problems and their assessment and is visiting professor of airport environmental acoustics at Manchester Metropolitan University.

Rolling Stock		Speed		
		250kph	300kph	320kph
Class 1	Limit on pass-by noise from existing trainsets	87dB(A)	91dB(A)	92dB(A)
Class 1	Limit on pass-by noise from new trainsets (note 1)	85dB(A)	88dB(A)	89dB(A)

Table 1: TSI Limits for Pass-by Noise (Committee Decision 2008/232/CE)[25]

Rolling Stock		Speed		
		350kph	Current HS2 Maximum 360kph	Future HS2 Maximum 400kph
Class 1	HS2 Ltd's stated pass-by noise from actual trainsets[26]	95dB(A)	Not given but presumably more than at 350kph.	No trains in service apparently travel at this speed.
Class 1	HS2 Ltd's stated pass-by noise from proposed trainsets (captive fleet) – see note 2	Not given (note 3)	Not given	See note 4

Table 2: HS2 Ltd's Stated Limits for Pass-by Noise of its Captive Fleet

Notes on Table 2

All noise measurements made at 25m.

1. Ordered after 1 January 2010.

[25] 21 February 2008 Technical Specification for interoperability relating to the 'rolling stock' sub-system of the trans-European high-speed rail system paragraphs 4.2.6.5.4 and 7.1.5.3 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:084:0132:0392:EN:PDF

[26] FOI 10/032

2. Noise values in Table 2 are for HS2's captive fleet. In contrast, HS2 Ltd's bespoke classic compatible fleet which make up 70% of the total HS2 fleet are yet to be designed.

3. TSIs state there should be a 3dB(A) reduction in the pass-by noise emitted from trains ordered after 1 January 2010 compared to trains ordered prior to this date. This applies to trains travelling at 300kph and 320kph. For example, for trains ordered before 1 January 2010 the pass-by noise when travelling at 300kph is 91dB(A). In contrast, for trains ordered after 1 January 2010 the pass-by noise when travelling at 300kph is 88dB(A) (Table 1).

HS2 Ltd states that it has assumed future trains will be quieter.[27] If it is assumed the required reduction is to be 3dB(A) for trains travelling at 350kph, the permitted pass-by noise from HS2 Ltd's proposed trains travelling at 350kph would be 92dB(A) (Table 2). The difference between this value and the pass-by noise permitted from trains ordered after 1 January 2010 and travelling at 300kph is 4dB(A). This difference in noise level is between noticeable (i.e. a 3dB(A) difference) and significant (i.e. a 5d(B)A difference).

4. HS2 Ltd's data[28] assume that should HS2 trains travel above 360kph in the future, their pass-by noise levels would not exceed that produced by HS2 trains which are proposed to initially travel at 360kph. However, careful reading of this FOI response shows HS2 Ltd does not actually state this: "HS2 Ltd has assumed that a higher ultimate maximum speed, above the 360kph appraised, would be permitted only if through future train design, the sustainability impact were to be constrained within the parameters of the appraised 360kph envelope".[29]

Although the HS2 Appraisal of Sustainability[30] refers the reader to its Project Specification [31] and from thence to TSI regulations for noise limits for train speeds in excess of 360kph, as noted earlier there are no TSI limits on noise generated by trains exceeding 320kph.

[27] HS2 Explanatory Note – Noise http://www.hs2.org.uk/assets/x/57618

[28] High Speed 2 London to West Midlands Appraisal of Sustainability – Route Corridor and Design Speed Review dated January 2012, issued April 2012 http://www.hs2.org.uk/assets/x/85354

[29] FOI 10/074

[30] HS2 London to West Midlands Appraisal of Sustainability Appendix 5 AoS Technical Reports page 45 Paragraph 5.6.4. http://highspeedrail.dft.gov.uk/sites/highspeedrail.dft.gov.uk/files/hs2-aos-appendix05.pdf

[31] HS2 Project Specification Paragraph 3.1 http://www.hs2.org.uk/assets/x/85360

Table 3: Major Impacts of the HS2 Surface Route in the Chilterns AONB

Feature/Community	Current Impact	Aim
Wendover Dean Viaduct	Maximum 17m high, 500m long	To reduce viaduct height and length.
Wendover Viaduct	Maximum 12m high, 500m long	To reduce viaduct height and length.
London Road/Rocky Lane Community	HS2 175m from nearest building Embankment height is up to 10m	To increase distance between HS2 route and the community. To reduce embankment height.
1.4km route section between the two viaducts	30% cutting and 70% embankment (up to 10m high)	To increase % of route section in cutting and decrease % on embankment To decrease embankment height.
Wendover	Edge of green tunnel 170m from nearest property on Pound Street Wendover. HS2 cuts through properties on Ellesborough Road (see notes j, k, l). Landscape impacts at the Chilterns escarpment.	To bore tunnel.
South Heath	Edge of green tunnel approximately 50m from nearest property in Sibley's Rise South Heath. 250m of the length of the green tunnel will project above present ground level. There are concerns over the green tunnel appearing on the skyline.	To bore tunnel.
Ancient woodland	Jones Hill Wood and Sibley's Coppice directly impacted. (If the tunnel portal is fixed, it is accepted a surface route cannot avoid Mantle's Wood and Farthing's Wood.)	To avoid impact on ancient woodland (see note n).
Grim's Ditch	Route cuts through it.	To avoid scheduled monument.
Route section between South Heath and Wendover Dean which includes Potter Row.	The route lies immediately adjacent to buildings on a lane off Potter Row. The cutting depth was reduced by 7m in January 2012. HS2 with its associated bunds will have landscape, land-take and potential increased noise impacts.	To lower the vertical alignment (see notes o and s).
Leather Lane	Historic sunken lane will be dug up and embanked for 600m, diverted and elevated on to a bridge over HS2	Lowering the alignment allows the lane to stay at its present level and not be diverted. Historic, landscape and ecology feature maintained.
Listed buildings		Avoid

Notes on Table 3

Table 3 does not list other concerns and aims of route design which include:

a) Landscaping to be of highest quality and in keeping with the AONB.

b) Consideration of maintenance and management of certain lands – for example over green tunnels - to be in perpetuity.

c) Gaining landscape improvement, for example by removal of pylons and putting overhead electricity cables underground.

d) Concerns over bunds impacting on landscape and land-take in the AONB particularly where the proposed cuttings are shallow or where HS2 is traversing a slope.

e) Concealing the route by tree cover in the AONB should respect landscape character in planting arrangement and species.

f) The Chiltern Buildings Design Guide and Environmental Guidelines for Highways Management should be used.

g) Built infrastructure including viaducts, tunnel portals, road bridges and foot-bridges to be of high quality design, specifically designed for their setting and in keeping with local character.

h) Ensuring all roads crossing HS2 do so at (current) grade.

i) Ensuring design minimises HS2's impact on the public's enjoyment of rights of way.

j) A corridor of isolated land between HS2 route and the A413 will be created at Wendover. Can this land be accessed for farming during operation? Will the soil quality be suitable for farming?

k) Ensuring Ellesborough Road is re-instated.

l) Altering the proposed site of the possible Bacombe Lane diversion to minimise landscape impacts on the AONB.

m) The construction width of green tunnels is far wider than that of their finished width. The resulting disruption must be minimised.

n) The Government – in its 2011 Natural Environment White Paper – is committed to conserving and restoring ancient woodland.[32]

o) The HS2 Engineering Report says side slopes of cuttings can often in practice be made steeper than 1:2 (1 vertical to 2 horizontal).[33] *If the alignment was lowered between South*

[32] Natural Environment White Paper 2011 page 25 paragraph 2.53 http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf

[33] HS2 Route Engineering Report page 5 http://highspeedrail.dft.gov.uk/sites/highspeedrail.dft.gov.uk/files/hs2-route-engineering.pdf

Heath and Wendover Dean, increasing the gradient of the cutting's side slopes would minimise spoil and land-take impacts.

p) Noise mitigation to be of world class standard.

q) The design, location and appearance of noise barriers must be sympathetic to the natural beauty and tranquillity of the AONB.

r) All tracks, lanes, hedgerows and re-engineered roads to be restored to former alignments and current rural appearance. Severed and damaged hedges, verges and trees to be managed and maintained to support biodiversity to produce an appearance generally indistinguishable from that which has been removed or damaged by HS2.

s) The Government is committed to establishing coherent ecological networks for the benefit of wildlife and people.[34] HS2 will damage ecological networks from the considerable loss of bio-diverse rich hedgerows. Bunds, for example, will cause loss of hedgerows. Lowering the route alignment will minimise the need for bund building. Such bunds would be extensive because of the need for them to be blended into the Chilterns landscape. [35]

[34] Natural Environment White Paper 2011 Annex I Commitment 3 http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf

[35] High Speed Rail: Investing in Britain's Future Consultation February 2011 paragraph 5.76 http://highspeedrail.dft.gov.uk/sites/highspeedrail.dft.gov.uk/files/hsr-consultation.pdf

Speeds

400kph (250mph) - HS2 line speed. The HS2 route alignment is designed for up to 400kph ultimately. This is the line speed throughout the surface route in the AONB including the green tunnels.

360kph (225mph) - HS2 initial technologies and trains are designed for up to 360kph.

320kph (200mph) – HS2 line speed in the twin-bore M25 to Little Missenden tunnel.

300kph (186mph) - HS1 line speed. HS1 route alignment is designed for trains travelling up to 300kph.[36]

[36] HS2 Ltd's Technical Seminars October 2010 Infrastructure and Technical Specification http://www.hs2.org.uk/assets/x/77048