HS2 Phase 1: REPA's Response to the Environmental Statement

A response from REPA – residents of the South Heath area of the Misbourne Valley, in the Chilterns Area of Outstanding Natural Beauty

27 February 2014

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REPA's response to the Environmental Statement (ES) Consultation

1 Introduction

1 REPA is an association of community based groups in the South Heath/Hyde Heath area of the Chilterns Area of Outstanding Natural Beauty (AONB). The area extends from near Mantles Wood to Leather Lane. REPA is concerned that HS2 Ltd's proposals for the area have an unreasonable and unacceptable environmental impact, and that the alternative proposal of extending the Chilterns bored tunnel – at least to well beyond South Heath – should be adopted.

2 We consider that HS2 Ltd wrongly dismissed a 3.6km bored tunnel extension northwards to beyond the South Heath area on the basis that it would cost more and delay the build programme, as recorded in the ES. This response reviews the ES as it concerns the South Heath area. South Heath is the only community in Buckinghamshire that HS2 Ltd identifies as suffering an adverse community impact from HS2. We explain that

- The environmental impacts of HS2 are substantial and significant at national level. There are impacts on the landscape, hedgerows, public rights of way, the community, tranquillity, and roads. This stretch of HS2 accounts for 25% of all the ancient woodland losses on Phase 1 of the route, directly affecting 3 ancient woodlands. Over 500 properties lie within 500m of the line and, with construction lasting 8 years, the disruption will be extensive both locally and for the wider area.
- The environmental benefits of alternatives and the impacts of the HS2 Ltd proposal have not been adequately taken into account in the decision to reject the South Heath Chilterns Tunnel Extension (SHCTE)
- SHCTE actually saves money compared to HS2 Ltd proposals – some £12m (in engineering costs, ie before the environmental impacts are taken into account) – rather than costs £48m as HS2 Ltd claims
- The tunnel extension need not delay the tunnel build programme.

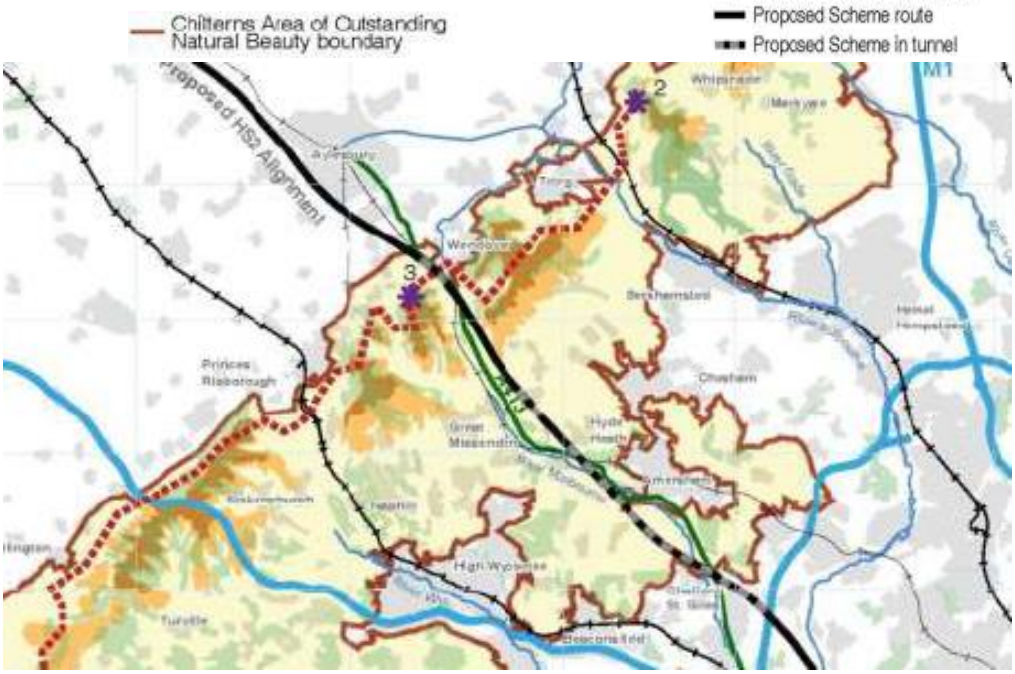
3 REPA commissioned and submitted an engineering report on the SHCTE as part of its 2013 draft ES consultation response. This ES response updates the earlier work. HS2 Ltd have accepted that the SHCTE is feasible, and that it has clear environmental benefits. The issue has narrowed to a divergence of view on the costs, its impact on the build schedule, and how the environmental benefits are taken into account in the decision making process.

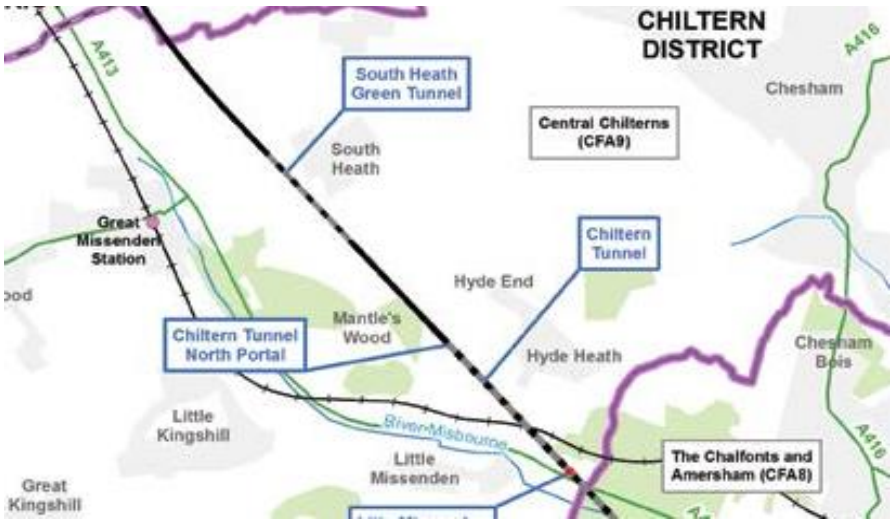
4 Our response is structured as follows:

- **REPA** – Who we are, and our origins
- **Overview** – Our key areas of concern, together with a summary of our mitigation "asks" that will inform our petitioning
- **Topic sections** – Our comments are organised by topic rather than by ES Volume. This is because of the substantial inconsistencies between Volumes on the same topic.

1.1 REPA's origins and concerns

5 The maps below show the geographic area of our concern:





HS2 emerges from a bored tunnel in the midst of an ancient woodland bordering Hyde Heath.

It travels in a cutting to Hyde End, where it enters the South Heath green tunnel for 1.2km.

HS2 then proceeds in a cutting parallel to Potter Row towards Wendover.

HS2 is remote from the A413 transport corridor on its surface route through this area.

6 REPA was set up in 2013 when the extent of the environmental devastation that would be caused by HS2 became clear. In the planning of HS2 seemingly little regard has been paid to its passage through the widest part of an AONB. For example on the basis of the ES it is proposed that:

- HS2 should destroy large parts of three ancient woodlands (in the South Heath and Hyde Heath area) rather than follow a transport corridor
- HS2 should climb a steep hill and be on the surface at 180-190m above sea level – the highest point on the route – above the village of Great Missenden, rather than burrow under

- HS2 should sever footpaths, eliminate hedgerows and wildlife habitats, rather than avoid them
- HS2 should be routed within 1km of over 500 properties even in the small area from Mantles Wood to Potter Row (see Appendix 2 at the very end of this document) where people's lives, communities and tranquillity will be devastated by the impact of HS2 – with a number many times greater affected during its 8 years construction period.
- HS2 should permanently change the character of this part of the AONB in perpetuity for visitors and residents, rather than protect the landscape and respect its AONB designation.

7 REPA is an association of both long established groups (eg in Potter Row; Hyde Heath and Chesham Society) and several newer resident-based groups (eg representing various parts of South Heath itself). All are united in

- A concern about the impact – both in construction and in operation – that HS2 will have on the natural environment, the historic and cultural environment, the recreational environment and access to it, as well as the built environment in this particular part of the AONB.
- Support for extending the Chilterns bored tunnel through the AONB.

8 Below is the list of REPA members and supporting groups. Members are primarily representative groups in the South Heath/Hyde Heath area (and surrounding communities eg of Potter Row) who are directly and specially affected by HS2's proposals to run HS2 in open cuttings and in a green tunnel in the heart of the AONB.

REPA members and supporters

Amersham A G (including Re-vitalisation Group)
Amersham and District Residents' Association (ADRA)
Chesham Society
Ballinger Road Residents' Association
Barn Management UK (2) Ltd (Cudsdens Court)
Hyde Heath Village Society (HHVS)
Grimms Dyke (Liberty) Estates Ltd
Lappetts Lane Neighbourhood Watch Scheme
Marriots Avenue Group
Potter Row Neighbourhood Watch Scheme
Sibley's Rise Residents' Group
South Heath Action Group
Wood Lane Residents Association

Photographed from the actual proposed HS2 route (above ground) parallel to Potter Row, priceless scenery that will be destroyed.

Section 2: Overview

2.1` Themes

1 Four main themes run through this response

- **Minimum requirements**: despite all the pages of material in the ES, HS2 Ltd has not provided the minimum information required for those affected to gain an informed opinion of the proposals in the ES and local alternatives to them
- **Clarity and accuracy**: the ES is an unwieldy document that contains many errors, misleading statements, inconstancies and omissions. This makes it difficult to survey and have confidence in its findings
- **Understating impacts**: the environmental impacts from HS2 on the South Heath area would be considerably worse than the ES suggests
- **Case for a tunnel**: HS2 Ltd should have adopted an extension to the Chilterns bored tunnel to avoid many of the highly detrimental effects of HS2 on the Chilterns ANOB and the people living in the vicinity of South Heath – given that such an extension could actually have a lower cost than HS2 Ltd's preferred solution – and in any event taking account of the environmental and social benefits such an extension has an overwhelming case in its favour

2 HS2 Ltd recognise that South Heath is the only community significantly adversely affected by Phase 1 of HS2 in Buckinghamshire. Despite South Heath being sited in the middle of the Chilterns AONB, HS2 do not propose effective remediation.

3 We see no evidence that HS2 Ltd has given serious consideration or weight to their obligations under Countryside and Rights of Way (CRoW) Act 2000. Such obligations require that public bodies such as HS2 Ltd *"have regard to the purpose of conserving and enhancing the natural beauty of the Area of Outstanding Natural Beauty"* (s 85). To cut through the widest part of the AONB and only provide a bored tunnel for 45% of the AONB (emerging in the midst of an ancient woodland) leaving the remainder to be crossed by viaducts, cuttings, green tunnels and embankments is unacceptable.

4 Were HS2 Ltd to put in the minimum effective mitigation appropriate to the AONB location of South Heath (and Hunts Green), this additional cost would further improve the economics of having more extensive bored tunnelling.

2.2 Minimum information

5 A number of individuals and organisations, unconvinced that HS2 Ltd preferred route and construction method represents the best solution, have wished to examine alternatives, eg more bored tunnel. However, requests for the basic information, on which to either test the accuracy of HS2 Ltd's assessments or examine new alternatives, have been declined.

6 This economic information is clearly fundamental to assessing both the reliability of HS2 Ltd's work and alternatives. The refusal to provide the information frustrates any attempt to scrutinise HS2 Ltd's work and the legitimacy of its conclusions. It has been justified on the basis that cost information is commercially sensitive. This assertion appears impossible to sustain, as it has been used for some years and yet we are still some years before competition for the construction of HS2 could commence.

7 This not only breaches the principles of fair consultation, but fails to meet the UK's Aarhus Treaty obligations.

8 HS2 Ltd have provided limited information:

- They published unit cost data, but when used in support of the REPA tunnel proposal, HS2 Ltd claim the information to be out of date, insufficiently specific, and inappropriate to the Chilterns – but refuse to provide the information that they claim superseded it.
- Engineering (tunnel, civils and systems) costs for HS2 Ltd's preferred scheme, and two options proposed by CRAG for longer Chilterns bored tunnels were provided, which REPA used to try to estimate/cross check their own tunnelling cost estimates. The tunnel estimate of the cost of HS2 Ltd' own proposal has proved (and now admitted to be) erroneous.
- In response to FOIs information has been provided on the cost of green tunnels, but this is for the better part transparently incorrect
- HS2 Ltd, in discussion with REPA, claim that the marginal costs of extending tunnels are only slightly below the average cost of the Chiltern's bored tunnel. However, from a response to another FOI, this appears to be incorrect.
- REPA raised other inconsistencies in cost data in correspondence some six weeks ago but have yet to receive any answer. These issues are discussed further in the Engineering Report for the REPA tunnel at section 10.

9 We are not in a position to determine whether HS2 Ltd do not wish to provide readily useable information and so frustrate effective scrutiny, or whether it has arisen from a lack of quality procedures. In either case, the need for effective public scrutiny is clear.

10 The need for independent scrutiny is further re-enforced by the presence of erroneous and misleading material in the ES. HS2 Action Alliance (HS2 AA) commissioned independent experts to assess different aspects of the ES and made them available. These assessments show that the work in the ES is insufficiently developed. HS2 Ltd's approach systematically underestimates the detrimental effect that HS2 would have, with HS2 Ltd failing to propose appropriate mitigation.

11 It is profoundly unsatisfactory that it is difficult to challenge HS2 Ltd's conclusions because they refuse to act transparently. There is a wealth of evidence that HS2 Ltd cannot be relied upon to reach robust conclusions.

2.3 Impact of HS2 on the area (see section 4)

12 On HS2 Ltd's plans South Heath is heavily impacted by HS2, both during construction, and when HS2 is operational.

13 Despite categorising South Heath as a community significantly affected by HS2, the ES fails to give a sense of the multiple adverse effects that all apply to a small area that should have received special consideration because it is in the heart of the Chilterns AONB.

14 This section brings together the various adverse effects, so that it can be seen how they apply in combination along this part of HS2's route.

15 The Government's gloss on how this area has been treated is a travesty of the facts.

16 When the extended Chilterns bored tunnel was announced in January 2012, it was presented as a major concession to the environment. In reality it saved money, some £250-300m, with the cuttings in the South Heath area made shallower and more obtrusive, and from extending the bored tunnel to Mantles Wood taking a slightly different route for engineering reasons. For under half of the AONB, HS2 is in a bored tunnel. The portal at Mantles Wood destroys the largest amount of ancient woodland on the Phase 1 route.

17 The green tunnel introduced to protect South Heath is too short to do the job, leaving properties in South Heath, Potter Row and Hyde End exposed to excessive noise, once HS2 is operational. HS2's construction will cause the dislocation of South Heath and nearby hamlets due to the severance and congestion of transport lines. This will make everyday life extremely difficult for residents, and the area's value as a national amenity will be effectively suspended for the eight years of HS2's construction.

18 This area has been preserved by the vigilant application of strict planning requirements required by its AONB status. It is entirely unsuited for the construction and operation of a high speed railway through it and along the ridge above the Misbourne Valley. The ES fails to disguise this, although its distortions, contractions and the dispersal of relevant information over many volumes, do not assist the reader in reaching this conclusion without serious effort. But ultimately it is clear that it is impossible to build HS2 on the surface through this area without unacceptable short and long term environmental consequences.

19 Bored tunnelling is the only means of construction that has tolerable environmental impacts.

2.4 Noise issues (see section 5)

20 HS2 AA have assessed the coverage of noise in the ES, and obtained a legal opinion. It concludes that the materials in the ES are so inadequate that it would not be lawful to proceed with HS2 on the existing basis.

21 HS2 Ltd adopt standards for significant noise effects that are inconsistent with the World Health Organisations (WHO's) guidelines, and are also tolerant of higher levels than those used in other European countries. Far from delivering a high quality of environmental protection, levels that are plainly unacceptable for an area of tranquillity are proposed.

22 HS2 Ltd have failed to correctly identify appropriate thresholds for noise, or demonstrate that noise has been appropriately minimised. Indeed they have left levels of exposure that on their own criteria require to have been prevented.

23 Particularly significantly, HS2 Ltd place three key restrictions on what they consider to be significant effects:

- HS2 Ltd only concede that HS2 has a significant adverse effect if the noise of HS2 alone exceeds a threshold level of noise above which an adverse effect is observed. This means that where the thresholds exceeded by the combination of background (pre-existing) noise and HS2, HS2 Ltd ignore the adverse effect created. The purpose of the WHO limits are that if they are exceeded there is potentially an adverse health and quality of life effect, and this inherently applies to the entire exposure, not just the exposure from a specific source.
- HS2 Ltd apply the restriction that noise must affect a 'community', so where an isolated dwelling is affected this is effectively ignored (apart from insulation that may apply).

- HS2 Ltd argue that the interim WHO limits – rather than the full ones – are appropriate. The interim standards are clearly inappropriate for designing and building a new railway. The idea that railway noise is more acceptable than other transportation noise, and hence higher limits should apply is not supported by the latest evidence concerning high speed rail (particularly high-frequency high speed rail).

24 In addition, the evidence that it is the peak noise as trains pass-by that correlates better with sleep disturbance is effectively discounted, despite the WHO guidelines on this. The only peak threshold used by HS2 Ltd is again for insulation (but for a noise level five times louder than the WHO guideline level). This will substantially underestimate the health effects at night, as we show for the South Heath area at section 5.

25 For quiet areas, despite noise from HS2 being intrusive, and even if it is at a level to cause the threshold for adverse health effects to be exceeded, such noise is not considered by HS2 Ltd to constitute a significant adverse effect. This means that HS2 Ltd's approach does not align with:

- Health effects
- Perceptions and annoyance
- Effect on property values

26 As a result HS2 Ltd fail to provide mitigation in circumstances where there would be material benefit. This must be an indefensible position.

27 HS2 Ltd justify their deviation from the WHO recommendations on the basis that for night time levels they are using the WHO's interim targets. While UIC argue that rail is less obtrusive than other types of transportation noise, the evidence is to the contrary in a previously quiet environment. It is clearly inappropriate to use an interim target for long-life new build, when the health effects are related to the long term target.

28 Partly as a consequence, HS2 Ltd's post-mitigation proposals expose a large number of residents to excessive noise. Furthermore no consideration is given to the adverse impact HS2 will have on the enjoyabilty of the AONB as a leisure resource for visitors using footpaths and lanes. The AONB is a tranquil recreational space qualifying for special consideration, but it has received none in this area.

29 HS2 Ltd adopt even less stringent noise requirements on construction, than when in operation and seem to be content to expose hundreds of households to damaging levels of noise for many years.

30 There are also a number of erroneous or inadequately supported assumptions about:

- The attenuation of noise by distance from atmospheric absorption
- That HS2's noise would be effectively mitigated by low height noise barriers, despite the preponderance of aerodynamic rather than wheel rail interface originating noise at the speed in question
- That pantograph design can be improved to achieve un-demonstrated levels of noise reduction
- The use of averages over periods too long to correctly discriminate effects – particularly on children

31 HS2 Ltd do not commit to remediation should their theoretical assumptions prove to underestimate the true level of noise exposure. This is unacceptable.

32 At minimum the land, properties, and rights of way potentially impacted by HS2 should be fully protected, ideally by a bored tunnel, or by the use of state-of-the art full height noise barriers, the use of retained cuttings and reducing speed to minimise adverse environmental impacts.

33 HS2's noise pollution should be minimised, and HS2 Ltd's approach of doing so only if otherwise there would be a significant exposure of a community to noise at harmful levels should be rejected. Full and effective mitigation should be the default. The narrowness of HS2 Ltd's approach is illustrated by the use of noise barriers at the north end on the South Heath green tunnel only on the Potter Row side, as opposed to protecting the footpath and the isolated properties as well.

34 The green tunnels are demonstrably ineffective at protecting residents from excessive operational noise on HS2 Ltd's own estimations of noise, as they are too short. We demonstrate this in relation to the South Heath green tunnel at section 5.

35 HS2 Ltd should be obliged to deliver against claims that it will provide best practice mitigation.

2.4 Waste and Hunts Green (see section 6)

36 Work was commissioned work on the approach taken to waste disposal in the ES. It reveals that HS2 Ltd fail to:

- Provide the core documentation to which they refer
- Abide by the hierarchy for waste management
- Correctly identify local authorities' policies on waste
- Adopt an approach that is appropriate for an AONB

37 A core section describing HS2 Ltd approach to waste management is missing from the ES. The Integrated Engineering Earthworks Design Approach, upon which the environmental impact assessment of waste management associated with HS2 appears to be predicated, is not included in Volume 1 at Section 4.5 – despite there being repeated references to it at this location.

38 However, HS2 Ltd did release some documents in January 2014 that include what seems to be a statement of their criteria[1]. The creation of a land fill site in the AONB is actually ruled out by these criteria.

39 It is extraordinary that creating a new land fill site in an elevated position in the Chilterns AONB is perceived by HS2 Ltd as consistent with their duties as a public body 'to preserve and enhance' the AONB (CROW Act), or compliant with the requirements of waste disposal hierarchy, or their own criteria. HS2 Ltd describe the dumping of spoil at Hunts Green as 'sustainable', but the use of this term is not justified.

40 Additionally, HS2 Ltd makes inconsistent statements about:

- The quantum of waste that would be deposited at Hunts Green

[1] Management of Surplus Excavated Materials, Deliverable Approach Statement, HS2 3 December 2013 PO3

- Where it originates from
- How it would be transported to Hunts Green

41 HS2 Ltd state that they intend to deposit 1.93Mt of spoil to occupy 1Mm^3 of currently unspoilt agricultural land at Hunts Green, which is in an elevated position within the Chilterns AONB. However this requires a density in excess of the value that HS2 Ltd have adopted elsewhere of 1.5t/m^3. At this density a 28% greater volume of land fill would be required.

42 HS2 Ltd have said that this spoil would be transported along the trace. While this may be practicable if the spoil coming from the area from Hunts Green south to Mantles Wood, if is stored near the point excavation, and moved when the development of the trace has reached an appropriate stage. However, this would not be practicable for spoil originating north of the proposed viaduct, or from outside the AONB, for which road transport would be unavoidable.

43 The difficulties in building surface features of HS2 in terms of waste disposal, due to the limited transportation infrastructure and unsuitability of on-site disposal are powerful reasons for avoiding this construction method, and adopting more bored tunnelling.

2.5 Impacts on ancient woodland (see section 7)

44 In the area from Mantles Wood to Leather Lane HS2 Ltd's proposal would damages five ancient woodlands, with direct losses from three, destroying 25% of all the ancient woodland lost in Phase 1 of HS2, according to The Woodland Trust.

45 Ancient woodland is irreplaceable, and siting the northern portal of the Chilterns bored tunnel in Mantles Wood creates the largest single loss of ancient woodland on HS2's route. Aligning HS2 through Sibley's Coppice in South Heath creates a second substantial loss. The siting of the portal at Mantles Wood is described by The Woodland Trust as '… *completely unacceptable and shows a blatant disregard for the significance of this habitat*.'.

46 HS2 Ltd's Non Technical Summary states that compensatory planting will mean that HS2 is unlikely to have any significant adverse effects on the special characteristics of the Chilterns AONB. However The Woodland Trust strongly repudiate this.

47 The Woodland Trust support our proposal for the SHCTE, and are strongly critical of HS2 Ltd, asserting that HS2 Ltd's conclusions '*underplay the magnitude and significance of the environmental effects of the proposals*',

2.6 Assessing Landscape impacts (see section 8)

48 DfT and HS2 Ltd have deployed a method of monetising landscape impacts. This process is not fit for purpose, as it involves various methodological mistakes.

49 While DfT accept that the detrimental effect of HS2 is permanent, they only value its detriment over the 60-year assumed economic life of HS2. This is erroneous unless the valuation period is terminated by restoration of the environment to its former state. In the case of HS2 this may well be impossible, and certainly would constitute a very large cost. However, no cost of restoration is included in the assessment. This plainly is methodologically unsatisfactory. While the railway might cease to operate after a period, the scar on the landscape would remain, if restoration work is not undertaken.

50 The problem for DfT is that if there is no restoration, using Green Book assumptions on values and discount rates for an unbounded period into the future, the future series of costs has an infinite sum (as values increase faster than the discount rate reduces them as a present value). The £1bn that DfT claim to be the value of the landscape damage is therefore entirely incorrect for this reason alone.

51 DfT's approach contains a number of further deficiencies, ie the failure to use a special value for the AONB, but instead using the lowest landscape value – despite the AONB being a nationally designated landscape. This is discussed in the Chilterns Conservation Board paper[2] on non market effects. In all, the DfT approach is seriously flawed.

52 An alternative approach has been proposed for landscape assessment, which is based on shadow pricing. This approach to valuation is in accordance with the Treasury Green Book. In essence this approach is to identify a development that is perceived as less detrimental than HS2, but which has a clearly quantifiable economic benefit, in this instance releasing land for ribbon residential development. Being in an AONB, this alternative development could not proceed, so the Government (in imposing the planning restriction) consequently must value the landscape impact of HS2 at least at the level of the preferable development prevented. This establishes a lower bound for the cost of the landscape damage that HS2 would have.

53 This method indicates that the REPA tunnel would save [£42-84m] and the CRAG tunnel [£210-350m]. It is developed at section 8.

54 The formal, non-monetised, assessment of the landscape impacts is poor.

- The extent of the assessment ie the study areas and the viewpoints were not agreed with the appropriate stakeholders (eg the Chilterns Conservation Board)
- The AONB was given the briefest of description. The corridor from the line was far too narrow, both in comparison to the actual visibility of HS2, and in relation to other work done by HS2 Ltd. that used a corridor twice as wide eg in CFA 18
- There was a failure to take into account railway furniture such as the gantry and overhead line equipment, which being the highest points of the proposed railway in many places, is particularly visible. Cranes that might be there for years were similarly ignored.
- No proper assessment of the night-time impact of waste light etc was undertaken
- The assessment of the sensitivity of the landscape focused on tranquility, but gave no evaluation of other qualities eg the scale, complexity, openness and wildness
- Very few photomontages were done and they were not done to the required standards. Many viewpoints had no photos (just 20 out of 36 for CFA 9). Interesting in other areas of greenbelt far more were done - 55 out of 87 viewpoints in CFA18.
- The criteria for predicting and describing the visual effects seems not to have been followed eg it should cover the nature of the view, distances, proportion of HS2 that would vi9sisble, how the view would change.

Certainly for the AONB where the landscape is a core part of its special quality the assessment was unsatisfactory.

[2] '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 Scheme', November 2013

2.7 Transportation issues (see section 9)

55 During HS2's construction there would be material detrimental effect on local roads and residents.

56 The scale of this effect has been miscalculated:

- Some of the junction assessments imply that vehicles disappear at junctions and must be erroneous
- The conclusions about queuing are demonstrably erroneous, as there are already queues at a number of junctions in the am and pm peaks, before increased traffic volumes
- No account is taken of the considerable hazard that the frequent use of local roads and lanes would have for other users, particularly cyclists, pedestrians and equestrian users
- Inappropriate assumptions are made about the use of local roads.

57 It is plausible that the true impacts of the dislocation and congestion are such as to make the current usage patterns for commuting, schools etc non-viable for many years. For South Heath the construction is scheduled to last over 7 years. These effects would be of a duration that they cannot sensibly be considered temporary.

58 The Chesham Society has conducted a detailed review of the traffic assessment that HS2 Ltd include in the ES. It concludes that the assessment is not robust:

- That the predicted traffic queues with increased traffic are actually less than those observed
- HS2 Ltd's traffic assessment is so inadequate that it provides no basis for determining how adverse the effect of HS2 will be on traffic flows, or for deciding what should be done about it
- HS2 Ltd's junction analysis is defective (vehicle flows do not balance, and estimated queues do not reach current levels – despite projecting additional traffic

59 The Chesham Society concludes that:

'If the present scheme proceeds, it is clear that no matter what mitigation is attempted, the Chilterns will suffer immense disruption for 7 to 10 years, and that this is of little or no concern to HS2 Ltd'[3]

60 The analysis also fails to reflect the hazard that the HS2 construction traffic would pose to vulnerable road users, ie pedestrians, cyclists and horse riders. The lanes of the South Heath area are currently well used by hikers, cyclists and equestrians.

2.8 Inappropriate dismissal of extending the Chiltern bored tunnel (see section 10)

61 We attach a revised engineering and cost assessment of the South Heath Chilterns Tunnel Extension (SHCTE). It updates our previous report of July 2013 submitted as part of the Draft ES.

62 In the ES HS2 Ltd reject this proposal (at CFA 9 Vol 2, 2.6.23) on the basis that it involves additional cost, and that it would delay the completion of Phase 1. Our analysis demonstrates that neither of these reasons appear correct.

[3] 'HS2 ES Response' Chesham Society

63 HS2 Ltd have failed to provide information that might support these contentions, despite undertaking to provide REPA with:

- A report that shows that the SHCTE proposal involves extra cost
- A breakdown of those costs that do not vary with tunnel length
- Detailed review of the costing analysis that we provided in support of our evaluation of the SHCTE.

HS2 Ltd also have not responded to two letters that raises issues with HS2 Ltd's contentions about costs. Neither have they agreed a date for a promised meeting.

64 The attached report at Section 10 demonstrates that extending the bored tunnel to Liberty Lane (near Leather Lane), can be justified in engineering costs alone. It does this on the basis of the cost information that has been issued by HS2 Ltd and the construction industry's authoritative source of engineering cost data Spon.

65 The analysis shows that using the incremental cost for extending the bored tunnel, there is a small saving compared to the proposed green tunnel at South Heath and deep cuttings of HS2 Ltd's proposal.

66 We reviewed tunnelling costs, and concluded that:

- Marginal costs were the appropriate ones for costing the extension,
- The bored tunnel costs used by Atkins in assessing the CRAG tunnel options are high compared to those released in response to a parliamentary question
- Differences and a lack of clarity in the basis of cost information released by HS2 Ltd makes is use difficult

67 We also concluded that the apparent disappearance of a sufficient window in the Draft ES schedule for the Chiltern bored tunnel works is inexplicable, given the higher tunnelling rates assumed. We also determined that the ES schedule information is internally inconsistent.

68 When SHCTE's greatly reduced impact on the AONB are taken into account, we conclude that it is perverse that HS2 Ltd has not itself adopted the SHCTE option.

2.9 Environmental Statement for the SHCTE (see section 11)

69 The Environmental Statement for the SHCTE sets out the relative effects of the SHCTE compared to HS2 Ltd's preferred option.

70 It shows that it avoids almost all of the negative impacts of HS2 from Mantles Wood to Potter Row. HS2 Ltd in their ES concede that the SHCTE is superior in terms of environmental impact, as discussed at sections 2.6.18 to 2.6.20 of Volume 2 CFA9 report ES3.2.1.9)

2.10 Economic case

71 The response to the ES is not the natural vehicle for an economic analysis of why HS2 is a poor project – despite HS2 Ltd rehearsing its reasons for rejecting alternatives.

72 However, HS2 Ltd valuation of journey time saving is crucial to many of the decisions concerning the details of the route. The fact that journey times savings are grossly over-valued has material

implications for the detailed design of HS2. Were HS2 redesigned on the basis that capacity and not speed were the relevant factor for economic benefits, putting aside whether there would be a viable case for HS2 at all, the preferred route would be one that followed existing transport corridors punctuated by stations that would deliver benefits for the communities through which it passed.

73 The DES noted that dropping the speed to HS1 levels meant an extra 4.5mins on journey length. This was rejected because the current business case valued every minute saved so highly.

74 There is almost nothing about the route and detailed design of HS2 which is robust to taking a correct view of the value of time savings.

75 DfT has accepted that people can and do work on trains. As a result, the dominant benefit of business time saving in HS2 business case is not the result of a valuable increase in productive time. However, rather than abandon the time saving benefits, as this acceptance implies, DfT continues to claim them. While DfT concede there is no productivity benefit, they claim that business would be prepared to pay for the journey time reductions as if they yielded the same productivity benefits. But they do this without any supporting empirical evidence at all, just the fact that other countries use similar values for business time savings. However this is neither surprising nor good evidence, as other countries employ the same method as that previously used by HS2 – and also have not caught up with changing business usage of time spent travelling on trains.

Section 3 Summary of "asks"

The table summarises our mitigation requirements, which will inform our petitioning.

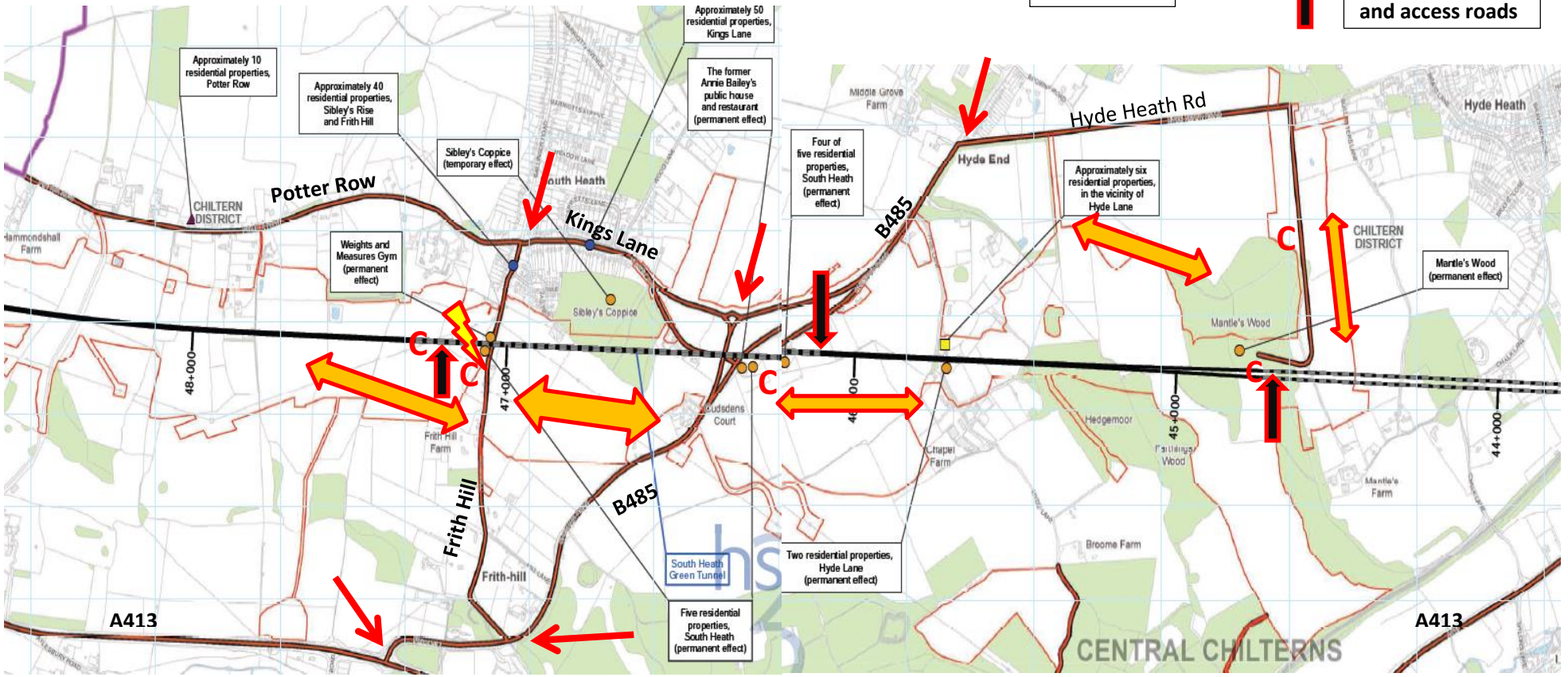
	Mitigation "asks"	**Justification**
1.	Extension of the deep bored tunnel as far as possible through the Chilterns AONB, and well beyond the South Heath area. First priority is the CRAG tunnel (to Wendover). If this cannot be achieved than the REPA tunnel to Liberty Lane	To mitigate the most disruptive impacts of the HS2 route on the AONB including: loss of amenity, damage to the environment, ecology and ancient woodland; noise, traffic and congestion issues; disruption to local heritage and the community, agriculture, property blight, landscape/visual, cultural, socio economic and health issues. The SHCTE proposal can be achieved at no cost.
2.	No surplus excavated material to be deposited at Hunts Green, or anywhere in the AONB. Neither should any surplus be brought into the AONB for dumping.	Inappropriate to create new landfill sites in AONB. It does not "conserve or enhance the natural beauty of the AONB" as required by the CROW Act and NPPF. The analysis of options is inadequate. HS2 Ltd's criteria specifically exclude waste disposal in "*nationally sensitive landscapes"*
3.	Legally enforceable '*average'* and '*peak'* noise limits, with restrictions on night-time train speeds where they are exceeded Failure to comply with limits requires mitigation – ie reducing train speeds until requirements met	To minimise health and quality of life/sleep impacts (using the World Health Organisation (WHO) Guideline limits on the appropriate thresholds, eg 60dB's for measuring '*peak'* noise). 'Best endeavors' or 'as far as reasonably practicable' does not prevent harm, while meeting the standards does.
4.	Dedicated haul road (to A413) for construction traffic rather than use of local village roads as construction routes during construction of Green Tunnel and cuttings.	Local roads narrow and unsuitable eg Potter Row. A dedicated haul road for HGVs and other construction traffic would avoid commuter and school disruption, and placing strain on already overloaded junctions in peak hours.
5.	Construction traffic prohibited from using the lanes (including those HS2 Ltd have identified as construction routes)	Allowing HGVs to traverse narrow lanes presents an unacceptable safety hazard to cyclists, horse riders and pedestrians
6.	Traffic Management System to be agreed with the Council.	Help ease congestion on local roads and deal with concerns regarding access to stations and schools in morning and evening peaks. Safe access also needed for emergency services. A safety measure as combination of heavy loads on school bus routes/commuter roads at peak times could lead to increased risk of accidents.
7.	The route to be lowered eg north of South Heath and in particular to such a level that the pantographs cannot be seen. Cuttings should have side slopes with the steepest possible gradient railway-side to minimise land-take.	Minimise permanent environmental effects for residents particularly concerning noise. Will also reduce property blight and loss of visual amenity.
8.	International best practice for noise barriers.	To allow a sound environment of 50dB's during daytime and 40dB's at night in accordance with World Health Organisation Guidelines.

9.	Additional noise barriers for both cuttings (north and south of South Heath) eg a barrier both sides of the line at the green tunnel north portal	To reduce noise impacts to Potter Row, Frith Hill, and Hyde end in particular (that exceed WHO guidelines).
10.	Tall screening of auto transformer station, tunnel sites, portal buildings, construction compound sites and new access roads.	Minimise visual impact on the landscape in South Heath area – for the three portal areas (in Mantles wood , Hyde End and South Heath/Frith Hill).
11.	Replacement of Balancing Ponds with alternative solutions and landscaping of balancing ponds. Dedicated maintenance supervisor to be employed.	Large engineered features are out of character in the AONB
12.	Any spoil or other surplus excavated material to be removed by rail at night from the AONB on Chiltern Rail – dedicated siding to be built to connect to Chiltern Rail.	Avoid need for a site to deposit excavated material in AONB. Lessen construction traffic on the public highways
13.	Planting to include mature trees (not just saplings), with guarantees to ensure their maintenance.	Improve visual impacts as quickly as possible
14.	New buildings eg portal buildings and autotransformer station at South Heath, to be in keeping with the area eg replicate style of farm buildings.	Blend into the landscape
15	Community funds to compensate for loss of village amenities ie in South Heath (where local pub and gym to be demolished).	To compensate for amenity loss to villages
16.	Materials stockpiles. To be monitored for watering, dust etc; and to have an adequate buffer from all residential properties and ancient woodland.	To protect ancient woodland and residents.
17.	Additional resources to keep roads, properties and public spaces, free of dust and dirt eg funds for window/road cleaning.	To minimise health impacts on those living and working in the area affected by the works.
18.	Green bridges	Improve visual amenity and allow wildlife crossing.
19.	Avoid road closures in South Heath eg provide temporary Frith Hill bridge	To prevent isolation effects of the village that depends upon Great Missenden/Chesham etc for its services
20.	Pylons that will be moved to be buried underground	Improve visual amenity of area.
21.	Enforcement of undertakings eg funding for policing of Draft CoCP arrangements including penalties for non-compliance	To give assurance to communities affected that promises will be delivered on
22.	Free-phone community hot-line for local residents during construction, to report issues and follow-up on their resolution. Calls to be monitored and reported on as contractual commitment.	To improve communications, and to give greater assurance to communities that the CoCP will be complied with.
23.	All Public Rights of Way to be reinstated – diversions to be avoided.	To retain the amenity of the AONB and to avoid trackside diversions.

HS2 Ltd map of South Heath community "significant" effects

Red arrow additions by REPA on vulnerable areas/issues ignored on HS2 Ltd map

C **Compounds** | **Elect. Substation** | **Stockpiles** | **Junctions** | **New buildings and access roads**



Section 4 --Impact of HS2 on the Area

South Heath is the only village in Buckinghamshire that has been identified by HS2 as having a significant community impact from HS2. Yet even then the map of community impacts (on the left) underplays the cumulative effects of all the different aspects – it ignores the compounds with their new roads and car parks; it omits the material stockpiles, the new infrastructure that will be built. While it clearly identifies the construction routes it misleadingly suggests they are all the same size eg that Potter Row is the same as the A413.

The map has been added to, to identify these features.

Construction compounds
Within a distance of just 2.5kms there are no less than 5 compounds in this immediate area, for works relating to the Chiltern bored tunnel (eg the portal and removal of the TBMs), the demolitions and cuttings going north; for the south heath tunnel and then the cutting parallel to Potter Row going towards the 6th compound at Leather Lane. They will also fit out the railway when the civils works are complete. This makes it an area of intensive construction work within a very small rural area.

However the information in Volume 2 is not presented in a way that illustrates the extensive nature of this disruption and how long it will last. Construction work is defined as temporary work which is particularly disingenuous to those who live there and must suffer the impacts, for what can be 8 years. Over 100 homes will be significantly adversely affected, although this is collated and evident in the ES (see the section on noise

Ref	**Name**	**Purpose**	**Time Open**	**Workers**	**Vehicle movements per month (peak)**	
			Years	Nos (peak)	HGV	Cars/LGV
2.3.34	Chiltern Tunnel north portal (Mantles Wood)	Civils	4.25	25 (55)	30 (40)	90 (100)
2.3.43	Chiltern Tunnel north portal (	Rail	2.00	20		
2.3.46	South Heath Tunnel (south) Annie baileys old site)	Civils and rail systems	7.75	110 (135) 40	60 (60)	150 (190)
2.3.56	South Heath Tunnel (north)	Rail systems	1.75	25 (45)	20 (50)	70 (100)
2.3.59	South Heath Tunnel (north)	Civils Elect. Station	3.75	25 (40)		
	Leather lane	Civils				
	Total Workers			**245 (335)**	**110 (150)**	**310 (390)**

The description of the works involved is sometimes partial. In describing the South Heath works the reference to an electricity auto substation being sited here is very often omitted. New access roads are required, but it is difficult to see what screening is intended.

The amount and placement of materials stockpiles is very extensive as the map shows. In two particular areas it crowds around a clutch of residential properties, providing a difficult, unhealthy and unreasonable environment for many years: at Cudsden Court and at Frith Hill by the portal

compound. Dust can travel 200yds and it must be doubtful if stockpiles this size can be satisfactorily kept watered.

The suitability of the construction routes identified, and the impact of the construction traffic on the public highways on those using such roads. As in many rural areas some roads are completely unsuitable for the sorts of traffic involved, as the transportation section discusses.

Footpaths

The area is served by a network of footpaths. Again they are not brought together to assist appreciation of the extent of the impacts. The table summarises those affected in the 3.5km stretch between Mantles wood and Liberty Line

Footpath	Temporay diversion	Time diverted	Permanent Diversion	Comments
LMi/17	1,500m	(1yr	South of Portal	Via Bullbaiter's Lane
LMi/21	Open		450m	Realigned to LMi/17
GMi/23/6	100m	6-9mnths		Permanent existing route
GMi/23	50m	3-6mnths	700m	Realigned via LMi/17
GMi/27	400m	6-9mnths	150m	Via Hyde Lane bridge
GMi/33/2	750m	3-6mnths	100m	Via Chesham Rd and Hyde Lane Via Hyde Lane bridge
GMi/33/3	Open		50m	Via Hyde Lane bridge
LMi/27	Not given			
GMi33/4	100m	6mnths	400m	Hyde Lane
GMi33/5	250m	1.5 to 2ys	Reinstated	
GMi/28	400m	1.5 to 2ys	Reinstated	Kings Lane, Chesham Rd
GMi/79	400m	1.5 to 2ys	Reinstated	Kings Lane, Chesham Rd
GMi/80	400m	1.5 to 2ys	Reinstated	Kings Lane. Chesham Rd
Frith Hill	400m	1.5 to 2ys	Reinstated	
GMi/13	Open		750m	Via GM/12 overbridge
GMi/12	100m	6-9mnts	Reinstated	Via GM/12 overbridge

The ES acknowledges the extensive network of PROW in the AONB, but fails to give recognition that the network of PROWs make much of the woodland accessible to the public. Loss of connectivity and the introduction of construction works for many years will be bound to reduce visitors to the AONB, in particular to the Misbourne Valley.

There is minimal recognition that the area is one extensively used by cyclists.

The extent of demolitions is shown below. In addition to the 8 homes, there are 23 outbuildings and 6 commercial properties. For small rural communities these are material

Property demolitions

Ref	Road / Area	No of Residential Properties	No of Outbuildings	No of Commercial properties
2.3.37	Rowen Farm	1	3	
2.3.37	Hedgemoor	1	1	
2.3.37	Sheepcotts Cottage		2	
2.3.37	Chapel Farm		2	
2.3.37	Meadowleigh	1		
2.3.39	Annie Baileys	1		1
2.3.39	94 King's Lane	1	5	
2.3.39	90 King's Lane	1		
2.3.39	86 King's Lane		2	
2.3.39	Elwe's Farm		2	1
2.3.39	Weights & Measures Gym			1
2.3.39	Orchard Cottage		1	
2.3.39	Chiltern Cottage	1	1	
2.3.39	National Grid Pylons			2
2.3.62	National Grid Pylons			1
2.3.62	Mulberry Park Hill	1	4	
	Total Demolitions	**8**	**23**	**6**

Section 5: Noise issues

1. Noise potentially impacts on health and the quality of life of those living in or visiting the Chilterns AONB. Noise is also a highly technical area. This makes it important that those who would be affected by noise have the extent of their exposure made intelligible to them so they can offer an informed response to the ES. Unfortunately the ES fails to do this.
2. The information provided is seriously incomplete and inadequate, with the analysis failing to meet the minimum requirements for an Environmental Statement to meet the purposes of the Environmental Impact Assessment Directive. HS2 AA have obtained a legal opinion (attached as Appendix 2 to this section). It expresses the view that it would not be lawful to precede with HS2 on the current treatment of noise in the ES.
3. There are many inconsistencies, errors, and omissions in the data that is spread over many Volumes. Most seriously the basis adopted by HS2 Ltd to identify those seriously affected understates the extent of the noise problem. For example, people who live in an isolated property is no basis for effectively disregarding that they would be exposed to unacceptable levels of noise on HS2 Ltd's proposals. And because they disregard some of the effects on isolated properties, they offer inadequate mitigation despite it being entirely practicable.
4. The World Health Organisation (WHO) guidance (from their Night Noise Guidance (NNG) of 2010 and their earlier Community Noise guidelines of 1999) is generally recognised as setting the benchmark for best practice. The table below records how HS2 Ltd thresholds for airborne noise (when HS2 is operating) compare with those of the WHO.

Body	**Average noise levels (*LAeq) – trigger points for impact on health and quality of life***		**Peak noise level (*LAmax)*** Trigger points
	Daytime-(16hr average) (06.00 to 22.00)	**Night-time (8hr average) (22.00 to 06.00)**	
WHO: 1. NNG 2. Community Guidelines	**50dB** = annoyance threshold (max. for new developments) 55 = *serious* annoyance	**40dB=** risk of sleep disturbance (NB interim target = 55)	60 outside (based on 45 peak inside)
HS2 Environmental Statement	65dB = *significant* impact 50dB = threshold for measuring change** in noise levels due to HS2	55dB= *significant* impact 40dB = threshold for measuring change** in noise levels due to HS2	85/80= *significant* at night [85 if < 20 pass-bys; or 80 if >20 pass-bys].
**eg 3dB or more= minor effect; 5dB or more = moderate effect; 10dB or more = major effect			

5. We consider there are fundamental issues with how HS2 Ltd assess and present noise impacts. For airborne noise when HS2 is operating, HS2's approach is to set an absolute level (65/55db) that counts as a significant impact, and for lower levels above the WHO thresholds (50/40) to assess the size of the change in noise due to HS2, (where adding 3dB would be treated as a minor adverse effect). This is further qualified by only considering this for properties in 'communities'. This fails to identify the majority of cases where people would be exposed to annoying and potentially harmful levels of noise, and where HS2 would either cause or exacerbate this.
6. The table below shows the numbers of properties in CFA 9 affected (after mitigation) if the WHO criteria are applied based on the calculated exposures given in Volume 5 for residential

properties (SV-004-09). Because no information is provided on the total noise LAmax, we have used the HS2 generated peak noise.

Affected by HS2 operational noise

	Exceed WHO *average* thresholds where HS2 makes the level of noise worse*			**Exceed WHO *peak* threshold from HS2 generated peak noise**		**Total exceeding some threshold** (in col 2, 3 or 5)
	Exceed day threshold 50dB (total noise)	**Exceed night threshold 40db (total noise)**	**Total exceeding day or night** (in col 2 or 3)	**Total exceeding 60dB LAmax**		
(1)	(2)	(3)	(4)	(5)		(6)
Nos of properties	66	87	**110**	**168**		**183**
Main locations exposed	Potter Row Hyde End Hyde Heath	Sibleys Rise Bayleys Htch Frith Hill Potter Row Hyde End	NB	Potter Row Hyde lane Cudson Court Frith Hill Sibleys Rise	Kings Lane Bayleys hatch Chesham Rd Chalk Lane	
**Where positive change is shown in "Change " column of SV-004-009, and WHO threshold exceeded*						

7. The true position will be worse than the 183 properties shown in the table, because being based on HS2 Ltd's estimates of noise levels, it incorporates the underestimation that derives from inappropriate periods for averaging and other 'optimistic' assumptions (discussed below).

8. The noise mitigation measures – including the South Heath green tunnel – fail to protect residents from excessive noise (as para 42 discusses below). Interestingly the same failure to protect residents from noise is found in connection with the Wendover green tunnel.

9. In contrast HS2 Ltd identify just 15/22* properties as significantly affected and a further 5 as adversely affected – but because they are isolated properties, HS2 Ltd do not regard the effect as significant. It is hardly surprising that many residents have no confidence in HS2 Ltd's analysis, and regard the proposals for sound mitigation as inadequate.

Affected by HS2 operational noise (calculated as 'significant' by HS2 Ltd)

	Exceed day threshold 50dB (HS2 noise only)	**Exceed night threshold 40db (HS2 noise only)**	**Total exceeding day or night**	**Total exceeding 85db LAmax (HS2 noise only)**	**Total exceeding some threshold**
Nos of properties	15	14	15*	1	15
	Potter Row (10) Hyde lane (5)	Potter Row (10) Hyde Lane (5)		Hyde Lane	
*inconsistently reported : 15 in Vol 2 (para 11.4.20), but 22 when examining raw data in SV-004-009					

10. The properties identified as significantly affected by HS2 Ltd (in Potter Row, and Hyde Lane) are stated in (at Vol 2 Para 11.4.6), to be the only residual permanent noise effects in South

Heath area are here. The wording is careful here to even exclude the isolated properties that suffer exactly the same amount of noise.

11. The only effective mitigation of these impacts is considerably more tunnelling.

HS2 Ltd fail to apply the WHO guidelines for day and night (on LA *average*)

12. HS2 Ltd use airborne noise limits of 65dB (daytime) and 55dB (nights) as their absolute trigger points to count as a '**significant'** noise impact. This is the SOAEL level (Significant Observed Adverse Effect Level). The noise level is calculated on an average basis over daytime (16hrs average) and night time (8hrs average). Under the Noise Insulation Regulations, insulation is offered to all properties over this limit.

13. HS2 Ltd agree that the WHO guidelines say that the lowest point at which health and quality of life effects are first noticeable are at 50dB (daytime annoyance) and 40dB (night time sleep disturbance). This is known as the LOAEL trigger point (Lowest Observed Adverse Effect Level). But HS2 Ltd do not adopt it as their main trigger point.

14. For **daytime** HS2 Ltd ignore the WHO guidelines[4] that say 55dB is the level for being **seriously** annoyed (while HS2 Ltd use 65dB) and that 50dB should be used for new developments

    "To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development".

15. This suggests that HS2 Ltd should be designing to 50db, and not 65dB. A 15dB difference equates to sound being more than three times as loud.

16. For **nights** the ES relies upon the WHO **interim** target (of 55bB) which is higher than the WHO base 40dB level for when the noise level is noticeable (ie their LOAEL point). But importantly the ES does not refer to the fact that:

    - WHO[5] specifically says that the higher interim target of 55dB is not for health and quality of life reasons but purely for feasibility reasons ie where 40dB is not practicable in the short term. In these circumstances 55dB can be temporarily considered by policy makers for "exceptional local situations" as an interim target. It is not appropriate for HS2 which is a now long-term development.
    - The WHO guidelines go on to emphasise that the 40db night limit is needed to protect the public for health reasons[6], especially vulnerable groups eg of children, the ill, and the elderly.

[4] World Health Organisation (WHO) Community Noise Guidelines 1999
[5] WHO Night Noise Guidelines (NNG), 2009 *" An interim target (IT) of 55 dB Lnight, outside is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons. It should be emphasized that IT is not a health-based limit value by itself. Vulnerable groups cannot be protected at this level. Therefore, IT should be considered only as a feasibility-based intermediate target which can be temporarily considered by policy-makers for exceptional local situations."*
[6] NNG 2009 "*For the primary prevention of subclinical adverse health effects related to night noise in the population, it is recommended that the population should not be exposed to night noise levels greater than 40 dB of Lnight ,outside during the part of the night when most people are in bed. The LOAEL of night noise, 40 dB*

17. While HS2 Ltd do use the 40dB night thresholds when considering changes in noise levels (discussed below) it is inadequate that they do not have a design limit of 40dB for nights.

18. Further, as also discussed at para 52 below, other countries have lower limits than us. Using higher levels is not justified in the ES.

Issues with the basis of noise calculations that underplay noise impacts

Misapplying the WHO thresholds of 50 and 40dB (for changes in operational noise impacts)

19. As well as identifying noise impacts above the **significant** levels (using 65dB/55dB trigger points (SOAEL)), HS2 Ltd are also required to "mitigate and minimise adverse effects on health and quality of life" where noise effects lie between the **lowest** point where impacts are felt (LOAEL) and the **significant** level. HS2 Ltd do this by measuring the change in noise levels due to HS2, as representing the change in quality of life that might arise. These changes (if large enough) are then treated as a significant effect if the LOAEL threshold has been exceeded.

20. While HS2 Ltd do use the WHO thresholds of 50dB (daytime) and 40db (nights) as the LOAEL they in our view misapply them. They consider the change in noise level from HS2 only if the additional noise contributed solely by HS2 (ie "proposed scheme only" in table below) has exceeded the 50dB/40dB thresholds rather than the total noise exposure (of background noise plus HS2 train noise, termed "do something"). This makes a material difference.

21. Example from CFA9 Vol 5 technical appendix SV-004-009 (operational airborne noise)

ID	Area represented	Proposed Scheme only (Year 15 traffic)			Do nothing (Opening year baseline)			Do something (Opening year baseline + Year 15 traffic) ****		Change		Type of effect	Number of impacts represented	Type of receptor	Receptor design
		Day *	Night **	Max ***	Day *	Night **	Max ***	Day *	Night **	Day *	Night **				
375322	Potter Row, Great Missenden	49	40	67/69	44	39	46	50	42	6	3	A	5	R	T

22. In this example the daytime change in noise levels from HS2 ie 6dB is not regarded as an adverse noise effect because the additional noise from HS2 was below the 50dB threshold (only 49dB in col 3) despite the fact that the total noise effect ('do something' column) is now at 50dB threshold. For nights the 3dB change does count as an adverse effect as the HS2 train noise reaches the 40 dB threshold (col 4). To equate to what the WHO guidelines actually mean it would seem more appropriate that the threshold applies to the total noise now experienced ie the 'do something' column?

23. Such properties are being ignored. The extra noise that HS2 trains is bringing is being disregarded, even though the residents of that property will experience health and quality of life effects because the threshold is exceeded.

Lnight,outside, can be considered a health-based limit value of the night noise guidelines (NNG) necessary to protect the public, including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise.

24. Use of the "dose response curves" evidence (that HS2 ltd refer to in Volume 5) is inappropriate. These curves only look at what additional noise is introduced by the project and not the total noise being suffered. In some CFA areas this interpretation removes whole swathes of properties from being treated as having adverse noise effects. This is a material deficiency in how noise is being treated.

Ignoring properties that suffer large changes in noise in quiet areas (for operational noise)

25. The Potter Row example above shows a property that suffers a 6db change in daytime noise level. (5dB is "clearly noticeable" and 10dB is "twice as loud"). But if that 6dB addition from HS2 is in a particularly quiet area then it will not breach the 50 daytime threshold (however it is calculated). Parts of CFA9 are particularly quiet ie at 45dB daytime and 35dB night time.

26. It is unreasonable that properties that will experience a large change in noise levels from HS2 should be ignored (even though they have suffered a material detriment in the quality of life from HS2), because they were in a particularly tranquil area before HS2 arrived.

27. Clearly any rule that acts on a particular threshold figure places great pressure on getting accurate estimates – some figures in the Appendices look highly implausible.

Ignoring "isolated" properties that are treated as not having community impacts (for operational noise impacts, and for construction)

28. The EIA Directive and the NPPF requires that the "*the nature of the noise source, the sensitivity of the receptor and local context*" should all be taken into account. But where there are "isolated" properties (eg single dwellings by themselves) on HS2 Ltd's approach these may suffer large 'changes in noise' and exceed the 50dB/40dB thresholds but still not have this regarded as a "significant impact". (Though if any property reaches the absolute 65dB level they then get noise insulation). This is because HS2 Ltd require that there must be a "community" effect for it to be regarded as "significant noise impact".

29. In South Heath five properties suffered adverse change in noise effects but they are excluded in the Volume 2 discussions, as they were not treated as "significant impacts" at the community level. The more remote the rural area, the more this is likely, and the more acutely discriminating this is, lacking any basis that adverse health effects will not be caused.

30. Only acknowledging community-wide noise impacts is justified by HS2 Ltd on cost/ benefit reasons for mitigation for individual isolated single properties. But it cannot be reasonable from the individual property owners perspective, and should be changed. It is indefensible that there should be a policy to disregard health effects on occupants of isolated properties.

31. It is dependent on the professional judgment of the HS2 ltd assessors as to whether an impact on a property is treated as community-wide or not. Some decisions look arbitrary- in many cases will have done from desk top exercises.

32. For construction impacts, there needs to be 5 properties impacted to count as a significant effect ie a community effect. Again this is immoral.

Nights

HS2 Ltd understate the actual night noise impacts by not adjusting for the most sensitive periods *(for operational noise effects,) and construction too?))*

33. The LA average figure that is calculated for night times, averages over the whole 8hr period. HS2 trains however are only operational for a few hours in that period and using the whole 8-

hr period does not reflect the impact of HS2 on the most sensitive 3hr periods (between 11pm and midnight, and 5am to 7am).

34. For example a 4dB increase over an 8 hr period would actually imply noise increases of 7/8dB (approaching twice as loud) in the times when the trains are operational eg (11-midnight and 5-7am in the morning). Using this criteria massively increases the number of properties that would be exposed to adverse effects eg BCC have calculated that in CFA11 alone another 145properties would experience a 4dB increase in noise.

35. The same logic applies for using a 16hour LA average for day time effects. People have a right to expect a quieter evening, but the 16hraverage does not differentiate between daytime and evening ie it goes up to 11pm at night. The impact of changes should also be examined.

36. Differentiation between day and evening only happens for applying different thresholds in the construction period (using the A/B/C method). The distinction should also apply when calculating noise when trains are in operation. Failure to do this looks like deliberately ignoring adverse effects that apply particularly to children.

37. It is hard to see how HS2 Ltd can state that the impacts are mitigated to the noise levels they calculate when it is most likely that the estimated noise impacts understate the true impacts in early evening and early morning.

Ignoring the peak noise (LA max) threshold advised by WHO that disturbs sleep (for operational noise impacts).

38. The WHO 2009 Night Noise Guidelines (NNG) reiterates earlier advice in the 1999 Community Noise Guidelines, and in particular demonstrates how for high frequency train pass-bys, maximum (ie peak noise, rather than average noise levels) correlates better with sleep disturbance:-

> *"If the noise is not continuous, sleep disturbance correlates best with LAmax and effects have been observed at 45 dB or less. This is particularly true if the background level is low"*
> *"To prevent sleep disturbances, one should thus consider the equivalent sound pressure level and the number and level of sound events. "*

39. WHO show in their summary table[7] that the 60maxpass-by noise level is the relevant outside level at which noise can disturb sleep (based on 45max inside the bedroom). The ES however makes no reference to this WHO guideline on peak noise, despite a very extensive write up in Volume 5 on their methodology and evidence for it, and its obvious relevance.

40. HS2 Ltd do use peak noise for night but 85maxpass-by noise level is used as the threshold for night levels to count as "significant impact" (or 80max if more than 20 pass-bys). At that point you can get insulation (as applied for HS1). 85dBmax is 25dB higher than 60max level. This means that HS2 Ltd's only use of peak levels represents a noise level that is 5 times louder than the WHO 60dBmax. As para 9 showed, only one property had noise levels greater than 85db pass-by levels, in South Heath area

41. Interestingly although HS2 Ltd downplay the peak noise they do provide the peak noise for each individual property (in Volume 5 Appendices) which acted as a receptor. The number of properties exceeding the 60max pass-by noise can hence be calculated, as we have done in to get the results in para 9 above..

[7] Community Noise Guidelines, 1999, Table 1 of Executive Summary Page xv

42. Using 60dB max demonstrates that

- Many more properties are exposed to sleep disturbance than using 85max indicates (that almost no one breaches – one property in CFA 9). This is a material deficiency in their process. It shows as discussed at para 9 above 168 properties in CFA9 as exceeding this level. This demonstrates that the noise effects on the South Heath area when HS2 is operating will be extensive and can be expected to disturb sleep.
- 60max and 70max contours can be drawn on the maps (as well as the LAaverage basis that HS2 Ltd draw on SV-02-17) and this should have been done. Totals of properties affected should also have been provided. We have done this freehand to show the likely impact, as shown at the end of the section (section 5, Appendix 1).
- Drawing the contour for CFA 9 and 10 shows for example that neither of the proposed Green Tunnels (at South Heath and at Wendover) protects the respective communities from noise arising from HS2. In these circumstances it is unreasonable to state that the impacts are mitigated, as HS2 Ltd do at Volume 2 CFA9 11.4.17 (for all but the 15 properties). In fact it shows for South Heath that much of South Heath, Potter Row and Frith Hill will experience health and quality of life impacts, particularly at night.

The Wendover Society state in their response to the ES:

'*It shows that despite the introduction of a 1.8km green tunnel, it is not long enough to prevent hundreds of dwellings in Wendover, being exposed to maximum noise levels exceeding the NNG 60dB recommended maximum noise level for the avoidance of adverse effects on sleep. These include London Road, Wendover Dean, all of Bacombe Lane, St Mary's Church and Wendover campus, Hale Lane and Hale Road, the whole of the central village including South Street and High Street, at least ten houses in Ellesborough Road, Bridleways and upper Lionel Avenue, together with western Thornton Crescent, North Lee area and Nash lee lane to Loudwater farm! Indeed many in Bacombe lane and the Nash Lee area are likely to be exposed to over 70dB at each train pass. Moreover numerous homes and businesses will experience a peak noise increase of over 15dB or three times the current peak noise level! The situation in Stoke Mandeville is similar in spite of introducing the bypass.*'[8]

43. Even developers in planning applications are expected to design so that LAmax is kept below 60- 65dB . BCC calculate that 48 more properties would be exposed in CFA 11 at 65max.

44. For the South Heath area therefore with 36 trains per hour passing through the area (from Mantles Wood to Hyde Heath, South Heath, Potter Row and onwards towards Leather Lane) the peak noise level as each train passes is very relevant, yet no noise contours based on LAmax were produced. Despite the WHO guidelines recommending a maximum pass-by noise level of 60dB, in addition to average day / night noise limits of 50dBA / 40 dBA, respectively, this too was ignored. The pass-by noise levels are particularly important in the early morning and evening, for healthy sleep and quality of life. In the summer it should not be necessary to close windows to enjoy a night's sleep.

45. Given the extent to which the effect of night noise is underestimated more extensive tunneling is required. At minimum there should be a reduction in the speed of trains at night to limit the impacts on residents.

[8] 'The Wendover Society: Response to HS2 Environmental Statement Consultation'

Misuse of the "rail bonus" argument in setting the relevant peak noise level

46. "Rail bonus" is the term generally adopted to mean that for rail traffic similar noise levels are less annoying than for air and road traffic. DfT use it in Webtag, so the peak noise level ie LAmax for rail is justified at a higher level than for roads. But for high frequency and high speed rail ie speeds of up to 360mph, this is increasingly highly questionable. Indeed the opposite reasoning applies to peak noise at night.

47. HS2 Ltd recognise that noise induced awakenings are not yet fully understood but then cite evidence to underpin the upper 80/85LAmax they adopt. They pay little regard to the evidence that suggests more work is needed in particular on the effects of high speed rail noise eg on school children.

48. Particularly relevant recent research[9] in this context (that is not used) refers to Japanese experience – one train every second minute- and other research that says annoyance increases in proportion to the number of trains. It states

    "*As the railway traffic is very intense and the quiet time periods are substantially reduced, railway traffic seems to generate similar general noise annoyance as road traffic, depending on exposure metric and degree of annoyance.* [31],[34] *This result is, to some extent, in agreement with results from studies by Morihara et al.*[10] *conducted in areas with a very large number of high speed trains in Japan (up to 800 trains/24h or about one train every second minute) and also with previous railway studies in Sweden by Öhrström and Skånberg,* [21] *which found that the extent of annoyance increased in proportion to the number of trains per day and night."*

49. This principle is also accepted by the UIC publication[10] which says "*With higher train frequencies the difference between road noise and railway noise will decrease".*

50. HS2 will operate very intensively, running at more than 1 train every 2 minutes (36 trains an hour in phase 2, and 28 in phase 1 will pass by). Given the high speeds, - there is no drop in speed for a green tunnel –it is hard to justify a different treatment for rail from road.

How do the proposals compare with EU levels?

The HS2 Ltd noise limits are higher than what many other countries adopt.

51. Legal limits relevant to residential or equivalent areas for new-build high speed rail are reported in a recent UIC study. The report shows it is common to have stricter limits for new railways, and that noise limits may vary by who is affected eg hospitals and residential areas have lower limits than cities. Caution is needed however as the calculation basis can be different eg the Netherlands.

52. The table is compiled from detailed information in the report. The HS2 Ltd comparable limits are the 65db in daytime and 55db for nigh-time ie the point where HS2 Ltd regard it as being "significant".

[9] Rail Noise and Health journal, 2012, Vol 14 , Issue 59 "*Rail noise annoyance and the importance of number of trains, ground vibration, and building situational factors"*

[10] UIC "Exploring bearable noise limits and emission ceilings for railways. Part 1: National and European legislation and analysis of different noise limit systems" Section 1.2.2

53. The table shows most other EU countries have lower limits that HS2 Ltd propose, and nearer to the WHO levels. None of this is presented or discussed in the ES.

EU Country	Daytime dB limit (06.00 to 22.00)	Night-time dB limit (22.00 to 06.00)	Specific rail lines?	Applicable category
France	60	55	HSR. Non-high speed 3dB less	Residential
Germany	57/59	47/49	New & upgraded	Hospital/residential areas
Switzerland	50/55	40/45	All new. 5dB less than existing	Recovery/residential areas
Poland	50/55	45/50	No distinction	Health resorts, hospitals/residential
Portugal	55 (24hr average)	45	No distinction	Residential, hospital, school
Netherlands *	55 (24hr average)	as daytime	New & upgraded	Residential.(* diff calc basis)
Sweden **(1) Outside:** **(2) Inside:**	 55 (24hr average) 30 (24hr average)	 60 peak ie LAmax 45 peak ie LAmax (bedrooms)	New & upgraded	"Inside" limits are in addition to the normal "outside" ones that all countries have
Source: UIC (International Union of Railways) "*Exploring bearable noise limits and emission ceilings for railways. Part 1: National and European legislation and analysis of different noise limit systems". 2012*				

The AONB

Quiet areas like AONB require more special attention

54. HS2 Ltd make no mention of the WHO guideline that refers to conservation areas where the "*Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low".*

55. In CFA 9 there are areas with a baseline recorded as low as 45 in the day and 35 at night. Because of the way the calculations are done (discussed above) this means that changes in noise levels in very quiet areas will be ignored eg when the baseline is below 50dB in daytime and 40dB at night.

56. The National Planning Policy Framework (NPPF) says the "acoustic environment" ie the noise climate impacted on by the project, should be taken into account. The noise limits used should reflect "*the nature of the noise source, the sensitivity of the receptor and local context*". The ES adopts a route-wide approach for setting limits, which does not comply with the NPPF.

57. HS2 Ltd should have done a comprehensive baseline assessment on noise for the AONB, using the AONB as a 'receptor'. This is justified on the basis that

    - The intrinsic value of the AONB may be affected by the scheme because of the noise and vibration impacts arising from HS2. HS2 goes through the widest part of the AONB with

less than half (45%) in a bored tunnel and the remainder in cuttings, two green tunnels, a viaduct, and on embankments.

- The Preservation of Rural and Quiet Areas (give ref) recommends that quiet areas be given a different treatment with an upper noise limit of 40db calculated over 24hrs.
- Most of the LCA's in the AONB are shown in the landscape assessment as having a high sensitivity to change.

58. Currently however HS2 Ltd have only looked at where people live or work and did not assess the AONB differently.

59. HS2 Ltd say noise in the AONB overall is a landscape issue –and refer to that section of the ES. But that section gives no comfort that the wider issues has been addressed. Indeed the landscape assessment "study areas" that were adopted (which were not agreed with the relevant bodies as required) use a narrower corridor ie 1km for AONB than was used for the other green belt area (the meridian gap), where 2km was used. This seems particularly difficult to justify in the circumstances.

Other unsupported assumptions

Attenuation may not be calculated correctly ie HS2 Ltd assume the noise levels fall off faster than the latest research suggests.

60. The noise model is set out in Vol 5 Appendix SV-001-000 at Appendix D2. It is recognised that many factors will affect the actual noise level that will be experienced eg the train frequency, speed of trains, precise trains used (TSI compliant or not), wind direction, effectiveness of noise barriers, rail grinding and its effect etc. The model thus depends on many assumptions. Of particular concern is the assumption being used for attenuation.

61. HS2 ltd provide the formula at para 1.3.16 for how noise is absorbed by the atmosphere. They refer in a different to the source of this figure – it comes from a 1991 paper[11]. HS2 Ltd do not however refer to a very recent 2013 Federal Railroad Administration publication[12] which states (at para 2.3.2) that

    "For purposes of rough estimation, atmospheric absorption can be taken to be 1 dBA per 1,000 ft for "standard day" conditions (temperature of 59 °F and relative humidity of 70 percent), assuming that the A-weighted sound level for trains is most influenced by noise in the 500- to 1,000-hertz frequency range."

62. 1dBA per 1000ft equates to 1dBA per 300metres. This is a considerably lower figure than that used by HS2 Ltd in their figure 13 (and the equation) which implies a drop of 2.4dBA/300metres. This raises the question as to whether HS2 ltd are assuming too large a drop in noise levels for distances from the line. This would mean that the noise levels are underestimated.

Justification for higher thresholds for construction noise impacts, than for operational effects

63. HS2 Ltd justify using higher thresholds for construction noise on the basis they are temporary, and this is what HS1, Thames Tunnel etc used. (They say "significant" is at 75dB (daytime)

[11] A 1991 paper "*Validation of the AEL Methodology for the Calculation of Train Noise, Proceedings of the POLMET Conference 1991*."
[12] "*High-Speed Ground Transportation Noise and Vibration Impact Assessment"* US Federal Railroad Administration, 2013.

65dB (evening) and 55dB (nightimes)- with flexing to 65/55/45 using the A,B,C system, according to the baseline ambient levels that homes have now).

64. Given the long time that construction will take for HS2, it is unreasonable that residents should be subjected to years of significant noise impacts. In South Heath area over 100 homes are significantly affected and many more will experience health and quality of life impacts. HS2 ltd however never collate the information on **all the homes** that will be affected by construction works as we do in the table below – even just using their data. For example Table 15[13] excludes the "indirect" effects of construction traffic. They do not draw contours, and map the results. Contours for example are only done for the operational impacts. It is unsatisfactory that the reader must review the raw data in the appendices to reach an informed position. Construction work can last up to 8 years.

Houses affected by construction noise (source HS2 Ltd data, SV-003-009)

Ref	**Roads**	**Homes (nos)**	**Cause**	***Significant* impact (typical/highest)**	**Comment**
CV09-C01 (community area impact)	Sibleys Rise Bayleys Hatch Frith Hill	50	Green tunnel works	Typical: 60dB Highest: 65-70dB	Inconsistent reporting between chapters Many errors in App 5 datalists of individual records No maps with contours
Individual home impact	Kings Lane Hyde Lane Chesham Rd	3	Green tunnel works	Typical (59-66) Highest (66-69)	Isolated properties (not treated as significant)
CV09-CO2	Kings Lane	50	HGV lorries	6dB increase (from 58 to 64dB	Claimed as "indirect effect" only as due to construction traffic. Figures excluded from table 15
CV09- D01	Kings lane (Chesham rd?)	2		80	2 properties stated in Vol 2 para 11.3.10, but only 1 found in datasets

65. Combined with this, although they calculate the periods that homes suffer in excess of these levels (after mitigation), the work is inaccurate. Remarks are made that the movement of surplus spoil along the trace should not increase noise levels but that noise will just happen for longer. Given the huge quantity of excess spoil it is proposed to deposit at Hunts Green in the AONB (nearly 2Mt) it is hard to see that this will not take several years, whereas HS2 Ltd show the construction traffic as lasting 8 months (Table 14, 11.3.14, Volume 2 CFA9) rather than the many years it would be in reality.

Miscalculation and misrepresentation of construction impacts through using monthly averages (for construction noise impacts)

66. For construction noise levels an A/B/C method is used. (described at Vol 5 (SV 001-000) para 1.5.12) and in the Appendices for each CFA eg SV-003-009). This requires calculating monthly averages. There is no example given. The relevant British Standard discusses the A/B/C method. (BS 5228-1). We are concerned that monthly averages

- Ignore significant effects that can occur over shorter periods
- Find no support from the relevant British Standard (BS 5228) ;
- Underplay the resulting figure so as to underestimate the position on damaging health effects. . For example if 70db was the figure for the first 15 days and 60db for rest of

[13] Table 15, Volume 2 CFA 9, page 180.

month then the log average over the month is 67dB ie 3db less. The worst values for the first half of the month is hidden.

- Is inconsistent with the noise insulation/temporary re-housing criteria . This uses a trigger of 10 days in any 15 day period, and would be exceeded in the above example.

67. These deficiencies mean that HS2 Ltd's estimates of construction disturbance are under estimates.

General comments

Penalties for not delivering on promises

68. There are examples where design promises are made. But there are no binding enforcement procedures provided. There need to be binding penalties for non-compliance. This should include the reduction in speed if other methods of mitigating excessive noise are not effective.

Pressure waves from portals – inadequate assessment

69. There needs to be an assessment of the mitigation of micro-pressure waves at all tunnel portals. The ground-borne noise and vibration effects in soft soils and chalky soil (the bow wave effect); how the model applies in each specific case; maintenance requirements; use of floating track slab etc. In the AONB alone there are two portals from the green tunnel at South Heath and the north portal at the Chiltern tunnel , and the 2 portals for the Wendover green tunnel.

70. The green tunnel picture referred to in the ES, does not even include porous portal material.

Construction mitigation in accordance with the "best practicable means" (BPM)

71. BPB will be used to manage noise and vibration to residents during construction. It is part of the Draft CoCP. It is said to be defined by Environmental Protection Act 1990 and Control of Pollution Act 1974. But BPB is not defined in the latter. There may be cases where better than BPM is needed eg to use a better technical method.

72. Reference is continually made to the mitigation (available under the Draft CoCP) which will ensure that there will not be significant noise effects. Given the DCoP it is only a draft it can still be changed. The specific mitigation should have been stated in the ES.

73. As part of the BPM there is a list mitigation measures that will be applied in a particular order – working hours should be higher in the list (noise in evening or night should be avoided for residents).

Not providing data that individual residents can use

74. Despite all the noise detail in the appendices for receptor locations, unless a resident is aware of whether their property was measured the data cannot be used to challenge the results. Clearly some are errors.

Downplaying of effects in Volume 2 noise chapters, and Vol 5 issues, plus inaccuracies

75. There are **direct** effects from construction noise and **indirect** effects from HGV traffic. Only the direct effects are tabulated and quantified in Vol 2 noise. The indirect effects are mentioned but NOT tabulated with no reference to the number of properties affected. The numbers are in Volume 2 transport chapter. This is an unhelpful presentation

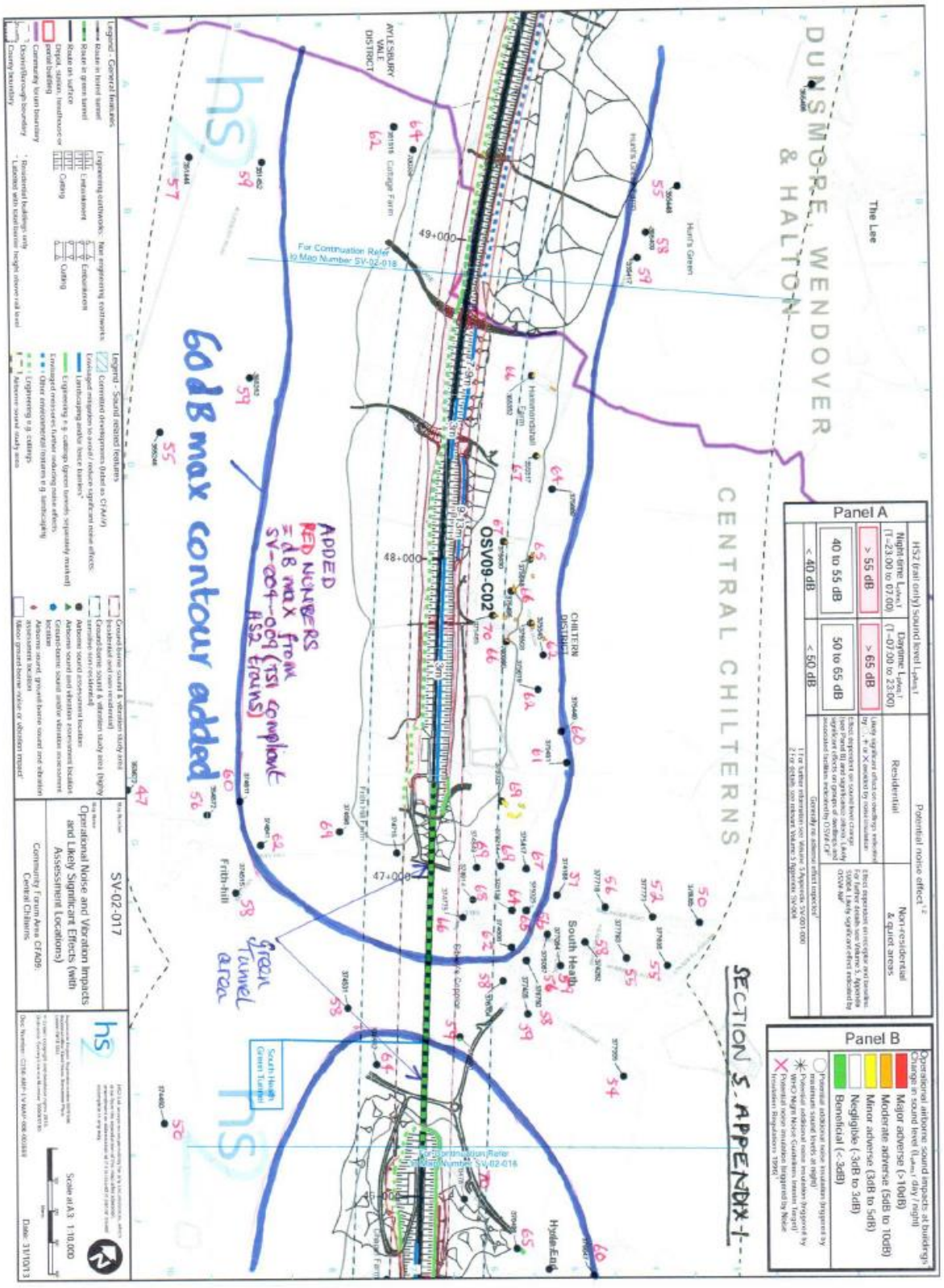
76. The 'significant' noise effects only are quantified which means only those at community impact level – isolated properties with significant effects must be satisfied with insulation – which triggers only at very high levels.

77. All non- significant noise impacts that still result in health and quality of life changes are not even mentioned in Vol 2. Neither are they discussed in Volume 5. While the core numbers are given the reader is left to try and understand it and interpret it – which is difficult – not least given the numerous errors that can be found.

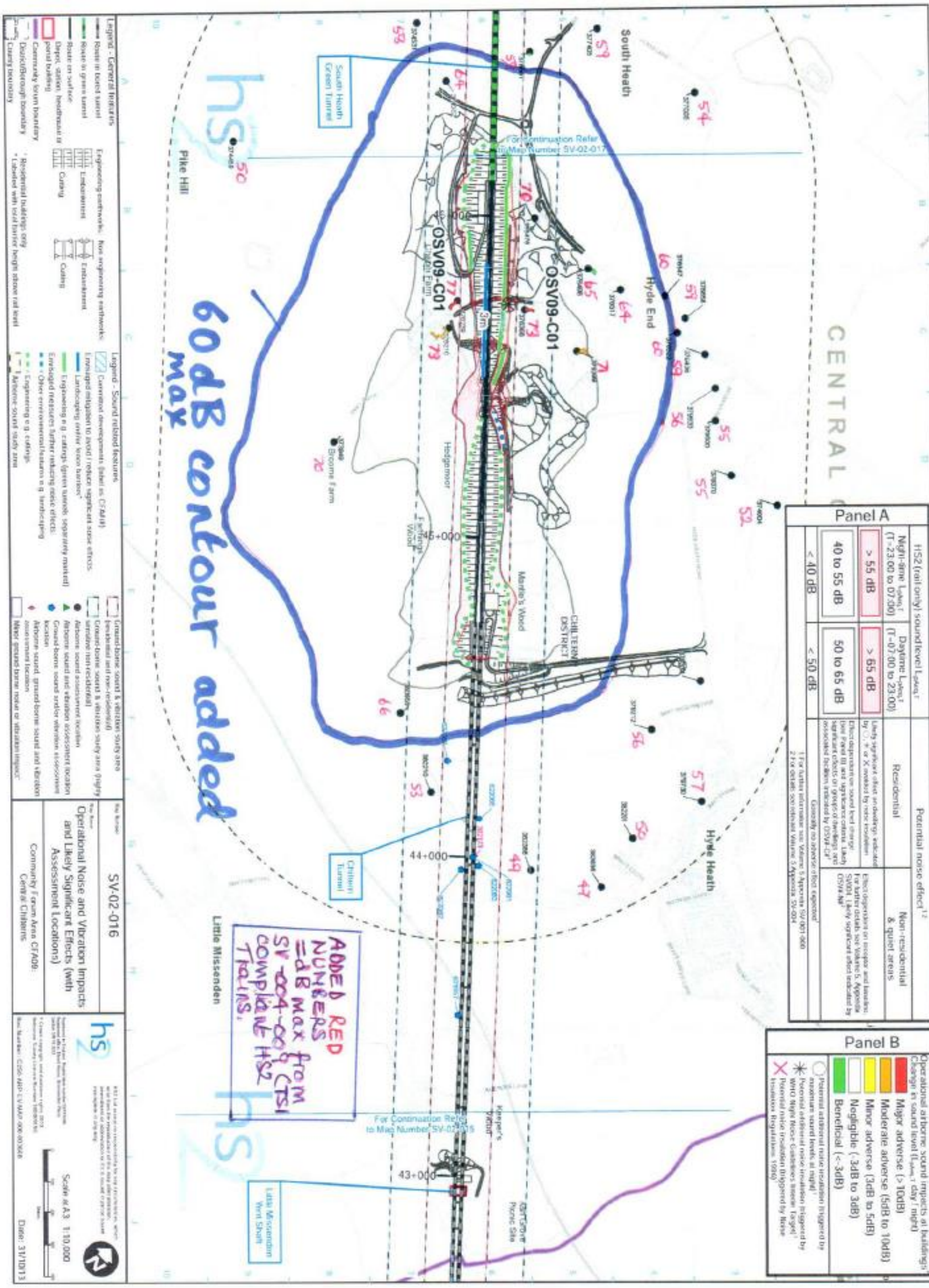
78. Partly no doubt because the results are reported in different volumes they get reported differently eg Vol 2 (CFA 9) says approximately 40 properties have significant noise effects from construction works while Vol 5 records exactly the same places but states its approximately 50, while adding up the properties from the detailed Appendix totals 53 – plus there are others with significant changes but which are individual properties – so get ignored.

79. The construction appendix (SV-003-009) appears riddled with errors in categorising properties as A/B/C according to the methodology using the figures baseline numbers from a different Appendix (SV-002-009). It is hard to find a property where it seems to have been classified correctly. There are many small errors eg missing bits from the legends describing the terms, numerous cross refs that are to whole documents (not sections) that make them almost no help in trying to illuminate how something has been calculated; individual property results giving rise to impacts that are clearly wrong; individual properties when clearly neighbours will be affected too.

80. The large number of errors give no confidenece that the results are correct even within the time frame that HS2 Ltd were setWith so many errors it is hard to have confidence in the results listed.


DUNSMORE, WENDOVER & HALTON
CENTRAL CHILTERNS
SECTION 5 APPENDIX 1
60dB max contour added
ADDED RED NUMBERS =dB max from SV-004-009 (1st complaint HS2 Trains)
OSV09-C02
Green Tunnel area
Panel A
Panel B
Operational Noise and Vibration Impacts and Likely Significant Effects (with Assessment Locations)
SV-02-017
Community Forum Area CFA09: Central Chilterns
Scale at A3: 1:10,000
Date: 31/10/13

R E P A
Residents' Environmental Protection Association


60dB contour added
max
ADDED RED NUMBERS =dB max from SV-004-001 (TSI compliant HS2 trains.
South Heath
Pike Hill
Hyde End
Hyde Heath
Little Missenden
CENTRAL
Panel A
Panel B
South Heath Green Tunnel
Chiltern Tunnel
OSV09-C01
SV-02-016
Operational Noise and Vibration Impacts and Likely Significant Effects (with Assessment Locations)
Community Forum Area CFA09: Central Chilterns

Section 5: Appendix 2

Legal advice: HS2 – Environmental Statement – Noise Impact Assessment.

Summary

1. The assessment of the potential noise impacts within the ES needs to be conducted on a basis that is consistent with relevant national policy. There are a number of material aspects of the ES appraisal framework which are not consistent with national noise policy.

2. In particular:

    a. The Lowest Observed Adverse Effect Level and the Significant Observed Adverse Effect Level have not been correctly identified;
    b. The LOAEL and SOAEL levels utilised in the HS2 ES are too high, leading to material underestimation of the adverse noise impacts and the significant adverse noise impacts;
    c. The impact upon those receptors falling within the range between LOAEL and SOAEL has not been assessed on an individual receptors basis as required by national policy;
    d. The HS2 ES does not identify that the impact upon those receptors lying between LOAEL and SOAEL has been mitigated and minimised as required by national policy;
    e. The uncertainties in identifying the effect levels, the assessment of impact and the analysis of mitigation to minimise adverse impacts have not been identified – this information is required by the EIA Directive and means that the Environmental Statement is not compliant with EU Law.

3. As a result, HS2 is contrary to national policy and to permit it to proceed would give rise to breach of the EIA Directive. To allow HS2 to proceed would be unlawful.

National Noise Policy

4. National Noise Policy is set out in the Noise Policy Statement for England (NPSE).

5. The Noise Policy Statement identifies an approach based upon three effect levels:

    a. The No Observed Effect Level - this is the level of noise exposure below which no effect at all on health or quality of life can be detected;
    b. The Lowest Observed Adverse Effect Level - this is the level of noise exposure above which adverse effects on health and quality of life can be detected;
    c. The Significant Observed Adverse Effect Level - This is the level of noise exposure above which significant adverse effects on health and quality of life occur.

6. The draft National Planning practice Guidance explains that:

    a. The range below LOAEL equates to a level where:

        "Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

    b. The range between LOAEL and SOAEL equates to a level where:

"Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows for some of the time because of the noise. Potential for non-awakening sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life."

c. The range above SOAEL equates to a level where:

"The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area."

7. The LOAEL levels and SOAEL levels must be defined by reference to this policy approach. As set out below that is not the case in respect of the LOAEL and SOAEL thresholds adopted in the HS2 ES.

8. Where noise will be produced that lies between the LOAEL level and the SOAEL level the Noise Policy Statement explains that all reasonable steps should be taken to mitigate and minimise adverse effects whilst taking into account guiding principles of sustainable development.

9. Thus, the national policy approach is to avoid noise above the SOAEL level. However if this cannot be done, then the policy is that noise impacts should be mitigated by taking all reasonable steps and any residual impacts should be weighed in the planning balance.

10. This approach is also reflected in the draft National Planning Policy Guidance which contains a Table explaining the appropriate response at each tier of the noise assessment hierarchy:

a. at or below NOEL no action is required;
b. at or below LOAEL no action is required;
c. between LOAEL and SOAEL – noise impacts should be mitigated by taking all reasonable steps.

11. It follows that national policy requires the following approach to be adopted in determining whether to permit the HS2 and if so, the noise mitigation controls to which it should be subject:

a. Where HS2 will give rise to noise below the NOAEL level it will be acceptable in policy terms;
b. Where HS2 will give rise to noise levels between the NOAEL level and the SOAEL level all reasonable steps should be taken to mitigate and minimise noise levels;
c. Noise levels beyond the SOAEL level should be avoided.

12. This approach is also reflected in the draft "National Policy Statement for National Networks" which is to apply to nationally significant rail projects. It advises at paragraph 5.179

"The Secretary of State **should not grant development consent unless** satisfied that the proposals will meet the following aims:

- avoid significant adverse impacts on health and quality of life from noise as a result of the new development;
- mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and

- where possible, contribute to improvements to health and quality of life through the effective management and control of noise." (emphasis added)

13. This policy approach also reflects that adopted in other NPS's. Consequently, if HS2 were permitted on a basis other than through the application of this policy approach it would be treated on a basis that is inconsistent with the approach adopted in relation to other nationally significant rail and infrastructure projects. Such an inconsistent approach cannot be and has not been justified.

14. It follows that it is national policy that projects that do not avoid impacts above SOAEL are unacceptable and should not be permitted. Further, projects that have impacts between LOAEL and SOAEL are unacceptable and should not be permitted unless it is demonstrated that:

    a. All the impacts between LOAEL and SOAEL have been identified; and
    b. Those impacts have been mitigated and minimised.

15. Even on the basis of the SOAEL's adopted in the HS2 ES (which are not accepted to be appropriate), HS2 is forecast to give rise to numerous and wide ranging impacts above SOAEL upon a wide range of receptors in a wide range of locations. It follows that consistent with national noise policy HS2 does not avoid significant adverse impacts on health and quality of life from noise. As such it is national policy that HS2 must be refused consent.

16. Further, in general terms (elaborated further below) the HS2 ES does not identify all of the impacts between LOAEL and SOAEL upon every relevant receptor; rather it employs an approach of examining impacts within this range on a "community impact" basis[14]. This is justified by reference to projects undertaken prior to the adoption of the NPSE. It is an approach which is now out of date and which does not reflect current national noise policy.

17. National policy as set out in NPSE does not allow for an assessment of impact on a community wide basis; rather it requires every individual receptor that is likely to receive an impact lying within LOAEL and SOAEL to be identified. This has not been done in the HS2 ES. As a result, by following the approach adopted in relation to projects that pre-date NPSE, HS2 has not identified the impacts as required by national policy. Consistent with that policy it must be refused.

18. Yet further, the HS2 does not demonstrate that the impacts upon those receptors lying within LOAEL and SOAEL have been mitigated and minimised. Policy requires an assessment of the benefits that would be obtained by mitigation for a receptor against the economic and social benefits being derived from the activity causing the noise. Because the approach adopted is one taken on a community wide basis rather than on the basis of individual receptors, the assessment of the cost effectiveness of mitigation is not compliant with national policy. Indeed, the HS2 ES explains in terms that the consideration of mitigation has been undertaken by reference to reducing and controlling exposure to noise for communities[15]. National policy does not provide for the assessment of mitigation on a community wide basis; rather it requires it on an individual receptor basis. As a result, HS2 does not comply with national policy in this respect and consistent with that policy must be refused.

[14] HS2 ES Vol 5 Annex A p3 para 1.3.4.
[15] HS2 ES Vol 5 Annex A p7 para 1.3.23

The Definition of LOAEL and SOAEL

19. It follows from the above that national policy requires that SOAEL and the LOAEL must be defined. Paragraph 2.22 of the Explanatory Note to NPSE states:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times."

20. Whilst the HS2 ES purports to identify LOAEL and SOAEL for a number of noise sources and potential receptors, the approach set out is flawed in a number of respects addressed below. The result is that the HS2 ES does not provide an assessment of the potential impacts of the construction and operation of HS2 which is compliant with national noise policy. As matters stand, the HS2 project is therefore contrary to national noise policy and must be refused.

21. It is crucial to note that the HS2 ES explains that the effect thresholds it has adopted are "based upon best practice and previous projects"[16]. They are not then necessarily based upon dose response research which identifies for a particular receptor in relation to a particular source of noise the lowest level of noise that will give rise to an adverse effect on health or quality of life or a significant effect upon health or quality of life.

Ground Borne Noise during Construction and Operation

22. In relation to ground borne construction and operational noise, the HS2 ES has adopted 35 dB LA_{Smax} as LOAEL and 45 dB LA_{Smax} as SOAEL[17]. These are levels applicable at any time of day or night. The HS2 ES suggests that Table 28 of the SMR "defines the LOAEL and SOAEL for ground borne noise". However, Table 28 merely sets out impact classification criterion and does not purport to define LOAEL or SOAEL. It follows that the basis for the selection of 35 dB LA_{Smax} as constituting LOAEL for a ground borne noise source is not justified in either the HS2 ES or the Scoping and Methodology Report.

23. The WHO Night Noise Guidelines of Europe identify that 32 dB LA_{Smax} is a level at which effects upon motility during sleep are observed. This is a threshold for noise induced motility to occur which a sign of arousal. The WHO NNG explains that frequent "arousal and accompanying sleep fragmentation can affect mood and functioning next day and lead to a lower rating of the sleep quality. Therefore, motility is relevant for adverse health effects"[18]. Further. The WHO NNG also recognise that noise events at 32 dBA and below will be audible within a property. This would suggest that adverse effects could be experienced within a property at a level of 32 dB $LA_{max.}$

24. That would suggest that the LOAEL is lower than the 35 dB LA_{Smax} adopted in the HS2 ES and that the level adopted in the HS2 ES is inappropriate. It would then follow that the entire appraisal of the impact of the HS2 project from ground borne noise sources is flawed because a LOAEL level has been adopted which is 3 dB too high. Thus the impact assessment does not and cannot have identified all of those subject to a level of noise above LOAEL but below SOAEL. It also follows that the impact assessment cannot have considered the need to mitigate and minimise noise caused to receptors which ought to have been considered as falling within this range but were not because a LOAEL level was adopted that is 3 dB too high.

[16] HS2 ES Vol 5 Annex A p6 para 1.3.18.
[17] HS2 ES Vol 5 Annex A p10 Table 1
[18] WHO NNG page 99.

25. The consequence is that the appraisal of the impact of construction ground borne noise (e.g. noise from TBMs or from the proposed underground railway) is flawed. It also the case that the appraisal of the impact of operation groundborne noise is flawed.

26. These errors give rise to conflict with national noise policy which requires the identification of LOAEL, the identification of those experiencing noise between LOAEL and SOAEL and the mitigation and minimisation of such impacts. As a result, to grant consent for HS2 would be in direct conflict with national noise policy.

27. It is similarly, the case that the 45 dB LA_{Smax} level identified in the HS2 ES as SOAEL in relation to ground borne noise sources has not been justified in the HS2 ES or the SMR.

28. There is no dose response research relied upon in the HS2 ES that establishes that this is the level at which significant adverse observed effects occur. Indeed, the level of 45 dB LASmax is not identified in Table 5.1 of the WHO NNG in relation to any threshold; rather waking up in the night and/or too early in the morning is identified to occur at 42 dB LASmax. In other words, levels at 42 dB LASmax and above will wake people up. By adopting a level for SOAEL that is 3 dB higher than this, the HS2 ES fails to assess impact significance against SOAEL.

29. Again, the HS2 ES has adopted an effect level which is not justified and which appears to be 3dB too low. The consequence of this is that the appraisal of significant effects set out in the HS2 ES is flawed. The ES will not have identified receptors which will experience an impact above the SOAEL.

30. This gives rise to a conflict with national noise policy which requires the identification of SOAEL, the identification of those experiencing noise above SOAEL and the avoidance of impacts above SOAEL. As a result, to grant consent for HS2 would be in direct conflict with national noise policy.

31. In relation to ground borne noise associated with construction impacts, the HS2 ES adopts an approach relating to the duration fo impact that means that even where noise levels are above the level identified in the ES as SOAEL they are not considered to be significant if the noise level is experienced for a period of less than one month[19]. There is no basis in either research or policy for suggesting that those who experience construction related ground borne noise above a SOAEL level for a period of less than a month do not experience significant adverse impacts as defined in national policy. The consequence of this approach is the HS2 ES does not identify receptors as experiencing a likely significant adverse effect when in fact they are forecast to experience impacts that are above SOAEL. The HS2 ES is therefore flawed in this respect.

Ground Borne Vibration

32. The HS2 ES identifies a LOAEL level in respect of ground borne vibration of 0.2 VDV $m/s^{1.75}$ and a SOAEL level of 0.8 VDV $m/s^{1.75}$ for the daytime. At night the HS2 ES identifies the LOAEL level in respect of ground borne vibration as 0.1 VDV $m/s^{1.75}$ and 0.4 VDV $m/s^{1.75}$.

33. Again the HS2 ES indicates that the SMR defines these levels[20]. However, once again the SMR does not set out any justification for the adoption of these levels as LOAEL and SOAEL; rather it states that these levels "have been developed using the guidance in BS6472 and are consistent with those applied to other projects such as HS1 and Crossrail".

[19] HS2 ES Vol 5 p14 para 1.4.36.
[20] HS2 ES Vol 5 App A p10 paragraph 1.4.18

34. BS6742 at Table 1 does indeed refer to the VDV levels referred to above. However, it does not do so in the context of defining the lowest level at which an adverse effect would be experience or the level at which a significant adverse effect would be experienced. Rather, the levels taken from BS6742 are levels identified by reference to the likelihood of adverse comment being made by person who experienced a given dose. In other words, the levels are drawn from research into whether people are likely to complain when they experience a given dose. This is far from being based upon research as to whether people will experience adverse effects from a given dose.

35. Further, the fact that these levels were utilised by projects assessed prior to the adoption of the NPSE does not mean that these levels are appropriate to adopt as LOAEL and SOAEL.

36. It follows that the both the LOAEL and SOAEL levels adopted in the HS2 ES in respect of ground borne vibration do not represent thresholds derived by reference to adverse effects that can be observed; rather they are levels that relate to likelihood of complaint. As a result the LOAEL and SOAEL levels adopted do not correspond with levels required by the NPSE to be adopted. It follows that he HS2 ES appraisal of ground borne vibration is entirely flawed. HS2 must therefore be considered to be contrary to policy and should be refused.

Ground Borne Noise and Non-Residential Receptors

37. The HS2 ES identifies a series of criteria to be applied in respect of the assessment of adverse impacts upon non-residential receptors[21]. These are all described as representing a threshold of "adverse" effect. In other words, these levels are identified as the point at which adverse effects are experienced or LOAEL. It appears that no SOAEL level is identified in respect of non-residential receptors.

38. As a result, the HS2 ES does not follow the approach required by national policy as set out in NPSE in respect of identifying both LOAEL and SOAEL in respect of non-residential receptors. This means that it is not possible to identify whether any non-residential receptor experiences an effect above SOAEL. This means that the impact of HS2 in terms of ground borne noise upon non-residential receptors cannot be assessed in accordance with national policy. The HS2 ES is thus flawed in this respect also. The result in that HS2 is contrary to national policy and must be refused.

39. Further, no justification is provided for the adoption of the thresholds in the HS2 ES as being considered to be LOAEL for the particular receptors in relation to ground borne noise sources.

40. Indeed, some of the criteria appear to be anomalous. The 40 dB LA_{Smax} criterion for hospitals if exceed would give rise to an adverse effect i.e. it is said to represent LOAEL. This can be contrasted with the LOAEL adopted in the HS2 ES of 35 dB LA_{Smax} for residential properties. It thus appears to be suggested that receptors within a hospital are less sensitive to ground borne noise than residential receptors. However the WHO NNG states that "the following groups may be hypothesised to be more vulnerable to noise during sleep: old people, ill people, people with chronic insomnia, shift workers and people resting during the daytime, people with a tendency to depression, light sleepers, pregnant women, people with high anxiety and high stress levels."[22]

41. This would suggest that a LOAEL for a hospital could be expected to be at a lower than that adopted generally for a residential receptor. In the HS2 ES however the reverse is true and without any explanation provided. It must follows that the level adopted as LOAEL for

[21] HS2 ES Vol 5 p 16 Table 4
[22] WHO NNG p100

hospitals in respect of ground borne noise impacts cannot be and is not justified. This gives rise to a breach of national policy in that a group of receptors has not been appraised against LOAEL as required by that policy.

Airborne Noise - Construction

42. In respect of airborne construction noise the HS2 ES identifies SOAEL for the daytime, evening and night time periods as 75 dB LAeq, 12 hr, 65 dB LAeq 1 hr and 55 dB LAeq 1hr during the night respectively. These are levels to be measured externally.

43. No justification is provided in the HS2 ES for the identification these levels as SOAEL. They appear to be drawn from BS5228 Annex E ABC method category C. However, the values set out in BS5228 Annex E are not values derived from any dose response study; rather the 75 level can be traced back to having origins in the Wilson Report as being a level at which a meeting could be held in a building with windows shut.

44. In relation to the adoption of an evening 1 hour LAeq level of 65 dB as SOAEL, no dose response evidence is referred to in the HS2 ES to justify the use of this threshold.

45. Further, in relation to the adoption of a 1 hour LAeq level of 55 at night as SOAEL no dose response evidence is referred to in the HS2 ES to justify the use of this threshold. Indeed, it is instructive to have regard to the WHO NNG section 5.6 which explains that in relation to the range of 40 to 55 dB L_{night} (i.e. and LAeq measured over 8 hours of the night):

"adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected."

46. This suggests that significant observed adverse effects will be experienced at levels of 40 dB at night and above. On this basis it would appear that the 55 dB adopted does not represent SOAEL but a much higher level. Indeed, the WHO NNG states at section 5.6 that at levels above 55 dB L_{night} :

"The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence of the risk of cardiovascular disease increases."

47. Thus the 55 dB level adopted in the HS2 ES is not SOAEL but rather a level much higher than SOAEL.

48. It follows that the HS2 ES appraises construction impacts from airbourne noise at night by reference to a threshold level that is above SOAEL. As a result, it fails to capture all of the likely significant impacts arising. The fact that that level has been used in assessments conducted in relation to other projects conducted prior to the adoption of the NPSE does not justify the selection of 55 dB as SOAEL now.

49. In addition to these matters, the HS2 ES does not identify LOAEL for any receptor in relation to airborne construction noise. This means that a critical threshold has not been defined and there has been no assessment of the adverse impacts of the project against such a threshold. The consequence is that there has been a fundamental failure to engage with the requirements of national policy as set out in the NPSE and indeed as emerging in the draft NPS.

50. It is not possible to identify from the ES the receptors that lie in the range between LOAEL and SOAEL in respect of airborne construction noise impacts. The impact upon these properties cannot therefore be taken into account by the decision maker. It is also not

possible to have identified those properties in respect of which there is a policy requirement to mitigate and minimise the impacts. Nor can any judgement be reached as to whether this policy objective has been attained.

51. Once again, only where the airborne construction noise SOAEL is exceeded for a period exceeding one month does the HS2 ES record the impact upon a receptor as significant. There is no basis in either research or policy for suggesting that those who experience construction related airborne noise above a SOAEL level for a period of less than a month do not experience significant adverse impacts as defined in national policy. The consequence of this approach is the HS2 ES does not identify receptors as experiencing a likely significant adverse effect when in fact they are forecast to experience impacts that are above SOAEL. The HS2 ES is therefore flawed in this respect.

52. The HS2 ES is thus fundamentally flawed in respect of its approach to airborne construction noise. HS2 is contrary to policy and cannot be permitted.

Airborne Noise - Operations

53. In respect of operation airborne noise, the HS2 ES adopts as SOAEL levels of 65 dB LAeq 16 hour during the day and 55 dB LAeq 8 hour at night.

54. The day time SOAEL is said to be consistent with the daytime trigger level in the UK Noise Insulation (railways and Other Guided Systems) Regulations. The daytime SOAEL is measured as an external level.

55. The WHO Guidelines for Community noise identify that 50 dB LAeq 16 hour is a threshold of moderate annoyance for the daytime and evening for outdoor living areas and that 55 dB LAeq 16 hour is a threshold of serious annoyance for the daytime and evening for outdoor living areas. The threshold of 65 dB adopted as SOAEL is thus 10 dB above the level that the WHO Gudelines has identified as the threshold of serious annoyance. The level adopted in the HS2 ES is thus a level that is twice as loud as a level where serious annoyance would be caused.

56. Indeed the WHO Guidelines for Community Noise indicate that an internal level of 35 dB LAeq 16 hour for the daytime represents the threshold beyond which there is an adverse impact upon speech intelligibility within a dwelling and moderate annoyance caused. The WHO NNG identifies that in general a partially open window will provide 15 dB of noise attenuation to an external noise level. Thus, an SOAEL level of 65 would equate to 50 dB internally with a partially open window. Even with a window closed it is unlikely to offer significantly greater than 20 dB of noise attenuation i.e. the 65 dB level equates to 45 db internally. Those levels are 10 dB greater than the threshold identified by the WHO guidelines as appropriate i.e. a level of noise which is up to twice as loud as the WHO threshold is considered not to have a significant adverse effect on the approach adopted in the HS2 ES.

57. It is plain 65 dB is a level that is set without regard to the relevant dose response research and does not represent SOAEL; rather a lower level of 50 dB LAeq 16 hour for SOAEL from operational noise in the daytime should have been adopted.

58. This means that the HS2 ES does not assess the impact of operational noise form the operation of HS2 upon residential receptors during the daytime on a basis that is appropriate or consistent with national noise policy. The HS2 ES by adopting an level for SOAEL necessarily significantly under-estimates the likely significant impacts arising from operational airborne noise during the daytime.

59. In relation to the nightime, the HS2 SOAEL level for operation noise is 55 dB LAeq 8 hour externally. This is identified at equating to the Interim Target defined by the WHO NNG.

60. The WHO NNG describes this interim target in the following terms:

"An interim target (IT) of An interim target (IT) of 55 dB L_{night},outside is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons. It should be emphasized that IT is not a health-based limit value by itself. Vulnerable groups cannot be protected at this level. Therefore, IT should be considered only as a feasibility-based intermediate target which can be temporarily considered by policy-makers for exceptional local situations."[23]

61. Indeed, a threshold of 55 dB Lnight is described in the WHO NNG as a level where:

"The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases."[24]

62. The Interim Target is thus not a level that represents SOAEL. Rather the WHO NNG advises that between 40 and 55 dB Lnight,

"Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected."[25]

63. Further the WHO NNG states that:

"For the primary prevention of subclinical adverse health effects related to night noise in the population, it is recommended that the population should not be exposed to night noise levels greater than 40 dB of Lnight,outside during the part of the night when most people are in bed."[26]

64. Again, the HS2 ES has adopted a value for SOAEL which is far above the level that actually represents the threshold of significant observe adverse effects as described in national policy.

65. This means that the HS2 ES does not assess the impact of operational noise from HS2 upon residential receptors during the night on a basis that is appropriate or consistent with national noise policy. The HS2 ES level for SOAEL at night necessarily significantly under-estimates the likely significant impacts arising from operational airborne noise during the night.

66. LOAEL in respect of daytime operational noise is identified in the HS2 ES as 50 db LAeq 16 hour. As set out above this is a level which the WHO Guidelines identify a representing the threshold of moderate annoyance, and impacts upon speech intelligibility within a dwelling. It is not a threshold below which there are no observed adverse effects, thus it cannot be LOAEL.

67. The HS2 ES is thus fundamentally flawed in respect of its approach to airborne operational noise. HS2 is contrary to policy and cannot be permitted.

[23] WHO NNG p109
[24] WHO NNG p108 table 5.4
[25] WHO NNG p 108 Table 5.4
[26] WHO NNG p109

Airborne Noise and Non-residential receptors

68. The HS2 ES adopts a series of different assessment criteria in relation to airborne noise and non-residential receptors. The approach is similar to the approach adopted in relation to the thresholds for ground borne noise and no-residential receptors namely, that a LOAEL level is identified.

69. It appears that no SOAEL level is identified in respect of non-residential receptors. As a result, the HS2 ES does not follow the approach required by national policy as set out in NPSE in respect of identifying both LOAEL and SOAEL in respect of non-residential receptors. This means that it is not possible to identify whether any non-residential receptor experiences an effect above SOAEL. This means that the impact of HS2 in terms of airborne noise upon non-residential receptors cannot be assessed in accordance with national policy. The HS2 ES is thus flawed in this respect also. The result in that HS2 is contrary to national policy and must be refused.

70. Further, no justification is provided for the adoption of the thresholds in the HS2 ES as being considered to be LOAEL for the particular receptors in relation to airborne noise.

Traffic Noise

71. No LOAEL or SOAEL values are identified for use in assessing the impact of noise from traffic. Indeed, the impact methodology followed is one that simply examines the magnitude of change in terms of road traffic noise.

72. As approach to impact assessment that simply assesses the magnitude of change without reference to absolute levels and without reference to LOAEL and SOAEL is one that does not comply with national noise policy. This is because it does not enable a decision maker to identify whether properties would be affected by traffic noise above a SOAEL level, nor does it allow for the identification of properties adversely affected between the LOAEL and SOAEL levels or consideration of whether the impacts upon such properties have been mitigated and minimised in accordance with policy requirements.

73. A SOAEL level must be defined for road traffic noise. Properties that are already experiencing levels above SOAEL should not experience any increase in road traffic noise as a result of HS2: such impacts are to be avoided consistent with national policy.

74. A LOAEL level must also be defined for road traffic noise. Properties experience adverse impacts lying between LOAEL and SOAEL have to have those impacts mitigated and minimised consistent with national policy.

75. The failure to adopt this approach in relation to road traffic noise means that the HS2 ES appraisal of road traffic noise impacts is totally inadequate. The ES presents no impact assessment on a basis that could be considered to be remotely consistent with national policy.

76. The HS2 ES is thus fundamentally flawed in respect of its approach to road traffic noise. HS2 is contrary to policy and cannot be permitted.

Ground Borne Noise Assessment Methodology

77. The assessment of ground borne noise has assumed that a temporary construction railway will be utilised. However, the use of such a railway gives rise to a number of impacts above SOAE and above LOAEL and SOAEL. It is therefore incumbents upon the HS2 project in accordance with national policy to consider how to avoid the impacts above SOAEL and how to minimise the impacts between LOAEL and SOAEL.

78. No such consideration is presented in the ES consistent with the requirements of national policy. For example, there is no examination of whether alternatives to using a railbased railway (e.g. trucks on rubber tyres) might be used.

79. Although the HS2 ES refers to matters relating to uncertainty in the forecasting of ground borne noise and vibration, it present no data relating to a train travelling at the speeds that HS2 is proposed to operate at. Nor does it present any data that indicates to the reader how accurate the forecasts are likely to be. This is crucially important in respect of those receptors where forecasts are just below LOAEL and SOAEL levels as it may be that due to inaccuracy in the forecasting such receptors may experience adverse or significant adverse impacts.

Airborne Noise Assessment Methodology

80. In relation to construction noise, it is to be noted that the impact assessment has been conducted using predicted calendar monthly average noise levels. The HS2 ES acknowledges that daily levels can be around 5dB higher than the monthly levels[27].

81. It follows that given that SOAEL and LOAEL should be defined by impacts over a single day, night or evening (as appropriate), to assess impacts by reference average monthly levels will not identify either the number of recpectors that will actual experience impacts above SOAEL levels or adverse effects between LOAEL and SOAEL. In other words, the methodology adopted seriously underpredicts the scale and nature of the impacts arising from construction. The methodology is thus inconsistent with the requirements of noise policy because it allows receptors to experience impacts above SOAEL whereas policy states that such impacts should be avoided. The methodology is thus wholly flawed.

82. Further, the impacts are only presented for the worst affected floor in buildings with multiple floors. This means that a particular occupier on a floor other than the worse affected floor cannot identify from the HS2 ES what the project predicts the impact upon his/her particular property is likely to be. Further, it means that in circumstances where in a building some floors may be affected above SOAEL but other between LOAEL and SOAEL, the reader o the ES is unable to identify the dividing line. This means that there will be properties between LOAEL and SOAEL that experience adverse effects that are not identified in the ES. Accordingly, it is not possible to determine whether the impacts upon such properties have been mitigated and minimise din accordance with national policy.

83. The precise specification of HS2 trains is unknown. Sensitivity testing has demonstrated that changes to the specification could lead to changes in predicted sound level of up to 3 dB[28]. It is wholly unclear from the HS2 ES whether the project has appraised the operational airborne noise impact on the basis of an assumption that trains may be up to 3dB noisier. If that has not been done then there has been a failure to appraise the project on a robust basis. The need to make allowance for such uncertainty is crucial in relation to properties lying within 3dB of either the LOAEL or SOAEL levels as these might be subject to adverse or significant adverse effects which the ES would not report if this matter is not taken into account.

The Approach to Mitigation

84. National noise policy is clear that noise impacts above SOAEL are to be avoided and that development consent for nationally significant infrastructure projects should be refused if this aim is not achieved.

[27] HS2 ES Vol 5 Annex C p5 para 2.1.11
[28] HS2 ES Vol 5 Annex D p24 para 1.3.5

85. Where adverse impacts are experienced by receptors i.e. impacts between LOAEL and SOAEL, national policy requires these impacts to be mitigated and minimised on a basis that is consistent with the costs and benefits that the project would deliver.

86. In relation to construction related ground borne noise, no appraisal is presented that demonstrates that the forecasts adverse impacts have been minimised. For example, there is no appraisal that justifies the use of a construction railway as opposed to the use of trucks with rubber tyres on the basis of a cost/benefit analysis.

87. Similarly in relation to operation ground borne noise, there is no appraisal of whether such noise could be further minimised through the use of floating slab track on the basis of a cost/benefit analysis.

88. In relation to airborne noise impacts (both construction and operational) noise insulation for properties is only proposed where impacts above SOAEL are predicted to arise.

89. There is no material presented in the ES that examines whether it would be possible to extend noise insulation to those affected by airborne noise between the LOAEL and SOAEL levels. The only appraisal conducted has looked at the provision of noise barriers.

90. This means that properties predicted to experience noise just below SOAEL levels will not be provided with noise insulation whereas properties above will. The latter properties will then experience a reduction in noise to levels below that experienced by the properties just below the SOAEL. In other words the approach creates a "black hole" where properties will experience high levels of noise and materially adverse conditions without mitigation.

91. It follows that the HS2 ES does not present the information necessary to determine whether adverse effects have been minimised in a manner that is consistent with national policy.

Noise from Stationary Systems

92. As with road traffic noise, the approach adopted to the assessment of noise impacts from stationary systems is based upon examination of the magnitude of change in noise levels. For the same reasons set out above in relation to the road traffic noise this approach does not comply with the requirements of noise policy because it is not based upon the identification of LOAEL and SOAEL levels.

Utility Diversions

93. The precise nature of the utility diversion required has not yet been defined[29]. Where the HS2 project requires utilities to be diverted any noise impacts of those works fall to be assessed as part of the project itself because they form part of the project. It follows that the failure to assess the impacts of utilitiy diversions is a failure to assess the likely significant impacts of the project. The HS2 ES is thus defective in that it fails to assess the likely significant impacts of the project in this respect.

CONCLUSION

94. For the reason set out above, the appraisal of the noise impacts arising from HS2 set out in the HS2 ES is not compliant with national policy. Further, the defects within the ES are so numerous and of such consequence that it cannot be reasonably concluded that the ES is an ES within the requirements of the EIA Directive.

[29] HS2 ES Vol 5 Annex C p 8 para 2.2.6

95. As a result it would be contrary to national policy and it would be unlawful to allow HS2 to proceed.

Section 6: Waste and Hunts Green

Summary

1. A large area of agricultural land (at Hunts Green) that is part of a long established farm on the ridge overlooking the Misbourne Valley in the Chilterns Area of Outstanding Natural Beauty (AONB), (in CFA 10), has been identified as a "suitable" location for dumping excess excavated material, for which the HS2 project itself can find no use.

2. There are very substantial environmental implications (both during construction and in the long term for the owners, the farmers, local residents and visitors) with the area overlooking Grimms Ditch (an ancient monument) and adjacent to Leather Lane. A proposal to create a new landfill site in the AONB, to which material from outside the AONB are imported, shows a breath-taking disregard for the landscape, the environment, and the relevant waste policies. Alternatives have not been adequately considered.

3. HS2 Ltd omitted to specify the process which they intended to apply in settling their waste policy (the referenced part of the ES being entirely missing), but, in response to an FOI request, HS2 Ltd have given what appear to be their criteria. However, HS2 Ltd have demonstrably not applied them, indeed one criterion specifically prohibits the Hunts Green site because it is in the Chilterns AONB which is 'a nationally sensitive landscape'.

4. .HS2 Ltd consider three options for the deposition of surplus material. They do not appear to give any consideration to the beneficial use of surplus materials, as they are required to do. They do not consider alternative means of transportation to road.

5. HS2 Ltd's account of how materials might be transported to Hunts Green is inconsistent, both in terms of the origin of the materials and the quantum of materials at issues.

6. The issue of the disposal of surplus material in the AONB arises from the perception that surplus materials created in the AONB cannot be removed along the construction route (ie trace). This is the case because south of the South Heath area there is a bored tunnel, with the tunnelling and surface works planned to occur in parallel. This reasoning neglects the fact that the material could and would be removed along the trace (ie through the tunnel) were the Chilterns bored tunnel extended.

7. Hunts Green is not an appropriate location for a new landfill site, and more distant and costly means of spoil use are required, which must further improve the economic case for having extended bored tunnelling through the AONB.

8. Hunts Green should not be used as a new landfill site, and the generation of spoil within the AONB should be avoided by the more extensive uses of bored tunnelling.

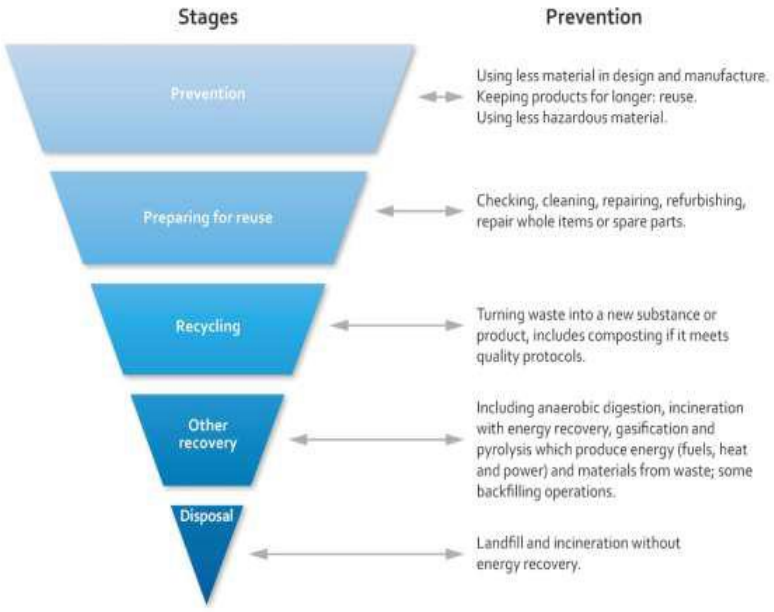
Context

9. The construction of HS2 produces an enormous amount of excavated material. We are told in Volume 3[30] it is forecasted to total some 128Mt – although a figure of 112.1Mt is given elsewhere[31]. Putting aside this substantial discrepancy these figures should be put in context. 128Mt represents almost three times the total amount of sand and gravel that was extracted in the whole of the UK in 2011. Given the obvious linear and localised nature of HS2 and the

[30] Volume 3 Section 14, table 22
[31] Table 1a in Annex 1 of the Waste Assessment reports gives a cumulative total of 112.1Mt from the 26 CFA's.

potential environmental implications of moving and disposing of such a huge amount of material this issue merits very careful assessment.

10. Volume 3 of the ES that discusses route-wide effects sets out the waste hierarchy, which provides the overarching context for waste management decisions. Figure 18 (below) shows this as one of **prevention** followed by **re-use**; **recycling**; **recovery**; with disposal to **landfill** as a last resort.



11. Volume 3 also makes reference to the "proximity principle" (contained in both the EU Waste Directive and in DEFRA's Planning Policy Statement 10) ie to manage waste as close as possible to its point of production. However both these source documents also make clear that waste should be disposed of in one of

"the nearest appropriate installations by means of the most appropriate methods and technologies, in order to ensure a high level of protection for the environment and public health"

12. The ES states most of the 128Mt will get re-used in the project (as engineering fill or in creating earthworks etc for environmental mitigation) ie 116.6Mt. But this leaves 11.35Mt surplus to requirements to be disposed of. Volume 3 table 22 shows disposal is split between:

- Off-site disposal of 4.49Mt to existing landfill sites, and
- On-site permanent disposal of the remaining 6.86Mt to what are effectively new areas of landfill (euphemistically called "sustainable placements")

13. Volume 3 describes the on-site disposal and selection of places for it as follows (the red emphasis is added):

"14.6.5 Sustainable placement is the on-site placement for disposal of surplus excavated material to avoid causing environmental effects (e.g. transport) that would otherwise be associated with the off-site disposal of that material.
14.6.6 Three sustainable placement areas have been selected on the basis of their suitability for the disposal of surplus excavated material. These sustainable placement areas are detailed in Table 21.

Table 21: Sustainable placement areas for the Proposed Scheme

Sustainable placement area (SPA) reference	Quantity (tonnes)	Sustainable placement region	Sustainable placement site	Map references
SPA1	2,884,487	Greater London	Four areas at Harvil Road	CT-06-019a-R1 and CT-06-019a-L1[181] CT-06-019b-R1 and CT-06-019b-R2[182]
SPA2	1,928,002	South East	South Heath	CT-06-035[183]
SPA3	2,044,471	South East	Calvert	CT-06-055[184]
Total	6,856,960	-	-	-

14. The selected site at **South Heath (SPA2) is the Hunts Green** location that is immediately north of Leather Lane, in the Chilterns AONB. It covers four fields. The actual site is just within CFA 10 (Dunsmore, Wendover and Halton), although South Heath itself falls within CFA 9 (Central Chilterns). The site is where the Leather Lane construction compound is located [and large materials stockpile] but this is not referred to as the reason for its suitability. Over one quarter of the surplus material from Phase 1 will be deposited here – 1.93Mt of the 6.9Mt, in an area some 1.3km long, 450 wide and 15 metres high.

15. We are told that the surplus material at South Heath will be 'landscaped' and the area returned to workable agricultural land. Thus while an effect is admitted during construction, no permanent residual effect is attributed to this land in the ES. That the ground level would be raised by 15m over an extensive area in the AONB is disregarded.

16. Examining the different Volumes in the ES that cover waste (Volume 3 that looks at route-wide issues and covers waste in each CFA; Volume 2 that looks at each CFA area; Volume 5 and its appendix that concentrates solely on waste) reveals very substantial and concerning inconsistencies and serious omissions in four areas:

    - The application of the waste hierarchy and justification for selecting sites for on-site disposal of surplus excavated materials, and in particular at Hunts Green
    - The amount to be deposited at Hunts Green farm site
    - Where it will come from ie local surplus material or imported surplus from other CFA's?
    - How the waste gets to Hunts Green – by road, if so which roads, or on the trace itself?

Application of hierarchy and justification for local disposal

17. The waste hierarchy set out above, and qualified in terms of the "proximity principle" should have been applied in each CFA, by:
    - Demonstrating how each method above disposal in that hierarchy was considered, eg prevention, re-use, recycling and recovery.
    - Demonstrating how disposal was specifically considered eg the range of options examined in order to determine which was the closest "*appropriate*" installation at which waste should be deposited.

But this is not apparent in the CFA sections in Volume 2 (where unlike other topics, waste did not have its own separate chapter) or in Volume 3 or 5 that discuss waste in detail.

18. There are permitted mineral working sites within which the HS2 surplus spoil could be beneficially placed.

Site	**Site Distance to closest point of HS2 route**
Meadhams Farm Brickworks, Blackwell Hall Lane, Ley Hill, Chesham, HP5 1UN	4.5km
Springfield Farm, Broad Lane, Beaconsfield, Buckinghamshire, HP9 1XD	8.1km
Wapseys Wood, Oxford Road, Gerrards Cross, SL9 8TE	5.5km
All Souls Farm, Wexham Park Lane, George Green, Wexham, SL3 6LX	8.4km
Park Lodge Farm, Pinewood Road, Iver Heath, SL0 0NE	5.6km
Calvert Landfill site, Brackley Lane, Calvert, MK18 2HF	0.4km
Westhorpe Lake, Westhorpe House, Little Marlow	14.1km
Denham Park Farm, Denham Green, UB9 5DL	0.9km
New Denham, Denham Road, Uxbridge, UB9 4EH	3.3km
East Burnham Quarry/Beechwood Nurseries, Farnham Lane, SL2 2AS	10.6km

Source: Buckinghamshire County Council

19. Besides these Pitstone (near Tring) and Chinnor Quarry offer the opportunity to beneficially take chalk waste.

20. Further, given the creation of a new landfill site in the heart of the greenbelt and the Chilterns AONB, it is disappointing that Volume 5[32] omits from its Baseline Report for Bucks the relevant local planning policies (CS20 and 21) that impact on waste management in the Greenbelt and AONB. It is clear from these policies that a new landfill site would not be supported by the Council given it is neither "*in connection with the restoration of mineral working*" or the "*redevelopment of a waste site to improve and enhance Green Belt objectives*"[33].

21. We are referred in para 14.1.17 (of Volume 3) to an "*integrated design approach*" to ensure the surplus is minimised, but no details are provided. In addition Volume 5[34] continually refers to

> *"the integrated engineering earthworks design approach, described in Volume 1, section 4.5*".

But Volume 1 has no section 4.5, and the two references in that Volume tell us no more.

22. What we do learn from the ES is that surplus materials will only go to fill up a mineral site if its transportation does not result in significant environmental effects. Otherwise there will be the

[32] Volume 5, Technical appendix WM-002-000. Route-wide waste and material resources supporting information.
[33] Policy CS21
[34] Every section in Volume 5 WM-001-000 begins with this reference eg para 2.2.1; 3.2.1; 4.2.1 etc

"sustainable placement" of surplus material because it cannot be re-used and there are significant environment effects resulting from transportation issues[35].

23. HS2 Ltd have focused solely on the need to avoid road transportation, and this has skewed their approach towards creating a new land fill site, but without proper consideration of alternatives. Such a deviation from the waste hierarchy is only permitted in certain circumstances:

> "*where justified by life-cycle thinking on the overall impacts of the generation and management of the waste*[36].

There is no indication that such a holistic approach has been taken.

24. Given the very obvious issues with creating a major new landfill site in the Chilterns AONB, it is extraordinary that avoiding the creation of waste in the AONB by more extensive bored tunnelling, so the spoil could be disposed of from outside the AONB where the transportation infrastructure is better suited appears to have been given no consideration.

25. Specifically in Volume 2 for CFA 9 (for the Hunts Green farm site) we are told that the surplus material is locally placed where it

> "*cannot be re-used beneficially along or locally beyond the route and where it cannot be removed by rail or along the construction corridor"*[37].

The ES justifies the decision (in CFA 10) on the basis of lower cost, reducing the number of HGV movements on local and main roads that would be otherwise needed, with the surplus material instead being deposited at a local site (at Hunts Green). We question this decision.

26. The Hunts Green decision fails to meet HS2 Ltd's <u>own</u> design criteria, as set out in their latest Management documentation[38], dated December 2013. Access to this was provided under a recent FOI but would have been available in an earlier form when the ES was prepared. It was not however included in the ES. This HS2 Ltd documentation states that the purpose of selecting sites (which is the "*option of last resort*") is to give "*flexibility to optimise the design at late stages*". It is not clear what is meant by this "*flexibility*", but reference is not made to it in the ES.

27. The HS2 Ltd documentation then goes on to say (at para 4.6) that the chosen site must be demonstrated to meet the following four criteria:

> *a. There is no available and / or suitable landfill void space within a reasonable distance from the source of the material arising (e.g. 25 km by road); or*
>
> *b. The significant environmental impacts associated with the transportation of excavated material off site (for either disposal or recovery), as identified by the Environmental Impact Assessment, would be worse than those associated with depositing the material onsite; or*
>
> *c. There are clear environmental or social benefits of such an approach (e.g. land remediation or restoration, enhanced public open space provision, etc); and*
>
> *d. The area of land is suitable for this type of material and is <u>not located within nationally sensitive landscapes</u> or on legally protected sites."*

[35] Volume 3 para 14.1.22
[36] Article 4 (2) of the Waste Framework Directive
[37] Volume 2 CFA9 par 2.3.82
[38] Management of Surplus Excavated Materials, Deliverable Approach Statement, HS2 3 December 2013

28. HS2 Ltd recognise that the AONB is a nationally sensitive landscape, stating:

> ***'Value***
>
> *2.3.21 As the landscape of the AONB contains large blocks of ancient woodland, many areas of registered common land, RPG, National Trust properties and National Trails, and given the statutory national designation, this landscape is of national value.*
>
> ***Sensitivity***
>
> *2.3.22 Given that the landscape condition is good, the tranquillity is medium, and the character is of national value, the resulting sensitivity to change of the AONB is considered to be high'*[39]

29. To assess how the Hunts Green decision was taken (and how it performed against these criteria), we look to CFA10[40] where three options were examined:

- Transporting the waste 35kms by road to Calvert for onward transfer by rail
- Transporting it by road to nearest suitable landfills
- Depositing it in Hunts Green (South Heath) "*using the construction route to avoid local roads*".

The analysis simply records that moving 1m cubic metres by road (along temporary access roads, B485, A413 and beyond), would involve 240,000 lorry movements – 1 a minute, 8hrs a day for 3 years – and this would have impacts on the road capacities, other road users and communities so would have a significant environmental impact. Thus Hunts Green was selected.

30. Aside from the arithmetic (it is less than 1 a minute) and the fact this issue was not mentioned in the Draft Environmental Statement (only emerging late in 2013) the decision is deficient in several ways:

- **Beneficial use**: It does not consider taking the surplus material to where the spoil can be used beneficially in the restoration of a mineral working or partially full landfill sites. This should have been examined.
- **Option 2 rejection:** this is dismissed on the same road transportation grounds as the Calvert option ie taking such a large quantity on public roads is obviously environmentally disadvantageous. There is no discussion of the closest appropriate landfill sites to where the surplus was coming from, nor consideration of different means of moving it there – apart from using public roads.
- **Rail transport alternatives**: It fails to examine other transport removal options from the AONB eg creating a new temporary rail route to remove the surplus. This is entirely appropriate where there is evidence that the use of existing public roads for such a large volume is wholly unrealistic. The following could be considered:
    - Building rail sidings connecting to the Chiltern Line – allowing the surplus material to be loaded in the day and moved by night. There are various access points where this would be possible in the immediate area eg near Deep Mill bridge where the proposed route crosses the Chiltern rail line.
    - Moving the surplus material along the trace (ie the construction route which is envisaged under the Hunts Green option) northwards to a convenient access point for taking it to other rail sidings. Given the surplus is actually from a large

[39] Volume3: Route Wide Effects page 13
[40] Volume 2 of CFA 10. Para 2.6.4 to 2.6.7 of CFA 10

area (from the first cutting at Mantles Wood, in CFA 9, as far as Quainton (see below) AND it is clear it will be moved along the trace southwards to Hunts Green[41] this undoubtedly should have been considered.

- **Sensitive sites**. It ignores the fact that the selected site (Hunts Green) is in a nationally *sensitive landscape* area (despite critera 'd' in the statement at para 27 above) – in the AONB. It is disappointing that HS2 Ltd's own rules are so blatantly ignored and the criteria were not included in the ES despite its 50,000 pages.
- **Other benefits**: The selected site does not provide of itself "*clear environmental or social benefits" (*criteria c) – indeed it increases the land-take for HS2, and changing the landscape in this way in an AONB does not comply with the CROW Act.]
- **Other new sites**: no alternative sites for "sustainable placement" are discussed that are outside the AONB. Given the surplus partly arises further north (from CFA12 to 9), and according to HS2 Ltd can be moved along the trace, a wider search is warranted.

31. The criteria themselves also ignore the noise and related impacts of moving the surplus material. They are neither included in the assessment that decides to deposit it at Hunts Green, nor are in the section of the CFA reports that concern (1) the noise impacts or (2) the traffic impacts or (3) the community impacts on the area. Yet moving 1 million cubic metres to Hunts Green will take many thousands of lorries over a very lengthy period.

32. An environmental impact assessment is not complete without also taking into account noise, air pollution and traffic, for whichever means of transport apply.

The amount to be deposited

33. The Hunts Green site is reported to be for depositing 1.93Mt of surplus material (Table 21 of Volume 3). In Volume 2 (CFA 10) the amount that is reported for disposal here is approximately 1 million cubic metres of fill[42]. But this implies a conversion factor to estimate the tipping volume needed to dispose of 1.93Mt that is inconsistent with that used elsewhere, and inadequate.

34. A conversion factor of 1.5 tonnes/cubic metre is used in several places in Volume 5[43] for inert waste landfill, for converting landfill void space to tipping capacity. If a density of 1.5 tonnes/cubic metre is used then the tipping volume needed to dispose of 1.93Mt at Hunts Green would be 1.28million cubic metres not 1 million cubic metres. This is a 28% increase on that described for Hunts Green.

35. Hunts Green is in the Chilterns AONB making this an even more material and sensitive issue which should affect the landscape assessment of this site.

Where will the surplus material come from?

36. It is stated in several places that the excess material to be disposed at Hunts Green is from the local cuttings. But in totality the statements are not consistent as to where exactly the surplus arises, and the detail inadequate to understand the correct position.

[41] Volume 5 WM-001-000 para 11.2.6 "excess materials… transported …southwards… along the construction corridor"
[42] Volume 2 CFA10 para 2.2.6 fifth bullet
[43] For example in para 3.2.6 of Route wide waste supporting information(WM-002-000) in Vol 5 Appendices on waste.

37. When CFA 10 discusses the Hunts Green site it says (in footnote 16 to para 2.2.6) that the material is specifically from the *South Heath cutting*. This cutting runs from the north end of the South Heath green tunnel (at frith Hill) to Leather Lane (in CFA 9), and then a further 1.6kms to Wendover Dean (in CFA 10). But at para 2.6.4 it states a wider area ie from "*the adjacent South Heath cutting and from cuttings in the Central Chilterns area (CFA9)".*This therefore now includes the cutting from the Chiltern Tunnel in Mantles Wood to the South Heath green tunnel – several kms from Hunts Green

38. But Volume 5 (WM-001-000) presents a wholly different position, and says the surplus material will be imported into the AONB from much further afield, and as far as Quainton:

> *11.2.6 Excess excavated materials are anticipated to be transported from the Stoke Mandeville and Aylesbury and the Waddesdon and Quainton areas southwards to theDunsmore, Wendover and Halton area along the construction corridor.*

39. It is wholly unacceptable that surplus material should not just be deposited in the AONB but be imported into an AONB. Clearly where the surplus arises is wholly relevant to the decision on siting.

How will it be transported to Hunts Green?

40. The fact that Hunts Green is an on-site disposal location and local to the cuttings – where at least some of the material is being excavated – does not avoid the fact the material still has to get to the site. The different parts of the ES are not consistent.

41. When describing selecting the Hunts Green option Volume 2 CFA10 clearly states that the construction route will be used to transport it, and not local roads[44]. By this we assume it means the trace (or other specially designated roads for construction traffic only).

42. Using the construction route is reinforced by Volume 5[45] which states that the surplus material from further afield from CFA10-12 will be transported south along the construction corridor (to Hunts Green); and that the excess from CFA 9 will go northwards and "*the balance will be taken along the trace to the sustainable placement area at Hunts Green Farm*[46].

43. Using the trace will obviously depend on through access along the route, which in turn depends on the scheduling of the works. The route crosses several public roads. No detail has been given as to when the surplus would be deposited.

44. It clear from looking at the scale of HGV movements on local roads eg Potter Row, B485 and A413 that the million cubic metres are not planned for the public roads. The numbers of movements are too low to include serious truck movements eg 3 HGVs in AM peak on Potter Row, and 1 in PM peak. Even 60 HGV's a day for the A413 (as is shown) would be inadequate.

45. Despite all the above

- The traffic analysis for CFA 9 and 10 (in Volume 5) clearly states excavated material will use the A413[47]. No exception is made for surplus excavated material. This leaves the position unclear.

[44] CFA 10 Volume 2 para 2.6.5
[45] Volume 5 para 11.2.6 WM-001 000
[46] Volume 5 para 10.2.7 WM-001 000
[47] Para 7.5.72 Volume 5 Appendix Transport assessment (TR 001-000)

- Part of the original justification for needing the Hunts Green site[48] is that the surplus cannot be removed along the construction route. If this is so then it is hard to see how this can be the method of movement for all the surplus to arrive and be deposited at Hunts Green?
- In discussing the construction effects on the community at South Heath and the surrounding area, no specific mention is made of the noise or associated impacts to properties nearest to the trace that will be experiencing many thousands of tipping trucks moving to deposit some proportion of the 1.93Mt of spoil. It is inconceivable that there will not be a considerable environmental impact on those closest to the trace for several years as a result of this decision. This is a serious omission in the Environmental Impact Assessment for Hunts Green. It is a problem that is not just confined to the Hunts Green area but the length over which spoil will be transported
- If spoil is imported from outside the South Heath area, it will not be possible to move the spoil along the trace, but no suitable routes have been identified, and the lorry movements would exacerbate already badly affected local traffic during the extensive period of construction. The most direct route from the A413, Leather Lane, is steep and single track, and like other local roads is unsuited to frequent heavy goods vehicle usage. The additional lorry movements have not been factored into the traffic analysis, and could not be accommodated.

46. If surplus spoil is to get Hunts Green along the trace then this must be factored into the assessment underpinning the decision and identified in the wider community impacts. If spoil is to be moved on public roads, the impact on local traffic o also must be assessed.

47. Neither of these considerations appears in the ES. If the area cannot sustain the production and removal of 1m cubic metres of surplus material, then HS2 Ltd's proposals are not viable. The alternative solution of extending the bored tunnel would avoid the creation of this problem.

Conclusion

48. Hunts Green is not a suitable location for a new land-fill site. It is in the Chiltern's AONB – which should preclude such a use in its own right - and Hunts Green also has inadequate road access to allow spoil to be imported.

49. HS2 Ltd, in deciding to use Hunts Green have failed to comply with their own processes.

50. If the alternative means of disposing of spoil that is not required for beneficial local mitigation is prohibitive in environmental or cost terms, the appropriate solution is not land fill at Hunts Green, but the avoidance of surface works within the AONB through bored tunnelling.

[48] Volume 2 CFA 9 para 2.3.82

Section 7: Ancient Woodland

1 Of the 32 hectares of ancient woodlands that will be destroyed by Phase 1 of HS2, one third are in the Chilterns AONB (according to The Woodland Trust in their ES consultation response). Almost all of this is from the area in the vicinity of South Heath, with by far the largest loss at Mantles Wood (over 6 hectares). The table below summarises these losses.

Ancient Woodland	Loss (ha)	Note
Mantle's Wood	6.0 – 6.2	Further losses may occur under the limits of deviation
Sibley's Coppice	2.3 – 2.6	
Farthings Wood	0.5 ancient (3.5 other)	
Havenfield Wood*	na	Inconsistent information. Maps show the wood inside the construction boundary, although it is said
Jenkin's Wood*	na	Some refs say land is required (eg at 6.3.5), but the opposite is said at 7.3.4

(*) indicates ancient woodland that The Woodland Trust considers will be directly affected but is not on the list of 19 woods provided by HS2 Ltd.

2 In compiling this analysis of the ES concerning ancient woodland, we have consulted The Woodland Trust. The Woodland Trust have stated that:

"The Woodland Trust is keen to work with others to protect irreplaceable ancient woodlands from loss or damage. The Woodland Trust recognises the benefits of proposals for tunnels in several sections of the HS2 route, and fully supports proposals that satisfy all of the following three criteria:

1) No ancient woodland is lost or damaged during construction;
2) The tunnel heads are at least 100m away from any ancient woodland and appropriately buffered from the woodland;
3) The vents or affiliated infrastructure have no impact upon ancient woodland".

3 The SHCTE avoids damage to all the ancient woodlands affected by HS2 in CFA 9, meets the Woodland Trusts criteria and is supported by them. They specifically state in their ES response

"Construction of a tunnel portal and associated site compounds within irreplaceable ancient woodland [at Mantles Wood] is completely unacceptable and the tunnel needs to be extended further to the north to reduce the impact on Mantle's Wood".

4 According to the Woodland Trust ancient woodland is irreplaceable – there is no mitigation for its loss, and any planting proposed is merely compensation. This is recognised in the ES, that states (in Volume 3)

"*ancient woodland is an irreplaceable resource and this loss is considered to be a permanent adverse residual effect, which is significant at a national level*"

and in Volume 5

"*Significant effects on habitat types that are considered irreplaceable (e.g. ancient woodland) should be listed as a significant residual effect even when compensation or enhancement is proposed*".

But the ES is not consistent and confuses compensation with mitigation. The Woodland Trust say

> *"Ancient woodland is irreplaceable – whilst the ES asserts this in Volumes 1, 3 and 5, this key fact is absent from the Non-Technical Summary and Volume 2 and often, the analysis in these sections mistakenly implies or states that the proposed compensation planting will mitigate the loss of ancient woodland. This leads to conclusions which underplay the magnitude and significance of the environmental effects of the proposals."*

5 Section 9 of the Non Technical Summary does just this. It states that "*by year 60 of operation, planting will have further matured and integrated the project into the AONB so that the effect will not be significant*". It then concludes "*Overall the assessment concludes that the project is unlikely to result in any significant adverse effects on the special characteristics of the Chilterns AONB*".

6 We entirely support the Woodland Trust's view of this statement

"To state that the effect of the loss of over 10ha of irreplaceable ancient woodland will not be significant after 60 years is incorrect and misleading to consultees".

It clearly contradicts their other statements in the ES on ancient woodlands being an *irreplaceable resource"* whose loss is *significant at a national level*".

7 Ancient woodland acts as a reservoir for biodiversity. Ancient woodland only covers 2% of the UK and much of this is highly fragmented. According to the Woodland Trust, larger areas of ancient woodland should be conserved and enhanced to build on their significance, not fragmented which reduces their conservation value. HS2 both destroys and fragments ancient woodland in CFA 9.

Mantles Wood

8 The biggest single loss of ancient woodland along the route of Phase One is to occur at Mantle's Wood. The ES gives more than one figure of woodland loss, either 6ha or 6.2ha. The reason for the large loss of woodland from this area is the placement of the north portal for the Chilterns Tunnel within Mantle's Wood ancient woodland. As well as removing over 30% of the wood, work will also result in the wood being permanently cut into two sections. Fragmentation of the wood will increase the permanent impacts of the scheme on this habitat.

9 The Woodland Trust say in their consultation response"

"For the ES to accept on one hand that ancient woodland is irreplaceable, but then to construct a tunnel portal in the middle of one is completely unacceptable and shows a blatant disregard for the significance of this habitat."

10 They also note that as the works in this area are expected to take around 6 years to complete, the indirect effects on the woodland from noise, dust, lighting etc. are also expected to be significant. The ES does discuss the alternatives that were considered to the current proposed tunnel portal in Mantle's Wood but for reasons of cost and potential delay to the project, other less damaging proposals were discounted. The ES misleadingly states that the impact of the proposed works will be "mitigated" by a range of environmental measures. This is not possible.

11 Other works associated with the tunnel portal are also impacting on this wood. An access road running to the east of the wood will result in additional woodland loss and a satellite construction compound has been situated directly on the northern boundary of the wood. Both the road and the satellite compound should be moved away from the wood to reduce the impacts on this

habitat, and vegetated buffers should be used to protect the core of the woodland from neighbouring construction activities. At present no buffering is proposed in the ES.

12 HS2 Ltd did not survey this wood, so the baseline conditions have been based on aerial photographs and desktop studies only. Several rare bat species have been recorded in the vicinity of this wood and the ES accepts that some of these bats are likely to be roosting within the section of Mantle's Wood to be removed.

Sibley's Coppice

13 Wood loss for Sibley's Coppice ancient woodland is inconsistently reported within this report (2.3 and 2.6ha) with a different figure also given in Volume 3 (2.5ha). HS2 Ltd. has confirmed that the figure is actually 2.4ha.

14 As with Mantle's Wood, Sibley's Coppice is bisected by the proposed route, leaving a small area of 0.2ha to the south of the line, with the larger area (5ha) to the north. The ES accepts that given the size of the smaller area of woodland its conservation value will decline. The fragmentation of Sibley's Coppice will increase the impacts of the proposed scheme on the habitat.

15 In addition to the direct loss of woodland, maps for this area show a large temporary materials stockpile placed along the southern boundary of Sibley's Coppice. Information within the draft Code of Construction Practice (Vol.5) states that stockpiles will be stored away from sensitive areas. This appears not to have been adhered to, and the stockpile should not be adjacent to the wood.

Farthings Wood

16 Farthing's Wood is also directly affected by the proposed scheme. The ES states that 3.5ha of this wood is to be removed, but that only 0.5ha of this is wood on the Ancient Woodland Inventory.

17 The construction boundary runs along the edge of Farthings Wood but no buffer is proposed between the wood and the works. The Woodland Trust expects in such circumstances that there be a vegetated buffer of at least 30m wide to separate the ancient woodland from the proposed works. Access was not granted for surveys at Farthings Wood, so the environmental baseline is based on desk top studies and surveys from neighbouring woods.

Havenfield Wood

Havenfield Wood is an ancient woodland that was identified in the draft ES as being directly affected by the placement of an overbridge and associated road realignment. The ES states that this overbridge has been altered to avoid Havenfield Wood. However the accompanying maps still show the construction boundary as being just within the wood. For this reason, this wood has been included on The Woodland Trust's list of 26 ancient woods that will be directly affected by the proposed scheme, although it is not on the HS2 Ltd. list of 19 woods to be affected. Even if the proposed works are outside the footprint of the wood, they are directly adjacent to it and this wood will be indirectly affected by the proposed scheme.

Jenkin's Wood

18 Jenkin's Wood is included on The Woodland Trust's list of 26 woods to be directly affected by the proposed works because of conflicting information within the ES. It is not listed by HS2 Ltd as

affected, but CFA report paragraph 6.3.5 states that Jenkin's Wood is within land required for construction as does the report on ecological baseline data in Volume 5 (paragraph 4.4.42, CFA 7 – 15). However, paragraph 7.3.4 of the CFA report states that this wood is adjacent to works. Given the inconsistency in information The Woodland Trust has assumed that this wood will be directly impacted.

Hedgerows

19 In addition to the woodland loss over 16km of hedgerow are being removed, 2.1km of which is considered to be important (under the Hedgerow Regulations 1997). The loss of hedgerows between woodlands will result in fragmentation of the landscape in addition to the fragmentation caused by the removal of woodland. The ES recognises that the removal of these hedgerows will result in a permanent adverse effect, but later on contradicts itself by stating that there "*will be no permanent adverse effects on the conservation status of hedgerows in this area"* as a result of the proposed planting. There is no information about the potential lag time between hedges being removed and new hedges being planted. The longer this time period is, the greater the potential effect on the environment

Compensatory planting

20 40ha of woodland planting are proposed within CFA 9, with soils from affected ancient woodlands being translocated as part of the proposed compensation. However, this figure is inadequate to replace the loss of around 9ha of ancient woodland, and The Woodland Trust considers that a planting ratio of 30:1 would be more appropriate. This would require the planting of at least 270ha of woodland within this CFA. Total woodland loss in CFA 9 is reported as either 12ha or 13.8ha depending which part of the report you read.

21 The ES states that

"*Following the maturation of the new woodland any adverse impacts on Mantle's Wood LWS, Hedgemoor and Farthings Wood LWS and Sibleys's Coppice LWS will be reduced to a level that will not result in a significant adverse effect on the integrity of the sites*"

22 The CFA report considers maturation to be a period of 50 years (other reports within Volume 2 state 60 years). The Woodland Trust think it is categorically wrong that in 50 years time the compensatory planting will significantly reduce the adverse effects of removing over 9ha of ancient woodland.

23 The Woodland Trust are sceptical that translocation is effective, as it is yet to be proven, and have expressed concern that there is no discussion of any contingency plans.

24 Without management, the great majority of plantings are likely to fail. Apparently the management, maintenance and monitoring of planting schemes will be contained in Environmental Management Requirements (EMRs) but these will not be part of the hybrid bill so there are serious issues about adequacy and enforceability.

Section 8: Valuing landscape

1. Introduction

1 The approach outlined below was developed by 'Bluespace Thinking', and is commended in the Chilterns Conservation Board analysis on the non-market effects of HS2[49].

2 It offers a clear, simple and defensible basis for valuing landscape impacts, and how it would apply to HS2 is detailed below.

3 It suggests that if applied, the approach would indicate that the landscape costs of HS2 in the Chilterns is about £210-350m and for the area that the SHCTE would be £42-84m. These are the value of the landscape that the CRAG tunnels and the SHCTE would preserve.

2. Summary

4 The Treasury Green Book sets out methods to be used to value benefits or costs where there is no free market to enable a direct value to be revealed. The Green Book specifically refers to the use of these methods when:

"preventing or replacing non marketed goods such as a natural habitat or recreational facility".

5 Industrial development is not normally permitted in an "Area of Outstanding Natural Beauty" (AONB) so it is not possible to establish a free market value of the land. This makes it more difficult but not impossible to value the damage that will be caused by HS2 or any other form of development.

6 The methods proposed in the Treasury Green Book could have been used by HS2 Ltd in the economic evaluation of the project, however they were not.

7 The Treasury methods can also be used to assess the value for money of measures to avoid or militate against the environmental damage that is planned.

3. Treasury Green book guidance

8 The following abstract from Annex 2 explains the requirement to value the impact of any Government proposed project:

Valuing non-market impacts Annex 2 - Value, utility, Welfare and Well-Being

"Social Cost Benefit Analysis seeks to assess the net value of a policy or project to society as a whole. The valuation of non-market impacts is a challenging but essential element of this, and should be attempted wherever feasible. The full value of goods such as health, educational success, family and community stability, and environmental assets cannot simply be inferred from market prices, but we should not neglect such important social impacts in policy making. This Annex outlines techniques for valuing non-market impacts, and some typical applications such as time-savings, health benefits, prevented fatality, design quality, and the environment. These approaches can be complex but are equally as important as market impacts."

9 The following Green Book abstracts provide further detail on methods to be used:-

Market based approaches - Stated Preference and Revealed Preference

[49] High Speed rail in the Chilterns. Little Missenden to Wendover: A comparison of the potential non-market effects of the Proposed Scheme and the Alternative proposal. November 2013

"The market based approaches consist of 'Revealed Preference' approaches and 'Stated Preference' approaches. Stated preference techniques use specially constructed questionnaires which describe a hypothetical choice within a hypothetical market in order to elicit estimates of the willingness to pay (WTP) for, or willingness to accept (WTA), a particular outcome. When using stated preferences the main choice is between contingent valuation and choice modelling (CM). CM studies elicit values by presenting respondents with a series of alternatives and then asking which is most preferred. They are often used in order to value specific attributes of a good, rather than the good as a whole. "

Other approaches

"A second approach, where a direct assessment of the value of a benefit or cost is particularly uncertain, is to make reference to the costs of preventing the loss of, or replacing, a non-marketed good (such as a natural habitat or recreational facility). This does not provide a measure of its value but can provide a figure to focus discussion upon whether the good is worth as much as this expenditure."

Shadow price

"The opportunity cost to society of participating in some form of economic activity. It is applied in circumstances where actual prices cannot be charged, or where prices do not reflect the true scarcity value of a good."

4. Valuation Methodology

10 From this guidance it is relatively simple to apply the methods to estimate the value of damage that will be occur as a result of HS2 or any other industrial development when the route passes through an area that is controlled and restricted by law from normal development.

11 The method has a two-step approach.

- Firstly, a shadow price for development needs to be established
- Secondly, using Stated Preference Choice Modelling, a level of development density that is considered comparable in damage terms to that attributable to HS2 can be established.

Establishing a shadow price lower boundary

12 As there is no free market for industrial development land in an AONB a shadow price needs to be established. While there is also no free market for residential development in unblemished areas, there is a market for the redevelopment of residential land. This occurs when existing properties are demolished and are re built. This is a well-established land market and can act as a shadow price indicating the minimum value of the land along the route of HS2.

13 It is only the planning restrictions, necessary to preserve the nature and intrinsic value of the AONB, which are to be over ridden by the HS2 Hybrid Bill, that prevent this land having this shadow price market value today.

Stated preference - Choice Modelling

14 In the event planning restriction were to be removed to permit a level of development that equates in term of aesthetic and social damage to that which will occur as a result of HS2 then that development scheme, valued at the shadow price, will equate to the value of damage caused by HS2.

15 In order to establish the appropriate scheme Choice Modelling involves coming up with a range of schemes and then surveying residents and other who are impacted to establish at what level the "willingness to accept" the development is similar to that for HS2.

16 A starting point in developing these alternatives would be a single road along the length of the route with residential housing on each side. This can then be adjusted to provide less or more damage by the reduction of housing density, the avoidance of key environmental aspects (ancient woodland, particular views etc) or conversely increasing the level of housing particularly in areas that are not as visible and do not adversely impact existing residents.

17 From this approach a value to society of the restriction to develop can be estimated and used in any economic evaluation of the project and in evaluating avoidance schemes by re-routing or tunnelling. It can also be used to evaluate mitigation schemes, for example the removal of permanent spoil heaps from an AONB to fill local quarries or other areas where the environment can be improved rather than ruined by the addition of excess materials.

5. Example 1 - Extending the HS2 Chiltern bored tunnel through the AONB – 14 kms

18 **Step 1** Establish shadow price - The area that this part of the route passes through was, prior to HS2, a much sought after property area close to good schools, medical facilities and in reasonable distance of shopping centres, it also has a very good commuter rail link to London. The area obviously has good environmental and aesthetic amenity due to it being in the AONB and its restriction on development.

19 Typically re- development land prices for a rural plot in this area with 20-meter frontage would be valued at £350,000 to £400,000[50]. Allowing for infrastructure costs to develop new roads and services it might be expected that £300,000 per plot would be the value of residential development land along the HS2 route.

20 **Step 2** Choice modelling - Three alternatives for comparison of "willingness to accept" verses accepting HS2 can be established as: -

- **Base case** - single road, 20m-plot width, housing each side of the road for 80% of the distance. Total value **£336 million**
- **Reduced density case** - as above but only 50% of distance avoiding key environmentally sensitive areas. Total Value **£210 million**
- **Increased density case** as above for 50% of the route but having a greater housing density and additional roads in less visible areas. Total Value **£350 million**.

21 Choice modelling survey - All three alternatives would dramatically change the environment of the AONB and survey participants initial reaction will be that they are not acceptable. A view that is held by society and enshrined in law.

22 However in comparison with HS2 there may be a bias on the part of local residents to say that even the most extreme residential development is preferable to HS2.

23 It is probably reasonable to assume that the modelling survey will provide a valuation within the £210 – £350 million range.

6. Example 2 – Extending the Chiltern Bored tunnel 3.5 kms

24 **Step 1** Establish shadow price - The area is a subset of that described above with closer amenity to existing developments, the estimate of £300,000 per 20m plot width is again supported by market data.

[50] From inspection of build plot sites

25 **Step 2** Choice modelling - Three alternatives for comparison of "willingness to accept" verses accepting HS2 can be established as: -

- **Base case** - single road 20m plot width, housing each side of the road for 80% of the distance. Total value **£84 million**
- **Reduced density case** - as above but only 40% of distance avoiding key environmentally sensitive areas. Total Value **£42 million**
- **Increased density case** as above for 40% of the route but having a greater housing density and additional roads in less visible areas. Total Value **£84 million**.

26 Choice modelling survey - Initial survey reaction will be negative however with the increased density scheme involving hypothetically building a new residential development within an existing road structure and away from the most environmentally sensitive locations in the area may well be a more attraction alternative than HS2.

27 The results will probably come out between £42 - £84 million although as tunnelling in this section will also substantially mitigate property blight by an equivalent amount it maybe that the survey will show a much higher level of "willingness to accept"

7. Conclusions

28 Using the Treasury Green Book guidance it is possible to estimate the value of removing the legal restrictions to development within an AONB and hence establish the cost of environmental damage that will occur through HS2.

29 The methodology is relatively straightforward and is applicable to similar situations involving HS2 or other projects. With adaption It is probably applicable to help establish the value of flood defences and the impact of wind farms and shale gas development along with other less topical issues.

30 Failure to carry out this sort of analysis and failure by Government to take it into account in decision making means that there will be no sound assessment methodology to prevent the UK being "concreted over". Planning restrictions can be viewed as purposeful to maintain the quality of the environment and the quality of experience and life for UK residents or they can be viewed as increasing costs and a restriction to business growth. In practice there needs to be a middle ground that requires a sound valuation methodology.

31 Based on the two examples provided

- Extending the HS2 Chilterns bored tunnel for 14 km could add between £210 - £350 million of value after allowance for direct cost impacts.
- Extending by 3.5 km could add £42-£84 million, or more when blight impact is added, to the value established from direct cost analysis.

32 The results can be more definitively refined and established by a choice modelling survey of the communities involved.

33 REPA support this approach and believe that in the circumstances of an AONB it provides an appropriate methodology to pursue. Figures of between £42-£84m would more than cover the cost that even HS2 Ltd ascribe to the SHCTE.

Section 9 Transportation Issues

Introduction

1 HS2 Ltd proposal for the construction of HS2 have major consequences for those living in the South Heath area, and those using the A413, the B485 and other roads used to access local facilities (eg schools) and for commuting.

2 As construction in the area is scheduled to last 7 years 9 months at the compound adjacent to Annie Bailey's (on the main road between Chesham and Great Missenden (B485) this cannot be dismissed as a temporary inconvenience. Nor given the likely effects can the degree of effect be dismissed as trivial:

- Risk of fatal injury to road users – particularly vulnerable users such as pedestrians, cyclists and horse riders
- Noise, effecting health and wellbeing
- The inability to reach stations, businesses and schools during peak traffic hours
- The inability to access or be accessed by emergency services
- The de-stabilisation of foundations, causing structure failure of road-side properties

3 A number of studies and analyses have been undertaken of HS2 Ltd's proposals that reveal that insufficient consideration has been given to the consequences of proceeding with HS2 Ltd's plan.

4 The Potter Row Neighbourhood Watch commissioned work by a structural engineer on the consequences of using Potter Row as a construction route, as HS2 Ltd propose. It demonstrates that such a use would have grave consequences. The analysis of the issues for Potter Row is reliant on this analysis (conducted by RWA Consulting). Potter Row is of a width that allows two way traffic (if not of HGVs), whereas many of the lanes (eg Leather Lane, Herbert's Hole, Hyde Lane, Keepers Lane) are single track, and if used by large vehicles presents serious risk and inconvenience to other users – particularly vulnerable ones.

5 The Chesham Society, concerned at the dislocation that the construction would cause to access to the A314, examined HS2 Ltd's analysis of traffic flows, and found serious mistakes and untenable conclusions.

6 The reality is that the South Heath area, as a tranquil and unspoilt area of the Chilterns AONB is unsuited to building HS2 on the surface, and that to do so would have a range of unacceptable consequences. The serious problems that would arise underscore the need to build HS2 as a bored tunnel in this area. HS2 Ltd's proposals, if implemented, would create serious risk to children and other vulnerable road users. This risk is evident now, and if not effectively mitigated, we and other concerned parties expect prosecutions under Health and Safety legislation should this risk crystallises into accidents.

Analysis of issues with Potter Row

7 Potter Row is a narrow country lane built to serve light traffic on a local basis. The road is on a bus route on which buses run every day and there are many local deliveries, postal services, refuse collection, emergency services, agricultural vehicles, farm delivery lorries serving Cherry Tree Farm plus others, making up the remainder of traffic over and above cars. The lane is also popular with cyclists, including tourists who have travelled to the area specifically for the purpose of travelling its lanes

8 The approximate width of the lane is between 5.0 and 5.5 metres, varying slightly along its course. The lane is approximately 1.0 mile long, from Leather Lane to Ballinger Road, with four

farms noted along its length on the OS map. Locally it is not considered to be a thoroughfare or a shortcut as the road is narrow and winding and the regular large vehicles that use the road cause temporary blockages.

9 There are no kerbs to the verges of the lane and in places these immediately adjoin the front gardens of some of the properties. A hedgerow bounds other parts of the lane immediately adjoining farmland.

10 There are no road gullies to take surface water rainfall.

11 Within the highway there is a foul sewer that is believed to have been installed around twenty years ago.

Domestic Properties

12 Potter Row is made up of a number of cottages and other houses, generally constructed from 1860 onwards. Many are built of brick and flint construction. The thickness of the walls to these properties range from between 9 inch solid brick and 30 inch solid brick. In some cases the cottages are within one metre of the lane.

13 Over the years exploratory holes have been excavated to some of the properties in Potter Row that have revealed that there are little or no foundations to these cottages. Several properties constructed in 9 inch thick brickwork have foundations that extend possibly only three or four brick courses below ground level. There are no concrete foundations and there is no corbelling to spread the load of the building onto the ground.

14 The Geological Drift Map indicates the sub soil to be Clay.

Other Factors

15 The lane, by nature, has no public footpath and therefore all pedestrians, elderly folk, children, those using the bus service or the post box on the side of The Old Lamb, all have to use the lane for access.

16 Not all of the cottages along Potter Row have off road parking. Lamb Cottage, has only one car parking space and visitors park on the road. Sunnyside, has space for only two cars. Lace Cottage has no off road parking therefore there is virtually permanent parking on the roadside 24 hours a day. The Chalet has limited off road parking so all visitors park on the road. Likewise with Beeway and Chiltern Cottage.

17 At the southeast end of Potter Row there are three or four modern houses where cars frequently park outside on the roadside and these properties are situated close to a blind bend.

18 All delivery lorries, collections etc, park on the road from time to time on a temporary basis.

Construction Traffic Proposals

19 From the drawings it is clear that Potter Row is a designated route for construction traffic, giving access to the bridges along the south side of Potter Row and a large compound and stockpile area known as "sustainable placement" according to the proposals.

20 The quantity and movement of such traffic is uncertain but sources suggest 64 movements a day. The weight and size of the vehicles is unknown, but likely to be at least 12.0 tonne tipper lorries or greater (un-laden weight, with a permitted pay load of approximately 12 tonnes). Such vehicles are typical in earth moving contracts. Although currently occasional vehicles along Potter Row will have a similar un-laden weight to this, the proposed site vehicles will have laden loads far in excess of what the road was originally intended or designed. This multiplied by the number of vehicles will place an extreme burden on the road construction. The current lane will not have been built to standards sufficient for such heavy vehicle loads.

21 Ground borne vibration is a known feature and many papers have been written on the subject including Transport and Road Research Laboratory (TRRL) Research Report 102 conducted by G R Watts MSc PhD, with further evaluation and measurement by British Standard BS7 and the TRRL PPR202 entitled "Characteristics of Vehicles Producing Excessive Noise and Ground Borne Vibration by G R Watts and R E Stait". There are many other publications that refer to ground borne vibration.

22 It is key to understand the behaviour of the clay sub soil when impacted by large heavy vehicles in close proximity in respect of not only noise, but also the effects of vibration through the ground on the extremely shallow and vulnerable foundations of the cottages along Potter Row.

23 Those properties with no foundations within a metre of the road verge are particularly susceptible to ground changes and repeated vibration will have a detrimental effect on the buildings along Potter Row.

General Comments and Conclusions

24 Potter Row is a narrow country lane, not constructed to take large volumes of heavy lorries and site traffic. It will suffer catastrophic road failure under the loads of these vehicles. As the surface disintegrates and ruts, the vehicles will impact with the ruts, increasing the ground borne vibration and intensify the frequency and magnitude of vibration through the sub soil to the base of the brickwork walls of the cottages adjacent to the lane constructed subterranean. There are no foundations to these cottages and therefore the risk of damage to these old buildings is significant.

25 The risk of injury to those using the lane will be high with the proposed volume of site traffic.

26 There will be no opportunity for lorries to pass each other in the lane, as is demonstrated by the current level of vehicular movements along this road. Parked vehicles along this road will also interrupt the significant increase in traffic

along the road and increase the potential for major traffic holdups. Therefore congestion and damage to the verges and property will occur. If this were to coincide with the use of an emergency vehicle this would have a detrimental affect on the Health and Safety and welfare of the occupants along Potter Row.

Traffic forecasts

27 Page 89 of the Non-technical summary says:

> **Traffic and transport**
> The increase in traffic during construction will lead to congestion and delays at junctions in the area including at the A413 London Road/A4128 Link Road and the A413 London Road/B485 Frith Hill; B485 Frith Hill/Chesham Road. Construction traffic in this area will affect pedestrians and cyclists using roads in the area including the A413 London Road/Nash Lee Road, Potter Row and King's Lane.
>
> Temporary closure of Frith Hill and Hyde Lane during construction will increase journey times for users of these roads due to the additional travel distance required. Temporary closure and associated diversion of eight public rights of way during construction will affect pedestrians and cyclists due to the increased travel distances required by associated diversions.
>
> The permanent realignment of eight public rights of way and two roads (King's Lane and the B485 Chesham Road) will have significant effects on pedestrians and cyclists due to the increased travel distances required by use of diverted or alternative routes.

28 But whereas Volume 2 CFA9 12.4.13 agrees that significant changes to congestion and delays at these locations, Volume 5: Appendix Transport assessment- TR – 001-000 predicts queues of just 1, 2 or 3! From this plainly incorrect analysis HS2 Ltd conclude that the roads would not be near capacity and that there would not be a substantial impact.

29 The reality is that the A413/B485 is already at capacity in peak, with substantial queues on the B285 onto the A413 roundabout in the morning and the Link road from Great Missenden onto the A413 in morning and evening, and on the A413 into these junctions southbound in the morning and northbound in the evening.

30 The following pictures shows the typical weekday conditions at present. The addition of substantial numbers of HGV movements would create gridlock. There are effectively no alternative routes, with nearby roads from the South Heath area (ie Leather Lane, Hyde Lane and Keepers Lane being single track.

B485 onto the A413 - typical weekday am peak hours, and Link road onto A413 (am or pm peak)

Junction of Frith Hill with B485, showing its extreme gradient and unsuitability for HGV traffic

Road closures

31 As a result of the proposals, Hyde Lane and Frith Hill will be diverted for up to one or two years respectively. The diversion route for Hyde Lane will be up to 6km, while the diversion route for Frith Hill will be up to 2.6km. The document states that the diversion of Hyde Lane will affect 120 vehicles per day, while the diversion of Frith Hill will affect 1930 vehicles per day.

32 This will have a significant impact on the local community that depends upon access to Great Missenden for all facilities. Alternative arrangements should be made eg a temporary road bridge built.

Buses

33 Extraordinarily HS2 Ltd state:

'No significant impact on bus services during the construction of the Proposed Scheme

has been identified in this area.[51]

34 This is despite acknowledging the significant effects on traffic at junctions used by the local busses. The table below summaries the routes of public buses that use the junctions:

	Route	Effected area
55	Chesham - Amersham - Wendover - Stoke Mandeville Hospital – Aylesbury	A413, Amersham - Wendover
177	Great Missenden/Chartridge – Chesham	A413 Amersham- Gt Missenden; A4128, B485, Kings Lane Potter Row

35 Besides the public buses, there is a network of school buses that would be subject to serious delays. The Chesham Society report that 15 school bus routes utilise or cross the A413 on their journeys, and are likely to be delayed by peak hour congestion.

36 For children starting secondary school in 2017, the adverse effects will last for most of their school career, which must have a major cumulative adverse effect on academic achievement.

Other road users

Cyclists

37 The Chilterns AoNB is an important facility for cyclists – both on and off road. Three major cycle routes cross the proposed line, in four different locations. Only one crossing has been noted; no measures to reduce the risk to cyclists have been proposed.

38 The Chilterns Cycleway is a 170 mile circular cycle route through the Chilterns AONB, taking in the best of the Chilterns scenery. The route is mainly on-road and is signposted throughout. The cycleway crosses the A413 at two points –

- Keepers Lane – Little Missenden Junction.
- London Road-Small Dean Lane- at Wendover.

39 The Chiltern Heritage Cycling Trail is the District Councils Millennium project. The 25 mile trail (divided into three loops) links the Districts two towns and fourteen parishes and visits many of the areas picturesque villages and places of historic interest. The Hampdon route passes along Frith Hill, Potter Row and Keepers Lane, all seriously affected by the construction works.

40 The National Cycle Network Route 57, which is a long distance cycle route along quiet lanes also uses part of the Hampdon Chiltern Heritage Cycling Trail route.

41 In the South Heath area the specific construction routes that HS2 plan to us are on long and medium distance safe cycling routes. For the duration of construction activities it would not afford a safe route.

Ramblers and equestrian users

42 The foot paths, right of way and lanes are a popular resource for ramblers, with parties of school children frequently seen on the routes.

43 The lanes of the South Heath area are also popular with local equestrians as they currently offer quiet and safe environments for road work. Besides three livery stables in close proximity to

[51] Volume 2 CFA9, Page 193 section 12.4.20

South Heath (Middle Grove Farm (on the Chesham Road), Deep Mill (on Hyde Lane) ,and Riddings Farm (on Herbert's Hole), horses are kept domestically and in local fields.

44 While the ES acknowledges these issues, it proposes nothing that will allow either residents or visitors to enjoy the former amenities of the area without exposure to risk from large vehicles in an unsuitable environment.

Section 10: Engineering Report on the South Heath Chilterns Tunnel Extension

Engineering Report on South Heath Chilterns Tunnel Extension

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27 February 2014

(July 2013 report updated)

Contents

Engineering Report on South Heath Chiltern Tunnel Extension (SHCTE)

1. Summary

This report is an update of the July 2013 Report submitted as part of REPA's response to the Draft Environmental Statement. There are no changes as regards the engineering issues, and it still finds that extending the bored tunnel by 3.6kms from Mantles Wood to beyond South Heath (where the land falls away at Liberty Lane) is feasible. The engineering feasibility has been agreed by HS2 Ltd.

Substantial environmental benefits would be delivered by this extension. The SHCTE would lengthen the Chiltern bored tunnel to almost 17km and replace the HS2 Ltd's proposed cuttings and green tunnel through South Heath.

The report provides an update on the costs after taking account of new information. Our best estimate is still that there would be no net engineering cost, and probably a small saving (about £12m). HS2 Ltd estimates a small net cost (£48m), but will not release the details of their costings. These costs do not include a monetisation of the environmental benefits, although it would considerable.

2. Background

Since January 2012 HS2 Ltd's proposals have involved the 13.3km Chiltern bored tunnel ending in the ancient woodland at Mantles Wood, near Hyde Heath. The Central Chilterns Community Forum (CFA 9) questioned why the bored tunnel is not planned to continue further to a suitable place beyond the end of the proposed South Heath green tunnel. Besides having considerable environmental benefits, it would seem to have no net engineering cost.

HS2 Ltd eventually agreed in 2013 (in correspondence between both the Chesham Society[52] and with Cheryl Gillan[53] MP) to have this option formally reviewed by their engineers (Atkins). However, the 2013 Draft Environmental Assessment[54] (DES) subsequently published stated that the option of extending the tunnel to the north end of South Heath, and to Leather Lane, had already been examined (by Atkins) and rejected on cost grounds. This had apparently happened a year earlier in 2012.

None of HS2 Ltd's 2012 work on this option was disclosed to the Community Forum, nor has it been forthcoming as a result of subsequent correspondence and meetings that have requested it. HS2 Ltd assert that this matter was taken account of in their published tunnel reports that look at other options, but this is not evident. An undertaking by Alison Munro that the original work by Atkins would be updated and made available when the hybrid bill was laid has not been honoured.

One local group – the Residents' Environmental Protection Association (REPA) whilst accepting that the only way to safeguard the Chilterns properly is to tunnel to Wendover – decided in 2013 to commission an Engineering Report on the option, to cover both the technical issues and costs. This had become necessary because access to the relevant HS2 Ltd reports had being refused. The main purpose was to establish whether the SHCTE would be likely to give rise to extra engineering costs or not.

The remit from REPA was to

- Examine the vertical alignment of the proposal to extend the bored tunnel from Mantles Wood to South Heath emerging at a suitable point where the land falls away
- Provide estimates of the costs of the SHCTE proposal in comparison with HS2 Ltd's preferred proposal (for a green tunnel and cuttings)
- Set out the main environmental consequences of a SHCTE compared to HS2 Ltd's proposal. These would be balanced against any resultant net cost of SHCTE

[52] Letter of 4 March 2013 from Chesham Society and response from Alison Munro of same day
[53] Letter of 25 April 2013 from Alison Munro, HS2 ltd to Cheryl Gillan, MP for Chesham and Amersham
[54] Page 28 of Central Chilterns Forum (Report 9) – option (b) to South Heath, and Option (d) to Leather Lane

The resultant engineering report was submitted as part of the response by REPA to the Draft ES in July 2013. It showed that SHCTE was a practical proposition on engineering grounds, it had environmental benefits and might actually save money. It used the work done by Atkins for HS2 Ltd on the longer tunnel options by CRAG (T1 and T2). The Atkins work either had been used directly to derive cost estimates, as a source of standards to which the tunnel should comply, or as a cross check on costs that has otherwise been sourced from HS2 Ltd (in their HS2 Cost and Risk Model Report 2012) or Spon's Civil Engineering and Highway Works Price Book 2013.

The Environmental Statement (ES) published in November 2013 referred to the REPA option[55], and rejected it. It stated that

> *"while the extended tunnel option is feasible in engineering terms and would have environmental benefits, there would be a financial cost in extending the bored tunnel. This remains the case even when accounting for savings in engineered structures which would no longer be required".*

The ES also said the REPA option would impact on the current project completion dates.

This current engineering report now updates the July 2013 report, which was discussed with HS2 Ltd in October 2013. It includes more recent data on costs from FOI's, Parliamentary Questions, exchanges with HS2 Ltd as well as a correction to Atkins data that resulted from REPA highlighting discrepancies. The updated report also includes HS2 Ltd.'s own estimate of the net engineering cost of the SCHTE proposal (£48m) that was provided following a meeting in October 2013.

There are several unresolved cost issues. At the time of preparing this report HS2 Ltd are still refusing to release information on how their figures are derived. They have yet to provide their promised comments on specific issues raised by the earlier REPA report, or fix a date for a promised further meeting. The updated Atkins report on the extended SHCTE tunnel option has not been released. The most recent two letters, of six weeks ago, from REPA on cost issues have yet to receive a reply from HS2 Ltd[56].

3. Outline of proposal

Under HS2 Ltd's current proposal

- The line enters a 13.5km deep bored tunnel from inside the M25 and exits through a portal in Mantles Wood at Chainage 44.700.
- It then goes through a deep cutting for 1,560 metres before entering a 1,070 cut and cover ('green') tunnel around South Heath.
- Thereafter it continues in a cutting of variable depth until the viaduct at Durham Farm, Wendover Dean.

Both the deep cutting from Mantles Wood and the green tunnel around South Heath are expensive to construct and will cause immense environmental damage in an Area of Outstanding Natural Beauty (AONB) both while being constructed and when built. The deep cutting will generate large quantities of spoil which would either need to be moved off site or be re-used in obtrusive structures and the cutting will irreparably damage ancient woodland, as will the green tunnel.

Four roads will be bisected by the cutting and green tunnel causing considerable disruption during construction and requiring new bridges or permanent diversions. Houses will need to be demolished and many more will be blighted. Footpaths will be severed. The currently protected landscape will be irreversibly damaged. There will be the physical impacts of noise, air quality, light pollution and obtrusive structures in an area of exceptional landscapes and tranquillity, currently accessed via a network of country lanes, quiet roads and footpaths.

[55] Volume 2 CFA 9, para 2.6.18. page 41
[56] 13 January 2014, and 15 January 2014 from REPA to HS2 Ltd (Neil Cowie, Alison Munro)

All this could be avoided by the Tunnel Boring Machines (TBMs) continuing to create a bored tunnel from Mantles Wood (44.700) another 3.63km (including the portal) to Liberty Lane at chainage 48.330 (approx). Under this proposal

- The continuous bored tunnel would be just under 17km long, which is shorter than the 20km limit beyond which special safety measures must be considered
- The vertical alignment would be some 20 metres lower where the line passes under Mantles Wood and Hedgemore Wood. This is necessary to ensure sufficient cover for the tunnels.
- The bored tunnel would continue upwards to pass 20 metres under the low point at 47.250 near Frith Hill exiting at a portal at 48.330 (at Liberty Lane)
- The line would then pass through a partially retained cutting until 49.330 where it would join the vertical alignment of the current HS2 Ltd proposed approach (at Cottage Farm footpath).

An additional vent would be required. This could be in the field behind Annie Baileys (at 46.000), with access to the Chesham Road. To comply with the 3km intervals, the vent should be at 46.000, but when discussed at a meeting on the CRAG tunnel proposals[57] it was suggested moving the vent 100m (to 46.100) would be unlikely to be an issue. This would protect the dwellings on Hyde Lane.

Access to the portal could be along a new road next to Liberty Lane, northward to Potter Row. The TBMs would be removed along this more direct route to the A413 – as Leather Lane is considered too steep for this.

It might be possible to combine the compound for the portal works with the compound that is required under HS2 Ltd's proposal for the adjacent works at Leather Lane, reducing costs and disturbance.

It might also be possible to extend the SHCTE from Liberty Lane to Leather Lane. This should be investigated if the SHCTE option is agreed.

The engineering drawing by Peter Brett Associates (PBA) is at Appendix 1. It shows the plan and profile of the SHCTE proposal and in comparison to HS2 Ltd's preferred proposal. PBA have used the standards applied by Atkins in their adjustments to the CRAG tunnel proposals (and uses the Atkins map). SCHTE's vertical alignment is similar to the southern part of the CRAG proposal that has the break at Durham Farm, (T2), as adjusted by Atkins.

HS2 Ltd have now formally agreed (in meeting with REPA in October 2013 and in the ES) that the proposal is feasible in engineering terms. This report therefore focuses on the cost and scheduling issues that have been raised.

4. Benefits of SHTCE compared with the current HS2 Ltd proposal

There are substantial benefits to the SCHTE proposal:

- Protects a further 3.63 km (20%) of the AONB on the route, and the amenity of the landscape, the character of the roads and footpaths for residents and visitors in perpetuity
- Deep cutting from Mantles Wood to Chesham Road is avoided as is the shallower cutting from South Heath to Liberty Lane.
- Access to and construction of portal is easier, with a shorter access on more level ground
- It has no need for a green tunnel next to the community of South Heath (or its portals, electricity substation and new access roads) or the five compounds lasting up to 8 years to support the work.
- Road diversions involving Hyde Lane, Chesham Road, Kings Lane and Frith Hill are unnecessary.
- It saves three ancient woods – Mantles Wood, Farthings Wood and Sibley's Coppice– this constitutes 25% of all the loss to ancient woodlands (9.3ha) being fragmented or destroyed by Phase 1. The loss to Mantles Wood (6.3ha) is the largest proposed loss from Phase 1.

[57] At a meeting of 25 June 2013 between Atkins/HS2 Ltd/Brett and the Crag Tunnel Group on their T1 and T2 proposals.

- During construction it avoids noise, dust, waste light, etc for residents of Hyde Heath, Hyde End, Cudsden Court, South Heath and most of Potter Row.
- During construction it benefits users of the Great Missenden/Chesham Road, and users of local access to Great Missenden for residents of Hyde Heath, Hyde End, South Heath, Ballinger, Potter Row and Pednor who will otherwise suffer from the increased traffic on the proposed construction routes (of Kings Lane, B485/Chesham Road, Frith Hill, Potter Row, Hyde Heath Road and A413)
- It lowers the alignment of the route from the new tunnel portal (at 48.330) for one kilometre (to 49,330), and materially (over 3 metres) for 0.5km, reducing visual and noise impacts particularly towards the tunnel end (and hence benefits residents of Potter Row)
- It avoids light pollution for the 3.63km section – from the catenaries and trains (more than 1 every 2 minutes), from maintenance work, and from the road layout changes requiring a lit roundabout at South Heath
- It avoids noise impacts from the two open cuttings and the two portals which are estimated (by REPA) on HS2 Ltd's own data to affect far more properties than HS2 Ltd suggest. In justifying the rejection of the SHCTE option in the ES, HS2 Ltd state that their own proposals provide "*effective noise mitigation for the majority of South Heath during the operation of the railway*[58]. The REPA response to the ES disproves this.
- It saves changing 16 footpaths [59]
- It saves 8 homes from destruction in addition to several other buildings (23 outbuildings and 3 commercial ones), moving 3 pylons, blighting over 500 houses that are within 1km of the HS2 Ltd proposal for this 3.63km section, and the loss of the local amenities of the gym and pub/restaurant.
- It avoids the need for 11 balancing ponds that are out of character in the Chilterns ridges.
- It reduces land take and compensation payments.
- It avoids properties becoming empty, decaying (as Annie Baileys has done) due to the blight, and impacting on the character of the area.
- It saves the need for a local site in which to dispose of surplus excavated material.
- It avoids the building of unsightly embankments of spoil, vast materials stockpiles needed for several years, and tree planting.

5. Dis-benefits of SHTCE compared with the current HS2 Ltd proposal

The dis-benfits are:

- A 19.6 metre separation of lines coming out of the bored tunnel will result in an increased land take towards Bowood Lane. This is taken account of in the costings.
- An additional vent by B485/Chesham Road near the site of Annie Baileys. While this would still represent an unwelcome addition to the landscape of the AONB it is minor by comparison to the proposed works. It is already taken account of in the costings (as the relevant unit cost figures allow for the necessary vents).
- Continuing the bore from Mantles Wood to Liberty Lane (chainage 48.330) HS2 Ltd have said would add about 1 year to the time, as it would take an additional 36 weeks to complete the bored tunnel at the expected incremental tunnelling rates (100m/week).

This last issue is discussed in Appendix 5, which examines what impact the additional tunnelling and fitting out for rail systems that is needed might have on the overall completion of the project. It suggests that although one of the latest schedules in the ES now contains no gap for the work (unlike the previous Draft ES), there are clear inconsistencies between the schedules. It should be perfectly possible to accommodate the time required, and not prejudice the overall timing of the project.

[58] Volume 2 CFA 9, para 2.6.20

[59] From north to south these are: GMI/12; GM1/13; Frith Hill; GM1/80; GM1/79; GM1/28; GM1/33/4; GM1/33/5; LMI/27; GMI/33/3; GMI/33/2; GM1/27; GMI/23; GM1/23/6; LMI/21; LMI/17

6. Comparison of the Engineering Costs

Table 1 below examines the costs on several bases, using available data. Table 2 re-presents the identical data but by construction category (tunnel, civils and systems), and shows the four figures HS2 Ltd provided.

The tables show **HS2 Ltd's own costing** (col 3 of Table 1) of the REPA option, for which very few figures were made available. The other columns represent **our own estimates** of the SCHTE option, showing:

- Average built up cost figures (Columns 4 and 5 in Table 1)
- Marginal cost figures (for deep bore tunnel) on three bases – (column 6 to 11 in Table 1)
- Man-year figures (column 12[60]) in Table 1

Spreadsheets with the itemised costings are available but a summary is provided at Appendix 4.

Particular points on the costs are:

- This report finds that the **marginal** bored tunnel costs are the appropriate basis on which to assess extending a bored tunnel. The reasons are discussed in Section 7 and at Appendices 2 and 3. Our central estimate uses Column 9 (table 1), suggesting a small £12m saving. But other bases are included ie the average built-up cost figures and a simple man-years sense check.
- All figures are base costs only – as stated in the HS2 Ltd unit cost source and in the Atkins material.
- Various cross checks are also done on the data using the recently corrected Atkins data provided as part of the meetings on the CRAG proposals; as well as FOI's/PQ responses
- The costs assume the cost of the portal, access and associated facilities are the same for Mantles Wood and Liberty Lane. In practice it may be cheaper at 'Liberty Lane', due to easier access.

Table 1: Analysis of costs (see Appendix 4 for more detail)

All costs are base costs only		HS2 Ltd's	Costings for REPA of the SHCTE compared to HS2 Ltd's proposal								
	distance	own	Average cost		Marginal bored costs:						Man-
	(metres)	Costing	built up		A: calc green tunnel		B: HS2 green tunnel		C: HS2 Ltd base costs		years
			cost/m	cost £m	cost/m	cost £m	cost/m	cost £m	cost/m	cost £m	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Additional costs of SHCTE											
Bored tunnel Mantles Wood to Liberty Lane	3,630	?	£42,496	154.3	£34,102	123.8	£33,997	123.4	£42,971	156.0	275
Additional rail systems cost		15.0		7.5		7.5		7.5		7.5	
Vent (cost included in tunneling)		?									105
Deeper wider cutting Liberty L. to Cottage Farm	1,000	?	£16,694	16.7	£16,694	16.7	£16,694	16.7	£16,694	16.7	
extra cost of wide 1st km		?		3.0		3.0		3.0		3.0	
Total		**?**		**181.4**		**151.0**		**150.6**		**183.2**	**380.0**
Savings on HS2 Ltd proposal											
Cost of cutting Mantles Wood to green tunnel	1,560	?	£16,863	26.3	£16,863	26.3	£16,863	26.3	£16,863	26.3	
extra cost of wide 1st km		?		3.0		3.0		3.0		3.0	
South Heath green tunnel	1,200	?	£74,428	89.3	£74,428	89.3	£56,449	67.7	£56,449	67.7	450
South Heath to Liberty Lane cutting	1,000	?	£13,032	13.0	£13,032	13.0	£13,032	13.0	£13,032	13.0	
Liberty Lane to Cottage Farm footpath Cutting	1,000	?	£7,884	7.9	£7,884	7.9	£7,884	7.9	£7,884	7.9	
Spoil movement to Hunts Green		?		15.0		15.0		15.0		15.0	
Roads, bridges etc		?		14.8		14.8		14.8		14.8	
Temporary diversion of National Grid		?		5.0		5.0		5.0		5.0	
Land/property required		10.0		10.0		10.0		10.0		10.0	
Total		**?**		**184.4**		**184.4**		**162.8**		**162.8**	**450.0**
Net cost of SHCTE		**48.4**		**-3.0**		**-33.4**		**-12.2**		**20.3**	**-70.0**

All notes to the table refer to column numbers:

(3) Provided by HS2 ltd to REPA by letter, following a meeting on 22 October 2013

(4) Bored tunnel cost is the low figure (ie £32,400 for a long tunnel) per metre for twin bore tunnels from Appendix A[61] scaled up in proportion to the ratio of the radii to the power 1.4 for Chiltern bored tunnel (8.8m diameters) over the

[60] This uses data from the Draft environmental statement.

reference data (7.25m diameters), to give £42,496). The increase is less than the ratio of the cross sections, as some of the cost elements increase at less than proportionally to cross section (eg labour)

Cutting costs use same Appendix A for cutting and on site re-use for embankment, volume based on average cutting depth for each of the specific cuttings

Green tunnel cost is built up from digging cutting, structure construction, materials, but removing from site only the volume of spoil of green tunnel itself. Using Appendix A and also Spon's data. Appendix 4 shows the details.

(5) Costs per metre (at 4) are scaled by distance (at 2).

Cost of volume of spoil from wider cutting needed near bored tunnel portal (assumed as extending 1 km) costed as reused for on-site embankment.

Roads, bridges etc costed using Spon's.

(6) Bored tunnel cost is the FOI13-621R figure for the cost (£26,000) of tunnelling per metre, scaled for the larger tunnel diameter on the same basis as at (4), to give £34,102.

(7) Calculated as (5) but based on costs per metre from (6)

(8) The bored tunnel takes the marginal cost to be 80% of average cost in (4), giving £33,997. The 80% is the variable cost (£21k/m), as % of the average cost (£26k/m) in FOI13-621R.

The green tunnel cost uses the Atkins figure for the Wendover tunnel, from the correction to Table 4.8 in their report on the CRAG tunnel option costs. It then derives the South Heath green tunnel cost. This is scaled from the Wendover tunnel cost by the ratio of the tunnel costs given to Frank Dobson (see Appendix 3)

(9) Calculated as (5) but based on costs per metre from (8).

(10) The bored tunnel costs are 80% of the Atkins Chilterns bored tunnel cost for HS2 Ltd's preferred option, derived from subtracting the costs of the two green tunnels from the total corrected tunneling costs (£849.5m) and divided by the length of bored tunnel.

The green tunnel cost is calculated as (8).

(11) Calculated as (5) but based on costs per metre from (10).

(12) Manpower costs in man-years derived from the average manpower and site duration figures given in the various volumes of the DES[62] It is assumed that the tunneling site at the M25 end would continue nine months longer, an additional vent would be built and the construction sites at the north and south ends of the South Heath green tunnel would not be needed with the SHCTE. It is assumed the additional vent will have same manpower as the Little Missenden vent (which has the highest manpower requirement of the vents).

Table 2: data in Table 1 re-presented to align with the format of how HS2 Ltd provided their data

All costs are base costs only	HS2 Ltd's own costings	Costings for REPA of the SHCTE compared to HS2 Ltd's proposal			
		Average cost built up	Marginal bored costs:		
			A: calc green tunnel	B: HS2 green tunnel	C: HS2 Ltd base costs
Construction	**£m**	**£m**	**£m**	**£m**	**£m**
Tunnels:					
(1) 3.63kms extra bored tunneling	n/a	154.3	123.8	123.4	156.0
(2) South Heath green tunnel saving	n/a	-89.3	-89.3	-67.7	-67.7
Tunnel total	98.5	64.9	34.5	55.7	88.2
Civils	-54.7	-65.4	-65.4	-65.4	-65.4
Rail Systems	15.0	7.5	7.5	7.5	7.5
Construction sub total	**58.8**	**7.0**	**-23.4**	**-2.2**	**30.3**
Land/Property	-10.0	-10.0	-10.0	-10.0	-10.0
Total construction, land and property	**48.8**	**-3.0**	**-33.4**	**-12.2**	**20.3**

The data in Table 2 is exactly the same as Table 1, but totaled by construction category. It shows the one additional figure that HS2 Ltd provided ie the Civils costs. HS2 Ltd estimate a slightly lower Civils saving than we do. We suspect this relates to spoil disposal and possibly pylons. This is discussed below at section 7.

Again it shows HS2 Ltd estimate the proposal will have a net cost of £48.8m, while this report estimates a small saving of £12m (using our central estimate) in the engineering and land costs.

[61] 'HS2 Costs and Risks Model Report', HS2 Ltd, March 2012

[62] 'Table 1 Location of construction compound sites' in Draft Environmental Assessment Community Forum Area Report – 9 Central Chilterns , and the same table in Reports 7 – Colne Valley and 8 – The Chalfonts and Amersham.

7. Discussion

Table 1 (and 2) on costs indicates that the savings exceed the costs of SHCTE on the basis of two of the three marginal cost analyses for extending the bored tunnelling. Appendix 2 discusses the alternative cost bases and suggests that the marginal cost basis is appropriate where it is an extension to a bored tunnel.

HS2 Ltd has refused to disclose detailed costings on the basis that they are commercially sensitive. This is despite it being several years before contracts will be let, and their obvious importance to addressing HS2 Ltd's own environmental responsibilities. As discussed earlier they have also given neither the figures nor the report to justify their decision in 2012 to reject Option (b), nor its subsequent re-working that led to its rejection in the ES in 2013.

As a consequence several methods are used to estimate the relative cost of extending the bored tunnel against HS2 Ltd's plan. This includes figures provided in June 2013 by Atkins as part of the latest assessment of the longer CRAG tunnel option, as corrected in 2014 for an error in the breakdown of costs for HS2 Ltd's preferred option.

There is difficulty in using information from HS2 Ltd:

- Rarely is the basis of the costs given (ie precisely what they exclude and include)
- Releases of information (eg in response to a parliamentary question or an FOI) can be on different bases with no clarity as to how or why they differ
- Different pieces of information provided by HS2 Ltd on key cost elements are inconsistent with each other. While individual pieces of information (eg about the Chiltern tunnel costs in response to a parliamentary question) may be recent, there is no way of using them in a consistent analysis apt for comparing options even were they assumed accurate.

It is not credible that the information has been released in this manner is accidental: HS2 Ltd clearly seeks to avoid scrutiny of their own work, or the effective costing of alternatives. If this conduct is deliberate it is highly reprehensible for a public body spending public funds.

As a result, our preferred approach is to use information on a consistent basis where possible, that generally involves building-up costs from unit cost data that HS2 Ltd have published or otherwise released.

Despite HS2 Ltd now being disparaging about its own published unit cost data[63], we feel it provides a consistent basis for performing a comparative costing. Further, the *2012 HS2 Cost and Risk Model Report* (para 2.2.1[64]) says of the unit cost information (published in the updated Appendix A) that it enabled the assessment of the alternatives of "*complex surface works versus the costs of tunnelling and the associated environmental benefits"*. This is precisely the use to which we have put it.

7.1 Bored tunnel costs

We have now had sight of some information on tunnel costs that HS2 Ltd has put into the public domain but of which we were unaware when we drafted the original version of this report, and also some which has been provided subsequently.

HS2 Ltd's response to a Freedom of Information request (references FOI13-607 and FOI13-621R) of July 2013, specifically addressed tunnelling cost. It provided several useful insights:

[63] At our meeting in October 2013 it was suggested it was not appropriate for the Chilterns, and each tunnel cost assessment was done individually

[64] *2.2.1 To derive the base costs, the updated rate set is applied to the scope defined by the engineering teams. As part of the ongoing development of our cost models, the scope templates now used provide a greater level of granularity – previously 45 scope elements could be selected, 250 elements are now available. This enables us to more accurately reflect our understanding of the scope as it emerges. In some cases, this level of detail has meant that we have been able to reflect on the balance of costs between potential options for a route section. A particular example is the balance of costs between complex surface works versus the costs of tunneling and the associated environmental benefits*.

- It confirmed the meaning of the "*range dependent on length*" phrase in Appendix A unit costs (namely that the £32.4k/m was for the **longest** twin bored tunnel and £61.6k/m for the **shortest**), as it shows in the FOI that the highest figure is for shortest length of tunnel. (FOI13-607)
- It contained a figure (from a graph) that shows that the combination of fixed and variable cost increases at £26k/m for tunnel lengths over 7.5km. (FOI13-621R)

This suggests it is reasonable to

- Use the lower Appendix A figure of £32.4k/m for the built-up costs (increased to £42.5k/m for the larger diameter) as the full or average cost for the Chilterns tunnel
- Assume that that the marginal cost is materially lower than the average cost. The FOI response is therefore clearly supportive of our view of the deep bored tunnel incremental costs, and inconsistent with the position that HS2 Ltd have adopted in our exchanges – that marginal costs are only very slightly less than average costs.

However, although not stated, it seems plausible that the numbers for tunnelling costs used in the graph in FOI13-621R relate to a twin bore tunnel of 7.25m diameter, as this is the basis of both the 2010 and 2012 versions of the Appendix A unit costs. This would give an incremental cost for the Chilterns tunnel (diameter 8.8m) **of £34.1k/m**. We have therefore now updated our REPA marginal cost analysis to base it on this cost (in col 6 and 7 in Table 1).

However there are other ways we now might wish to examine marginal costs.

Information on the costs of HS2's tunnels was also given to Frank Dobson's Parliamentary Question[65](PQ). This gave the total costs and length of every HS2 tunnel (which are shown at Appendix 3). It shows the average cost of the Chiltern bored tunnel was £61.2k/m, and the two Chilterns green tunnels are £60.8k/m and £57.8k/m. We are aware these figures are not in the same coin as other HS2 Ltd cost figures[66], although should be consistent between the different tunnels.

The marginal cost of the bored tunnel must be less than the average cost, and therefore be less than the cost per metre of the South Heath Green tunnel.

From Atkins costings as corrected in January 2014 (discussed at Appendix 2) the **average total** cost for the three Chiltern tunnels is **£53.9k/m**, – as an average of 13.3km of bored tunnel and two green tunnels adding 2.45km, together with the vents and portals. This is understood to be a bare cost, and therefore should be less (and is less) than those given to Frank Dobson.

The bored tunnel comprises two 8.8m bored tunnels, while the green tunnel is a concrete section installed via surface excavation. It is plausible that the full cost per metre of the green tunnels is higher than for a long bored tunnel (although HS2 Ltd's own figures in the PQ response indicate the reverse). In any event the marginal cost of extending a bored tunnel will be less than its average cost.

So a key issue is how much less the **marginal cost** of the bored tunnel is than the **average whole cost** of the Chilterns bored tunnel? Using the data of the lower average cost given in Appendix A (of £32.4k/m), and the marginal cost from FOI13-621R, the variable cost (of £21k/m) is 20% less than the average cost (of £26k/m). Bearing in mind that the boring machines, the costs of their extraction, the [M25] facilities to support the tunnel (stockyards etc), and the waste handling and disposal facilities all are fixed, this does not seem an excessive reduction. This figure updates our previous report that assumed a one third reduction.

Three marginal cost bases examined

By using the corrected Atkins data, the PQ data, and the new marginal cost information discussed above we can construct three plausible bases for assessing the marginal cost:

[65] Frank Dobson: *To ask the Secretary of State for Transport what the (a) location, (b) length and (c) estimated cost is of each tunnel proposed for the London to Birmingham leg of High Speed 2*. [176919] 25 November 2013. See Appendix 4
[66] REPA are engaged in correspondence with HS2 Ltd on the differences (which at the time of writing is incomplete).

A: Basing the cost on the FOI13-621R base value of £26k/m, but adjusting it for the larger radius tunnels (to give a marginal cost of **£34.1k/m**).

B: Basing the cost on being 80% of the average built-up cost (£42.5k/m) derived from Appendix A (ie producing a marginal cost of **£33.99k/m**)

C: Basing the cost on 80% of the average cost (estimated at £53.7k/m) of the Chiltern's bored tunnel (as derived from the Atkins revised assessment of the CRAG tunnel, but also using relative costings from the PQ data ie giving a marginal cost of **£43.0k/m**)

Basis C can now be done because the 2014 correction moved the cost of the Wendover green tunnel from 'civils' to 'tunnels', worth £68.8m. We derive a cost for the South Heath Green tunnel by adjusting the Wendover tunnel costs in the proportion of the costs for the two tunnels given in response to Frank Dobson's parliamentary question (ie £68.8m x 74/75 = £67.9m). We take the cost of the green tunnel off the total tunnel cost (£849.5 –(£68.8 + £67.9) = £712.8m) and divide by the length of the bored tunnel (13.27km) to give a cost of £53.7k/m. 80% of this gives a marginal cost of **£43.0k/m**.

The marginal costs include the cost of an additional vent shaft.

Of the three bases we would expect the second case to be our central case ie using the Appendix A unit costs. But in the absence of having access to the detailed data, each approach has merit.

A crosscheck on the total bored tunnel cost

In our previous report we found the close correspondence (4% difference) between our built up tunnel costs and the HS2 Ltd costing of their preferred option that they gave as part of Atkins' CRAG tunnel costing reassuring that our assessment was right. However, following the correction of this costing, the correspondence is less good – 12% lower than the £849.5m now given as the tunnel costs of HS2 Ltd's proposal. This is not a close agreement. It clearly implies that Atkins figures for the costs of the Chiltern bored tunnel are estimated to have a higher unit cost than those for the longest tunnel in Appendix A. However it is not clear why this should be the case, given that the Chilterns tunnel is the longest built as part of HS2.

Interestingly, if the Chilterns bored tunnel cost is estimated from the Appendix A number for long tunnels, but costs are assumed to be proportional to cross section, instead of proportional to the radius of the tunnel to the power of 1.4, a close correspondence would exist. Equally, were a smaller difference from average to marginal tunnelling assumed, a better correspondence might exist. As we have not been allowed sight of HS2 Ltd's (or Atkins') calculations and assumptions, we cannot comment on the explanation of HS2 Ltd's higher bored tunnel costs.

In fact the discrepancy is in the opposite direction from that which might be expected, as the Atkins numbers have rail systems costs on top of the tunnel costs, whereas the Appendix A derived ones should already include them (according to FOI11-271). But the pertinent question is not just why the Appendix A derived costs appear low, but why the Atkins costs are so high.

The costs produced by Atkins for the tunnel costs are inexplicably high. The average cost is £53.9k/m, and the bored cost about £53.7/m. But this excludes rail systems, that according to FOI11-271 add about £7.5k/m, but from Atkins Table 4.8 from the CRAG report seem to cost £8.4k/m for tunnel, raising the bored tunnel cost to £62.1k/m. This is the level for a short tunnel given by Appendix A unit costs. It similar to the unit cost from the costs given to Frank Dobson, of £61.2k/m. But this last cost includes the contractor costs excluded from the base cost, so putting the Atkins cost on a comparable basis gives £77.0k/m. This is a materially discrepancy (over a quarter).

In contrast our Appendix A derived costs are £42.5k/m before contractors costs and £52.7 including them – some 14% less than the Frank Dobson data.

In general we might expect out-tun tunnel costs to be lower than those estimated by HS2 Ltd, because tunnelling in chalk can be achieved at higher drivage rates than HS2 Ltd have assumed, which reduces unit costs, by spreading time-related costs over a greater output. The recently completed Thames Water tunnel from Becton to Abbey mills, which is predominantly in chalk, had an overall rate of progress of 85m/week.

The external diameter was 8.8m and the length 6.9km. However on account of the constraints of the working site all the back- up equipment for the TBM was on the surface. After the drive had completed 432m it stopped and the back-up was installed in the tunnel. This caused a one month delay, but the average rate of progress from that date to the end of the drive was 107m/day.

We understand that HS2 Ltd are assuming an average drivage rate of 90m/week, well below what can currently be achieved.

7.2 Green tunnel costs

HS2 Ltd have released a wide range of values for the costs of green tunnels, the lowest being £25k/m (FO13-607), with £40k/m for extensions to the South Heath and Wendover tunnels (from a 2012 Atkins options analysis), £53.8k for the Wendover green tunnel (latest Atkins correction to the CRAG Report), and a range of costs from £53.2k/m to £67.4k/m in response to the PQ by Frank Dobson. These are all lower than the built up cost that REPA produced of £74.4k/m. However, this last figure includes, for example, £9k/m (over £10m for the whole tunnel) for spoil disposal off site which may not be included in HS2 Ltd's figures.

The lowest cost given by HS2 Ltd is actually less than the cost of a simple cutting given in Appendix A, which suggest that it cannot possibly be more than a component of the cost.

Indeed the recurrent difficulty with the HS2 Ltd cost is that it is not clear what cost items are included. The treatment of spoil will have a major effect on the overall cost (ie the extent to which the costs include allowance for its use locally or of its removal from site and use or disposal elsewhere). This is essentially why REPA's built up cost (despite being apparently high) is useful. We know what is included, and believe it to be comparable to the bored tunnel costs of Appendix A, and understand how it fits with our assessment of other civils costs that are calculated using Spon's data.

We have assumed that of the spoil generated from the surface works creating the green tunnel, only the volume of the concrete box in the green tunnel is taken off site. We assume that the rest is stored temporarily and then used to bury the concrete structure of the tunnel.

In updating the report we have looked again at alternative ways to cost the green tunnel. This has become possible as a result of the correction Atkins released to the CRAG Report in January this year. The correction provides a cost for the Wendover green tunnel, which should be on a base costs basis, and hence comparable to the Appendix A numbers. However, it remains unclear whether all the elements of cost are included (for example does spoil handing remain part of 'civils', and if so are spoil disposal costs excluded for off-site movements only or all spoil usage including on site?)

However, we have used the Wendover green tunnel cost based approach in our marginal cost assessment for basis B and C in Table 1 (and 2). While we still have reservations as to whether this green tunnel figure is too low, Atkins used it.

Hunts Green disposal

Our previous report already included £10.9m for spoil disposal for the green tunnel, within the green tunnel cost figure. This related to the disposal of some 300,000 cubic metres. But there was no figure for the large amount of **surplus** spoil that it has subsequently been decided will be deposited at Hunts Green. We had assumed that all other spoil would be re-used on site.

Originally, in October 2013, we were told that a total of 800,000 cubic metres of surplus spoil would be deposited at Hunts Green. In the ES this has grown to 1M cubic metres – or possibly 1.28Mm^3 (allowing for a compaction of 1.5 tonnes/m^3) and it no longer originates entirely in the South Heath area.

In correspondence with HS2 Ltd we estimated that 500,000 cubic metres to be disposed of at Hunts Green needed to be added into the costing in addition to the 300,000m^3 we had assumed needed to be taken off site for the green tunnel. We estimated this to cost £15m (using Spon's data). HS2 Ltd have not raised any issue in regard to it. Indeed, the cost may be an underestimate of the transportation to the Hunts Green site, depositing, levelling and compacting the spoil, and restoring the top soil.

The issue is, as ever, which costs have been included, and which are picked up under another classification or have been left out in the costing. We were assured by HS2 Ltd when we met in October 2013 that Atkins had fully included the cost of surplus material in their comparative assessment.

7.3 Built-up cuttings costs

The costs for the deep cutting from Mantles Wood to the South Heath green tunnel, and the cutting from the green tunnel to Liberty Lane (in col 4, 6, 8,10) have also been built up using the cost figures in Appendix A assuming that all the spoil from cuttings is used locally. This is unlikely to be the most environmentally sympathetic approach, but using the spoil locally is cheapest. This assumption is effectively revised by the inclusion in the cost of the £15m for disposing of 500,000m^3 at Hunts Green. (See Table 1).

Allowance has been made for extra width and depth of the cutting where it comes out at Liberty Lane and at Mantles Wood (under the HS2 Ltd proposal). This is shown separately in Table 1.

It is impossible to tell how Atkins have costed the deep cutting from Mantles Wood to the South Heath green tunnel, or the cutting from the green tunnel to Liberty Lane, and with what result.

The extent to which spoil is taken off site is included in all costings (including HS2 Ltd's) as a cost of £15m for disposal at Hunts Green (as discussed above).

Rail systems

HS2 Ltd have informed us that the extra rail systems cost associated with the longer REPA longer tunnel will add £15m, as Table 1 records. The additional cost is on the basis that rail systems costs are more expensive in a tunnel than in the open.

On the available evidence the estimated £15m of additional cost seems high. The Atkins costing of the CRAG options gives an additional rail systems cost of £33.9m for option T1 over the HS2 Ltd option. This implies an additional cost of £4.3k/m, and a total rail systems cost in the tunnel of £8.4k/m.

We assume the rail systems costs are the same irrespective of whether the tunnel is green or bored. An additional 2.4km of tunnel is required for the higher rail systems costs (the 3.63km of the SHCTE less the 1.2km for the South heath green tunnel it replaces). On the basis of £4.3k/m this would give a cost of £10.4m rather than the £15m that HS2 Ltd report. However, this in itself is likely to be an overestimate. Part of the additional cost is the track bed, which is slab rather than ballast. However, a slab base apparently has total-lifetime cost advantages, so the higher initial cost leads to an overall saving.

However, while it may be true that the rail systems costs are higher in tunnels, FOI11-271 clarified unequivocally that the rail systems costs were already <u>within</u> the unit costs of Appendix A (together with ventilation shafts and base construction). It therefore seems incorrect to add the cost of systems to a cost that already includes it. REPA have raised this matter in their letter of 15 January 2014, but have had no response.

We do not see that the £15m should be added to a cost that already includes it. Indeed the logic would be that there is a saving from not having the cost for the systems on the open track (worth about £4.1k/m or £9.8m for the additional length of tunnel).

Similarly HS2 Ltd were insistent that the cost of the additional vent should be added, although this also is allowed for in the unit costs for tunnels given in Appendix A, confirmed in the same FOI (FOI11-271)..

While we are concerned that there are serious issues with the costs Atkins have produced, that they are materially too high, and that approach they commend is inappropriate to costings based on the published unit costs, we have notwithstanding added £7.5m to the REPA tunnel cost in respect of rail systems.

7.4 Built-up costs for reinstatement of roads etc

Appendix A data and Spon's data have been used for estimating reinstating roads (Frith Hill and Kings Lane over the green tunnel) and the bridge over Hyde Lane, that would not now be required. This totals just under £15m. The ES makes clear that some 16 footpaths are affected over this stretch of the AONB, and they are

either diverted or reinstated. These have not been specifically included in our updated report. Our figure may therefore be too low.

We also understand that £29m has been estimated as the cost for diverting overhead electricity supply between Aylesbury and Great Missenden. Clearly a proportion of this is appropriate for South Heath, where three pylons must be moved temporarily and later restored. We have included a notional £5million, given the likely works. This was not included in our previous report.

7.5 Property acquisition

HS2 Ltd have estimated that the SHCTE would save about £10m in property acquisition cost. This seems to be low, as we understand it does not include a number of high value properties which are badly impacted by HS2, and at least some will end up being purchased by HS2 Ltd. It also does not take account of the final compensation scheme that has yet to be announced. So while we are not in a position to provide an accurate estimate, we can say that the actual figure will be larger.

7.6 Results Summary (see Table 1 and 2)

Our marginal costs analysis shows that the extended tunnel should result in either a small saving or a small cost. Two of our marginal cost bases suggest a saving (£33m and £12m), and one suggests the REPA tunnel would result in a small cost £20m. This contrasts with HS2 Ltd's estimate that they have provided that it would result in a net cost £48m.

While each of the marginal cost bases has merit, Basis B is our central case. This uses the latest Appendix A unit cost data for bored tunnels combined with an estimate of the marginal costs that is supported by FOIs. It also uses a new lower South Heath green tunnel cost figure that clearly reflects the lower costs that all the green tunnels on the Phase 1 route are being reported as having (see Appendix 3). This suggests the SHCTE might produce a small saving (£12m).

Importantly all these figures exclude the value of the environmental benefits that are substantial and should be taken account of in the decision.

8. Conclusion

This report finds that the extension of the bored tunnel from Mantles Wood (44,700) to Liberty Lane (48,330) is feasible. The design takes account of the work that Atkins have done on the CRAG proposal and the standards that they applied to the tunnels. HS2 Ltd also agree that in engineering terms it is practicable.

The report finds that marginal costs are the appropriate basis on which to assess the extension to the Chilterns bored tunnel. On this basis extending the bored tunnel to Liberty Lane would save money (estimated at £12m) compared to the current HS2 Ltd proposal.

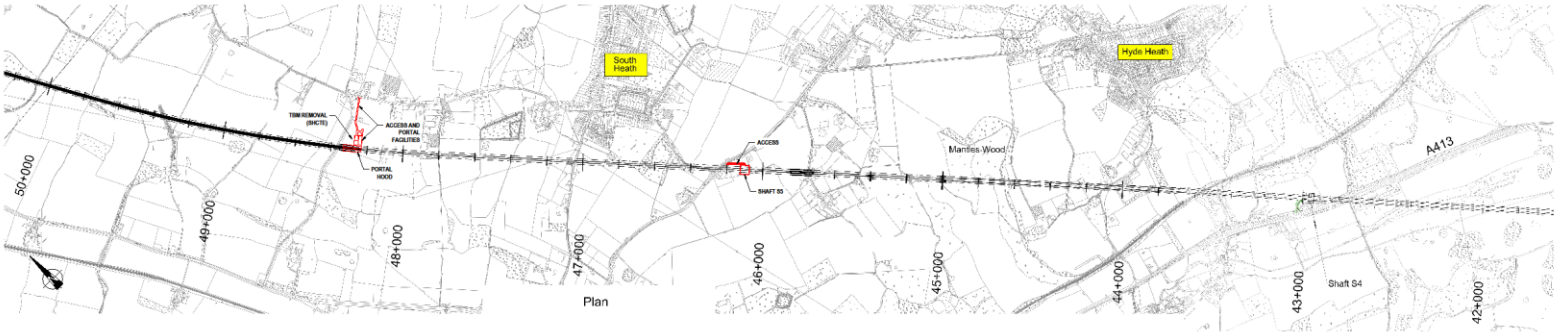
HS2 Ltd by contrast estimates that the SCHTE would cost some £48m extra, and rejected its adoption in the ES.

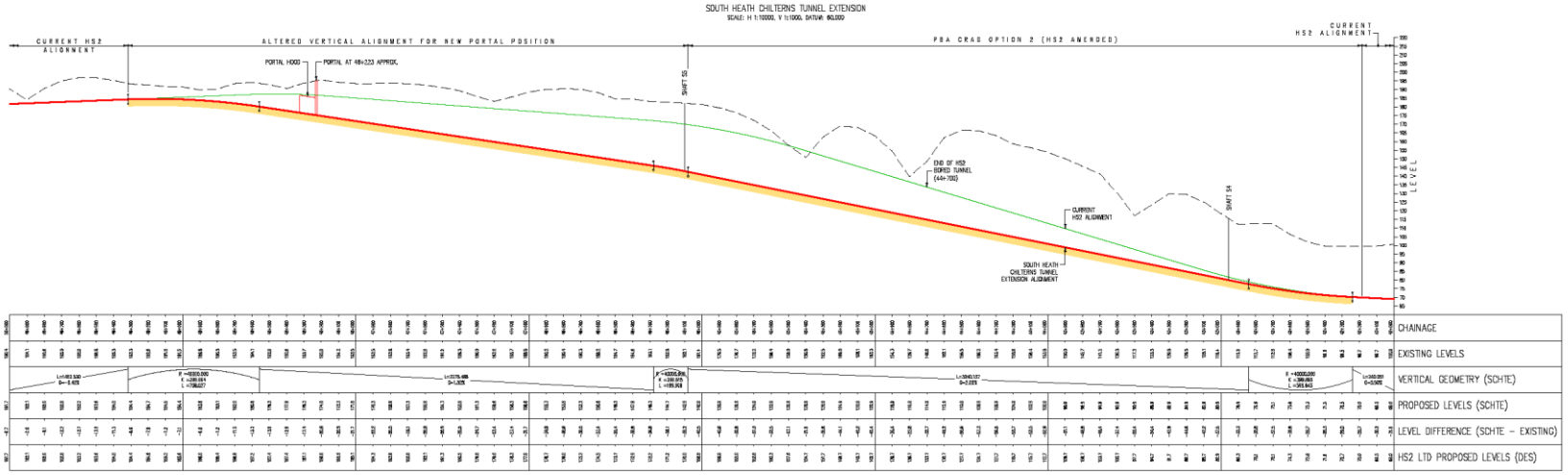
Other cost bases are considered. eg the average built-up cost figures and a simple man-years sense check.

The environmental savings and benefits are also very important, and are not taken account of in either this report, or HS2 Ltd's analysis.

There is unavoidably some uncertainty as to the relative costs of the SHCTE compared to HS2 Ltd's proposal, because HS2 Ltd refuse to provide detailed costs. However, even those variants of the costing that show a net cost for the SHCTE have a sufficiently modest additional cost, (£20m), that the environmental advantages are sufficient to justify the adoption of the SHCTE.

Appendix 1: South Heath Chilterns Tunnel Extension (SHCTE): plan and profile





Mark	Revision	Drawn	Date	Chkd
A	Length of section & plan revised. HS2 current alignment added.	tjl	03.07.13	

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is given for information only. The accuracy cannot be guaranteed. Other such plant or apparatus may also be present but not shown. The Contractor is required to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status:

SOUTH HEATH CHILTERNS
TUNNEL EXTENSION (TO 48+233)

Client:
RESIDENTS' ENVIRONMENTAL PROTECTION ASSOCIATION

Date of 1st Issue	Drawn by
14.06.2013	tjl
01 Scale	Checked by
as shown	BB

Drawing Number: SK 001 | Revision: A

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Appendix 2: Marginal and full costs

To assess whether SHCTE is cheaper than HS2 Ltd's proposal, the appropriate basis for costing is one that accurately reflects the costs of changes from the HS2 Ltd proposal.

There are many different bases on which to produce costs. What is critical in exploring the effect on costs of extending the Chilterns bored tunnel is to have the various elements of change costed on the same basis that allows valid comparisons. It is understood that the costs provided by Atkins to CRAG of the HS2 Ltd proposal and CRAG's two tunnel options[67] were on the basis of 'base costs', before optimism bias and risk adjustments are made. This seems to be similar and possibly identical to the basis of the unit costs given in the cost and risk reports published by HS2[68].

A key issue is what the costs incurred by boring the tunnel the additional length required by SHCTE are.

There are three sorts of cost that might apply:

- Unit costs
- Full costs
- Marginal costs

Unit costs are generally used in scoping exercises, where an average total cost for 'that sort of tunnel' for 'that sort of length' in 'that sort of ground' are used to estimate roughly what a tunnel might cost without detailed site specific information. The 2009 Arup cost factors were of this variety, as were those in the 2012 update of the 'HS2 Cost and Risk Model Report' by Davis Langdon (the producers of the Spon's compendium of current engineering costs) published by HS2 Ltd.

Full costs are the costs built up to reflect all the costs for a specific project. We understand that the HS2 Chilterns tunnel is costed in this manner. It is understood that the Atkins figures given to CRAG (eg on 25 June 2013) are also built up in this manner, but have then been aggregated so that individual cost elements are not distinguishable as given in Table 4.8 of the June 2013 Report (or in the 2014 corrected update of this table).

The average full cost of tunnels for the Chilterns is about £53,900/m, but this is an **average** of 13.3km of bored tunnel and 2.45km of green tunnel. It includes vent shafts, but not fitting out the tunnels with track, signaling and OHLE.

The **marginal cost** is the extra costs incurred by an *incremental* increase in the length of the tunnel. These

- **Include** the costs of the extra materials, labour, running the various facilities, maintenance, spoil disposal (including extending the in-tunnel spoil conveyance system for the extra distance) and maintenance to support tunneling for the longer period. HS2 Ltd promised REPA a definitive list but this has not been provided.

- **Do not include** costs that are not increased by tunneling a bit further: which include the costs of building and decommissioning the access and spoil disposal site; the costs of purchase, build, extraction and removal the TBMs (unless the new extraction site (Liberty Lane) has different costs than the HS2 Ltd proposed one (Mantles Wood)); the costs of the tunnel portal unless this is different for Liberty Lane than Mantles Wood.. It is likely (due to relative accessibility) that Liberty Lane would be a less expensive portal and extraction site than Mantles Wood.

The 2012 HS2 Ltd Cost and Risk Model Report (Appendix A) gives two costs for bored tunnels (£63,600/m and £32,400/m, for a twin bore tunnel of internal diameters of 7.25m). These costs vary by almost a factor of two with length. This is clear evidence that a fixed cost/variable cost split is appropriate for bored tunnels, with the considerable fixed costs (set-up and close down) being spread over the drivage: as the drivage increases, the average cost reduces. This is supported by the information given in response to an

[67] 'Engineering Review of the Proposal by CRAG for an extended Chilterns Tunnel', 7 June 2013, Atkins
[68] 'High Speed Rail London to the West Midlands and Beyond HS2 Cost and Risk Model ', December 2009 and 'HS2 Cost and Risk Model Report: A report to Government by HS2 Ltd ', March 2012, HS2 Ltd

FOI request (FOI13-621R) that gives the breakdown between fixed and variable cost – showing that the variable cost component is just £21k/m, and the cost for tunnels over 7.5km is about £26k/m.
HS2 Ltd's proposed Chilterns tunnel is likely to be at the long end of the range for which factor costs are given. Were the Chilterns tunnel longer than those used in deriving the Appendix A low figure, the 'economies of scale' would be greater and the average cost lower.

FOI13-607 provided final proof when it confirmed the meaning of the words "*range dependent on length*".

However, the Chilterns bored tunnel is of greater internal diameter (8.8m) than that given in Appendix A, so the Appendix A costs needs to be adjusted to reflect this.

When assessing the cost of extending the proposed Chilterns tunnel, it is the **incremental or marginal costs** that are relevant, and as a substantial part of the total cost of HS2 Ltd's proposed tunnel effectively does not vary if the tunnel is made a little longer, these costs are less than the average full cost per unit length of HS2 Ltd's proposal.

Estimating unit and full costs

HS2 Ltd have not disclosed the details of their costings, but it is possible to use the information that they have provided to derive estimates of costs.

The 2012 Cost and Risk Model data gives unit costs for a twin bore tunnel, and while the lower cost may be more appropriate for the Chilterns bored tunnel, it is for considerably smaller tunnels. Were the £32.4k/m scaled up by the increase in internal cross-section this would give £47.7k/m . In fact the increase will not be directly related to the area, as while some items such as spoil will be by area, others such as the lining segments and labour cost are not. Experience indicates that costs increase in the ratio of the radii raised to the power of 1.4. This latter basis has been used, giving an average cost for the Chilterns bored tunnel of **£42.5k/m**. See Appendix 4.

The Chilterns tunnels costings (from Atkins) also can be used to derive tunnelling costs. Were green and bored tunnels to have the same average cost, the cost per metre is as shown in the table below.

tunnel	Twin bored (km)	Green tunnel (km)	Total tunnel (km)	Total cost (£m)	Cost per metre (£k/m)
HS2 Ltd proposal	13.3	2.45	15.75[69]	849.5[70]	53.94
CRAG T1	22.1[71]	1.45	23.55	1305.3[72]	55.43
CRAG T2	22.1	1.45	23.55	1330.9	56.51

It is assumed that the CRAG options are more expensive than the HS2 Ltd proposal per metre as it involves two bored tunnels working from opposite ends, with an average drivage of 11.05km rather than 13.3km.

Considering T1, which retains ending the southern Chilterns tunnel at Mantles Wood, albeit not at exactly the same place as HS2 Ltd's proposal: as a result the costs of the M25 to Mantles Wood tunnel is effectively common, the additional cost must all be associated with the additional bored tunnel (given there is substantially less green tunnel). The 7.8km of additional tunnel costs £455.8m, or £58.4k/m. The reason for this increase is not clear.

A central question is how much less than the average full cost the marginal costs are. In the built up cost figures, it is assumed the full average costs can be derived from the Appendix A long tunnel rates. For the marginal cost we consider several options:

[69] See Engineering Review of Proposal by CRAG for an Extended Chilterns Tunnel, 07 June 2013, Page 9 Table 4.3 of C222-ATK-TN-REV-020-000001, and the revised table released in 2014
[70] Op cit Table 4.8, Page 25
[71] Op cit Table 4.4, Page 14
[72] Op cit Table 4.8, Page 25

By using the corrected Atkins data, the Frank Dobson Parliamentary Question data (discussed in the report, and given at Appendix 3), and the new marginal cost information from the FOI's we construct three plausible bases for assessing the marginal cost:

> **A**: Basing the cost on the FOI13-621R base value of £26k/m, but adjusting it for the larger radius tunnels (to give a marginal cost of **£34.1k/m**).
>
> **B**: Basing the cost on being 80% of the average built-up cost (£42.5k/m) derived from Appendix A (ie producing a marginal cost of **£33.99k/m**)
>
> **C**: Basing the cost on 80% of the average cost (estimated at £53.7k/m) of the Chiltern's bored tunnel (as derived from the Atkins revised assessment of the CRAG tunnel, but also using relative costings from the PQ data ie giving a marginal cost of **£43.0k/m**)

This last basis can now be used because the 2014 correction moved the cost of the Wendover green tunnel from 'civils' to 'tunnels', at £68.8m. We derive a cost for the South Heath Green tunnel by adjusting the Wendover tunnel costs in the proportion of the costs for the two tunnels given in response to Frank Dobson's parliamentary question (ie £68.8m x 74/75 = £67.9m). We take the cost of the green tunnel off the total tunnel cost (£849.5 – (£68.8 + £67.9) = £712.8m) and divide by the length of the bored tunnel (13.27km) to give a cost of £53.7k/m. 80% of this gives a marginal cost of £43.0k/m.

The marginal costs include the cost of an additional vent shaft.

The cost of the SHCTE are: these marginal costs, (plus the additional costs of the deeper and wider cutting from Liberty Lane northwards) reduced by the savings for the works in the HS2 Ltd proposals that would not be required. These works are the full costs for constructing the railway and the associated surface works (diverting roads and utilities, building bridges, etc) from Mantles Wood to Liberty Lane – as none of this would be required.

Appendix 3: Costs provided in response to Frank Dobson's parliamentary question

25 November 2013 cost statement by DfTs:

Frank Dobson: To ask the Secretary of State for Transport what the (a) location, (b) length and (c) estimated cost is of each tunnel proposed for the London to Birmingham leg of High Speed 2. [176919]

Mr Goodwill: There are 13 tunnel locations along the London to west-midlands leg of high speed rail. These total over 52 kilometres in length and at second quarter 2011 prices are estimated to cost £3,488 million. The detail of these are:

Location; Approximate length (route metres); Approximate estimate £ million (2Q 2011).

General notes and assumptions: Estimates are based at second quarter 2011 price levels

Particular notes and assumptions: The estimates above exclude allowances for land and property and contingency

	cost (£m)	length (m)	cost/metre
BORED TUNNELS			
Long Itchington wood	87	1480	58,783.78
Bromford	242	2800	86,428.57
Northolt - east (incl OOC tun	497	5880	84,523.81
HS1 Link	208	6280	33,121.02
Euston	521	7290	71,467.76
Northolt - west	613	7860	77,989.82
chiltern	812	13270	61,190.66
GREEN TUNNELS			
Long itchington wood	29	430	67,441.86
Burton green	33	620	53,225.81
South heath	73	1200	60,833.33
Wendover	74	1280	57,812.50
Greatworth	134	2100	63,809.52
Chipping warden	165	2470	66,801.62
TOTAL	**3488**	**52960**	65,861.03

The cost per metre column has been added for this report, using the provided data in the PQ.

These figures are not on the same basis as the Atkins cost figures (which are bare costs). In correspondence, HS2 Ltd have stated the PQ figures include allowances for tunnel systems; indirect costs, design changes and efficiency measures. A response to further questions raised by REPA is still outstanding.

Appendix 4: Build-up of costs (behind Table 1 of the Report)

The costings in Table 1 (and 2) use HS2 Ltd sources as far as possible:

- The HS2 Ltd's 2012 Cost and Risk Model Report (Appendix A)
- Atkins data (from their 7 June 2013 Report on CRAG tunnel T1 and T2 options)
- Spon's Civil Engineering and Highway Works Price Book 2013
- Green tunnel and cutting assumptions based on engineering judgment and available data

The following tables set out the derivation of the key source numbers in Table 1 (and 2) of the Report

2012 Cost Risk Model Report, Appendix A, HS2 Ltd					
twin-bore tunnel costs		**diameter**	**radius**	**2 x πr^2 (cross section)**	
long tunnel cost/m	£32,400	7.25	3.625	82.56	
Chiltern cost/m (area basis)	£47,735	8.8	4.4	121.64	
			radius	**2 x πr$^{1.4}$**	
long tunnel cost/m	£32,400	7.25	3.625	38.13	
Chiltern cost/m (1.4 power basis)	**£42,496**	8.8	4.4	50.01	

Implied tunnel costs (using Atkins corrected cost):

					difference	
Implied cost of HS2 Ltd tunnels	**Green**	**Bored**	**Total**	**Atkins cost**	**£m**	**%**
£/m	£74,428	£42,496				
length (km)	2.48	13.27				
total cost (£m)	**£184.6**	**£563.9**	**£748.5**	**849.5**	**£101.0**	**11.9%**

South heath green tunnel built up costs:.

Green tunnel							
	volume (m^3)			**Depth (m)**	**Width at base (m)**	**Width at top (m)**	
excavation: spoil/m	1,027.28			15.36	40.00	93.76	
green tunnel: volume/m	300.00			10.00	30.00		
excavation cost/m	**volume (m^3)**	**cost/m^3**	**cost/m**				
open cut stored on site	727.30	£ 27.91	£20,299	all stored except green tunnel volume			
returned over roof	727.30	£ 11.02	£8,015	all returned except green tunnel volume			
removed from site	300.00	£ 30.00	£9,000	green tunnel volume			
total			**£37,314**				
slab cost/m	**volume (m^3)**	**cost/m^3**	**cost/m**	**Width (m)**	**Thickness (m)**	**height (m)**	
concrete base	41.31	£150.00	£6,197	27.54	1.50		
concrete roof	34.43	£200.00	£6,885	27.54	1.25		- includes propping
concrete walls (external)	18.13	£200.00	£3,625	1.25		7.25	- includes propping
concrete walls (internal)	7.25	£200.00	£1,450	1.00		7.25	- includes propping
concrete total			**£18,157**				
reinforcing cost/m	**t/m^3**	**cost/t**					
base	0.15	£1,250	£7,746				
roof	0.15	£1,250	£6,455				
walls	0.15	£1,250	£4,758				
reinforcing total			**£18,958**				
overall green tunnel total/m			**£74,428**				

	Cuttings							
1	**Mantles Wood to South Heath green tunnel South portal**							
		volume (m^3)			**Av depth (m)**	**Width at base (m)**	**Width at top (m)**	
	excavation: spoil/m	433.16			10.54	20.00	62.17	
	excavation cost/m	**volume (m^3)**	**cost/m^3**	**cost/m**				
	open cut stored on site	433.16	£27.91	£12,090				
	used locally	433.16	£11.02	£4,773	all used locally			
	Total/m			**£16,863**				
1a	**Extra cost for extra width for first km**							
		volume (m^3)			**Av depth (m)**	**Initial extra width (m)**	**Final extra width (m)**	
	excavation: spoil/m	78.33			10.73	14.60	0.00	
		volume (m^3)	**cost/m^3**	**cost/m**				
	open cut stored on site	78.33	£27.91	£2,186				
	used locally	78.33	£11.02	£863	all used locally			
	Total/m			**£3,049**	**(£3.0 for 1km)**			
2	**South Heath green tunnel North portal to Liberty Lane**							
		volume (m^3)			**Av depth (m)**	**Width at base (m)**	**Width at top (m)**	
	excavation: spoil/m	334.75			8.87	20.00	55.48	
	excavation cost/m	**volume (m^3)**	**cost/m^3**	**cost/m**				
	open cut stored on site	334.75	£27.91	£9,343				
	used locally	334.75	£11.02	£3,689	all used locally			
	Total/m			**£13,032**				
3	**HS2 Ltd cutting from Liberty Lane to Cottage Farm footpath**							
		volume (m^3)			**Av depth (m)**	**Width at base (m)**	**Width at top (m)**	
	excavation: spoil/m	202.51			6.24	20.00	44.95	
	excavation cost/m	**volume (m^3)**	**cost/m^3**	**cost/m**				
	open cut stored on site	202.51	£27.91	£5,652				
	used locally	202.51	£11.02	£2,232	all used locally			
	Total/m			**£7,884**				
4	**SHCTE cutting from Liberty Lane to Cottage Farm footpath**							
		volume (m^3)			**Av depth (m)**	**Width at base (m)**	**Width at top (m)**	
	excavation: spoil/m	428.81			10.47	20.00	61.89	
	excavation cost/m	**volume (m^3)**	**cost/m^3**	**cost/m**				
	open cut stored on site	428.81	£27.91	£11,968				
	used locally	428.81	£11.02	£4,725	all used locally			
	Total/m			**£16,694**				
4a	**Extra cost for extra width for first km**							
		volume (m^3)			**Av depth (m)**	**Initial extra width (m)**	**Final extra width (m)**	
	excavation: spoil/m	76.45			10.47	14.60	0.00	
		volume (m^3)	**cost/m^3**	**cost/m**				
	open cut stored on site	76.45	£27.91	£2,134				
	used locally	76.45	£11.02	£842	all used locally			
	Total/m			**£2,976**	**(£3.0 for 1km)**			

roads/bridges		**base cost(£m)**					
1	new bridge over Hyde lane	4.00					
2	reinstating 2 roads over green tunnel	5.60					
3	Hyde Farm access and Park Farm footpath & fencing	5.20					
	Total	**£14.8m**	**(no allowance for reinstating other footpaths)**				

Summary of major assumptions – Green Tunnel and Cuttings

The following assumptions were also made for the built-up cost of the green tunnel.

Cross Sections

- Green Tunnel – 5m working room each side of box for handling materials and dumper/trailer access.
- Slope of batter – 1:1.75 for Green Tunnel temporary works, 1:2 for Cutting
- Green Tunnel depth of cut – rail level minus 1.0m trackbed, minus 1.5m base slab
- Height of box 10m scaled
- Excavated spoil for Green Tunnel box removed from site. All other spoil, including for Cuttings excavated to spoil heap then reused for landscaping
- Green Tunnel box section thicknesses – base slab 1.5m, walls 1.25m ext & 1.0m int, roof slab 1.25m

Rates

- Excavate cutting, transport and deposit to spoil heap, £27.91/m3 (Appendix A, Infrastructure Rate Comparison)
- Excavate from spoil heap, transport, fill and compact, £11.02/m3 (Appendix A, Infrastructure Rate Comparison)
- Excavate and remove spoil from site, £30/m3 (SPONS)
- Concrete supplied and placed, £150/m3 to base slab, £200/m3 to walls and suspended slab (SPONS)
- Rebar fixed, 150kg/m3 concrete and £1250/tonne (SPONS)

As provided to HS2 ltd at meeting on 22 October 2013

Appendix 5: The significance of extending construction times

The SHCTE will add to the construction and fitting out time for the Chilterns bored tunnel.

The SHCTE is intended to be achieved through continuing the HS2 Ltd planned tunnel through a change of vertical alignment and a longer drivage. It is expected that the tunnelling will continue a further 36 weeks (at the expected final drivage rate of 100m/week). In the light of the recent Thames Water tunnel drivage rate experience this is conservative. However, as the tunnel is used for spoil extraction, fitting it out with railway infrastructure cannot commence until it is complete.

The issue is whether the delay engendered by the additional bored tunnel drivage is critical to the project. There is a further question of whether a delay to completing Phase 1 would actually be detrimental, but this is not addressed here[73].

On HS2 Ltd's engineering drawings the last 2km at the northern end of the Chilterns tunnel are in the Central Chilterns Community forum area, with the body of it in Chalfont and Amersham, and its entrance and depot in the Colne Valley forum area.

There has been a substantial change in the construction schedules between the Draft ES and the final ES. An originally planned four quarter gap between tunnel completion and fit out no longer is shown, but there are inconsistencies between the current ES schedules suggesting that a gap in fact still remains.

(1) The Draft ES

Key dates from **Central Chilterns CFA** reports that accompanied the Draft ES were:

- Tunnel boring, lining, adits and base slab works from 2nd quarter 2021 to 2nd quarter 2022 inclusive.
- Track laying and overhead line equipment in 3rd quarter 2023
- Rail systems and tunnel fit-out 2nd quarter 2024
- Vent shaft fit out 2nd quarter 2024 to 1st quarter 2025

Key dates from the **Chalfonts and Amersham CFA** reports that accompanied the Draft ES were:

- Tunnel boring, lining, adits and base slab works from 2nd quarter 2018 to 2nd quarter 2022 inclusive.
- Track laying and overhead line equipment from 1st quarter to 3rd quarter 2023
- Rail systems and tunnel fit-out 3rd quarter 2023 to 1st quarter 2025
- Vent shaft fit out 1st quarter 2023 to 1st quarter 2025

Key dates from the **Colne Valley CFA** that accompanied the Draft ES were:

- Tunnel boring, lining, adits and base slab works from 3rd quarter 2017 to 3rd quarter 2018 inclusive

The timing of the Colne Valley work indicates the tunnel boring commences as early as is practicable on HS2 Ltd's current plan – so starting earlier is not a way by which extra time can be spent on tunnel boring.

There were no key dates in Dunsmore Wendover & Halton area that affect timing of tunneling or completion.

It seems that the Central Chilterns works on the Chiltern tunnel were sequential for the tunnel boring, but in parallel for other works with the exception of fitting out the tunnel that requires boring to be complete. Vent shafts are fitted out in parallel to tunneling and fit-out. The potential critical path seems to be tunnel boring going through to completion in the Central Chilterns CFA, followed by rail systems and tunnel fit out in the Chalfonts and Amersham CFA. This activity ran through from 3rd quarter 2017 to 1st quarter 2025 – but there is **a gap of four quarters (from end 2nd Quarter 2022 to start of 3rd Quarter 2023)** between finishing tunneling and commencing the rail systems fit-out.

[73] In response to challenges to the HS2 timetable at PAC (1 July 2013) David Prout pointed out that the economics (BCR) of HS2 improve with a deferred start, as DfT forecast demand to still be growing in 2026. This is consistent with the sensitivities done by HS2 Ltd that show an improving BSR with later completion (see Figure 6 page 54, 'Economic Case for HS2: The Y Network and London – West Midlands', HS2 Ltd, February 2011.

The rail systems fit out does not appear to be done from both ends, as there would otherwise be such activity in the third quarter 2023 in the Central Chilterns Gantt chart (as opposed to in 3rd quarter 2024). Were the tunnel to be fitted from both ends, there would be 8.5km to do from each end for SHCTE, as opposed to 13.5 km from the Colne valley end (with the HS2 Ltd bored tunnel). The tunnel fit out for the Central Chilterns presumably relates to the green tunnel.

It seemed that a further three quarters of tunneling could have been accommodated in the four quarters of gap, and that the tunnel could still be fitted out without compromising the project completion date.

(2) The ES

The ES contains revised schedules for the Chiltern tunnel works, in which it appears that the gap that would have accommodated the SHCTE has disappeared.

We have examined the new schedules in both CFA 8 and 9 and believe that the new schedules contain obvious errors and questionable changes, and could readily be amended to accommodate the SHCTE works without affecting the overall timescale of the project.

The table below summarizes the differences between the DES and the ES:

Stage	**Draft ES (DES)**		**ES (ES)**		**Source, comment (change on Draft ES)**
	Time(Q's)	dates	Time (Q's)	dates	
Portals/ shafts/ vents	16	Q1 2018 to end Q4 2021	17	Q1 2018 to end Q1 2022	**There is a new later end date.** (The Little Missenden auto transformer station is now done after a gap and after all others - Q3 '21 to Q1 '22). Otherwise all done in 13 Q's and complete by Q1 2021. Work is not on the tunnel boring critical path
Tunnel boring	17	Q2 2018 to end Q2 2022	21	Q3 2017 to end Q3 2022 (CFA 8)	**CFA 8** schedule now shows it **takes 1 year longer** ie 5.25yrs (23% increase), starting 3Q sooner, and ending 1Q later. **CFA 9** schedule inexplicably has **no ref to** the 2.2kms of tunneling (that was in the DES) but states the **TBM is extracted in Q4 2021 to end Q1 2022** at Mantles Wood. There is no reason for tunneling taking longer- particularly as the evidence is that higher drivage rates are sustainable than those originally assumed.
Time gap before fit-out	4 Quarters		Nil (based on CFA 8) Or 2 Quarters*		At our October meeting REPA were told that there was still a gap (but only **1 Q**). CFA 8 schedule suggests **no gap**. *However if CFA 9 correct about the TBM extraction dates, then there would be a **2Q gap**. The current schedule is internally inconsistent.
Rail & tunnel system fit-out	7	Q3 2023 to end Q1 2025	11	Q4 2022 to end Q2 2025	**CFA 8:** Now takes **1 year longer** ie 2.75yrs (57% increase), starting 3Qs earlier, ending 1 Q later. **CFA 9**: now takes **2.25yrs** starting Q2 2023 (ending Q2 2025), yet in the DES it took **just 1 Q** (Q2 2024). NB the on-line CFA 9 FES (page 35) has **no scheduling data at all.** Our understanding is that this relates to changing how the rail fit-out would occur, proceeding north of Calvert before proceeding south. This decision un-necessarily delays the tunnel fit out.
Vent fit out	9	Q1 2023 to end Q1 2025	9	Q2 2023 to end Q2 2025	**CFA 8:** has now **slipped by 1 Q** **CFA 9 :** now takes **twice as long** ie 2 years (starting Q3 2023) but in DES was 1 year starting Q2 2024. NB the on-line CFA 9 FES (page 35) has no scheduling data at all.
Commission	4+ all 2026	Q1 2025 onwards	5+ all 2026	Q4 2024 onwards	Starts 1 Q earlier & now overlaps with fit-out by 3 Q's, not 1 Q

The table illustrates a range of important issues, some of which have been clearly overlooked.

- **First**, the bored tunneling now takes a whole year longer (5.25 years) with work starting earlier and finishing later. This extended time period is perverse, given we had been informed that HS2 Ltd are now assuming a higher drivage rate per week (of 90m/wk, compared with 80m/wk in the DES). This suggests either the original period was in error, or the current one is, or both. To put this in context, the 13.27km tunnel would take 147 weeks to bore at 90km/week – ie less than three years.

- **Second**, the tunneling time-period shown in CFA 8 for its 11.3 kms of tunneling in this area now extends to Q3 2022. There is however no mention of the tunneling time period in the CFA 9 ES schedule, despite 2.2kms being in this area and it having been shown in the CFA 9 DES. Instead CFA 9 ES refers to when the TBM machines are extracted (in Q4 2021 and Q1 2022) which is before tunneling in CFA 8 ends (Q3 2022). This not only looks plainly inconsistent with the CFA 8 schedule, but suggests that a time gap (of 2Q) still exists.

- **Third**, the fit out (that requires the boring to be complete) now takes a year longer for the Chalfont to Amersham CFA 8 section ie over 50% more than previously estimated, and as this is starting earlier it is taking up most of the previous 4 Q gap. The fit-out for the CFA 9 section is even stranger, now taking over 2yrs compared to just 1 quarter. Again this implies either the previous or the current estimates are substantially wrong. These are not minor changes. If the change is because rail fit out now proceeds North from Calvert before going South then this would seem to be an entirely avoidable delay tunnel fit out.

- **Fourth**, the detail in the schedule for CFA 9 ES (last part of page 34 and all page 35) is entirely omitted from the on-line source document. While it is included in the printed version, for those relying on the internet this is clearly unsatisfactory and raises questions of process as to how this can happen, and go unchecked.

- **Finally**, we note a considerable overlap between fit-out and commissioning. We are not aware of the feasibility of this, but simply note that previously the overlap had been just one quarter, and now it is three.

These issues suggest that the revised schedule is highly questionable. There are important questions about competence and reliability of the work done. If the Draft ES was wrong and the much longer time periods are required, this calls into question the competence of those doing the planning and estimating and also the level of reliance which should be placed on not only the details of the schedule but other information such as the costings.

Most significantly the current ES schedule contains errors – it is impossible to continue to bore the tunnel having extracted the TBMs.

Given the schedule covers no more work, and the fundamental tunnel boring process is expected to proceed at a faster rate, and to start no later, the conclusion that the previous window in which the SHCTE could be built has disappeared is plainly questionable. We therefore suggest that further analysis would reveal that it is entirely possible to accommodate the additional time the REPA proposal would require.

Appendix 6: Depth of cuttings eliminated and changed by SHCTE

The SHCTE eliminates the need for

- The deep cuttings from Mantles Wood to the South Heath green tunnel, and
- The cutting from the north portal of the South Heath Green tunnel to Liberty Lane.

It also results in a deeper (and wider) cutting from Liberty Lane to the Cottage Farm public footpath.

The following tabulates the surface level, cutting level and depth of cutting for these sections.

Table 1: Mantles Wood (44,700) to South Heath Green tunnel southern end (46,000)

chainage	46000	45900	45800	45700	45600	45500	45400	45300
surface[74]	180.5	178.4	174.6	170.1	162.6	156.3	154.9	166.9
HS2 Ltd[75]	168.6	166.9	165	162.8	160.4	157.7	154.7	151.7
depth	11.9	11.5	9.6	7.3	2.2	-1.4	0.2	15.2

chainage	45200	45100	45000	44900	44800	44700	Average
surface	169.1	166.1	159.9	148.4	139.2	155.6	
HS2 Ltd	148.7	145.7	142.7	139.7	136.7	133.7	
depth	20.4	20.4	17.2	8.7	2.5	21.9	10.5

Table 2: South Heath green tunnel northern end (47,400) to Liberty Lane (48,300)

chainage	48300	48200	48100	48000	47900	47800	47700
surface[76]	195.3	195.3	193.8	193	193.7	193.4	193.1
HS2 Ltd[77]	187.1	186.6	185.9	185.1	184.3	183.6	182.8
depth	8.2	8.7	7.9	7.9	9.4	9.8	10.3

chainage	47600	47500	47400	Average
surface	191.9	190.5	188	
HS2 Ltd	182.1	181.3	180.5	
depth	9.8	9.2	7.5	8.9

[74] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[75] C222-ATK-CV-DPL-020-000004
[76] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[77] C222-ATK-CV-DPL-020-000004

Table 3: Liberty Lane (48,300) to Cottage Farm public footpath (49,300) (cutting will be wider to reflect wider separation of tracks coming out of the bored tunnel)

Chainage	49300	49200	49100	49000	48900	48800
surface[78]	193.5	192.6	192.1	191.2	189.3	19240
HS2 Ltd[79]	184.4	184.8	185.2	185.6	186	186.4
SHCTE[80]	184.5	184.7	184.7	184.4	183.9	183.1
SHCTE depth	-9.0	-7.9	-7.4	-6.8	-5.4	-9.3
difference from HS2 Ltd	0.1	-0.1	-0.5	-1.2	-2.1	-3.3

Chainage	48700	48600	48500	48400	48300	Average
surface	194.1	193.9	192.4	190	195.3	
HS2 Ltd	186.8	187.1	187.4	187.4	187.1	
SHCTE	182.1	180.8	179.3	177.8	176.3	
SHCTE depth	-12	-13.1	-13.1	-12.2	-19.9	
difference from HS2 Ltd	-4.7	-6.3	-8.1	-9.6	-10.8	-4.2

[78] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[79] C222-ATK-CV-DPL-020-000004
[80] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*

Appendix 7: Levels of surface, HS2 Ltd's current proposals, and the SHCTE

The tables below show the depths at 100 chainage intervals from where the SHCTE diverges from the vertical alignment of HS2 Ltd's Chilterns deep tunnel to Cottage Farm public footpath, where it re-joins the alignment (at 49300). The deep bore tunnel sections are shaded blue, and the HS2 Ltd green tunnel is shaded in green. Particular phases are

- From the point of divergence from the Chilterns tunnel (42800) to Mantles Wood (44700) where the currently planned bored tunnel emerges
- From Mantles Wood (44700) to the end of SHCTE deep tunnel proposal (Liberty Lane at approx. 48200, plus portal ie approx. 48300))
- From end of SHCTE (48300) to the point where it meets up with HS2 ltd proposed alignment (at 49300)

It shows the increased depth of the cutting where it emerges at Liberty Lane (48300) ie almost 20m deep, by comparison to current proposed depth of 8.2m

It also shows that the different maps have different current surface levels (row 1 and 2). The differences (in row 5) have been taken from surface levels shown on the Brett Map SK001, that in turn used the latest Atkins assessment of the CRAG tunnel proposals (in the map series C22-ATK-TN-DGA-000251 through to 265, all dated end May 2013). These will post-date the Plan and Profile maps published alongside the Draft Environmental Statement (DES) – shown in row 2 for information only.

	Chainage	49300	49200	49100	49000	48900	48800	48700	48600	48500	48400	48300	48200	48100	48000	47900
1	Surface (PBA) [81]	193.5	192.6	192.1	191.2	189.3	192.4	194.1	193.9	192.4	190.0	195.3	195.3	193.8	193.0	193.7
2	(surface (DES)[82])	(195.8)	(193.7)	(193.2)	(192.5)	(190.5)	(191.0)	(193.8)	(194.3)	(193.4)	(191.3)	(193.8)	(195.7)	(194.3)	(193.5)	(193.9)
3	HS2 Ltd (DES)[83]	184.4	184.8	185.2	185.6	186.0	186.4	186.8	187.1	187.4	187.4	187.1	186.6	185.9	185.1	184.3
4	SHCTE[84]	184.5	184.7	184.7	184.4	183.9	183.1	182.1	180.8	179.3	177.8	176.3	174.8	173.3	171.8	170.3
5	Below surface (row 4-1)	-9.0	-7.9	-7.4	-6.8	-5.4	-9.3	-12.0	-13.1	-13.1	-12.2	-19.9	-20.5	-20.5	-21.2	-23.4

	Chainage	47800	47700	47600	47500	47400	47300	47200	47100	47000	46900	46800	46700	46600	46500	46400
1	Surface (PBA)[85]	193.4	193.1	191.9	190.5	188.0	184.7	183.9	187.0	189.5	190.2	190.5	189.4	186.5	184.7	184.1
2	(surface (DES)[86])	(194.0)	(193.4)	(192.7)	(191.2)	(189.4)	(186.1)	(183.2)	(188.5)	(188.4)	(190.0)	(190.5)	(190.4)	(188.2)	(184.4)	(184.4)
3	HS2 Ltd (DES)[87]	183.6	182.8	182.1	181.3	180.5	179.8	179.0	178.3	177.5	176.7	176.0	175.2	174.5	173.7	172.9
4	SHCTE[88]	168.8	167.3	165.8	164.3	162.8	161.3	159.8	158.3	156.8	155.3	153.8	152.3	150.8	149.3	147.8
5	Below surface (row 4-1)	-24.6	-25.8	-26.1	-26.2	-25.2	-23.4	-24.1	-28.7	-32.7	-34.9	-36.7	-37.1	-35.7	-35.4	-36.3

[81] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[82] C222-ATK-CV-DPL-020- 000004 (from DES)
[83] C222-ATK-CV-DPL-020-000004 (from DES)
[84] Peter Brett SK001 (*Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[85] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013*)
[86] C222-ATK-CV-DPL-020- 000004 (from DES)
[87] C222-ATK-CV-DPL-020-000004 (from DES)
[88] Peter Brett SK001 (*Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*

Appendix 7: Levels of surface, HS2 Ltd's current proposals, and the SHCTE

	Chainage	46300	46200	46100	46000	45900	45800	45700	45600	45500	45400	45300	45200	45100	45000	44900
1	Surface (PBA)[89]	183.2	182.7	181.7	180.5	178.4	174.6	170.1	162.6	156.3	154.9	166.9	169.1	166.1	159.9	148.4
2	(surface (DES)[90])	(183.0)	(182.7)	(181.9)	(181.3)	(179.4)	(176.7)	(172.5)	(167.1)	(157.6)	(150.6)	(163.3)	(169.2)	(168.2)	(163.4)	(154.1)
3	HS2 Ltd (DES)[91]	172.2	171.2	170.1	168.6	166.9	165.0	162.8	160.4	157.7	154.7	151.7	148.7	145.7	142.7	139.7
4	SHCTE[92]	146.3	144.7	142.9	140.9	138.9	136.9	134.9	132.9	130.9	128.9	126.9	124.9	122.9	120.9	118.9
5	Below surface (row4-1)	-36.9	-38.0	-38.8	-39.6	-39.5	-37.7	-35.2	-29.7	-25.4	-26.0	-40.0	-44.2	-43.2	-39.0	-29.5

	Chainage	44800	44700	44600	44500	44400	44300	44200	44100	44000	43900	43800	43700	43600	43500	43400
1	Surface (PBA)[93]	139.2	155.6	164.6	166.9	164.9	161.6	157.1	155.3	152.4	145.5	144.4	137.1	129.0	117.8	123.3[94]
2	(surface (DES)[95])	(139.6)	(148.8)	(162.2)	(166.5)	(166.2)	(163.4)	(158.5)	(156.2)	(153.8)	(150.0)	(145.7)	(141.3)	(130.3)	(117.0)	(123.3)
3	HS2 Ltd (DES) [96]	136.7	133.7	130.7	127.7	124.7	121.7	118.7	115.7	112.7	109.7	106.7	103.7	100.7	97.7	94.7
4	SHCTE[97]	116.9	114.9	112.9	110.9	108.9	106.9	104.9	102.9	100.9	98.9	96.9	94.9	92.9	90.9	88.8[98]
5	Below surface (row 4-1)	-22.3	-40.7	-51.7	-56.0	-56.0	-54.7	-52.2	-52.4	-51.5	-46.6	-47.5	-42.2	-36.1	-26.9	-33.5

	Chainage	43300	43200	43100	43000	42900	42800									
1	Surface (PBA)[99]	129.8	129.5	125.1	118.4	112.2	112.7									
2	(surface (DES)[100])	(129.8)	(129.5)	(125.1)	(118.4)	(112.2)	(112.8)									
3	HS2 Ltd (DES)[101]	91.7	88.7	85.7	82.9	80.4	78.1									
4	SHCTE[102]	87.8	85.8	83.8	81.8	79.8	77.8									
5	Below surface (row 4-1)	-42.0	-43.7	-41.3	-36.6	-32.4	-34.9									

[89] Peter Brett SK001 (*Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[90] C222-ATK-CV-DPL-020- 000004 (from DES)
[91] C222-ATK-CV-DPL-020-000004 (from DES
[92] Peter Brett SK001 (*Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[93] Peter Brett SK001 *(Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[94] C222-ATK-TN-DGA-020-000260
[95] C222-ATK-CV-DPL-020- 000003 (from DES)
[96] C222-ATK-CV-DPL-020-000003 (from DES)
[97] Peter Brett SK001 (*Source: Atkins with plans dated May 2013, accompanying the "Engineering Review of Proposal by CRAG for extended Chilterns tunnel" dated 7 June 2013)*
[98] C222-ATK-TN-DGA-020-000260
[99] C222-ATK-TN-DGA-020-000260
[100] C222-ATK-CV-DPL-020- 000003 (from DES)
[101] C222-ATK-CV-DPL-020-000003 (from DES);
[102] C222-ATK-TN-DGA-020-000260

Section 10: Environmental Statement for the South Heath Chiltern Tunnel Extension

South Heath
Chilterns Tunnel Extension

Environmental Statement

Photography: www.chartridgephotographic.co.uk

Environmental Statement on the South Heath Chilterns Tunnel Extension by REPA

This document assesses the likely significant environmental effects of an extended tunnel from Mantles Wood portal to Liberty Lane – the South Heath Chilterns Tunnel Extension (SHCTE) – and makes comparison of the environmental effects of this proposal against those effects detailed by HS2 Ltd for their proposed route in their Environmental Statement.

Part A Introduction

1.1 Purpose of this report

This report presents the significant environmental effects of extending the Chilterns bored tunnel from Mantles Wood to Liberty Lane, called the South Heath Chilterns Tunnel Extension (SHCTE). It also gives a comparison of the environmental effects on that part of the AONB between Mantles Wood and 49.330 (when the proposed route re-joins the vertical alignment of HS2 Ltd's proposed route) between HS2 Ltd's scheme (as set out in consultation documentation reports Volume 2 Report 9 covering the Central Chilterns Community Forum area) and the extended tunnel proposals contained in REPA's response document.

HS2 Ltd's Environmental Statement does briefly concede that the REPA tunnel option would have environmental benefits (par 2.6.19 Vol 2):

> *Option B [which is SHCTE] would perform better on environmental grounds compared with option A. It would avoid a range of impacts on environmental receptors due to reduced surface impacts. There would be reduced landscape and visual effects on South Heath and the AONB and benefits for ecology. In particular a number of ancient woodlands would be avoided including Mantles Wood, Farthings Wood, and Sibleys Coppice. In addition some land severance impacts on agriculture and habitats would be reduced under Option B compared with Option A.*

But these appear to be discounted when weighed against other factors eg the new impacts (of a vent, and wider cutting at the exit); their proposals for mitigation of the route– a green tunnel, landscaping, noise fence barriers and planting to reduce the noise and visual effects; cost and scheduling issues. They conclude by saying that their measures would mitigate the impacts of their proposal for this section of the route. REPA disagree.

This comparison demonstrates clearly the benefits to the environment of the extended tunnel options

1.2 Structure of this report

The overall structure of this report follows that of the HS2 Environmental Statement Volume 2 Community Forum Area Reports.

- **Part A** is this introduction

- **Part B** is an overall description of the extended tunnel proposal and a linear comparison of the scheme between Mantles Wood and a point near the south of the Wendover Dean viaduct (Cottage Farm footpath) where the proposal re-joins the HS2 Ltd vertical alignment. It also details the differences between the HS2 solution and SHCTE and the deeper and wider cutting north of the new north portal of the Chilterns bored tunnel.

- **Part C** is a summary and a comparison against each environmental topic as listed in the HS2 documents.

This report is supported by a plan and profile of the proposed tunnel extension (at Appendix 1 in the Engineering Report in the REPA response).

This report takes only limited account of understated or unidentified impacts in the ES. Such impacts when identified will increase the benefits of the extended tunnelling.

Part B: Overall description of the extended tunnel proposal and comparison with that proposed by HS2 Ltd

2 Overview of SHCTE

2.1 Overview of the area covered by the extended tunnel proposal

The overview of the area is covered in the HS2 Volume 2 Report 9 section 2.1.

It is deficient in that it fails to note all the communities that are part of the area eg Little Kingshill (800 inhabitants) and Prestwood (9000 inhabitants) that will also be affected by HS2 Ltd's proposal for this area. Some amenities are also not listed (the gym in South Heath that will be demolished by their proposal) and the extent of recreational activities such as cycling, horse riding, walking on local lanes/roads that will be affected by the proposal (both in its construction and operation).

2.2 Description of the extended tunnel proposal

Overview

The extended tunnel follows the horizontal alignment defined by HS2 from Mantles Wood to chainage (Ch) 49,330. The vertical alignment of the extended tunnel proposal is lower from 42,250 to 49,330, for the tunnel to allow sufficient ground coverage to meet Atkins' specification in passing under Mantles Wood and the low point in the surface near Frith Hill, and from the tunnel portal at 48,330 to 49,330 to re-gain the level of the HS2 Ltd alignment from the portal that is at a lower level.

The tunnel length between the M25 portal near Denham and the proposed end of the tunnel at 48330 at Liberty Lane is 16.9km, which is less than the maximum of 20km before special safety considerations apply under TSIs.

One additional vent shaft will be required slightly north of Hyde Lane, behind Annie Baileys (positioned at 46,100).

In effect the portal at Mantles Wood would be moved to Liberty Lane, where access is easier.

From inspection of the proposed extended tunnel drawings it is clear that the permanent impact on the AONB, and the communities of Hyde Heath, Hyde End, South Heath and Potter Row is reduced. The construction impact is similarly reduced but the reduction affects a wider area (than just these villages). It includes those using affected roads of A413, B485 and the roads by which the villages are accessed. In particular the impact on the routes between Chesham and Great Missenden; and Amersham and Wendover is reduced.

A further 3.6km of the AONB is preserved to the benefit of residents and visitors in perpetuity.

The case for the new land fill site at Hunts Green is destroyed, as virtually none of the spoil that would be accommodated would be generated in the AONB nor could the waste be moved along the trace. Creating a new land fill site in the Chiltern's AONB in order to dispose of imported spoil is simply indefensible.

2.3 SHCTE section by section

The HS2 Ltd Chiltern Tunnel portal at Mantles Wood is eliminated together with all cuttings and is replaced by a continued bored tunnel to a vent shaft behind Annie Baileys at Ch 46100.

The satellite compound at Mantles Wood is moved to Liberty lane (48,330). There is an additional vent shaft at Ch 46100 which is accessed from the B485.

The route continues in a bored tunnel to the portal located at Ch 48330 where Liberty Lane crosses the line of route.

This length of tunnel eliminates the following significant impacts arising from the HS2 scheme between Mantles Wood and Liberty Lane:

- The new access route from Hyde Heath Road to Mantles Wood
- Construction of the Mantles Wood portal and portal building
- Loss of some of Mantles Wood ancient woodland, a mainly coniferous plantation (6.3ha)
- Loss of some of Farthings Wood ancient woodland (0.5 of ancient woodland, and 3.5 of woodland).
- Loss to Hedgemoor Wood (beech wood)
- Loss of 16km of hedgerows (overall) including 2.1km of "important hedgerows"
- Take of agricultural land
- Use of Hyde Heath Road for construction traffic
- All utility diversions (including the National Grid)
- All the fencing, cuttings, embankments and landscaping works including new planting and noise bunds.
- Extensive drainage and 11 balancing pond requirements
- Hyde Farm access track and footbridge
- Hyde Lane over bridge and road diversion
- Demolition of Rowen Farm and Dar Lor and associated out buildings on Hyde Lane
- Demolition of outbuilding related to Chapel Farm and Sheepcotes Cottage on Hyde Lane
- Demolition of Meadow Leigh on Chesham Road
- Demolition of Annie Bailey's public house restaurant
- The Chesham Road and Kings Lane diversions and road realignments with new lit roundabout. Both roads also to be used for construction traffic
- Demolition of numbers of dwellings and out buildings at 86, 90 and 94 Kings Lane, Chiltern Cottage and Weights and Measures Gym on Frith Hill and buildings at Elwis Field Farm, and Orchard Cottage
- Removal of approximately half of The Coppice and Sibley's Coppice ancient woodland (2.6 hectares)
- Temporary closure of Frith Hill (1.5 – 2 years), and its use for construction traffic
- Use Potter Row for construction traffic
- The construction of the South Heath green tunnel, two portals and associated tunnel and Auto Transformer Station buildings, portal buildings and a new access track
- Proposed changes to a series of footpaths. The full list is here:

Ref in CFA9	Footpath	Temporary Diversion	Permanent Diversion	Comments
2.2.30	LMi/			No diversion needed, but there will be landscaping
2.3.39	LM1/17	1,500m	South of Portal	Via Bullbaiter's Lane
2.3.39	LM1/21	Open	450m	Realigned to LMi/17

2.3.39	GM1/23/6	100m		Permanent existing route
2.3.39	GM1/23	50m	700m	Realigned via LMi/17
2.3.39	GM1/27	400m	150m	Via Hyde Lane bridge
2.3.39	GM1/33/2	750m	100m	Via Chesham Rd and Hyde Lane Via Hyde Lane bridge
2.3.39	GM1/33/3	Open	50m	Via Hyde Lane bridge
2.3.41	LM1/27	Not given		
2.3.51	GM133/4	100m	400m	Hyde Lane
2.3.51	GM133/5	250m	Reinstated	
2.3.51	GM1/28	400m	Reinstated	Kings Lane, Chesham Rd
2.3.51	GM1/79	400m	Reinstated	Kings Lane, Chesham Rd
2.3.51	GM1/80	400m	Reinstated	Kings Lane. Chesham Rd
2.3.51	Frith Hill	400m	Reinstated	
2.3.64	GM1/13	Open	750m	Via GM/12 overbridge
2.3.64	GM1/12	100m	Reinstated	Via GM/12 overbridge

- The description of those between Mantles Wood to South Heath is below:
  - GM1/80/1 northern part of Sibley's Coppice
  - GM1/79/1 southern part of Sibley's Coppice
  - GM1/79/1 and GM1/28/1 Southern part of Sibley's Coppice;
  - GM1/33/4 between Chesham road and GM1/33/3 footpath;
  - GM1/33/3 between Chesham road and Chapel Farm
  - GM1/27/1 westerly edge of Hedgemoor;
  - GMI/23/7 easterly edge of Hedgemoor and Farthings Wood;
  - GM1/21/1 in Mantles Wood
- Footpath disruption and diversions at South Heath, which involves three ancient pathways:
  - GMI/13/3: Great Missenden North East via Stockings Wood, Bury Farm and Jenkins Wood to link with the Chiltern Way National Trail and Long Distance Route at Ballinger Bottom:
  - GMI/12/1: from Great Missenden via Park Farm, Field End Grange to link with the Chiltern Way National Trail and Long Distance Route at Lee Common:
  - GMI/2/1: from Great Missenden via Potter Row, Croft Dell to link with the Chiltern Way National Trail and Long Distance Route at Lee Common.)
- Footbridge construction at Mulberry Park Hill
- Demolition of 2 main building (including a dwelling) and outbuildings on Mulberry Park Hill
- Temporary use of extensive areas for materials stockpiling (5 metres high) and spoil storage needed for the cuttings and green tunnel. Areas near to residential locations and ancient woodlands (Jenkins wood) with no allowance for buffering

The portal at Ch 48,330 will require permanent access to be provided. This can be achieved from Potter Row without additional impact, over and above what HS2 Ltd's plan entails. Landscaping and planting may be required.

The route continues at a lower alignment to a re-join HS2 Ltd's vertical alignment at ch 49,330 near the Cottage Farm public footpath.

This length of deeper cutting reduces noise and visual impact from the HS2 scheme, although the portal may emit additional noise in this area.

The new vent shaft (and associated building) near Annie Bailey's (46,100) would be accessed from B485 Chesham Road. Landscaping and planting will be required.

2.4 Land required for the extended tunnel options

Land requirements are reduced compared to the HS2 scheme, although the land take from the new bored tunnel portal (48,330) north will be greater (to 49,330) due to the increased separation of the tracks on exiting the tunnel (at 48,330)

2.5 Construction of SHCTE.

This section only addresses those matters which are different from the HS2 scheme.

Construction site compounds

The construction of the extended bored tunnel will require the HS2 Ltd scheme tunnelling operations to be extended in length and time.

The drive north from the M25 portal will stop at Liberty Lane instead of Mantles Wood in the HS2 Ltd scheme. The tunnel boring machines will be extracted at Liberty Lane, and removed via Potter Row.

The following changes in construction compounds are required

- **Eliminated:**

  The Mantles Wood satellite compound

  South Heath Green Tunnel satellite compound 1 at B485 Chesham Road (near south portal)

  South Heath Green Tunnel satellite compound 2 (near HS2 Ltd's planned north portal)

  The South Heath Systems compound (near HS2 Ltd's planned north portal)

- **Required**

  A satellite compound for the vent shaft at ch 46100, accessed from the B485 Chesham Road

  A satellite compound is required for the tunnel portal at Liberty Lane ch 48330 accessed from Potter Row

- **Extended operation**

  The main tunneling compound near the M25 will need to be operational for spoil extraction and disposal for about a year longer to support the additional tunnel boring

Cumulatively the new compounds will have much less impact than those proposed for the HS2 scheme.

Construction site traffic and access

The HS2 scheme has a significant impact on the local roads, residents and visitors of the AONB from Hyde Heath to Liberty Lane, in particular the A413, B 485 Chesham Road, Frith Hill South Heath leg, Kings Lane, Hyde Heath Road, and Potter Row.

The SHCTE eliminates the majority of the construction traffic in the South Heath, Hyde Heath and Hyde End areas – other than that required to service the additional vent shaft (on Chesham Road) and the re-sited portal (at liberty Lane). This will bring significant reduction in impact to the area.

Spoil from the extended tunnel would be extracted using the Chiltern tunnel facilities at the M25 end of the tunnel and give rise to no traffic movements in the Central Chilterns.

Preparatory and enabling works

Demolition works

The demolition works required for the HS2 scheme are eliminated up to Ch 48330 under the extended tunnel proposal.

There are no demolition requirements from the greater depth and width of from the Liberty Lane portal (48,330) until it re-joins the HS2 Ltd alignment (at ch 49,330).

Drainage and culverts

The drainage requirements from Mantles Wood to Liberty Lane are eliminated compared to the HS2 scheme requirements.

Watercourse Diversions

There is no requirement under the extended tunnel option

Utility Diversions

The extensive utility diversions needed under the HS2 scheme will be eliminated for the 3.63 km section from Mantles Wood to Liberty Lane.

The deeper and wider cutting north from Liberty Lane is not expected to have any more effect than that anticipated for the HS2 Ltd vertical alignment.

Highway and road diversions

All road diversions required from the HS2 scheme at Hyde End and South Heath are eliminated.

Footpath, cycleway and bridleway diversions

The extensive diversions and over-bridges required under the HS2 scheme will be eliminated south of Liberty Lane.

No footpaths cross the route where the SHCTE has caused the cutting to be deeper, so this will have little additional impact.

Main construction works – Earthworks

All major earthworks south of Liberty Lane will be eliminated.

Main construction works – Structures

All surface structures between Mantles wood and Liberty Lane are eliminated, although a vent and a road access will be required at Ch 46,100.

Green tunnels

The HS2Ltd scheme's green tunnel at South Heath is eliminated.

Viaducts

The proposal makes no changes to the HS2 proposed viaducts at Wendover Dean and Small Dean.

Bridges

All over bridges and under bridges required under the HS2 scheme are eliminated south of Liberty Lane

Bored Tunnel.

The HS2 Ltd's bored tunnel ending at Mantles Wood is extended to Liberty Lane. Construction is covered in the above sections.

The portal structure required effectively replaces that which HS2 Ltd plan for Mantles Wood. The portals for the South Heath green tunnel are not required

Vent shaft

An additional vent shaft at Ch 46,100 is required.

Rail Infrastructure fit-out

Power supply

The ATS at Mantles Wood would be relocated to Liberty Lane.

Landscaping and permanent fencing

The extensive landscaping requirements from the cuttings are eliminated.

The extensive permanent fencing required for the HS2 scheme for the surface route to Liberty Lane are eliminated, as is the fencing required for the 11 balancing ponds that would not be required

Only localised permanent fencing for the vent shaft is required.

Construction programme

There are consequential changes to the construction programme. The most significant of which is continuing the boring of the tunnel to achieve the additional 3.63kms. However as discussed in the Engineering Report in the REPA response we believe that this should be able to be accommodated.

Part C: Environmental topic assessments

This section summarises the difference in impacts between the HS2 scheme and extended tunnel (SHCTE).

Agriculture, forestry and soils

All issues and impacts south of Liberty Lane to the HS2 bored tunnel portal at Mantles Wood are eliminated by the extended tunnel option apart from localised impacts the vent shaft.

The land take will be larger from Liberty Lane for 1-1.5km northwards (as the track be will be 14.6m wider at the portal). (For the costings we used 1km).

Air Quality

Air quality impacts arising from construction activities will be significantly reduced from that of the HS2 scheme due to the vastly reduced surface work south of Liberty Lane.

Community

In general the impacts from the HS2 scheme south from the north end of the extended bored tunnel are eliminated except and for the vent near Annie Baileys.

Residential Property

All demolition requirements of the HS2 scheme are eliminated by the extended tunnel south of the new tunnel portal.

Community Infrastructure

The loss of amenities; Annie Bailey's on Chesham Road, Weights and Measures gym on Frith Hill under the HS2 scheme are eliminated by the tunnel extension.

The disruption to the community of South Heath during construction of the HS2 scheme will be eliminated.

Public rights of way and open space

The impact on public open space at South Heath by the HS2 scheme will be eliminated.

Cultural Heritage

Designated and non designated assets

The impact on designated and non designated assets under the HS2 scheme will be eliminated along the extent of the extended other than at the vent shaft location which will be insignificant compared to the HS2 impacts

Ecology

The impact on ecology under the HS2 scheme will be eliminated along the extent of the extended tunnel other than at the vent shaft location, which will be insignificant compared to the HS2 impacts.

Land Quality

The impact on Land Quality under the HS2 scheme will be eliminated along the extent of the extended tunnel other than at the vent shaft location, which will be insignificant compared to the HS2 impacts.

Landscape and visual assessment

The impact on landscape and visual assessment under the HS2 scheme will be eliminated along the extent of the extended tunnel other than at the vent shaft location, which will be insignificant compared to the HS2 impacts.

The additional depth at Liberty Lane especially for the first 0.5km will reduce the railways visibility and contribution to light pollution

Socio-economics

The disruption to the AONB and the local communities will be largely eliminated with a reduced impact upon tourism and leisure use of this area of the Chilterns, as the footpaths and roads from Great Missenden will be unchanged. Also the dislocation during construction will be eliminated with the elimination of adverse effects on journey times and additional cost to businesses.

A high proportion of residents in the vicinity commute to London, so that impeding access to Great Missenden station will further depress the areas attractiveness for London commuters.

Visitors will find that visual and noise pollution of HS2 detracts from its attractiveness as a leisure destination in the AONB – with loss of business for shops, pubs and restaurants.

Sound, noise and vibration

The wide reaching and nature of the sound and noise impacts caused by the construction and operation of the HS2 scheme will be eliminated by the tunnel extension south of the new portal except at the vent shaft location, as will the need for all the mitigation such as bunds and barriers.

The exposure to peak noise levels (60dB LAmax) from HS2 trains in cuttings will be avoided by 168 properties[103]. (This is the threshold for sleep disturbance in the World Health Organisation WHO Night Noise guidelines). Many of these properties will also avoid breaching the lower average noise threshold (of 50dB day and 40dB night) as a result of train noise that WHO advise is the onset of adverse health and quality of life effects.

The new tunnel portal at Liberty Lane is in a deep cutting and away from the housing of South Heath and that on the South Heath end of Potter Row. As it will be considerably lower than the cutting part of the HS2 Ltd plan, this should mitigate the additional noise.

The cutting from Liberty Lane is lower than the HS2 Ltd one for1km, where it joins the HS2 Ltd vertical alignment. For this distance the greater depth should allow more effective mitigation, with less noise beyond the land occupied by the railway and its embankments.

The route of the extended tunnel will pass under dwellings saved from demolition, eg at Hyde Lane, Chesham Lane, Kings Lane, Frith Hill, and Mulberry Hill. Vibration from tunnelling operations and rail operations would not be different from elsewhere on the route and would be mitigated in the same way.

Traffic and transport

Under the HS2 scheme the local roads will incur heavy impacts from both heavy haulage and light vehicles accessing and egressing the works. Also there are many road diversions and closures which will cause confusion and disruption.

The extended tunnelling will considerably reduce the amount of traffic on the local roads and eliminate the need for diversions and closures between Liberty Lane and Mantles Wood. Neither of the two South Heath green tunnel satellite construction sites and storage compounds would be needed, and so the traffic associated with them will be eliminated. A smaller compound would be needed in connection with the additional vent, but this requires considerably less manpower and materials, and will have good access to the Chesham Road, the largest access route to the A413.

Spoil from the extended tunnel would be extracted via the main compound near the M25, so disposal of spoil will not use the A413 or the smaller roads between it and the line of route.

Water resources and flood risk

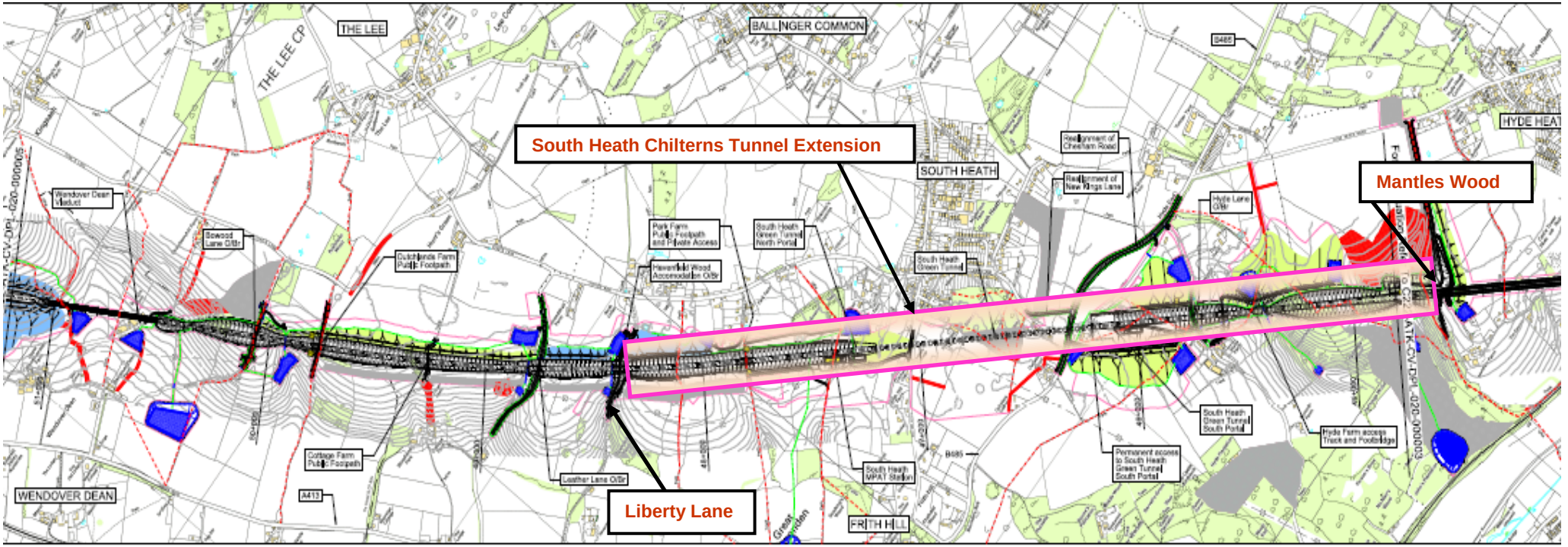
The impact on water resources and flood risk under the HS2 scheme will be eliminated along the extent of the extended tunnel other than at the vent shaft, which will be insignificant compared to the HS2 impacts

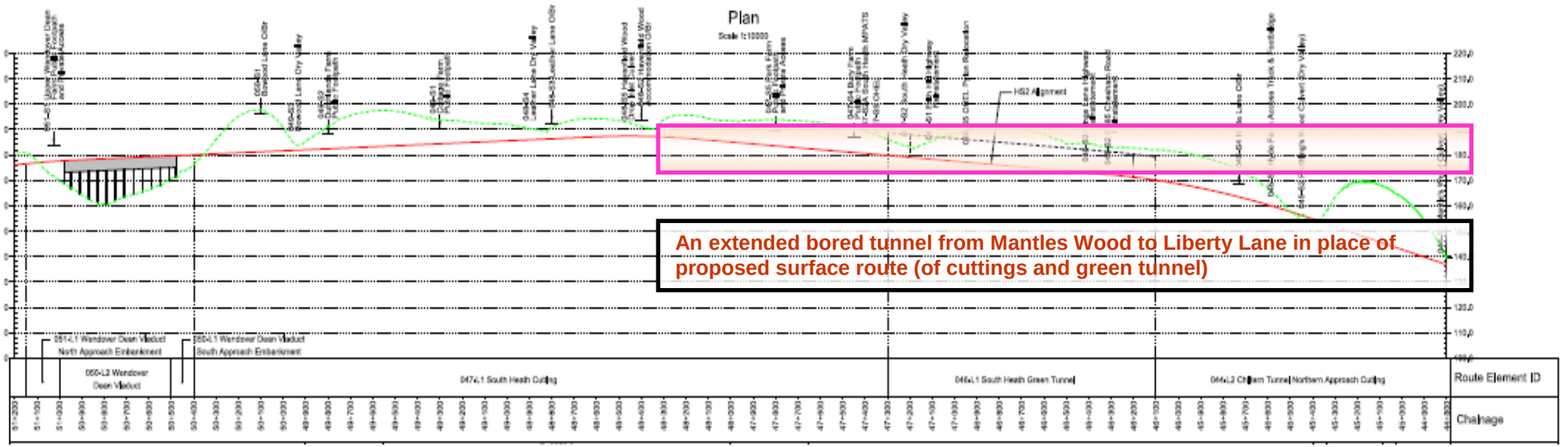
The deeper cutting from Liberty Lane to Cottage Farm Level crossing is in an elevated position and should have little effect on water resources or flood risk.

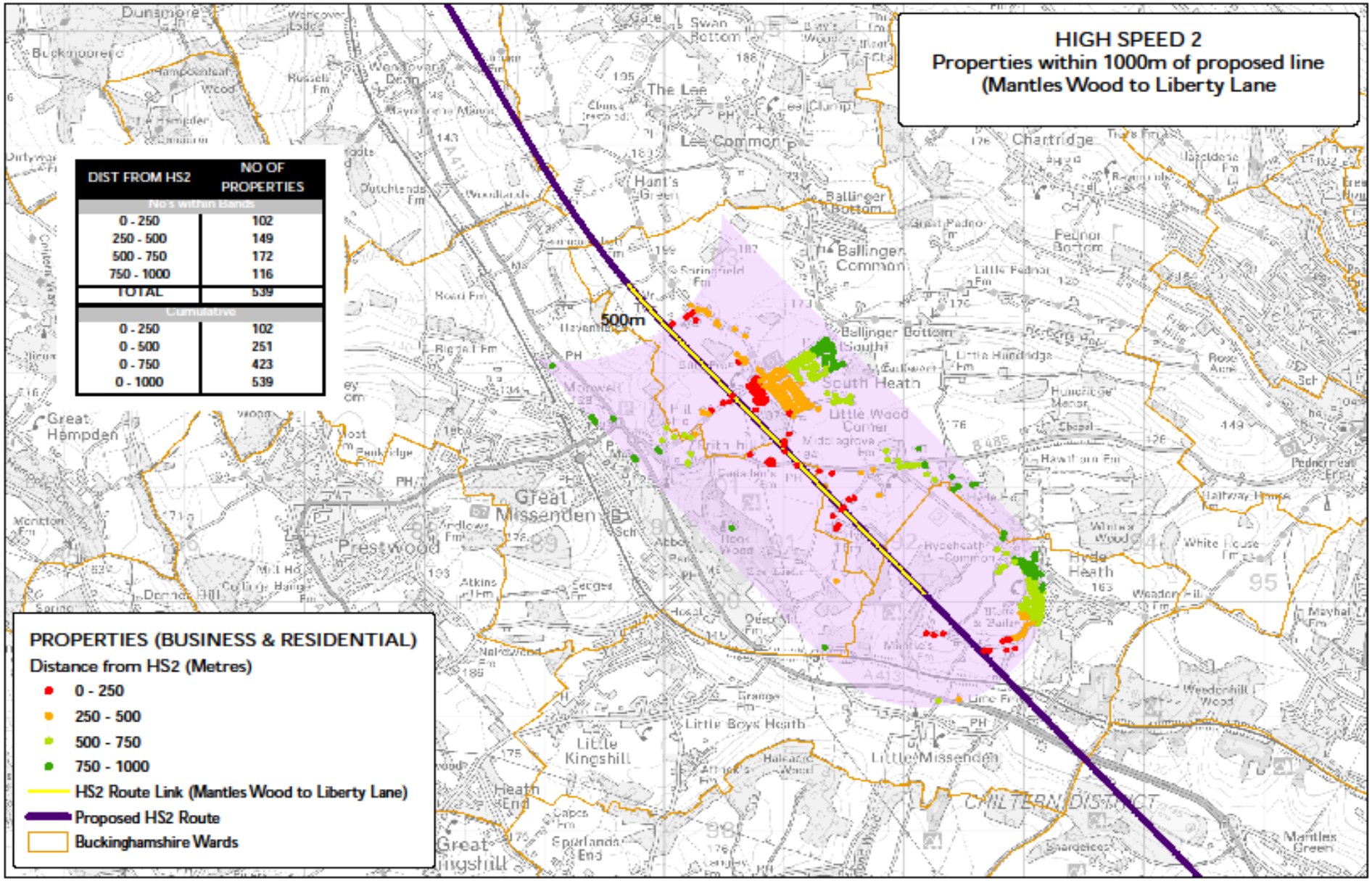
[103] This uses HS2 Ltd published data in the ES but is not the threshold that HS2 Ltd has adopted. For LAmax they use 85dB which represents a noise that is five times louder.

Appendix 1: Area covered by South Heath tunnel extension

Orange amendments by REPA, Feb 2014






HIGH SPEED 2
Properties within 1000m of proposed line
(Mantles Wood to Liberty Lane
DIST FROM HS2
NO OF PROPERTIES
No's within Bands
0 - 250 102
250 - 500 149
500 - 750 172
750 - 1000 116
TOTAL 539
Cumulative
0 - 250 102
0 - 500 251
0 - 750 423
0 - 1000 539
500m
PROPERTIES (BUSINESS & RESIDENTIAL)
Distance from HS2 (Metres)
0 - 250
250 - 500
500 - 750
750 - 1000
HS2 Route Link (Mantles Wood to Liberty Lane)
Proposed HS2 Route
Buckinghamshire Wards