

High Speed Rail in the Chilterns

Summary of the Feasibility Study Report for an
Alternative Tunnelling Option

The Chilterns Long Tunnel

1. The Government's proposals for a high speed railway through the Chilterns AONB will have significant impacts on the protected landscape, the Green Belt, the environment and local communities. This report describes an alternative railway alignment that not only impacts less than the Government's proposed scheme, but is also a better alignment for a high speed railway.
2. Peter Brett Associates LLP (PBA) was commissioned by Chiltern District Council to consider options for alternative solutions to that being promoted by Government. It worked in association with Aylesbury Vale District Council, Buckinghamshire County Council and the Chilterns Conservation Board (the Stakeholders) in the commissioning and development of the work leading to this alternative proposal: the Chilterns Long Tunnel.
3. The Stakeholders have not accepted the role of commissioning this study lightly. They have done so because Government is considering the imposition of this major linear infrastructure project across the widest part of the Chilterns AONB. The basis of the Stakeholders argument is that the current Government proposals will result in an adverse and irreversible impact on the Chilterns AONB statutory designation. The Government's proposals militate rather than mitigate the impact. It is the purpose of this report to draw attention in an evidence-based and objective way to the consequences of the Government's approach in this case and to provide what the Stakeholders considers being a better proposal.
4. Proposals for the construction of a High Speed Railway, known as HS2, between London and Birmingham and then to Manchester and Leeds have been developed by Government and its holding company established for the purpose, HS2 Ltd. In 2013, the Environmental Statement was published and the Hybrid Bill prepared for the construction of Phase One of the line on this route, incorporating the construction, operation and mitigation measures considered necessary by Government at this stage.
5. The arrangement of the Government's proposed scheme is shown diagrammatically in Exhibit 1.

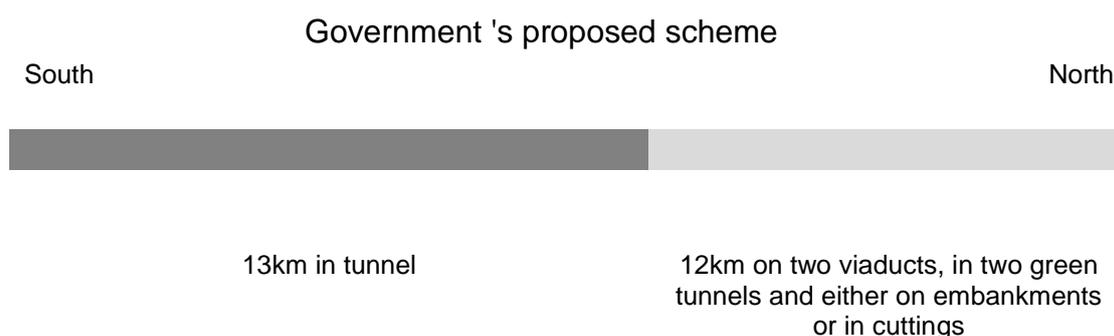


Exhibit 1: The Government's proposed scheme

6. The designation of the landscape of the Chilterns AONB rests on the unique characteristics of its landscape. The design of the Government's proposed scheme north of the proposed bored tunnel takes no account of this designated landscape or the protective provisions of Part IV of Countryside and Rights of Way Act 2000.

7. In order to address this problem the Stakeholders commissioned PBA to undertake a study to determine an alternative route designed as a bored tunnel. That is designed specifically as a tunnel rather than a surface route modified to provide a tunnelled route and on the same horizontal alignment. PBA worked together with OTB Engineering Ltd on tunnelling and Beazley Sharpe (Railwise) Ltd on rail alignment and systems. This work was commissioned in February 2014 and the report, *High Speed Rail in the Chilterns: Feasibility Study of Alternative Tunnelling Options* (PBA, April 2014), (April 2014 Report), was published.
8. The purposes of that report were to devise an alignment which:
 - Was designed as a bored tunnel from first principles rather than a surface route part of which subsequently became a tunnel route;
 - Mitigated the consequences of the surface alignment;
 - Recognised the variable geology and topography of the Misbourne Valley;
 - Mitigated so far as is possible the impact on Wendover and provided a more sensitive response to the location of the northern portal;
 - Avoided the steep summit climb and a tunnel exit at the top of the Chilterns hills thus making it a more economic route to operate;
 - Recognised the design criteria used by HS2 Ltd; and
 - Adopted the safety requirements of the current EU Decision: *Technical Specification for Interoperability on safety in railway tunnels on conventional and high speed rail systems* (TSI 2008/163/EC) (2008 TSI)
9. The April 2014 report provided a technical evaluation of alternative continuous tunnel alignments. The alternatives which were considered are all along the Misbourne Valley and within 3km either side of the horizontal alignment of the Government's proposed scheme. The report advocated one of these alignments, known as the Green Route, as the preferred engineering and environmental option. This alignment was chosen because it satisfied the purposes described in paragraph 12 better than the other alternatives considered.
10. A major determining factor in the route alignment, both horizontally and vertically, was the 2008 TSI which required an intervention gap open to air on all tunnels over 20km in length. The horizontal and vertical alignment of the Green Route incorporated this feature.
11. This requirement is now being changed and the new *EU Commission Regulation concerning a technical specification for interoperability relating to the 'safety in railway tunnels' subsystem of the rail system in the European Union (08/57-ST21 Version EN03)* has been published and became law in January 2015. This Regulation has four features which are relevant to tunnel alignments under the Chilterns. These are:
 - It recognises that innovation in the design of high speed rolling stock is taking place including that relating to emergency arrangements;
 - The requirement for a mandatory intervention gap open to air has been removed and replaced with a requirement for tunnels over 20km in length to be provided with either such an intervention gap or an underground emergency station, referred to in the draft Regulation and in this report as a Firefighting Point;
 - These arrangements are to be subject to a safety investigation to determine the specific or detailed infrastructure required; and
 - The 2008 TSI was an EU Decision but the new draft is an EU Regulation which does not require any UK enabling legislation to give it effect.

12. The report assumes an underground fire fighting point will be adopted.
13. The direct result of the publication of this EU Regulation was to compel the Stakeholders to commission another study. Its main purpose was to determine if the Green Route selected as a result of the previous work was still relevant and if not to determine an alternative route which was. This has been done and the result is this report: *High Speed Rail in the Chilterns: Feasibility Study of an Alternative Tunnelling Option* (PBA, March 2015). The alternative route resulting from this is referred to as the Chilterns Long Tunnel. The route is illustrated on drawings 30067/001/017 and /018 and diagrammatically in Exhibit 2

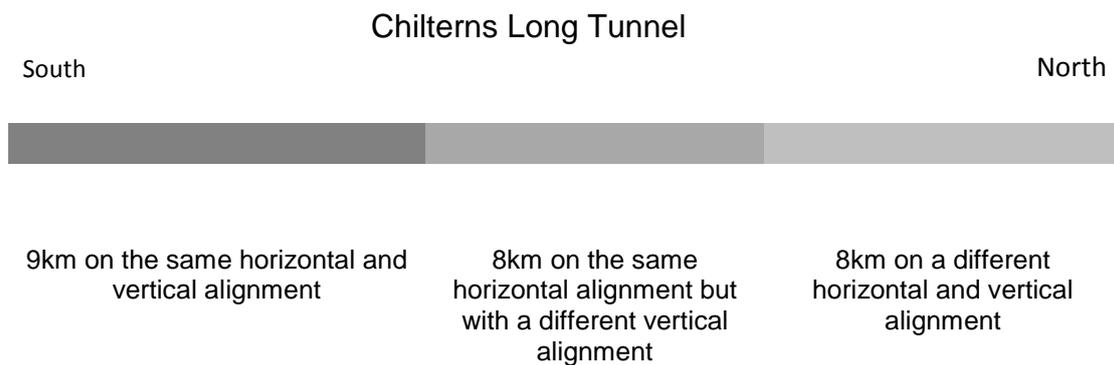


Exhibit 2: The Chilterns Long Tunnel

14. This report concludes that:
 - a long tunnel for the transit of the Chilterns by HS2 is technically feasible and protects the designated landscape of the Chilterns AONB.; and
 - the Chilterns Long Tunnel has far less impact on the Misbourne Valley than the Green Route or the Government's proposed scheme and will be a better route operationally
15. The Chilterns Long Tunnel Route shares the horizontal and vertical alignment of the Government's proposed scheme from the M25 portal for the first 9km and shares the same horizontal alignment for the next 8km. For the last 8km the Chilterns Long Tunnel and the Government's proposed scheme are on different horizontal and vertical alignments.
16. Exhibit 3 illustrates the horizontal alignment of the Government's proposed scheme and the land required and Exhibit 4 the effect of the Chilterns Long Tunnel.

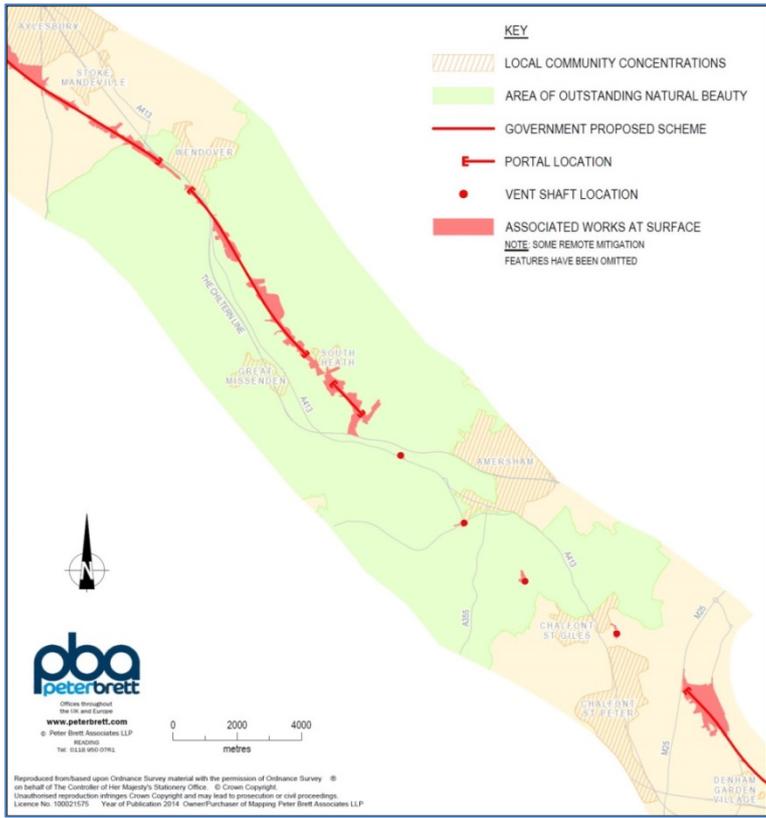


Exhibit 3: The Government's proposed scheme

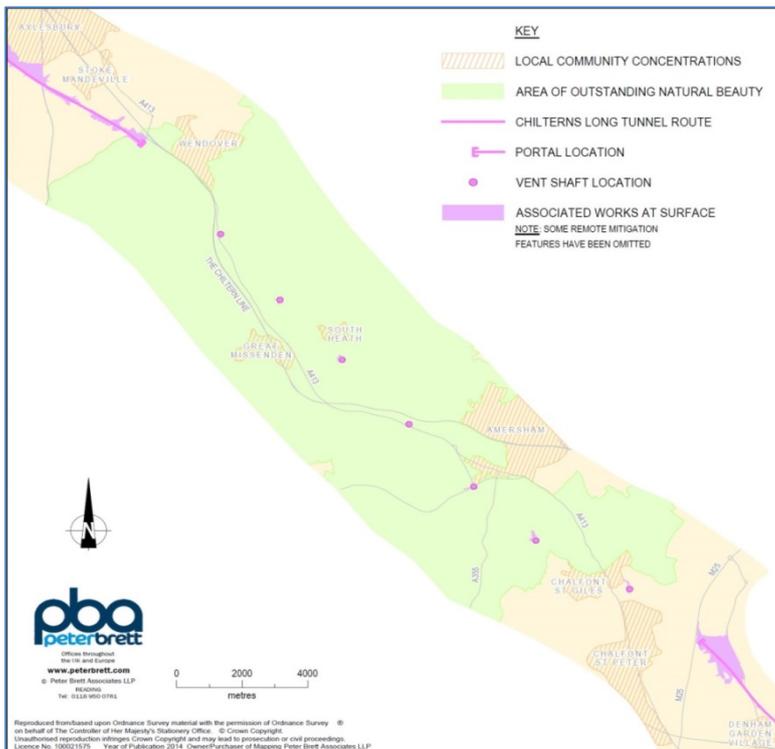


Exhibit 4: The Chilterns Long Tunnel

17. The Government and HS2 Ltd. have asserted that anything which causes delay to the Parliamentary/planning approval process, such as new or supplementary public consultation or additional time to construct the works, will be discarded since its default position is to view them as negative impacts on the business case. One of the advantages of the Chilterns Long Tunnel is that about $\frac{3}{4}$ of the length is on the same horizontal alignment as the Government's proposed scheme.
18. The Stakeholders take the view that even if the Parliamentary/planning process takes another nine or more months then:
- this is likely to be less than the combined effect of delays for similar reasons currently being incurred on the HS2 route as a whole;
 - even if this was not the case then such a delay represents a relatively modest proportion of the likely life span of say 60 years of the completed and operational fixed asset; and most importantly
 - any comparatively short delay in the programme resulting from the development of most appropriate scheme to avoid irreversible damage to this protected landscape must be in the national interest
19. The main characteristics of the Chilterns Long Tunnel Route alignment is compared to the Government's proposed scheme in Exhibit 5. The divergence point is at the south portal near the M25 and the convergence point is at the point south of Stoke Mandeville where the Chilterns Long Tunnel rejoins the Government's proposed scheme.

Route	Government's proposed scheme	Chilterns Long Tunnel
Tunnel start	M25	M25
Tunnel end	Little Missenden	Wendover
Bored Tunnel length	13.2km	24.2km
Route length (divergence to convergence)	28.2km	28.0km
Number of tunnel portals	6	4
Number of ventilation shafts	4	7

Exhibit 5: Comparative characteristics.

20. The northern portal of the Chilterns Long Tunnel Route is located, vertically and horizontally, within the Chilterns AONB where views from the Chilterns AONB, such as Coombe Hill, can be mitigated. The horizontal and vertical alignment would also re-connect to the Government's Proposed Scheme south of Stoke Mandeville thus avoiding any change to the existing

proposals by HS2 Ltd for a maintenance loop and facilities in this area assuming that this is still required. Its proposed location is shown on Exhibit 9.

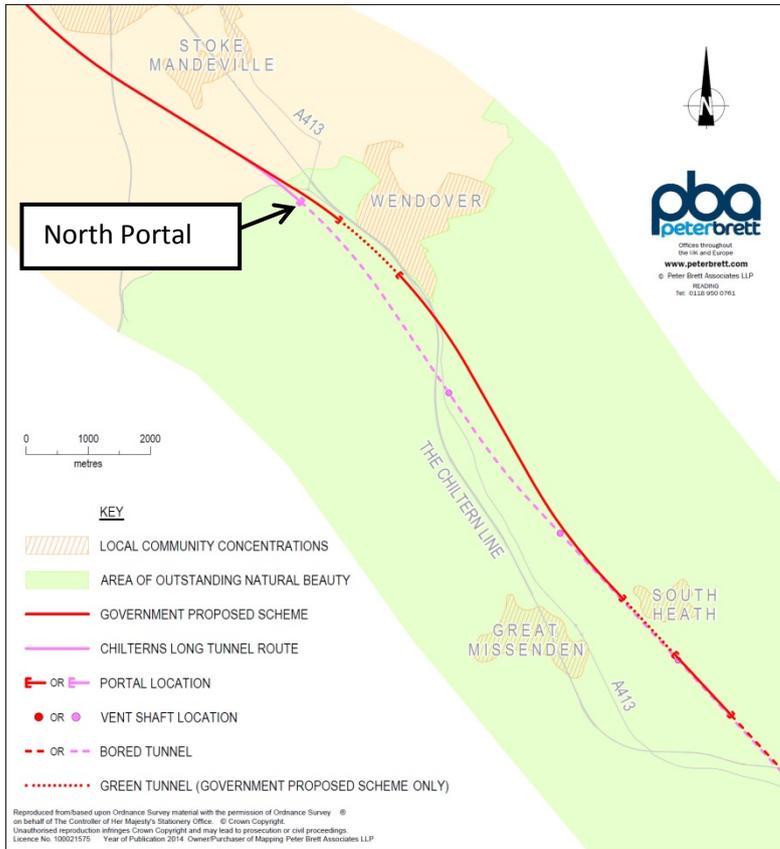


Exhibit 9: Location of the North Portal

21. The comparative characteristics of the Government's proposed scheme and the Chilterns Long Tunnel are shown in the table in Exhibit 13.

Route	Government's proposed scheme	Chilterns Long Tunnel
Bored Tunnel length	13.2km	24.2km
Location of Fire Fighting Point	None	Little Missenden or Wendover Dean or None
Distance from Wendover Station	160m	480m
<i>Up gradients South to North</i>		
Maximum	3.0% (1 in 33)	1.0% (1 in 100)

Maximum gradient length	2.3km	2.1km
<i>Up gradients North to South</i>		
Maximum	2.1% (1 in 48)	0.67% (1 in 150)
Maximum gradient length	0.9km	3.3km
Summit location	Leather Lane	Wendover Dean at the A413
Rise from River Misbourne to summit	149m	81m

Exhibit 13: Comparative characteristics

22. The vertical alignment of the Chilterns Long Tunnel will be more beneficial in operation because the gradients are less than 1%, whereas the Government's proposed scheme has gradients of up to 3%. The more gentle slopes reduce energy requirements and wear on the track. This is an example of the case where a specifically designed continuous tunnel is better than the partial or whole suppression of a surface based route to become a tunnelled route on the same horizontal alignment. Both the horizontal and vertical alignments can be optimized to provide smoother and more efficient alignments. Such is the case for the Chilterns Long Tunnel which, overall, has flatter curves and gentler gradients, with less undulation,
23. In operational terms, the Chilterns Long Tunnel is therefore a more attractive alignment, both vertically and horizontally. The actual speeds achieved on the Government's proposed scheme will make the lower design speed of the extended length of tunnel irrelevant in the context of overall journey time because of the gradients. The difference in vertical alignment is illustrated on drawing 30067/001/018

24. The Chilterns AONB is covered by two forms of designation:
- That recognised by The International Union for Conservation of Nature (IUCN) provides international recognition for the AONB designation, which it places in its Category V - Protected Landscapes and Seascapes; and
 - That required by Section 87(1) of the National Parks and Access to the Countryside Act 1949 and Section 82(1) of the Countryside and Rights of Way Act 2000 (the CRoW Act 2000) which define an AONB in England as an area that is not in a National Park but which appears to Natural England to be of such outstanding natural beauty that it is desirable that the protective provisions of Part IV of the CRoW Act 2000 should apply to it for the purpose of conserving and enhancing the area's natural beauty.
25. This protection is currently based on Natural England's six technical criteria for designation of AONBs relating to:
- Landscape quality;
 - Scenic quality;
 - Relative wildness;
 - Relative tranquility;
 - Natural heritage features; and
 - Cultural heritage.
26. The Chilterns AONB was designated in 1965 and satisfies all of these criteria. In 2004 the Chilterns Conservation Board was subsequently set up whose duties under S.87 of the CRoW Act 2000 are to:
- i) Conserve and enhance the natural beauty of the AONB; and
 - ii) Increase the understanding and enjoyment by the public of the special qualities of the AONB.
27. It is acknowledged that because planning consent is being obtained through an Act of Parliament the CRoW Act 2000 can be overcome. However Government should take account of Section 85 of the CRoW Act 2000 which places the following general duty on public bodies (including the Government): "85: (1) In exercising or performing any functions in relation to, or so as to affect, land in an area of outstanding natural beauty, a relevant authority (including a Minister of the Crown) shall have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty."
28. It is also accepted that the status of AONBs and National Parks is equal in planning terms. Paragraph 115 of the National Planning Policy Framework (NPPF) states: "Great weight should be given to conserving landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty, which have the highest status of protection in relation to landscape and scenic beauty."
29. The Government's proposed scheme will affect the upper Misbourne valley. The designation of the protected landscape of the Chilterns AONB rests on the unique characteristics of its landscape. The upper Misbourne valley system represents not only a fine example of this landscape but also has the distinction of being different to the other four valley systems which cut through the north west facing scarp slope of the Chiltern Hills – being the highest and least urbanised.

30. The designation and the unique special qualities of the Chilterns AONB within the upper Misbourne valley are summarised in the following subsections, together with a summary of how these national assets will be irrevocably harmed by the HS2 scheme and how they would substantially benefit from the long tunnel proposals.
31. Most infrastructure programmes or projects impact on the urban or rural landscape in which they are placed and on the people within them. The impacts which are the subject of this report are those which impact on environmental quality and value of a nationally designated landscape.
32. The long-term consequent changes to the environment after construction, and the temporal changes as a result of the construction process, will generate considerable direct and indirect adverse impacts on the Chilterns AONB.
33. In the face of criticisms that the environmental impacts on the Chilterns AONB would be considerable and unacceptable, HS2 Ltd gave an undertaking to consider an investigation into the feasibility of extending the tunnel in the Government's proposed scheme to the northern boundary of the Chilterns AONB. The purpose of this extension would be to reduce considerably the negative environmental and economic impacts. It was expected there would be an additional cost for a longer tunnel compared with the published surface alignment and this proved to be the case. The conclusion which it reached was that such a tunnel extension was a practical engineering solution although HS2 Ltd has decided not to pursue it because it is of the opinion that it will cost more. The ES (CFA 9 Central Chilterns) notes that:

“Whilst the extended (tunnel) options are feasible in engineering terms and would have an environmental benefit; there would be a financial cost in extending the bored tunnel”.

34. These impacts may have a number of effects:
 - Elimination of valued assets of the upper Misbourne valley;
 - Severance of valued assets, land holdings, social networks and landscape features and connections;
 - Permanent and significant adverse effects on the character and appearance of the special qualities of the upper Misbourne valley; and
 - Long term temporary effects of construction phase such as compounds, storage and temporary accesses over 6 years
35. The Government's proposed scheme will result in:
 - The loss of extensive Ancient Woodland;
 - Destruction of a Scheduled Ancient Monument;
 - Severe impacts on the landscape and visual aspects;
 - The loss, severance and degradation of biodiversity features;
 - Extensive land takes around the route of approximately 400ha of land within the AONB.
 - The use of a large tract of productive farmland for the disposal of over 1 Mm³ (about 1.9 million tonnes) of surplus soil ('sustainable placement') and a further 0.5 Mm³ (about 1 M tonnes) at South Heath ; and
 - A number of dwellings will be lost and many more will still be affected by the construction and operation of the railway with ongoing noise effects.

36. In contrast, the Chilterns Long Tunnel Route will result in:
- No houses demolished;
 - No landfilling of surplus soil;
 - Minimal disturbance to the irreplaceable and tranquil AONB; and
 - Minimal impacts on communities, businesses and residents.
37. Exhibit 18 summarises the costs of the Government's proposed scheme each between the portals and the equivalent point north of Wendover.
38. The cost base used by HS2 Ltd has also been used in these calculations. It is therefore not surprising that the Chilterns Long Tunnel Route has been estimated to cost more. About 85% of the estimated cost of the Chilterns Long Tunnel Route is accounted for by the cost of the tunnelling and the total cost is therefore very sensitive to the HS2 unit rates for this element of work which have been used. A 13% change in this cost results in a reduction of £0.20bn in the total cost. None of the alternative features referred to in this report have been taken into account in preparing the cost of the Chilterns Long Tunnel Route.

Summary Table of Comparative Costs	
Government's proposed scheme	Chilterns Long Tunnel Route
23.7 km	24.2 km
£ 1.45 billion	£1.85 billion
Comparative Rate £'000/km	
62.4	76.0

Exhibit 19: Summary of comparative capital cost from the point of divergence at the south portal to the point of convergence south of Stoke Mandeville

39. The difference in cost presented by the Chilterns Long Tunnel Route represents less than 2 % of the overall construction cost of the HS2 Phase One in a budget currently with a P50 contingency level, which is there is a 50% probability of the estimated cost being exceeded. However, it will be a significant mitigation of the effects of the route through the Chilterns AONB and avoid extensive compensation costs which are not included in this budget.