amongst the best we have in natural beauty terms in our landscapes.

103. The CRAG/CCC case is not, however, a plea for the T3i tunnel at all costs. The CRAG/CCC work – with HS2's assistance, it must be said – has very carefully, and with compromises as to what it seeks to achieve in environmental terms in some areas, attempted to cost things where that can be done so that the Committee can see what the financial parameters are. The extent to which we cannot complete that exercise is in the main attributable to HS2's reluctance to provide details of costings which would permit an examination of, for example, the full mitigation costs of the Bill scheme. The reality is that we do not know the full cost of the Bill scheme. The result of the latter issue is that whilst we can compare the performance of the Bill scheme across a range of parameters as set out in the HS2 SIFT report, the true comparison between the Bill scheme and T3i in cost terms cannot be made. In the consideration of these cost issues, whilst elsewhere being willing to work very clearly within costed parameters, at some points HS2 declines to do what it refers to as the 'local level'. In this instance, in dealing with the Chilterns AONB, it is better perhaps to find that as being a refusal to address cost matters at a regional or sub-regional level.

104. The conclusion of these sessions on the AONB tunnel options provides the opportunity, we submit respectfully, for the Committee to signal that the case for T3i is now overwhelming, even on the basis of HS2's own analysis and even allowing for some, as alleged by HS2 at least, marginal increase in cost. The cost is one which, so far from being unacceptable, should be regarded as entirely acceptable, demonstrating that as a nation, whilst we are cost conscious and efficient, we are among those who do know the value of the exceptional range of assets that we have in our AONBs and, in this particular case, in the Chilterns AONB.

105. Thank you very much, sir. If I may, I'll move to the first witness. And the first witness is Mr Usborne, and we're here looking at the full cast list except. So, first of all, Mr Usborne dealing with the design and cost of T3i. And if we go, there's the introductory slide, thank you. And the next one. Thank you. Go to the, as it were, the long tunnel options.

106. Before you deal with that slide, Mr Usborne, can you just tell us about your own experience please? Is there a slide before that with the experience on it? Thank you.

You set it out for us; just tell us please about your own experience.

107. MR USBORNE: I studied mechanical engineering at Oxford and then subsequently went into the oil industry and spent 35 years or so in the oil industry. The first 12 of those was actively involved in engineering aspects of the industry before going into more general management roles.

108. MR KINGSTON QC: And we should perhaps explain that cheek-to-cheek with you, to your right, is Mr Rodney Craig whose experience is set out also on this exhibit. And he at least I think is well known to members of the HS2 tunnelling team. Is that right? Yes?

109. MR USBORNE: Yes.

110. MR KINGSTON QC: Thank you.

111. SIR PETER BOTTOMLEY: He's been boring before.

112. MR KINGSTON QC: He's been boring before, yes. Lots of it and very appropriately and effectively. And he's here, that is Mr Craig is here, because if there are any engineering technical questions with regard to the evidence on tunnels, Mr Craig is here to assist.

113. So next please: design and cost. That's what you're here to deal with, is that right?

114. MR USBORNE: Yes, indeed. Should I perhaps say that the engineering team that we have is a small team and has included two experienced tunnel engineers, my colleague being one of them. We've worked on the concept of the full tunnel through the AONB since the end of 2010 and have been supported in our work by Peter Brett Associates.

115. MR KINGSTON QC: Hooray, I've changed names, I see. Thank you very much. That was very, very impressive. Thank you so much. Right. Chiltern Tunnel long tunnel options; what do you want to say about this, Mr Usborne, please?

116. MR USBORNE: First of all, let me remind you that a long tunnel is the top tier as you see of a more detailed mitigation that would be required if there were no long

tunnel. You heard last week from the Wendover groups about the extended green tunnel options at Wendover, and that is tier 2. Tomorrow you will be hearing about the REPA tunnel option, also tier 2. From September onwards you are due to hear about all the detailed local measures that people will be asking for if there is no tunnel. Mr Morris, our chairman, will be referring to this again later in the presentation.

117. MR KINGSTON QC: Thank you. And then slide 6, please. Thank you. What's this about, please?

118. MR USBORNE: This slide provides the link back to last week when the district council presented a list of the three tunnel options that were being considered. I will not go over the same ground but will focus on the only option which has not been discussed yet.

119. CHAIR: May I ask why people couldn't agree on one tunnel option? Why we have three long tunnel options?

120. MR USBORNE: I think that will become evident later on in my discussion.

121. CHAIR: Okay.

122. MR USBORNE: But in brief it was that we started at an earlier stage constrained by the way we looked at tunnels, wishing to follow exactly the constraints that HS2 had in their design rather than challenging anything.

123. MR KINGSTON QC: So, for example, with regard to the alignment that you've worked on for the tunnel, you've not set out, as it were, to design your own alignment but said 'no, this is the alignment HS2 have chosen; let's as far as possible work with that alignment'; is that right?

124. MR USBORNE: That's exactly correct. There were two other constraints as well that we followed: one was to do with the depth that the tunnel should be underground and the limit to how deep it might be; and also the separation of the two tunnels. These had impacts on the design but we accepted that constraint and said 'let's see what we can do within the existing constraints rather than challenging them'.

125. MR KINGSTON QC: So in essence what these petitioners have tried to do is not

to completely change HS2's scheme or the parameters that they say are appropriate, but to use those parameters in order to shape an alternative proposal which you're going to be told about as we go along. Thank you. Then next please? So the T3i tunnel option. Tell us about this please, Mr Usborne.

126. MR USBORNE: These are the key features of the option. The first two features, they are shared with other long tunnel options. But it is item 3 that really distinguishes T3i from the others. As we've just been discussing, we followed the constraints that HS2 had in order to minimise any changes that there might be if the tunnel option were to be adopted. We might have chosen a different line had the principle of a full tunnel been accepted earlier on, but we haven't: we followed the existing line. And that is perhaps the contrast between ourselves and the district councils that you mentioned, Chairman, that they felt that rather than following what we were doing they would challenge some of those constraints.

127. MR KINGSTON QC: And we know, because I've told the Committee, that 'I' is for intervention gap; and we can see in the fourth bullet point on this slide that you've included an open-to-air intervention gap, is that right?

128. MR USBORNE: Yes. The European safety standard, the TSI, specifies that no tunnel for a high speed train should be more than 20 kilometres unless it has been approved following a special safety investigation – an investigation that HS2 has not yet undertaken.

129. MR KINGSTON QC: What about the location of the intervention gap here? The case suggested that it would be at Durham Farm. What, in terms of good, bad or indifferent as a location, is Durham Farm?

130. MR USBORNE: Well, we're very fortunate – in fact nature has really provided the ideal location for a separation gap that we're required to have under the TSI. 19 kilometres from the south end of the tunnel, Durham Farm is in the middle of a wide valley which under the current proposal would be spanned by a 500 metre viaduct with embankments either side. So you have seen details of what this viaduct would look like – it's crossing the valley of Durham Farm – and we're able to make use of that facility to put in an intervention gap.

131. SIR PETER BOTTOMLEY: Just to help us, we couldn't look at a map just briefly, could we?

132. MR KINGSTON QC: Yes, the very next slide is the map, Sir Peter, so if you can contain your excitement about the map for a moment we'll just finish these bullet points.

133. 'North portal further from Wendover than the current proposal.' You're going to illustrate that for us in a moment, is that right?

134. MR USBORNE: I am, and to show that this will give added protection to Wendover – more protection from the noise than there would be under the current proposal. And yet it is still over two kilometres from Stoke Mandeville, the next door conurbation.

135. MR KINGSTON QC: And the next bullet point is to acknowledge that T3i was developed by HS2 from your T2 option and, as it were, by that means to acknowledge that HS2 have done a deal of work to, as it were, work the proposal up to something which is now agreed in engineering terms to be in the state I've described in opening, is that right?

136. MR USBORNE: That's true. There's been joint working on this. It's been an iterative process. We've gone back and forwards with a number of reports. HS2 has added to our proposals and made changes, particularly when there were changes to the specification like changes to the tunnel diameter, as the process evolved. And in our report on common ground we have included drawings that have initially been made by HS2. We have just presented them in a slightly different way. So it's a cooperative attack on the problem, if you like.

137. MR KINGSTON QC: Thank you. And let's go to the next slide which will, I hope, help with the map. Sir Peter, if it doesn't, please say so.

138. SIR PETER BOTTOMLEY: I'm just trying to make sure I remember where the farm is.

139. MR USBORNE: Yes.

140. MR KINGSTON QC: Help us. It did mention the gap is where Durham Farm is,

is that right?

141. MR USBORNE: Where Durham Farm is, yes.

142. MR HENDRICK: Can I ask what the person who owns Durham Farm feels about this option? Obviously preferable to the viaduct.

143. MR USBORNE: Sorry, I'm not quite sure.

144. MR KINGSTON QC: What's the difference in impact? Forgive me, Mr Hendrick, but I think the question is: what's the difference in impact on Durham Farm? Is Durham Farm still, as it were, going to suffer a significant impact?

145. MR USBORNE: The farm itself certainly is. Under the current proposal it is also because it would have a viaduct above it. And what we're proposing is that, instead of a viaduct above it, you've lowered the line so that it is going through a cutting, which is the intervention gap. There's flexibility on exactly how you do it and I'll come on to that later on.

146. MR HENDRICK: But does the person who owns the farm feel that they can continue farming as it is normally in either of those options?

147. MR USBORNE: No. It's very unfortunate for him; he's been there all his life. But under both proposals he's not going to be able to continue farming.

148. MR HENDRICK: Okay.

149. MR KINGSTON QC: So that's where Durham Farm is. That's where the intervention gap is. What else? Is there anything further on this slide that isn't self-explanatory? We can see that you've got the intervention gap; you've got the vent shafts; the extended tunnel. North portal is indicated, and also the Stoke Mandeville maintenance loop which is not affected by your proposals; is that right?

150. MR USBORNE: That's right, and we'll come on to that in a little bit more detail in the subsequent slide.

151. MR KINGSTON QC: Thank you. Anything further about that slide?

152. MR USBORNE: I think it's self-explanatory. We must just reinforce that this is

the route that is being taken by the current proposal. We made no changes to the route at all. We have put in, though, the extra vent shafts that would be required if the tunnel is extended as proposed.

153. MR KINGSTON QC: Thank you. The next slide, please. This is about the extraction of the tunnel boring machines from the vent shaft. What's the point about this please?

154. MR USBORNE: You visited the site, or most of you visited the site, and visited Mantels Wood and walked through Mantels Wood and will have been aware not only of the beauty of the wood itself but also how difficult it would be in construction terms to put a portal there; and moreover to extract the TBMs which would be required under the current schemes. They would have to be drawn out of that wood and transported down to the main road. Under our proposal, the TBMs would be withdrawn at the vent shaft that's already proposed down near the main road: the Little Missenden vent shaft.

155. MR KINGSTON QC: Indicated on this slide is the Little Missenden vent shaft. The T3i proposal immediately to the north of the A413, is that right?

156. MR USBORNE: That's right.

157. MR KINGSTON QC: And how much of an advantage is that? Marginal?

158. MR USBORNE: No, it has tremendous advantage I think. It's very significant because it's much easier to get the machines out from there. There would be minimum of damage at the vent shaft and Mantels Wood would be totally saved. There would be no surface intervention in Mantels Wood at all under this proposal.

159. MR KINGSTON QC: Thank you. Next, please. Now, what are we showing here? It's the northern portal, Stoke Mandeville and Wendover. What features do you want to draw to the Committee's attention, Mr Usborne?

160. MR USBORNE: The arrow on the right indicates the place that the portal under the current proposal would be.

161. SIR PETER BOTTOMLEY: Arrow 1?

162. MR USBORNE: Arrow 1 is the end of the green tunnel. Under the current

proposal, as you know, there's a green tunnel that goes past Wendover and that's where that would end, and you would then have a portal at that point. Under our proposal the portal would be moved to arrow 2; so taken further away from Wendover and that would leave it about 650 metres from Wendover, yet still some 2.3 kilometres from Stoke Mandeville. You can see Stoke Mandeville on the left, hatched in there; and on the right is Wendover. So, from Wendover's point of view, it's a significant move to move it that much further.

163. Arrow 3 is the Chiltern long tunnel proposal which, if you remember, changes the alignment a bit there; and so that's why the arrow is off the line. That has taken the portal further from Wendover and you will have heard last week the description of the advantages that a portal in this position gave.

164. MR KINGSTON QC: From Stoke Mandeville's point of view are there any advantages with your proposal in terms of the location of the track and its position?

165. MR USBORNE: Yes, there are. There are two obvious advantages. First of all, the train coming out of a bored tunnel is by design slower than it is out of a green tunnel. So we've got the train going slower as it approaches Stoke Mandeville. Also, under the T3i proposal, the line has been dropped lower down in order to get the cover that is required for the bored tunnel. And the track bend would be some nine metres deeper in the ground at the point that it comes out of the tunnel for the T3i proposal, providing added noise and visual mitigation for Wendover.

166. MR KINGSTON QC: Thank you. And next, please. The advantages. Some of these might not need explanation but to the extent to which you think it's helpful, could you take us through them please, Mr Usborne?

167. MR USBORNE: Yes, number 1: it follows the route. We've discussed that. And that's a route that has been fully discussed and consulted on. As we've said earlier, it's the result of a collaborative development with HS2 and we've not challenged existing design constraints.

168. We have, over the five years that we've been working on the idea of a tunnel, had many meetings with local councils and action groups, and also meetings and discussions at the local area forums. At all these, the CRAG proposal has been discussed and is

therefore well known, as the petitions indicate, by local residents. It's not something new that's been foisted on them at all; they've participated in the development of the idea and consented to it.

169. The project would cause no delay in the overall project to incorporate T3i. And although it costs more than HS2's current proposal – we don't dispute that – it is the cheapest of the full tunnel options.

170. MR KINGSTON QC: And we should perhaps say that the £349 million, as will become clearer later in the evidence, that that is HS2's estimate of the additional cost of T3i, not CRAG or CCC's estimate. Is that right?

171. MR USBORNE: That's correct.

172. MR KINGSTON QC: But even on HS2's figures we can see what the difference is and the Committee can see what the difference is between T3i and the CLT. 349 plays 485, is that right?

173. MR USBORNE: Yes.

174. MR KINGSTON QC: And next.

175. MR USBORNE: And then I've discussed Stoke Mandeville, the impact it has on Stoke Mandeville, and we regard that as an advantage. And that, as is said there, almost everyone is better protected than under the current scheme.

176. MR KINGSTON QC: So it provides, in essence, all the protection that everyone seeks but, in a context which you've described following HS2's line, additional costs we'll come to later. Yes?

177. MR USBORNE: Yes.

178. MR KINGSTON QC: Thank you. Next then please.

179. MR USBORNE: There are a few disadvantages and we've listed two there. Yes, it does have an open-to-air gap at Durham Farm which the Chiltern long tunnel proposal did not. But, as we've alluded to earlier on in our discussion, it is a great improvement on the current proposal and does meet the regulations. It's really also a factor that the

mitigation of a gap is much easier than it is of a viaduct. There's been discussion before you I think last week on how one might try and mitigate the noise and the visual impact of a viaduct, but it is structurally very difficult to do it and expensive. Whereas once you've got the line on the ground it's much easier to have bungs and noise barriers and eventually plant trees and insulate it visibly.

180. MR KINGSTON QC: So in essence we're considering the extent to which an intervention gap might be accommodated sensitively in the landscape as opposed to how to accommodate an 18 metre high, several hundred metres long viaduct?

181. MR USBORNE: Indeed.

182. MR KINGSTON QC: Thank you. I understand that. And then the second point?

183. MR USBORNE: The northern portal. We've discussed that and the position of the portal nearer Wendover has been accepted by Wendover if a Chiltern long tunnel is not approved. From their perspective they would prefer to have the portal further away but they have made it quite clear that it's a price that they are prepared to pay. The closer portal is still 650 metres from the edge of Wendover but they would be prepared to accept that in order to ensure that a fully bored tunnel is put in rather than the current scheme.

184. MR CLIFTON-BROWN: Can I ask what the difference in terms of noise impact on Wendover, particularly the church and school, would be in your proposed CLT as opposed to the existing proposals?

185. MR USBORNE: The difference between the two?

186. MR CLIFTON-BROWN: Yes, the difference in noise impact on Wendover, bringing it out from 1 to 2, in other words, on your slide 10. What would the noise reduction be on Wendover?

187. MR USBORNE: I think they would be very different because they're underground at that point. So the fact that CLT is a bit further away would not make very much difference to what is almost silence as it passes in any case underground. Is that what you had in mind?

188. MR CLIFTON-BROWN: Well, we're still going to have a portal, as I understand it, at 2 as opposed to 1, referring to slide 10, if I've understood the thing correctly.

189. MR USBORNE: Yes.

190. MR CLIFTON-BROWN: Moving it out just that little bit further north-west, what would the reduction in noise impact be on Wendover, particularly the church and the school?

191. MR USBORNE: Yes, that's the portal rather than past the church.

192. MR CLIFTON-BROWN: Yes. So what I'm asking you is: have you done any studies on what the impact on Wendover will be in terms of noise reduction on your proposals as opposed to the existing proposals?

193. MR USBORNE: No, I haven't done studies but Wendover has done studies and it's on the basis of that that they concluded that they were prepared to have it.

194. MR KINGSTON QC: Mr Clifton-Brown, you should have in the exhibits pack from these petitions the HS2 SIFT analysis which is a right up to date HS2 prepared document. And if you'd be good enough to perhaps – I wouldn't say at leisure but if you're interested to have a look – have a look at page 18.

195. SIR PETER BOTTOMLEY: Is there a reference number to that page?

196. MR KINGSTON QC: I'm sure there is. I'm afraid I only got the reference bundle immediately before the hearing. Someone will tell me. Yes, there is: A1237(18). And, lo and behold, here it comes at a degree, in terms of the size of the print, which indicates that these documents are mostly prepared by younger men. But you can see 'sound and vibration' at the bottom of the page there. And the way that this document works, the way HS2 prepared is, is that the Bill scheme is the left-hand one. 'Proposed scheme at Hybrid Bill', top of the column of the first of the options considered. And everything is compared with the Bill scheme and you'll see that it gets therefore that neutral colouring. And if you go along the options to option T3i, which is the column there where the cursor is now, you'll see that for sound and vibration and construction the T3i option compared by HS2 with the Bill scheme gets a green plus, plus, plus. And the reasons for that are explained briefly in the column.

197. And in terms of operation, if we can go to the next page in that document which is now there, you can see 'operation' there at the bottom: still, compared to the Bill scheme, noise gets a plus, plus, plus. 'Reduced noise effects overall but still significant airborne noise effects anticipated by communities at Nash Lee allowing for sustainable noise barriers at Wendover south.'

198. So HS2's own assessment in response to your question, Mr Clifton-Brown, is that overall T3i produces a benefit – plus, plus, plus type benefit – in terms of noise and vibration both in construction and operation. Now, I appreciate that may not be as particular as your question was but I think Mr Mould will be able to help about that. But given where the church is, from recollection, the significant benefits which are described in the SIFT report will attach to the T3i option in relation to the church.

199. Thank you. If we go back then to where we were. North portal. Thank you. Which you say is acceptable. So if the Committee decides that the CLT involves too much cost or too much disruption to HS2's scheme then T3i is there in terms you've described, Mr Usborne. Can we go to the next slide please? Areas of agreement. What do you want to say about this please?

200. MR USBORNE: I think they are fairly self-evident from the slide there and the items we have discussed. It just reinforces that we have had a very productive discussion with HS2. The item at the bottom there shows that we agreed within a range the likely cost where HS2 believes it is up at £350 million and we believe that it is at the lower end of the range. So we at least agree it's within that range.

201. MR KINGSTON QC: And as to clear environmental benefits, we need look no further than HS2's own SIFT analysis of 9 July this year.

202. MR USBORNE: Indeed.

203. MR KINGSTON QC: Thank you. Well, we won't go through them. You've got them and they're self-explanatory as you say. Where there's no agreement, next please: the exact costs. Yes?

204. MR USBORNE: We'll come on to that a little later in more detail but that is, as we've said before, an area where we don't agree on the exact costs. The value of the

associated benefits is the subject of the subsequent presentation on behalf of CRAG.

205. MR KINGSTON QC: That's Mr Hindle from Segal Quince Wicksteed who's coming next.

206. MR USBORNE: Spoil handling was discussed last week and proposals were put forward by the statutory bodies, the district council, so I won't go into that other than to say we believe strongly that the disposal of spoil by rail is quite feasible and would have significant advantages. The spoil that's coming out of the northern portal from the tunnel operation could easily be handled by rail.

207. MR KINGSTON QC: We know that one of things that's happened with HS2's proposal is that – I have to get the wording right so as not to call it a dump – the sustainable placement location for the spoil is now going to be a temporary placement and it's then going to be removed. Is that right?

208. MR USBORNE: That's right.

209. MR KINGSTON QC: Consequences in terms of double handling?

210. MR USBORNE: It would certainly be more expensive, and the point we'll make in the subsequent slide where you're having to remove the spoil, put it on Hunt's Green which you saw on your visit, and I think you will appreciate what that would involve: putting 1 million cubic metres of spoil on that land and then subsequently moving it and taking it down the line to a point near Aylesbury which is the current proposal.

211. MR CRAUSBY: Could I ask, what materials are in the spoil and how difficult is it to dispose of it in an environmentally friendly way?

212. MR USBORNE: I think it depends on the type of material, and it's not certain exactly what form it could take and whether all that material could be used for embankments and construction purposes or whether it has to be disposed of in some other way. But under the current proposal – and HS2 can explain this more than we can – but under the current proposal they're intending to remove it from Hunt's Green and take it down the trace as far as possible, which they can't do fully or it depends on at what stage they remove this material, and then use it further north; and I'm not sure exactly in what form they're going to use it.

213. MR KINGSTON QC: Having been moved twice in the current proposal.

214. MR USBORNE: It's a costly exercise and it's added to the cost and I don't think that has been factored into the cost estimates that HS2 has made. So it looks as though there will be an added cost to the current proposal that would clearly be saved if there were a tunnel and therefore no need for this double handling of spoil. There wouldn't be any spoil put on Hunt's Green.

215. MR KINGSTON QC: What about the last item on your slide there: construction compound at northern portal. There is no issue that there will need to be a larger construction compound at the northern portal, we understand, Mr Usborne; is that right?

216. MR USBORNE: That's right. We recognise that there's got to be a large… and I emphasise it's a temporary construction compound – it will last there six or seven years – while they are constructing the tunnel. It is a large compound but Wendover has confirmed, as I mentioned earlier, that they could accept that to get a bored tunnel. But what one must recognise is that this large compound is replacing a large amount of alternative constructions sites: eight construction sites would not be required; over 20 balancing ponds and drainage areas will not be required; many access roads that are required under the current proposed scheme will no longer be required; and the land-take during construction of the scheme between Mantels Wood and Wendover will be considerably less and it will be less after construction.

217. So although we accept that there is this construction compound that has to go in, it is a considerable reduction in what would otherwise happen. One mustn't forget that the green tunnels themselves, and the green tunnel in particular by Wendover, will be a vast construction site while it's being built. The way it is built is to dig down, remove the spoil, put a roof on it and put it back again. That will no longer be required if there's a bore tunnel and one must balance this saving that one is getting against the additional construction site at Wendover.

218. MR KINGSTON QC: Overall in your view, in terms of land take, looking at what's required in construction, and in the large construction compound in the northern portal against what's currently proposed in terms of the size of areas required for construction across the AONB, where does the balance lie, please, in terms of which is more and which is less?

219. MR USBORNE: It will be far more under the current proposal. It's difficult to be quite sure but it's about 10% of the land-take that would be required under a fully bored tunnel requiring a construction site. 10% of the amount that is required for the current proposal.

220. MR KINGSTON QC: And whilst one mustn't forget what impacts there might be if there were a large construction compound in relation to Wendover, that is something which you say they are prepared to accept as part of what would, for them, achieve a desirable objective of a fully bored tunnel.

221. MR USBORNE: Yes, and indeed the SIFT analysis seems to support that view as well.

222. MR KINGSTON QC: Yes, indeed, it does. Thank you. Then next please. Construction cost. We've got some figures here. HS2's claim: the T3i an additional £349 / 350 million. What do you want to say about this, Mr Usborne, please?

223. MR USBORNE: I'm not going to enter into the numbers game. One can go on debating exact numbers but I think that it's more helpful to illustrate this in broad terms. What we're saying is that we don't believe that it will cost as much as £349 million for a number of reasons. I can illustrate roughly the figures. But take, for example, the fast tunnelling. HS2 have done all their design work on the basis that tunnelling would be proceeding at 18 meters a week. Now, there's a lot of evidence, and my colleague, Rodney Craig, has assembled that evidence and if you were interested he would be happy to take you through it. He will be going into more detail tomorrow in a subsequent presentation about tunnelling speeds. But we believe that it would be quite reasonable to have assumed a tunnelling speed of at least 100 meters a week or as much as 120 meters a week.

224. To speed up the tunnelling does have consequences. It isn't trouble free because you've got to dispose of the spoil more rapidly. If you're tunnelling faster you have got to make sure that your facilities are there for handling the spoil, treating the spoil and removing it. So there are costs associated with that and we're not aware and don't know what those costs are and I don't believe that HS2 has analysed those costs. But just by tunnelling faster you are reducing the time taken for tunnelling and therefore the marginal cost benefit that you get. It could be significant.

225. MR CRAUSBY: Is it the case that the speed that you tunnel at is dependent upon the material you're tunnelling through?

226. MR USBORNE: I'm sorry?

227. MR KINGSTON QC: Is the speed of the tunnelling dependent on the material you're tunnelling through?

228. MR USBORNE: It is ultimately, yes. But the evidence that we have got is that one can tunnel faster even in this material. There are examples and, Mr Chairman, if you'd like my colleague can explain some of them if you want him to do so.

229. SIR PETER BOTTOMLEY: The estimated cost by the promoters of the things you're suggesting could be 40% higher than it need be.

230. MR KINGSTON QC: And just so we're clear, we don't make the comment uninformed about the geology; indeed we are informed about the geology and aware of what is being bored through. And so these estimates are informed by that knowledge.

231. What about the quicker fit-out? What's the point there please?

232. MR USBORNE: I think I will leave that until tomorrow when my colleague will go into more detail.

233. MR KINGSTON QC: But in essence?

234. MR USBORNE: In essence it means that there is the work in installing in the tunnel the fittings, the slab concrete and the electrical fittings which can be done more rapidly than we think has been allowed for in the proposal..

235. MR KINGSTON QC: Thank you. And 'less spoil at Durham farm'; what's the point there please?

236. MR USBORNE: Yes, Durham Farm. I've explained what it is: it is a natural gap and a gap of about 700 metres across. Under the earlier proposal that we worked on, when the length of the porous portal was thought to be just 100 metres, you then had a requirement for a gap that was made up of the 500 meters: the gap itself plus 200 metres at the end so a total of 700 metres. That fitted rather neatly into the natural

Durham Farm gap. But now that it appears that the requirement is for the portals to be 200 metres long each, that has added 200 metres and has forced the design to go into the high rising ground at either end and increased the amount of spoil that would be required to be removed.

237. MR KINGSTON QC: Whereas with the T3i proposal there would be less spoil disposal at Durham Farm, yes?

238. MR USBORNE: Well, there could be less spoil than has been allowed because there has been no design of this gap at Durham Farm made since the portals were extended. The original design that was done by HS2 and that we have in our documents was on the shorter portal. Now HS2 have said that there will be a requirement of about 1.4 million cubic metres of spoil from Durham Farm that had to be removed. There's no basic reason why a lot of that shouldn't be used for mitigation within Durham Farm.

239. MR KINGSTON QC: Thank you. And savings by removing the need for double handling of spoil, we've referred to already and we don't need to go through it again. What is the 'inappropriate allocation of overheads'? That sounds though it might be driven by accountancy considerations rather than anything else.

240. MR USBORNE: Yes, we were a little surprised when we got the latest cost details. We've had to put in cost details from HS2 and we had relied on details from a table known as 4.8. In the latest details an overhead figure has been added to the bottom and it appears to us that that is an accountant's allocation of costs and not a reflection of the economic difference of having a bored tunnel as opposed to the current proposal.

241. MR KINGSTON QC: This is an HS2 document. I'm afraid I haven't got the slide reference for it. It was our document A3. And it's an HS2 document called 'High Speed Rail in the Chilterns Part 3: CRAG Proposal'. A123(1). And the cost tables are right at the back of that. Page 22. Thank you. The item that you're looking at, in the left-hand column under 'Indirect costs' we can see a figure of £66.6 million. That's the indirect cost which is just added as a matter of course, is it, by HS2?

242. MR USBORNE: It appears to be. It's probably made up of one or two items. And elsewhere you can see the slightly lower figure.

243. MR KINGSTON QC: Yes. Have you had any convincing reason which indicates to you that it's a cost which should be borne by the T3i proposal?

244. MR USBORNE: We don't believe that all of it should. Certainly there are likely to be some extra overheads but the straight allocation of overheads seems to us to be inappropriate when looking at an economic comparison.

245. MR KINGSTON QC: Thank you. Then back to your construction costs slide if we could, please. Thank you. And you say those could reduce the additional cost to in the order of £250 million.

246. MR USBORNE: That is the total from those items. Now, it may not be as much as that – we don't want to be precise – but we believe there is evidence that it could reduce the construction cost significantly. But I make clear that in our analysis that you'll hear more of later on we have accepted the £349 million. The analysis has been done against that and the lower cost has been shown as a variant on that analysis.

247. MR KINGSTON QC: And we'll come to that with Mr Hindle in just a few moments perhaps.

248. MR CLIFTON-BROWN: Can I just ask before you go on?

249. MR KINGSTON QC: Yes.

250. MR CLIFTON-BROWN: Have you done any work on the vertical alignment of your tunnel proposal? Would it allow the alignment to be flatter and, in other words, not to have to go up the summit so much? Have you done any work on that?

251. MR USBORNE: I believe it would. The vertical alignment that we've incorporated is the alignment that HS2 has proposed for us.

252. MR CLIFTON-BROWN: Your tunnel proposal compared to the proposal?

253. MR USBORNE: It's lower, of course – it doesn't go up as high.

254. MR CLIFTON-BROWN: Yes. So if it's flatter does that, in your view, mean that the operating costs would be less than the promoter's current proposals?

255. MR USBORNE: I think you've heard of that last week from the district councils

who have done more work on it than we have. We haven't analysed that one. But our view would be that it would be up to HS2, if the principle of a tunnel were accepted, to determine what was the optimum vertical alignment. You have to take into account also the cost of the vents. Of course, the lower the line the deeper the vents and the more expensive they are to produce. So it is an optimization that needs to go on there.

256. MR KINGSTON QC: But we make it clear, in response to Mr Clifton-Brown's question, that a T3i is effectively HS2's design for the CRAG T2 option. Is that right?

257. MR USBORNE: That's correct.

258. MR KINGSTON QC: Which is why we have the confidence we do that in engineering terms it will work and has nothing in terms of operation which would make it prohibitively expensive or inappropriate in that regard. Again, as we've said, the SIFT analysis deals not with operating costs or anything like that but with overall balance of advantage across the range of factors that I have referred to.

259. Let's go to your final slide, your conclusions then, Mr Usborne, please. Sorry, if I could just have a moment, sir.

260. That was just a point about the contours and, in essence, rather than having the line emerge at the top of a hill and then need a viaduct to get across to the top of the next hill, with the sort of engineering that we are talking about, T3i, we avoid that. Is that right, Ms Usborne?

261. MR USBORNE: Yes.

262. MR KINGSTON QC: So it's quite simple really, isn't it, rather than coming out at the top of the hill, viaduct across, go to the next hill. Not too challenging. Right, thank you. Your conclusions then, please. What would you like to say about these?

263. MR USBORNE: I think they're probably fairly clear on the slide, that not only is the scheme viable but its implementation would require fewer changes from the Hybrid Bill, so it'll be relatively easy to implement. It does not provide all the benefits of other long tunnel solutions put forward but the possibility even of a tunnel that doesn't require a gap at all is conceivable. And we feel that there should be a special safety investigation taking place before HS2 proceeds with the detailed design, rather than

waiting until after the design is complete.

264. MR KINGSTON QC: Because the special safety investigation carried out in accordance with the TSI might do away – might, we stress – altogether with the need for the intervention gap at Durham Farm.

265. MR USBORNE: We accept that that's not an easy or an obvious solution and it might not be feasible at all but it's something that should be considered, we feel. And we've been told it wouldn't delay the project at all to have such a safety investigation take place.

266. MR KINGSTON QC: And your last two points about this solution?

267. MR USBORNE: Yes. We believe that it's a balanced solution. It's not ideal and it's not the best that we could conceive of and we would certainly support the Chiltern long tunnel proposal if that were acceptable to the Committee. But we believe that this is a balanced solution that we are putting forward that costs less and achieves nearly everything that the Chiltern long tunnel would deliver.

268. MR KINGSTON QC: Hence the value for money option at the bottom. Thank you very much.

269. CHAIR: Do you want to ask any questions, Mr Mould?

270. MR MOULD QC (DfT): Just one or two if I may.

271. CHAIR: Okay.

272. MR MOULD QC (DfT): Could we put up A1228(8) please? And, Mr Usborne, just so we're clear on the key overground features of the T3i option, we know that until the point at which it arrives at Mantels Wood it is essentially indistinguishable from the Bill scheme. That's right, isn't it?

273. MR USBORNE: It's exactly the same.

274. MR MOULD QC (DfT): Yes.

275. MR USBORNE: Except for the alignment. The alignment would be lower as it comes up the hill to Mantels Wood under the T3i.

276. MR MOULD QC (DfT): Yes. The vertical alignment.

277. MR USBORNE: The vertical alignment.

278. MR MOULD QC (DfT): And so if we locate ourselves, there we have the Mantels Wood portal. And we can see that as one moves north one would need an additional vent shaft broadly at the point shown, 'vent shaft S5', between Hyde Heath and South Heath.

279. MR USBORNE: That vent shaft would be right away from Mantels Wood. It would be behind Annie Bailey's, as I think you saw in your visit. Annie Bailey's is a restaurant which has been closed down.

280. MR MOULD QC (DfT): And a vent shaft, S6, just at the point shown here, the vicinity of Hunt's Green, Leather Lane.

281. MR USBORNE: Yes, that would be between Leather Lane and Hunt's Green.

282. MR MOULD QC (DfT): Yes. Then the intervention gap which, as you know, under our current estimates would be required to be some 900 metres in length.

283. MR USBORNE: Yes, 500 metres.

284. MR MOULD QC (DfT): 500 plus 200 plus 200.

285. MR USBORNE: Under your…?

286. MR MOULD QC (DfT): Our estimate, yes.

287. MR USBORNE: The vent shaft.

288. MR MOULD QC (DfT): The intervention gap.

289. MR USBORNE: The intervention gap would be, yes.

290. MR MOULD QC (DfT): 900 metres overall?

291. MR USBORNE: Yes.

292. MR MOULD QC (DfT): Yes. Then a further vent shaft just to the south of

Wendover.

293. MR USBORNE: Yes.

294. MR MOULD QC (DfT): And then we have the northern portal which was some 350 metres north, if you remember, of the proposed northern portal site for the Wendover green tunnel.

295. MR USBORNE: Yes.

296. MR MOULD QC (DfT): Yes. Now, each of those will be permanent features of the tunnel scheme, won't they?

297. MR USBORNE: Yes.

298. MR MOULD QC (DfT): And each of them will require to be constructed so each would require construction sites in order to enable them to be built, won't they?

299. MR USBORNE: They will.

300. MR MOULD QC (DfT): Yes. And each of them will require a quantity of construction traffic, both heavy and light vehicles, in order to serve those construction sites.

301. MR USBORNE: Yes.

302. MR MOULD QC (DfT): And that traffic is going to be drawn principally along the A413 and then turn right as you look north at the secondary road network to access those sites, isn't it?

303. MR USBORNE: Yes, I think you have to compare that with what is going on under the proposed scheme that there would be a lot of construction traffic under that scheme. Also you need to allow for certain mitigation that is possible by the vent shafts. Not all the spoil that will be removed from the vent shaft would need to be disposed of away from the site.

304. MR MOULD QC (DfT): Not all of it, no, but some of it would.

305. MR USBORNE: Yes.

306. MR MOULD QC (DfT): Yes. And you posited the possibility of a railhead being created at the northern portal site, the size of which was estimated by Mr Blaine last week of upwards of 50 hectares in extent. A railhead being created. We had a letter last week from Schenker which suggested that they thought that theoretically there might be three to four train paths a day available. And I reported to the Committee through cross-examination that our judgement was that even if that theoretical availability was translated entirely into a real availability it would not enable one to bring in material; it would simply serve to accommodate the removal of spoil. So one would still need to bring in all the aggregates and other material to create tunnel segments and all the other matters that would need to be handled from that tunnel and portal site – they would need to come in by road, yes?

307. MR USBORNE: I think there is greater flexibility in bringing material in than there is in the extracting.

308. MR MOULD QC (DfT): The material, however flexible it is, it will still need to come in on the roads, wouldn't it?

309. MR USBORNE: Ideally, yes.

310. MR MOULD QC (DfT): Yes. And of course that all assumes that we could in practice achieve those train paths in competition with others who would be looking to achieve train paths on the busy Chiltern railway line. Yes?

311. MR USBORNE: Yes.

312. MR MOULD QC (DfT): Thank you.

313. MR USBORNE: I think that in the SIFT report you have taken a more pessimistic view. You don't assume the use of rail at all and yet at the end of the SIFT report you say that it is beneficial and that T3i is a preferable solution from the perspective of the SIFT report. So you have accepted that even on the basis of all the spoil having to be removed from the vents and no railhead.

314. MR MOULD QC (DfT): Well, clearly the greater the opportunity for rail based disposal the greater the advantage. But that begs the question, doesn't it?

315. MR USBORNE: Yes.

316. MR MOULD QC (DfT): Yes. Can we just turn please to your slide?

317. MR CLIFTON-BROWN: Sorry, while we're on that slide, could I ask the other half of the question that I posed? I didn't pose the other half. Whilst Wendover might get some relief from noise by extending the tunnel further north-west, what is the effect on Stoke Mandeville by bringing it nearer to them, i.e. this tunnel solution, in terms of noise and construction?

318. MR MOULD QC (DfT): Well, our position is that the effect on Stoke Mandeville would be to provide a worsening of the construction impact on Stoke Mandeville; or, put another way, would provide a greater challenge in trying to mitigate those construction impacts because the scale of activity going on both geographically closer to Stoke Mandeville and of far greater intensity of activity over a more prolonged period than is proposed in order to create the northern portal of the green tunnel would be very considerable indeed. I mean, one only has to think that there would be a tunnel bore drive site; there would be a tunnel segment construction factory also at that location. That is the inevitable consequence of having to bring in the material so as to create those segments. And the scale of activity would be commensurate with that major construction site which would be of fairly lengthy duration. I can ask Mr Smart, if necessary, to give you a little bit more detail on that, but that's our overall assessment of it.

319. MR KINGSTON QC: Mr Usborne might want to comment on that.

320. MR USBORNE: Yes, I'd point out that it's still quite far from Stoke Mandeville. As we pointed out, the portal is still over 2 kilometres and the sound attenuation is such that no noticeable extra sound from the portal itself will affect Stoke Mandeville over that distance. Stoke Mandeville will certainly hear the trains as they each rush past Stoke Mandeville, and I feel very sorry for them because they are affected, but that is so under whatever approach we've got.

321. On the construction side it is still quite some way away from the built areas of Stoke Mandeville. There are some people that will be affected undoubtedly but one doesn't want to get the impression that it is the whole of Stoke Mandeville that is going

to be affected by this temporary construction site. And I think that sometimes HS2 give that impression and don't make it clear that the particular site in question is some way from the built up area.

322. MR MOULD QC (DfT): In answering the question which Mr Clifton-Brown addressed to me, I was focusing on the construction impacts. I think the witness very helpfully focused on the operational effects and we will accept that once one has constructed the portal the distance between the portal and Stoke Mandeville would mean that the difference in noise impacts from the portal having moved 350 metres further north, because there will still be a fairly substantial distance between that portal and Stoke Mandeville, the change in terms of operational noise effects would be relatively little.

323. MR CLIFTON-BROWN: Thank you.

324. MR MOULD QC (DfT): Can I also just deal with one point that you raised during the course of questions as it's convenient here? You raised the question of whether the shift of the tunnel portals 350 metres to the north would have any appreciable effect on the residual noise effects of the railway on the church and also the school. If you recall, those facilities are both situated to the south of Stoke Mandeville and so their position would be ameliorated significantly by the substitution of a bore tunnel which emerged from the ground to the north of Wendover itself.

325. MR CLIFTON-BROWN: You said the south of Stoke Mandeville.

326. MR MOULD QC (DfT): I mean Wendover. I do apologise. So if I just point them out here, here is the tunnel portal. The church and the school are located broadly in this location here.

327. Mr Usborne, can I just ask that we turn on please to A1228(13)? And you indicated that one of the areas of agreement with HS2 Limited was that there was a range that the additional construction costs associated with T3i were likely to be at a range of £250 million to £350 million. I think it's fair to say from your discussions that HS2 Limited believe that for present purposes, and at this stage in development of the project, a prudent estimate of the additional costs is in the order of £350 million.

328. MR USBORNE: That is what HS2 say.

329. MR MOULD QC (DfT): Yes.

330. MR USBORNE: And we, as you've heard, question that and feel that it certainly is prudent but we believe that it is likely that it will be less than that and somewhere within that range.

331. MR MOULD QC (DfT): Right. I am grateful for your acknowledgement that it is prudent. If we turn to A1228(15) and faster tunnelling, you said that HS2 had assumed a tunnelling rate of about 80 metres a week. I do not know whether this is something which you want to comment on or whether Mr Craig would like to deal with it tomorrow – I know this is going to be dealt with in more detail – but my understanding is that what will be shown on a slide tomorrow is that in recent tunnel drives through chalk by slurry boring machines rates achieved on the Lee tunnel scheme, the Crossrail scheme and the channel tunnel rail link have been in the range of about 74 metres and 96 metres a week. Do you recognise those figures? I do not know whether Mr Craig wants to answer.

332. CHAIR: Who would like to answer? Mr Craig?

333. MR CRAIG: I will be going into this in quite a lot of detail tomorrow, so perhaps you want to leave it until then.

334. MR MOULD QC (DfT): I will leave it until tomorrow.

335. SIR PETER BOTTOMLEY: Is that a yes, no or maybe?

336. MR CRAIG: The problem is that those projects which Mr Mould has mentioned are much shorter in length – 6 kilometres or 7 kilometres rather than 13 or 14 kilometres.

337. SIR PETER BOTTOMLEY: It depends?

338. MR CRAIG: It does depend.

339. MR KINGSTON QC: If I may say, 80 to 100 is not much different from 74 to 96.

340. SIR PETER BOTTOMLEY: I think we will wait until tomorrow.

341. MR KINGSTON QC: If you are going to be troubled with that level of detail, you have my sympathies.

342. MR MOULD QC (DfT): Seductive as that observation is, as the last witness agreed, one needs to be prudent at this stage. We are all conscious of public works where budgetary estimates have been made and subsequently they have had to be greatly increased. The challenge thereafter has been that too sanguine a view has been taken of the costs.

343. SIR PETER BOTTOMLEY: In other words, you are saying that tomorrow we can see whether the pessimism is sensible or is a realism?.

344. MR MOULD QC (DfT): Or prudence. The word that has been used by both myself and Mr Usborne is 'prudence'. I am content with prudence. Mr Usborne, on a point of information, just to give you an opportunity to comment on it, my instructions are that we have included in the budget provided for your scheme the costs of handling material under the amendment at Hunts Green Farm; that is to say, the temporary storage of material prior to its onward disposal.

345. MR USBORNE: That is within the £349 million.

346. MR MOULD QC (DfT): It is within the base figure against which the £349 million has been computed.

347. MR USBORNE: That is surprising, because, as I understand it, the decision to move the sustainable placement from Hunts Green was taken well after the cost analysis.

348. MR MOULD QC (DfT): The decision was taken in time to enable those costs to be included within the base figure.

349. MR HENDRICK: Taking HS2's estimate and Mr Usborne's estimate, what percentage of those costs is represented by the speeding up of the tunnelling?

350. MR USBORNE: I am sorry. I did not hear it.

351. MR KINGSTON QC: What percentage of the difference between £350 million and £250 million is accounted for by speeding up the boring of the tunnel?

352. MR USBORNE: I have included £30 million to £40 million for that.

353. MR HENDRICK: So, it is about 30% to 40%?

354. MR CRAIG: In broad terms, if you go 20% more in rate of progress you reduce the cost by about 5%. The HS2 cost guide confirms this. If you go through the figures, it is about a 5% reduction.

355. MR MOULD QC (DfT): Thank you.

356. MR KINGSTON QC: If I may deal with one or two matters, I take first noise at Stoke Mandeville from the construction compound. When we look at HS2's SIFT analysis, does construction noise from the T3i scheme – the Committee has it, but we can turn it up if necessary – get a green when compared with the Bill scheme, as far as you recollect?

357. MR USBORNE: As far as I recollect.

358. MR KINGSTON QC: Do you recollect the SIFT analysis saying anything about any material disadvantage in noise terms from the construction point of view in relation to Stoke Mandeville?

359. MR USBORNE: No, I do not recall anything.

360. MR KINGSTON QC: Finally, I refer to the works involved in the construction of the vent shafts. Mr Mould was working his way up, saying that you needed a vent shaft at different points. Do you think it appropriate to compare the disruption from the construction activity from the vent shafts with the disruption caused by the construction of the Bill scheme? Is the amount of construction activity a fair comparison?

361. MR USBORNE: I think they are of completely different proportions. When one is talking of a vent, the final construction is perhaps no than a large house, but it is sitting on a big hole. That is where the spoil comes from, but when you compare it with the vast trenches which will be dug under the current scheme it is considerably less significant.

362. MR KINGSTON QC: There is one more matter for which we need A1237(7). Perhaps you could do an enlargement for us, as you did before. If we put up the T3i

option, at the bottom of the T3i column there should be some wording: ‘There is potential for the material to be excavated from the north portal to be stored at the Stoke Mandeville construction site and’ – we go to the next page – ’exported by rail and not road, increasing adverse impacts’. Those are HS2’s words. Mr Usborne, did HS2 rule out the potential for rail removal of spoil because of a lack of paths on the Chiltern line, or did they say there was a potential for it?

363. MR USBORNE: They appear to say here that there is potential, and one must assume they feel there are adequate paths to remove it.

364. MR KINGSTON QC: Thank you very much.

365. CHAIR: I think we will have a two-minute break.

Sitting suspended

On resuming—

366. CHAIR: I plan to have a break just before five and come back at 6.30 for Mr Kingston’s final witness and the response.

367. MR KINGSTON QC: The next witness is Mr Richard Hindle who is a director of SQW. The next slide should have on it his credentials. If you cast an eye over this, perhaps I could just ask Mr Hindle what he is dealing with in his evidence before the Committee. Do you have lots of experience with it over the years?

368. MR HINDLE: Not directly with the Committee but in formulating business cases and economic impacts assessments in various forms. Much of my career has been spent in some variation of applied economics and what I would regard as real-world situations.

369. MR KINGSTON QC: So you have not dealt with any Treasury forecasts?

370. MR HINDLE: I do not deal with the macro side. I was supported in this work that SQW conducted by a team within the firm, including other economists and specialists in property appraisal, and had a range of expertise, wider than my own, to draw on.

371. MR KINGSTON QC: You have taken into account both business development and tourism impacts and things of that kind?