MINUTES OF ORAL EVIDENCE

taken before the

HIGH SPEED RAIL BILL COMMITTEE

on the

HIGH SPEED RAIL (WEST MIDLANDS – CREWE) BILL

Tuesday, 17 March 2020 (Morning)

In Committee Room 4a

PRESENT:

Lord Hope of Craighead (Chair)
Lord Goddard of Stockport
Lord Horam
Lord Liddle
Lord Snape

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IN ATTENDANCE:

Timothy Mould QC, Lead Counsel, Department for Transport
Jacqueline Lean, Counsel, Department for Transport
Tim Smart, Chief Engineer, HS2 Ltd

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IN PUBLIC SESSION

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(At 10.30 a.m.)

1. THE CHAIR: We have matters to discuss before we start taking your evidence. One thing I have in mind is that a number of issues were left to be tidied up today arising from yesterday's opening statement. Perhaps at some point you will be able to give us the further information that was being asked for but can we just discuss future progress of these proceedings? We have decided we should proceed with today's programme as planned but we should then finish and adjourn from then onwards. I think, for obvious reasons, to bring people into this building to give evidence is unsatisfactory and the more sensible thing is not to attempt to lead evidence tomorrow.

2. We were going to go, I think, to the sound lab on Thursday, but I think for us to travel through London in the present situation would not be very sensible and we should defer that until we can come back at an adjourned hearing possibly in July/September. We'll see how it all develops. From your point of view, are you content that we should proceed in that way and that we terminate today and then adjourn the rest of the proceedings until a date yet to be fixed?

3. MS LEAN (DfT): Yes, my Lord, obviously we are in your Lordship's Committee's hands as to how you wish to proceed with the business but we are we are perfectly content with that proposed course of action.

4. THE CHAIR: Good. Thank you very much for that. I think over to you, then, if you have anything to say by way of further information before you start leading your evidence.

5. MS LEAN (DfT): My Lord, I was proposing to address some of, I think hopefully all of, the outstanding queries through the evidence of Mr Smart or Mr Miller. Perhaps if we could take it in that way because they may be better placed to explain these matters than I am, but if there is any outstanding queries or points you feel we haven't covered, then I can try and mop those up at the end if that is acceptable.

6. THE CHAIR: I think we're probably content with that. I think we just proceed that way if you can fit it in to the evidence as it comes out.

7. MS LEAN (DfT): Thank you.

8. THE CHAIR: I think over to you, Ms Lean, when you're ready.

9. MS LEAN (DfT): Thank you, my Lord. The first witness I wish to introduce to your Lordship's Committee today is Mr Timothy Smart. Mr Smart is a chartered civil engineer. He is currently the managing director for Phase Two of HS2 and chief engineer for the High Speed Two project. He is the promoter's witness on engineering matters, a role he performed both in front of the Committee in the other place and also through both stages of committee proceedings on the Phase One Bill. Without further ado, I was going to hand over to Mr Smart, who was going to address today matters related to tunnelling, ground investigations and traffic, if that would be acceptable to your Lordship.

10. THE CHAIR: We had the advantage of having Mr Smart with us on our tour last week. So we are familiar with your face and we have had one or two off-the-record discussions, so it would be helpful now to proceed to your formal presentation.

Evidence of Mr Smart

11. MR SMART: Thank you, my Lord. My Lord, there were two substantive outstanding points from yesterday which Mr Strachan asked me to address. One concerned, I think, a question from Lord Snape on how Phase One connects into the existing West Coast Main Line at Handsacre, which indeed you saw on the route tour. I'll do that first. The second question came from Lord Horam; I think it was about the assessment of traffic on the M6. If that's okay with you, my Lord Chairman, I will cover that when I actually talk about the traffic assessment later on in my presentation, if you're comfortable with that approach.

12. THE CHAIR: Yes, thank you.

13. MR SMART: This is the overview of the route. You can see the connection at Handsacre. I wonder whether it's possible to bring up a slide that you saw I think in Mr Strachan's routes presentation yesterday. You can see that the original connection was to go on to the up-fast and the down-fast, but that does involve more extensive viaducts and more intrusive engineering works. We're now coming on to the outside of the West Coast Main Line on the slows. The question from Lord Snape was: what does that do in terms of journey time, et cetera?

14. I should just say that these lines are all pretty much similar capability in that they are 110 miles an hour or 180 kilometre an hour lines but they are just used for a different mix of traffic. The slows tend to be the stopping services or freights whereas the fasts are obviously the intercity services. So when we connect onto the down slow, and that of course is always up to London, so 'down' is going north, there is no effect on speed. There is no effect in terms of that is a 110-capable line. There is a small effect when we are going up, in the London direction south, in that there is some of what we call 'switches and crossings', S and C, or points, which is where you can move from one line to another.

15. There are some junctions which mean that the trains have to go at a slower speed over those junctions. One of those junctions is just north of what is Rugeley Trent Valley station. That's a 75 miles per hour junction so the trains can't go quite as fast until they get past that. But when you look at the overall implication on the journey time it is measured in seconds and not minutes, so it is a very minimal time disruption by doing this. I wasn't going to say any more than that but if you would like me to, but I think you probably understand the advantages now of what we're doing in terms of this more cost-effective and easier approach. You can see on the red, making the number of interventions onto the lines on the hybrid Bill connection, we cut down those interventions so therefore there is less disruption to train services.

16. LORD SNAPE: Can I just raise a few points? Can you confirm for me that the speed of the junction is not going to be reduced with the new AP2?

17. MR SMART: No, my Lord, in fact we are looking at whether we would actually upgrade the junctions to get a better journey time. There is a balance of costs in terms of the journey time improvement, but as far as I am aware, unless Network Rail have any plans to do anything, we would not interfere with that.

18. LORD SNAPE: Okay. Can you just confirm for me then the speed of trains coming off the junction onto the down slow and the speed of trains going from the up slow onto the High Speed?

19. MR SMART: On the up slow we would probably be around the 75 mile an hour because of the crossover. They might have accelerated a bit. But a lot of it will depend on the detailed design of that junction and the grade, et cetera, which will be done in the

fullness of time. I would suggest that we're going to be in around 180 kilometres an hour or 110 miles an hour, depending on the final configuration of the junction and, more importantly, the signal configuration because when we come onto that junction we can't just enter when we feel like it. It will be a signalled junction so clearly we may have to be even stopping depending on the headway of the trains. If there's gaps in the services you can continue straight through but if the services are busy, then we will have to slow and pause at the junction, as you do commonly now on the National Rail network when you have crossings.

20. I think that will be a matter for the detailed design of the signal layout and approaching those signals in terms of the headway you can have between. The headway is basically the stopping distance that you need to allow for the train to stop at the signal.

21. LORD SNAPE: Okay. I'm sorry to labour this point, but under the original hybrid Bill connection, going from the HS2 line onto the down fast would mean that you would mix in with Pendolinos and the existing 125 miles an hour service. With the alternative, the AP2 connection, you'd agree going onto the down slow you would be mixing with much slower traffic, some of it down to 60 miles an hour, some of the freight trains. Surely that would have an impact on the overall timing.

22. MR SMART: It does. As I said, only when you are in the up direction but of course we can then cross back on to the fast at the next junction. So there is an impact, which I said is measured in, it's not minutes, it's seconds; but that is the impact on journey time that has been assessed for this.

23. LORD SNAPE: With respect, it's not just in the up direction is it? You're going on to the down slow from HS2. You haven't said what the distance is between the connection, the junction with the AP2, the junction there and the crossover to take the train presumably High Speed trains will then go onto the fast line further north.

24. MR SMART: Yes.

25. LORD SNAPE: Now, would that be through a completely new junction or using the existing infrastructure?

26. MR SMART: We would use the existing infrastructure but Phase 2A does connect into Crewe at our most northern end. Then it connects onto the central lines and goes into Crewe station effectively. This is just one of the connections, which is the Phase One connection, which is going essentially to Staffordshire or Stoke but we do have the other connection in Crewe. Of course, in Phase 2B, there is then another connection currently, the Golborne link, which connects to the West Coast Main Line south of Manchester.

27. LORD SNAPE: Thank you.

28. THE CHAIR: Thank you very much. That's that point.

29. MR SMART: My Lord, if I then move on, I'll pick up the M6 point later in my presentation. So we start with a presentation on tunnelling. If we go to the next slide please, you will have heard from Mr Strachan yesterday that we have two tunnels on this route. The south tunnel which is Whitmore Heath is 1.1 kilometres. As you heard from Mr Strachan, it was extended by about 180 metres under AP2. That had the advantage of allowing the A53 to now not be diverted over the railway; in fact we now go under the A53. So it avoids the need for a major intervention on that A-road.

30. I think you also heard that there is an allowance for a 150 metre porous portal. We can provide the Committee with pictures of porous portals from around the world if that would be helpful. There isn't actually one in the presentation but we can provide that if that would be helpful. Now, the purpose of the porous portal is when a train enters a tunnel at speed, there are some interesting aerodynamic effects. Two things, one is just going into the tunnel tends to produce a shock. It is a pressure.

31. So if you are an aircraft, you would experience quite a lot of a pressure drop in your ears but you're doing that over quite a long time as you come down from 35,000 feet to the ground. When you go into a tunnel in a train, it happens quite rapidly. So you have to make sure that the pressure that people might feel in in their ears as an aural effect is minimised. In fact, under certain standards it can't be more than 10 kPa, kilopascal, which is a measurement of pressure, at any time. The way of relieving that is to do with the diameter of the tunnel. You have a slightly larger tunnel diameter to alleviate that.

32. The other phenomenon that can occur is the so-called sonic boom effect, which you may have heard, first recognised in the Shinkansen railways. This is where the train enters the tunnel and pushes air ahead of it because it happens very rapidly. That air oscillates up and down the tunnel and eventually exits the tunnel at the other end, ahead of the train, because it is travelling faster than the train because it's travelling at the speed of sound. It can end up with an audible crack, in the worst case, but if you of course design that out by a porous portal that does not happen.

33. The other effect for microwave pressures is it could, even if it didn't result in an audible sound, create vibrations in the atmosphere. It does depend on wind velocity and wind direction, which could, if there were houses or residents were very close to the portal, it could rattle windows and things. So we deal with that by having a porous portal, which basically is a full coverage of the railway with holes in it. These can be designed aesthetically. We allow 150 metres in the hybrid Bill because that is a subject for detailed design, but I would anticipate that in detailed design, we would actually reduce the length of those porous portals, but they can be sympathetically placed into the landscapes. That is the point of the porous portal.

34. THE CHAIR: Are there any examples of that on the East Coast Main Line that we have at present, because you certainly get the pressure effect if you travel to King's Cross coming on the up line.

35. MR SMART: The only place I'm aware of on the National Rail Network where you would potentially experience that is on HS1 where the North Downs tunnel is actually two tracks in one tunnel. There are now problems with that under safety legislation but at the time, and it is still safe because of the way it was dealt with under the common safety risk assessment. But when two trains pass, you can sometimes feel, some people with sensitive ears feel it. There is a porous portal on the south section of the long tunnels on HS1 but trains on HS1 are not travelling at this speed. They're going at about 180 kilometres through the tunnel. So it's a very minimal porous portal that you wouldn't really notice but there is one there. I don't know of any other places where one would experience that effect. Potentially just that one section on the HS1 is the only one I've ever had identified.

36. LORD LIDDLE: There is often a bang on the West Coast Main Line.

37. MR SMART: When the trains pass.

38. LORD LIDDLE: But also when you enter, there's a couple of tunnels south of Rugby, between Rugby and London, you get that effect.

39. MR SMART: Yes, but I've not heard that people actually – they might feel the buffet, if you like, of that impact but I'm not aware that any of those tunnels have created problems.

40. LORD LIDDLE: The windows shake sometimes.

41. MR SMART: Yes. In fact, when you go into the tunnel one of the ways of dealing with the pressure is to seal the train, so that people inside the train don't feel that pressure. The problem is, with that, is an optimisation of costs because, of course, if the if the rolling stock seals are not maintained properly then of course that can be breached. So normally, it's an optimisation between sealing the trains and tunnel size. It's to do with what they call the blockage ratio, which is the aperture of the tunnel, with the size of the rolling stock and, indeed, the shape of the rolling stock.

42. The reason why the Shinkansen trains have such a long nose cone, if you've ever seen them, is so they can cut through into the tunnels. Therefore they deal with the air very effectively but that is quite a lot of train which is then not used for any passengers. That comes at a cost. Also there are issues with UK and European standards about how long such a nose cone can be in terms of rolling stock manufacture. So it is quite a complicated way of dealing with it, but there is a number of different things you can do to optimise, minimising those effects, in terms of porous portal, the rolling stock manufacturing and the size of the tunnel.

43. THE CHAIR: Are we to envisage separate tunnels?

44. MR SMART: Yes, we do. Our tunnels are all twin-bore tunnels so you can have crossovers. In the event of perturbation, outside of the tunnel you can cross. So if one tunnel got blocked you could cross over and come down the other tunnel but that would be under degraded mode operation and you wouldn't be operating anything like a full service. We'll come onto it later in the presentation but this is actually an HS1 example of how the twin-bore tunnels are, and I'll explain what a cross passage is in a minute,

which is there.

45. LORD HORAM: The famous Shugborough tunnel on the northwest route, which I and several others are familiar with, that's an old fashioned Victorian.

46. MR SMART: Yes, it is.

47. LORD HORAM: So that would have none of the advantages you're proposing. You go in there and you get a shock.

48. MR SMART: Yes, you do but it would be a lot lower speed than we are going in.

49. LORD HORAM: You are going at a lower speed.

50. MR SMART: Both our tunnels here are designed for 360 kilometres an hour. However, for normal operation, most of the tunnels we would be going through at about 330-340. The extra allowance if the trains are coming on and off the National Rail Network, they can get delayed. So sometimes the trains need to play catch up if they are slightly behind timetable and need to accelerate bit faster. So both these tunnels at Madeley and Whitmore Heath are designed for 360.

51. LORD HORAM: In the Shugborough tunnel the trains pass each other.

52. MR SMART: They do. As they do on my example in HS1, which is the North Downs tunnel.

53. LORD HORAM: Is there any residential property at either end of the Shugborough tunnel?

54. MR SMART: Not that close to be affected, I don't think. Also they wouldn't have the speed to be affected by it.

55. LORD HORAM: And the speed is low.

56. MR SMART: I mean there might be some noises of rolling stock and things but no, not in the way that I'm talking about for the aerodynamic effects of micro-pressures or the effects of people on the train. Going back to the slide, you've got just under six kilometres and then you get to Madeley tunnel. Madeley is a much shorter tunnel as it's 673 metres in length and also would have porous portals at 150 metres. As I previously

said, we would look to reduce that length in the detailed design.

57. LORD LIDDLE: Sorry, I'm not quite sure I understand what a porous portal is. Is it a little hole that goes up?

58. MR SMART: It's an enclosure over the railway. It's an enclosure over both rails with holes in. So it would look a bit like, I suppose, very crudely, it wouldn't look like this for the design purposes, but a bit like a cheese grater, if you can imagine. It needs to enclose the railway because otherwise, if it's completely open, you are not dissipating air. It's a way of dissipating air at a gradual rate as you come into a fully enclosed aperture where there are no holes. So it is basically covering both rails with an enclosure. It could be concrete. It could be steel.

59. There are examples of both on international railways but the apertures are designed to dissipate the air pressure. The design depends to a certain extent on the rolling stock capabilities in terms of the rolling stock size. Also the rolling stock aerodynamic profile because a lot of what you can do in the profile of the aerodynamics helps. I mentioned the long noses, which does minimise micro-pressures and also allows a better entry. So there is a number of trade-offs that you can do but whatever you do, you're going to need some sort of porous portal at the speeds that we are entering our tunnels.

60. LORD LIDDLE: Is the main concern here the comfort of the passenger or the avoidance of bangs, which upset residents near the line, as though they're being shot at or something?

61. MR SMART: So the porous portal is about residents at the line, if there should be an audible crack or very audible vibrations of windows, that's the porous portal. The aperture of the tunnel is about pressure on the ears of passengers as they enter the tunnel.

62. LORD LIDDLE: Right. I see. Fine.

63. MS LEAN (DfT): My Lord, we think we have an image somewhere, possibly in another presentation. I think this is something Mr Thornely-Taylor often covers when he does his noise teach-in so if we can track down an image we will try and make that

available to the Committee during the course of today.

64. LORD LIDDLE: Thank you.

65. MS LEAN (DfT): Mr Smart, perhaps this is a convenient moment to move to construction.

66. MR SMART: Yes. So if we move to this slide here. In terms of high speed rail there are generally three substantive methods of creating a tunnel. One is a boring machine, which is the sort of machines they use on Crossrail. On Phase One we will have ten machines. These basically bore their way through the ground and you create an in situ, well, you create a lining behind the machine by placing precast concrete rings, which the machine erects. I'll show you something on another slide in a moment. That is basically what is known as a boring machine.

67. There are many types of machines. I am going to dwell on the next slide on the two types we are most likely to use on Phase 2A. There are other types of machines you will hear, machines called slurry machines and variable density machines. These all involve using slurry in the creation of a tunnel and that is usually in very, very bad ground where it is running sands. We don't anticipate using those sorts of machines, so when we come on to the next slide I'll explain.

68. So bored tunnels are generally used on long lengths because of the capital cost of setting up a boring machine. There are two types that we're going to talk about and I'll come on to the next slide, a boring machine which is an earth pressure balancing machine or an open face machine. Because of the length of Madeley tunnel, or indeed both tunnels, but most certainly Madeley, depending on the ground conditions there is a chance in which we could use a technique known as mined or sprayed concrete lining. This was used fairly extensively on Crossrail, as indeed it was on the Channel Tunnel crossover, which is in the middle of the Channel Tunnel, which was the first time, I think, in the UK it was used. It was also used quite extensively on the Jubilee Line extension project. This is where basically you create an opening and you spray concrete onto that opening and you don't need a boring machine. You will see on the next slide what that is.

69. Then finally, there is what we call cut and cover tunnels where basically you

create a trench, either an open trench and then you form a box in the middle and fill it up again or you can create a restricted trench where you actually put what's known as diaphragm walls, which are long deep walls and you cannot have so much excavation. That is more expensive. I won't dwell on that unless my Lords want me to because there are no examples of cut and cover tunnels on Phase 2A.

70. So if we go to the next slide, this shows the two machines that we are most likely to be using on Phase 2A depending on final ground investigations. On the left, you see what is known as an earth pressure balance tunnel machine. The most common, I think, machines used in railway tunnels. So you can see just behind the red cutting face of the machine, and the cutter is configured with various different holes depending on whether you are in something like clay or whether you are in something like a silty sand. Each contractor will have their own way of configuring that cutter face. These machines are manufactured offsite, brought on to site and assembled and launched from the tunnel portal.

71. There are no machines currently manufactured of this sort in the UK. There used to be. So they are more likely to be either Chinese, French or German. The excavation chamber, which you can see behind the red face, is where the earth material will move into that excavation chamber. It's kind of like a bulkhead so when the earth comes into that chamber at a controlled rate and the machine transfers the thrush pressure, because it is thrusting off the lining with jacks to move forward. So the machine holds up the face of the ground in front of it.

72. The rate that you turn the cutter head, you create a mix if you will, almost like a cake mix, within that bulkhead that's under pressure. You can do things in that excavation chamber, depending on the ground. You can add water and/or other additives to control the material in that excavation chamber and then it is taken out at a controlled rate up. You can see the red screw, which is an Archimedes screw, that takes material out of the excavation chamber and then up onto a conveyor system and then ultimately out of the tunnel for disposal.

73. THE CHAIR: Can I interrupt you there?

74. MR SMART: Yes.

75. THE CHAIR: What happens, it's off to the right-hand side of the picture, it comes out the belt conveyor, does it go into bogies or trucks or something to be taken out of the area?

76. MR SMART: Depending on the length of the tunnel you could do it either way. The length of our tunnels, certainly Madeley, you may consider just having a conveyor. On longer tunnels often it goes – a section on a belt maybe – into what is like mini-railway trucks which then go out on rail tracks especially constructed behind the machine. It can even be, on some slightly larger tunnels, as I said tunnel size, it could even be onto diesel dump trucks. That has been used. The problem with that of course is the carbon monoxide which is now a very reduced level of exposure that operatives can have. So that is a less likely option. More likely ours will be a conveyor all the way.

77. THE CHAIR: As far as dust is concerned, is there going to be dust at the entrance to the tunnel that will affect the immediately surrounding area or is it all controlled within the framework?

78. MR SMART: Well, certainly there's not really dust at the front of the machine because there's a lot of wet activities going on within the excavation chamber and the Archimedes screw. So the dust would occur, if it was to occur, when the material exits the tunnel portal and goes in for disposal, but there's ways of controlling that by damping it down. Quite often the material is very wet anyway so actually, the issue is you usually need to dry that material before you can actually use it. So dust is less of a problem with tunnel arisings because generally you are at depths when you are dealing with wet material. Although in the geology where we are here, there is good sandstone, so I am not anticipating that would create necessarily a dust problem, but it probably would not need to be as wet as if you were in very silty sands in the sort of Thames basin or something like that.

79. MS LEAN (DfT): Mr Smart, just to add to that, Mr Strachan talked yesterday about something called the Code of Construction Practice. Are those sorts of measures the sorts of things that are encompassed within that?

80. MR SMART: They are and I dare say Mr Miller will address you on that following my presentation but there are a number of control measures in our Code of

Construction Practice that deal with air quality, traffic mitigation, which I will cover, and also things like dust and noise.

81. So you can see on this schematic of the earth pressure balance machine there is the tail skin. That is where the machine, if you will, meets the tunnel rings, which are erected by the erector. You can see on the bottom it says 'segment erector'. This is basically an arm which creates the tunnel segments, which are generally precast concrete, which form the actual final tunnel lining. They come in also down the tunnel behind the machine. They can be cast on site but for shorter tunnels they are often manufactured offsite and brought in. For longer tunnels, you might have a casting yard at the tunnel portal.

82. Unless there are any other questions around the earth pressure balance machine, and the earth pressure bit is all about what we call the driver of the machine if you will, the pilot, controlling that pressure in that excavation chamber so that the ground is not, if you like, falling away and then you get settlement. So it is a very, very important way in which you control settlement, because if you go through it very fast and you are running that cutter head and material is really throwing through the machine quite fast, then you will get a lot more settlement. But if you go through it as, I would say, a slightly more reduced pace, you can hold that pressure and then you don't move the machine again until you have erected the ring. So the ability for the ground to settle around that is very small.

83. On the right is an open-faced tunnel boring machine, which is basically a tin can with an excavator in it, which has jacks to thrust it through the ground, but it doesn't have the sophistication of the excavation chamber. It simply has what we call breasting plates which are just some mechanical breast plates just to hold the face. Then we can see at the top there's an excavator just below where the arrow is now. You can see it looks like a grab. That just would take out material. It's mined out in a more conventional way. There's also another grab beneath the breasting plate at the bottom there.

84. You can only use that sort of machine in very competent ground because it relies on the stand up time of the ground, if you will. So if you were in soil that was like clay, very good London clay, you could use this type of machine. If you were in something

like a sandstone, you could also use this type of machine because we know if you haven't got water pressure or you haven't got spoil material that wants to come in on you, this is a perfectly acceptable way of doing tunnelling. This was, in fact, used on CTRL for the tunnels that go between King's Cross and St Pancras because we were in London clay. It's a much cheaper machine because you haven't got all the sophisticated backup that you need with an EPBM. I will come on to costs later but this would be a very cost-effective machine. Also the set up time is much, much quicker and it doesn't need so much power. So the power demand for this machine is a lot less. The capital costs are less and it's quite quick to get going.

85. If my Lords are content to move to the next slide, this is what I was talking about when I mentioned the sprayed concrete lining. Now, you can see on the left, need the stand-up time of the ground to be able to do this. It's commonly used for, not so much round-bored tunnels, but for strange shapes in tunnelling. On Crossrail they had to have a number of different station passenger tunnels that are underground, which are curved or different shapes. This is a very good way of achieving those sorts of, not just round straight tunnels. What is shown there is a more unusual way of doing the spray concrete lining, because usually you do benches. So you would do sections of the tunnel in maybe three or four sections.

86. You can see on the right the spray concrete lining. This particular one does show that they have got some steel supports and some steel mesh. So this is when you are in ground that needs more support. It is possible, with the right competent ground, to just spray the lining directly on without needing any other steel support. What you have in the sprayed concrete that you use is polypropylene and steel fibres, which knit together and form a very strong lining. In fact, very, very useful in terms of fire resistance because one of the problems with steel mesh, which are used in some concrete segments is in the unlikely but unfortunate event that there was a fire in a tunnel, then of course that steel expands and the concrete tends to spoil off. So using polypropylene and steel fibres, which look very much like staples, as the reinforcing in both SCL or indeed the precast lining of a conventional bore tunnel, is a very cost-effective and very operationally effective method of achieving the reinforcement.

87. So we could potentially use an SCL type of approach. Certainly on Madeley, which is the smaller of our tunnels, but this is going to depend on the geotechnical

investigation, which I'll come onto later, as to whether we will be able to do this. Because with the small tunnel such as Madeley, which is about 700 metres, you would almost be as long setting up a sophisticated tunnelling machine to build that tunnel as you would be boring it in some ways. This could be a cost-effective way but it depends on the detailed design and on the contractors' methodology.

88. LORD SNAPE: Just before you move on could I just ask, Chairman? I don't want to pre-empt any of your presentation but do you intend to talk about fire risks in the tunnel?

89. MR SMART: I do, yes.

90. LORD SNAPE: Whether we've learned any lessons from the Channel Tunnel.

91. MR SMART: Yes, I certainly can cover that, Lord Snape. So in fact, it is the next slide. This is an example taken from HS1. Clearly, utmost importance in all railways and especially in tunnelling is fire life safety of the railway and how to evacuate people in the event that you have an incident in a tunnel. Now on Phase 2A, our tunnels are less challenging because there is only just over a kilometre and then about 700 metres. But the methodology that is used on longer tunnels, which is relevant to the two-way tunnels, is if there is a fire event in one tunnel, you stop the trains. If you can do the train under a controlled stop but you might not be able to if the power is burnt through and the train will just stop wherever it stops.

92. But you evacuate the passengers onto a walkway, which you can see beside the train, which is especially designed to take passengers. You go along the walkway and you go through a cross-passage into the adjacent tunnel. Now, you can see on the right, that is a cross-passage on HS1 London tunnels. It hasn't got the doors on but that was it under construction. These usually are hand dug cross-passages because you can't really get machines to do this so they're hand dug. You can see there it's SGI-iron which is spheroidal graphite iron, which is handled by the miners to form those cross-passages.

93. What happens is there are also fans in the tunnel to blow smoke away from passengers and pressurise the rescue tunnel. So in the event of a fire, if it was in the right-hand tunnel shown there, the train would stop, passengers would be evacuated onto the walkway. They would go down the walkway to the nearest cross-passage,

through the cross-passage and into the adjacent tunnel. Trains would have been stopped in the adjacent tunnel and their rescue is another train. So you bring a train in and they get on that train. They do not walk along the railway and go up a vent shaft. They are rescued by another train. There is a complicated system of what is known as a vent control, which is fans, which are situated strategically either in a shaft if you need a shaft and I will come back to that, or in line along the tunnel, which blow air at a higher velocity than smoke. Smoke is hot, so it travels at quite a high velocity. Therefore, first off you pressurise the safety tunnel, so when you open the cross-passage doors, all the smoke doesn't go into that tunnel because it is now pressurised, safely pressurised. But also you control the smoke in the incident tunnel by blowing it away from the passengers.

94. What you do need, going back to Lord Snape's point, is you have to have a place where you can get passengers safely into that rescue tunnel. Under the high-level legislation, the maximum length is 500 metres, so you cannot go more than 500 metres without some sort of cross-passage. Except that, mandated under both European and British safety legislation is something known as the CSM RA, which is the common safety method risk assessment. Now it is possible by doing a risk assessment that if you couldn't get a place of safety within 500 metres you could do other things to mitigate it. So an interesting example would be the Madeley tunnel because we are not far over that 500 threshold.

95. If you can demonstrate that actually creating a cross-passage and taking passengers up to a cross-passage somewhere is actually not as safe as just actually walking them an extra 50 metres to go out the portal, you might not have to have a cross-passage even though you've breached the 500 because you've actually got a better methodology of getting them out rather than take them through a cross-passage into another tunnel, et cetera. This is all subject to the detailed safety assessment review but on the face of it you would need a way of which you'd have a place of safety every 500 metres under the top legislation, subject to the common safety risk assessment method. So, for example, we might anticipate having a cross-passage on our longer tunnel Whitmore Heath, which is 1.1 kilometres.

96. The point of a vent shaft is on longer tunnels, one is it can act as a vent relief. I've talked about the pressures in tunnels. Of course, you can have the vent shaft with

dampers so as the train travels down the tunnel the air pressure can escape via vent shaft. But the main purpose of a vent shaft, usually, is that's where fans are which activate blowing the smoke in the way I previously spoke of. More importantly, it is the point of entry for emergency services to enter a tunnel because it's often too far for the emergency services to go in via either portal. The first time that this methodology was used in terms of having vent shaft and then cross passages was on HS1 CTRL, which was agreed with the London Fire Brigade of how they would access tunnels via vent shafts.

97. They are also pressurised vent shafts so that the emergency services can enter. There's equipment at the bottom of the vent shaft where they can get out onto the railway via cross-passages. But the length of our tunnels on Phase 2A mean we do not need any vent shafts because we can deal with it via fans at the portals and maybe a couple in line, which means they are actually in the tunnel rather than on the surface in a vent shaft. Unless my Lords have any further questions, I'll move to the next slide, which is basically the cost of tunnelling.

98. LORD SNAPE: One further question, if I may, before you do, on the slides the tunnels are well lit. Is it HS2's intention that the tunnel should be lit 24/7?

99. MR SMART: No. You would have emergency lighting in there but you would have them lit for maintenance purposes but not necessarily lit for operational services.

100. So the cost of tunnelling, the high costs of tunnelling are generally in the cost of set up of buying a tunnel boring machine. These are generally bespoke machines. So the internal diameter of our tunnels for a 360kph tunnel is 8.8 metres, so depending on the capability of the machine, you could be spending £15-25 million. However an open-face machine would be a lot less. That would be more in the £5-10 million range, but this is typically giving you a cost for an EPBM, an earth pressure balance machine. You have the backup of handling material, which is another similar order of costs. So if it's conveyors you have all the conveyors.

101. You may have a rail system to take away muck or you could even have – we wouldn't have this – but you could have dump trucks. Then you have the backup to deal with spoils. You've also got to have ventilation in there for the operatives, power, pumps, all the necessary mechanical and electrical plant and equipment to deal with the

tunnel operation or the construction of it. You also need a power supply. All of that is a fixed cost which you incur as soon as you decide you want to tunnel.

102. There are then linear costs. The further you tunnel these are incurred as you go along. So clearly labour, the longer the tunnel the more labour operatives are required. More lining the longer the tunnel, more excavated material to dispose of, that can be quite an expensive proposition if you have nowhere to put the spoil and you have to take it a long way. You've got more ground monitoring to do on a longer tunnel. You've got ground treatment, possibly, if the ground is not that competent. You might want to do some grouting ahead of the tunnel. And you have also got the tunnel logistics because it takes longer to get in and out of tunnels the longer they are. That's in the linear costs. Once you've got the fixed costs you've got them. In a way, I suppose, you could say for the fixed costs the longer the tunnel goes, the more economic it becomes but you have got the linear costs which add to that.

103. Then you've got what I call incremental costs. So in the event that your tunnel gets beyond a certain length, you now start to incur another order of costs. So arrangements for drive sites and reception sites and tunnel logistics can be much heavier because you have got much longer to go and you have perhaps more lining which you might have to manufacture on site at the portal. But more importantly, the introduction of shafts. You cannot really go any further in a tunnel than about 3 to 3.5 kilometres without the introduction of a shaft for the reasons I mentioned earlier about emergency services.

104. And you have got more cross passages because clearly, although the 500 metre cross-passage is the maximum stimulation in the legislation, it is high level. So it may be that you cannot, under the common safety risk method demonstrate that 500 metres does the job for your passengers. If you've got a high number of trains and you have a high density of passengers on your trains, maybe you need cross passages more often than 500 metres. Quite often around a shaft you actually locate at least two cross passages near the shaft because the fire brigade would need that. So you would then have more cross passages.

105. Also, the introduction of shafts adds a lot more cost to the mechanical and electrical plant. You've got to have pressurised vent shafts. You've got to have

emergency lifts for the fire and emergency service to be able to get up and down the vent shaft. And you have to have obviously fans and pumps and all the switch gear that then powers the fans. That is a sort of incremental cost you would incur once you start getting beyond three kilometres.

106. LORD LIDDLE: The tunnels we're looking at on this section of line, are they longer than the trains?

107. MR SMART: The trains are either 200 or 400 sets. So they are longer than the trains.

108. LORD LIDDLE: How does a 400 set compare to the length?

109. MR SMART: A Pendolino at the moment?

110. LORD LIDDLE: Yes.

111. MR SMART: Pendolinos are probably around five cars so they're probably over 100 metres longer.

112. LORD LIDDLE: Right. They're more like Eurostar trains.

113. MR SMART: Yes. So going back to my example of the Madeley tunnel, which is 673, I think it is. If it was a 400 metre train, you haven't got too far to go to go out the portal route, depending on where it stops. It might even stop halfway out the tunnel. So these are the things that you would take account of in the event of doing this common safety method risk assessment, looking at all the scenarios in which people could have to evacuate. The worst case scenario is really what you would design for.

114. LORD LIDDLE: Isn't an evacuation through walking people through the back of the train if you get stuck in the middle – is that not regarded as a safe process?

115. MR SMART: It can be. It can be, Lord Liddle, but the problem with that is the 400 set is two 200s joined together. So you'd have a point halfway down the train where you couldn't get past. Plus the fact it depends on where the fire on the train is. If you had the fire in the middle that's probably the worst place to get it. However, another important point, rolling stock is designed with fire safety prevention on that train. So it should be able to exist on its own for 15 minutes before it has to stop. If you

think about it at our speeds, in 15 minutes, the first thing you do, you don't stop in a tunnel, you drive out. I should have said that earlier probably. The point of the cross-passage and the fan is a last resort in the event of you lost power and a train was on fire and it couldn't move but you would always drive out of a tunnel with a train on fire, which would be assessed.

116. One way of doing that, as you've correctly pointed out, you move people away from the fire to the end of the train, assuming you could do that and it wasn't in a place where they couldn't get away from. Get out of the tunnel and evacuate them at the portal. You wouldn't stop in a tunnel. That would be absolute last resort. Even though it might be 10 to the minus, whatever, of chances of happening, you still have to allow for the very unlikely event that it might.

117. LORD SNAPE: In the event of such an occurrence taking place, how long would it take? Are there any estimates about how long it would take to evacuate a fully loaded HS2 train, the two units coupled together?

118. MR SMART: There has been some work done on that and if I quoted by memory, I might give you the wrong figure I'm afraid, Lord Snape. So I would rather come back to you on that as I might quote something which proves to wrong. But yes.

119. LORD SNAPE: It would be there for posterity if you do.

120. MR SMART: We haven't yet – this will be something which we will come onto in the detailed design of the evacuation, which will be where the cross-passages are located, etcetera. So we would have a maximum time that we think would be permissible. There were tests done on HS1 of how we did that. I cannot give you the figure. It was some years ago, I'm afraid, but this is all looked at, of course, and finally signed off by the regulator under the safety approvals process.

121. In fact, there are a number of different independent safety assessment bodies that work with us all the way along to sign off all of this. There's something known as a NOBO, a notified body, and also an ASBO, which is an assessment body. They are all independent safety experts that ensure that anybody building a railway to operate it is, if you like, signed off safely and that all the risks have been properly analysed, the hazards identified and the risks mitigated appropriately. This is something that Crossrail are

currently going through at the moment.

122. LORD SNAPE: Just one final question then on safety, you'll be aware from your own experience with the Channel Tunnel that the Fire Brigades Union in particular expressed a great deal of concern at that time about passengers being trapped in a burning train in a tunnel. What conversations or consultations have you had with them?

123. MR SMART: We have; we've spoken to all the fire brigades along the route. They tend to take their lead from the London Fire Brigade because obviously most of the tunnelling in the UK has happened in London. Therefore the London Fire Brigade are the most experienced brigade of dealing with this. In fact, we're still speaking with them. We spoke to them very early days to see if when we were dealing with the London Fire Brigade on the Channel Tunnel rail-link, this is where we had, if you will, the maximum distance between shafts.

124. One of the reasons we were able to maximise that to a certain extent was we provided trolleys at the bottom of the shafts so the fire brigade, when they come down the shaft, they can actually put their breathing apparatus on a trolley and then they can take it a distance without having to actually wear it or use it. We did check with them that all the maxims, if you will, that we'd established and what things varied. So as far as there's matters of detail, of course, in the detailed design to be dealt with but yes, the fire brigade are fully engaged with us. We have a particular forum with the fire brigade to keep them up to speed with our plans on fire life safety.

125. LORD SNAPE: Thank you.

126. MS LEAN (DfT): Mr Smart, I think that brings us onto a related but slightly different topic, ground investigations, if that's convenient for your Lordship's Committee.

127. MR SMART: Yes. Right, so if I move down to ground investigations. Obviously, when you are dealing with the amount of ground engineering that we deal with on a high speed railway, whether it's Phase One, Phase Two, Phase 2A or other sections, it's very important we have a good understanding of what those ground conditions are. The design of the Phase 2A was done as it always is on any big civil engineering scheme. You always start out with the geotechnical desk study based on

published information from the British geotechnical site or the British Geological Society have. There are national databases, which we input to when we put down boreholes and other stuff in terms of our trial pits and tests. We'll put that into the national archives. So there's a lot of rich information available and that is where we start off to assess ground conditions for the site of the railway and potential geotechnical risks.

128. Leading up to the delivery of the proposed scheme, you then get into specific geotechnical information. So you identify from the desktop study where you actually need a lot more information. And actually it kind of never stops, as you go through construction you are always gathering more geotechnical information either because you are opening the ground up or you just need to do more because you need to get better information to get a better design. So we have identified the sites where we will do boreholes and start an investigation.

129. It's standard practice that you start off with the desktop study and then you gradually get more and more information and improve your understanding as your design and your geotechnical investigation improves. So if we go to the next slide, and I will come on to what we have done because I am sure you will want to know that. There are a number of methods to obtain geotechnical information. Clearly boreholes, which can be a shell and augur rig, which is basically a percussive rig, which you just drop what looks like a heavy drainpipe. You can use that in soft material but if you get into more lithified or rock, you need to do core. You can also do cone penetration tests, which is where you push the cone in the ground, which also measures the resistance of the ground. From that you can draw conclusions about its strength.

130. There's also methods in which you can also look at the water pressure. There's also geophysical testing such as ground radar and resistivity testing, to also give you an understanding of what's in the ground. Of course, whatever you get from the ground, it needs to be properly logged and assessed. A lot of that comes from doing lab work in the laboratory where you take cores and you put them in a testing rig and measure their strength, their elastic modulus and all the parameters, the permeability and all the parameters that you need to do the design. So when you do a site investigation, once you've put the borehole down, it's not as simple as that. You then have to do a lot of work in terms of looking at what the ground profile is because you could put a borehole

down, as I have done, in a place in a country where you have had a very soft ground. Then you moved six metres away and you were in really hard rock because actually we were on an old buried coastline cliff from prehistoric times. So you can get a variation.

131. So once you start to get more and more geotechnical information you can start to see where there might be some gaps that you might need to do more intrusive investigation in a small place. Because there might be something like a fault or an old buried valley where you might need to say, "I need to do more here". So currently we have done 445 boreholes at about 170 locations around Phase 2A and 299 trial pits. So sometimes if you are in an area where you're not needing deep foundations, a trial pit which can be dug with a 360 excavator, a JCB or something like that, you can get a lot of information from the ground. Especially if you want to know what sort of material is the depth of top soil or potentially how shallow the water table is.

132. So we have done quite a lot of information. That is all currently going through the sort of due diligence of having been properly logged because the cores are kept at a core store. You don't keep every single core but quite a lot are kept so they can be logged not just by the drillers, who have a certain competency, but by proper geological engineers or geologists or engineering geologists and, indeed, geotechnical engineers. That all feeds into an interpretive report on the ground of what we would expect to find with all lab reports which explain permeability criteria, parameters that you can derive settlement and the strength of the soil. And indeed, most importantly, where water tables are. Usually where you first encounter the water is not where it ends up at rest so quite often you would have piezometers left in place that you would monitor how the water table fluctuates over the seasonal effects. That quite often involves ongoing monitoring to pick up that seasonal effect, especially if you were in a tidal area, that also will have tidal effects; not that we are.

133. I should say that actually it never stops because when you start tunnelling it's common practice now that you do geophysical testing ahead of the tunnel machine. You can correlate what you are what reading you are getting from your ground radar, or whatever you are using, with the ground you are encountering with the machine. So you can do a correlation there to see if there is anything that might be untoward ahead, such as if you were in short, there could be a solution hollow, a hole in the ground, a cave, if you will, that has been created by the groundwater migration. Again, we are not

anticipating that because we are not in short, but those are the sorts of things that you can tease out by carrying on that investigation ahead of tunnelling.

134. . And, of course, when you are doing bulk earthworks, as soon as you start digging into the ground, you get more information. So, basically, I think, my message here is that it's something that continues right through the construction process; you're always gaining more information but you do need to have enough information to be able to do a competent design, and we'll be doing more design as we go forward.

135. LORD LIDDLE: This is a silly question, but how much of this sort of information would Brunel have had when building the Victorian railway? Was it much more trial and error?

136. MR SMART: It was much more trial and error.

137. LORD LIDDLE: And, therefore, when you hit a problem, you had to do something about it, but you hadn't necessarily anticipated it.

138. MR SMART: Yes, he would have had some geotechnical information but not the sophistication we had; it was more trial and error. However, what is termed the 'observational method', if you can do it, is quite a powerful thing because, for example, you could spend an awful lot of the time when you're looking for an old what's known as a landslip – in soft soil there have been ancient landslips – and quite often when you start opening the ground they can reactivate. So, you could spend a lot of time looking for it, or you could use what we call the observational approach which is when you do open up the ground, you see it. So, you locally deal with it by putting in a retaining wall; when you thought it was going to be an open cut, you might say, 'Well now we'll put a retaining wall in'. So that's the kind of approach that you can do to overcome that which is, I guess, what Brunel did, although, primarily, apart from a few notable tunnels, he was on the surface with his plate layers, I think.

139. MS LEAN (DfT): We were then proposing to move onto traffic, if that was a convenient juncture for the Committee.

140. THE CHAIR: Yes.

141. MR SMART: So, if I go to the introduction. So, the transport assessment forms

an essential and important part of the overall environmental assessment and identifies the traffic and transport impacts both during construction and in operation. And the environmental statement then, of course, reports any residual traffic effects. And the traffic data also, as I was talking about earlier in terms of the construction practice, identifies if there could be issues with air quality, noise, in community health and equality. So, it's a very important part and I think you will hear probably from petitioners around traffic because it's something that does concern local communities, not just the fact of the railway but, when we construct it, the construction effects.

142. So, if I can move to the next slide. So, there are ways in which we can try and mitigate the impacts of construction traffic. And, obviously, the first one of these is to use the trace, or a haul road, as far as reasonably practicable. So, we do, and I'll come onto a slide in a minute, create these haul roads along the trace of our railway, where we can move excavated material around off the road. And your Lords will have seen from the site visit that there are some quite rural areas on Phase 2A where we have to do that because there aren't any roads touching our railway anyway. In fact, we couldn't get near to the railway in certain areas. But we do try and do that as a matter of course because it minimises the effects on local communities.

143. There are temporary highway measures that we do to try and improve the situation with taking construction traffic off the road and I think the most obvious one, and I'll come onto it later, is the temporary slip roads that we're creating on the M6 at Stone, the IMB-R, the Infrastructure Maintenance Base - Rail, where we can take material from what is the rail head when it's under construction, and will be an operational base, directly onto the M6 by our own slip roads without needing to use the existing M6 junctions.

144. Then there are specific highway improvements. Clearly, anything we do in terms of construction routes over and above a certain amount of vehicles, which I'll come on to, has to be agreed with the local highway authorities. Motorways, it's Highways England, but obviously for other A roads and local roads, it's the local highway authority, mostly in our case on Phase 2A Staffordshire County Council. So, we do get involved in doing local improvements where the highway authority says to us, 'If you're going to use that road you have to do improvements'. I think an obvious one that I think your Lordships may remember when we were on the site tour is Yarnfield Lane where

we need to improve that turn out onto Yarnfield Lane for lorries turning right, where we'll be doing work. These are all things we were doing in advance of the construction, the main works construction, so that the existing highways are improved or upgraded, where necessary, before we start actually the main construction.

145. We always like to keep roads open where reasonably practical; you can't always do that. We tend to use what we call 'offline diversions' if our railway bisects a highway, which means we will create a bridge offline where we build the new one, and then divert the traffic back, so there's temporary closures of the road, but might be only overnight or over a weekend, while we make the connection, because we put the new bridge in first before we take the old bridge away.

146. We also have provision for workers' accommodation at our main construction compound so that we cut down the amount of time, or sorry the amount of vehicles that construction workers will need to get to the site. And, indeed, under our Code of Construction Practice, we encourage our contractors to use efficient ways of getting workers to site, not just by accommodation but by using buses and things, and not having them all use their cars. So that's another measure we have. And, as I think you heard, we also have local placement which is, where it is possible, we sensitively place material which we don't otherwise need adjacent to the railway along the trace. Often that is required for either noise or visual mitigation which you will hear about from Mr Miller. Sometimes it is not strictly necessary for that, but we can still create a sensitive piece of sort of landscaping which will cut down having to put more excessive construction wagons onto roads and past people's houses.

147. THE CHAIR: Can you remind me where the construction compounds are? The places have been identified, have they, where they will be?

148. MR SMART: Yes, there's a slide I'll come to later, my Lord, where I can show you examples of the construction compounds. And on the plans, which are the CT-05 construction plans – you'll see them – but I'll come onto that in a moment if I may.

149. LORD LIDDLE: I don't think I understand really what a borrow pit is, what it looks like. We never saw on our tour.

150. MR SMART: No.

151. LORD LIDDLE: There was a lot of talk of it. So as an ignorant person —

152. MR SMART: I'm going to come onto borrow pits.

153. LORD LIDDLE: I don't really know what it is and how big it is and how deep it is and what its purpose is. So, you could —

154. MR SMART: I'm going to come onto that in a later slide or I can do it now, my Lord.

155. LORD LIDDLE: Be patient, all right.

156. MR SMART: Well I'm in your hands.

157. LORD LIDDLE: I'll do it on the later slide, yes.

158. MR SMART: Okay. So, if we move then, I think, to the next slide. So, this is just an overview of the route. And so, obviously, we try to use the best grade of road, where possible; we don't want to use local roads but we do have to at certain times especially at times such as setting up the site and before we can get the haul roads in. So, if we move to the next slide. So, you raised a question on the compound. So, you can see this is the Blithbury crossover satellite compound. So, there are a couple of different types of compound; there's the main construction compound, which is sort of like the main hub for a contractor, and they're shown on the plans. But, of course, with a long route, you do have to have local compounds because you need to have welfare facilities for, obviously, the operatives and you also need to have storage close to where you need it, because otherwise you'll actually end up moving material, you maximise moving materials around the trace and, therefore, on the roads.

159. So, this is an extract from what I call the 'CT-05 slide', and you can see what it looks like which is showing this section near Blithbury under construction. So, the green route in there is the construction traffic route and the yellow is the haul road. So, this where we actually move material around the trace without taking it on the road. And you can see the brown areas are temporary material stockpile, quite often topsoil, because I guess you will hear from Mr Miller later that we like to keep the topsoil, to put it back after our work, so we locally strip it back and keep it where we can on the trace. And we added a number of haul roads to minimise the traffic on the roads during AP2. I

should stress that the haul roads are generally not fit for eight-wheeler sort of muck wagons that you might see around London with material in, because it would be quite expensive to create a long haul road with what we call 'metalled road'; it's not metal but it's either aggregate or something. So, they can travel onto the trace for short distances but most of the haulage along these haul roads were what we call 'articulated dump trucks'. So, they're the big rubber-tyred dump trucks that you see – not like a small dumper although we do use them – but these are quite big Volvo or Moxy wagons that are articulated. They do the bulk haul and often then we take material to a transfer mode where we then take it offsite.

160. Having said the fact that the eight wheelers don't normally use these trace roads for very far, up in area CA5 – Community Area 5 – around the A500, we have in AP2 created an enhanced haul road facility where we have got almost a two lane highway where we can use standard spoil lorries on the trace route because there were some issues with that, so we have done that.

161. THE CHAIR: Before you leave this slide, the land that's coloured sort of pink.

162. MR SMART: Yes.

163. THE CHAIR: Is described as 'Land potentially required during construction'. It's not your field but I'm looking ahead to the land compensation issue. Is this land to be permanently acquired or is it land, or does it include land, which is acquired temporarily and will be restored to the proprietor?

164. MR SMART: Yes, that would include room for construction. So, the final take would generally be less than the pink area.

165. THE CHAIR: So, right, obviously for construction you need more space and so there's a temporary acquisition.

166. MR SMART: And some of that pink area would also – I mean this is basically construction – but some of that pink area might be because we needed to put in – again, from Mr Miller, you'll hear this – we might need to put habitat mitigation or maybe some landscape screening or something. So that would also be within the pink area but wouldn't really be what I'd call the engineering construction of the railway *per se*.

167. THE CHAIR: Thank you.

168. MS LEAN (DfT): Mr Smith this afternoon will talk about the promoter's approach to compulsory acquisition as against temporary possession because there are a few policy documents that deal with that. And, also, you'll see a series of slides from Mr Miller a little later this morning which will sort of show, what you're being shown is one of the construction drawings from the environmental statement. For every one of these drawings, there's an operation phase which shows things that are permanent features of the scheme which include planting. So that would probably give a clearer idea of land that's only required during construction and land that might be required for one thing during construction, but for something else during the operation of the railway, in the form of planting or such like.

169. THE CHAIR: Right, well we'll look forward to coming to that later then; thank you.

170. LORD SNAPE: Just before we leave the mitigation, again, given your past experience, Sir, and certainly having done two or three of these committees myself over the years, promoters normally in the midst of mitigation promise to use the existing railway line as much as possible to move soil and spoil from a construction site. I mean where HS2 runs close to the West Coast Main Line, for example, couldn't you reduce the number of heavy goods vehicle movements in many of these areas by using the existing or even closed railway lines.

171. MR SMART: Yes, we also consider, where we touch a railway, how we can do that. And actually, Lord Snape, if you wouldn't mind, I'm going to come onto the IMB-R railhead which does connect to the railway, and I can explain there the limitations of why we aren't necessarily going to use the railway.

172. LORD SNAPE: I'm sorry, I promise not to steal your thunder.

173. MR SMART: No, no, I am going to do that but I think what I would, if you will allow me, take your point now is that, obviously, the West Coast Main Line creates a lot of problems in terms of taking material away because one of the reasons for HS2 is the congested and very busy regional intercity railway, that is the West Coast Main Line. So, interventions on the West Coast Main Line are an expensive proposition.

Furthermore, you then need to get a way in which you can get trains off and on the West Coast Main Line from somewhere, which means that you need fairly large sidings, and they have to be at a certain level. And then that creates earthworks to create the siding, so we do look at this where we can, but for reasons which, hopefully, will become clear there are some limitations as to why you don't always use the rail, even though it may seem like the sensible thing to do.

174. So, if we move to the next slide and, Lord Liddle, I think this where I can hopefully explain the borrow pit question. So, borrow pits, essentially, you will have, I'm sure, around the country seen gravel pits. And they are areas of wetland and they are frequently where there has been gravel extraction, or sand and gravel, which are used for construction purposes. And that is essentially what a borrow pit is; we dig out the win, local sands and aggregates, rather than import them via the road. But, of course, you need to have the quality of the material locally to be able to do that. And we are in a situation on Phase 2A where there are a number of areas where we can do that.

175. And another advantage to the borrow pit is that if – well if I just come onto the slide – so you can understand that it's basically a hole in the ground from which we take material and often they are left as wetlands. The Colne Valley, for example, on Phase One is now regarded as an area of some sort of beauty for that part of London. And, indeed, there are old gravel pits, old extraction points, which have just been left to turn into lakes. So, where we can use borrow pits, it is a good way of which we can mitigate construction traffic on the road. So, it provides high quality access.

176. THE CHAIR: Can I just interrupt you there? I've come across this situation in connection with a wind farm where there's provision for a borrow pit. And it turned out, actually, that the quality of the material in the pit was not up to standard. And the result of that was a lot of heavy traffic having to take material from a considerable distance with problems for local roads. Are you satisfied that the places that you've identified as borrow pits are going to provide with the high-quality material you need, or is there a risk that you may not be able to get it?

177. MR SMART: So, we're satisfied as far as we can be on the basis of the desktop study. And, indeed, some of those locations I identified earlier are in the borrow pit areas; we're going more geotechnical. So, at this point in time, we are reasonably

satisfied that the borrow pits will yield aggregates for us. The actual amounts, and the depth we would actually extract to, and if you like the extent on the surface, will depend on more geotechnical information which we will be accumulating as we go through time. So, at the moment, we're confident we can win material in that area; how much and the final extent will be subject to further work as we go forward. Because we might not have the depth, Lord Hope, and we might have to reduce some of the extent of the borrow pit.

178. THE CHAIR: Yes.

179. MR SMART: But the aggregate is to be transported locally. We are allowing back-filling of the borrow pits with materials which we're not using from construction. So it has a two-way effect if you like. First off, we can win material from the borrow pits to save going onto the roads, because I will come onto the fact that a lot of these borrow pits touch the trace and we can access them from the trace. And we can also back-fill the borrow pits with material that is surplus to construction or is not of the suitable quality for high speed embankments and the like. So, it significantly lowers the HGV movements on local roads and the importation of aggregate because the embankments – high speed rail embankments, certainly the top portion – need to be made of some reasonable quality engineering fill; we can't just use clay or poor-quality fill. So, if we can win the aggregates locally, and especially if it's right by the trace, it saves us then importing, on the roads, aggregates to build the earthworks. So, it's a way of which we can sustainably use the material locally.

180. It does reduce the cost risks and the importation from commercial quarries because, clearly, the excavation in the borrow pits is done by our contractors with their own plant. And we're not relying on a commercial operation of a quarry to provide that.

181. MS LEAN (DfT): Sorry, just before Mr Smart moves on from borrow pits, Mr Strachan referred yesterday to a borrow pit review which had been carried out in response to, in fulfilment of an assurance that was given to the National Farmers Union whilst this Bill was passing through the other House. My Lord, what's just been brought up there was in response to Lord Liddle's question about what one of these looks like. This is an illustrative picture from that report. But the reason why I just refer to this report now was this sets out assumptions that have been made about the

likely depth, quantity and nature of materials in each of the borrow pits, including reviewing that in light of preliminary ground investigation works. I didn't propose to go into it in any detail now but just to flag up. I understand a copy of that report has been provided to the Committee as part of a pack of reference material. So, in terms of the work that's been done at the moment around what we think is in these borrow pits, what sort of material, indicative quantities, indicative excavation depths, there is more information about that in respect of each of the proposed borrow pits in that review report. And I'm sorry for interrupting Mr Smart.

182. MR SMART: That's very helpful, thank you. So, if I go to now, I think, exhibit P2-19, these are the locations – there's two slides on which we show where the borrow pits are – and you can see that we're using the borrow pits where either they span our railway or are very close to our railway. So, we can then win aggregates from that borrow pit accessing by our construction vehicles from the trace. And then we can then back-fill those borrow pits with material that is surplus, again from the trace, which all mitigates the use of construction vehicles or spoil material being excavated and then taken onto the local roads.

183. And again, if we move to the next slide, it gives the other locations – the first slide was in the Kings Bromley area – so we're now into the west Netherset Hey Farm area; again, two borrow pits which are touching our trace so have the advantages that I've outlined in what I've said.

184. If I now move, and I will then more fully address Lord Snape's question about moving material by rail. So, this is the site, as your Lordships visited, at the Stone Infrastructure Maintenance Base - Rail; it has two functions. It is a railhead for construction of Phase 2A, and it is also then in its final use an operational maintenance base for this section of the railway. So, it does have an existing railway connection which is the Norton Bridge to Stone railway line, which you can see coming in here. And it's a site that sits between the M6 motorway and our trace, so it's a land-locked site. The M6 is right beside this depot site and this is where we can access the M6 via some temporary slips that we will create, have agreed with Highways England. And I think we have an assurance and undertaking to get these slips in as soon as reasonably practicable, ahead of our main construction, so that we are not dealing with the existing junction 15 congestion. And we will access our construction vehicles on specially

designed slips onto the M6. And I think you will hear much more about this on the Yarnfield petition.

185. These slips are temporary except for the southbound slip will be left in place, not for public access, but will be an access for the operation, for HGVs and light goods vehicles coming into the operational maintenance base. And that has been agreed with Highways England. This area has a lot of earthworks in itself and is also a transfer node where we take the material from the trace onto the M6. Now to more particularly answer Lord Snape's question. Although we could create a railhead here to take material away, there are three things that we actually need to ensure that. One is a space to store spoil because a lot of it's coming along the trace to this transfer mode, because the trains don't always arrive at the time when you want to load them and, therefore, you need some space. Secondly, you need the train paths on which the take the material away. And then you also need the freight wagons, spoil freight wagons, themselves.

186. Now all of these things are somewhat of an unknown proposition at the moment; we don't know what's going to be happening on the national railways for the paths, etc. And also, there are other problems with creating a railhead for spoil away. First is the double-handling of material is maximised when you come along the trace, instead of coming along the trace and then going onto a conventional eight wheeler wagon and then onto the M6, you come along the trace, you have to unload it and then unload it onto a train, a spoil train. That spoil train then has to go a tip. And I'll come back to the fact there's not so much going to tip, but it will have to go to tip. And you've got to find a tip that's got a railhead facility and there aren't very many. I know there's one at Calvert and accessing that would be difficult for us, and there's probably one in Kent. But if you don't find a tip with a railhead facility, you'd end up having to unload the train at some other point and then take it by wagon to a tip which hasn't got rail facilities.

187. So, all of that comes at some time, cost and expense, as well as not necessarily mitigating construction traffic wherever you end up taking the train to. And I think the other thing is that we try and use as much as possible on the trace. So, of the excavated cohesive material which would be surplus to what we would use on the trace, it's about 1.6 million tonnes, which is only 4% of the material that we excavate is going to be surplus to requirements; the rest of it will be used in some other way. We do have about

twice that amount which is topsoil and agricultural soil. But we would look to actually utilise that elsewhere. So, although there are construction impacts on going onto the M6, taking material for disposal is not problematic.

188. So now perhaps if I could answer Lord Horam's question, he asked, do we do an assessment on the M6? Well, clearly, we did do an assessment of the junctions, and that's why we've decided we would need to do some specific measures by creating these temporary slips, so we don't clog up the existing junctions. When we get our wagons onto the M6, the numbers generated in terms of overall traffic are less than 5%, the increased capacity, if you like, is less than 5% of the traffic on that road in total. So, these are the best trunk roads that we've got in the country, so these are not levels of construction activity that cause a concern for Highways England; they can be accommodated on the M6.

189. LORD GODDARD OF STOCKPORT: We're practical people. Have you been down the M6?

190. MR SMART: Yes.

191. LORD GODDARD OF STOCKPORT: The M6 from Knutsford down to Stafford is probably the most congested motorway now. So, them saying 5 or 10% makes no difference, it will make a tremendous amount of difference.

192. MR SMART: Well we've assessed this on, I think, just south of junction 15, which I think is the busiest part and everything we have to do has to be agreed by the appropriate highway authorities or Highways England. So, this is the current scheme. Not I should say, of course, that it's totally out of the question that we could take some of the material, if things changed, that we could take some of the material out by rail. But for that to happen we need to have, as I've said, we need to source the freight wagons and there's a lot of earth being moved over the next few years in terms of HS2 as a whole, and there are some concerns within the freight industry about their ability to be able to service that. We need the train paths and there's also the handling and the storage requirements which are maximised. But if we were to assess the ES on, 'Actually we're taking all this material away by train', and we couldn't, we will have not then assessed the right potential environmental effects.

193. So, what we've done is we've assessed it on what we think is the most sensible construction proposition. If there are opportunities that we can, in fact, use the railhead facility to take spoil away, when we get further information about train pass, freight availability, and the amount of material we're dealing with over time is more precisely calculated, we may be able to do that. But at the moment we think the most sensible way is that which we have articulated in the environmental statement.

194. LORD GODDARD OF STOCKPORT: Before you said 4% of the total excavations were removed, 4% of 1,000 tonnes is so much, how much are we taking out; what is 4% of?

195. MR SMART: So, it's about 1.6 million tonnes. So, we can work that out in lorries and the wagons for you, which I can't do in my head but I can do it —

196. LORD GODDARD OF STOCKPORT: So, it's 1.6 million tonnes to be removed?

197. MR SMART: Yes, of about 92 million in total.[1]

198. LORD SNAPE: You mentioned the economics of it. I mean, obviously, from the promoters' point of view, using the existing motorway network is a lot cheaper than looking an alternative. But again, from memory, how many objections did you receive from local residents? And surely you must have a further comment on my colleague, Lord Goddard's, view on the M6 motorway; everybody that uses the M6 motorway knows just how congested it is. And, finally, you say the Highways Agency has been consulted. As far as I'm aware, the Highways Agency don't have any powers to stop a million heavy goods vehicles using the M6 motorway; it's not within their remit. Am I right?

199. MR SMART: I can't comment about the Highways Agency's remit as to whether

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[1] Footnote supplied by HS2 Ltd after the meeting: The Proposed Scheme will, in total, generate approximately 45 million tonnes of excavated materials. It is estimated that 92% of the excavated materials generated will be used as fill on a route-wide basis, with a further 4% of the excavated materials generated directed to local placement areas along the line of the route. Together, these measures provide for an estimated 96% of excavated materials to be managed within the Phase 2a scheme. The estimated quantity of surplus excavated materials that will require off-site disposal is approximately 1.6 million tonnes, less than 4% of the overall excavated materials.

they can stop us, but clearly, they must agree our proposals. And one of the reasons we've dealt with them is because that's why we've come up with the M6 slips as a way of mitigating the effects on the junction. With regards to the capacity, I suppose what I would say is that, yes, it's always an emotive subject, traffic on roads, because I know we all experience it in some way. But if you consider the amount of traffic that, for example, Crossrail generated, and I know that a lot of the spoil material went out to Wallasey to be spread off barges, but it didn't get to Wallasey without trucks going through London down to the facility on the Thames that took it to Wallasey. So, there are ways in which things are coped. And I think I would suggest that it's not in our interests to have our spoil wagons sat in traffic; it's not the best thing to do. So, clearly, as our construction programme is developed, and we look at what we're going to be doing over time, we can try and look at how we can mitigate the effects on the roads in general, because (a) it's in our interests to do it; and (b) the highways authorities would require us to do it.

200. LORD GODDARD OF STOCKPORT: Can you mitigate the effect on the M6 by an agreement about the timing of your vehicles? So, for example, them going at night?

201. MR SMART: Well that might be something that the highways authorities could require; at the moment they haven't suggested that we would. The trouble with night is it can be a disturbance at night.

202. THE CHAIR: Yes, traffic is obviously less.

203. MR SMART: Yes.

204. LORD SNAPE: The local residents might not be too keen.

205. LORD HORAM: They might not but, on the other hand, the traffic would flow better. It's like heavy lorries coming into London, you know, you have certain restrictions on time even though it obviously affects residents.

206. THE CHAIR: There could be patterns during the daytime, during daylight hours, when the traffic is heavier, rush hour type of thing. I'm not sure; I mean the M6 always seems to be very busy.

207. MR SMART: I'm going to, shortly in my presentation, take you through some of

the exhibits that you will see in the petitions as to how we show the traffic effects. And I am going to come onto some things which we do to mitigate the disruption effects, other than the things I've already talked about which is the borrow pits largely. So, there are some things around timing which also help.

208. MS LEAN (DfT): My Lord, may I just take this opportunity to clarify a couple of points with Mr Smart which may provide some assistance for the Committee? Firstly, Mr Smart, just when you were talking about the 5% figure, just to be clear, is that a 5% increase or is that 5% of capacity?

209. MR SMART: That's a 5% increase. Sorry, increase in capacity[2] is what it is, yes.

210. MS LEAN (DfT): And, secondly, there are some smart motorway upgrades, some to do with the M6, is that something the project has taken into consideration and does that have any implications for capacity on the M6 and in the context of our slip roads, for the slip roads?

211. MR SMART: Well I'm not totally clear how the smart motorways now sit but, yes, certainly we've been looking at the timing of our works in conjunction with the works that the Highway Agency were doing for their smart motorway schemes. So, we've kind of —

212. LORD HORAM: That section of the M6 smart motorway?

213. MR SMART: They had plans to put it in. In fact, it might well be that —

214. LORD HORAM: Is it now?

215. MR SMART: Yes. But they're expanding, I think.

216. LORD HORAM: Because they're very controversial. What I didn't quite understand was the way they affect, the slip roads you're proposing to construct, how do

[2] Footnote supplied by HS2 Ltd after the meeting: HS2 construction traffic is predicted to use up no more than 5% of the capacity of the M6 during the peak period of construction of the Proposed Scheme on the section between Stone and Junction 15. HS2 Ltd's forecasts are that the motorway would remain within its assessed capacity. The use of the M6 by HS2 construction traffic would be considerably lower elsewhere.

they mitigate the effect on the M6?

217. MR SMART: Well they're on the main section of the M6, on the carriageways, not necessarily, but it's not using the junction 15; we can go on our own slip roads. So, our construction vehicles aren't mixing with other M6 traffic when they come off at the conventional junction. So, we are not impacting.

218. LORD HORAM: I see. You've got your own junction?

219. MR SMART: We've got our own junction effectively, yes. And I'll come onto it, Lord Horam, but we do assess junctions for their ability to support the amount of construction traffic that we're going to be putting through them. And that is why some of the highway authorities, specifically Staffordshire County Council, require us to improve junctions before they would allow us to use the construction routes because they have to be agreed with the highway authority.

220. LORD HORAM: It's an interesting point which Ms Lean raised about whether the 5% was an increase in actual traffic, or a 5% increase in capacity, because judging from what Lord Goddard was saying, and my own experience, is the actual traffic is very near capacity. I mean the effect of the traffic there is quite regular; it's very long, slow moving, even without crashes, and even without vehicle works, even on an ordinary day. And that's the problem; I don't know how close we are – maybe Highways England could make an assessment – how close we are at that point to capacity.

221. MR SMART: So, obviously, this section of the M6 is part of our route-wide assessment. So, I think if you were to refer to volume 3 of the ES, specifically the second of paragraph 14.2.1, it does set out in there the approach that we have taken.

222. LORD SNAPE: You did say that you would look at the opportunities of moving spoil by rail. You did say that, did you not?

223. MR SMART: Yes. I mean we always keep under review plans to mitigate construction effects.

224. LORD SNAPE: So, if the Committee agreed to write something to that effect into the Bill, it wouldn't cause you too much angst.

225. MR SMART: Well only that, if the Committee were minded to do that, and of course we couldn't get sufficient train path, freight wagons, everything else, then the construction time period here would be maximised to the point that (a) the railway would be late, but also the effects on local residents would be a much, much longer time period.

226. LORD SNAPE: I don't get the idea you're not too enthusiastic about taking such a course then.

227. MR SMART: Well frankly, no, because I think this is the right scheme, which is why we've got it in the ES. But I do think there are things which – we do the ES on what is known as the worst credible position – because we can't be in a situation where we've said to people that it's not going to be too bad, and then of course it's a lot worse; we can't be in that position. So, we always try and set an envelope which is realistic but that we can usually improve on when our plans have detailed proposals, when the contractors come on board and actually start doing the logistic planning, how they want to build the job; we look to improve on the propositions set out within the ES.

228. LORD HORAM: Just to clarify this point, this 5% point. Is this during the construction phase or thereafter when the whole thing is completed?

229. MR SMART: No, construction phase, yes.

230. LORD HORAM: So, after the construction, this would be less than 5%?

231. MR SMART: Oh, much less. So, then it is a question of just servicing the operational depot. So, obviously, this is bringing in spares; it would be operatives that work in the depot coming in. But I mean this would be a very, very small amount.

232. LORD HORAM: You would still have the slip roads.

233. MR SMART: We will, yes.

234. LORD HORAM: Permanently?

235. MR SMART: Yes, on the southbound, not both; on the southbound we would. So one particular, but this might well come in by rail, but switches and crossings or points have to be replaced at some point in the railway life, and you might bring those in

when they are needed, maybe after 20 years or whenever; it may be less depending on the wear, on a very long articulated lorry wagon, and that would use the southbound slip that we've left there. But there's also the ability to access the depot by rail, so those sorts of spares might come in by rail.

236. LORD HORAM: How long does the construction period last?

237. MR SMART: The construction of this is, on the current programme – would you permit me to come back and confirm that?

238. LORD HORAM: Yes, sure.

239. MR SMART: I don't want to just give you the wrong figure off the cuff.

240. LORD LIDDLE: There isn't an issue of rail capacity on this Stone branch, is there? I mean, there's plenty of capacity there.

241. MR SMART: So, the Norton Bridge-Stone has three trains per hour at the moment for passengers. And we don't think that we would need to use that in any way that would reduce the current capacity, and it's very temporary for the construction anyway.

242. LORD LIDDLE: And, presumably, the freight trains carrying stuff to and from could operate through the night when there isn't the passenger services on the main line.

243. MR SMART: Yes.

244. MS LEAN (DfT): My Lord, if I may, the use of the M6 slips capacity and the use of the Norton Bridge to Stone rail capacity are matters that are being put in issue by one of the petitioners that you will be hearing later on in the Committee's business. We do have more information and more details around these matters; I'm just slightly concerned that we don't venture too far into essentially giving evidence on a matter that we know is in dispute with a petitioner. During the course of Mr Smart's teach-in, we've been trying to keep away from controversial issues and issues in dispute. And I think things around capacity of the M6, whether that's workable, what the implications for using the Norton-Stone railway might be, are matters that are live with the petitioner.

245. THE CHAIR: Well I think I understand your point. On the other hand, these

questions have been, I hope, very helpful to appreciate points that could be of concern to us. And you've got plenty of time, I think, during the adjourned proceedings to do a good deal of work to satisfy some of our concerns.

246. LORD SNAPE: I don't think the Committee should necessarily be constrained by what a witness may or may not say in the future.

247. THE CHAIR: Well I think, with respect, I think there is an issue as to, of course, there's a time constraint, we've now got to get through all these teach-ins; whether we really go further in probing the issues now because we will be coming back to it. It may be that members of the Committee will feel that we needn't press that too much further. But I think you'll grasp the tenor of the questions and it's enough to alert you to the need for a good deal of further work when we come around to the relevant petition.

248. MS LEAN (DfT): Well my Lord, we have certainly taken on board all the issues and I certainly didn't want to suggest that it was for us to cut down matters on which the Committee may wish to ask.

249. THE CHAIR: Yes.

250. MS LEAN (DfT): I'm conscious we're now getting into, Mr Smart getting into some quite specific details, which may or may not be accepted by those who may wish to come before you. So, I'm just conscious that we are not seen to be starting to make our case in response to a petitioner when they are not here to respond.

251. THE CHAIR: There is another point, Ms Lean, if you wouldn't mind, the question of timing; we've got two other teach-ins to come. I don't know how long you were expecting Mr Smart to take, but are we running into a time problem in finishing these two teachings, other two teachings, today?

252. MS LEAN (DfT): We can make sure we finish both teach-ins today, my Lord; we can certainly make sure over the lunch adjournment that we make any necessary tweaks to ensure that we don't go part heard on any of them.

253. THE CHAIR: It's an extremely interesting subject and I don't want to restrain too much the questions that members of the Committee are putting. But I think we need to bear in mind that we do have other things to do today as well. Well Mr Smart, would

you like to continue? We're still with mitigation.

254. MR SMART: If there are no more questions around the railhead and the M6, I will move to the next slide, which is really just an illustration of the local placement.

255. THE CHAIR: Can we just pause for a moment? Yes, of course; yes, that's fine.

Sitting suspended

On resuming –

256. THE CHAIR: We're hoping we'll finish by about 12.30.

257. MR SMART: I will try and do that, my Lord.

258. THE CHAIR: If you could bear that in mind.

259. MR SMART: So, this slide, the next slide, really shows we sensitively use the local placement. And I won't read all the slides, because they're available to you, and in view of the time, if there's no questions. But you can see that this is, from the cross-section, you can see this is done sensitively and where we don't have to move material very far. Next slide, which is mitigation of impact of construction again, just outlining that we use routes where we can – it's back one, is it? Yes, thank you, sorry. These are the measures to manage traffic impacts, phasing of the works, the timing of operations, road traffic management layouts you've heard me talk about, parking controls. I won't necessarily read all of these. These are all things that are – your Lordships have a copy of the draft Code of Construction Practice – this sets out the practice that is under the environmental minimum requirements that our contractors have to comply with. And so, these are the things that help to assuage the effects of construction traffic on the roads.

260. Next slide please. Clearly, when we have large goods vehicles over seven and a half tonnes, we need to agree – and we've got compounds as well – we need to agree with the highway authorities the traffic routes when we have 24 two-way trips per day. So, all the plans for the local roads have to be agreed by the highway authority.

261. Next slide. In our transport assessment, there are precautionary assumptions. For example, we work an 8 till 6 construction period, which is 10 hours a day. And we can,

with agreement of local authorities, work on Saturdays. So that's a five and a half day working week. However, the traffic assessment assumes a five day working week; we don't assume we can always work on Saturdays. So, these are the sort of things that we can do to help deal with some of the pressures on the traffic and I've said the impacts are assessed on a future baseline so it allows for the fact that the traffic builds up. And it uses local traffic modelling to ensure that we've got the most accurate assessment possible.

262. So, on the next few slides, I just want to take you through the type of exhibits you will be seeing in petitions when we are discussing traffic effects, and these are traffic routes and vehicle maps, histograms and daily week day construction flows. So, first off is the first sort of plan which shows you the construction traffic routes within a community forum area. And you can see from the boxes, it gives you the busy months, the months of peak and the peak daily two-way movements. So two-way movements means that's in and out. So, 1,000 lorries two-way is 500 in, 500 out. So, it just assesses that on the road.

263. So that's one type of exhibit that you will see when we come to talk about traffic and transport.

264. THE CHAIR: Are we going to have to be using this particular map because it's a bit of a test of eyesight?

265. MR SMART: Well in the presentations, sorry in the particular exhibit packs for petitions, this will be a bigger – this is just illustrative of the type of diagram that you will see. But when we move over, you'll see how this develops. So, the next slide shows a particular histogram on a particular road. So, really what this is showing is, when the HGV movements occur over the months and year of a particular construction activity. So, you can see that during the July/September '22, we've got some high flows of around 500 two-way movements in a month. And the top line, which is the orange line, suggests that we assess on 70% of the peak.[3] The reason we do that is, in a month, you might have a day when there might be 500 lorry movements; there might be a day

[3] Footnote supplied by HS2 Ltd after the meeting: For the purposes of traffic assessments, the peak month of construction is assessed, and within that peak month, the average day is assessed.

when there's only 100 lorry movements. So, we assess the road on the 70% level. And the busy period which is when, if you will, the traffic effects are a lot less than the peak, but nonetheless they are a busy period. And so, we use that 50% figure for the busy period. But the roads are assessed on the 70% level because, as I say, only certain odd days when you get that very high peaks in a month, and it may be less.

266. THE CHAIR: Well it's a single carriageway, isn't it, Mr Smart?

267. MR SMART: Yes. Sorry, I don't think it's a dual carriageway; I'm not sure; I'll double-check.

268. THE CHAIR: Well it's a single carriageway, isn't it?

269. MR SMART: Yes. So, this is an exhibit that you will see applied to a particular road. So, again, the box gives you the peak daily two-way movements that happen in the peak, the number of months where the peak occurs and the number of months busy period, which allows you to get some context as to how locals will feel flow on that particular road.

270. LORD HORAM: Sorry I don't quite understand the distinction between months peak and months busy.

271. MR SMART: So, the months peak is the 70% level which is sort of shown at the top orange line, horizontal line, going across the page. But we've got a busy period which goes on for a lot longer.

272. LORD HORAM: I see.

273. MR SMART: So, the peak period is the five months, but we've got a busy period of nine.

274. LORD HORAM: Is longer; I see.

275. MR SMART: If we then move to the next slide, which is the daily construction traffic flow. So, this is basically giving you a section of the construction route; in this case, Great Haywood and Tixall. And it explains, you can see the green Weston Bank Road and the A51 London Road, and this shows the construction traffic route into our construction site. And you can also see a number of alphabet letters in a circle which

correspond to the box at the side, the legend at the side. And so, these are shown for various different points on the construction road into the site. And if I go over the page, this is a bit less of a trying on the eyes, what these boxes show, in this particular location E, which is on the A518 Weston Bank between Witham Lane and Willmore, it shows that in the future you can see the baseline flow at 2023 generated by traffic that isn't HS2.

276. We then superimpose the traffic that will be created by the construction of HS2, and you can see all the vehicles and then the numbers of those vehicles that will be HGVs. And that then gives you the future baseline plus HS2, which gives you the full increase in vehicle traffic in percentage terms and the increase in HGVs that that road will see in percentage terms. And that's HGVs as a percentage of the total traffic of HGVs. So not just the HGVs that we – and these construction flows are based on the average 12-hour flows, depending on the programme and peak month. And the percentage of HGVs represents a proportion of the traffic, as I've said, without and with HS2. The percentage increase in vehicle traffic represents the change from the baseline flow.

277. So, this is the information you will see on each road that a petitioner may raise when they say, 'Well what's the increase in traffic? What's the increase in HGVs?' This is the way we show it on our exhibits for petitioners.

278. THE CHAIR: If a petitioner raises an issue about traffic in a particular location and they'll, presumably, either speak to it or lead a witness about it, are you, Ms Lean, intending in the presentation for the promoter to lead Mr Smart in evidence?

279. MS LEAN (DfT): Yes, Mr Smart will be giving evidence on traffic matters.

280. THE CHAIR: Yes.

281. MS LEAN (DfT): For the promoter.

282. THE CHAIR: And this is the kind of material you'll be using in your presentation.

283. MR SMART: Yes.

284. THE CHAIR: All right.

285. LORD LIDDLE: Can the petitioners dispute these figures?

286. LORD SNAPE: Perhaps we should wait and see, shouldn't we?

287. MR SMART: There have been petitioners that have said that they don't believe our traffic figures, but all our traffic figures are verified and done in agreement with the local authorities. Sometimes I think you can find that you'll get a petitioner that would say, 'Actually when I look at the' – you will have two figures – if I go back to P2-29, and if I just take G and H at the bottom left, they might say, 'Well the flows there don't work out when you go past that junction'. That's because when we do the traffic assessment, we do it on a particular road at a particular time; we don't try and work out how the flows all go up to junctions. We're doing a count on a road at a particular time, so it's the way that an assessment's done. But, as I say, we stand by our figures because they are done in accordance with the way one does these within standard procedures, and we take the highway authorities through these. So, I'm not aware that any highway authorities have disagreed with our figures.

288. LORD GODDARD OF STOCKPORT: When we went on the tour, we went to Woore, the village, and we just stood there for 10/15 minutes, and the number of HGVs went through down that road, and it was a random part of the day, about 3.30; it wasn't peak times. I just wonder if a study was done round there whether, because it is the randomness of when the count is done, whether that does show a true reflection of the actual number of vehicles that pass by.

289. MR SMART: Well we can give you the information, but the traffic and transport assessments are done in accordance with British Standards and other codes of practice, so you do it for a standard period of time; you don't just count for an hour or so. It's over a period of time that these assessments are done. So, they do represent the best possible way of collecting this information.

290. THE CHAIR: Well, Mr Smart, does that end your presentation?

291. MR SMART: It does.

292. THE CHAIR: I think we've got to the last slide.

293. MR SMART: That's the end of my presentation, yes.

294. THE CHAIR: Well thank you very much indeed; we look forward to seeing you in due course when these issues arise with regard to particular petitions. Thank you very much.

295. MR SMART: Thank you, my Lord Chairman. Thank you, my Lords.