

MINUTES OF ORAL EVIDENCE

taken before the

HIGH SPEED RAIL (CREWE - MANCHESTER) BILL SELECT COMMITTEE

PETITIONS AGAINST THE BILL

Monday, 17 April 2023 (Afternoon)

In Committee Room 8

A video of the proceedings can be found [here](#).

PRESENT:

Andrew Percy (Chair)
Dr Lisa Cameron
Antony Higginbotham
Grahame Morris
Holly Mumby-Croft
Martin Vickers

FOR THE PROMOTER:

James Strachan KC, Counsel, Department for Transport
Peter Miller, Director of Environment and Town Planning, HS2 Ltd
Lord Robert Mair, Expert witness for the Promoter

Exhibits referred to by the promoter during the hearing with Lach Dennis Parish Council can be found [here](#).

FOR THE PETITIONER:

1. Lach Dennis Parish Council
 - Cllr Simon Hayes
 - Dr Rosalind Todhunter

Exhibits referred to by the petitioner during the hearing can be found [here](#).

IN PUBLIC SESSION

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(At 4.15 p.m.)

1. THE CHAIR: Good afternoon and welcome to this afternoon's meeting of the HS2 Hybrid Bill Select Committee. I may have to take a call, which I have to answer. If that happens then Martin, as the most senior Member here, will take over from me for a brief moment, so proceedings can continue but I'll only be out for a minute or two.
2. Same process as normal. We will begin with Mr Strachan who will give us a brief overview of the petition area and then we will hand over to the petitioners and then, of course, back to Mr Strachan. And, members – we try and keep this fairly relaxed and free-flowing. Members will jump in if they have questions, as and when they wish. So, Mr Strachan, over to you.
3. MR STRACHAN KC (DfT): Thank you very much. And I was just going to ask you whether you wanted me to update the Committee by way of a brief overview of the historical evolution of the route alignment, because I can do that now or at some other stage.
4. THE CHAIR: I don't think the history of the route alignment is particularly relevant. I think we're concerned with the route as it is now. I don't think we need to go into the history of that. The route is where it is proposed and I presume we'll get into the bones of that as we move in. I'm not sure we need to go further yet.
5. MR STRACHAN KC (DfT): If I leave it in this way. I think when you were hearing, if I've got this right, the Northwich Town Council petition, there was some discussion about that.
6. THE CHAIR: By the town council, I think, not by us.
7. MR STRACHAN KC (DfT): No, but I think Mr Mould may have indicated in response to a question that there may have been a request for some more information about that. But rather than take you through it now, there is in a report, Appendix B, 'Crewe to Manchester – Understanding the Ground Risk across the Cheshire Plain', which was published in March 2023, in Appendix B, there is actually a chronology of the route and the consideration that was given to the various alignments. The reference for it is R12 on the system.

8. THE CHAIR: Yes, we've got it here.

9. MR STRACHAN KC (DfT): And it's Appendix B to that. If the Committee does want any more information about that, there is a summary –

10. THE CHAIR: I think it's because the parish or town council who were here made reference to why decisions had been taken and I think we were satisfied with what we heard in response from HS2, knowing that we were going to be hearing much more around ground conditions in future petitions. But we have the appendix here so we'll proceed with the brief overview of the location we're referring to today and then we'll alert members separately to Appendix B, in terms of the history of the route.

11. MR STRACHAN KC (DfT): Thank you. So on the screen now, you've got P150. That shows the parish council boundary in red, Lach Dennis Parish Council boundary in red. The alignment's running up and down, north-south of the page, and if I then ask if we could go to P151, the alignments turn, so north off to the right now, and this is the construction plan. The parish boundary, since we've zoomed in a bit, is again in red but you can see extending up to the top of the page. The Committee will be familiar with this area, very familiar I think, already. But you can see the line of construction running from left to right across the plan. Lostock Green is in the centre of the page and I'm sure that the parish council will be talking about that in a bit more detail shortly.

12. And if I could just take you to P152, just to remind you what's happening in terms of features. Just moving from the left-hand side of the page to the right, left-hand side we've got the Gadbrook Viaduct right on the left, which you've heard a bit about already. The settlement of Rudheath is up to the west but to the top of the page and the Rudheath Embankment runs along.

13. Could I just show you Penny's Lane? I don't know if the cursor can take you down, Penny's Lane to the left. Penny's Lane currently runs up and down the page. It's re-aligned and diverted off to the A530. As you run across the page, left to right, you've already heard about the A556, Shurlach Road, which is re-aligned to accommodate the railway and Lostock Green is just below that re-aligned road and the railway running alongside it. And then you move to the Wade Brook viaduct over to the right and the Lostock Gralam Viaduct and North Embankment and then the Smoker Brook viaduct,

again, which the Committee's heard about already.

14. In terms of the issues that you're going to hear about, I'll let the parish council explain those which they are going to focus on. One of the things that we anticipate is discussion – further discussion about the ground conditions and the Cheshire salts in this area. Secondly, the effects on the local community, particularly around Lostock Green and, related to that, the public rights of way, which are affected by the route and what we're doing about that. The effects of the construction, because from the last slide I showed you, there are various satellite compounds that need to be in place to construct the scheme and visual and noise effects from the railway and, potentially, effects on water and industry.

15. One update in terms of assurances. Since, or in anticipation of, the issues raised by the parish council, the promoter has sent a letter with an assurance to Lach Dennis Parish Council, also to Cheshire West and Chester Council. It's P169(1) on the system but it's probably simpler if I just explain it by reference to a plan. It's a letter dated 14 April. If I could just take you to P158, and we'll come to this in more detail, no doubt, in due course. This is to deal with public rights of way.

16. You can see, if you look at Lostock Green in the centre of the page, and if you move to the left of Lostock Green, along the line of railway, you eventually get to an orange line, which is the footpath 3-4 as it meets footpath 3X/1. That is severed by the railway but a re-aligned purple line takes the footpath along the railway to the re-aligned Penny's Lane and the subject of the assurance that was in the letter is to address the link between Lostock Green and that orange line, to potentially create a footpath that would run from Lostock Green to connect up to the purple line so that people can move from Lostock Green, all along that footpath, re-join Penny's Lane and access Rudheath that way around.

17. Going the other way from Lostock Green, you can see on this plan that there's a new public right of way that passes underneath the Wade Brook viaduct and back to Birches Lane. I suspect we'll hear some more about that in due course. But other than that, that's the latest by way of assurances. The other matters of concern have been addressed in the petition response document and I'll address you further, depending on what's raised.

18. THE CHAIR: Excellent, thank you. Thank you, Mr Strachan. We now move on to hearing the petitioners, Lach Dennis Parish Council, who are represented by Councillor Simon Hayes and Rosalind Todhunter who I believe you're presenting together now. Rosalind isn't a witness. You're going to be resenting together, yes?

19. CLLR HAYES: Yes.

20. THE CHAIR: That's absolutely fine. It's over to you then, whoever wishes to commence.

Lach Dennis & Lostock Green Parish Council

Submissions by Cllr Hayes

21. CLLR HAYES: Okay. I'll just give a very brief introduction and then hand over to Dr Todhunter. So, good afternoon, Chair, and good afternoon, Committee. Firstly, can we thank you all for taking the time to listen to our presentation. We genuinely thank you for this because it's not always been the case that we feel we've been heard fully in the past.

22. So I'm Simon Hayes. I'm parish councillor and here representing Lach Dennis and Lostock Green Parish Council. My colleague here is Dr Ros Todhunter. Dr Todhunter is a retired geologist who throughout her long career worked in mining, quarrying and site investigations in areas of active and former mineral extraction. Dr Todhunter worked for British Coal and also lectured in geology and geophysics, mainly at Staffordshire University and the Open University. She holds a BSc and a PhD in geology and is a former fellow of the Geological Society and is also a chartered geologist. She is, nevertheless, here representing the parish, as I am.

23. Our presentation will cover two broad areas. Like other parishes adjacent to us, and indeed across the county, our residents are deeply concerned about the destruction of roads and paths, which will impact their ability to travel to local amenities such as schools, shops and churches and feel that they could become isolated within their community.

24. Secondly, and perhaps more importantly, we will demonstrate that the geology of our area is unsuitable for the construction of HS2. May I remind the Committee that the

refined route, the route upon which this Bill is based, was revised partly as a result of evidence provided previously by Dr Todhunter. However, we will provide further evidence today that will demonstrate that the report already mentioned, namely that dated 3 March 2023, ‘Crewe to Manchester – Understanding the Ground Risks across the Cheshire Plain’, fails to fully recognise all the risks of construction across the area in question and that HS2’s planned embankments, geo-grids and planning techniques will not remediate the problem and may even make matters worse.

25. Further, while HS2 suggest they have ways to monitor ground movement and settlement, that is of little value when the train line subsides. We will demonstrate to this Committee that there is an unacceptably high risk and probability this will occur.

26. Mr Smart from HS2 has previously stated that, and I quote, ‘We’ve done our best to avoid the areas of higher risk ground’. We suggest that further investigation by HS2 needs to be taken to fully avoid those high-risk areas. Thank you. I’ll now hand over to Dr Todhunter.

27. THE CHAIR: Thank you. Just before Dr Todhunter commences, this is obviously going to be quite technical, I think. Just as a gentle reminder that none of us on this Committee are geological experts so please do bear that in mind, in terms of any of the technical information put before – we’re all incredibly bright and articulate as you can tell but we’re just not geological experts. I hope both parties will appreciate that. So, Dr Todhunter?

Submissions by Dr Todhunter

28. DR TODHUNTER: Right. Well, hopefully, I’ve explained things as best that I can so that everybody else would understand. Hello, everybody. I’m Rosalind Todhunter, as you know now. I’m a resident of Lach Dennis and Lostock Green Parish and also a geologist. So the resident is the main thing.

29. I’ve been asked by Lach Dennis and Lostock Green Parish Council to present their objections to the HS2 Phase 2B Bill. The parish council’s objections and concerns cover many aspects, which include geological topics, as our parish is within the Cheshire salt mining and salt solution brining area. Over the last 10 years, I’ve donated my time and my geological experience and knowledge for the benefit of the residents.

Lach Dennis and Lostock Green Parish Council appreciates the attendance at today's meeting of the proposer's geotechnical expertise that I'm surrounded by. Thank you very much for coming and I look forward to hearing any of their comments.

30. We were pleased to receive, about six weeks ago, the proposer's response document to the parish council's petition that was submitted in July 2022. In the short time available before this meeting, the parish council has reviewed the comments from the HS2 team. However, the parish council is not satisfied with HS2's responses. The proposer response document does not solve and/or mitigate the negative impacts recorded in the parish council's petition of July 2022, the parish council's environmental statement consultation response that we submitted in March 2022 and the many previous consultation responses submitted by the parish council and the parish residents over the last 10 years.

31. The proposer's response document, in many cases, sets out and justifies why specific problems exist. However, it does not give specific solutions on how the design can be re-assessed and revised to mitigate and/or to prevent our specific problems.

32. The parish council considers it's the responsibility of those who are proposing the scheme to produce specific solutions and options that incorporate the concerns of those affected by the scheme, i.e. the people and the environment of Lach Dennis and Lostock Green Parish Council. I should explain, we have changed the name to Lach Dennis and Lostock Green Parish Council but for the last 10 years, Lostock Green has been sometimes in Lostock Gralam Parish Council and then it was transferred to Lach Dennis Parish Council. So there's an awful lot of Ls in it basically.

33. THE CHAIR: It's awful when boundaries change.

34. DR TODHUNTER: Yes, exactly. So the specific concerns have been outlined by Mr Strachan here, which are community isolation and wellbeing; poor ground conditions; industry; roads; public rights of way; traffic and transport; construction; and visual and noise impacts, particularly the height and the provision of some noise fences, please.

35. So I'm going to start off with slide A23(2) and I'll explain where Lach Dennis and Lostock Green Parish is, with respect to the route of HS2 Phase 2B, which I know has

already been covered. The HS2 route, as you can see marked in the rather nice terracotta colour, runs for about 15 kilometres, almost 10 miles, from the Wimboldsley School to Heyrose Golf Course, which for HS2 is the HS2 Crewe rolling stock to just about half a mile south of the HS2 M6 Mere viaduct and it's crossing the Cheshire salt district.

36. The Cheshire salt district is underlain by potentially hazardous ground with shallow salt. Salt extraction as brine, as has rock salt, has been taking place since pre-Roman times. Through the parish of Lach Dennis and Lostock Green, there's a two-mile section where the salt is at depth. Here, the deepest salt is actively exploited via solution mining. There are about 200 brine wells, each connected to a massive salt solution cavity that are supplying the brine feed stock for the north west's chemical industry and it's also the site of the secure gas storage, the nation's energy security places, within these big cavities in the salt. There's about 40 of those.

37. THE CHAIR: When you say the brine – I don't understand any of this.

38. DR TODHUNTER: I'm sorry.

39. THE CHAIR: Is it literally swill the salt out with water?

40. DR TODHUNTER: So what they do is they sink a borehole down about 200/300 metres until they hit the salt that is about 200 metres thick, and then they put pressurised water and air down it and they dissolve a cavity that could fit St Paul's, or Blackpool Tower in our case, we'll quote, and there's eight of those 200 brine wells has a cavity beneath them where they're abstracting salt so that if we didn't have that salt supply within two days, you wouldn't have your sterilised water available. So it is, it's supplying the north west's chemical industry for the bleach down the toilet and your chlorine in your drinking water as well. So it's really where the supplies come from there. So it's called solution mining. So it's underground. From the surface, you just see green fields but every 200, 100 metres, there is a well-head, and there's 200 of them, and those surround – perhaps we ought to go to 23(8). There's an awful lot going on in our backyard, basically.

41. So if you see Northwich, and you can see the blue dotted line, that is the Lach Dennis and Lostock Green Parish boundary running around there. All the red blobs

amassed at the top end around about where the HS2 lines go, are these 200 brine wells. The green stars are the gas storage where the nation is storing probably about – we might have nine days' supply there. There's a bit more in the Rough gas field as well, which has come back on line, but we've got most of Britain's strategic gas storage within that area there.

42. The big green dot that's between the two lines is the gas storage that is sterilised by the HS2 line and the black star, which is outside our parish boundary, is the working rock salt mine. So that's a dry rock salt mine. So the others are – so there's 200 solution mines within the area of the parish boundary that are critical to the current line of HS2.

43. So local residents, myself and others, particularly those in and around our local salt town of Northwich who work in the salt industries, are very well aware of the challenging ground of mid-Cheshire, challenging and expensive ground to make safe enough to be built, as has been done recently where three out of the almost 30 empty brine filled mines were grouted so that the town could be developed. That still remains about 27 that aren't grouted, and the challenging and expensive ground to make safe where it's crossed by HS2 2B high speed rail route.

44. So, I will get technical now. So if we look at number three slide of ours, this is where it does get technical. So I think you're best to look at this as a slice of cake going underneath where HS2 is going and it shows you what the ground is made of. The ground is made of layers of mudstone and sandwiched between the mudstone, there's about a 200-metre-thick layer of salt. Where the mudstone is sitting on top of the salt, on the right-hand side, that is known as dry rockhead.

45. Well, I've lived in Lostock Green, one of the two villages within the parish of Lach Dennis and Lostock Green, for over 40 years. I chose to live in Lostock Green because it was on the stable ground of the dry rockhead. Rockhead is where solid rock, of any type, meets the overlying looser, weak-ground materials such as sands and gravels and clays and soils. Those are not shown on this diagram here but it would be like having a line across the top there, made up of sand and gravels and soils.

46. Dry rockhead is when the rock salt below at depth, so that's the pink colour, salt with interbedded mudstone, is overlaid by – is at depth below a protective layer of solid

rock, such as the mudstone. Wet rock is where the solid rock is near the ground surface and does not have a protective layer about it. So that is showing the bits that's got those broken illustrations in the middle there. This is from a paper that was published by Cooper, in 2020, and I'm sure your geotechnical people will have come across this paper.

47. So, in the wet rockhead, which on that earlier slide I showed you, that red dotted line was showing you where the wet rockhead was, is where the solid rock salt is near the ground surface. It does not have a protective layer of mudstone about it, hence this is where there is a potential risk of salt solution from contact with surface, and or ground fresh water. Rock salt is meta stable. That means it can change from a solid state to a liquid state in the presence of fresh water. Rock salt dissolves readily in fresh water, leaving voids and ground collapse, which is one of the reasons I did not buy a house on the wet rockhead. I avoided the area of known geohazards.

48. The HS2 2B north of Crewe is to be built over wet rockhead, known unstable ground where there's a potential risk of salt dissolution and ground collapse. The HS2 2B route therefore does not avoid the area of known geohazards. My interest in ground stability obviously stems from my background as a mining geologist.

49. THE CHAIR: So obviously you said you decided to purchase a house, which was above the dry rockhead. How much building is there over the wet rockhead area then? Because, I mean, presumably there's stuff all over this part of the country.

50. DR TODHUNTER: Yes, there's Northwich; there's Winsford; there's Knutsford; there's Sandbach; there's Middlewich. These towns are built over it. Northwich couldn't develop the town until 2007 when they completed the mines. There were areas in it where the ground wouldn't take – there were lots of free car parks, which was very nice, but there were areas where they couldn't build anything other than a very lightweight unit really, like a B&Q or something like that. Other stores are available, sorry.

51. THE CHAIR: We are on telly so be careful.

52. DR TODHUNTER: Yes. So until that, and since that, we've had a big development over one of the mines, called Barons Quay. So it's called the Barons Quay

big shopping development, which unfortunately is showing signs of ground movement. It's been built over a mine that's been grouted with cement mixed with saturated brine. So the old mine area is now completely full but the edges of it are solid salt.

53. And Keele University is doing research on this and they've found that there is subsidence still going on in Northwich and, recently, I met and talked with Mike Ainsbury, particularly about the area around this Barons Quay where there was movement of the ground and there was damage to various bits of it. When I plotted them all, they all occurred on the edge of the mine, where the solid rock salt is still there. So these rock salt solutions have been going on in since the ice melted, 15,000 years ago and it will still continue whether HS2 is there or whatever happens. So the ground is still on the move in Northwich.

54. THE CHAIR: Yes, I get that. I suppose my question is, obviously a lot of this is built over. I mean, there are roads going everywhere; there's a motorway going over it and I'm just trying to, in my head, understand what the difference is between –

55. DR TODHUNTER: Right, yes.

56. THE CHAIR: – how much is the weight of a railway versus the weight of a road?

57. DR TODHUNTER: Right. So, can we go back to slide 2 then, please? So slide 2, we've got that up in front of us. You said there's a motorway going over it. There isn't a motorway going over it. The M6 was routed so it avoided the salt area, which is what is shown on there. The M56 was routed to avoid the salt area as well.

58. THE CHAIR: But there's plenty of trunk roads. There's the A56 and A65. I'm getting old; I can't read it.

59. MS MUMBY-CROFT: The A56 going across it.

60. THE CHAIR: Thank you, you can read it. But you've got lots of roads going over.

61. DR TODHUNTER: Yes.

62. THE CHAIR: So I'm just trying to, in my head, understand what's the added risk of a railway versus a road?

63. DR TODHUNTER: It depends where you put them.
64. THE CHAIR: Right.
65. DR TODHUNTER: And also the roads, you can easily top up the tarmac of them and things like that and the roads are not going over active salt sink holes where the railway is.
66. THE CHAIR: Right.
67. DR TODHUNTER: And that active salt sink hole, which is approximately under the intersection of the HS2 line of the 'a' and the 'l' in salt is connected, is where the fresh water is hitting the salt and that salt is exiting underneath Northwich and it's what called a brine run, and I will get on to explain those later.
68. THE CHAIR: Right, okay. You understand the question though?
69. DR TODHUNTER: I do, yes. I do, yes.
70. THE CHAIR: Because if lots of it has been built over in other things, I wonder why a railway is more of a risk versus a B&Q or a housing development or a road. But, Holly?
71. MS MUMBY-CROFT: Yes. Just to check, so underneath where the HS2 line goes, that's going over active areas of concern.
72. DR TODHUNTER: Yes. In that red dotted line, that is the wet rockhead and there is the potential for – there is active ground movement taking place now.
73. MS MUMBY-CROFT: So that's active ground movement within the entirety of that circle but there are some areas that are even more concerning within that circle.
74. DR TODHUNTER: Within that circle and I will cover two particular areas that I'm going to cover as examples. This has been discussed from January 2013 onwards with HS2, so they are very aware of this. This information has been readily available to them and it's volunteered by lots of other people. Right. Where was I now?
75. THE CHAIR: Yes, sorry.

76. DR TODHUNTER: Right, as I said, that my interest, it's because I'm a geologist and because I talk to everybody as well and it's really talking to the local residents. They have an incredible local knowledge of the salty, unstable ground and their knowledge is based on generations of people working in this industry. So I was only talking to the chap who came round to sort our damp-proof problems out and his grandfather was in charge of the last mine in Northwich that collapsed in 1928 and the ground round there, under the Lion Salt Works, is still subsiding.

77. So they've got this knowledge from living and working in the salt industry on and among the very obvious unstable ground. Salt has been exploited, as I said, continuously over 2,000 years in mid-Cheshire, and it's currently being exploited and it will be continuing to the future. Admittedly, it's currently being exploited under what is called, 'controlled brine pumping', which is these big cavities which surround us in our parish.

78. So over the 10 years, as I said, since the announcement, this considerable local knowledge has willingly and readily been passed over to the promoter by a great number of local residents and parish councils. We will continue to pass our knowledge on, because we're always concerned about the safety and I think it's because they've had generations of people living in a town where the houses are built on rafts; the older houses are built on wooden frame, so when one side goes down, they can jack it up again. I mean, it's very worthwhile coming to have a visit in Northwich, and we are worried about the safety of the structure and the operation of the proposed rail route and the passengers on it and those of us living and working and farming beside it, on it and beneath it, because HS2 is going across the active salt mine.

79. Hence Lach Dennis and Lostock Green Parish Council, in the heart of the massive Cheshire salt basin where the salt is at its thickest, surrounded by the active salt solution mining of Holford brine field, deemed it very necessary to appear before the Select Committee and we're pleased to be here.

80. So if we now go on to slide number 4, please, which is very similar to the slide that Mr Strachan showed before. And this one is showing you our parish boundary here. So I haven't outlined the boundary but I think you can see, where I've put HS2 –

81. THE CHAIR: It's the black line.

82. DR TODHUNTER: Yes. HS2 within where it's solid is the parish boundary. So we abut lots of other little parishes as well. However, our parish covers an extremely large area and, within it, is a population of 600 or so people, about the same number as you have here in the members of parliament. It has two villages, each of less than 200 people. There're isolated farms and there're small groups of properties. So if you look – well, I'll get to that in a little bit.

83. The two villages are Lach Dennis and Lostock Green and I don't know how to make the pointer go on this thing here but Lach Dennis is in the middle, down a bit to the right. And Lostock Green is up again, if you head north towards – that's it. There's Lostock Green. It's split by the existing A556 and by the route of the proposed HS2. The two villages are Lach Dennis and Lostock Green.

84. The proposed temporary workers' accommodation between Penny's Lane and King Street, which is – if you go a little bit to the left now until – and then. That's it. It's sort of down a bit there. That will do. It's somewhere round there. There is the Gadbrook Viaduct North Satellite Compound, which will have 150 or so people living there when they're building the scheme and that represents an equivalent extra village within our parish, increasing the population by about 20%.

85. The HS2 route particularly impacts and goes through the village of Lostock Green, if we can look back at that slide again. And, as I said, Lostock Green extends either side of the HS2 line and it is a big severance of the village for our main access in and out, both by vehicles and by foot and bicycle and horse.

86. So if we now go on to slide number 8 that we had before. As you can see, our parish includes a vast array of industrial installation and activities, above and below ground, on and adjacent to the high-speed rail route and construction area. A lot of these activities, well, all these activities, are connected by an underground network of pipework that's going on. These are the major underground extractive industries, as I said: salt solution mining; there's the major chemical industries; there are COMAH sites, Control of Major Accident Hazards registered sites. The green star as you come down the furthest north one is the one that's nearest to the line and it's within the area that's required for construction in the pink areas that we see on the plans. It's also got within the area, there's the nationally strategic underground gas storage industries, the

nation's energy security gas reserves; there's Storengy; there's Keuper gas storage, and this is where I've got this map from, from their planning site, this is their map; and the undeveloped King Street Energy gas storage, which has now been sterilised, which is the most north-westerly of those stars between the original 2013 route and the 2017 route. So that remains sterilised. So that, because it's going to be constructed over, they won't be able to create the cavities underneath it. If we'd had it developed in 2013, we would have had maybe two weeks' supply instead of nine days' supply of gas storage when the Ukraine war broke out.

87. So there's underground waste and hydrocarbon storage; there's hazardous substances from a wide variety of chemical processes such as carbon tetrachloride, ethaline residue, lead additive for petroleum and Second World War aircraft fuel. These cavities have been developed from the 1930s onwards and the ones that are no longer in use is where the waste goes down. Some of them are very close to the route and will be in the area that is going to be crossed during construction.

88. THE CHAIR: What was the World War II aircraft bit, sorry?

89. DR TODHUNTER: Sorry, Second World War aircraft fuel.

90. THE CHAIR: Right, okay.

91. DR TODHUNTER: I think it was American; they stored it. So we've still got two cavities full of that and in Plumley they've got more, more of these cavities full. So if you run out of oil, we know where to go.

92. THE CHAIR: Exactly.

93. DR TODHUNTER: Right, sorry. So as you can see from slide 8, there's an awful lot going on in the parish of Lostock Green and Lach Dennis' own back yard and we're always concerned about what goes on in our back yard, with regard to the safety and we've got COMAH sites and all that and the risk to the environment. We're very aware of safety and the risks to our community's wellbeing and we certainly wouldn't want a ground collapse under the HS2 railway as it went through our back yard, not on the way in or the way out.

94. The parish council emphasises to the Select Committee that it's the responsibility

of the decision makers on the route of the high-speed rail scheme to establish the safety risks of the high-speed route, decide how much needs to be spent to mitigate these risks and to estimate the cost to ensure the high-speed rail scheme is safe during the 10 years of construction. And this is my concern about all this underground pipework that is within our area and the 120 years of lifetime of operation in the face of our current catastrophic climate breakdown.

95. Right. Now this is where we consider that we need to consider the route choice. And so if we go back to slide 2 again, please, and the parish council notes that the significant negative impacts of the HS2 scheme on our parish are a direct consequence of the original pre-2013 route choice of HS2 from Crewe to Manchester. And this slide, as I've explained before, shows the HS2 route across the Cheshire salt district. So that's the wet rockhead, within the red dotted lines, and the M6 route, which when in the planning took – made sure that they avoided the salt district.

96. So the HS2 route emerges from a tunnel 40 metres underneath Crewe, goes due north through the unstable ground and the heavily industrialised Cheshire salt district, then takes an abrupt right-angled bend to the east to the Manchester Airport and then an abrupt right-angled bend to the north and enters the tunnel to get to Manchester. We assume as the high-speed train leaves the northern portal of Crewe, it will be slowing down for the first right-angled bend, and I think it was shown that on the plans. It gives speeds along the line and does show it slowing down. We also note a slow speed would be a safety measure for the high-speed trains as they travel across the unstable ground of the Cheshire salt district.

97. The consequence of choosing the current route north of Crewe appears to be a slower speed train on a route built at a high cost to protect it from the ground instability and a route that has both now and, in the future, potential climate-drive ground instability and leaves an expensive 120-year legacy of levelling-up maintenance of the railway track. The selection procedures for the HS2 rail line the Select Committee are considering today, were not followed with due diligence. There were omissions in the data gathered and hence the route selectors were unaware of the presence of the salt reserves, the salt geohazards and the salt-based industries. We have brought this up repeatedly.

98. Slide number 8, we're back on there. The route selection procedures used by the proposer require the identification of mineral reserves of any potential routes. The salt mineral reserves were not identified on the 2013 preferred route. And I'll just bring in here that the, 'Understanding the Ground Risks Report in the Cheshire Plain', that was published on 3 March, mentions the post-2013 route choice but we consider the pre-2013 route choice is where we've ended up with the route that we've got now, what happened.

99. So the high-speed rail main report of the appraisal of sustainability in July 2013, and I can give you these references, page 84, paragraph 5(13)(6) on mineral sites states, 'At this stage, the appraisal of sustainability concludes that the western leg would not sterilise any designated mineral reserves'. This report also states in paragraphs 4(3)(1) on page 42 under, 'Planning and Development', that 'In selecting the route, this study has reviewed major proposals for all types of development, including major minerals and waste management sites, including both new and extended sites.

100. So using the basis for the route choice set out in the main report of the appraisal of sustainability, July 2013, HS2, via their consultants, Temple ERM, should have identified the widespread extractive salt industry that has been going on continuously for the last 2,000 years. The salt mineral reserves that were being exploited pre-2013, and also were being exploited in 2013, and continue to be and are currently being exploited and will continue to be exploited, especially if we want our sterilised water in bottles or our bleach to go down the road, as I said.

101. Those that chose the 2013 HS2 route north of Crewe, up to ministerial level, were not aware that the salt reserves and associated ground stability geohazards, were on and below the preferred route. A further HS2 document published in May and in September 2017, as it went through its various updates, also confirms the critical data admissions with regard to the Cheshire salt district. This was the consultation route technical note C320 Cheshire Salt Area Review and its paragraph 4, page 16, that states: 'Options considered in the initial preferred route and the 2013 consultation route, it is worth noting that considerations of salt and other geological risks were not explicitly considered at this early stage of option development', in spite of the appraisal eventually saying that they should have been.

102. So we have what we have, the route before us today. The delay in the HS2 scheme due to the alteration of the route in 2016 was due to that poor choice in 2013; the cost of the early ground investigations that don't usually take place until later in site development; the expensive mitigation and future maintenance that would be required to lessen the impacts of the geohazards; the cost of compensating the sterilisation of salt mineral reserves and the chemical industry's feed stopped; and the sterilisation of energy secure gas storage.

103. We in Lostock Green Parish are well aware of the route chosen, that we have to live with, and with the consequential negative and unpleasant effects on our community and wellbeing and connectivity. I repeat that the parish council and our residents' concerns have always been about safety. The parish council's opinion is that the current route of the high-speed rail infrastructure north of Crewe should be re-assessed and re-routed between Crewe and Manchester to avoid the salt district of Cheshire or an alternative route should be considered from Crewe to Manchester for high speed trains that utilise existing rail lines.

104. So I will now go on to community isolation and wellbeing. So we'll change back to slide number 4, please, which shows our parish. The slide is based on the public footpaths in our parish.

105. THE CHAIR: So just, Dr Todhunter, in terms of the issues with the geology, you have made your points on those and you're moving on to – I just want to be clear where we're –

106. DR TODHUNTER: Right, I'm moving on – I haven't made my issues about geology. I've made the parish council's issues about route choice. I'm now going to move on to community isolation and then I will cover the poor ground conditions after that.

107. THE CHAIR: Right, okay. Just so we're clear in our head, because it's very useful for us if we know what it is the petitioners are asking from us, what the actual asks are, in terms of what you think the solution is on any of these. I just wanted to be clear where you were on the – because obviously we've been spending a lot of time talking about the extractive salt industries and the ground conditions.

108. DR TODHUNTER: Yes.

109. THE CHAIR: So if that was the conclusion of your comments on those, I was going to ask you, what is it that you're looking for?

110. DR TODHUNTER: No, no, we're talking about the conclusion on the route now.

111. THE CHAIR: Right, okay.

112. DR TODHUNTER: And then we'll –

113. THE CHAIR: Sure, no, I just wanted to be clear.

114. DR TODHUNTER: Yes, right.

115. THE CHAIR: Just in case it was the end of that, that I was clear what it was you wanted from the Committee.

116. DR TODHUNTER: Yes.

117. THE CHAIR: But obviously if you're going to come back to that, or continue that, that's fine.

118. DR TODHUNTER: Yes. I mean, this is going to be lengthy because there's an awful lot happening in our parish. It's a large area but it's a very important area for the nation in supplies and things.

119. Right, so slide number 4, which is showing the footpaths, I said, and where we are. There is a large concentration, a wide range of negative impacts where the section of the HS2 high speed rail goes through our parish. Firstly, it's the community isolation and wellbeing is illustrated by this slide here because you can see we've got the two villages, especially Lostock Green and Lach Dennis, and it's actually the social capital of our communities. Our community vitality and wellbeing depend on us getting out and being able to connect with others outside the community, our residents' accessibility to community facilities and community resources that are not available within our parish. We have a pub and a couple of churches and that's about it really.

120. The promoter has engaged with the parish council and residents at formal consultations since January 2013 route announcement, and this is something that we

want, is better communication. However, direct engagement by HS2 face to face, with the parish council, has been poor and infrequent. HS2 has never attended a public parish council meeting, in spite of being promised it by Raj Chandarana who was the first north-west engagement officer, way back in 2013. Engagement has, and continues to be, initiated by residents or by parish councils on their behalf, with HS2 only responding when contacted. I must admit, there's been an awful lot of contact in the last month, initiated by HS2. As a consequence, the parish council considers the proposer fails to appreciate the impact of the scheme on the community character, culture, cohesiveness and connectiveness and the way of life in the parish.

121. Slide 4 shows that the community facilities and resources are only available outside Lach Dennis, such as public transport, shops, pharmacies etc, in the nearby community of Lostock Gralam. Now, Lostock Gralam is to the – there, there's Lostock Gralam there and that is where the shops are; that's where the chemist is; that's where the railway station is; that's where the school is; that's where the fish and chip shop is; that's where the hairdresser is. It's been going – Longworths has been going for 70 years and people have been walking across to Longworths for 70 years to get their hair cut and they want to continue doing that. And also the other place we go to is Broken Cross, which is down about the roundabout there and also Rudheath, which is that area to the left of it, which is the beginning of Norwich area there. So that is where – we haven't even got our nearest doctor on there. The nearest doctor is actually off that map there.

122. So the village of Lostock Green is the closest community to the proposed high-speed rail line and is already divided, as I said, by the A556 Shurlach Road dual carriageway trunk road and the village will be further split by the wooded raised embankment barrier carrying the HS2 high speed line. The nearest public available community facility is Lostock Gralam railway station. Access on foot and by bicycle is crossing the existing A556 trunk road and will be the proposed HS2 route. This will prove to be very difficult during the six years of construction and once HS2 is operational, only by proposed lengthy diversions and we've already had one that's come, an extra proposed extremely lengthy diversion, which came in a letter on 14 July, that my colleague here has shown already on the slide.

123. So the parish council were pleased that there was an opportunity to discuss

severance during our 60-minute online meeting with HS2 staff on 4 April. However, the parish's community isolation and community wellbeing issues have not been mitigated, or solved, by HS2's promoter's response document or that short meeting. To prevent community isolation, and maintain community wellbeing, during both the construction and the operation of HS2 high speed route, the parish council wants the proposers to maintain the shortest connection between Lostock Green southeast and Lostock Green northwest.

124. During construction, communication and engagement will be critical to prevent community isolation and maintain community wellbeing. The impact of the construction phase of HS2 planned around our parish from early 2025 to late 2031 will be unavoidable.

125. So if we now go on to slide number 5, please. Right, this is showing you, we've seen this one before and I've amended the HS2 document. So I've put where Lostock Green is there and north is to the right so we're looking east and west across the HS2 line. Broken Cross and Lostock Gralam are our two nearest community facilities, basically. So the impact of the construction phase will be immense.

126. The parish council wants to know what to expect specifically during the construction with regard to engagement and communication from HS2 and their contractors. What is the experience from the HS2 Phase One and Phase Two construction engagement that's going on? How effective is the engagement between the residents and HS2 and their contractors? What are the likely issues raised through engagement during construction? How often were the issues raised? What is the likely resolution success rate? Were acceptable resolutions reached via engagement? What were the most common issues and the most difficult issues to be resolved? Specifics please: we want to know what to expect. We want to be prepared.

127. So I will now go on to the poor ground conditions and the geohazards, surface water, ground water, flooding, ground stability. The parish council welcomes the preliminary report on Understanding the Ground Risk across the Cheshire Plain dated 3 March 2023. However, the parish council are disappointed that HS2's ground model has only been available in the public domain for just over a month, at this very late stage in the development of the high-speed scheme. For several years, the parish council, our

MP Esther McVey, and others have repeatedly requested HS2 for information on ground conditions and geohazard risks. For several years, HS2 have repeatedly replied that the information on the ground conditions, ground investigations, would be available.

128. Why has this information only recently been released at this very late stage for the whole project, planning, design and Hybrid Bill process? It's 10 years since January 2013 and the route announcement. Why was there nothing on the hydrological/geological information in HS2 2B's environmental statement of January 2022 or in the working draft statement of October 2018, I think it was? Hydrological and geotechnical information was included in HS2 Phase 2A's environmental statement of July 2017 in volume 5, the technical appendices.

129. In the last six weeks, the parish council has reviewed, 'Understanding the Ground Risk across the Cheshire Plain', document and concludes that the report gives an initial assessment of ground conditions and we're pleased about that, of Cheshire Plain, but needs more development and clarification and understanding of the challenges. Again, our particular concern is the lack of information on specific geohazards in our parish. The parish council expected the HS2 document, 'Understanding Ground Risk across the Cheshire Plain', would demonstrate that HS2 have a robust ground model at the standard level of ground investigation, application of engineering geomorphological assessment, as covered in the recent publication by Roger Moore et al. 2002 regarding HS2 Phase 2A, titled, 'Engineering Geomorphology of HS2: Management of Geohazards'.

130. I would like to draw your attention to the abstract of this paper. 'Development of robust ground models is essential to ensuring that geohazards are mitigated during design and a scheme is safely built and operated. To support this aim for HS2, an engineering geomorphological assessment was undertaken for the Phase One and Phase 2A route between London and Crewe. Fellow authors were employed by HS2 on this paper.

131. As yet for Phase 2B, the first ground investigation report, 'Understanding the Ground Risk across the Cheshire Plains', shows that HS2 is still at a very early stage of developing robust ground models for the HS2 Phase 2B, across Cheshire, north of Crewe. The parish council were disappointed that safety concerns with regard to the

unstable shallow water bearing unconsolidated ground were not addressed in that document.

132. The parish council and local residents, neighbouring residents and neighbouring parish councils have repeatedly raised safety concerns regarding the subsiding ground and deepening depressions on the flat ground in our part of Cheshire Plain, both associated with salt and with other reasons. The running sand as a potential hazard, particularly as this was a problem challenge during the construction of the A556 Northwich bypass in the 1960s, at the existing A556 Wade Brook Viaduct, and that is –

133. THE CHAIR: Sorry to interrupt, what's running sand?

134. DR TODHUNTER: Running sand, it's – you know when you go to the beach and you build the sandcastle and you add some water to it and the sand all runs down the side of it, it's that.

135. THE CHAIR: Right.

136. DR TODHUNTER: It's sand that's got a very high water content and when you dig into it, it runs into the excavation. The farmers around here know when they dig – around here, well, not around here – I mean around in our parish, know that when they dig through the clay capping, they'll meet this running sand and if they want sand for their building, it's just run in because you go through the clay capping and you've got a water saturated sand that runs in. So any excavation in the ground has got this running sand.

137. So the problem is this: the Wade Brook A556 Shurlach Road existing viaduct is the site of the HS2's Wade Brook viaduct which is going across there and also the, I think they call the Lostock Gralam north and south embankments. Those footings are going to go on the junction where this running sand is. And what occurs at this – the running sand is below a layer of clay capping to the top of it. Where the valley sides cut through this clay capping you get a spring line and sand runs out and spreads at the spring line. They're all along the valley sides of the Wade Brook that runs through our parish and similar along any valleys also in the mid-Cheshire area, the River Weave and the River Dane, the River Wheelock.

138. So these comments are readily available for reference in the responses that have been submitted by residents of the parish council to the numerous HS2 consultations that have been between 2013 and 2022. I do advise these are relooked at, as I have done frequently, advised the geotechnical engineers I've met from HS2 to do the same.

139. The parish council wishes to make sure that the Select Committee is fully aware of our concerns and why we want the proposer to resolve those concerns by providing information that demonstrates a thorough understanding of those concerns, that the promoter produces designs and proposals that will mitigate and prevent the likely adverse effects due to flooding, ground instability and geohazards within our parish boundary during the construction and the operation of HS2 high-speed rail and in the face of climate change as well.

140. I'll give you an example of our concerns, slide number nine, please. I've got 17 slides to go through, so we're about halfway. This one here is a geological one, so the rather nice, it looks like a Neapolitan slice of ice cream, doesn't it? However, the pink ones are sand and gravel. The nice pale green ones is the clay. The sand gravel is dipping from the east to the west and so it's covered over by the clay. Now it does look very complicated but you can see where HS2 is going through it.

141. I've marked on where Northwich is left hand, Winsford bottom left hand and Middlewich and Lach Dennis and Lostock Green Parish Council is roughly where the pointer is now in that middle bit there. So the Cheshire plain east of the River Weaver – now, the river valleys are full of recently laid down river alluvium, which is marked on that map as yellow. This comes from the British Geological Survey website.

142. So the River Weaver runs from where it says HS2, bottom left. and it goes past it, follow that yellow line up to Northwich. Then it joins into another one that there and then the River Dane, you can go upstream the River Dane by following that yellow one all the way back up there.

143. So the River Dane and the River Weaver are those ones and our Wade Brook is the thin yellow line that's going to those little red semi-circles are where we've got land slips taking place. Where we've got issues of these springs coming out. It actually says on there, 'Ground surface sags, liquefaction of sand, artesian aquifers,' is what those little red bits are. So you can see there's some up where the HS2 crosses the Wade

Brook there and there's another one down here where this is the Dane Valley viaduct that you've got down there, Bank Farm, which there was a collapse in January 2021 along there.

144. Right, so the Cheshire Plain east of the River Weaver, the ground surface subsidence occurs due to settlement of the water saturated sand and it's in a confined pressure, that means pressurised artesian aquifers. You've got a layer of sand with clay on top of it and the water has always been surcharged by the rain clouds between basically Macclesfield, which is just north of Chelford, down to Holmes Chapel and Sandbach. It rains there, that water goes into the pink area which is sand gravel and it goes underneath that clay capping and so it makes it pressurised. So it's always being topped up.

145. So if you dug a hole down the water and the sand would raise up. Every borehole, and of course I haven't seen the results of the boreholes because it's not been made available to the public, but you usually hit water and then the water level rises in the borehole because it's an artesian aquifer. So you've got this pressurised artesian aquifer in the sand.

146. THE CHAIR: Can I just –

147. DR TODHUNTER: Sorry, I know I'm going –

148. THE CHAIR: No, no, no, not at all. No, as I'm heading towards my Open University degree on Geology, I want to be very clear. It is actually interesting obviously, but you previously showed as the slide which had the wet rockhead versus dry rockhead. The wet rockhead underneath that was the brine and the salt, so the salt brine deposits.

149. DR TODHUNTER: It's the solid rock salt, yes, you've got there.

150. THE CHAIR: But here obviously you're talking about we now have running sands, so I'm just confused. Because I thought the principal argument for putting it in the simplistic terms that we politicians require, is obviously that the ground is prone to subsidence, and it's prone to subsidence as a result of it being built over this wet rockhead I think was what you were saying.

151. DR TODHUNTER: No, right, yes.

152. THE CHAIR: Okay. Good. Right, you're going to correct me there. And then I understood that the ground condition you were concerned about was this salt brine issue. Whereas this seems to be – so if you can just explain the difference just so I understand it.

153. DR TODHUNTER: Right, so there are two ground conditions, and I'm doing the one that's as you dug your way down through the ground, the first one you would hit. So if you go back to slide three, which is that slice through the cake. I think I said when I was explaining that, that rockhead is the junction between the solid rock. So what you've got is a slide just showing solid rock, which is a solid rock with a mudstone and the solid rock of the rock salt. And what is missing is above solid rock in most of Britain north of Birmingham, I think you get unconsolidated deposits.

154. I was brought up around here, so I'd go to the Chilterns, you'd see white chalk at the surface. To get down to see in the red mudstone and I'd have to dig a hole 14 metres down before I met it. So, because in most of Britain to the north or most of Britain really, is covered over by material that was laid down by the ice. It either brought in clay and then when it melted it spread layers of sand and gravel. Those are the things that you see when you take off from the airport a Heathrow. You go across big gravel pits. Those were laid down when the ice melted.

155. So what we've got on this cross section here, we've got that covered with a mixture. It tends to be clay first brought in by the glaciers. They melted and deposited sand. Then the glaciers came back and deposited a bit more clay on top of that. Then as it melted there was sand and gravel, so it was quite a mixture.

156. But in our area of Cheshire there's a lot of sand and gravel covered by a layer of clay. So when you look on the surface you think you've got clay land, but underneath it you've got this water saturated sand. It's like a water mattress that bounces. Because it's under pressure – say it's probably about 30-40% empty spaces with the sand in it – so when it's under pressure the sand actually settles down through the water and you end up with concentrated sand at the bottom. Like you do, going back to the beach with the bucket of sand and you shake it out. The sand will settle out. Then you have an empty water-filled space. And, of course, the clay above is not supported, so it sinks

down.

157. I'll give you example, so we've got this subsidence that is in the unconsolidated deposits above the rockhead, and we've got the salt subsidence in the solid rock below the rockhead. And, of course, you can get them combined together. So what we've got in Lach Dennis Parish Council and what I'm talking about is under the abutments of these viaducts is where the rivers have cut through the junction between this protective layer of clay and you've got the sand coming out. So that means the clay is sagging.

158. At the back of our house between us and the nearest brine well, we've got a depression that was filled in 31 years ago. It was a pond that was filled in 31 years ago. It's now two metres deep. So if you work that out, that's 60-70 millimetres it's gone down. It's gone down particularly a lot from when we started having these named storms, when we were getting a much wetter environment. So it's really sunk. These occur all over the Cheshire plane. So they're present as well.

159. THE CHAIR: For us to just understand what we're dealing with, the contention is that due to this less than usual ground condition with more sand than in some of the parts of the country that we have effectively spongier ground upon which building of these viaducts and the support mechanism, all the rest of it is at risk, in your contention because of the nature of the ground here of sinking.

160. DR TODHUNTER: Right, yes. Well, we're aware it's a risk and we want to make sure that HS2 are aware of the risk because it's our area and our roads that we'll be using and the line running through that's got danger to us. So we are concerned that this hasn't been picked up as yet by the geotechnical thing, so that's why.

161. THE CHAIR: We get that, because obviously we're very clear, because I'm conscious of time, because we've got to let HS2 respond.

162. DR TODHUNTER: No, I know.

163. THE CHAIR: It's not criticism, it's just that we have a limited time for today's Committee, but it's really important that other members understand what the ask is. I think taking from that, just to be really clear on the ask, then, your ask, as it were, is that you have a deeper engagement with HS2 around the technical work, that you're able to

contribute or respond to that and that their mitigation plans are shared with you early for comment. Is that the ask?

164. DR TODHUNTER: No, I think our thing is –

165. THE CHAIR: Right, I'll scribble out what I wrote.

166. DR TODHUNTER: I think our thing is that we feel that HS2 by now, after 10 years, should have a thorough understanding and really what we'd like is them, well, I'm going to say do a better job, basically, and maybe contact some of these people. It's just taken such a long time to get this understanding across. I feel the amount of stuff that we've been putting across is there already.

167. THE CHAIR: Is it that they aren't doing the work or that they're taking too long to do the work? Doing the work –

168. DR TODHUNTER: It's because not showing an understanding of it, and therefore we are concerned that they won't get the understanding of it. Then it won't be designed adequately, you see. But I'm confident the people we talk to will get the understanding.

169. THE CHAIR: But this is your concern, okay. I understand that. Holly?

170. MS MUMBY-CROFT: Mine is very quick. Is there some residual concern because of the change from 2013 to 2017? Obviously, stuff must have been learned in between those two.

171. DR TODHUNTER: I know it's not in our parish but I was quite shocked that the mine was pushed into an area that was more dangerous from sinkholes. It avoided the salt brining, the controlled brining area, but it was pushed further over the salt mine. It was pushed over a flooded sinkhole called Billinge Flashes, which is tied into these brine runs that are still operating where there's current subsidence going on. There's been papers published on this recently that I was going to cover.

172. I know there's a lot to say, but I do feel that we haven't had a chance to air this. I'm willing to come back and do more of this, but I do feel like I need to complete all of this.

173. THE CHAIR: I wasn't cutting you off immediately. I'm just saying that this Committee ends at 7.00 today.

174. DR TODHUNTER: I know that. We've got to train to catch at 7.33, and we've come on the cheap advance ticket, so we can't – we have to catch it.

175. THE CHAIR: So I wasn't asking you to end then. I was just encouraging you to ensure that we've got enough time for HS2 to respond. But also, in so doing in your comments, as you do reach the end, it's that we understand exactly what it is you're asking from us as a Committee.

176. DR TODHUNTER: Yes.

177. THE CHAIR: Because it's all very well explaining technical terms, which is very interesting. The issue, but what we also really need, or especially need to know, is what is the ask from this Committee that you want us to make a determination on?

178. DR TODHUNTER: I do think you have to understand the technical terms, because it's no good saying that the route is built on solid salt all the way through because it isn't, you see. It's not built on stable ground all the way through and therefore we want to make sure that that is across.

179. THE CHAIR: Artesian aquifers, they are emblazoned on my brain now. So you've definitely got the technical thing over to us. Don't worry, I do understand where you're coming from on it. It is important.

180. DR TODHUNTER: It is safety. I think the safety, and I think if you go and talk to people in town, they say – people are speechless. 'Don't they know there's 200 brine wells here?' 'Don't they know it's going through these things?'

181. THE CHAIR: Of course.

182. DR TODHUNTER: Having lived with it for generations, I think this is where we're getting. We want the Select Committee to reassure the residents of the mid-Cheshire area that it is safe.

183. THE CHAIR: Which is why it's important for us to know what it is you want from HS2 to ensure that we can satisfy that they're safe and that this – the last thing any

of us wants is obviously anything with the lines.

184. DR TODHUNTER: Right, so we've still got this slide up here. So really what you've got to put across there is like an area that's made out of the unconsolidated deposits and this is where the running sand is and this is where things are settling. So where have we got to?

185. THE CHAIR: You had the picture up with the three-colour coded from the British Geological Survey.

186. DR TODHUNTER: That's it, right. Okay. So, right, now, I said my concern is that this water and sand springs occur on – again it comes down to specifics. The proposed site of the HS2 Birches Lane compound, and this is slide number nine, which is a again back to the interesting coloured one. So if you move along there you can see those red marks, where those red crescents are. That is where the ground stability is.

187. So actually if we go to slide five now. So the pink areas are the areas required for construction. The bits that I'm concerned about, you can see where it says Lostock Green. Where the 'n' of green ends, to the right of it, there's a brown area and an orange area. That area is the Birches Lane compound. It's in the enclosure known on the tide maps, the Cheshire tide maps as Wellfield because it's where this artesian aquifer is and it's coming out. This is where Lostock Gralam used to get its water source from.

188. And it's upslope of number one, the bungalow, Birches Lane, which is on the spring line and it's got its spring-fed watercress beds there. Now, that is the problem because what you're doing is you're putting your compound and if you put your spoil mound there, you're loading an area of ground that you already know is a bit like a waterbed. So you know, water mattress, so when you put it on, it bulges out at the side.

189. MS MUMBY-CROFT: Is that because the sand is wet and the bolder clay is on top?

190. DR TODHUNTER: The bolder clays is on the top. And in some places they go down a slope, it would be straight onto the sand. It would push the sand will compress down and then if you compress something down it bulges out at the sides, you see. And

of course there'll be the bungalow downslope of that and the stream downslope of it as well.

191. These are very specific but they are our concerns and the owner of the bungalow had consultations with a compound manager of HS2 and I think there was some redesign of that as well. There's also, as I said, the Birches Lane North, so where it goes from the 'N' of green and it's heading up towards Lostock Gralam, that's Birches Lane North. It goes across the Wade Brook to the station. As it goes down, it cuts through this spring line. The slopes either side are running down the road continuously, because the spring's issuing the whole time.

192. I'm very concerned at the moment because the trees are like that and one of the trees has being killed by the latest brine spill we've had. So it's a mature tree that's going over like that on an unstable slope. How this affects you, this is the HS2 construction slope, the construction route.

193. MS MUMBY-CROFT: Could that cause a landslide or something?

194. DR TODHUNTER: That is what happened. The footpath is half covered over because the land is already slipping. So as soon as you add water to a slope, the ground, the angle of repose decreases, you see. So it's on both sides of that and there's a very narrow bridge to go through and it's also – the HS2 is the haul road but also you can see on that pink bit there. If you go up from the orange bit, that bit there, if you go straight to the north-northeast, you get some pink lines going across there. There's some internal haul roads. Those are actually following the spring line. So they're going along a slope that's already got instability. This has gone in the parish council's response to the –

195. THE CHAIR: The petitioners?

196. DR TODHUNTER: No, probably not to the petition. It has gone to the petition and it's gone into the environmental statement as well. But there's no mention of it in the understanding ground thing. This is where, because it's not mentioned, we're not aware that they've taken it into account and there's potential hazards. They're on either side, as I said, the Wade Brook viaduct and the Lostock Gralam north and south embankment.

197. We'll now look at slide 10, please, which is I've adapted a cross-section plan. We've been asking. We had cross-sections for the 2013 route, but we didn't have cross-sections for the 2016-17 route until the environmental statement, which was January 2022. So it's very hard to visualise some of these things. Now, that shows you the bit at the top is probably the best bit to enlarge. At the bottom you've got the information on how high things are going to be. So what you've got here is the Wade Brook viaduct and you've got the railway line going over the top. The little dotted green line is the present ground surface. I have used boreholes that have been on the British Geological Survey record site that tell you what is in there. So it shows the ground conditions.

198. And what you've got is that it shows you the blue dotted areas is meant to be clay and it's got cobbles in it. It's a common name for it; it's called boulder clay. So it's the moraine from the glaciers. Then underneath it, the yellow thing is the sand. And so what it's showing you that actually where the bridge abutments are, they're actually putting on the spring line. This is something, one of the concerns is there be surface and slope instability in soft, weak ground conditions due to outflow of artesian water and saturated sand from aquifers at the spring line here. So this is our concern. We want to make sure this thing is going to be built safely, so when, us living next door to it, and the road as well have to be that as well.

199. So we're now, if we go back to the previous one, which was number nine, this is when we're looking at the bottom left-hand section of it. It's where I've written in red, I put, 'Ground surface sag from liquefaction of sands in the artesian aquifer'. This occurred in January 2021 when a new spring issued and a sinkhole formed and a farm track collapsed with spreads of saturated running sand at the location.

200. It was very near Bank Farm in Bostock, and I know that members of HS2's geotechnical team went out and inspected it. Saturated sand, it's the location of the proposed HS2 River Dane viaduct support. It followed a period of very intense rain. This again is bringing the resilience for climate change as well. So there's an awful lot. I know we're only a little parish, but we do have an awful lot of things going on nearby. And this is what Winsford Town Council, etc, or Bostock, I can't remember which parish it is in, should be bringing up.

201. It's over the salt mine and in that area there's a borehole on that same location

drilled as an exploration bore off the salt mine. And it is on that exploration borehole and it was built in the 1960s. In 1968, one of these boreholes which was poorly backfilled and there was a flood of brine into the salt mine. It is admittedly not in an area that's currently working, but there is already an existing holes in the ground and there's four of these boreholes on the line of HS2 over the salt mine. But it's not our parish thing to bring up really. But I've put it in passing and HS2 have had this information.

202. I did talk to the mine manager and he wasn't aware of the spring line that took place where his borehole was. Right. So I think we've had enough of that. I think the final question about ground stability is what surface level measurements and monitoring have been taken and are being taken, and how long will they go on for and will they go on to 2106, which is when the lifetime of HS2 is meant to be 120 years. So that's approximately, I think if it's working in 2040, it makes 2126. Because what's going to change is the hydrology of that saturated sand as we get a change in the whole water cycle due to climate change.

203. Right, so Lach Dennis and Lostock Green Parish Council, have concerns on the consequence of climate-driven changes in groundwater aquifers and brine run regimes, which occur very close to our parish boundary and the other side of King Street. This is where I feel that I have to bring it up. I know it's not in our parish council, but the area that we've got, well I will bring it up. The Parish Council would like to bring to the Select Committee's attention an article regarding risks from rock salt solution for parts of the HS2 route north of Crewe that has impacted myself and other local residents of our parish and the mid-Cheshire salt town of Northwich particularly. I know, as far as I know, the HS2 staff and their consultants are aware of this paper. The paper is 'Halite Karst Geohazards Salt Solution Risks', that translates as, in the current edition of Geoscientist, Spring 2023.

204. The author is Dr Serridge who is an engineer and geologist in specialist ground improvement industry at Birmingham University. Local residents have a thorough local knowledge of halite karst geohazards from generations and they would certainly support Dr Serridge's concluding statement, and I quote: 'persistent instability.'

205. He's been talking about, the area he's been particularly looking at is in Tatton

Park, Melchett Mere and Tatton Mere, which are basically flooded sink holes, salt sink holes and where they're connected to. 'Persistent instability, wild brine pumping in Cheshire halted in 2006.' That wild brine pumping was in Northwich. 'However, the possibility of continued natural dissolution and metastable cavities remains. Further research is needed to ascertain the precise routes for brine in the subsurface, particularly given the implications for infrastructure developments such as HS2 in North Cheshire.'

206. He also refers to a paper by himself, Serridge and Cooper, who is somebody else who's done a lot of work on salt hazards. It was published in autumn of 2022. I'm quoting from him again. 'Future changes to the groundwater regime may also impact the long-term stability of these features.' And he's talking about dissolution, metastable cavities, i.e., holes in the salt that are likely to disintegrate at short notice.

207. 'Future changes in the groundwater regime may also impact the long-term stability of these features, particularly if the groundwater cannot be satisfactorily controlled.' Lach Dennis and Lostock Green Parish Council are therefore asking the questions, can the proposer, HS2 Ltd, satisfactorily control climate-driven changes to the groundwater regime? And that's the whole thing, that is the mitigation. And we've got to 2106, if I get it right. You've got to get 120 years of the lifetime.

208. THE CHAIR: No, none of us will be here so...

209. DR TODHUNTER: Yeah, so we'll see. By then it will have changed. Can the proposer satisfactorily control the long-term stability of the natural dissolution in these salt cavities as well? Rock salt is metastable. It can change from its solid state to its liquid state in the presence of fresh water. Cavities appear quickly and unpredictably. And in Cheshire district there are known unknowns. They're known unforeseen circumstances that we get. These are known because in the construction industry when you start doing an operation you come across unforeseen circumstances. Well, these are not unforeseen. We know they're going to be there. We know anywhere within that wet rockhead the ground could, especially with a change, climate-driven change. So it's something that for the future.

210. Right, I think it is this one now, which is number 11, which looks very similar. No, number 11. So number 11 should show brine runs now. So we still got the rain clouds hanging over at Chelford, Holmes Chapel, etc. It's raining there and what is

happening, that rainwater goes into the sand and gravel. Where it meets the salt it's providing the fresh water that then hits the salt and creates the brine runs.

211. I think the most important thing there is those solid arrows which showed you the brine runs. HS2 is going where the underground water hits the salt for the first time at a place called Billinge Flashes.

212. MS MUMBY-CROFT: Sorry, I'm butting in, only because of time. So does that mean that that rock salt could be turned by that water that's flowing from a solid into a liquid.

213. DR TODHUNTER: Rock salt is turning.

214. MS MUMBY-CROFT: It is?

215. DR TODHUNTER: It is turning into brine.

216. MS MUMBY-CROFT: Okay.

217. DR TODHUNTER: So what happens is where you get the junction between the rock sort at the surface and the overlying sands and gravels that are saturated with water, if it's freshwater directly onto rock salt, it'll turn into brine. If it's freshwater mixing with brine, it will dilute the brine, it will continue dissolving the salt. And then if the brine flows away, which it does in that case because there's a deep buried underground –

218. MS MUMBY-CROFT: Does it leave a hole then?

219. DR TODHUNTER: When it's dissolved away, it leaves a hole in the ground, sags. This will continue going. It's been doing it for 14,000 years since the ice melted so it'll continue doing it until the next ice age. So yes, so right.

220. MS MUMBY-CROFT: That's those two bits, so there and there?

221. DR TODHUNTER: So it is happening all along that area there. But the ones that I've got are two concerns, is the one that's between Winsford and Middlewich and the one at Billinge Flashes.

222. MS MUMBY-CROFT: I've got you.

223. THE CHAIR: Just to be clear again, because again I am conscious of time, because I think your point is well made in that in relation to all of this, in terms of ground conditions. The contention is, or the question is, whether HS2 are aware of, have taken these into account, and if they are aware, have taken them into account, how are they proposing to mitigate then?

224. DR TODHUNTER: Exactly.

225. THE CHAIR: So I think that that's really, those are really important questions. I think just, I don't know how far along you are in your presentation, but I'm just thinking, you know, the contention is, so whether or not we need to understand in so much detail the cause of what you feel is the ground instability is perhaps less important. What's more important is your concern that there is ground instability and what are HS2 doing to mitigate that and have they appropriately?

226. So I just think that as we try and move so that we are able to hear HS2's response. Just if you could just perhaps bear that in mind that we don't necessarily need to understand how a brine run would operate. We just need to understand that there is a question around the ground instability caused by this thing known as a brine run due to the weather. And then what's, as I say, the specific challenge to HS2 is are you aware, what are you doing and how are you going to mitigate?

227. So I think if you can maybe just –

228. DR TODHUNTER: So that thing you said, 'how a brine run operates'. That's the big question I've got, whether HS2 got a good understanding of that.

229. THE CHAIR: Which is the point you have landed very well this afternoon, is whether or not HS2 are aware. And as a Committee here, probably the most we can do on an issue like that is demand and require that assurances are provided in that and that the concerns you have raised are responded to appropriately. So I think I say that just to try and – we understand absolutely the ground condition question. It's just in technical detail terms, we're not experts.

230. DR TODHUNTER: Right, so I'll finish with slide 13 on this then. Right, this is a slide from a very useful reference called Calvert, and it was published in 1915. It's a

hand-coloured cross-section north/south from Billinge Flashes, where HS2 is crossing to the area where Keele University is currently measuring the ground going down at one of these mines. The mines under Northwich – so we've got a brine run. If you go from the right-hand side where it says 'still subsidising 2023 Billinge Flashes' this cross-section here shows that the land is subsidising. That still is subsidising. Fresh water is getting in. It's hitting the top of the rock salt and it's flowing down the top of that rock salt. It's issuing naturally because the brine springs in Northwich, which issued naturally before the Bronze Age people discovered them and they're still running. And also because the ground is still moving in Northwich, salt must be being dissolved. They've only grouted three of the mines and there's an awful lot of the mines that are ungrouted.

231. One of these ungrouted mines, the Adelaide mine, is up by the Lion Salt Works. This is where Keele University have been monitoring it for about 25 years. Emeritus Professor Peter Styles of Keele University says it's not if the Adelaide mine and the Lion salts were going to collapse, it's when. When we've had the big collapse in this area, and they're probably the biggest salt sink holes in Britain, the water in the canal at Billinge Flashes dropped down and people who've worked recently in the salt industry, and the new Cheshire-owned salt works only closed in 2007, were very aware when there's changes in levels in their saltworks pumping there, that you're also getting changes in levels at the Billinge Flashes. There's enough evidence that the repairs of the canal along there, that the brine run is still operating.

232. So I was concerned when I read that report that came out on 3 March that they talked about historic brine pumping, where the historic brine pumping is 2007. There is still natural brine being dissolved and issuing. So therefore the brine run is still running. This is what the papers by Serridge and Cooper say, and they're warning it as well. So I just do advise your advice to the HS2 to get in contact with these people.

233. THE CHAIR: That was the Halite report you referred to.

234. DR TODHUNTER: Yes. So if you just Google Serridge and Cooper, they have published an awful lot of stuff on it. I'm sure your professionals here will have hopefully have contacted them as well. But there's no evidence in the report. So hence I had to bring it up or we had to bring it up. So I've still got the industry to go, but there is a lot here because there's a lot going on in our parish. I do feel we've only got this

opportunity.

THE CHAIR: What was the relevance with the industry you mentioned, sorry?

235. DR TODHUNTER: Well, actually before I go into that, I'll say in summary, to reassure and satisfy the residents of Cheshire, their communities, on the existing and future structure, there is a need by the Government to demonstrate a comprehensive understanding of the future ground risk of HS2 and the Cheshire plain. We feel that hasn't been done yet. I feel it's just failing us, you see.

236. THE CHAIR: Yes. I understand that, I mean, that has been the point throughout.

237. DR TODHUNTER: That was the aim of my bit really.

238. THE CHAIR: Which I understand, which is what the ask is. So your concern on industry was?

239. DR TODHUNTER: My concern on industry is obviously the sterilisation of it and the cost of sterilisation. Let's see. Right. It's not only us that's talked about the sterilisation. I think the big one is the King Street Energy gas storage project has proved salt reserves. So it's proved reserves there, not resources, reserves. It was sterilised and it had planning permission to go ahead and it stopped. So we've removed that availability from the nation.

240. THE CHAIR: Yes, you mentioned that.

241. DR TODHUNTER: By that route there. Also, INOVYN brine field, there's salt reserves that have been sterilised there. I don't know whether they're appearing before this Select Committee. INOVYN is a company within INEOS – INOVYN Enterprise Ltd had raised issues of sterilisation of minerals in their petition.

242. Really, the question is: what is the expected cost to the taxpayers of compensation for the mineral extraction right for those UK salt reserves within the Lach Dennis and Lostock Green Parish boundary that are now not available as raw materials for the nation's chemical industry and the nation's fuel security.

243. But the other big content with us is during construction is what is the environmental damage going to be by the interaction of the construction movements

between – and we have had replies saying, ‘We are discussing this with INOVYN.’ Well, I think we are very aware of our brine runs.

244. THE CHAIR: The construction movement, the construction works – your concern on the environment impact is?

245. DR TODHUNTER: Right, well, okay, I think the best thing is the parish council residents have significant concerns on safety and adverse environmental effects and damages from leaks, from INOVYN’s Holford brine fields infrastructure during the construction and the operation of the high-speed rail, which could be initiated, for example, by excavations and construction traffic movement. And we quote from INOVYN’s petition. They say, ‘The majority of the INOVYN pipelines that pass beneath the existing A556 are made of ductile or cast iron.’ That’s ductile iron or cast iron, ‘both of which are particularly vulnerable to vibration, increasing loads and ground movement.’

246. THE CHAIR: I see, so it’s a concern about a breach.

247. DR TODHUNTER: A breach of those. The reason why we’re concerned is because – and they’re also concerned about potential settlement and impact, because they call it themselves ‘vulnerable aged services.’ These pipelines have been in for not quite 100 years, 70, 80, 90 years now, some of them, cast iron. The ground movement from the removal of the A556 embankment and the construction of the diverted A556 road – the new HS2 embankment is highly likely to have a long-term impact on INOVYN’s existing vulnerable apparatus cast iron ductile pipework.

248. Now our residents in Lach Dennis Lostock Green Parish are within a few hundred metres of this stuff. We need to look at number five. We’ve got these 200 or so brine wells and interconnecting pipework. They’re interconnected by high-pressure brine, high-pressure water to high-pressure air to each one of them and they’re everywhere.

249. I know recently this farmer has been approached about a borehole on his land. He said, ‘No, I can’t give you authorisation. You have to go to the landowner,’ which is INOVYN. And because they have to know specifically which particular patterns in the carpet here you’re going to put your borehole down because the pipework is dense. It’s like, it is absolutely dense. It’s very sensitive.

250. So we have brine failures, and I'll just mention one of them which is on this one here, which is on the Birches Lane haul road. So this is number five. We're on that there. So if you find Lostock, Gralam railway station, which is just to the left. It's up there. And we want to come down Birches Lane. Can you see there's those two tanks? There's two symbols there. Those are full of concentrated brine. Well, one of them burst. On 19 June there was a major surface brine flood from that brine field that's coming down from that tank up there, adjacent the railway station. The brine flowed down all of Birches Lane North down into the Wade Brook.

251. It was on the banks with the land slips there, which is why we've got the dead tree because it's killed mature trees along there. The footpath, the road surface, it went down the drains of Birches Lane and this is a construction route. It went into Lostock Hollows and it flowed across the fields within that pink area. So if you look on that sign there, we've got those haulage roads coming across there. Can you see where that haulage road? If you go further up a bit, that's it. That haulage road, it flowed across there. The volume was greater than the Wade Brook. The speed was greater than the Wade Brook.

252. It rode into the Wade Brook itself and it flowed continuously for three days until it emptied those two tanks. They had to get divers in to turn the valves off. So they're very susceptible. Just 100 yards from where I live, we've got people repairing leaks at the moment, so it's been going on for decades.

253. THE CHAIR: The concern is that the construction vibrations, movements could potentially cause damage?

254. DR TODHUNTER: Are highly likely to cause damage.

255. MS MUMBY-CROFT: The stuff in the tanks is the same as the stuff in the pipes.

256. DR TODHUNTER: It's the brine. It's saturated brine, completely saturated brine.

257. THE CHAIR: That point is landed. So if I can ask you to move on to your next one.

258. DR TODHUNTER: Yes. Right, so this is, so therefore I will read out my

concerns at the end. The parish council's concerns, they were in our petition, remain unresolved. We await information from and discussion with the proposer on the prevention and mitigation of these methods of the interaction between the two operations. Remedial measures and methods that need to be taken to avoid, reduce, mitigate and offset the likely significant adverse environmental impacts from the potential failures and/or damage of vulnerable brine field infrastructure during construction and during operation.

259. The brine field structures will fail. There's several failures a year. So they'll fail whether HS2 is there or not. And so you have to be prepared that you're going to have a brine flood that flows like a stream into your excavations or onto wherever your equipment are, let alone killing all the vegetation. Right. But that's another thing.

260. So now we'll get onto the roads. I will say this because it is important to the parish. We're going to have a lasting legacy when it comes to roads and public rights of way. This is where we look at plan number six, please. There will just be a lasting legacy of a decrease in ease of access to local services and increasing community severance. We want the Committee to look particularly at – there's seven particular accesses we want to look at: the closure of Birches Lane, A556 Shurlach Road, the pedestrian cycle crossing and the junction of Birches Lane. So that is the yellow.

261. THE CHAIR: Now, we did cover isolation earlier because I made a note of it. You made specific reference that the ask from the parish council was that the connections during the construction phase were the shortest possible.

262. DR TODHUNTER: Yes.

263. THE CHAIR: So, that relates to these.

264. DR TODHUNTER: Well, I just hope all these come up then. So really, so if I just go through them, and I won't have to give you the reason, because I'll just mention one point. I think it brought up in their petition that – this is what the petitioner said. 'Given the low levels of non-motorised users crossing at this location, less than 20 pedestrians per day were recorded to cross the road. The promoter does not consider the additional crossing facility as adequate.' Well, no wonder people don't want to cross, because it's a major road. I'm surprised there's still about 20 people going across, about

10% of our population. It's a very busy road. It's a site of accidents. So we need a better crossing, but we don't want one that extends it by 1,000 metres. And we don't want one as they proposed because we are then, instead of doing a 100-metre crossing, we're adding 1,000 metres to our distance. The one chosen on 14 April adds 3,000 metres, three kilometres to it. We just want to walk the 20 minutes to the station or the 30 minutes down to the local Spar garage to get a bottle of milk. They're talking about great, long distances. It's not satisfactory. Basically we want the existing pedestrian crossing put there.

265. The other thing that we have great concern with is the Birches Lane highway. We have repeatedly asked to have information about that and HS2 has come back, 'We've discussed it with Cheshire West.' But they haven't discussed it with us personally, the parish council. The way it's been transferred, it looks as if we'll be within a few 100 metres of the line of sight of traffic moving at speed at 70 miles an hour. It will be very dangerous. So that's why we want that. So that's the Birches Lane one.

266. The other one we want is we did propose a new pedestrian crossing that uses a new culvert which matches what HS2 is managed to provide for the Royal Cheshire Showground when you've got footpaths that are only used maybe two or three days a year for the show. Yet they're replacing that with underpasses. But they're coming up with reasons like it's too far from this or too far from the bridge abutments or whatever, when there's already a culvert under the road. So we do need more meaningful discussion with them. I'm afraid it's been unsatisfactory to now.

267. The proposed underpass that goes under Wade bridge, the security hazard, I already to cross the road, wear a hi-vis jacket, so I don't get knocked over. But I think that to wear something luminous because the 1,000-metre diversion they've got is very vulnerable. It's shielded from sight from people and school kids will not want to walk along it. I won't want to walk along it at all.

268. Right. And also there's the proposed diversion of the A556 Shurlach Road. That's very confusing what is actually going on there. So we've only recently, I think it was Thursday evening, been sent a plan about that.

269. THE CHAIR: We're well aware of that diversion. We obviously have had that raised in other petitions.

270. DR TODHUNTER: No, you haven't had that diversion.

271. THE CHAIR: The Shurlach Road one we have had raised.

272. DR TODHUNTER: Yeah.

273. THE CHAIR: The A556 diversion. We've had that raised by other petitioners.

274. DR TODHUNTER: There was something else came about it on Thursday night which I couldn't even get my head around because I hadn't got time to look at it. So there's a lot of big question marks. Then the Penny's Lane diversion, which we raised on our meeting on I think it was 4 April, which means that the road is straighter so there'll be less deacceleration and all that. That again is something that is not in the petition, that one.

275. THE CHAIR: Penny's Lane we've had a petition from another parish council. We are aware of the Penny's Lane. We don't need to rehearse Penny's Lane. We've had that raised with us in other petitions.

276. DR TODHUNTER: No, you haven't, because no you haven't. No.

277. THE CHAIR: We talked about it.

278. DR TODHUNTER: The parish council propose that we straighten the Penny's Lane diversion.

279. THE CHAIR: Your parish council.

280. DR TODHUNTER: Our parish council on 4 April. So it hasn't been raised with you before.

281. THE CHAIR: We've had Penny's Lane raised on another parish council.

282. DR TODHUNTER: Yes, you would've had Penny's Lane because there are problems with it, yes.

283. CLLR HAYES: Can I just raise something with you?

284. THE CHAIR: Yes.

285. CLLR HAYES: Because when you look at it, and we keep on this slide that we're on at the moment. It's slide number six. Penny's Lane, as you can see on the dark place, it's smack in the middle of that. That's right. Now, when you see where the diversions begins, which is on the two dotted parallel red lines, if you bring your cursor further down and now to your right. That's it. Keep going along that line and stop there. So that's where the Penny's Lane diversion begins.

286. That is the only point on that whole road that runs from the middle of this screen right down and below the bottom of where there are houses. So you are commencing the diversion of Penny's Lane right outside the very few houses that there are on Penny's Lane. Now where the roundabout is that it joins, you'll see of course that the Penny's Lane has to go under the HS2. Surely an expensive thing to do. Further down Penny's Lane, you'll notice there are no houses at all.

287. And furthermore, off the bottom of that plan there is already a road that links Penny's Lane to the pink diagonal line, which is the A530, I think, King Street. So by either improving that connecting road called Crowder's Lane, or by building a new road further down Penny's Lane, which would almost be off the screen, you're going to go through open fields and not disturb any houses. So all the houses on Penny's Lane you're affecting, whereas quite easily you could avoid any disturbance for those residents.

288. THE CHAIR: Thank you. Right. We're going to have to wrap this up in five minutes to give HS2 the time to respond. Well, we'll say three minutes, so 6.10 I'm going to call this bit to an end so we can get HS2 to respond. The Committee does have to complete at 7.00 because I have another meeting at 7.00. So I have to be out of here and we can't run on.

289. DR TODHUNTER: Right. Well, I think we've probably covered the construction mound, but I think the thing that is really – construction traffic has got to the parish council. The management of traffic during the construction sets out that the nominated undertaker would be required to prepare a route-wide traffic management plan with local traffic management, local authorities and traffic authorities, but we want it prepared with us. What we're concerned is can we have the management plan now? Why is it only being prepared now? We want to know what's going on. We want to

know where the diversions are now. They're talking about when it starts going we will then do the traffic management. We've only got two places, two vehicle places to get in and out of the parish. So we want to know where to go, and diversions are very long-winded.

290. The other thing is the noise fences, which I feel at the moment that we are asking – we've got a flat landscape. The whole thing is going to be very visible. Its noise will travel. HS2 have put in noise fences in other places that are as badly affected as we are, but we're not having them. I think why we can't have the noise fences to protect Penny's Lane, and also the northwest side of Birches Lane where the A556 will now be closing to them as well.

291. So it's to put those noise fences in. I think we have got no benefit out of this scheme at all. If at the end of the day it's going to be a few more noise fences. I found, myself and the other people, especially on the parish council, found a resistance to put in extra noise fences does seem like penny pinching for me in the whole cost of the scheme, so.

292. THE CHAIR: The noise barriers, we have that down. So we'll wait for HS2 to respond.

293. DR TODHUNTER: Yeah, so.

294. THE CHAIR: I'm going to draw it to an end there because we do need to hear from Mr Strachan and his witnesses. So our thank you, Dr Todhunter and Councillor Hayes. We obviously also have the full petition. Mr Strachan?

Response from Mr Strachan

295. MR STRACHAN KC (DfT): Thank you. What I'm going to do is I think deal with it in three parts. Just say something briefly about route selection and give you some references, rather than take you through that in detail and engagement. Secondly, I'm going to ask Lord Mair to give you some evidence about ground conditions and engineering solutions. And lastly, we'll come to specific effects on Lostock Green and the local area in terms of public rights of way, noise and matters of that kind.

296. THE CHAIR: Crossings and the barriers, the construction traffic undertakings

and all the rest of it.

297. MR STRACHAN KC (DfT): Exactly.

298. THE CHAIR: Good.

299. MR STRACHAN KC (DfT): Can I do it in that way. Just before I call Lord Mair to give you some assistance on the ground conditions, I didn't take you to Appendix B of the March 2023 report.

300. THE CHAIR: We have read it, though.

301. MR STRACHAN KC (DfT): Could I just emphasise about the report of 3 March 2023, R12. It is in fact, an answer to one of the questions raised, 'What does HS2 know about the position in relation to ground conditions and the area?' The answer is a very large amount of knowledge has already been acquired and has been acquired over the years. You will find a lot of that identified in that March 2023 report.

302. And so, for example, the question of the underlying salt geology, salt brine runs, the brine extraction industry, the history of it, the locations of the more sensitive areas within that, have all been considered and taken into account by HS2 over a number of years. That, of course was part of route refinement process that's described in that report, including a detailed explanation as to the route selection, taking account of that geology, taking account of the brine extraction, taking account of the salt mines.

303. I can't hope in the limited time available to take you through all of that, but I can assure you, if you look at the March 2023 report, you will see the extent, the full extent, of the knowledge. There's a much greater body of work that lies behind it, but it explains that situation.

304. The other document that you ought to be aware of that explains that, again in the public domain, is the Phase 2B route refinement document, HS2 Ltd's advice to government, which dates from 2017. In that document, this was HS2 after consultation, taking account of many of the points that were being raised by stakeholders, including Dr Todhunter. There is an assessment of the route between Middlewich and Pickmere with which you're concerned. Section nine of that deals with the selection of the route.

305. If one goes to paragraph 9.3.7 through 9.3.12, and really I'm just flagging this up for you in answer to one of the questions. You will see that there's a full account – sorry, a summary account of all of the factors that I've just been explaining. So, for example, 9.3.8, the risk of passing over existing controlled brining and gas storage underground, caverns and surface structures was considered to be a greater risk than the others. The issues raised during the consultation process about those brining operations and gas storage infrastructure was addressed.

306. 9.3.9, careful management of drainage and geological risk, with ground stability leading to the selection of the raised route, which I know the committee's heard about already. If you carry on through all of those you can see, for example, how – 9.3.13 – a balance was struck between the longer route through the saltier areas, and a slightly longer crossing of the Winsford rock salt mine, about which you heard, was a considered decision in consultation, of course, with all the stakeholders. Winsford rock salt mine, which you heard over which the route does pass – as do many other pieces of infrastructure in that locality – that has been decided upon in light of the construction requirements of the railway, the knowledge of the salt mine and its depth, and the management of risk, mitigating risks in terms of the salt mine and the way it's controlled, and the construction methods for HS2. You're going to hear a bit more about that, but I just wanted to make it clear that these documents date from some time ago.

307. MS MUMBY-CROFT: How old is this one? Is this the 2017 model?

308. MR STRACHAN KC (DfT): This is 2017.

309. MS MUMBY-CROFT: In 9.3.9, which I can't see anymore, but somewhere in the bottom of there it says about doing some further – 'I want to take more detailed consideration of the specific salt dissolution risks'. Has that happened or is it going to happen?

310. MR STRACHAN KC (DfT): Yes, I think you heard some of this from Mr Smart previously, but since that time – and indeed 2020 and 2021 – there's been further ground investigation work. I think cone penetration tests you heard about, but in the area a lot more work has continued and, I should stress, will continue. A lot more work has continued to satisfy the project of the continued viability and appropriateness of

passing the route through this area, in the full knowledge of the geology. I just wanted to be absolutely clear to the committee: the notion that HS2 is not aware of the geology you can see is clearly not the case.

311. MS MUMBY-CROFT: What are the further tests that you need to do? You've not reached a point where you're completely satisfied you've got all the information, then? You're still planning to do further tests?

312. MR STRACHAN KC (DfT): Yes, I'll let an expert tell you about that a bit more, but in short there is enough to know with the ground conditions and the background knowledge of the ground conditions that you can build the route through this location because of the nature of the geology. But, for example, when you come to build – as you heard about a moment ago – in relation to a particular piece of ground, and there's concern expressed by Dr Todhunter about the salt composition or – there's the ability to do further ground investigation work before you actually construct in a particular locality and to control your method of construction, as you'll hear in a moment, to take account of even more local conditions.

313. I hope I'm answering your question. There's sufficient known that you can build the route through this with the challenges that the ground conditions present, but there's always going to be further investigation work done when you come to the detailed design, and then the construction so that you know where you're actually digging or boring a hole. You even know the conditions in that specific locality.

314. MR VICKERS: Bearing in mind what you've just said, Mr Strachan, about the fact that HS2 are fully aware of the ground conditions and so on, which I think we can take as read, I can understand – in the ground risk report of 3 March, in paragraph 4.2.4 it states that the strategic benefits that have been given priority is, in effect, how I would read that, which I can understand why local residents would then think that perhaps those considerations have outweighed their concerns about the geological situation. Presumably you would reject that?

315. MR STRACHAN KC (DfT): I would. There are strategic considerations as to, broadly speaking, which route to follow. One of the important strategic considerations that's been through a lot of processes is getting the route to Crewe for the obvious connections to the West Coast Main Line and the connectivity benefits that brings. That

does mean, of course, when you go north from Crewe you've got to pass into a certain area, but none of those strategic benefits trump, as it were, geological concerns where the strategic considerations are to have a particular destination, and then there's been detail consideration whether that can be achieved and how it's best achieved through the Cheshire salt area. That's been the product of considerable consultation and route refinement, the detail of which, for example, was where to pass the brining operations, where to pass the salt mines, taking account of the geology. Rather than hear it from me I'm going to let Lord Mair give you a little bit more detail about the satisfaction with the idea that we can build the railway through that geology.

316. MR VICKERS: There is a very complex rail network around there – particularly around Crewe – that we're well aware of, and the West Coast Main Line in particular. Are other parts of the rail network constructed on very similar ground conditions to what is proposed by HS2, or have previous routes deliberately avoided the most vulnerable areas?

317. MR STRACHAN KC (DfT): We're going to show you a slide about that. The answer is there's a lot of infrastructure that passes through very similar geology conditions, including, as it happens, the M6, which we'll show you in a moment, and including the West Coast Main Line. Just to be clear, the West Coast Main Line goes off slightly to the west. There's a Crewe to Sandbach line, which then goes off to the right, which travels over wet rockhead.

318. A lot of these railways were built obviously a long time ago, and have responded to ground conditions when there were, for example, greater ground movements as a result of historic brining operations, about which you can read in the March 2023 report. But in short, yes, there's a lot of infrastructure. Indeed, there's a lot of development in this area. There is ground movement in the area, and you're going to hear a bit more about that. The question is, 'Does that mean you can build a new high-speed railway for HS2's purposes?' The answer to that is undoubtedly yes, for a number of reasons which I'll let Lord Mair explain.

319. Could I just say one other thing about engagement, because there was criticism made about engaging with the parish council. I think in fairness I ought to say this, because criticisms of that kind are easily made but don't necessarily reflect the efforts

that are made by those that sit behind me to engage with parish councils. I appreciate that there's a difference between not always doing what petitions would like to be done as a result of engagement, but in fact in page four of the petition response document you see the many engagement processes that have taken place, not just through the environmental statement but, for example – although not mentioned there was a meeting with the parish council on 2 December, long before we've come to committee, to sit down with them, initiated by HS2, to try and understand their concerns. That was in addition to the 4 April meeting.

320. There's been a response in the petition response document, and I just refer you to the efforts of engagement. It should be an ongoing process, and indeed we'll happily continue to engage with the parish council and we try to understand their concerns, but I just didn't want it to be left on the record that there was some failure on the part of HS2 in that regard.

321. Could I then just invite Lord Mair to come to the seat so he can assist you? You should have details of Lord Mair's background, but if I could just introduce Professor Lord Mair to you, he's the founding head of the Centre for Smart Infrastructure and Construction at Cambridge University. He's the emeritus Sir Kirby Laing, professor of civil engineering. He worked in the industry for 27 years before being appointed in 1998, to professor of geotechnical engineering at Cambridge, and head of civil engineering. He's also one of the founding directors of the Geotechnical Consulting Group, which is an international consulting company based in London, which has been involved in a huge number of projects. I won't read all of those out to you. The important point is he's been involved in all sorts of construction, including numerous projects involving soft-ground tunnelling, retaining structures, deep excavations and foundations. They stretch to places such as Amsterdam, Barcelona, Bologna, Florence, Rome, Singapore, but perhaps closer to home the Jubilee Line extension for London Underground, the Channel Tunnel Rail Link, and Crossrail.

322. THE CHAIR: We have read these, so we can just move straight on.

323. MR STRACHAN KC (DfT): Lord Mair, first of all, could I just – for the committee's benefit, there is a report from Lord Mair in the exhibits, but what I was going to ask Lord Mair to do was just deal with the principle elements of what's in the

report, having in mind the concerns that have been raised, which is P160(1). Lord Mair, if you could just summarise, in effect, the purpose of the note that you provided to the Select Committee for today's proceedings?

Evidence of Lord Mair

324. LORD MAIR (DfT): Thank you. I'll be brief. I realise time is an issue. The note that I prepared with a colleague, Dr Menkiti, the purpose of the note was to really comment specifically on the two documents, the briefing statement by Dr Todhunter dated 6 July 2022, and the report by HS2 dated 3 March 2023, the understanding of the ground risk.

325. I will be very brief, because I realise that's important. The background, of course, is that the alignment of the proposed scheme crosses the Cheshire plain in areas of former salt mining and other areas where salt mining is ongoing. There is clearly a history of ground settlement in the area arising from historic mining and from salt dissolution processes.

326. In terms of ground conditions and geotechnical risks I think it's fair to say that there's already been a considerable amount of investigation, some of it quite advanced, with boreholes – a lot of boreholes now – and cone penetration testing and geophysical testing. The important point I think to make is that there are going to be a lot of further investigations. I believe at this stage of a scheme it's reasonable not to have undertaken a fully comprehensive ground investigation in the form of many, many more boreholes. I know that HS2 is planning for more investigations. Further supplementary investigations will be essential for the detailed design. The detailed design will require a lot of investigation, specific boreholes, specific CPTs, and that is fairly normal in a project like this.

327. As far as potential geotechnical risks are concerned, Dr Todhunter really comprehensively identifies the complex geological issues in this whole area, highlighting the influence of rock salt dissolution on potential future ground subsidence, and I think that's fully recognised by HS2.

328. THE CHAIR: There's nothing in Dr Todhunter's presentation that you take issue with in terms from a technical, geological point of view?

329. LORD MAIR (DfT): There are one or two details. I perhaps would come to that in a short while, but in general everything that she is identifying in terms of the history of the area and the broad mechanism of potential salt dissolution hazards she explains very well, and the HS2 report also explains that very well. There is going to be future ground subsidence. I think there's no question about that. That future ground subsidence must be allowed for in the detailed design of the proposed scheme.

330. At this point I would perhaps draw attention to Dr Todhunter's fairly extensive reference to terms like 'extensive ground instability', 'ground collapse', and 'safety concerns'. I think that they are potentially misleading, because I think what we're really talking about now is ongoing subsidence. That's completely recognised by HS2, and that's not really the same as ground collapse and ground instability, although I understand in the past, especially in the days of uncontrolled brine – or I think you call it bastardised brine pumping and other such activities – and indeed lapsed mines, those sorts of incidents would have led to real ground instability. It seems to me, looking at everything HS2 have been doing in the form of current investigations, is that those sorts of collapses and ground instability are much less likely, but ground movement and ground subsidence is to be expected.

331. MR MORRIS: Can I just ask about that? I fully understand from Mr Strachan's earlier explanation that we can do anything, can't we? We can have a snowball fight in the Sahara Desert but we're making sure that that public money's spent effectively. I don't doubt that we could construct something that was suitable and risk-free, but weighing up the relative costs this is a dynamic process, isn't it? We're talking about historic mining operations and brining operations, but there is a dynamic where, with it raining and with climate change that's happening more frequently, these 200 interconnected boreholes are liable to be unstable.

332. I'm just wondering as well, because you haven't really mentioned the gas storage facilities. I know it's a little further away, but why were these selected? Are these naturally occurring caverns or do the gas storage facilities have constructions in them to stabilize the caverns? We've been to the site but you can't see anything. We're just looking at it from above.

333. MR STRACHAN KC (DfT): I'll let Lord Mair answer the technical side, but just

so far as the gas storage and the brining caverns that we're talking about, those are not passed over by the route. That's one of the points made in the consultation route refinement. The selection of the route was – one of the changes was to go past those particular facilities as opposed to the Winsford salt mine, which we do pass over, but I explained the reason for us responding to that. Was that the question?

334. MR MORRIS: I'm just curious to know why these were selected for strategic gas storage. Is it a naturally occurring cavern resulting from previous mining operations, and is that cavern reinforced to ensure that ground conditions are stable? Because although I've been there, you can't see anything, so I'm intrigued to know how is that still stable? Do you know, or does Professor Mair know?

335. DR TODHUNTER: I know. They're designed to be stable. If you Google 'store energy' or 'Kuyper gas storage project', they design them stable. They're in deeply buried salt and they dissolve it with high pressure water and air, and they design a stable side, stable cavities. They are stable, yeah.

336. THE CHAIR: Obviously I'm conscious we need to stick to things directly related to the route.

337. MS MUMBY-CROFT: I just wanted to understand what the difference between a collapse and ground movement was. Is it the amount of changes at the speed at which it happens, or some other difference? How much potential foreground movement would be considered acceptable underneath the route?

338. LORD MAIR (DfT): You ask a very good question. Collapse is as the word implies. It's something really rather dramatic, a big hole appearing. That's what is associated with collapse, whereas ground movement or ground settlement is very often a slowly ongoing process. I'll come on to say a bit about this very briefly, but providing it's being measured and being measured very carefully then ground movement in itself is a very much more acceptable process than a collapse.

339. Indeed, it's very rare to get a collapse without any warning. It does happen, but by and large the principle which really does apply here is to make absolute maximum use of measurement, monitoring and surveillance, and that's needed to be done throughout the operational phase of the railway.

340. MS MUMBY-CROFT: Is that a reassurance that you can give, because that was one of the questions that we were asked. Is it going to be monitored for the entirety of its lifetime, and how will it be monitored?

341. LORD MAIR (DfT): I would say that it certainly is going to be monitored throughout the design life, which goes on for a long time. But it's very important, particularly in ground conditions like this, where the ongoing movement and ongoing subsidence is likely to occur.

342. MS MUMBY-CROFT: How predictable is that movement?

343. LORD MAIR (DfT): Some of it is not so predictable, but again, the best approach to dealing with that – and there are lots and lots of schemes in many parts of the UK and the world – where the predictability may be in question, but if you're measuring and you're observing and you have well-organised plans as to what to do if the movement exceeds a certain amount then the predictability in itself is not so important.

344. MR STRACHAN KC (DfT): Perhaps, Lord Mair, you could come on to explain the scheme response to, as you've identified, the potential for ground movement in the area?

345. LORD MAIR (DfT): Yes, indeed. As I've said, we all agree that future ground subsidence is to be expected. The HS2 report outlines how this can be safely accommodated by the detailed design. This is a really important point here. By that I mean bridges and viaducts will be on piled foundations, with those piles taken down to adequate depths. The decks of the structures will be designed to have jacking facilities, so that if there is movement that's part of what I was saying earlier about having a plan in response to measurements. If there's a need to adjust those bridges and viaducts that can be built into the detailed design.

346. Where the scheme is on low embankments, those embankments will probably incorporate geogrid reinforcement. I think you've heard about that in the past. Those stiffer embankments – and they're stiffer because of those geogrids – will be able to mitigate against the effects of subsidence. There may be a need to adjust the rails to allow for ongoing settlement. That's not unusual. The settlement development is likely to be slow – that's the really important point – so such adjustment is entirely feasible.

347. MR STRACHAN KC (DfT): Lord Mair, can I just interpose at that point at a point which was raised about the Billinge Flash by Dr Todhunter? There's a particular concern about a location. There are two locations where she raised, but just to give you a reference and get you to comment, in the March 2023 report, which is R12(42), there is an example of what you've just described already being factored into the location at Billinge Flash at 4.4.18.

348. LORD MAIR (DfT): Yes, I see that, the proposed scheme comprising the Trent and Mersey canal viaduct.

349. MR STRACHAN KC (DfT): And that's the specific location Dr Todhunter was concerned about, I believe, in relation to continuing ground movement.

350. LORD MAIR (DfT): Yes, indeed.

351. MR STRACHAN KC (DfT): And could you just help a little bit on the – well, is there anything more you want to say about the proposed scheme response?

352. LORD MAIR (DfT): If I may say one more thing, the key to the whole approach outlined in the HS2 report is to mitigate the risk of ongoing settlement. That's by means of the engineering solutions, some of which I've mentioned already – the provision of jacking facilities for bridges and viaducts, the possible adjustment of rails in the case of the embankments – but the important point to really emphasise is that dealing with any further settlement by means of comprehensive monitoring and appropriate interventions, depending on what the monitoring shows, is really the key to the success of this scheme.

353. MR STRACHAN KC (DfT): On that, Lord Mair, you've also provided some assistance on the types of monitoring surveillance technology. It's in section seven of your report, and there are some illustrations you've provided of some of that technology. I know we're short of time as ever, but if you could just assist the committee with an explanation of that technology and what it shows? P159(1) is some slides illustrating how the technology has arisen in other circumstances, and perhaps you could just help briefly on that?

354. LORD MAIR (DfT): Indeed. Well, what I should say here is that the improvements in monitoring and surveillance technologies have been really

considerable in the last few years. There was a tragic train derailment in Scotland near Carmont, west of Stonehaven, in August 2020 following a period of intense rainfall. Network Rail appointed me to chair a taskforce review of all their management of earthworks, in other words all their cuttings and embankments across the whole Network Rail system. Our report was published in February 2021 and it contained many recommendations, but the one I want to focus on –

355. MR STRACHAN KC (DfT): That's the report itself, I think.

356. LORD MAIR (DfT): The one I really want to focus on was the importance of monitoring and surveillance technologies. We drew attention in our report to the considerable value of InSAR. That's the satellite technology, which I think you will have heard about. As an example, which I can – perhaps we can have the slide?

357. MR STRACHAN KC (DfT): P159(2).

358. LORD MAIR (DfT): P159(2), please. So what is shown here is an extensive use of InSAR technology, satellite technology, of the entire Netherlands railway network system from satellite observations. So what you're seeing here on the left-hand side is the deflation map for the whole of the Netherlands, and the right-hand side is a flagging system. The red zones there are where the settlement is exceeding ten millimetres a year. The blue ones are where there is heave, because sometimes you get movements upwards as opposed to settlement.

359. The point of showing you these is that this is a very, very good example of the power now of satellite technology in being able to add to the monitoring and surveillance technologies, to have a really clear idea all the time as to what is happening to HS2 even when it's built.

360. If I could go to the next slide, please, this is one other example that I think you should see. This was using satellite technology in hindsight after a bridge collapsed at Tadcaster. It collapsed due to considerable flooding.

361. THE CHAIR: On the River Ouse.

362. LORD MAIR (DfT): It was very well publicised. What I wanted to just draw attention to is that after the collapse satellite images were then examined very carefully,

in fact by one of the PhD students in my group at Cambridge. The red line is the one to look at. On 4 November in 2015 there had been some movement. Very little, 0.9 of a millimetre. That's a really tiny amount of movement, but by 15 November that had increased quite rapidly to 5.9 millimetres, and by 26 November to nine millimetres. The bridge collapsed on 29 December. The point of showing you this is that the power of InSAR technology in giving warning before something dramatic happens is really enormously powerful.

363. THE CHAIR: Nobody had picked up that movement?

364. LORD MAIR (DfT): No.

365. THE CHAIR: Right.

366. MR STRACHAN KC (DfT): They presumably didn't have InSAR monitoring of those sorts of structures.

367. THE CHAIR: One should have it.

368. LORD MAIR (DfT): That's right. The nearly final slide I want to show you is the use of tiltmeters.

369. MR STRACHAN KC (DfT): P159(4).

370. LORD MAIR (DfT): This is a rather steep cutting of Network Rail's, close to a tunnel entrance, and those little white dots you'll see in the photograph are wireless tiltmeters. These are little devices that are placed on the ground, and they are measuring tilt – in other words, movement – and they're transmitting that wirelessly to a website to Network Rail. This is another very powerful new technology which Network Rail are beginning to adopt more widely, again illustrating how, in areas where there are potential movement problems or stability problems, you can get very good warning before the problem becomes serious.

371. MS MUMBY-CROFT: What would be done if, say, for the Tadcaster one we had looked at the satellite images? Clearly we would have closed it so nobody was hurt, but could it have been fixed? Could it have been prevented?

372. LORD MAIR (DfT): Also a good question, because actually the cause of the

collapse was scour of the foundations by the flooding of the river. It certainly would have given warning that something bad is likely to be happening. Whether it could have prevented the scour is a different question, but it would have given warning that something serious was happening. That's the point.

373. MR STRACHAN KC (DfT): The other slides, five, six and seven, if you could just explain those? I think they relate to sensor grids in the project in relation to HS2 itself.

374. LORD MAIR (DfT): Yes. This is very relevant to what we are discussing today. My group at Cambridge University, in conjunction with HS2 and with a number of other bodies, have been looking at using fibreoptic sensing in conjunction with geogrids in order to give warning and understanding of potential movements developing. This is a trial. What you can see in the upper part of the slide are some water bags which are emptied of water to simulate the beginnings of an instability, the beginnings of something more serious. What's called the sensing warning layer in red is a geogrid, which is a plastic grid manufactured in the factory incorporating fibreoptic into it. Just before the next slide, the bottom slide there shows a deformed shape as those deflated water bags. You can see the shape of the geogrid and the fibre optic. If you go to the next slide, please, number six?

375. THE CHAIR: This is a technology that's experimental?

376. LORD MAIR (DfT): It's experimental but it's going a very long way. It's actually being incorporated in part of HS2.

377. THE CHAIR: Right, okay. That was going to be my question, because if it's experimental – and very interesting that may be – it's of no help here if it's not going to be deployed. The purpose of showing this is that you're saying along this section here this is the technology that will be deployed.

378. LORD MAIR (DfT): This is exactly the sort of technology that could be employed.

379. THE CHAIR: The sort of, but is the technology or is it a different technology?

380. LORD MAIR (DfT): It's very likely this will be employed, and the very reason

HS2 have done this trial on phase one is in order to show that it can be done and it's got considerable promise. If we go to the next slide – number seven, because I know time is an issue – you can actually see the trial happening. That's on an HS2 site, and it's deliberately been designed in such a way to show that this has really enormous potential. It's part of a suite of things I've been showing you, the satellite technology, the tiltmeters, the fibreoptic sensing. All of this is the sort of technology that I'm certain HS2 will deploy.

381. THE CHAIR: As I keep saying, none of us here are experts in geology, but what we've heard today is very legitimate concerns put across very well by Dr Todhunter as to what might happen with this particular type of ground. And then of course the response from yourself and HS2 is that this can be monitored, it can be mitigated and prevented. It's hard for us to know exactly where to come down and who to place more weight on, I suppose. It can tell you what movements are happening, but Dr Todhunter's point was that as climate changes and as you have increased amounts of water falling the brine runs can increase in ferocity. I don't know if that's correct. Whether you know there's movement happening, if there's a collapse there's a collapse. If there's a significant collapse you can't mitigate against that, can you?

382. LORD MAIR (DfT): Can I deal with the first point? The climate change point that Dr Todhunter raises is completely right. She's absolutely correct on that. It will in the course of time change the rainfall, the way in which groundwater distributes and so on, and it could well lead to enhanced dissolution. The important point is that it will be very gradual. We're talking about that developing over decades, so the amount of extra ongoing settlement that might take place as a result of climate change is very, very manageable because the actual rate of settlements would be extremely easy to deal with in terms of adjusting structures and adjusting rails. Again, the key point being measurement and reacting to the measurement.

383. THE CHAIR: It seemed like what we were presented with today as a concern – and if I am incorrect in this, Dr Todhunter, please do correct me – was that at some point there could be a catastrophic collapse along the route. I fully understand how you can measure, monitor and mitigate, but I think the contention was that this ground is such that a catastrophic collapse is perfectly possible. What's your response to that?

384. LORD MAIR (DfT): Well, I take issue with catastrophic collapse being perfectly possible.

385. THE CHAIR: Those were my words.

386. LORD MAIR (DfT): I think some of the historic work, some of the bastardised brine pumping, some of the collapsed mines, those sorts of events did, indeed, lead to a catastrophic collapse. But in today's environment, I think HS2 are right in saying that the chances of a catastrophic collapse are very, very much less likely.

387. THE CHAIR: What's the difference? Because the ground conditions haven't changed. They're the same ground conditions, aren't they? So why is it less likely now, given that there have been these catastrophic collapses?

388. LORD MAIR (DfT): Because the mechanisms that caused those catastrophic collapses are no longer operating.

389. MS MUMBY-CROFT: Is that the mining?

390. THE CHAIR: Do you mean the mining?

391. LORD MAIR (DfT): Mining, absolutely, yes.

392. DR TODHUNTER: The brining.

393. LORD MAIR (DfT): But also some of the collapsed mines—some of the mines that themselves collapsed caused terrible subsequent collapse of the ground above.

394. MR STRACHAN KC (DfT): And can I just ask you, Lord Mair, on that point, first of all, does the route pass over any of the abandoned mines where catastrophic—there's reference to catastrophic collapse from abandoned mines. Does the route pass over any of those?

395. LORD MAIR (DfT): As far as I'm aware, no, it doesn't.

396. MR STRACHAN KC (DfT): I just wanted to show—because we said we'd come back to this—the selection of the route. It's covered in the March 2023 report.

397. THE CHAIR: Before you do that, I did quote Dr Todhunter, so it's only fair to let

her—she wanted to respond, because I did quote her.

398. DR TODHUNTER: I think the critical thing is the abandoned mines in Northwich are connected by a brine run that runs to Billinge Flashes, where HS2 is. That brine run is still operating. The mines, there are probably about 20 of them left. The pillars between these brine-saturated mines are probably 10 metres apart. Keele University has been monitoring one, and the ground is moving there. When those mines collapsed there, because the brine run is connected to Billinge Flashes, and it's also connected to Tatton Park, and this is what both Serridge and Cooper are bringing up in their papers. It is very difficult.

399. THE CHAIR: I get that.

400. DR TODHUNTER: Therefore, it doesn't matter if they're running over—

401. THE CHAIR: The point is it's the concertina effect and not the domino effect.

402. DR TODHUNTER: Yes, it's not that they're running over mines. It's that they're running over an area which is connected to the mines and, if those mines flood, what happens in Northwich happens in—

403. THE CHAIR: We understand.

404. MR STRACHAN KC (DfT): Can I get Lord Mair to comment on that? Because there is a basic difference between—

405. THE CHAIR: This halite karst geohazards report by Serridge and Cooper that Dr Todhunter just—you've presumably read that and are fully aware of that.

406. LORD MAIR (DfT): I'm familiar with it, and what that Serridge and Cooper paper is all about is the terrible things that happened in the past. And I think Dr Todhunter is right about brine runs, but that would cause just further dissolution. It wouldn't cause the collapses that you are concerned about. It can cause disillusion, and dissolution would lead to settlement, but the settlement is entirely manageable.

407. MS MUMBY-CROFT: Does the dissolution leave a hole?

408. DR TODHUNTER: Yes.

409. LORD MAIR (DfT): No.

410. DR TODHUNTER: Yes.

411. MS MUMBY-CROFT: So the rock salt gets the water from the old mines, it turns to liquid, it leaves a hole. It runs away, it leaves a hole. Is that basically what happens?

412. THE CHAIR: It's dissolving the salt.

413. LORD MAIR (DfT): It's dissolving the salt.

414. MS MUMBY-CROFT: It's dissolving the salt. So where does that dissolved salt go? Does it run away?

415. LORD MAIR (DfT): The dissolved salt does lead to the ground above it settling. We're talking about this happening at great depth. That eventually, at the ground surface, can lead to some surface settlement, but that's very different from an unexpected catastrophic collapse.

416. MS MUMBY-CROFT: But depending on how much gap there is depends on how much it could settle, I guess.

417. LORD MAIR (DfT): Yes, indeed, but you have to remember this dissolution process we're talking about is taking place at considerable depth.

418. THE CHAIR: Mr Strachan.

419. MR STRACHAN KC (DfT): This is covered in more detail in the March 2023 summary, but could we just show R12(29), just so you can get a perspective of the route choice and the history? Lord Mair, I think you can speak to this, but on R12(29), you have a map of the Cheshire Brine Subsidence Compensation Board area. It's shown in red, and that's an area that was created in the event of subsidence caused by Cheshire salts. You can claim compensation in that area of red. Within that, there are the yellow areas, which are the consultation areas for the board. Where planning applications are made within those yellow areas, there's a need to consult the board, and the route avoids those.

420. And if we could also go to R12(28), there's what are known as the karst doline

areas, points and sinks. And just to be clear that, again, you can see from that map that the route, broadly speaking, avoids those areas. The Billinge Flash is one area of yellow which it does cross, and you've heard about the design solution for that.

421. THE CHAIR: I'm conscious you have a train to catch, to give you a time—

422. DR TODHUNTER: We can get a later one.

423. COUNCILLOR HAYES: We can get a later one. Carry on.

424. THE CHAIR: I didn't want your supersaver ticket or your super off-peak return to be lost.

425. MR STRACHAN KC (DfT): Lord Mair, can I just get you to comment on the idea of, first of all, whether there's any evidence of the route that the line is following being an area of collapse or sudden collapse? Is there any evidence of that that you're aware of?

426. LORD MAIR (DfT): I'm not aware of there now beginning evidence, no. And I think HS2 have looked into this in considerable detail as to whether there are actually any incidents of ground collapse on the current route that's shown on the slide.

427. MR STRACHAN KC (DfT): And I think, in your report, you've identified at paragraph 5.2 that, in fact, there aren't any recorded claims to the compensation board for subsidence of that nature. Indeed, I don't think there've been claims for some time now. 5.2 of your report.

428. LORD MAIR (DfT): That's my understanding too. The Cheshire Brine Compensation Board have said that, in the decade following 2006, they received only one notice of damage within one kilometre of the HS2 route, and even that was rejected, as it was not attributable to salt dissolution.

429. MR STRACHAN KC (DfT): Thank you. I think we do need to cover this: artesian groundwater. Dr Todhunter raises a different concern about the presence of artesian groundwater in the locality. Please can you just assist, Lord Mair—

430. THE CHAIR: Which is the clay, and that's artesian.

431. MR STRACHAN KC (DfT): Well, the artesian water is in that higher level of clay, which is sand and gravel.

432. MS MUMBY-CROFT: Is it the water bed?

433. MR STRACHAN KC (DfT): It's, in effect, water under pressure as a result of other geographical features.

434. THE CHAIR: And very sandy, I believe.

435. MR STRACHAN KC (DfT): And the running sands.

436. THE CHAIR: On the British Geological Survey map—the three-coloured one.

437. MR STRACHAN KC (DfT): Yes. Lord Mair, could you just assist, first of all, about the principle of artesian groundwater and projects of this kind, and also the concern about running sands?

438. LORD MAIR (DfT): Yes. I think the first thing to say is that artesian groundwater is not a rare phenomenon. It's found in many parts of the country. And I think it's a bit misleading when Dr Todhunter talked about running sands and described what happens when sand and water are causing instability. Of course, she's right, but that's absolutely germane to all well-controlled construction, so that you cut a slope in sand in many conditions, whether or not it's artesian. And unless the water is properly controlled, it will run. The sand will run.

439. But I don't believe that running sands is a particular feature that is unique only to the Cheshire salt plain. The potential of uncontrolled water destabilising sand is very well known to all civil engineering projects. So I think it's been not well expressed in somehow saying that artesian pressures are linked with running sands and, therefore, there is something very difficult about the construction of HS2. I don't believe that to be the case.

440. MR STRACHAN KC (DfT): Could I take you to section 8 of your report? Just to get to the heart of it, you've heard about the concerns about the geology. You've heard about artesian groundwater and sands, and the local conditions. Can you just set out your position, Lord Mair, as to whether any of those concerns give rise, on your part, for

concern as to the ability to construct the scheme through this area?

441. LORD MAIR (DfT): Well, I think I would just very briefly summarise my conclusions. I think, since the refined alignment was published in 2016, lots of additional surveys and studies have been undertaken. And I think it appears to me that there is sufficient ground investigation already for HS2 to define the vertical alignment and the horizontal alignment. Nevertheless, further extensive ground investigation will be needed. There's no question about that, and that's going to be needed to fully develop the detailed design.

442. The complex geological mechanisms that Dr Todhunter has correctly identified relate principally to the influence of rock salt dissolution, and these are well recognised in her report and in the HS2 report, and I fully agree that these are important mechanisms, but they will result in ongoing surface settlement that must be accommodated by the design, and there are well-established ways of dealing with that. And the 3 March HS2 report discusses many of the engineering approaches to dealing with this ongoing settlement.

443. So I think the key, as I've said before, absolutely lies in the monitoring, surveillance and appropriate maintenance interventions, and you have that all absolutely laid out. You know what you're doing. And in response to the measurements, you can decide this particular section may need some adjustment. So that's very different from a sudden collapse or from an unexpected sinkhole type of event.

444. So I think the last couple of points to make is that climate change—and I think Dr Todhunter is absolutely right to address climate change. We all have to think about that a lot now. It will result in some marginally quicker rates of settlement at the ground surface, but nothing dramatic. It will increase the rates of subsidence. So I believe that the scheme is entirely resilient against climate change by the methods I've been talking about.

445. So the final thing to say is that, based on all the information that's available so far, I don't see any insurmountable obstacle to the successful construction and operation of the HS2 proposed scheme. It's simply a question of the detailed design will be very important. That will require a lot more boreholes, and that's completely normal for this kind of project.

446. MR STRACHAN KC (DfT): Thank you.

447. THE CHAIR: Mr Strachan, with the Committee's indulgence, my next meeting is waiting for me downstairs. If we say a hard stop at 7.15, so that just gives you another five or six minutes.

448. MR STRACHAN KC (DfT): I shall do my very best, yes. If I thank Lord Mair, I'll just cover the connections with the public rights of way and noise very briefly. I think Mr Miller will just step in for five minutes to speak to those.

449. THE CHAIR: Mr Miller, yes. We have to end at 7.15.

450. DR STRACHAN KC (DfT): Mr Miller is going to come to your seat, if that's all right.

451. THE CHAIR: Thank you, Lord Mair.

452. DR STRACHAN KC (DfT): I want to cover those things specific to Lostock Green. You're going to hear a bit more about Lostock Gralam tomorrow. Some of these things overlap. So can I just get Mr Miller to focus particularly on the public rights of way? Mr Miller, I think we could probably do this quite simply by looking at P158, when it comes up on the screen. Lostock Green in the centre, and I think there are two concerns about connections between Rudheath to the left and Lostock Gralam to the right. The existing Birches Lane is stopped up—or realigned is probably the best way. So the current connection is now taken with a right-hand turn. A Birches Lane diversion goes back on to the A556. There's also a pedestrian diversion. Could you just explain why that's the case and the consequence for Lostock Green?

Evidence of Mr Miller

453. MR MILLER: Yes. We've realigned the access, or maintained the access across Birches Lane on a different route alignment between Lostock Green just to the east. It follows a footpath and then follows a route in purple beneath the Wade Brook viaduct, beneath the railway and beneath the realigned A556 road. It takes a slightly longer path but maintains the access to Lostock Gralam railway station. And as was said earlier on, there's about 20 movements between Lostock Green and Birches Lane to the east.

454. THE CHAIR: So why can't that be a shorter connection? Because the question for all of these by the parish council was, "Why are these diversions up to two miles long?" So why can't they be shorter? That's what we want to know.

455. MR MILLER: Well, it's taking the safest route beneath the railway and the road. The road connection, as you can see there, is maintained, but the pedestrian access will be closed off by a central reservation barrier to stop people crossing the road in that location. As you heard from Dr Todhunter, she has to wear a high visibility vest to get across the road there, and there are not many people using that particular crossing at the moment. And it's likely that our new crossing will attract more people and allow them to cross safely.

456. MS MUMBY-CROFT: Is that the 20 people a day crossing?

457. MR MILLER: That's the 20 people a day. You can't quite see it on here, but if you go from Lostock Green almost straight across to where it says Birches Lane, that is the route. It is a surface crossing of the existing A556, which is, basically, in the vicinity of the railway formation of HS2, and the road gets realigned. You'll remember travelling down there on the site visit. This is the area where the A556 gets realigned towards the west there. So it's quite a different alignment of the road and the railway in this location. So we adopted a route which is the safest route. It segregates people away from the railway and the road.

458. MS MUMBY-CROFT: It's the same railway and the same road.

459. THE CHAIR: I think the thing we don't understand is, if it's going over the same road and the same railway, it would be a shorter route.

460. MR MILLER: It's going underneath the railway.

461. MS MUMBY-CROFT: Why can't it go underneath a shorter version?

462. THE CHAIR: Underneath in a different place. The thing to understand here is, if it's got to go under the railway and it's going over the road, why can't it do that in a shorter route?

463. MR MILLER: That is the shortest route that we've found.

464. THE CHAIR: Well, it clearly isn't the shortest route potentially, is it, because I can see the other side of the road, where it's trying to get to, and I can see the railway line and the road, so why can't it go under the railway line further up? Is there some technical reason?

465. MR MILLER: As I understand it, we want to avoid people crossing the four-lane carriageway of the A556.

466. THE CHAIR: They're going to have to cross it anyway, aren't they?

467. MR MILLER: You can cross it beneath it.

468. THE CHAIR: Is there an existing underpass there is what you're saying, or not?

469. MR MILLER: No, that would be new.

470. MR STRACHAN KC (DfT): Just to be clear, the possibility of going under has been looked at and there are several problems with it. First of all, you'd have to raise the railway and the road, and secondly, you'd be into the drainage. There's a culvert, so if you dug under, you're into a drainage issue.

471. THE CHAIR: It's going under anyway, isn't it?

472. MR STRACHAN KC (DfT): The footpath goes under the viaduct. Where the purple line is, there's the beginning of the Wade Brook viaduct, so the footpath and the cycleway go under the railway and the road. The road connection to the left comes up to the A556, goes over the railway and joins the road, but we avoid having a pedestrian crossing there, because you would be crossing the A556, which is four lanes of traffic.

473. MS MUMBY-CROFT: Is that where you cross now?

474. DR TODHUNTER: We cross four lanes of traffic.

475. MS MUMBY-CROFT: Has anyone got hurt?

476. DR TODHUNTER: There have been several accidents. More people would use it if it was a safer route. We were promised, when they built it in the 1960s, an underbridge or an overbridge, and really what we're just asking for is an under or overbridge of both the road and railway in the existing place.

477. THE CHAIR: As I understand it, the reason we're looking at it as it is is because you can utilise the viaduct.

478. MR MILLER: You can utilise the viaduct of the railway and the road.

479. THE CHAIR: So you don't have to construct an underpass.

480. MR MILLER: Constructing an underpass—and the parish council have shown—

481. THE CHAIR: If you'd just made that clear, that would have been easier from the beginning. Now we understand that. You're not having to construct any underpass, so you're just using the viaduct.

482. MS MUMBY-CROFT: Is it cost?

483. MR STRACHAN KC (DfT): It's not simply cost, because, as I said, if you built another underpass more directly, you're going to have to raise the route of the road and the railway to get sufficient clearance at that point and, indeed, further down.

484. MS MUMBY-CROFT: Can't you just dig deeper?

485. MR STRACHAN KC (DfT): Then you're into the drainage issue.

486. MS MUMBY-CROFT: You know about pumps in underpasses.

487. MR STRACHAN KC (DfT): I do know about pumps in underpasses.

488. MS MUMBY-CROFT: You can pump them out.

489. MR STRACHAN KC (DfT): You're going to come back to this issue, because I think Cheshire West and Chester don't want to see the existing crossing remain. They have proposed an overbridge—a footbridge—to go over the road in that location, which we've also considered and rejected, because of its cost but also because, with the ramps, you end up with a very similar length distance. So we have looked at the various options, but if you're concerned about it, you're going to come back to consider this, I think, in due course. I'm just flagging it up.

490. MS MUMBY-CROFT: I'm concerned about it, because I think 20 people is quite a lot.

491. DR TODHUNTER: There would be more if it wasn't such a dangerous road.

492. THE CHAIR: We'll be coming back to this when we hear from Cheshire West then.

493. MR STRACHAN KC (DfT): I believe so, yes, unless we resolve their concerns, but yes.

494. THE CHAIR: Good. Birches Lane. I shall make a note.

495. MR STRACHAN KC (DfT): And then, going to the left, getting to Rudheath, Mr Miller, can you just explain what the proposal is? So from Lostock Green, currently, if people cross Birches Lane, our indications are, I think, two people would turn left.

496. MR MILLER: The survey that was carried out indicates that there are two people per day using that route going over towards Broken Cross, just on the left-hand side of this page. So they would go across the A556 Birches Lane on that surface crossing, and then they would turn left, I believe, along the existing road at the moment, and then along to some shopping facilities in Broken Cross. So that's a very limited number of people.

497. MR STRACHAN KC (DfT): And under the current proposal, the assurance that was issued was to look into creating a footpath from Lostock Green that would run left on this side of the railway and connect up with the new, realigned footway towards Penny's Lane and then back into Broken Cross that way.

498. MR MILLER: That would be an additional opportunity to take a more direct route. It still would add to the distance, but it would offer a different opportunity for a footpath in that location. So you would have, effectively, two routes to get into Broken Cross. You could either elect to go under the Wade Brook viaduct as I've just described, or you could go along this new footpath arrangement that we would take up with Cheshire West and Chester Council, and we've let the parish council know that we're happy to look into that.

499. MR STRACHAN KC (DfT): And then, in relation to noise, which was the other issue, can I just show you the plan, P156(1)? Mr Miller, can you confirm that there is a noise barrier that's introduced alongside the railway? You can show the blue line up to

four metres.

500. MR MILLER: Yes, there's up to a four-metre-high noise barrier. That's a combination of an earthwork bund and a noise barrier. That's located alongside the main population of Lostock Green, and our noise assessment shows that there are beneficial effects for Lostock Green from the rail noise and the positioning of the railway in conjunction with the A556 realignment of the road. It essentially provides some screening overall, so we're reporting beneficial effects for the main community in that location.

501. The point about further to the west, you'll see that Springbank Farm is there. There are a number of more isolated properties. This is in the area where the construction site was highlighted. It's more agricultural land, open land, where the industrial area is. And what we're showing there is that Springbank Farm would qualify for noise insulation and, for an individual property, that's the more relevant remedy for noise attenuation compared to a large and expensive long length of noise barrier that would otherwise have to be put in alongside the railway to avoid that effect. So we've aimed to strike the right balance and to be proportionate the sort of effect that is arising, and that's out in the environmental statement.

502. MR STRACHAN KC (DfT): Thank you. I'm conscious you've got to finish.

503. THE CHAIR: Yes. I really cannot make my people wait any longer for this next meeting. Thank you, everybody, for attending. That's the end of today's meeting.