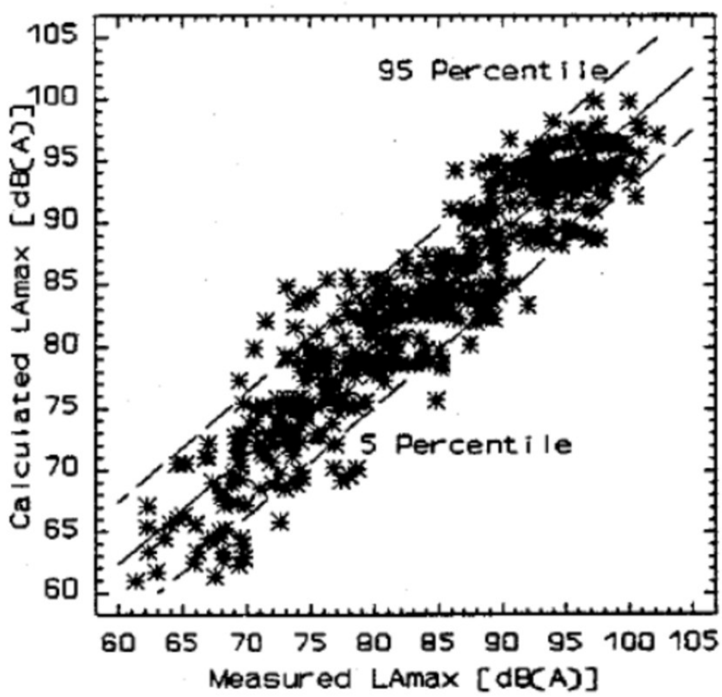
HS2 Noise Model Inaccuracy

Details of how HS2 calculate the expected noise levels is documented in the [Environmental Statement](#) (ES) that is part of the Act of Parliament for Phase 1 of HS2.

In Annex D2 of this document there is a description of the operational assessment algorithm used to estimate the airborne sound at a distance from the line, which was based on the methods used previously to predict noise from HS1 trains, on what was then called the "Channel Tunnel Rail Link".

Measurements were made on TGV trains in France during 1991, and compared with theoretical figures considering the main sources of noise such as aerodynamic effects from the front of the train, the rolling noise from wheels and track, the engine noise, and the pantograph which is exposed above the train to collect power from the overhead line equipment. The resulting diagram showing the difference between the theoretical and measured values (Figure 7 in the ES) is extracted from the 1991 paper and shown below.



A simple linear algorithm was developed based on the four source components to fit the measured data, and is shown as the solid line generally passing through the middle of the measured values shown as asterisks. Dotted lines parallel to the straight line graph show the 5 percentile and 95 percentile values due to the variation of actual field measurements, and statistically these show a standard deviation (or error) of 3.1dB. Close examination of the figure shows that for calculated values over 70dB there is a close fit between the predicted and actual results – the asterisks lie between the dotted lines. However below 70dB there are few results to the left of the solid (50 percentile) line and numerous readings to the right of the 5 percentile. This means that the actual measurements were much noisier than predicted by the straight line algorithm. Levels below 70dB could be expected at some distance from the line as a result of "air attenuation". In the original 1991 paper it states that *"These results indicate that train* *noise levels can be reliably predicted at distances of up to 800m"* but then goes on to say that this does not hold further away. The results were measured over open flat soft ground, and downwind of the track.

Following the HS1 experience Arup were contracted by HS2 to produce demonstrations of expected train noise in their SoundLab; which were given to Select Committee MPs and used at public exhibitions. Arup decided that to gain an accurate representation of the impact that the sound needed more precise modelling than provided by the HS2 algorithm, as it is well recognised that air attenuation is different with frequency, as documented in the ISO 9613-2 international standard. Arup decided to use the Dutch RMR96 algorithm (the European draft standard for Railway Noise measurement since 2002) which is a much more complex modelling method.

Wendover HS2 built two models to calculate the expected train noise. One of these used the HS2 algorithm and the associated "source terms" that describe the various train noise characteristics which forms the basis of the ES. This enabled the evaluation of factors such as noise barrier height and train speed and resulted in the ability to graph the duration and profile of train "pass-by" events including the associated "Sound Exposure Level" enabling quantification of the relative effectiveness of various scenarios.

The second model used the RMR96 principles with the same HS2 source terms. Unlike Arup we were unable to obtain the HS2 source frequency characteristics, but we used profiles in the public domain from Swedish assessments of High Speed Trains.

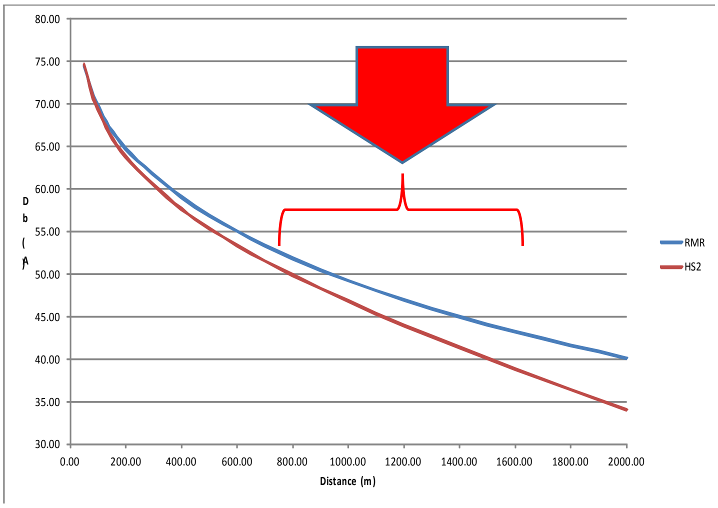
What we discovered were:

The RMR96 method produces a curved graph which more closely fits the 1991 TGV data than the straight line method used by HS1 and HS2.

The differences appear to be related to two factors:

- The relatively low attenuation experienced by low frequencies, and their prevalence due to noise barriers and air absorption.
- The ground effects close to the receptor, where urban features such as roads and pavements will reflect sound compared to the absorption expected with open ground.

The impact of this is a prediction that at a distance of 1000 metres from the line in Wendover the HS2 algorithm underestimates the noise that would be experienced by about 3dB, as shown in the graph below.



This was reviewed with HS2’s Noise Assessment team and it was concluded that while our findings were probably correct, that this divergence could be handled within the 3dB standard margin of error allowed in the ES.