

Noise Mapping & Action Plans: The Rail Industry Realities

Richard Greer, Arup Acoustics (richard.greer@arup.com)
Michelle Francis, Railtrack (part of the Network Rail group of companies)
Adrian Lyons, Railway Forum
Rick Jones, AEA Technology Rail

1. INTRODUCTION

The EU Directive on Assessment and Management of Environmental Noise 2002/49/EC (the 'Environmental Noise Directive' or END) and the Paper Towards and National Ambient Noise Strategy for England are an attempt to cope with increasing levels of mobility in an increasingly crowded environment where individuals feel a need for greater protection and privacy. This is a real challenge.

This paper outlines the pilot studies sponsored by the Railway Forum and Railtrack to investigate the implications of the EU Directive. The studies have formed the beginning of what is hoped will be an effective approach that will ensure that the costs of the Directive and any noise strategy in the UK will result in real world noise control without undue impact on railways which are already the most environmentally friendly mode of mass/public transport. It is hoped that this will help promote informed debate within the acoustic community and thus assist in the successful UK implementation of the Directive and the parallel developments towards an ambient noise strategy for England.

4. PILOT STUDIES

The Railway Forum has sponsored a number of small-scale pilot studies to investigate the implications of the Directive and the Strategy. The first study considered the noise mapping and action plan process. Three sites were selected on three major UK railway lines to reflect the situations that will have to be considered under the Directive.

Selection criteria were:

- An open section of line over at least 1 km;
- At least two types of track layout relative to wayside receivers (one always being straight, at grade, plain open line, the other embankment/cutting/viaduct) – the second type of track layout to be varied between the three sites;
- Residential property close to the lines;
- Residential property arranged parallel to the line (this enabled the barrier effect of rows of residential property to be considered);
- A variety of rolling stock (to encompass diesel and electric passenger stock and freight); and
- Open space to the side of the line to facilitate an estimate of predictions in rural areas with dispersed buildings and otherwise interrupted propagation.

A shortlist of sites, that were visited, was drawn up before making the final selection (selected jointly by Railtrack, Railway Forum and Arup Acoustics).

The sites selected were Didcot: on Great Western Line (GWL), Welwyn: on the East Coast main Line (ECML), and Perry Bar: on the Midland Main Line (MML).

The conclusions from this study and those from other elements of the work undertaken by and on behalf of the Railway Forum and Railtrack are set out in the following sections.

2. NOISE MAPPING

The Directive sets a framework. There are therefore a number of critical issues that have to be determined by each member state.

- What level of noise mapping can / should be undertaken?

The Directive is clear that Strategic Noise Mapping should be undertaken, although it is less clear on the nature of the relationship, if any, between the strategic noise maps and action plans.

It is becoming generally accepted in the UK that Strategic Noise Mapping is a tool to identify overall noise impact (i.e. the percentage of the population exposed to bands of noise levels) and 'hot spots' where action plans need to be instigated. Strategic Noise Mapping is not the tool for developing an action plan. Rather additional specific and more detailed calculations and possibly measurements would be required. A possible form of the resulting process and responsibilities is presented as Figure 1.

This approach is more likely to provide more successful results. To do otherwise, namely to use the Strategic Mapping as the basis for action plans, would necessitate a far higher level of accuracy in the modelling than is realistically feasible in terms of time and cost. Strategic mapping will therefore provide a robust, epidemiological assessment of noise levels at a national county and local authority basis. Strategic noise maps can never realistically also provide accurate noise levels at specific plots of land or properties.

- Who will generate the mapping?

Generating strategic noise mapping that is cost effective and does not add unreasonably to the burdens of industry will require the development of national 3D geographical databases of format and accuracy that can be used by any party undertaking noise mapping. Such databases are currently under investigation but are far from developed.

Railways are also dependent on detailed information with regard to rail level, cuttings, embankments and wayside fences and noise barriers. This information is currently not provided with any accuracy in 'off the shelf' digital mapping but is held (in a variety of formats) by Railtrack. In addition, another key information stream is the number of train movements, their make-up, which lines they traverse over the day, evening and night. Again this information is either held by Railtrack or can be effectively accessed by Railtrack from the Train Operating Companies.

Overall, it makes most sense for Railtrack (or the SRA) to undertake strategic noise mapping for railways, although a precursor to this will be the integration of the railway alignment information into digital mapping datasets. Similarly it makes sense for road authorities to model road traffic noise. The most logical 'responsible bodies' for noise mapping is therefore set out in Figure 1.

- Amalgamation of maps for different sources.

The development of strategic noise mapping by different responsible bodies for each major noise source has benefits as discussed above. However, this approach means generating mapping for agglomerations and many transport corridors will require that the different components be 'added' together. This will require pre-planning and clear, continued guidance and steering from DEFRA and DfT to ensure that the individual maps can be, and are, added together in a manner that is equitable to all noise sources.

Currently the mapping as specified by the directive does not take into account the rail balance factor (i.e. the difference in dose / response relationships between rail, road and air). This will have to be taken into account when deciding thresholds above which action plans should be developed.

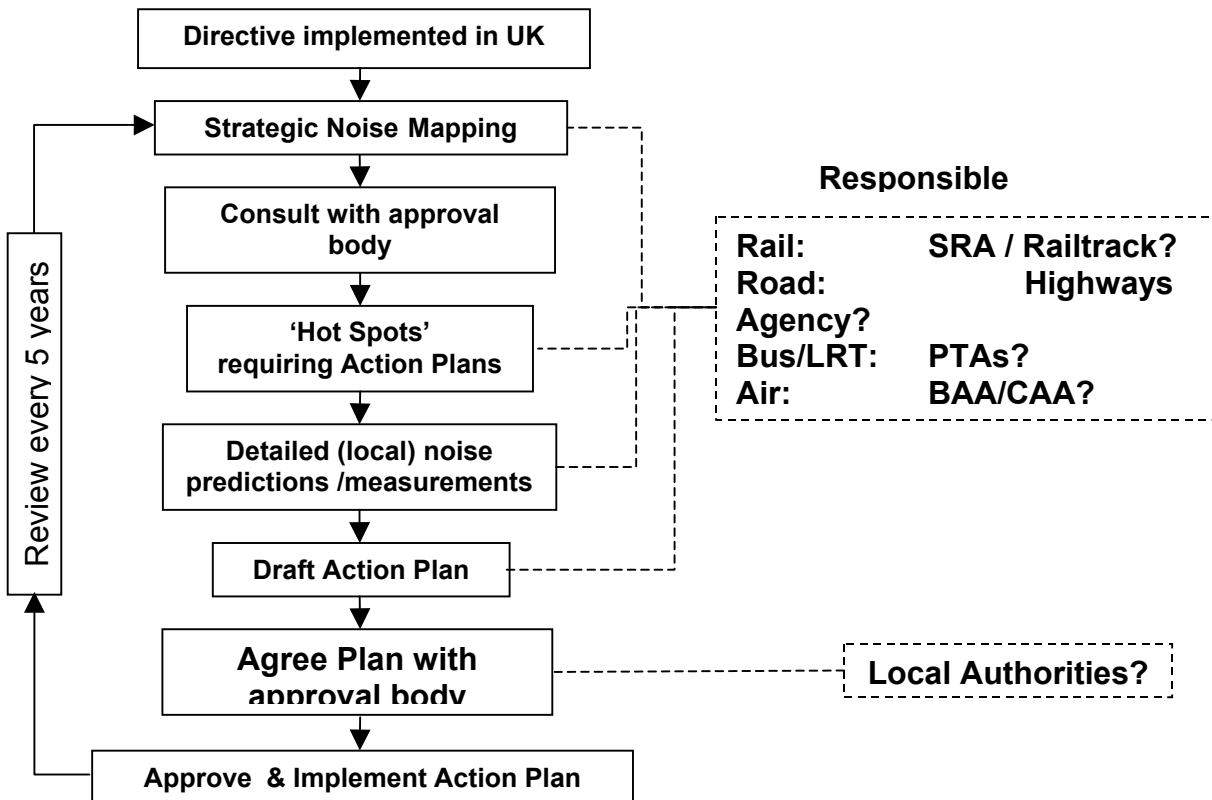


Figure 1: Possible Process for Implementing the Directive

- Routes likely to be modelled under the Directive.

AEA Technology Rail has recently been commissioned by Railtrack to identify, based on number of train movements, the lines in the UK that will require strategic noise mapping. These are shown in Figure 2.

- Information required to map railways

Geographical information:

Rail roughness / Rail positions (horizontal and vertical) / Location of jointed track and switches & crossings / Track type (if not ballast) / Height and shape of railway cuttings and embankments / Location (and type) of bridges / Height (compared to rail) of wayside solid screens and noise

barriers / Topography and ground types around the rail corridor / Height and location of all buildings and other man-made structures.

Traffic information

Number of trains (by class) on each line / Train speed (by class and line)

- Challenges in gathering input information



Figure 2: Lines Likely to be Mapped (in red)

Much of the geographical information required is common with road traffic and other sources. This has implications as discussed below. However, critical elements associated with railway cuttings and embankments are not well detailed in current digital mapping databases because surveys have not generally had access to railway lands for safety reasons.

Parts of the rail network are over 100 years old. This means that whilst the rail industry does hold information that defines rail position and the shape and form of embankment and cuttings it is distributed throughout the country and is often in a varying format and quality. Pulling this data together or acquiring new data to support noise mapping will therefore be a challenge.

Before this data can be converted into digital maps or the data is collected afresh, it is necessary to understand what data is required and at what level of detail.

- Detail of input information: Parity with road traffic and other sources

Strategic noise mapping is intended to give overall epidemiological assessments of the percentage of the population exposed to particular noise levels and to identify 'hot spots' where further analysis and action plans may be required. Strategic noise maps are not intended, and can never practicably provide, noise level prediction on a location-by-location basis (that could be used for local planning purposes for example).

The accuracy of the input information for strategic mapping therefore needs to reflect this 'level' of mapping.

One of the prime objectives of strategic mapping is to identify 'hot spots' that will then be the subject of action plans. As a consequence the strategic mapping will, in some locations, identify specific sources as requiring action plans. It is therefore critical that all sources are treated equitably.

Given that the accuracy of the model is determined in part by the geographical input data, the only means of delivering cost effective mapping in the long term that is equitable to all sources is to develop a national geographical database that can be accessed by any party undertaking strategic noise mapping.

Clearly calculations and analysis undertaken to support action plans will require a higher degree of accuracy in the input information than strategic noise mapping.

- Prediction Methods and Filter Software

The form (specification) of the information included in a national geo-database is to a great extent determined by the prediction methods used. Currently any mapping would be on the basis of CRN for railways and CRTN for roads.

However, the EU has formed a 5th Framework project - 'Harmonoise' - to develop unified road and rail prediction methods to be used by all member states. On the basis that these unified models are unlikely to be available for several years, there is a risk that the development of any national geo-database, which needs to be started as soon as possible to be ready in time for 2006 when the mapping has to be undertaken, could be compromised by the changes in prediction method.

3. ACTION PLANS

Given that strategic noise mapping is intended to identify 'hot spots' and the need for action plans, it may be necessary for strategic mapping to be 'conservative' leading to some over-estimation thus ensuring that the mapping leads, if anything, to false positives. Mapping that 'missed' hot-spots would undermine the entire process.

Once 'hot spots' have been identified, the sources that make-up the overall noise environment in the area need to be identified and ranked, to identify which, if any, require consideration in terms of mitigation. In undertaking this activity it is important to allow for different dose-response relationships (e.g. the rail balance - i.e. for a given L_{den} or L_{night} value the number of people annoyed by road traffic is greater than the number annoyed by railway noise). Historically, in the UK this difference in dose response has been evaluated as 3 dB. However, recent work in Germany suggests that it is actually considerably higher.

In a situation where a hot spot is identified and it is associated with a railway, then it is necessary to know what mitigation options are possible, their effectiveness in terms of noise control, their cost and any engineering implications. Generic mitigation that could be considered includes:

- rail grinding / polishing (assuming that the site selected has roughened or part roughened rails);
- on-track technology: e.g. tuned absorbers and wheel and/or flange squeal control in specific locations;
- noise barriers: although these -
 - provide site specific mitigation only;
 - are expensive to install and very expensive to retrofit (because this can only be done under rail possessions);
 - can be impracticable because there is no space within an existing rail corridor to install them or their installation, without major retaining and supporting structures, would put at risk the railway infrastructure;
 - can cause visual, landscape and right-to-light impacts; and
 - have significant maintenance costs (e.g. in removing graffiti).
- on-train technology: changing from clasp brakes to disc brakes; cast iron to composite brake blocks, normal wheels to damped wheels, provision of encapsulation for engines and traction equipment etc are all in theory

possible. However, they are generally only practicable as part of major refurbishment or procurement of new stock; and

- power system: changing from diesel to electric power for train sets clearly provides potentially significant noise reduction. However, the change not only requires new trains but also (in most cases) would require the line to be electrified. This is therefore an unreasonable and impracticable form of mitigation. As with other on-train technology, the introduction of quieter power sources and traction equipment of the same form (i.e. quieter diesel power trains) is generally only practicable as part of major refurbishment or procurement of new stock

In theory, reduction in speed and / or reduction in traffic volume are mitigation measures. However, firstly they are 'blunt instruments' in terms of noise control. To a first approximation, halving traffic volumes or speed would only provide a 3 dB and 6 dB noise reduction respectively. Secondly, and most importantly, mitigation by these means would have very significant adverse effects on passenger journey times, timetabling and hence over-crowding.

This later point also highlights a very critical matter. Any action plan associated with public transport needs to consider the strategic regional and national implications associated with localised, site specific mitigation; e.g. actions plans must not stifle growth of public transport and overall environmental and sustainability benefits associated with people switching from road traffic to public transport.

The final point about mitigation is the need to consider timescales. The form of mitigation that is most likely to provide strategic benefits is the reduction of train noise as part of new train specifications and the introduction of new, replacement or refurbished stock. This is an area of active development within the EU in the form of technical specifications under the Interoperability Directive and the rail industry in terms of technology.

Once developed, action plans are likely to be approved by a nominated body. In order that any noise mitigation provided is sustainable it is essential that the action plan is negotiated and agreed between the bodies responsible for the approval process and the noise source to ensure that any mitigation proposed is reasonable, practicable and has a good cost benefit ratio.

5. CONCLUSIONS

UK Railway Forum and Railtrack have identified a number of matters that need to be resolved before the EU Directive on Assessment and Management of Environmental Noise can be sustainably implemented in the UK (i.e. without

undue cost and adverse effect on industry and particularly public services). These matters are reported in this paper.