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The use of colours in END noise mapping for major roads

Wiebe Alberts
Ministry of Infrastructure and the Environment, Rijkswaterstaat, Centre for Transport and Navigation, Delft, the Netherlands.

Jesús Rubio Alférez
Ministry of Development, General Directorate of Roads, Madrid, Spain.

Summary
On reviewing the END strategic noise maps produced by national road authorities in 2007, it became clear that the colours used by each member state to depict the various noise bands differed significantly across Europe. In order to standardize END strategic noise maps, it is recommended that each national road authority should follow a common approach to the colours used in noise mapping the major roads in their respective networks. Such a colour scheme should fulfil several considerations. It should cover a wide range of 5 dB noise band contours e.g., from 40 dB up to levels greater than 80 dB. All noise bands below 50 dB should be depicted with green colours and the colour red should be used to depict the noise band of 65-69 dB. Also, there should be sufficient differentiation between the colours to avoid problems with printed versions of the maps. Based on these considerations, a diverging colour scheme is recommended for the noise bands covering the range from 65-69 dB down to 35-40 dB. For noise bands greater than 65-69 dB and up to greater than 80 dB, a sequential colour scheme is recommended. This results in a proposal for a colour scheme to be used in END noise mapping for European major roads.

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1. Introduction

On reviewing the END strategic noise maps produced by CEDR national road authorities in 2007, it became clear that the colours used by each member state to depict the various noise bands differed significantly across Europe (see figure 1). At a European level, there appears to be no coordination regarding the choice of colours to be used for the various noise bands under consideration.

1.1. Objectives

In order to standardize END strategic noise maps across the EU, it is recommended that each CEDR member state should follow a common approach to the colours used in noise mapping the major roads in their respective networks, provided that national legislation does not dictate the use of specific colours.

In addition, to ensure that there is more consistency on the use of colours in END strategic noise mapping, it is proposed by CEDR Project Group Road Noise that there be coordination on this issue between the various experts groups working on the development of the common noise assessment methods in Europe (CNOSSOS-EU). To date, no work has been undertaken in the area of a colour scheme for END noise mapping. Any proposal from CEDR Road Noise would be welcomed, especially by the working group dealing with the development of guidelines for the competent use of the CNOSSOS method.

1.2. Searching for an existing solution

ISO 1996:2 [1] defined a range of colours to be used for the presentation of noise maps. In the second edition of ISO 1996:2 [2] they cancelled the relevant section of the first edition in which colours were defined. However, in Germany for instance they still use the colours based upon those set out within ISO 1996:2 [1] since it is required by national legislation.

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Noise band [dB]:	AT	BE	DE	DK	EE	ES	FI	FR	GR
35-39 (<40)									
40-44									
45-49									
50-54									
55-59									
60-64									
65-69									
70-74									
≥75 (75-79)									

Noise band [dB]:	IE	IT	LV	MT	NL	NO	PL	SE
35-39 (<40)								
40-44								
45-49								
50-54								
55-59								
60-64								
65-69								
70-74								
≥75 (75-79)								

Figure 1. Colours used to depict noise bands by a number of CEDR member states during the first round of END strategic noise maps for major roads.

1.3. Initial steps for the development of a colour proposal

In preparing a proposal for the use of specific colours for various noise bands, the proposal should fulfil the following considerations:

1.3.1. Cover a wide range of noise bands

The proposal should cover a wide range of 5 dB noise bands, from 40 dB up to levels greater than 80 dB, including:

- noise bands up to 80 dB and more for mapping very high noise levels;
- noise bands down to 40 dB in order to cope with the possible addition of noise bands with low noise levels in the future as proposed by the EC in their report: "In the current Directive, Member States are required to use specified noise indicators of L_{den} and L_{night} and report the noise exposure of the population of 55 dB and 50 dB or more, respectively (...). However, the current reporting neglects the fact that there is a considerable share of EU population exposed to noise pollution at lower levels which are still likely to cause harmful effects on health (…). According to the latest WHO recommendations, reporting bands of the indicator values of L_{night} should be lowered to 40 dB L_{night} in order to achieve a much more realistic assessment of noise pollution impacts across the EU" [3].

Having noise band colours covering the range from 40 dB up to greater than 80 dB does not mean that all bands have to be used in strategic noise mapping. According to the information in figure 1, most CEDR member states will use the noise bands in the range from 45-49 or 50-54 dB up to 75 dB and more in their second round noise mapping for major roads.

1.3.2. Green colours for noise bands below 50 dB

In general, there seems to be a consensus that noise levels around 50 dB L_{den} represents a good quality noise environment [4]. Therefore, it is accepted that all noise bands below 50 dB should be depicted with green colours, because such colours are normally associated with a safe and good quality environment.

Considering the scientific evidence on the thresholds of night noise exposure, a $L_{night,outside}$ of 40 dB should be the target of the night noise [5]. Therefore, a noise band of less than 40 dB should have a dark green colour indicating that this noise band represents the best situation. Under the present END regulation mapping noise levels in the range of 40 dB and lower is optional, so noise maps do not have to show these low level noise bands.

1.3.3. Limiting the area of noise mapping

Mapping low noise levels will:

- increase the need for data regarding surrounding terrain, buildings and population, resulting in increasing costs for obtaining and processing these additional data;
- exceed, at least in some cases, the validation distance of noise calculation models, limited to for example 800 metres in the proposed CNOSSOS-model [6] and the French road noise prediction model [7] and to 600 metres in the Dutch road noise calculation model [8];
- result in maps that give the public a too optimistic representation of the actual noise levels, certainly far from the major road, because accumulation of noise from other sources is neglected in mapping noise from major roads.

To avoid these problems, one can chose not to map low level noise bands far outside the validation distance of the noise calculation model.

1.3.4. Red colour for noise band 65-69 dB

In many EU member states, noise levels above 65 dB L_{den} are considered to be problematic due to annoyance and associated health implications. Therefore, the colour red is used to depict the noise band of 65-69 dB. For noise bands with levels greater than 65-69 dB, dark red and violet colours are used to indicate a deteriorating noise situation.

1.3.5. Suitable for different noise indicators

It is also proposed that any colour proposal should not only be suitable for use with noise indicators such as L_{den} and L_{night}, but also for supplementary indicators such as L_{day}, $L_{evening}$ and L_{Amax}. It is recommended to use the same colours in situations where noise levels are the same for different noise indicators. The justification for such recommendation is that noise maps should give objective information about noise levels in dB. From the perspective of annoyance or health risks however, the impact of e.g. 60 dB L_{den} is not the same as 60 dB L_{night} or 60 dB L_{Amax}.

1.3.6. Definition of colour codes

The colours should be given in RGB (Red, Green, and Blue) and HEX (hexadecimal) code.

1.3.7. Noise band of 5 or 10 dB

Some EU member states, such as Sweden for instance, tend to use noise mapping based on the 55, 65 and 75 dB contours instead of a range of 5 dB noise bands. In such circumstances, these member states should use the colour of the 55-59, 65-69 and 75-79 dB noise bands to map their specific noise bands. And in case of adding the 45 dB contour or the noise band less than 55 dB, simply use the colour for the 45-49 dB noise band.

1.3.8. Differentiation between colours

Current computer monitors are capable of showing all colours. However, printing such colours may present some difficulties. In some situations, the differentiation between colours disappear or are not entirely evident. Although, the colour proposals have been tested on different computer monitors and printers throughout Europe, there still may be some minor problems with the differences between the proposed colours while printing maps based on these colours. In situations where a map reader can see subtle differences between the individual colour patches in a legend, this does not mean that they will be able to recognize those same differences on a map [9].

1.3.9. Transparency of the colours and topographic information

To prevent colours fading, it is recommended to use non-transparent colours for the noise bands. And to facilitate orientation, topographical information like roads, buildings, rivers, etc., should be used as the layer(s) at the highest level(s) in a geographical information system. But the topographic information must not be conspicuous. To prevent the topographical information dominating the noise map, it is recommended to use (partially transparent) light gray colours.

2. CEDR Road Noise colour proposal

Colour plays a central role in thematic cartography. Despite this, using colour effectively on maps is surprisingly difficult. On the one hand, a good colour scheme needs to be attractive while on the other hand, the colour scheme should support the purpose of the map and be appropriately matched to the nature of the data [10].

Diverging colour schemes use a light/neutral colour to represent average values and contrasting dark colours for low to high values. A diverging colour scheme is made for the noise bands from 65-69 dB down to 35-40 dB, based on the use of yellow to represent the average value and the use of green and red for low and high values. For the noise bands from 65-69 dB up to 80 dB and more, a different approach is used. For these higher noise bands, a sequential colour scheme is proposed, using intervals of two colours graduating from light to dark with low values in the lighter red colours and high values in darker blue and violet colours. Fortunately, there are a number of software tools available, such as Colorbrewer2 <http://colorbrewer2.org/> and RGB Color Gradient Maker <http://www.perbang.dk/rgbgradient>, to assist with colour scale generation for different schemes.

Therefore, based on the requirements outlined above, the CEDR Project Group Road Noise has developed the following proposal for a colour scheme to be used in END noise mapping for European major roads (see figure 2).

References

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[9] C. A. Brewer: Evaluation of a model for predicting simultaneous contrast on colour maps. The Professional Geographer 49 3 (1997) 280-294.

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Noise band [dB]	Colour	RGB code	HEX code	Name
less than 35	none			
35-40		R: 35 G: 132 B: 67	#238443	Moderate sea green
40-44		R: 120 G: 198 B: 121	#78C679	Greyish green
45-49		R: 194 G: 230 B: 153	#C2E699	Light greyish chartreuse green
50-54		R: 255 G: 255 B: 178	#FFFFB2	Pale yellow
55-59		R: 254 G: 204 B: 92	#FECC5C	Light brilliant amber
60-64		R: 252 G: 141 B: 60	#FD8D3C	Brilliant tangelo
65-69		R: 255 G: 9 B: 9	#FF0909	Light brilliant red
70-74		R: 179 G: 6 B: 34	#B30622	Moderate amaranth
75-79		R: 103 G: 3 B: 59	#67033B	Dark rose
80 and more		R: 28 G: 0 B: 84	#1C0054	Deep blue violet

Figure 2. Colour proposal for the various noise bands to be used for END strategic noise mapping.