



## **FROM STRATEGIC NOISE MAPS TO ACTION PLAN: PERSPECTIVE OF SPANISH MAIN ROADS**

The General Directorate of Roads of the Spanish Ministry of Public Works is finishing the process of Strategic Noise Mapping of Spanish Major Roads (EGRA). The whole National road network noise mapped for the first END has a length of 6.400 km round. The present paper contains – Some conclusions from the process of Noise Mapping; – A general view of the process of making decisions about Action Plans; - Definition of the first steps to decide the scope of Action Plans: design of a pilot study to establish the elements needed technical studies, coordination with other administration bodies and public involvement.

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### **1. INTRODUCTION**

During the last three years, the General Directorate of Roads of the Spanish Ministry of Public Works, has been working in the process of making the strategic noise maps of the major roads. To comply with the requirements of the Directive 2002/49/EC *relating to the assessment and management of environmental noise (END)*, 6.000 kilometres of the national road network (Red

de Carreteras del Estado) have to be mapped and have to be approved after the process of Public information.

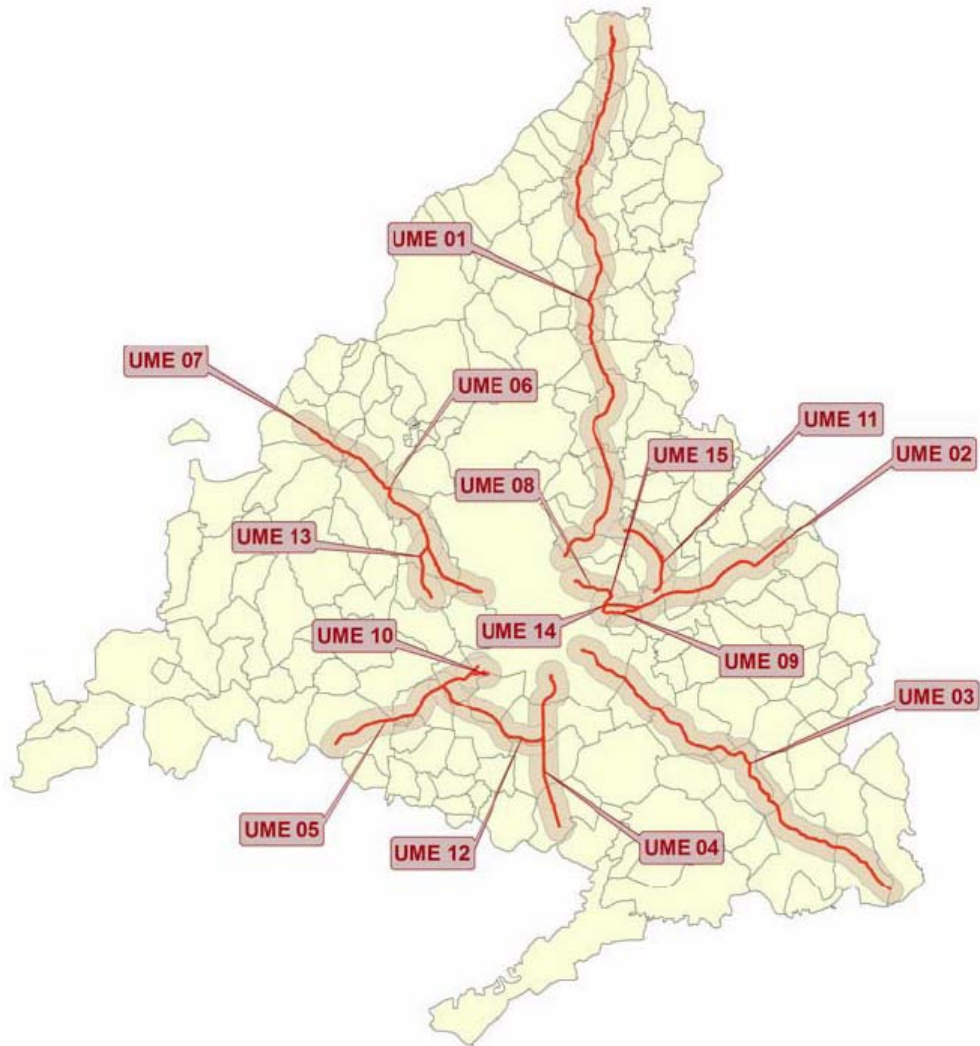
The process of noise mapping for the first phase is going to finish this year with the action plans. The object of this paper is to present how these maps were made, where are the maps for consultation and what form do they present so the information are comprehensible and useful for the next steps: the action plans.

## **2. STRATEGIC NOISE MAPS**

The END requires that Major Roads (roads that have more than six million vehicles a year) must have finished the noise mapping in 2007. This is known as the first phase of implementation of the END). Later, in a second phase (year 2.012) roads with more than 3 million vehicle passages a year, will have their maps made and those that were made in 2007 will be reviewed and updated.

The General Directorate of Roads is responsible of 25.000 km round of the national road network in Spain. 6.000 km of roads mapping were made and it is estimated that another 6.000 km will be mapped in 2.012. So it is expected that the half of the national road network will be mapped in the second phase.

The first concern is to define a Unit of Strategic Map (UME) of each road. The criteria are continuity and geometric design of the roadway. All the information that the END requests of exposed population, dwellings, schools and hospitals, is analyzed for each UME separately.



*Picture 1. Example of Units of Strategic Maps in the Region of Madrid.*

The General Directorate of Roads has carried out 20 studies. Each study includes several major roads of a region.

The strategic noise maps are presented as graphical plots with numerical data in tables of the number of people, dwellings, schools and hospitals that are exposed to specific values of the indicator  $L_{den}$  and  $L_{night}$ . In addition, the same analysis is done for the indicators  $L_{day}$  and  $L_{evening}$ .

### **3. THE CREATION OF EGRA**

The strategic noise maps of the national roads are available in the website [www.cedex.es/egra](http://www.cedex.es/egra). All the information can be consulted and downloaded from this website.

In each study there is a description of each UME that has more than 6 million annual vehicles.


The information that requires END is in EGRA:

- A report summary that summarizes the main characteristics of the study
- Maps of noise.  
There are three types of maps for each UME standardized according to the Spanish sheet division of the National Geographic Institute:
  - Noise map of isophones  $L_{den}$
  - Noise map of isophones  $L_{night}$
  - Map of affected zone. It contains information related to  $L_{den}$  and includes a table with the number of people, dwellings and surfaces exposed to  $L_{den}$  values higher than 55, 65 and 75 dB.

### REGION OF CANTABRIA

The zone of study is located in the region of Cantabria. In a first approach two corridors can be distinguished. They go from East to West and North to South and they intersect at Torrelavega, where all road sections of this study are located.

From East to West, the study area begins in the limit with the Province of Biscay and finalizes in the neighborhoods of Cabezón de la Sal. From North to South, the corridor begins in Santander and finalizes in Los Corrales de Buelma.



*Press the image to see the distribution of IGN sheets*

The study has been divided in the following seven UME's:

- **UME 01. S-10**, (old N-635), from the access to Santander to Astillero, PK. 2,010 to PK. 7,090.
- **UME 02. S-20**, from north access to Santander to Bezana, PK. 0,000 to PK. 5,150.

*Picture 2. Region of Cantabria in Spain. Description of each UME.*

*Tabla de población afectada*

• SELECCION POR HOJA

Hoja 607-I\_Fuentidueña de Tajo

Hoja 633-IV\_Montalbo

**Hoja 607-III Belinchón**

Hoja 624-III\_San Lorenzo de la Parrilla

Hoja 607-IV\_Tarancón

Nivel sonoro Lden
Nivel sonoro Lnoche
Zona de afección

Hoja 633-I\_Saelices

Hoja 632-I\_Claricas

Hoja 690-I\_Pinarejo

Hoja 632-II\_Fuente de Pedro Naharro

Hoja 690-II\_Honrubia

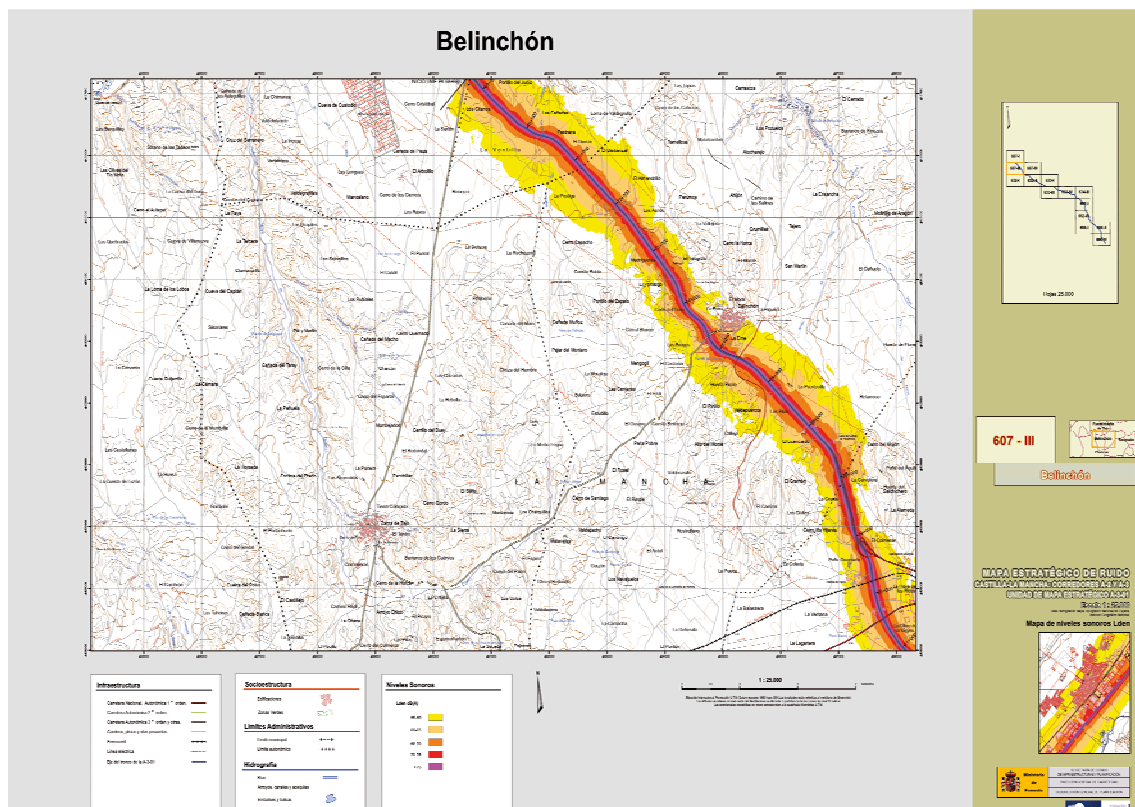
Hoja 633-I\_Saelices

Hoja 690-II\_Honrubia

Hoja 633-III\_El Hito

Hoja 690-IV\_El Cañabate

Picture 3. Spanish sheet division of the National Geographic Institute.

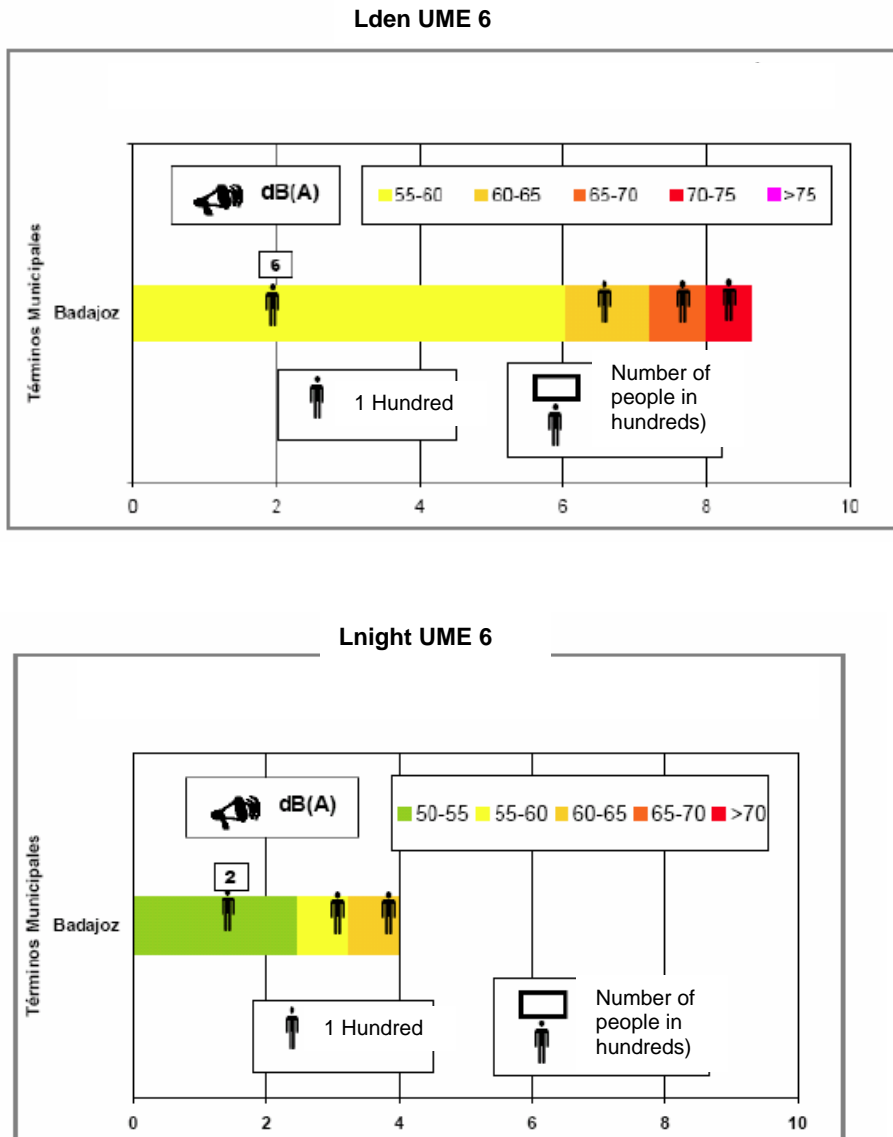


Picture 4. Map of isophone Lden





Each Unit of Strategic map presents a table with the population exposed to the indicators,  $L_{den}$  and  $L_{night}$  in 5 dB ranges.



Picture 7. Example of tables with the number of people (in hundreds) exposed to bands of  $L_{den}$  and  $L_{night}$ .

#### 4. DIAGNOSIS AND ACTION PLAN

The report summary is a document that summarizes the main characteristics of the study, the local and regional legislation in the zone, the description of the roads, and an analysis of the conflict areas with the possible solutions.

It is important to have a description of the acoustic situation in each zone due to the number of people exposed to the noise and the presence of schools and hospitals. Furthermore, two new ideas are included:

1. The identification of the most exposed zones
2. To establish a diagnosis of these areas.

#### 4.1. Methodology in the proposal of actions: types of solutions

Firstly, it is necessary to define the affected zones. Secondly, a solution is proposed in each affected zones.

There are two main types of solutions. One of them is the noise barrier and the other is called in the studies as “other solutions”. Noise barrier is one of the most well known and effective tool of mitigating roadway noise sources. However, with certain locations and topographies the noise barrier is not suitable for reduce the noise, so it is necessary to make a more detailed and specific study. The proposal is called “other solutions”.

The joint of these proposals will form the action plan and will provide the effective tools for noise pollution abatement.

CONFLICT ZONES						
UME	Length	Name Conflict Zone	Lenth (meters)	% UME length	Conflict	Proposal
S-10	5.080	Maliño	1.000	7 %	Population closet o the road	Noise Barrier
		Astillero	1.500	29 %	High number of dwellings near to the road	Complex solution
S-20	5.150	Santander	1.000	20 %	New buildings. Close to a future technologic park	New buildings in the future, noise barriers
N-623	6.780	Murieras	1.000	14 %	Dispersion of people.	Complex solution
A-67-01	12.500	Los Corrales de Buelna	1.000	9 %	Buildings with different heights	There are noise barriers

*Table 1: Summary of the most exposed zones in some UME ´S and proposals.*

The possible solutions in the exposed areas are the followings:

- Acoustical barriers: it includes all those reducing devices of noise, type soundwall, embankment or a combination thereof (such as a wall atop on earth berm) that screen and absorb the noise emitted by the road.
- “Other complex solutions”. In some cases noise barriers are not effective by the urban character of the road, in other cases because there are two or more



sources affecting the disturbance of the population. The solution should be taken not only by the road, but also by the other sources.

#### 4.2. Criteria applied in the noise protection.

The criteria applied are not universal for the whole road network. Although the source –the road- the terrain and the buildings are perfectly defined, different cases appear to define a typology of situations and solutions.

The criteria have been based on the number of people exposed to the  $L_{night}$  indicator of 55 dB in consolidated residential zones and the number of schools exposed to levels of 60 dB  $L_{day}$  and the number of hospitals. This new parameter is called **exposure degree**. This parameter takes into account the sensitive land uses to protect them from noise pollution.

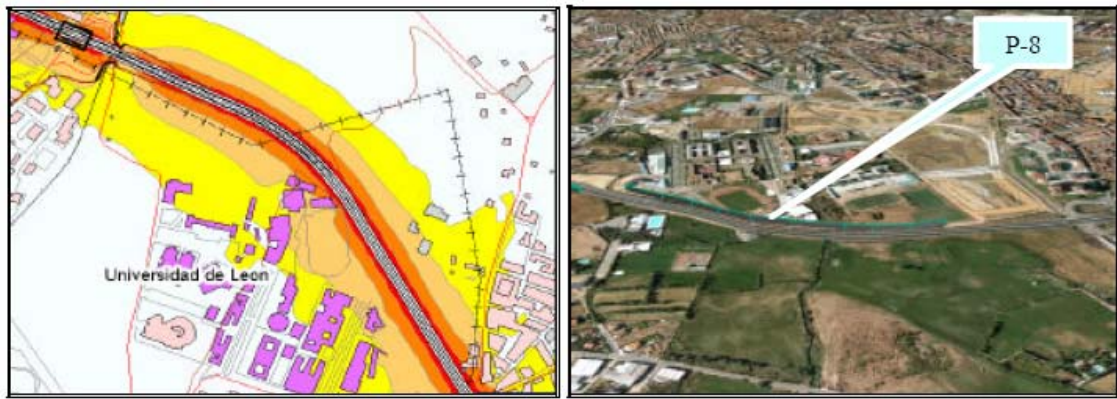
The easiest case is when the area has mainly residential use, it means that a great number of buildings are used as residential, and the situation and the height of the buildings allows protecting the zone with an obstacle as a noise barrier or embankment (acting as a noise barrier).

So in these areas the proposals are based on the number of people exposed to the indicator  $L_{night}$ .



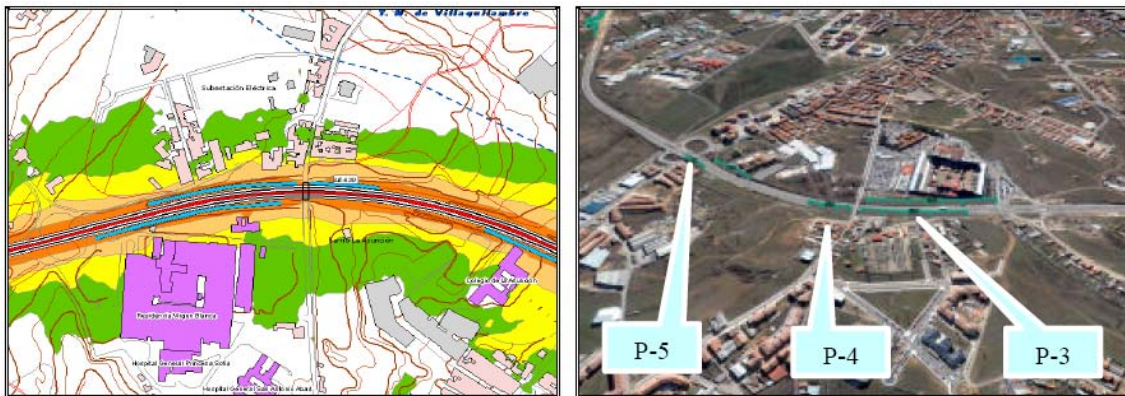
Picture 8. Maps of  $L_{night}$  and acoustic barriers.

In other cases, where the existing construction is mainly of educative use; the solutions considered are based on the number of people who are affected by high sound levels but only during the day period.



Picture 9. Maps of Lday. University area in León.

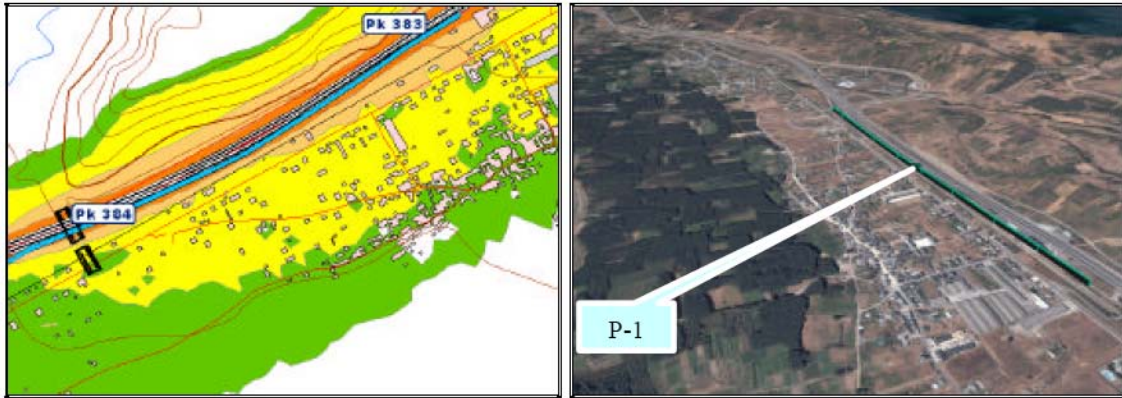
In other situations there are zones with different uses (residential, educative, sanitary) combined in both edges of the road and it is necessary to evaluate indicators during all the period.



Picture 10. Maps of Lnight. Dwellings and schools.

In other places there is a great dispersion of houses. Here, the number of people is not very height by km of infrastructure, but there are population exposed to the noise of the road. Which is the best solution? It is not only a problem of the noise produced by the road, but also is associated to a specific distribution of the land use. There are two solutions: doing nothing or constructing a continuous barrier all along the road.



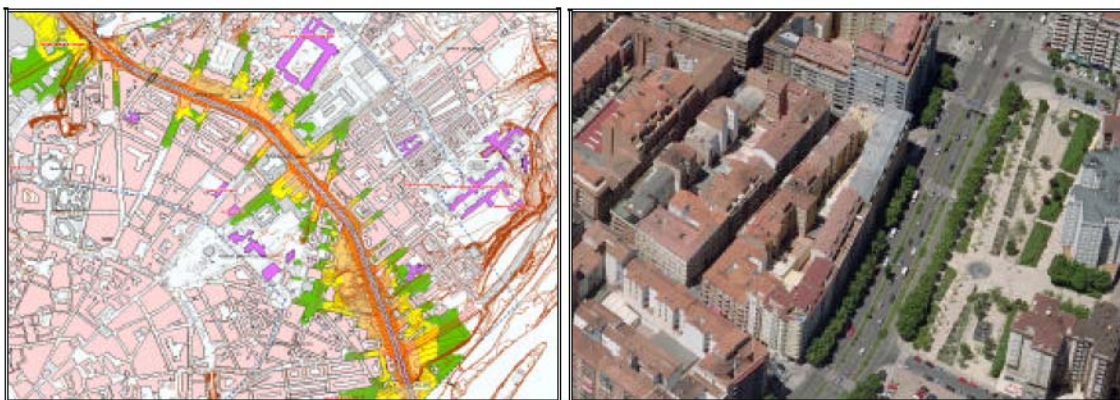


*Picture 11. Maps of Lnight. Dispersed houses.*

In Spain there are roads near the coast. These areas present a special characteristic in comparison with the rest and it is because the existence of houses called “second residence”, occupied during the holidays. It is not evident how this singularity would have to be approached. In most of the cases these houses are occupied only one certain part of the year, during the months of the summer and they are empty during the rest of the year. How is it possible to compare the priorities reflected in some studies with the others? The Directive has not considered the factor seasonal and the partial occupation of the dwellings.

Furthermore, noise maps of arterial network are made although in fact these roads are streets in urban zones.

These “urban roads” are integrated in the city, and it is necessary to indicate that the noise that supports the population is not only due to the traffic of the road, but also from different sources in the city. In this case the idea of major road as it is defined in the END is lost, because it has to be associated to the traffic of long distance.



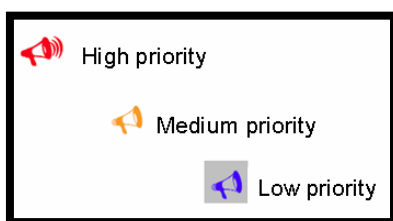
*Picture 12. Maps with the indicator Lnight in urban zone.*

### 4.3. Priorities in the proposals

A new concept is established and it is called “environmental benefit” or “sonorous benefit”. It means the effectiveness forecast for the implementation of the solution. Noise barriers can be extremely effective tools for noise pollution abatement, but certain locations and topographies are not suitable for use of any reasonable noise barrier.





- It is considered that the environmental benefit is high when it is expected to obtain good results with his execution; it is the case of noise barriers located in zones with low buildings (one or two floors of height), and/or located below the platform of the highway in densely populated zones.
- The environmental benefit is medium when it is expected to obtain an improvement on the current situation although this improvement is not able to eliminate the affection totally (acoustical barriers located in areas with constructions of several floors).
- The environmental benefit is low when it is foreseen that the improvements obtained with these solutions are going to be limited. This is the case of sound barrier located in zones with high buildings close to the road or located to a height level over the ground.

Based on the exposure degree and the effectiveness in the implementation of the solution or environmental benefit, priorities are established classified in three levels: high, medium or low. This is very useful for noise pollution abatement and for the application of a program in the action plan.



*Picture 14. Priorities in the UME.*

Finally, it is necessary to mention that the next steps that are going away to undertake consist of making an analysis with all the studies to establish global priorities, and defining a reference parameter to evaluate the efficiency of the proposed actions, in this case, noise barriers design adjacent to a specific roadway.

UME	PK	Name	Edge	Building type	Length (meters)	Proposal	Priority
A-66	12	La Vega	Right	Detached, 1-2 heights	200	Noise barrier	
A-66	14	Santa Rosa	Right	Semidetached, 1-2 heights	250	Noise barrier	
A-66	18	Fonciello	Left	School	100	Noise barrier	
A-66	21,5	La Fresneda	Boths	Buildings of 4-5 heights	700	Complex solution	

*Table 2. Example of UMES with proposals and priorities.*

## 5. CONCLUSIONS:

In the studies made in 6.000 kilometres of the Spanish national road network there have been detected zones with consolidated constructions, distinguishing residential, sanitary and educative uses and determining the possible solutions for each UME. An action priority has been marked where it is estimated that the noise affects more population and a priority classified in three levels (high, medium and low) is marked. The exposed population, the presence of specific buildings (hospitals and schools), the indicator named as a exposure degree, - index defined by the values of exposed population to  $L_{night}$  by unit of length and the number of schools exposed to  $L_{day}$  by km of length, and the number of hospitals exposed to noise during the three periods (day-evening and night)- and the viability of the proposals, are defined in these studies. A priority has been established for each area. The priority weighs the necessity of an action and the viability and the effectiveness of the proposal.

From this first approach to the strategic noise mapping of the roads some conclusions have been extracted:

1. It is underlined the importance of the creation of a website to exchange information of the strategic maps of environmental noise.
2. It is necessary to have a tool that allows evaluating the benefit of the measures and to establish priorities in the proposals.
3. The criteria established in the noise maps have been specific for each zone. It is necessary to define a reference parameter to evaluate the efficiency of the propose measures.
4. It is necessary to incorporate a pursuit so that once the noise barriers are built; the effect of the measurements should be quantified