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**Results of the first round of the strategic noise maps in Spain and actions derived.**

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**1. NATIONAL ROADS NOISE MAPPING**

The 37/2003 Noise Law of 17 November, which incorporates into the Spanish Legal System the 2002/49/EC Directive of 25 June, relating to the assessment and management of environmental noise, has come to fill an important national regulatory gap with reference to compliance with the health and environmental protection constitutional mandate.

The body responsible for the creation of strategic maps for the major state-owned roads is the Ministry of Public Works, which has acted through the General Road Directorate.

The development of Strategic Noise Maps has been organised by grouping roads into geographical areas and traffic corridors. Twenty studies have been carried out, all following the same methodology.

Each of these studies is guided by a common template. The Strategic Map Units (SMUs) are initially defined; SMUs consist of a road section, or group of adjoining sections, with the same denomination and traffic features. Due to its characteristics, the SMU is a unit which cannot be divided when calculating the exposed population. This needs to be taken into account when handling the information. For each SMU, the appropriate calculations are carried out and noise maps drawn up. In total, Strategic Noise Maps have been developed for 213 SMUs, covering 4,779 km of state roads belonging to the National Network (the maps done by the state-owned toll motorways and other administrations are not included).

The general structure of the studies consists of a report, appendices and a map collection, the content of which is detailed below:

Report: - General description of the study.

- Legislation.
- Basic strategic maps.
- Detailed strategic maps.
- Analysis and conclusions regarding the acoustic evaluation of the area under study.
- Actions against noise proposal.

Appendices:

- Urban planning, land uses and acoustic area definition.
- Building analysis.
- Obstacle inventory.
- Traffic data.
- Studies detailed in Phase A.
- Inventory of buildings and residential areas under construction.

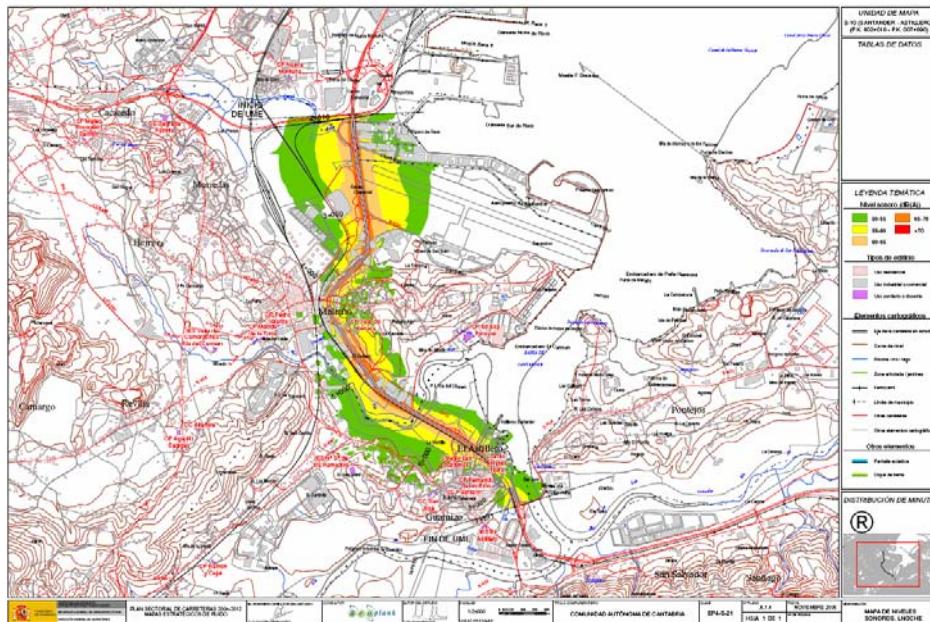
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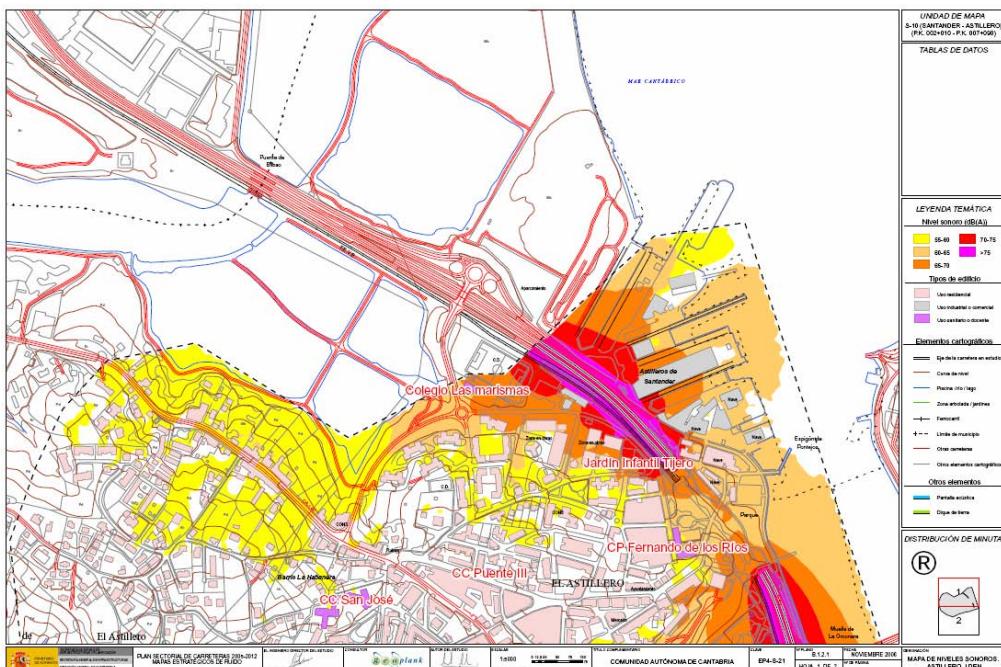
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Maps: - Phase A: Basic Strategic Noise Maps.

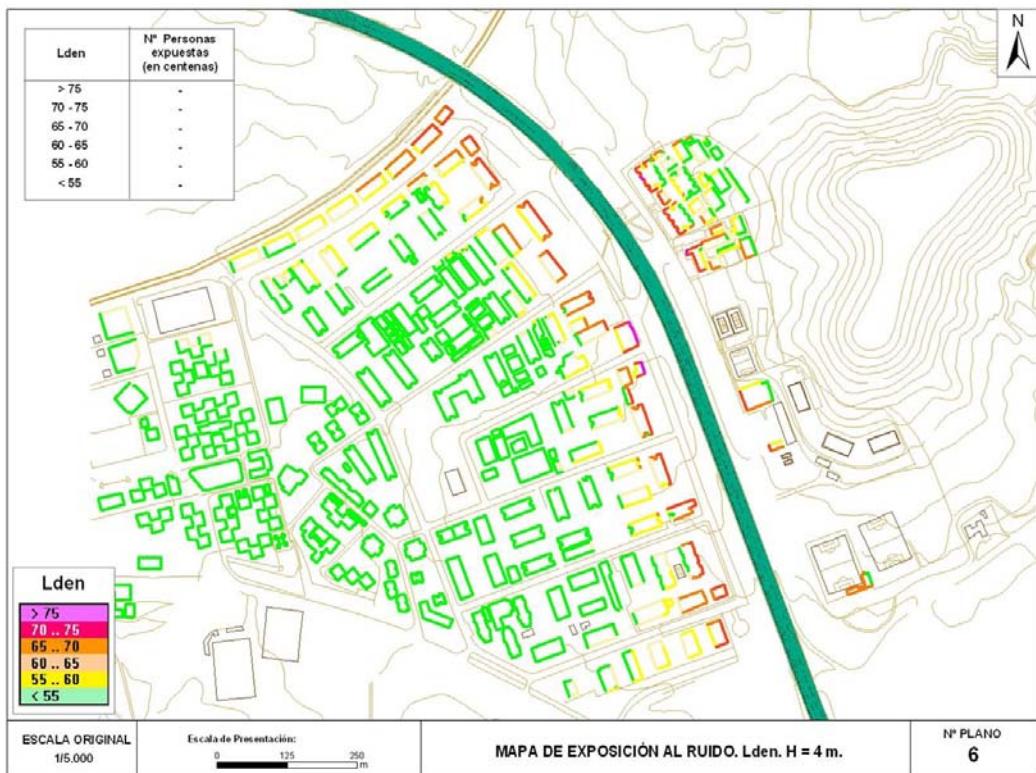
- Sound level Maps.
- Exposure Maps.
- Affected Area Maps.
- Demarcation of detailed study areas.
- Phase B: Detailed Strategic Maps.
- Sound level Maps.
- Exposure Maps.



**Figure 1:** Example of basic map



**Figure 2:** Example of detailed map



**Figure 3:** Example of façade map

In order to facilitate access to information regarding the methodology adopted and the main results obtained, and to fulfil the public information demands for the strategic noise maps, the General Directorate of Roads of the Ministry of Public Works has authorised a website where one can consult the main results and most relevant noise maps from all the studies undertaken: [www.cedex.es/egra/](http://www.cedex.es/egra/)

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**Access to studies and strategic noise maps (only spanish)**

1. A-42: Madrid M-40 - Toledo

2. Sierra Nevada Highway (A-44) and N-323: Bailén - Motril

3. Autovía del Sur Jaén-Sevilla

4. Lleida Province

5. Tarragona Metropolitan Area

6. Region of Asturias

7. Andalucía Occidental (Sevilla - Huelva - Cádiz)

8. Andalucía Oriental (Málaga - Granada - Almería)

9. Galicia

10. Castellón Province

11. Barcelona, Girona and Tarragona Provinces

12. Region of Cantabria

**STRATEGIC NOISE MAPS**

The General Directorate of roads has made 20 studies that include all major roads of its responsibility (5,000 km approximately). Each study (except first) includes several major roads, generally, a complete Province or a "Comunidad Autónoma" (region), or one or several traffic corridors.

The following information is available for the public, and it can be consulted and downloaded from this web site.

**ACTION PLAN AGAINST NOISE SNAP (2008-2012)**

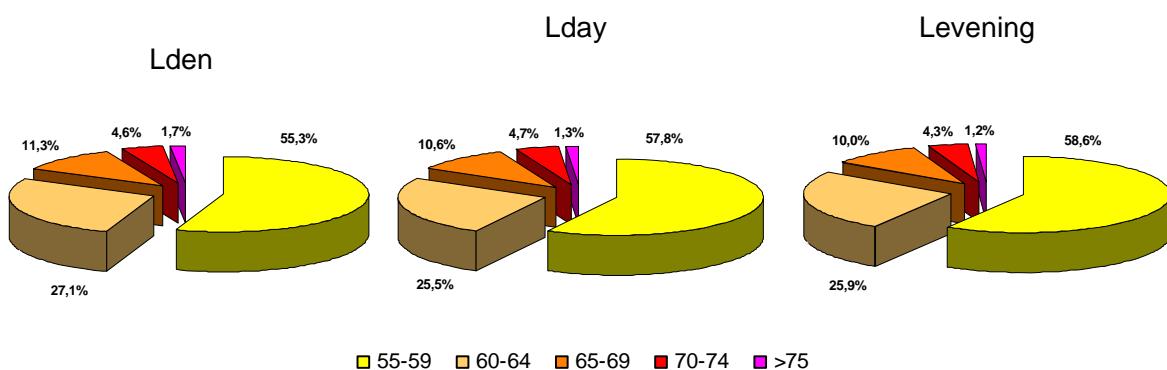
- [Summary](#) (pdf file)
- [Anejo I: datos suministrados a la Comisión Europea](#) (zip file) (in Spanish)
- [Anejo II: resultados por Demarcaciones de Carreteras del Estado](#) (pdf file) (in Spanish)
- [Anejo III: Datos de población expuesta](#) (pdf file) (in Spanish)

**ARTICLES AND PUBLICATIONS**

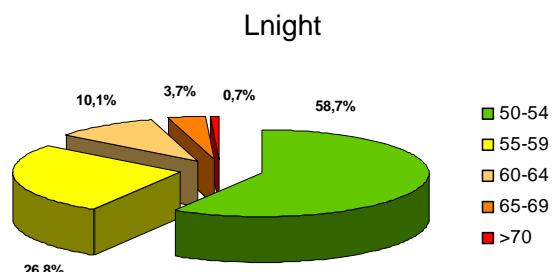
The total exposed population results for the group of National Network roads included in the first implementation phase of the 2002/42/EC Directive are those found below:

Exposed population in hundreds.

Indicator	55-59	60-64	65-69	70-74	>75	TOTAL
Lden	9,084	4,461	1,852	756	283	16,436
Lday	5,157	2,276	946	423	115	8,917
Levening	6,277	2,779	1,075	459	126	10,716



Indicator	50-54	55-59	60-64	65-69	>70	TOTAL
Lnight	6,062	2,761	1,042	378	76	10,319



The SMUs studied vary notably, from less than 1 km up to more than 100 km. To find the concentration level of the exposed population, the relationship between the total exposed population (number of people exposed to values Lden>55 dB(A)) and the length of the detailed mapping has been calculated. This data shows the amount of people who are concentrated in one km of road in a densely built-up area.

Population distribution per road length studied

Demarcation	Length studied	Population* Lden>55 dB(A)	Nº inhab. exposed per km.
Western Andalucía	586.06	1,768	302
Eastern Andalucía	525.92	2,259	430
Aragón	186.54	450	241
Cantabria	135.03	827	612
Western Castilla y León	320.02	607	190
Eastern Castilla y León	148.86	115	77
Castilla La-Mancha	632.38	978	155
Cataluña	514.98	3,609	701
Madrid	386.67	1,886	488
Valencia	703.70	1,217	173
Extremadura	37.43	204	545
Galicia	279.22	1,121	401
Asturias	126.02	775	615
Murcia	196.37	621	316
<b>TOTAL</b>	<b>4,779.20</b>	<b>16,437</b>	<b>344</b>

NOTE\*: Lden>55dB(A) population in hundreds.

The affected area maps represent Lden indicator noise contours for values equal to or above 55, 65 and 75 dB (A). Apart from the graphic representation, the map incorporates data referred to the number of dwellings (estimated in hundreds), number of schools and hospitals (in units) and the surface area data (in km<sup>2</sup>) included in the areas delimited by these noise contours.

Totals for the affected areas.				
Lden LEVEL	AREA (km <sup>2</sup> )	DWELLINGS (hundreds)	Nº of HOSPITALS	Nº of SCHOOLS
>55	5,254.52	7,753	123	1,423
>65	1,393.22	1,486	47	389
>75	334.70	180	9	45

The following conclusions can be drawn from the global results:

-The European framework against environmental noise, in accordance with the 2002/49/EC Directive, includes the need to draw up Strategic Noise Maps. In that way, all the Spanish state-owned roads with traffic levels (2003 data) above 6 million annual vehicles have been studied. Approximately 4,779 km of roads have been mapped.

-During Phase A, noise maps at a 1:25,000 scale have been developed for all the road sections considered. Besides, detailed studies at a 1:5,000 scale (Phase B) have been undertaken in areas with higher population concentrations, where a more exhaustive study is needed. Phase B covers a total 730 km of road, which represents 15% of the total road length studied. These areas are mainly concentrated in big cities and metropolitan areas such as Sevilla, Madrid, Barcelona and Valencia.

-The population included in the study area, which is the population potentially exposed to values above 55 dB(A) Lden, is approximately 3,140,000 people. After calculating the exposure levels on façades, the population truly affected by these noise levels is close to 1,644,000. These results confirm the need to calculate the noise that affects building façades, in order to identify dwellings which are not directly exposed to road noise.

-The Directive requires the different exposure ranges to be calculated for each of the indicators. The main conclusions per indicator are analysed separately below:

-For the Lden indicator, the total population exposed to values above 55 dB(A) is 1,643,600. Over half of this population (55.3%) is found in the 55-59 dB(A) range. In the subsequent ranges, the exposure of the population is considerably reduced, being distributed as follows: 27.1% in the 60-64 dB(A) range, 11.3% in the 65-69 dB(A) range, 4.6% in the 70-74 dB(A) range and only 1.7% of the population considered would be exposed to levels above 75 dB(A).

-The Lnigh indicator involves ranges below those of the other indicators (Lden, Lday, Levening) in accordance with the Directive. The total population exposed to values above 50 dB(A) is 1,031,900. The largest exposed population concentration occurs in the ranges of a lesser magnitude. 58.7% is found in the lowest range, 50-54 dB(A). 26.8% of the estimated population is in the 55-59 dB(A) range, 10.1% in the 60-64 dB(A) range, 3.7% in the 65-69 dB(A) range and 0.7% in the highest range of over 70 dB(A).

-For the Lday indicator, the total population exposed to values above 55 dB(A) is 891,700. The distribution is similar to that of Lden, with 57.8% of the population being concentrated in the 55-59 dB(A) range, 25.5% in the 60-64 dB(A) range, 10.6% in 65-69 dB(A), 7.7% in 70-74 dB(A) and 1.3% in the above 75 dB(A) range.

-The Levening indicator shows results that are very similar to Lden and Lday, related to the distribution of the exposed population by noise level range, with most of the population being concentrated in less affected ranges. The total population exposed to values above 55 dB(A) is

1,071,600. Besides 58.6% of the exposed population is concentrated in the 55-59 dB(A) range, 25.9% in the 60-64 dB(A) range, 10% in the 65-69 dB(A) range, 4.3% in 70-74 dB(A) and 1.2% in the above 75 dB(A) range.

-With regards to the affected zones, the total area covered by the  $Lden > 55$  dB(A) noise contour, reaches 5,255 km<sup>2</sup>, of which only 26.5% is submitted to levels above 65 dB(A) and 6.3% to levels superior to 75 dB(A).

-The relationship between the population exposed to values of  $Lden > 55$  dB(A), and the length of the roads studied allows to establish comparisons in terms of the territorial concentration of the exposed population. The greater exposed population values per road kilometre are found in Cataluña, followed by Madrid, Andalucía and Valencia.

-With respect to the population exposed during the day and evening periods, it is necessary to underline that the greatest number of exposed population is obtained in the evening period. This is because, for most of the roads studied, rush hour is in the evening, and the noise emissions during this period are, therefore, greater.

-While talking about the night period, it is important to remember that the Directive has established 50 dB(A) as the lower limit for the analysis, 5 dB(A) below the limit for the other indicators. This means that comparisons between night results and results for the other periods must be managed carefully.

## **2. SPANISH NOISE ACTION PLAN - SNAP (2008-2012)**

This Spanish Noise Action Plan (SNAP) is part of the actions included in the Sectorial Road Plan for the state network which is currently at the elaboration stage. The SNAP has a dual purpose. On the one hand it includes the corresponding Action Plan of Round 1 required by the 2002/42/EC Directive. On the other, it incorporates other General Road Directorate actions, both for the roads included in the Strategic Noise Maps (SNMs), and for other roads, with less traffic, which belong to the National Network.

The Basic objective of the Plan is to channel the actions for subsequent years. Many of these actions have already been foreseen, in order to facilitate coordinated financing and completion. As a result, the data needed to define possible action areas has been compiled from the Strategic Noise Maps. Having analysed the action possibilities in each area, priorities have been established, to ensure that criteria exist when they are scheduled.

The Action Plan has been conceived and managed by the administration responsible for the noise source, in this case, the National Road Network. This entails certain administrative limitations when considering possible actions. The General Road Directorate has no competence over territorial layout and planning. Its competence is limited to the road public domain and the implications resulting from the obligations and demands of road legislation. In this context, the possibilities for action are confined to the area of responsibility of the General Road Directorate. Therefore sound insulation for building façades has not been included.

Other noise sources are often present for most densely populated areas located in the close vicinity of the roads of the National Network. In these instances, the 1513/2005 Royal Decree, of 16 December, establishes the obligation to develop the corresponding area plan with the collaboration of the different administrations involved. It is therefore not possible to tackle the actions in these areas in a sectorial manner. These actions must be incorporated in the area plans proposed by the local administrations.

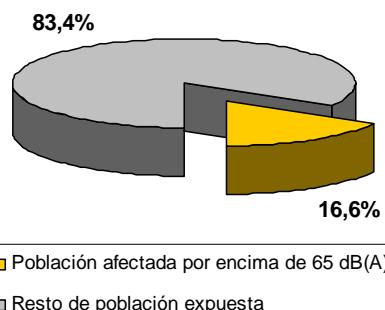
The general objective established in the SNAP is reaching, in the exterior of the residential buildings,  $Lday$  and  $Levening$  values below 65 dB(A) and a  $Lnight$  value below 55 dB(A).

Special considerations apply when there is a hospital or a school. In those cases, the possibility of achieving levels 5 dB(A) below those established for residential buildings will be considered. (In the case of educational use, only the daily quality objective applies). The global data of the total exposed population for all the Network studied in relation to the population that is submitted to sound levels superior to 65 dB(A) in the case of Lday and Levening and 55 dB(A) in the case of Lnigh is as follows:

#### Lday

Indicator	Total exposed population	Population >65 dB(A)
Lday	8,917	1,484

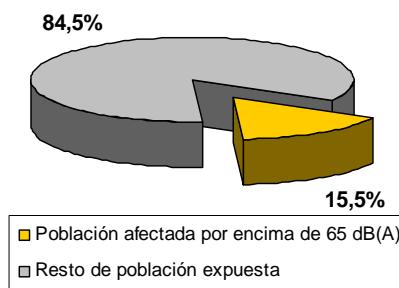
NOTE: Population in hundreds



#### Levening

Indicator	Total exposed population	Population >65 dB(A)
Levening	10,716	1,660

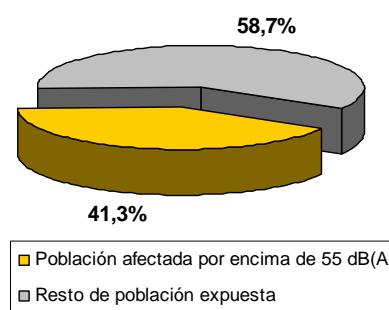
NOTE: Population in hundreds



#### Lnigh

Indicator	Total exposed population	Population >55 dB(A)
Lnigh	10,319	4,257

NOTE: Population in hundreds



As shown in the tables, the population exposed to sound levels superior to those established in the quality objectives is significantly less than the whole population considered in the Strategic Noise Maps. Night-time turns out to be the most critical period for all the roads studied. The population that lives in residential buildings, with sound levels acoustic quality objectives is around 425,000 people. The mentioned number represents approximately 25% of the exposed population considered in the SNMs. This applies to the totality of the state-owned roads included in the Strategic Noise Maps for Phase 1 of the implementation of the 2002/42/EC Directive.

The current plan has focused on two aspects: noise reduction at source and reduction of noise transmission via the installation of noise barriers. In the first case, within the responsibility of the General Directorate, the measures can only focus on road pavements, as it is outside their competence to regulate the vehicles that circulate on the roads. Currently, the General Directorate is conducting several experimental studies to determine the acoustic efficiency and the general behaviour of different road pavements. A significant number of kilometres with sound absorbing pavements have already been installed. Their durability and effectiveness is still to be evaluated. Some experiences related to double layered pavements are resulting in a substantial reduction in noise emissions. In the near future, the following are expected to be achieved: the acoustic classification of different pavements and the establishment of their usage criteria, in order to subsequently substitute current pavements with quieter ones for predetermined sections of the network.

The basic line of action included in this plan is the installation of noise barriers. After analysing the results of the Strategic Noise Maps, actions aiming to install acoustic barriers have been considered for 584 sections of road margins. These actions are divided in two groups according to the priorities assigned to such barriers. 109 sections have also been defined where the study of complex solutions is being considered. This action proposal has enabled the justification of the global budget until 2012.

In the analysis of the SNM results, a definition of the areas suitable for noise barrier installation was attempted. This definition establishes a priority for each specified action, using the criteria of efficiency and affected populations.

However, for some of the areas which are affected by the noise from the roads studied, with a significant amount of the population exposed to noise levels above those recommended, the installation of noise barriers is questionable. The reasons are its low effectiveness or the physical difficulties encountered for its installation. In these areas, future actions, so-called "complex actions", must be addressed via specific plans.

For the definition of the areas established for barrier installations, the following criteria have been considered:

- Exposure levels. Areas in which the Lnight exposure values are below 55 dB(A) have been excluded.
- Affected population. Generally, the exposed areas with a minimum of 300 affected people have been included in the proposals. However, a considerable number of areas with less population have been included, due to the singularity of the area, the presence of schools or hospitals or the characteristics of the city centre.
- Technical viability: the real possibility of barrier construction is evaluated, having rejected the proposal when there is not enough space or when the receptor is much higher than the road.

In the areas determined for the establishment of priority actions, the A and B categories have been defined based on the severity of the impact and the effectiveness of the action.

For action proposals, only the buildings of a residential, educational and medical nature have been considered.

A summary of the actions being considered is shown below, with an estimate of the number of people who will benefit and the cost.

When there are action areas on both sides of the road, the two independent areas have been taken into account. The estimate of the people who will benefit includes all the population present in each area, regardless of the sound levels to which it is exposed.

Noise Barrier Proposal.	Nº of areas	Barrier length (m)	People benefitting	Cost (euros)
Priority A	222	179,562	617,361	108,337,200
Priority B	362	203,740	510,652	122,352,000
Complex actions	109	151,045	353,574	

### 3. In conclusion:

The Spanish Directorate of Roads has finished the process of Strategic Noise Mapping in 4779 km of the National Roads Network.

The Spanish Noise Action Plan (SNAP 2008-2012) has also been accomplished and the legal demands of public information of both the studies and the Plan have been fulfilled, with the Plan being approved the 22.12.2009.

In order to facilitate the access to the more relevant information, a web page has been started ([www.cedex.es/egra](http://www.cedex.es/egra)), including the results of the 20 studies done in the past four years (90.000 maps aprox.), the SNAP, and the projects and other actions derived from it.

The first projects to build noise barriers in this context have been started.