

From Noise Mapping to Action Planning

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As result of four years of concentrated work of invited international experts and subsequent debates in the Council and the Parliament on 18 July 2002 the DIRECTIVE 2002/49/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 June 2002 relating to the assessment and management of environmental noise (in brief: Environmental Noise Directive [END]) has been published. According to this Directive the following actions shall be implemented progressively:

- (a) determination of exposure to environmental noise, through noise mapping, by methods of assessment common to the Member States;
- (b) ensuring that information on environmental noise and its effects is made available to the public;
- (c) adoption of action plans, based upon noise-mapping results, with a view to preventing and reducing environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and to preserving environmental noise quality where it is good.

Furthermore, the Member States have to ensure that the public is consulted about proposals for action plans (►END, Article 8). Also early and effective opportunities to participate in the preparation and review of the action plans have to be offered to the public.

This paper gives a brief overview over the dynamic process starting with Strategic Noise Mapping and ending with an Action Plan.

1 Strategic noise mapping

Strategic noise mapping is defined as one important requirement to be fulfilled based on Article 7 in connection with the Annexes IV (MINIMUM REQUIREMENTS FOR STRATEGIC NOISE MAPPING) and VI (DATA TO BE SENT TO THE COMMISSION) of the Directive 2002/49EC.

1.1 Maps and mapping

Strategic noise maps

A ‘*strategic noise map*’ is the presentation of data on different aspects according to Annex IV of the END:

- an existing, a previous or a predicted noise situation in terms of a noise indicator,
- the exceeding of a limit value,
- the estimated number of dwellings, schools and hospitals in a certain area that are exposed to specific values of a noise indicator,
- the estimated number of people located in an area exposed to noise.

Strategic noise maps may be presented to the public as graphical plots, numerical data in tables, numerical data in electronic form. They are to be worked out separately for the different noise sources or for overall predictions for such an area under investigation.

Strategic noise Mapping

‘*Strategic noise mapping*’ is a dynamic process and will be used for

- the provision of the data to be sent to the EC,
- a source of information for citizens, and
- a basis for action plans.

Each of those applications can require a different type of strategic noise map [1].

1.2 Relevant types of noise source

The Directive 2002/49EC shall apply to environmental noise to which humans are exposed in particular in built-up areas, in public parks or other quiet areas in an agglomeration, in quiet areas in the open country, near schools, hospitals and other noise-sensitive buildings and areas.

Strategic noise maps have to be made for:

Agglomerations

(territory with more than 100 000 inhabitants and a typical population density for an urbanised area)

- until 30 June 2007 for agglomerations with more than 250 000 inhabitants,
- until 30 June 2012, and thereafter every five years for all agglomerations

Strategic noise maps for agglomerations shall put special emphasis on the noise emitted by road traffic, rail traffic, airports, industrial activity sites including ports. Maps for other sources may be added.

Major roads

(a regional, national or international road, which has more than three million vehicle passages a year)

- until 30 June 2007 for major roads which have more than six million vehicle passages a year,
- until 30 June 2012, and thereafter every five years for all major roads

Major railways

(railway with more than 30 000 train passages a year)

- until 30 June 2007 for major railways which have more than 60 000 train passages per year and
- until 30 June 2012, and thereafter every five years for all major railways

Major airports

(a civil airport, with more than 50 000 movements per year (a movement being a take-off or a landing))

- until 30 June 2007

1.3 Types of maps

Noise maps

Noise maps show the noise level in certain areas in terms of L_{den} and L_{night} (► Figure 1).

Maps usually are the result of calculations (*not* of measurements). Such calculations can vary in complexity. Strategic noise maps for local or national application must be made for an assessment height of 4 m (other heights can be added) and the 5 dB ranges of L_{den} and L_{night} .

The definitions of the day-evening-night level L_{den} and the night-time noise indicator L_{night} are given in Annex I of the Directive 2002/49EC. The graphical presentation by noise maps must at least show the 60, 65, 70 and 75 dB contours.

As experience has proven it is more practical to show all the contours from 55 dB up to >75 dB for L_{den} and all the contours from 45 dB up to >70 dB for L_{night} .

Noise maps are recorded digitally based on the ground plans of the area, considering e.g. buildings and noise sources. The contours of terrain and the heights of buildings, noise barriers and other elements with an effect of shielding and reflection along with the noise sources are overtaken into the calculation model.

By doing this a *three-dimensional ground plan* is created, considering effects of shielding and reflection.

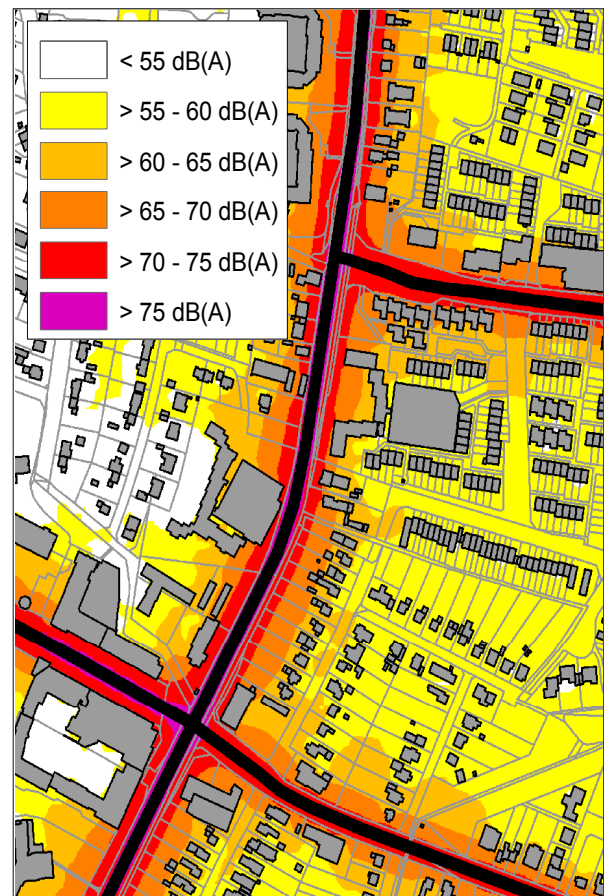


Figure 1: Example for a road traffic noise map [2]

Sensitivity Maps

By relating specific guide values to designated land-uses, it is possible to determine the **sensitivity map** (► Figure 2). The type of land use is taken from the specifications in the urban development plans. Other land uses specified in urban development plans as well as areas and facilities for which no specifications exist are to be evaluated according to how much protection they require.

Conflict maps

The **conflict map** (► Figure 3) is produced through subtraction of the guide values stated in the sensitivity map from the noise levels obtained in the noise map. This map shows, independently of the number of people affected, where guide values are exceeded or not met at all.

A separate conflict map is produced for each type of noise source (such as road, railway) and each assessment period (such as night). If various noise sources act in combination, this generally leads to a worsening

of conflict. The conflict situation resulting from this combination can be shown through overlaying the individual conflict maps.

Impact maps

The conflict maps can be added by so called *impact maps*. They show for instance how many residents are actually affected by a certain noise source exceeding certain guide values (► Figure 3). Maps of this type can also be used to present calculation parameter (like traffic flow, percentage of HGV, average speed, etc.).

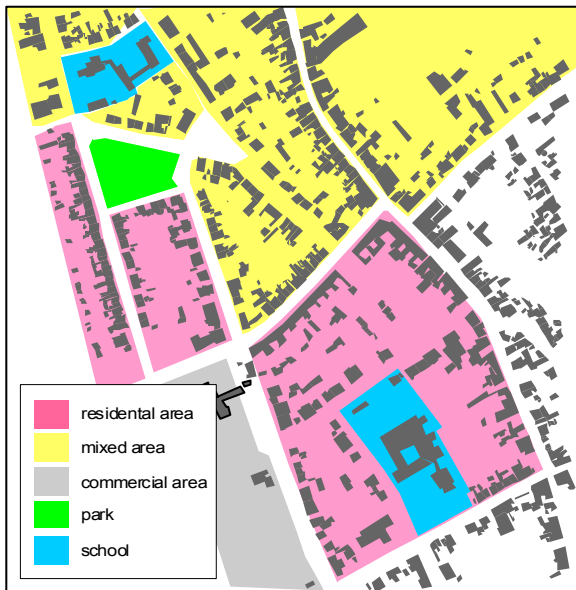


Figure 2: Example for a sensitivity map [3]

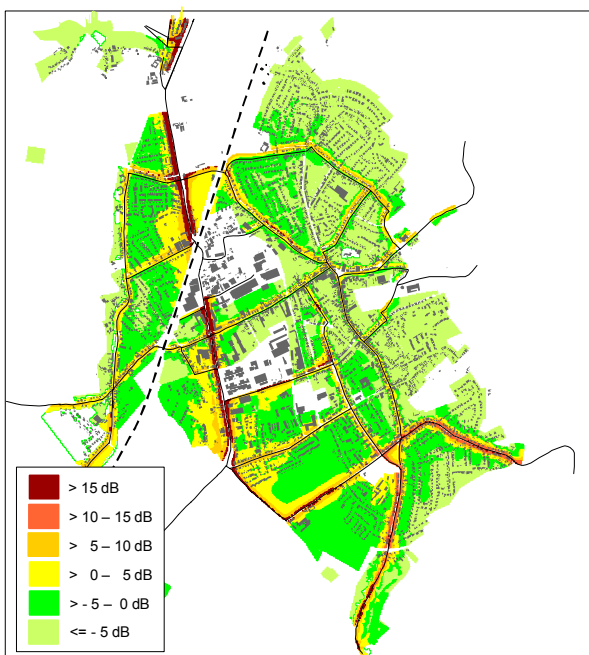


Figure 3: Example for a conflict map [3]

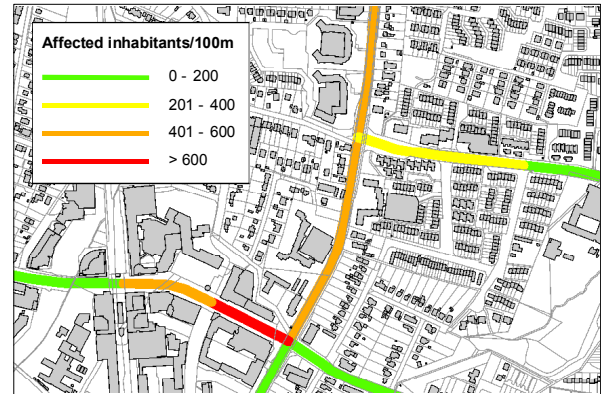


Figure 4: Example for an impact map [2]

Difference maps

Difference maps (► Figure 5) are usually comparing the existing situation with one or various possible future situations. It is particularly important to know, when assessing the effectiveness of proposed noise mitigation measures, whether residents have been provided with relief or have just been re-inconvenienced.

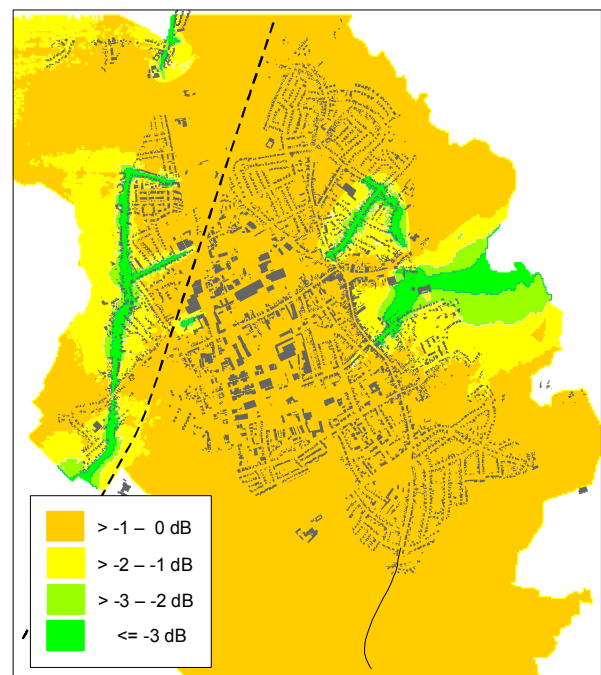


Figure 5: Example for a difference map [3]

1.4 Exposure of inhabitants

The END requires that the Member States give details on the number of people exposed in certain level bands. According to Annex VI, the number of people living in buildings with an L_{den} and/or an L_{night} (each in dB(A)) at 4 m height at the most exposed façade of the

building must be counted separately in each of the following noise level bands:

- L_{den} : 55-59, 60-64, 65-69, 70-74, > 75 [dB(A)]
- L_{night} : 50-54, 55-59, 60-64, 65-69, > 70 [dB(A)]

This data must be reported separately for road traffic noise, railway noise, and aircraft noise as well as noise of industrial sites.

Establishing the position of receiver points

The receiver points are located 4 meters above the ground; their horizontal position is determined according to the following rules (►Figure 6):

- For façade sectors longer than 5 meters, several receiver points are determined. Therefore, the façade sectors are subdivided into façade sub-sector (shorter than 5 meters). One receiver point is determined for each façade sub-sector and is situated in its centre (green + blue).
- Receiver points are situated in the centre of either the façade sector or the façade sub-sector.
- For every remaining façade sector longer than 2.5 meters one receiver point is determined (pink). No receiver points are determined for façade sectors that are shorter than 2.5 meters, if the requirements of rule d) are not met (black).
- Various adjacent façade sub-sectors, each shorter than 2.5 meters and summed-up no longer than 5 meters are treated as a façade sector (red).

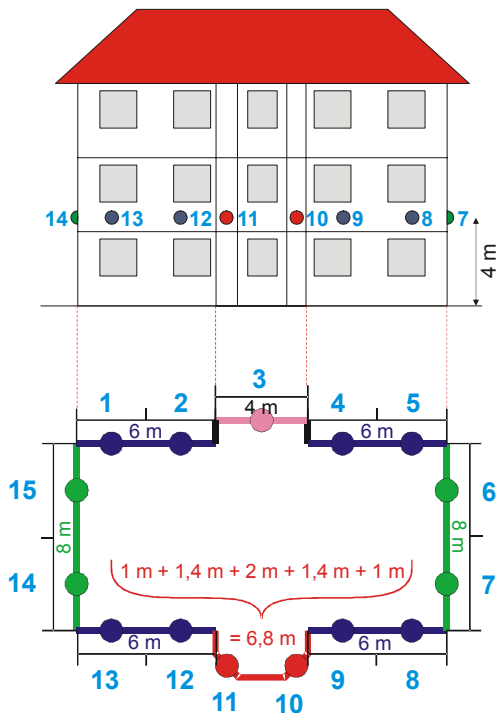


Figure 6: Position of receiver points [4]

Assignment of the people exposed to noise levels

In principle there are two possibilities to

- assign all inhabitants of a building to the most exposed façade or
- distribute the inhabitants equally to the different receiver points of the building.

As a result of the discussion of this topic during an EU-Project in Hungary [5] the equal distribution of people over all receiver points of a building was recommended. All project team members, the chair of the EU Working Group “Assessment of Exposure to Noise” and the Ministry of Environment and Water Management agreed on this proposal and added the following specifications:

- "Equal distribution" shall mean a distribution of the number of inhabitants to the composing façades of the building proportional to the individual area covered by each façade.
- Common walls of terraced houses or other not fully detached houses are not regarded as façades. A façade is always directly connected with the open air. In the case of integral houses the total number of people must be added up over all buildings and is then distributed over the sum of all façade areas.

Presentation of results

The results of the estimation of numbers of people exposed to certain noise levels have to be presented separately for noise from road, rail and air traffic, and from industrial sources in tables (►Figure 7) or maps.

Figure 7: Number of people exposed to noise

Noise level band [dB]		Number of people exposed	
L_{den}	L_{night}	L_{den}	L_{night}
55-59	50-54	50 000	60 000
60-64	55-59	20 000	25 000
65-69	60-64	3 000	4 000
70-74	65-69	1 000	1 500
>75	>70	0	500

2 Action planning

2.1 Meaning of action planning

Action plans are to be designed to manage noise issues and effects, including noise reduction if necessary. Noise mitigating measures have to be built out in particular for the most important areas as established by strategic noise mapping.

The measures within the plans should notably address priorities which may be identified by the exceeding of any relevant limit value.

Action plans have to be drawn up

- no later than 18 July 2008 for places near major roads which have more than six million vehicle passages a year, major railways which have more than 60 000 train passages per year and major airports and for agglomerations with more than 250 000 inhabitants.
- no later than 18 July 2013 for all agglomerations, for all major roads as well as the major railways.

The action plans shall be reviewed and revised if necessary, when a major development occurs affecting the existing noise situation, and at least every five years after the date of their approval.

The public shall be consulted about proposals for action plans, giving early and effective opportunities to participate in the preparation and review of the action plans. Reasonable time-frames shall be provided allowing sufficient time for each stage of public participation.

An action plan must at least include the following elements:

- a description of the agglomeration, the major roads, the major railways or major airports and other noise sources taken into account,
- the authority responsible,
- the legal context,
- any limit values in place,
- a summary of the results of the noise mapping,
- an evaluation of the estimated number of people exposed to noise, identification of problems and situations that need to be improved,
- a record of the public consultations,
- any noise-reduction measures already in force and any projects in preparation,
- long-term strategies,
- actions which the competent authorities intend to take in the next five years, including any measures to preserve quiet areas,
- financial information: budgets, cost-effectiveness assessment, cost-benefit assessment,
- provisions envisaged for evaluating the implementation and the results of the action plan.

Each action plan should contain estimates in terms of the reduction of the number of people affected (annoyed, sleep-disturbed, or other).

To save money, the action plans to mitigate noise should be combined with the action plans to reduce air pollution.

2.2 Noise reduction capacities in principle

Actions to reduce noise in principle have to consider for example the following instruments and approaches [6]:

- traffic planning,
- land-use planning,
- technical measures at noise sources,
- selection of quieter sources,
- reduction of sound transmission,
- regulatory or economic measures or incentives.

Provisional measures which are already in place at the source of noise are to be given high priority.

In the following, a brief description of possible measures for reduction, avoidance or relocation of noise for the various types of noise source is given:

Road traffic

- reduction of traffic density,
- reduction of percentage of heavy goods vehicles,
- reduction of speed / traffic calming,
- renewal of vehicles,
- change of road surface.

Rail traffic

- reduction of rail and wheel roughness,
- speed limitation,
- optimisation and damping of the tracks,
- types of carriageways,
- optimisation, damping and screening of the wheels,
- mitigation of propulsion noise – development of modern vehicles,
- mitigation of aerodynamic sources.

Industrial and commercial facilities

- technical noise abatement and retro-fitting for facilities, equipment and vehicles as well as structural noise protection for operational buildings,

- shielding obstacles on operational premises,
- organisational measures (operational restrictions and relocations, promotion of increased use of railways and waterways).

Air traffic

- optimisation of flight routes and flight procedures (low-noise flight procedures),
- operational restrictions in terms of time, in particular no-fly restrictions,
- noise differentiating charges,
- incentives to implement noise abatement procedures, planning and operational measures,
- restriction of operation of aircraft that do not comply with a minimum certificate.

2.3 The example Road traffic noise

Measures to reduce road traffic noise include for example the following approaches:

- concepts for avoidance of traffic by promotion and linkage of environmentally-friendly modes of transport (combining walking, bicycling and public transport),
- concepts for relocation of traffic-flows (e.g. by diversion of traffic via less sensitive routes),
- concepts for speed reduction (e.g. by using the partial-access zones stabilising traffic flows and reducing driving speeds),
- concepts for relocating black spots of sound emission (e.g. by setting up gateway facilities, optimisation of traffic signals),
- concepts for optimisation of traffic volume (e.g. by parking concepts),
- concepts for road surface improvements and maintenance (e.g. by low-noise road surfaces).

2.3.1 Reduction of traffic density

Furtherance of Public Transport

The furtherance of the public transport can be realised by

- the improvement of the quality of transport (e.g. by speeding up the service through public transport priority, by installing bus lanes and by increasing the frequency of buses), and
- the improvement of the area served (e.g. by the increase of the number of bus stops).

In addition to the acoustic effects the layout of streets and urban development, plans affecting the conflict area should be incorporated into the evaluation process to reach an efficient approach.

Designation of HGV route

The possibility of concentrating HGV-routes for a specific area is investigated on the basis of the existing lorry-route network.

This approach is often combined with time-restriction for lorries in residential areas (► Figure 8, ► Figure 9).

In addition to the acoustic parameters, current plans and future urban development targets should be included in the evaluation process for an efficient approach.

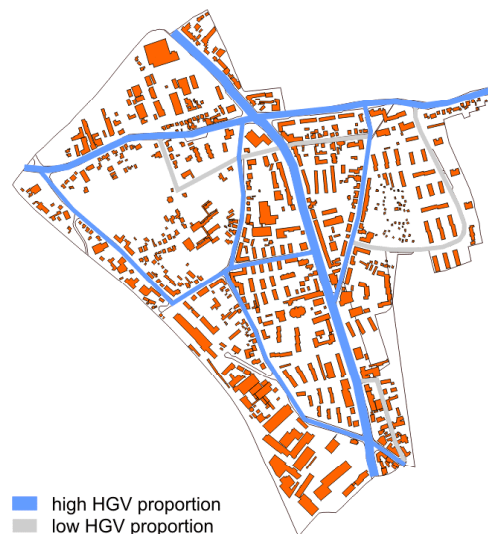


Figure 8: HGV routes – initial situation [7]



Figure 9: HGV routes – predicted situation [7]

Support of bicycling and walking

The support of bicycling and walking includes

- the improvement of existing cycle paths as well as
- the construction of new cycle paths.

For an efficient approach, planned significant investments, building measures and traffic-relevant plans affecting the conflict area should be incorporated into the evaluation process along with the acoustic effects and the existing layout of streets.

One important detail is e.g. the maximum permitted speed of cars and lorries in the road network under consideration.

Additionally, the specific provisions for pedestrians should be considered. This can be e.g. introduction of pedestrian islands.

Traffic and parking management

One possible measure could be the implementation of parking management. Parking management should be based on limiting access to congested areas by high prices for parking. This can lead to

- the furtherance of public transport, and
- the reduction of traffic density.

In addition to the layout of streets, urban development plans affecting the conflict area should be incorporated into the evaluation process along-side the acoustic effects to reach an efficient approach.

Road management

The potential for a possible relocation of the main traffic is investigated on the basis of the existing main thoroughfares. One potential measure is the establishment of by-pass roads.

To reach an efficient approach, current plans and future urban development targets should be incorporated into the evaluation process in addition to the acoustic effects.

In this step the investigation of whether new environmentally harmful effects could occur through the proposed measures is of particular importance.

An environmental impact assessment can sometimes be a good help on this.

2.3.2 Road surfacing and speed reduction

Change of road surface

The possible improvement of the road surface of the individual roads / road-sections is investigated on the basis of the existing road surfaces under consideration.

In addition to the acoustic effects, planned building measures with an impact on the conflict area, as well as maintenance measures and urban development plans should be incorporated into the evaluation process for an efficient approach.

Speed reduction and traffic calming

The possibility of imposing a possible speed restriction on individual roads or road sections is investigated on the basis of the existing maximum permitted speed levels (distinguished between cars and lorries) in the road network under consideration.

For an efficient approach, traffic planning and traffic safety related plans affecting the conflict area should be incorporated into the evaluation process in addition to the acoustic effects.

This could be e.g. 30 kph zones or traffic-calmed (commercial) areas. Important details can also lie in existing plans and future urban development targets as well as planned significant investments and public sector maintenance measures or subsidised development programmes.

In principle one has to take into account the whole road network of the area under investigation (► Figure 10, ► Figure 11) considering the road hierarchy and its specific function.

It is advisable that traffic calming measures are accompanied by enforcements of speed limits.

Measures to reduce traffic speed additionally contribute to improved road safety.

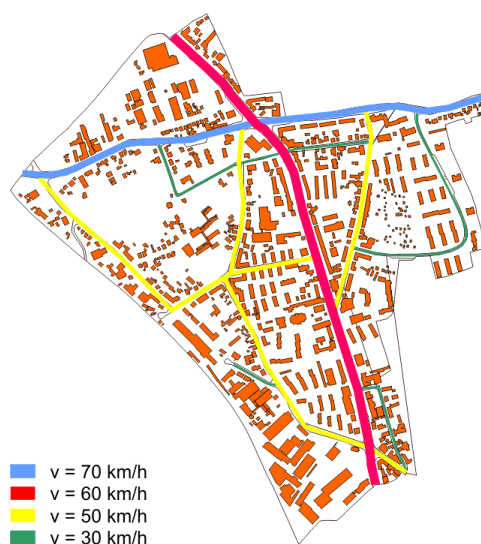


Figure 10: Speed reduction – initial situation [7]

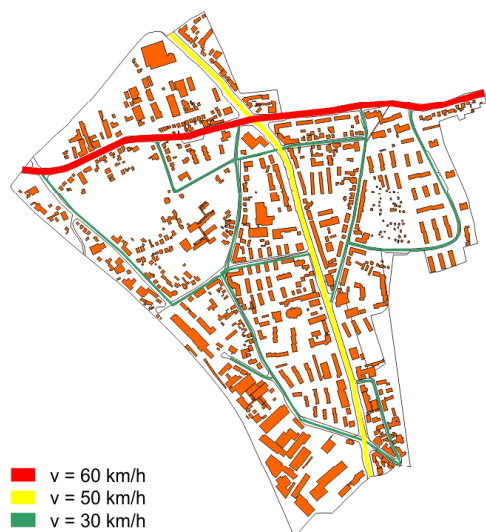


Figure 11: Speed reduction – predicted situation [7]

3 Conclusions

To form an effective *overall concept* for the reduction of noise the individual measures have to be combined into a single set of measures. Experience has shown that this kind of overall concept will be involved overwhelmingly with the reduction of road traffic noise.

However, it has to be emphasised that excellent internal and external co-operation is needed to implement such overall conceptions for all types of noise source successfully.

To save money, noise mitigation action plans should be combined with action plans to reduce air pollution wherever this is possible.

References

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