



# **Noise Abatement Demonstrative and Innovative Actions and information to the public**

Project coordinator



Provincia di Genova

Supported by



LIFE 09 ENV/IT/000102



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# Nadia project

## Summary

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### The project NADIA

## Noise Abatement Demonstrative and Innovative Actions and information to the public

### The problem

It has been widely recognised that the noise is not only a form of disorder, but a real causes of environmental pollution. You estimate that it affects the health and quality of life of about 20% of the European population and is even regarded as the most urgent environmental problem and the main because of worsening environmental standards in urban areas.

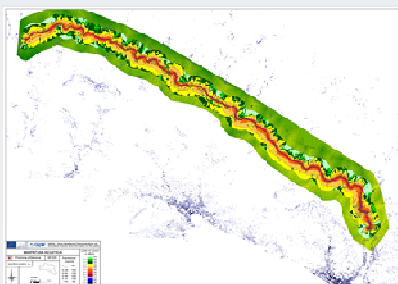
11% of the urban population are exposed to a noise level of 70 dB. In most cities noise disturbance, in densely built up areas, exceeds limits and guide values by a wide margin. At the same time subjective nuisance from noise is increasing.

Noise levels have been increasing especially during the night (especially the traffic ones).

Studies show that noise effects are easily perceived (awakenings, impact on conversation, etc.) or not (impact on health) and demonstrated that sleep disturbs and health effects increase especially when the sound pressure level at night is higher than 50-55 dB.

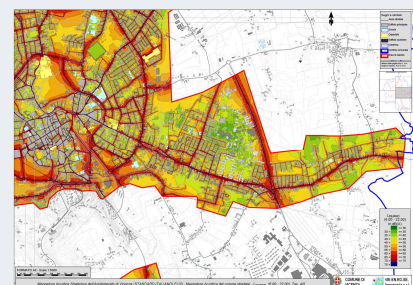
On 25 June 2002, The European Commission has approved the Directive 2002/49/EC related to the assessment and management of environmental noise, also known as the "END".

The END aims to "define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to the exposure to environmental noise" to reduce energy costs.



*Example of road noise map*

According to this Directive and national transpositions, Local bodies have to monitor, map and reduce the environmental noise and in particular that produce by traffic.



*Example of city noise map*

NADIA is a project on the reduction of the noise from traffic, co-financed by the European Commission under the LIFE+ programme (2009 call) (ENV/IT/000102).

## Where

The project has been carried out in Italy and in particular in three Italian regions: Veneto, Liguria and Toscana.

Participating partners belonged to both types of local authorities affected by the law:

- ✚ municipalities (Vicenza and Prato) that need to reduce the noise in urban area;
- ✚ the Province of Genoa and Savona representing the entities in charge for interurban roads management and need to reduce the noise produced by traffic.

## Who benefits from the project?

End users are local bodies that are in charge for environmental noise management according to roles attributed by national transposition of Directive 2002/49/EC:

- ✚ Municipalities with more than 100.000 inhabitants,
- ✚ Provinces and similar local bodies (NUTS III) and Regions that manage roads with more than 3.000.000 vehicles per years

On the other side other organisations that have to reduce noise emissions such as airports, railways, etc. may benefit from some project solutions as well as technicians and other interested parties that are involved in noise management.

## Objectives

The overall objectives are to contribute to the END implementation and to demonstrate:

- ✚ the technical and economic feasibility and effectiveness of best practices for reducing the noise caused by road traffic.
- ✚ the effectiveness of stakeholder involvement and proper communication with the public

Specific objectives are:

- ✚ to demonstrate the technical and economic feasibility and the effectiveness of best practices for reducing the road traffic noise levels (as well as the CO2 emissions and energy use reduction in some cases), thanks to the integration of noise mapping and planning activities, innovative techniques (noise barriers, windows, asphalts), traffic management and education;
- ✚ to demonstrate the effectiveness of the involvement of the stakeholders and the correct communication to public for increasing the awareness on traffic noise emissions and their effects on health and quality of life and the responsibility and contributing to the AEN workgroup's activities;
- ✚ to realise an integrated model based on an innovative model (NMPB), considering the population distribution, the meteorological data, the ground nature for allowing a more effective noise monitoring of noise and its propagation;
- ✚ to give a contribution for the innovation and the reliability of models in cooperation with national and European working groups;
- ✚ to valorise the project activities and results in terms of education and sensitisation of pupils;
- ✚ to widely disseminate the results during and at the end of the project, at local, national and European level and to prepare the communication activities after the project conclusion.

## What are main questions to which the project responds?

- ✚ How to collect reliable data?
- ✚ Which kind of model we have to use to produce noise maps?
- ✚ How to move from the maps to the noise reduction action plan?
- ✚ How to communicate to the public?
- ✚ How to take advantage from the experience and know how to increase the awareness of pupils?
- ✚ What are technical solutions available to reduce the noise produced by traffic and which are their performances?

## Activities

To achieve such objectives the following activities were scheduled:

- ✚ noise mapping of a significant portion of urban areas and some provincial roads;
- ✚ draw up action plans for noise reduction according to innovative working methods;
- ✚ implementation of demonstration actions and noise reduction;
- ✚ make available to the schools the knowledge acquired in order to sensitise and educate students on dangers related to noise and possible solutions to avoid and reduce it
- ✚ dissemination activities

The project ensures the participation of stakeholders and accurate communication with the population, according to statement of the European working groups.



# Nadia project

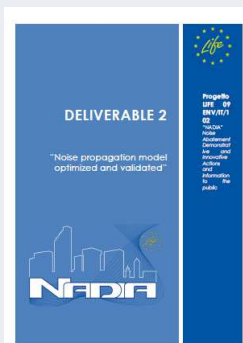
## Activities and results

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### From data to noise mapping

The data set needed for noise simulating were established in the Milestone 1 of the project “**Data quality and quantity** with regard to models specifications”.

According to this, the project partners collected:



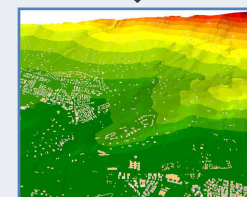
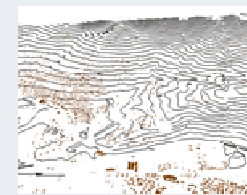
- ✚ Data related to the noise level of infrastructures such as traffic flow and composition (light and heavy vehicles); average vehicles speed; road pavement types; traffic flow characteristics (steady, unsteady, accelerate or decelerate); Digital Ground Model; noise measurements.
- ✚ Data related to the distribution of population from the national official census (census areas).
- ✚ Meteorological conditions (the effect of meteorological conditions have not been considered relevant).
- ✚ Characteristics of the ground.
- ✚ Noise levels.

In addition to this deterministic approach, **data on noise annoyance have been collected** in some specific urban areas where demonstrative actions would have been realised. About 500 people in each project area have been interviewed before and after the noise reduction actions.

Results have confirmed the positive feedback obtained using measurement devices.

Using obtained data the **noise propagation model has been implemented** on the basis of Routes-NMPB-96 indicated by the European Directive 2002/49/UE.

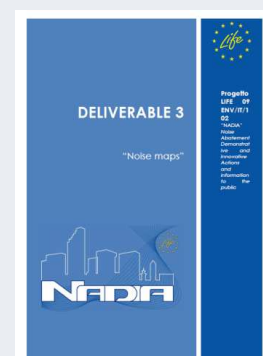
The noise emission of each modelled road depends on the average traffic flow and its composition (% heavy and lightweight vehicles and speed in the reference periods day, evening and night), the road slope (evaluated by the DGM) and the type of the road pavement surface.

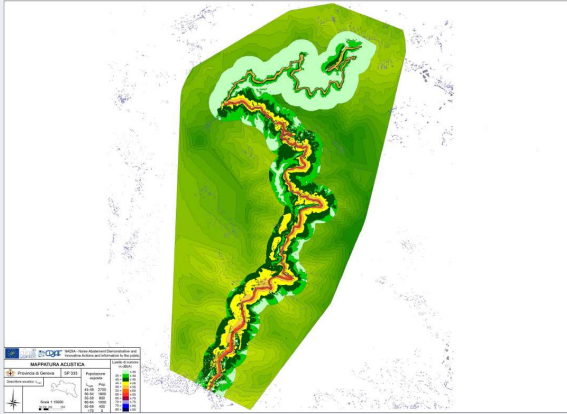


Example of data processing:  
Realization of digital ground model (DGM)

Two kind of results were produced: graphical maps and numerical estimates.

- ✚ The graphical maps are easier to be analysed by people who are not expert in acoustic problem.
- ✚ The numerical estimates allow to evaluate the acoustical criticism of the roads combining the results of the noise simulation with other information like the use of the building and the people living inside. This methodology allows to evaluate the value of the indicators “population exposed to noise” and “number of people living in buildings that have a quiet façade (NPQ)” in compliance with 2002/49/EC.
- ✚ This work has been done for all involved partners. Here below you can find some examples of the maps obtained.



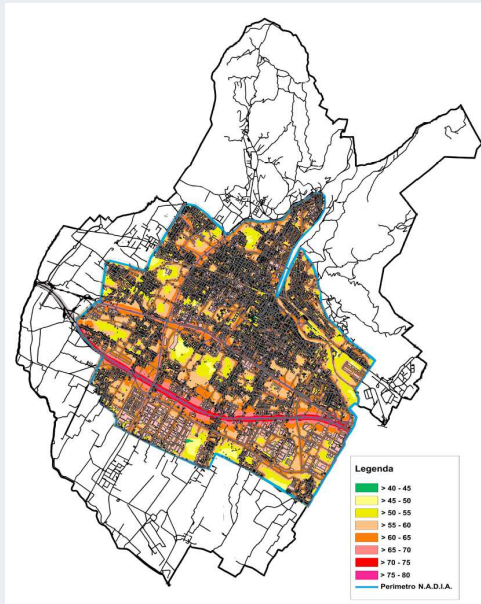


Province of Genova - Noise map: SP 333 night

This picture is an examples of a noise map of an interurban road (this is the case of road n. 333 managed by the Province of Genova).

Different colors show which the noise level along the road and how it decreases with the distance from the road.

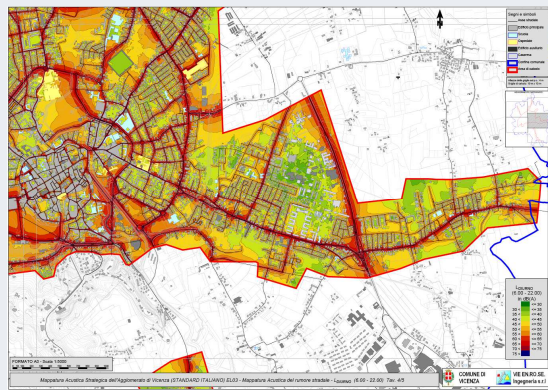
This picture refers to night.



City of Prato

This picture shows the areas with the same sound pressure according to Lden indicator (equal loudness contour).

Similar results have been obtained for the city of Vicenza.

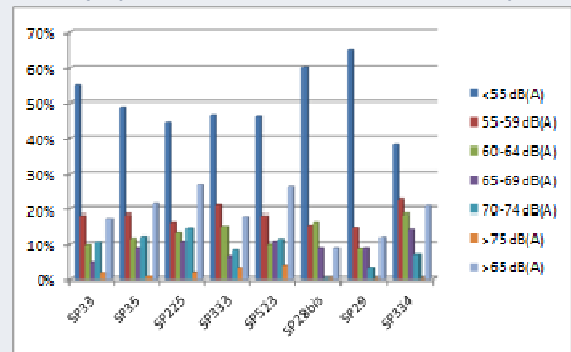


City of Vicenza

Noise mapping provides local authorities information such as the percentage of people exposed to noise with regard to Lden and Lnight classes.

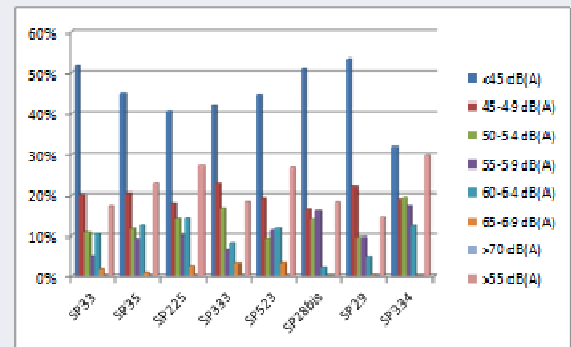
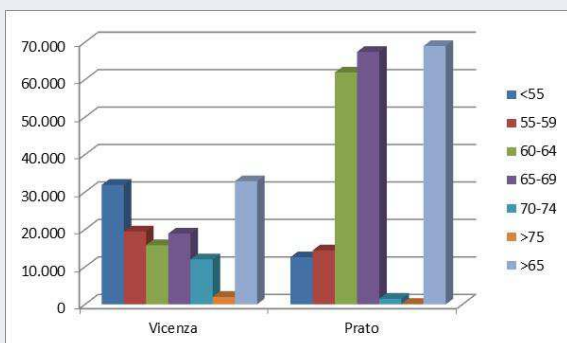
Pictures on the right refer to roads managed by the Province of Genova (the five roads on the left side) and Savona (the three on the right).

and population with other descriptive



Percentage of people exposed to Lden noise classes

The picture below represent the situation at Vicenza and Prato with reference to Lden indicator.



Percentage of people exposed to Ln noise classes

## From noise mapping to noise reduction action plans

The noise maps are starting points to set up the action plans. The noise action plans define strategies for realising noise abatement measures. The steps of a noise action plan are the following:

- ✚ comparison between noise maps and law limits and definition of the critical areas. A critical area is a part of territory having noise problems that can be acoustically rehabilitated using noise abatement measures.
- ✚ Definition of a ranking of priority of the critical area. The results of the comparison, together with buildings and dwellers information, are used to select the areas in which the acoustic environment is more critical.
- ✚ Selection of the most efficient noise abatement measure for each critical area. A cost-benefit analysis was defined to identify the best noise reduction measure.

In order to identify which measure was technically feasible in each critical area, a classification of critical areas was defined.

Three kind of areas have been identified:

- ✚ Urban area;
- ✚ Rural area: small group of buildings that cannot be identified as an Urbanized area as stated by Italian Rules of Road;
- ✚ Special Buildings: hospital, nursing homes, retirement homes, schools and kindergartens.

High insulating windows, low-noise road pavements and noise barriers, cycle lanes and speed reduction have been the solutions considered and analysed with reference to selected areas.

A priority index has been calculated for each critical area in order to determine where the noise abatement measures were most urgent. Cost/benefit analyses have been performed in order to evaluate in each critical area the most efficient measure between those that are technically feasible.

A procedure for the cost-benefit analysis was developed to:

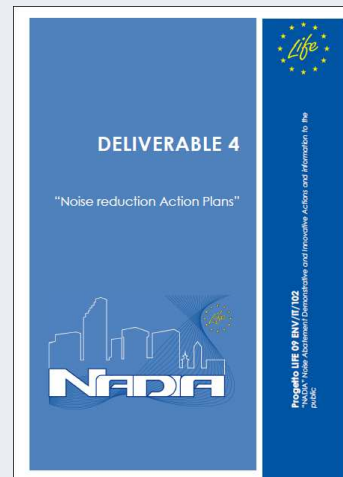
- Identify the most efficient noise measure for each critical area: the cost-benefit analysis aims to identify which is the cheaper noise reduction measure that solve the noise limit exceed in a critical area;
- Establish an innovative index of priority for the realization of noise reduction measures: a ranking based on the results of the cost-benefit analysis was prepared.

The ranking based on the index of priority (IP) is useful to determinate in which areas the acoustic environment is more critical.

The ranking based on the cost-benefit analysis (CBI) is useful to optimize the budget available for the managing authority for the acoustic rehabilitation.

If for one area or special building the noise solution A has the same cost of B, the most efficient noise measure in terms of IP reduction will be preferred.

The cost-benefit ranking considers also the noise reduction solutions that do not completely rehabilitate the critical area.





The following table is an example of template used for defining the actions of the noise reduction plan (it refers to the Hospital at the City of Vicenza)

<b>Building Ranking of priority</b>	<b>Hospital 2</b>
<b>Main noise sources</b>	Contrà San Bortolo – Viale Fratelli Bandiera
<b>Traffic flow data</b>	
<i>Lightweight vehicles day (06-20)</i>	117 (Contrà San Bartolo) – 1452
<i>Lightweight vehicles evening (20-22)</i>	82 – 1016
<i>Lightweight vehicles night (22-6)</i>	23 – 290
<i>Heavyweight vehicles day (06-20)</i>	0 – 6
<i>Heavyweight vehicles evening (20-22)</i>	0 – 4
<i>Heavyweight vehicles night (22-6)</i>	0 – 1
<b>Critical area/special building data</b>	
<i>N° residential critical buildings</i>	-
<i>Population inside critical buildings</i>	-
<i>N° schools* (asili nido, scuole dell'infanzia, primaria e secondaria)</i>	-
<i>N° students, teachers and technical/administrative staff members</i>	-
<i>N° hospitals or nursing homes* (ospedali, case di cura e case di riposo)</i>	5
<i>N° beds and staff</i>	1200
<b>Greatest value of noise limits exceeds [dB(A)]</b>	24,1
<b>Mean value of noise limits exceeds [dB]</b>	12,5
<b>Data about population exposure to noise</b>	
<i>N° people exposed to noise level over the limit in the diurno period</i>	1195
<i>N° people exposed to noise level over the limit in the notturno period</i>	1195
<b>IP value</b>	<b>64020</b>
<b>Noise measures foreseen by other plans</b>	
<b>Noise measures foreseen by the Noise Action Plan</b>	High noise insulating window
<b>Cost (rounded to the nearest hundred)</b>	€ 2.265.700 (standard) € 3.272.700 (auto-ventilating)



The special building is in cyan in the figure.

## Adopted noise abatement innovative solutions

The NADIA project allowed to improve the noise level in critical Cities areas and along the provincial roads included in the project.

The main target of the project are the primary and secondary schools because they need silence, they are attended by children and they are the best place where results can be valorised in terms of education and teaching.

The adopted solutions are:

**Noise barriers**, for instance, made of wood and recycled polyester fibre with the following abatement performance:

- Acoustic absorption  $DL_a = 17\text{ dB}$  Cat. A4
- Acoustic insulation  $DLR = 26\text{ dB}$  Cat. B3 –  $R_w = 31\text{ dB}$



Barriers are made of wood and the noise absorbing layer is made of recycled polyester fibre.

All the barriers installed provided very good results and a reduction of 9 dB was obtained on the average.

Also the aesthetic has been well cared for and the result was excellent, especially in the side gathered up from school.



Different kinds of **asphalts** (i.e. made of a relevant percentage of recycled rubber) with high sound absorption performances have been used (2-5 dB less than conventional asphalt in European applications in urban areas at 40-45 km h speed).

Their initial costs are a bit higher than traditional asphalts but the maintenance is less intensive and less expensive.

The Life Cycle Cost is lower.

The project results are in line with such expectations in cities but quite poor in interurban roads since they are located in the mountains, with inclines and curves. In this case results varied in relation with stretches characteristics.

**Windows** composed by 2-3 glasses of different thickness with the insertion of a film to eliminate vibrations. Such solutions are also useful to reduce the energy consumptions because they reduce the air circulations as well as the transmittance.

Materials and air circulation system make the difference.

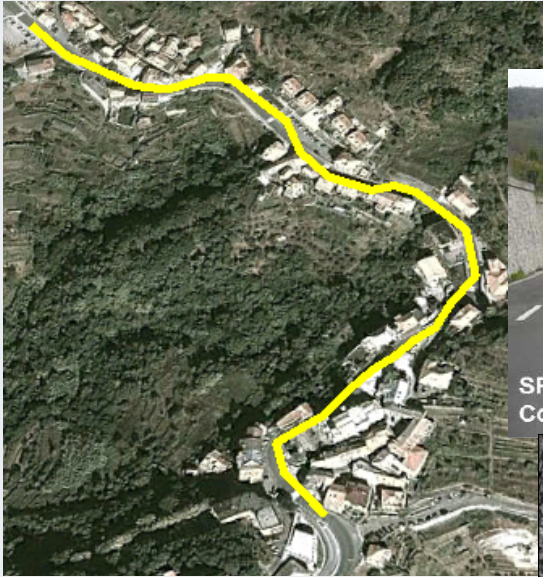
Windows are made of two or three glasses of different thickness, with the insertion of a transparent film useful to the elimination of vibrations.

The solution is in line with the energy saving needs as well.

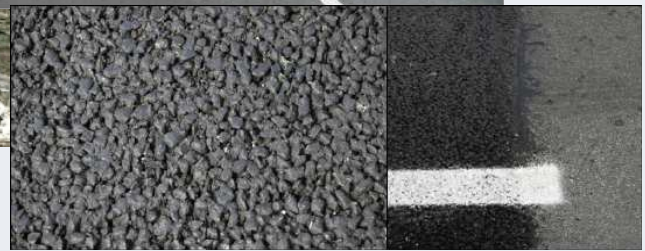
The results obtained were very good: all the interiors that were exposed to noise comply now with legal limits



Here below you can find some pictures of the works done during the NADIA project.



SP225, prog.va km 27+000 in  
Comune di Neirone

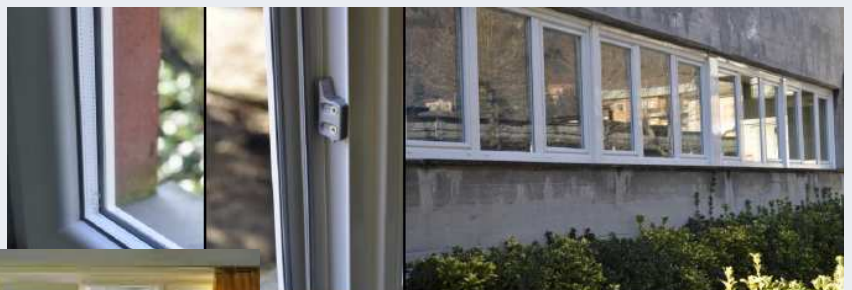


Example of asphalted stretch of road  
in Province of Genova and Savona

Noise barrier at the primary school "La carica dei 101" at Ronco Scrivia (GE)



Noise absorption windows  
at the primary school "La  
carica dei 101" at Ronco  
Scrivia (GE)





Windows installed at the primary school "Cabianca" at Vicenza: the satisfaction of school users raised from 20% to 56% after the substitution



Noise barrier installed at the primary school "Lattes" at Vicenza



Noise absorption asphalt at Prato



Primary school Meoni in Prato: noise abatement windows

## Education

Project results have to be exploited for increasing the awareness of people (mainly youngsters) and changing their behaviour. The NADIA project stressed this principle and developed many ways to reach young people and convince them that too much noise is a serious pollution problem very harmful to their health and quality of life.

Schools are the main key actor addressed by the project: the project partners provided several lectures and training session, also at project sites.

On the other side, some educational events were exploited such as the Science festival hold each year in Genova. So, thanks to this kind of institutional events, hundreds or thousands of pupils were reached by NADIA.



Technical training at high school

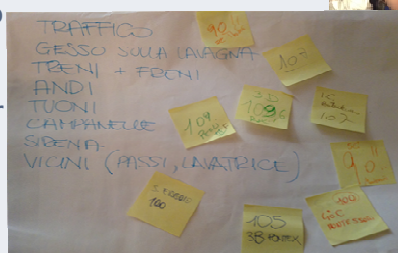


Visits to project sites



NADIA e-book: noise and surroundings

How to teach acoustic physics to children. The NADIA project provides a number of profitable experiences (see Deliverable 6)



Plenary training sessions at school



# Nadia project

## Conclusions and contacts

WWW.NADIA-NOISE.EU

### What are the NADIA's strengths?

The project demonstrates the effectiveness of the involvement of the stakeholders and of the communication to the public for increasing the awareness on traffic noise topic.

Moreover the project allowed to define a methodology for the realization of noise action plan through an innovative cost-benefit analysis.

Even if some relevant problems occurred (i.e. floods), concrete solutions have been tested on real scale and made available to the public. They allowed to reduce the noise level in critical contexts.

### Difficulties and lesson learnt

Floods in Italy affected the project and delayed it but, from the technical and organisational points of view, no relevant problems were met.

The initial set of data wasn't adequate to face the obligations on noise mapping but the project provide local bodies with requirements on data useful to organise themselves (milestone 1)

Few citizens participated in the communication events. Nevertheless an active participation of technicians and pupils in the project activities was observed. Future project could focus their dissemination activities on this part of population.

### What kind of materials are available?

The NADIA project makes available:

- ✚ The project deliverables which stress the methodological approach adopted.
- ✚ The technical documents that are strategic maps, plans
- ✚ Communication and education material
- ✚ Works done that are available for visits to citizens, technical experts, local bodies in charge, etc.

Results are available at the following internet site:

<http://www.nadia-noise.eu/en/download>

### Who to contact?

Ms. Cecilia Brescianini - Province of Genova - Project Coordinator

Mr. Alessandro Conte – Province of Genova

Mr. Danilo Guarti – Municipality of Vicenza

Mr. Sergio Spagnesi – Municipality of Prato

Ms. Stefania Ghirardo - Province of Savona

Prof. Francesco Asdrubali – CIRIAF, University of Perugia

## Acknowledgements

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Comune di San Colombano Certenoli

Comune di Genova

Comune di Firenze

Provincia di Torino

Arpa Piemonte

Arpa Liguria

Provincia autonoma di Bolzano

Comune di Bolzano

Provincia autonoma di Trento

Provincia di Venezia

Provincia di Verona

Provincia di Treviso

Comune di Modena

Comune di Padova

“HUSH” LIFE+ project

“QUADMAP” LIFE+ project

“HARMONICA” LIFE+ project

and



programme

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