



Quiet Area Definition in the Implementation of European Directive 2002/49/EC

G. Licitra¹, C. Chiari², E. Ascari³ and D. Palazzuoli¹

¹ARPAT Environmental Protection Agency of Tuscany Region, Florence, Italy

²ARPAT Environmental Protection Agency of Tuscany Region, Pisa, Italy

³CNR-IDASC Institute of Acoustic and sensoristic science "O.M. Corbino", Rome, Italy

A paper previously presented at ISSA 2010, 29-31 August 2010, Auckland

Abstract

The Directive 2002/49/EC requires that Action Plans for agglomeration should aim to protect quiet areas too: they have to be identified not only in open country, but also in an urban context. However, there is not yet an international agreement and a robust method to perform this identification; many approaches have been proposed from the non-acoustic one (distance from major sources of noise, public accessibility; function as a recreational space; population density; presence of sensitive buildings) to the mixed one, in which a maximum sound level is also fixed ($L_{den} < 55$ dB(A) in an area greater than 4.5 ha). The importance of quiet areas will increase with the second step of the Directive implementation that will regard cities with more than 100,000 inhabitants (more than 1,000 cities in Europe): large parks are not common, so it could be convenient to determine small areas where people could relax without spending too much time to reach a quiet extra-urban location. In this paper a method to determine possible "neighbourhood quiet areas" has been tested in the city of Pisa (Italy) belonging to the second step. Road traffic noise has been recognized as the principal annoying source, therefore, areas with road noise $L_{day} < 55$ dB(A) have been identified and selected with a GIS techniques based on land use (parks, green historical and sensitive areas) and dimensional criteria. A post-process selection has been performed taking into account also the other noise sources in order to allow decision makers to evaluate resources availability and to develop specific Action Plans..

Introduction

The European Directive 2002/49/EC, relating to the assessment and management of environmental noise [1], aims "to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise".

It also defines for all Member States common environmental noise indicator: L_{den} , which is a weighted energy sum of noise equivalent levels during day-evening-night periods, defined in Italy as L_{day} 6am-8pm, $L_{evening}$ 8pm-10pm and L_{night} 10pm-6am. Furthermore, it defines quiet areas, which are obviously important to compensate annoyance and stress caused by noisy home and work environments.

However, the definition of a quiet area is not unique within the Directive and two kinds of areas can be distinguished:

- A Quiet Area in agglomeration that "shall mean an area, delimited by the competent authority, for instance which is not exposed to a value of L_{den} or of another appropriate noise indicator greater than a certain value

set by the Member State, from any noise source" (art. 3, lett. l);

- A Quiet Area in open country that "shall mean an area, delimited by the competent authority, that is undisturbed by noise from traffic, industry or recreational activities" (art. 3, lett. m).

Both areas are to be protected and actions have to be planned in order to comply with the Directive requirements. Nowadays the greatest problem is still defining a shared procedure and noise limit values in order to identify quiet areas especially in agglomerations. During recent years, some Member States (MSs) have already tried to set up criteria and methodologies to define quiet places: generally these criteria are based both on acoustic properties and geographic distance from the major noise sources. Different approaches will be discussed in the following paragraphs.

In the first part of the paper the main approaches will be described and applied to the municipality of Pisa, a small town in the Tuscany region, Italy (about 100,000 inhabitants). In Italian legislation, before the acknowledgment of the European Directive, quiet areas

were not clearly defined. The legislation established in 1991 sets noise limits for areas whose primary usability requirement is quietness. Usually those limits ($50 L_{day}$, $40 L_{night}$) are suitable for natural parks and other not urbanized areas but they may be applied to historical sites too.

The authors believe that those limits are not adequate to identify quiet areas because these areas may have a higher noise level but may still be a place to stay away from town noise and relax. So we define quiet areas in agglomeration as neighbourhood quiet zones (even if small) whose public accessibility is the main property. Therefore, a new approach for small town is proposed that could be applied for similar Italian cities. In fact, we believe that perceiving quietness is something related not only to acoustic criteria but also to how public places are perceived by inhabitants: this is a cultural factor related to local practise of sociability and to attitude to noise sources by competent authorities [2], and it could not be easily taken from other European contexts. This belief is confirmed by a current tendency, which leaves decisions about quiet areas to local authorities.

State of the Art: Available Approaches

Acoustical criteria

Some MSs have already adopted noise level limits for quiet areas [3] but only in Norwegian legislation are they defined in terms of L_{den} according to the Directive 2002/49/EC. At the moment some suggestions and reports are available from EU research projects:

1. The study of Symonds Group [4], required by the European Union, that recommends limits for quiet area in agglomeration ($50 \text{ dB } L_{den}$) and in open country ($40 \text{ dB } L_{eq,24h}$);
2. A study of the Irish Environmental Protection Agency EPA[5] suggests a $30 \text{ dB } L_{90}$ limit for not geophonic or biophonic sounds in open country;
3. A Finnish study [6] remarked that quietness level should differ according to the context and suggested 45 dB during the daytime in agglomeration, a $35\text{-}40 \text{ dB}$ range in rural areas and $30\text{-}35 \text{ dB}$ in natural parks and where human activities are not frequent.

Considering these low noise level limits, public experience in quiet areas is not usually considered in the mapping procedure.

In order to analyse in detail this topic a study has been carried out in Amsterdam to identify and map quiet areas [8]. Also in Amsterdam citizens have been involved in giving feedback about the real usability of different sites.

Distance based criteria

Other methodologies to identify quiet areas start from geographic considerations using urban planning approaches based upon distance criteria. Both the Irish EPA study and the Finnish one [5, 6], suggested different distances from main towns and infrastructure.

A similar approach was also suggested by the Campaign to Protect Rural England (CPRE) [9] to identify quiet areas in open country. Distance criteria are suitable to identify large natural areas: in [3] they are compared and areas subtracting buffers of main roads and railways and urbanised sites are identified (see Table 1).

Table 1: Distance criteria [3]

Noise Source	Quiet Areas		Tranquil Areas
	Waugh <i>et al.</i> (2003)	Karvinen & Savola (2004)	CPRE (Undated)
Motorway/Dual Carriageway	7.5 km	4 km	4 km/2 km
National Primary Route	5 km	4 km	1 km
Regional roads	---	3 km	1 km
Local roads	---	2 km	---
Railway lines	---	3 km	1 km
Air and water transport	---	3 km	---
Motor sport	---	3 km	---
Large Towns / urban areas with a population of >10,000 people	15 km	---	4 km
Smaller towns / urban areas with a population of >5,000 people	10 km	---	2 km
Urban areas with a population >1,000 people	3 km	---	---
Major industry site	10 km	---	---
Local industry	3 km	---	---
Largest power stations	---	---	3 km

The goal of such methods is to identify large quiet areas that could be preserved from urbanization and regarded as natural reserves of quietness: a global environmental protection approach is integrated in this concept. These criteria are fixed for large rural areas of these countries, which are not so frequent in Italy. The methods seem unsuitable for the Italian territory, as it is described in the second part of this work.

Moreover, the project [8] defines tranquil areas as 'places which are sufficiently far away from the visual or noise intrusion of development or traffic to be considered unspoiled by urban influences'. Therefore, we notice that this concept is not suitable for agglomeration, in which authorities should consider more factors, especially public accessibility.

Mixed approaches

A comprehensive approach to identify quiet areas in the first mapping round has been set up by Defra [3], which establishes a short-term procedure for quiet areas in agglomeration. A sequence of filters is applied to a territory to identify quiet areas. The main filters are:

- Land Type: woodland, nature reserves, landscape, country parks, gardens, recreation and sport grounds, playing fields and playgrounds, amenity that are accessible to general public;

- Noise level: area must include a part under $55 \text{ dB } L_{den}$;
- Minimum area: the area must be greater than 9 hectares;
- Minimum area of quiet: the area under 55 dB must be greater than 4.5 hectares.

Minimum area filters are optional and they are used to reduce the number of quiet areas so that they became manageable for local administration.

Defra also suggests a long-term procedure that involves local authorities and stakeholders to assess candidate areas; however, this procedure for agglomerations identifies big areas and not small (public) gardens, which are more likely to be accessible and usable.

Small areas do have the same benefits in terms of quiet, as asserted by the Dutch Health Council, which includes quiet built up areas in cities and identifies a different step-wise procedure [9]:

1. A sound must be classified as appropriate/inappropriate or desirable/undesirable for each type of area (nature reserves, green spaces in the countryside, green spaces in cities, quiet built-up areas in cities);
2. The current level of inappropriate or unwanted sound must not exceed a certain 'level of quietness', which can be exceeded only for a limited amount of time;

3. This 'level of quietness' is an expected background level that varies according to the (type of) area;
4. An additional criterion is that it should not be possible to hear any loud inappropriate/undesirable sounds, or that any such sounds that can be heard should be as quiet as can reasonably be achieved given the producer/source of the sound.

Therefore, evaluating quiet areas in urban environment means considering citizen perception of quietness: in fact, more recent studies have also begun to take into account the opinion of the general public, asking them to discover which quiet areas can really be considered to be accessible [2, 7, 10].

Quiet Areas in Small Cities: Application of Available Methods to the Tuscany Region

Although some methods shown above are oriented to the identification of quiet areas in agglomeration, when applying them to our national territory, it is hard to define areas large enough to be suitable for relaxing and restoring from every day noise.

Evidence of these difficulties are greater applying distance based criteria: An attempt to identify potential quiet areas has been carried out according to the methods listed in Table 1 and summarized in [3]. These criteria have been applied to the Tuscany region with particular attention to the small municipality of Pisa, which includes a large natural reserve of national interest.

The following figures show the results of distance-based approaches:

- The Irish EPA method - Figure 1;
- The Finnish method - Figure 2;
- The English CPRE method - Figure 3; All buffers for each type of noise source (infrastructure or town) are considered as exclusion criteria to identify potential quiet areas, which are defined as resting territory.

Notice that, excepting the Finnish methods, these approaches are intended to identify quiet areas in open country; in particular the CPRE method is oriented to protect tranquil rural areas.

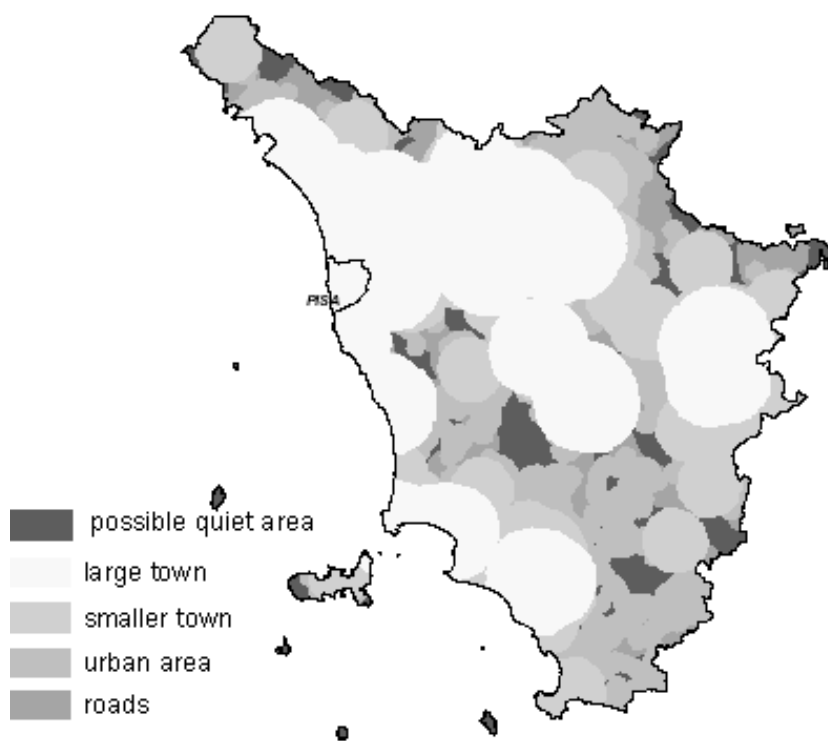


Figure 1. Irish EPA method [5]. Darker areas are quieter.

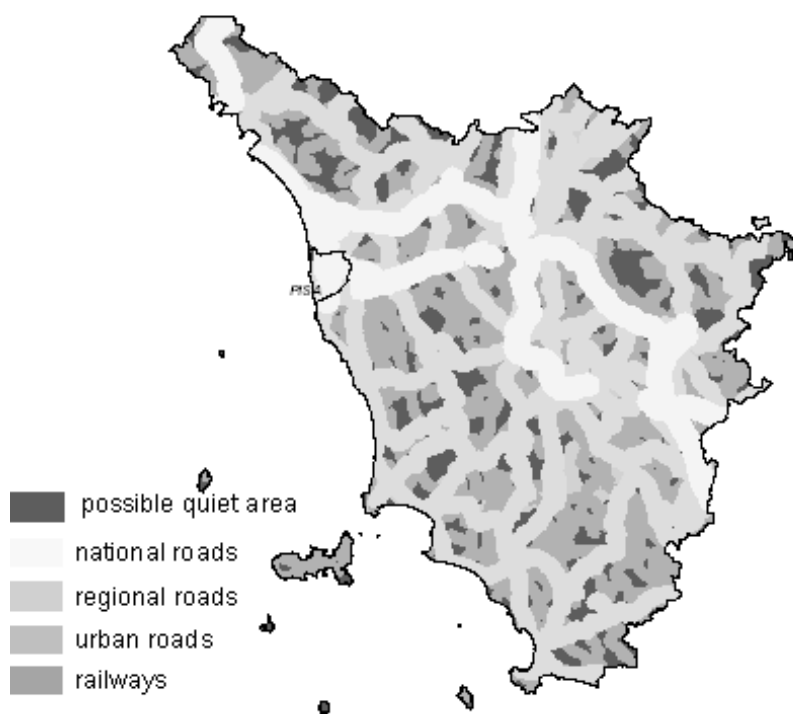


Figure 2. Finish method [6]. Darker areas are quieter.

These methods appear to be unsuitable for Tuscany region: in particular the Irish and the Finnish ones are too strict, excluding almost all of the Tuscany region, which is known as a green territory. Better results are obtained with the identification of tranquil areas method: a lot of rural areas far from major roads and town are identified;

however, only a small part of Pisa municipality seems to be a quiet area.

Areas identified with those approaches are still unsuitable for every day relaxing not only because they may be not public spaces but also because they are too far away from the home and work places of Pisa inhabitants.

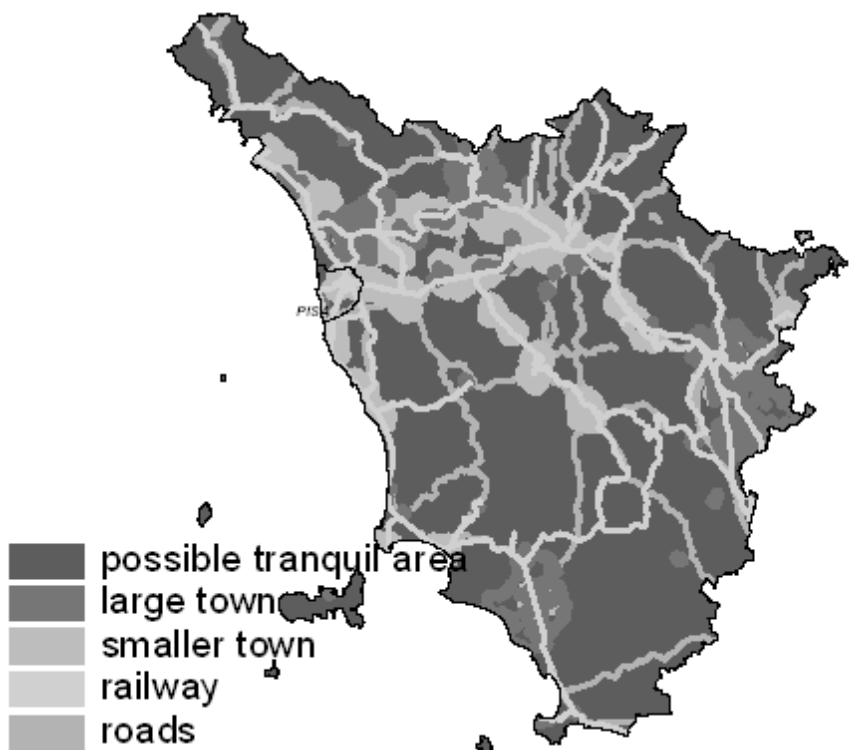


Figure 3. CPRE tranquil area method [8]. Darker areas are quieter.

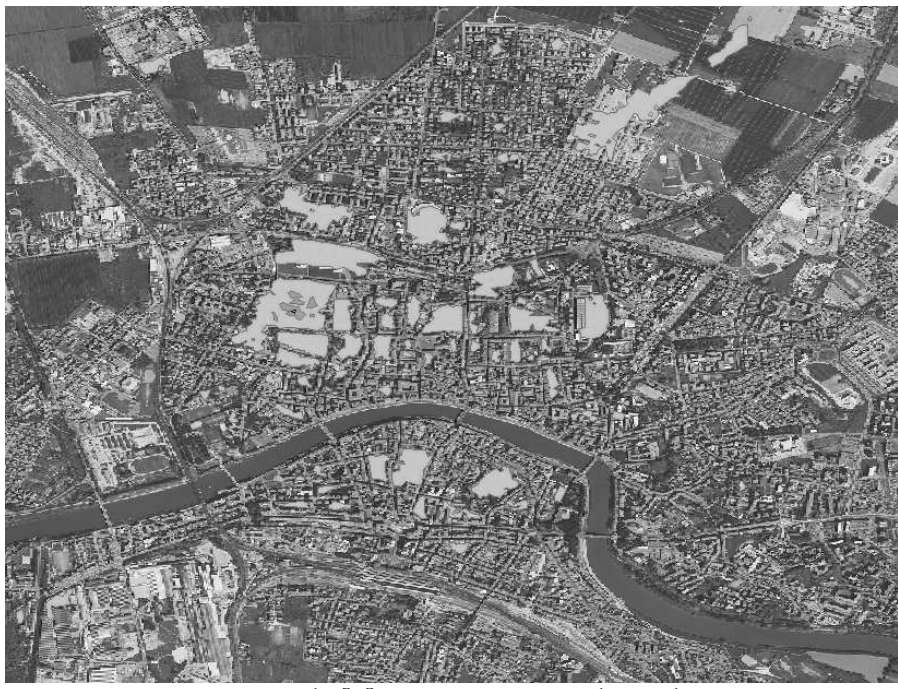


Figure 4. European study [8] acoustic approach. Lighter areas are quieter.

Therefore, these methodologies don't reach the aim of quiet areas in a small agglomeration such as Pisa. Better results have been achieved with acoustical criteria approaches: we applied noise threshold level $L_{den} < 50$ dB(A) suggested in the European study [8], as shown in Figure 4.

The results identify a number of quiet small areas in the city centre that are

very accessible. However, the threshold level is not able by itself to select real relaxing city areas because other facets have to be considered: land use, minimum area size, public accessibility and usability.

Defra Approach: Application

A more detailed and complex approach is the one proposed by Defra, which

is a multi-criteria approach with more than one filter. When we applied it to the Pisa municipality, with noise and land type filters, we obtain a too large a number of quiet areas (light areas in figure 5). In fact, almost all areas with low levels have the correct land type.

However, the results when introducing minimum area filters are not better (dark areas in figure 5). In fact, most of the identified areas are located far outside the city centre, in which only small areas are available, and they are agricultural areas or woodland not necessarily accessible to the public.

Therefore, applying dimensional filters we lose important quiet areas in city centre and at the same time we obtain too many publically inaccessible areas.

The reasons for failure of this method (and of the previous one) are mainly due to the context of planning. In fact, in North Europe urban characterization is very different from the Italian one; small spaces in Italian towns don't allow such large areas, therefore we have to use a different approach that could be suitable for a small town.

In the next section an attempt to modify the Defra approach to fit Italian urban characteristics is carried out.

Neighbourhood Quiet Area: A Defra Italian Interpretation

The Pisa municipality is a quite small one in the Tuscany region (less than 100,000 inhabitants): it carried out strategic noise mapping, even if not compelled by law, taking into account the presence of university students (more than 10,000 new students per year), which are to be considered inhabitants even if not officially registered.

Strategic noise mapping was carried out through a detailed modelling of municipal area, performing calibration measurements (both traffic data and noise levels) and running a noise model [11]; this led to an estimate of noise levels over a 5x5 m spaced grid.

Model results, verified by means of further noise measurements, had good accuracy according to the GPG2 (Good Practice Guide ver. 2 [12]).

The town of Pisa has a large historical city centre (partially closed to traffic) and an enormous amount of traffic around city walls caused by commuting, which is the main noise source.

A city like Pisa with many students and pedestrian areas needs small quiet areas within urban quarters so that quietness will be embedded in an urban milieu. This process should involve citizens expressing their opinions and needs a number of these quiet oases.

Quantitative phase

To define a new approach we started from the final aim of defining quiet easy-accessible areas, embedded in an urban context, then we considered the pros and cons of the previously implemented methods and finally defined a new methodology, which is more suitable for a small town.

This new approach is of course a mixed one that identifies areas under a threshold value whose land use is adequate.

Some observations have been taken into account to define a multi-filter procedure:

- Noise levels are analysed to identify quiet areas are L_{day} values: in fact, areas are projected for daytime relaxation and we decided not to consider night time exposure to noise;
- Studies and surveys carried out for the Pisa municipality and Tuscany region [13, 14] highlighted that main annoyance source is the road network; annoyance from a continuous source like road noise is higher than a source with short high peak events like railway or aircraft noise;
- The minimum area size could be smaller than the one of Defra, especially considering the global size of the municipality; moreover, excluding national natural reserve, there are no big parks but only small green district areas, yards of historical buildings, historical and monumental areas.

The following is the detailed multi-filter procedure that is used for the identification of possible quiet areas in Pisa:



Figure 5. Defra method [3]. Lighter areas are quieter.

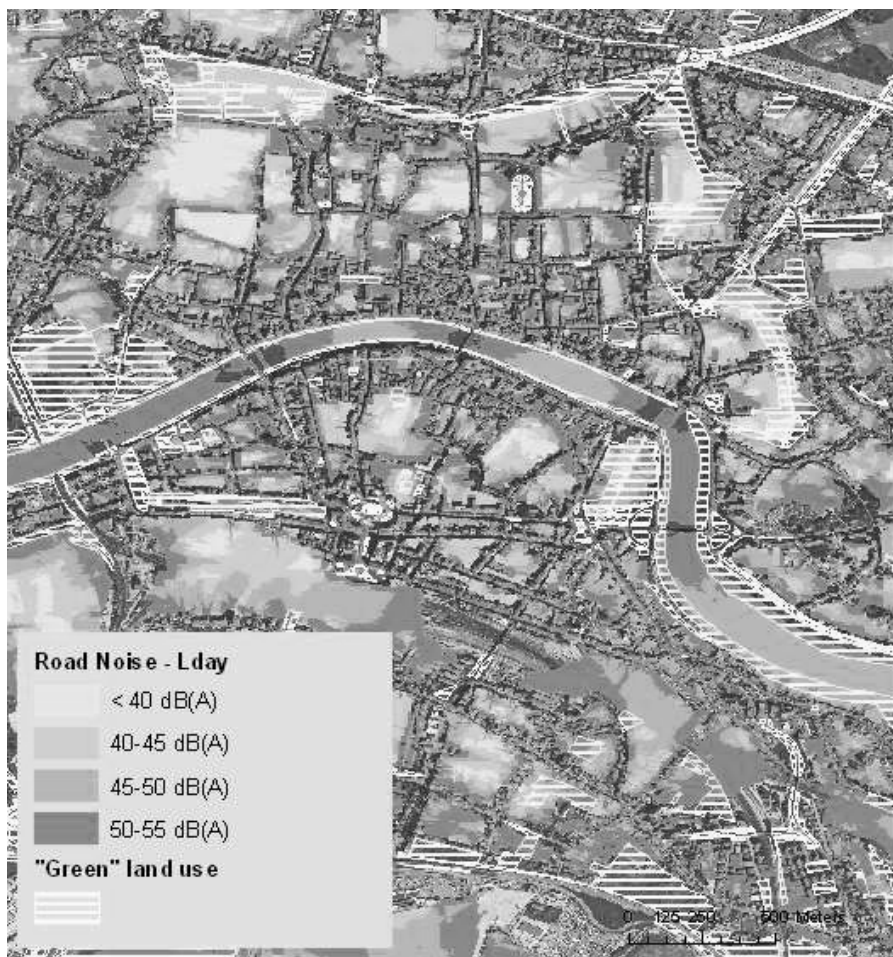


Figure 6. Pisa city centre -Step 1 & $2L_{day} < 55$ dB(A).

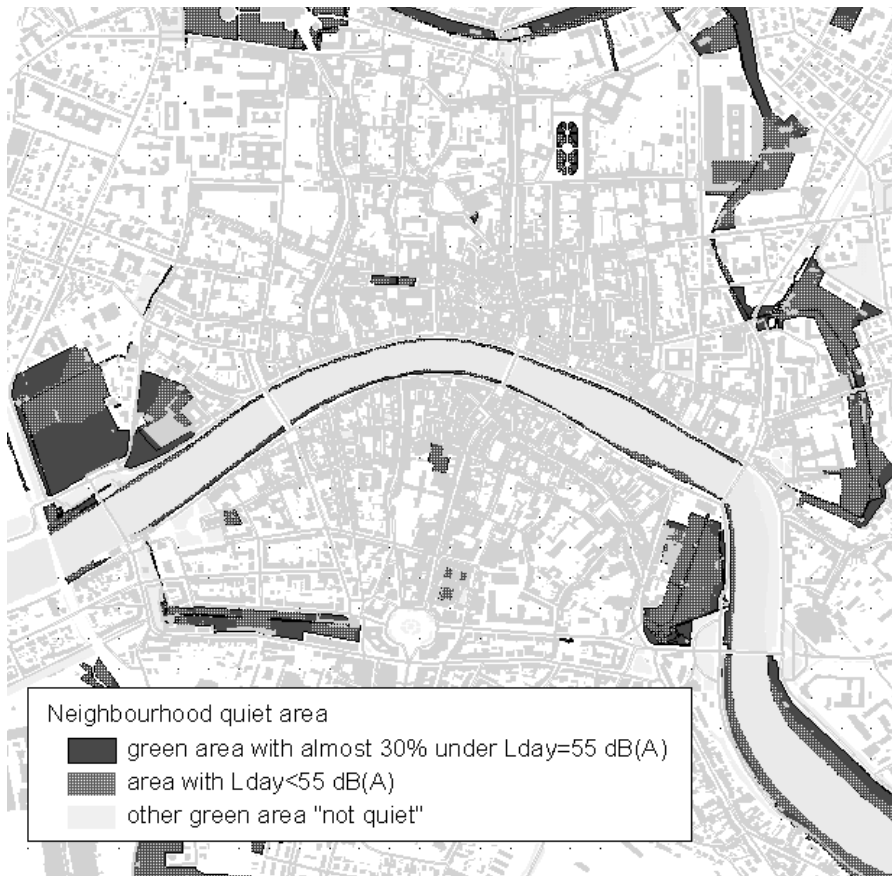


Figure 7. Pisa city centre. Step 3 Selected 30% quiet areas are dark.

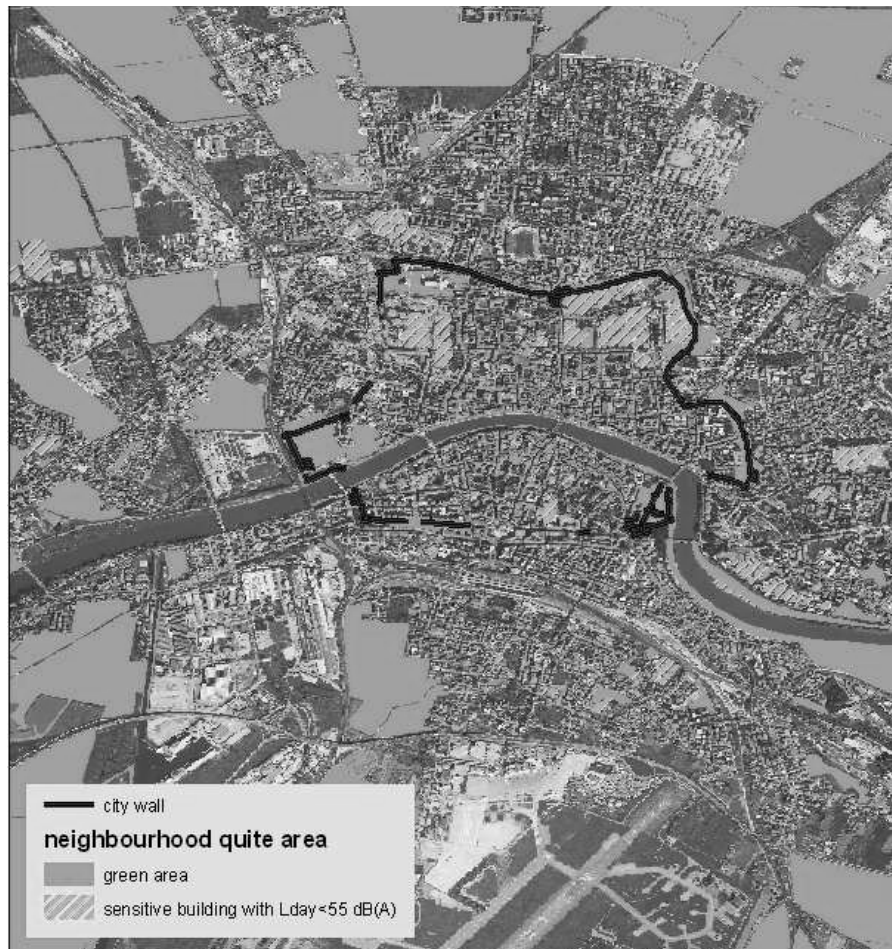


Figure 8. Pisa city centre. Step 4 Quiet areas and sensitive buildings with L_{day} noise levels under 55 dB(A).

1. Select areas whose land use characteristics are suitable for parks, green spaces, historical areas;
2. Select area with day time noise road levels $L_{day} < 55$ dB(A) (notice that the grid resolution is 5 m^2) (see Figure 6);
3. Identify from set 1 only the areas whose percentage of quietness, as defined in set 2, is greater than 30% (figure 7).
4. Include sensitive buildings (such as a school, hospital, nursing or retirement home) whose diurnal level (L_{day}) doesn't exceed 55 dB(A) (figure 8).

A post process check (figure 9) is convenient to verify if this procedure included areas with too high strategic noise level (areas with strategic levels $L_{day} > 65$ are deleted).

Qualitative phase and development post-process selection

This method also includes areas that may be not accessible to the public: that's why a qualitative phase is needed to select real quiet areas.

This phase may involve not only urban planners but also citizens. Identification of quiet areas by citizens may be a check of the quantitative phase that could be carried out involving citizens living and working near quiet potential areas but also all inhabitants.

The real needs of citizens and the real accessibility of an area not always depends on noise characteristics but sometimes social factor (security, clearness, clean area, landscape, vegetation, ...) are more relevant [7].

In fact, some surveys have been already done [8] but now improvements in web technology (i.e. online social networks) allow a broader approach. An example of this is the e-participating process as described by the Bristol Citizenscape [13] project in which citizens are able to identify quiet areas on a map: both potential and actual quiet areas are identified and comments, audio and video can be added.

Therefore, a similar survey would be suitable also for the Pisa municipality to involve citizens and to know actual needs of people.

Final quiet areas to be included in action plans should be defined by local authorities considering not only acoustic and land type criteria but also citizen needs and sensibility: this process will lead to identification of quiet areas that will provide a concrete possibility of relaxation in every day life.

With these quantitative and qualitative phases, decision makers are allowed to evaluate resources availability and to develop specific action plans that include definition of quiet areas [15]. In this way decision taken by authorities could be more efficient and could be better understood by inhabitants.

Conclusions

A comparison between different approaches to select quiet areas in open country and inside agglomerations has been carried out. All the applied methods seem not to be suitable for identifying quiet areas in a small municipality, being focussed on large areas. The quiet areas concept and any procedure to select these for local areas should take into account the urban history and cultural heritage: the main characteristics of quiet areas have to be both quietness, usability and “well being” perception. A new promising approach has been developed which considers some peculiar characteristics of the Italian, in particular, Tuscan small cities.

References

1 European Commission, European Noise 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 (2002)

2 G. Faburel, N. Gourlot, Référentiel national pour la définition et la création des zones calmes, Centre de Recherche sur l'Espace, les Transports, l'Environnement et les Institutions Locales (C.R.E.T.E.I.L.) de l'Institut d'Urbanisme de Paris -Université Paris XII (2008).

3 P A Morgan, P G Abbott, G R Watts, C A Burke and C Harmer (TRL Limited), Research into quiet areas- Recommendation for identification, Department of Environment Food and Rural Affairs, (2006).

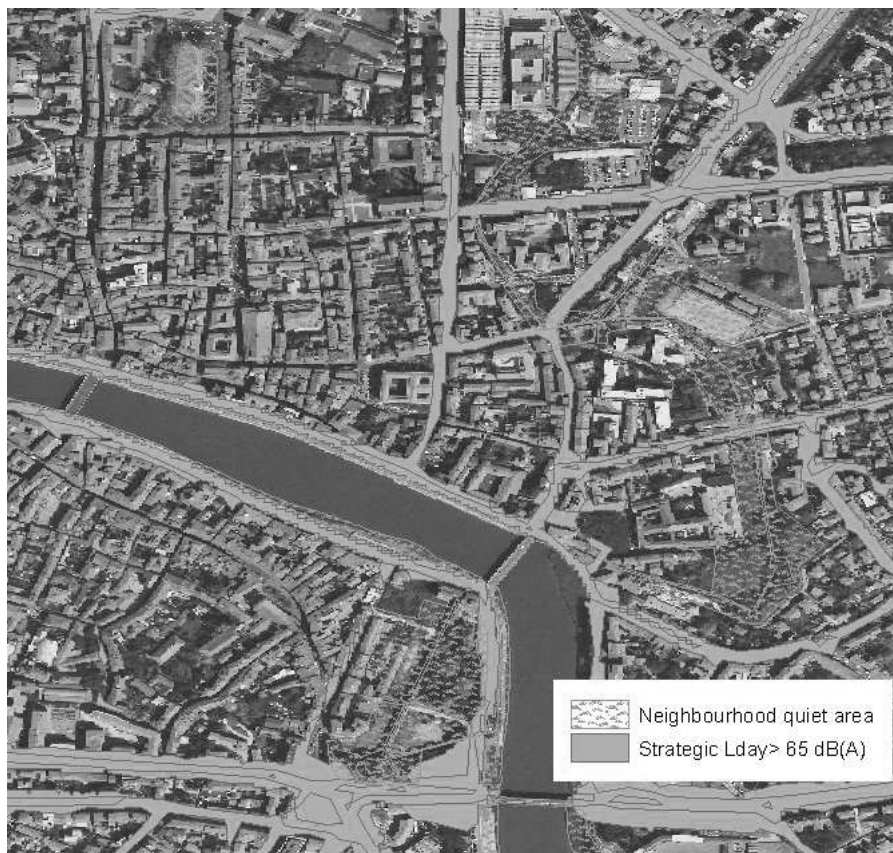


Figure 9. Post process check of high strategic levels in selected quiet areas

4 Symonds Group Ltd, Report on the definition, identification and preservation of urban and rural quiet areas. Final Report 4E 59492. Symonds Group Ltd, East Grinstead, UK. (2003).

5 D. Waugh, S. Durucan, A. Korre, O. Hetherington, B. O'Reilly, Environmental quality objectives. Noise in quiet areas: synthesis report. Environmental Protection Agency, Johnstown Castle, Ireland. (2003).

6 P. A. Karvinen and A. Savola, “Oases of Quietness in the Satakunta Region – A pilot study of low-noise areas in Satakunta region.”, Joint Baltic-Nordic Acoustics Meeting 2004, 8-10 June 2004, Mariehamn, Aland. (2004).

7 L. Maffei, “Urban and quiet areas soundscape preservation”, Proceedings of VI Congreso Iberoamericano de Acústica FIA -Buenos Aires, Argentina (2008).

8 F. van den Berg, A. Brand, “Recommendations for public quiet places in Amsterdam” , Proceedings of EuroNoise 2009, Edinburgh, Scotland. (2009).

9 R. MacFarlane, C. Haggett, and D. Fuller, Mapping Tranquillity: Defining

and Assessing A Valuable Resource. CPRE, UK. (2005).

10 M. M. H. E. van den Berg and G. P. van den Berg, “Quiet areas: health issues and criteria.”, Proceedings of EuroNoise 2006, Tampere, Finland. (2006).

11 G. Licitra; G. Memoli. “Limits and advantages of Good Practice Guide to noise mapping.”, Proceedings of Acoustic08, Paris, France. (2008).

12 European Commission Working Group Assessment of Exposure to Noise. Good practice guide for strategic noise mapping and the production of associated data on noise exposure, 2nd version (2007).

13 <http://www.bristol.citizenscape.net/core/>

14 G. Licitra and M. Noll, “The response of population to urban noise: the results of a socio-acoustic survey performed in a residential area of Pisa”, Proceedings of Internoise 2006, Honolulu, Hawaii, USA. (2006)

15 G. Licitra and G. Memoli, “Testing new solutions for action plans in quiet areas.”, Proceedings of EuroNoise 2006, Tampere, Finland. (2006).