
# Implemented comprehensive approach for the identification of quiet areas in the city of Paris

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**Since the 2002/49/EC European Directive came into force, the definition and the identification of quiet areas in urban environment gave rise to many research projects. However, the implementation of these projects in the field, as a requirement for the preservation of quiet areas, remains difficult to grasp for public local authorities. On the initiative of the Paris City Hall, with the support of the regional agency Bruitparif and the private compagny Acoustique&Conseil, a new, simple and comprehensive approach has been developed and implemented in the city of Paris. The first stage identifies potential quiet areas through the analysis of existing noise maps and additional geographical information. The method incorporates the concept of "relative noise" well adapted to a search at a neighbourhood scale. The second step is based on local consultation with Paris inhabitants to take into account all the perceptual parameters and to ensure the consistency of the proposals. For this purpose, residents and local authorities are invited to express themselves through consultation meetings and a collaborative tool available on the website of the Paris City Hall. Finally, the last phase is based on the accurate characterization of some locations, shortlisted by a measurement campaign coupled with in situ perception surveys.**

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# 1 INTRODUCTION AND REGULATORY CONTEXT

Quality of life is a strong and legitimate aspiration for Parisians and noise is regularly mentioned as the first urban nuisance, with all the health and psychological effects it generates.

The 2002/49/EC European directive regarding the management of environmental noise aims to better take this issue into account with two tools: strategic noise maps and action plans. This directive introduced the original concept of "quiet areas" by specifying that action plans must help preserve the sound quality of the environment when it is satisfactory.

In its transposition into French law, "quiet areas" are defined in the article L 572-6 of the Code of the Environment as "external spaces notable by their low exposure to noise, where the authority in charge of the plan wants to control the evolution of this exposure considering the current or future human activities." This means preserving some areas from the hustle and bustle of the city and its noise nuisances, and offering its inhabitants some places where they can relax from the daily stress and recharge.

The lack of complementary indication, especially on how to determine these quiet areas, leaves the authorities free to establish their inventory method, their preservation objectives and the means to implement them. The City of Paris and its partners, Bruitparif and Acoustique & Conseil, decided to work on this question and drew up a methodology suitable for Paris.

# 2 A SIMPLE AND OPERATIONAL METHOD FOR PARIS

## 2.1 An urban context not really suitable for quiet

The Paris environment is not exactly made for quiet. Beside its 2.19 million inhabitants – with 21,000 inhabitants per $km^2$, it is one of the densest cities in the world –, 4 million people enter Paris every day through its many road infrastructures, the six passenger stations or the regional train network. The mixed-use development and the overlap of the different lifestyles and rhythms of the inhabitants unavoidably create noise annoyances and expectations of peace and quiet at the same time. The interpretation of the strategic road noise maps shows that 65% of the inhabitants are exposed to a noise level (expressed with the European harmonised indicator Lden) above 55 dB(A).

In order to know more about the feedback from other French and European cities, an international conference was organised in February 2010 at the Paris City Hall. The findings of this event and the various research works on the notion of "quiet" in an urban environment convinced the City that the methodology to characterise "quiet areas" on its territory should meet the following two requirements:

- be suitable for the particular urban context of Paris,
- have simple steps in order to be easily accepted by local stakeholders and implemented in the field.

## 2.2 Two complementary typologies of quiet areas

First of all, considering the diversity and the spatial heterogeneity of the areas that can be characterised as quiet in Paris – a park, a cemetery, a bank of the Seine, an urban public space… – and their related varied attractiveness, it was relevant to identify two main complementary categories of quiet areas:

- **big (> 3 ha), emblematic areas** such as the main Paris parks, the woods, the historical cemeteries, or with a **very strong attractiveness** like the banks of the Seine or the canals, with an area of influence that can exceed one kilometre. Unfortunately, these areas do not follow a very homogeneous spatial distribution on the Paris territory since they are completely dependent on historical and natural factors.
- **local areas**, available to everybody with a five minutes' walk (500 m). These areas aim to cover all of Paris for every inhabitant to have a quiet area close to them.

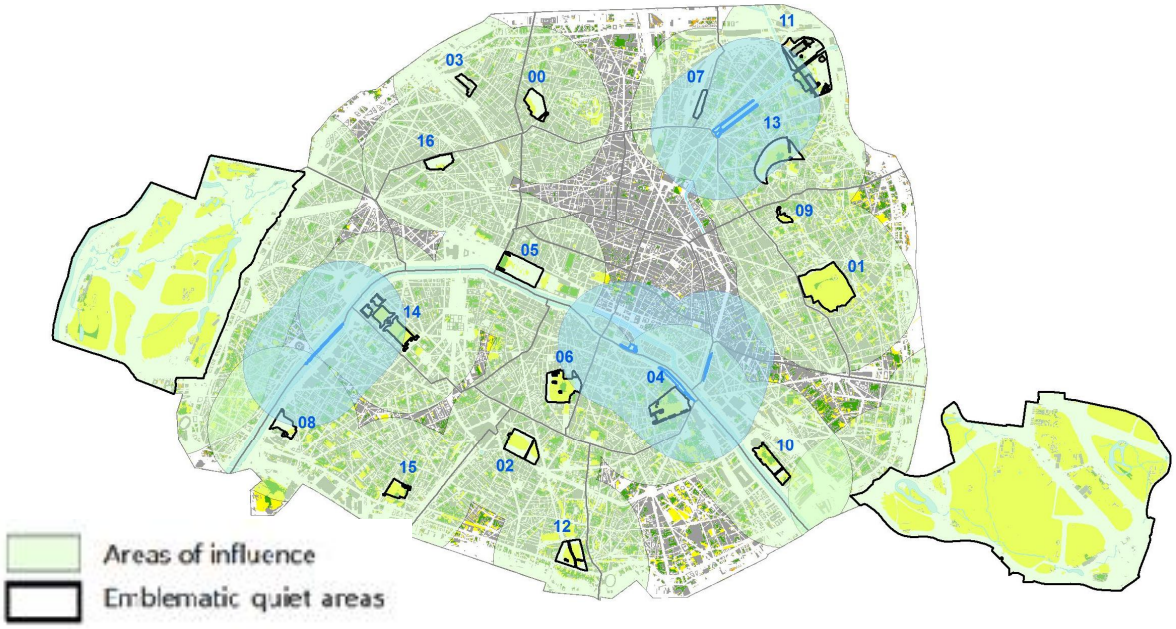


*Fig. 1 - Map of the emblematic quiet areas and their related areas of influence.*

## 2.3 A participatory and progressive approach

The exclusivity of acoustic criteria in the definition of quiet areas is rejected by everybody. They are all aware that other amenity criteria are also interesting to consider and necessary to the social acceptability of such areas.

Therefore, the methodology that emerged relies both on the most extensive analysis of the strategic environmental noise maps and the georeferenced elements available, and on the inventory and the analysis of the feelings of the inhabitants, users and local organisations regarding the suggestions of quiet areas in their neighbourhoods.

This comprehensive approach is made up of three steps:

- the pre-selection of potential quiet areas from the analysis of the maps;
- the local consultation with the inhabitants;
- the multi-criteria analysis and the validation with the district halls.

### 2.3.1. The cartographic pre-selection of the potential quiet areas

This step consists in locating the sites that can considered as quiet areas thanks to an exclusively acoustic criterion. To do so, the chosen approach is based on the updated results of the strategic noise maps of Paris crossed with the other georeferenced data available (public property, parks, city facilities). Various filters of the Geographic Information System (GIS) are

then used to select the potential areas where the average exposure to transport infrastructure noise seems the lowest.

2.3.2. The local consultation

Once the potential sites are identified, it is necessary to start a consultation in the field with the population. Indeed, whatever the quality of the data used in the pre-selection step, it cannot take into account all noise sources, such as the emergences of powered two-wheelers, the sirens of emergency vehicles, the noise nuisances related to shops and small businesses and simply the sound reality of the different neighbourhoods. The objective is to confront the local feelings with the acoustic analysis.

The semi-consultative approach chosen consists in presenting the potential quiet areas to Parisians through several tools in order to enrich and share the reflection.

2.3.3. The final multi-criteria analysis

All the criteria, acoustic and perceptive, are then combined for all the sites in order to reach the most comprehensive vision possible. Many field visits complete this analysis; the lack of strong on-site obstacles like security or insalubrity is duly noted. The last discussions with district halls lead to a shared validation on a reasonable number of quiet areas.

## 3 THE CARTOGRAPHIC PRE-SELECTION OF THE QUIET AREAS

### 3.1 Hypotheses and entry data

This step requires the use of a GIS that can apply several levels of filters on the existing data. These essential entry data depend on the working hypotheses that have been defined to implement the identification methodology.

These are mainly the environmental noise maps made according to the European directive, both for road traffic (maps updated in 2007) and rail traffic (data from 2010 for rail tracks and the elevated metro), the main sources of noise nuisances related to transport infrastructures in Paris. The annoyance generated by the air traffic of the Paris-Issy-les-Moulineaux heliport will be included later on.

The processing of the maps with a GIS avoids any bias on the nature and the location of the results. The basic principle chosen is that any space open to the public is a potential “quiet area.” The predominance of green spaces in the results of the GIS filters can be guessed but we tried to identify all interesting spaces, even if they are not parks and gardens. The variety of the urban spaces selected must be an advantage for the approach and the quality of the suggestions submitted to the inhabitants. A particular attention is given to the geographic information elements that describe these potential quiet areas.

The attendance considered and prioritised happens during diurnal periods, over a rather long time but not including nocturnal periods when most spaces like gardens are closed to the public. Consequently, based on the European indicators Lday, Levening, Lnight and Lden, specific noise maps have been generated for the indicator Lde (Level day – evening), i.e. over the 6 am – 10 pm period.

### 3.2 The calculation of the combined road and rail noise map over the 6 am – 10 pm period (Lde)

Based on these mapped entry data, Bruitparif built maps with ARCGIS representing the energetic combination of the road and rail noise maps for the Lde indicator. Here, rail noise means the acoustic emissions generated by:

- the rail infrastructures of the main six Paris stations;
- the elevated rail infrastructures of the metro network.

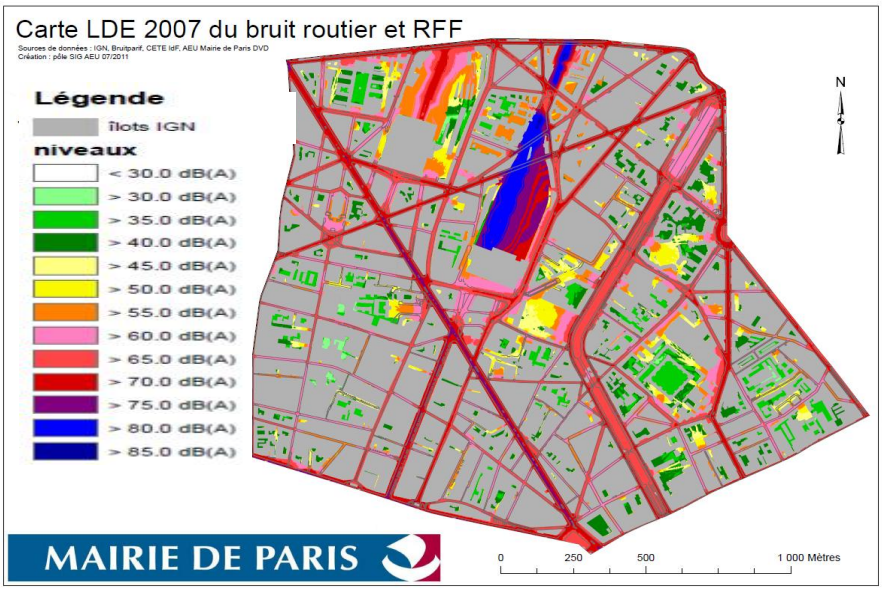


*Fig. 2 - Lde map of the combined road and rail noise for the 10th Paris district.*

The multi-exposure map for the diurnal period for all of Paris has then been split by district in order to have a viewing scale more suitable for analysis and for the presentations planned for the consultation stage. The two Parisian woods, Boulogne and Vincennes, are shown on specific maps. These 22 pages make up the basis of the cartographic study.

### 3.3 A new notion: relative noise

On the basis of these maps, it is easy to make an inventory of the areas where the calculated levels do not exceed a certain noise limit value. The choice of this strategic threshold is up to the authority in charge. The value of 55 dB(A) in Lden is often used by other European cities. In Paris, if we apply this threshold to the results in Lde of the road noise maps, it appears that 60% of the population is exposed above the 55 dB(A) threshold. The maps also show that the populations preserved from the noise nuisances related to land transport infrastructures mostly live in the centres of blocks of buildings, far from the main streets, and mainly on private spaces, not available to everybody.

Consequently, in this context of a dense urban environment usually close to traffic nuisances, limiting the definition of quiet areas only to the criterion of absolute noise level seems particularly restrictive. It is sensible to introduce for the two typologies of spaces a new notion, “relative noise,” consisting in also identifying areas of lesser noise within every neighbourhood. This way, the “quiet” aspect of a site is appraised in this step not only with its absolute noise level, above or below 55 dB(A), but also with its difference with the surrounding areas (like a “haven” of quiet).

To come close to this notion of “relative noise” or “sound contrast,” another map was made from the combined road and rail noise map in order to represent the moving average of the noise level assessed in the surrounding neighbourhood. This neighbourhood is represented by a circle or buffer of 250 m around every point of spatial coordinates (x,y).

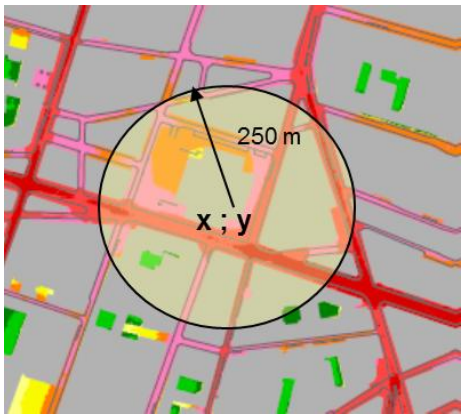


*Fig. 3 – Definition of the neighbourhood with a circle of radius 250 m.*

A 10mx10m mesh is built. For every mesh point, the arithmetic average of the noise values of the mesh points located in the circle is calculated. A circle of radius 250 m seems relevant to define the notion of neighbourhood surrounding a point of the territory.

Based on the map of the moving average of the surrounding noise levels, it is possible to make a comparison between this average value representative of the neighbourhood and the “absolute” noise value taken from the combined Lde map (2mx2m mesh resolution). This $\Delta$ difference obtained for every mesh point highlights the areas where the noise gradient $\Delta$ = Ldeaverage(R=250m) – Lde is the highest.

With this formulation, $\Delta > 0$ corresponds to a point less noisy than the average level of the surrounding neighbourhood. Thanks to this approach, we can make up 5 categories of $\Delta$ noise gradients in dB(A), from the quiet area notable in comparison with the atmosphere of the neighbourhood ($\Delta \geq 20$) up to the noisiest area ($\Delta < -10$).

Making a sound contrast map highlights the areas quieter than the average level of the neighbourhood and brings appreciable new information. To be fully effective, the analysis must however take into account the combined noise map in Lde in order to characterise the areas where the exposure to noise is either > or < 55 dB(A) and with a $\Delta$ sound contrast > or < 10 dB(A). Thanks to a coloured identification of the 4 different cases, the spaces can be classified according to how interesting they are. The ones coloured in orange, i.e. with a Lde > 55 dB(A) but $\Delta$ > 10 dB(A), need particular attention as they would not have stood out with a simple analysis of the absolute noise of the map whereas these spaces have advantages in a noisy neighbourhood.

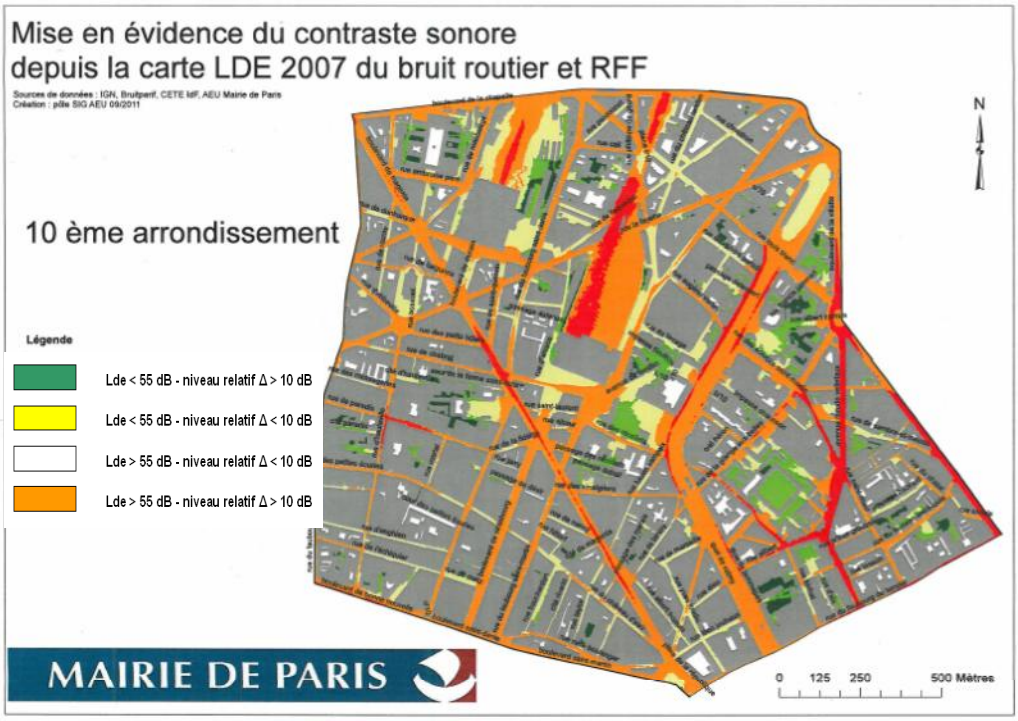


*Fig. 4 – Sound contrast map according to the classification by categories for the 10th Paris district.*

### 3.4 A first inventory of the quiet areas

The first list of areas pre-selected with the noise maps comes from the crossing of the combined road and rail noise maps and the sound contrast maps for each Paris district. At this level of the analysis, two more important filters are going to be used.

First, the public space layer: this data is complex to obtain since it is different from the delimitation of public property, which is better known. The space open to the public is made up of public property but also notable private spaces (hospitals, museums...) that can have sufficient opening hours to let the public benefit from the exceptional cultural heritage of Paris. The choice to identify quiet areas only in spaces open to the public requires building this new layer. It can be obtained from the map of Paris buildings where the centres of blocks with inner courtyards have been "masked." This filter rules out the areas with favourable acoustic characteristics but with restricted or even forbidden access to the public.

Second, the nuisances related to air traffic: this nuisance exists in Paris even though it is not identified as predominant. There are flights over the capital with airliners or related to the activities of the Paris – Issy les Moulineaux heliport. The zones of the Noise Exposure Plans of the two main Paris airports do not reach the territory of the city, contrarily to the ones of the heliport, which impact on the 15th district. These zones aim to limit the increase in the population in the areas that are exposed or likely to be exposed in the medium term to the noise nuisances generated by the activity of the heliport. The areas included in the first three zones have exposure levels to air traffic noise above 56 dB(A). The areas located inside the limit of zone C will not be considered as potential "quiet areas" and will be clearly indicated on the map of the 15th district.

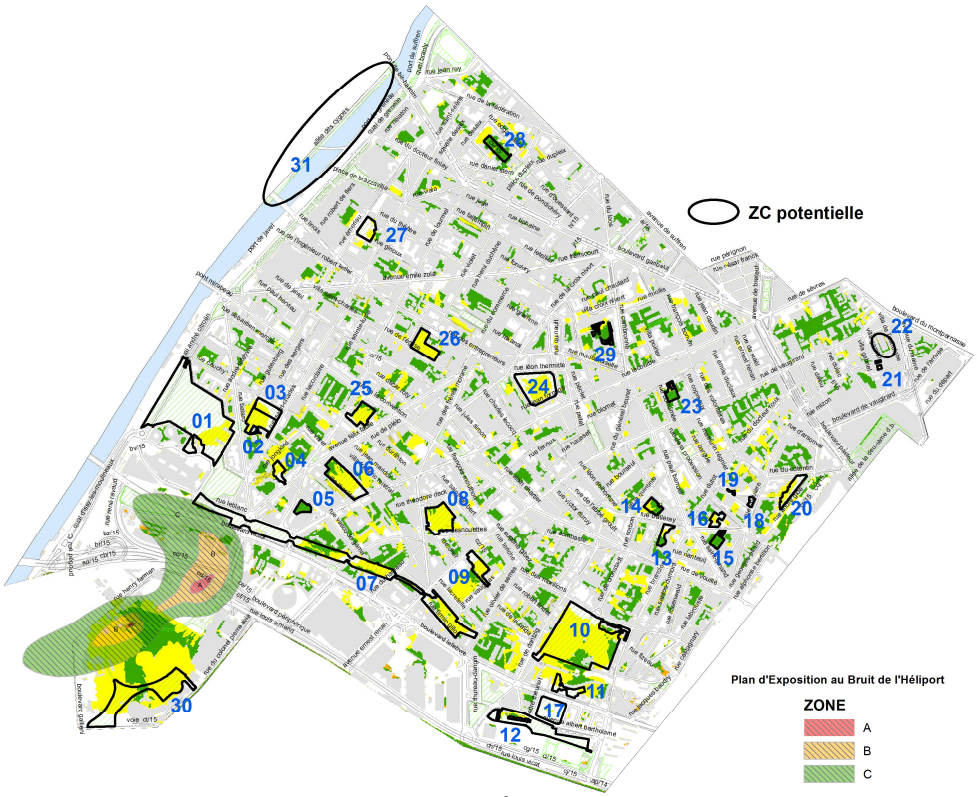


*Fig. 5 – Map of the pre-selected quiet areas in the 15th Paris district.*

The analysis of the maps let us know more about the potential quiet areas from an acoustic point of view by identifying nearly 500 areas of varied typologies, parks and gardens but also squares and alleyways, and relatively well distributed in space. This is a promising basis for the rest of the approach but we need to be aware of its limits:

- The quality of this list strongly depends on the quality of the noise maps that come from modelling the emissions and the propagation of sound waves based on road traffic data among other things. These traffic data are well known for major roads but remain uncertain for small, out-of-the-way streets. And the latter are where quiet areas are going to be the most present.

- The noise maps show calculated average noise levels. They cannot take into account all the noise nuisances related to emergences, nor neighbourhood noises (behavioural noise, noise related to shops and small businesses). And yet these sources are often what Paris inhabitants complain about.

- The creation of the GIS layer for public space works at the scale of the city, but at the more local scale of quiet areas, it is not precise enough and needs to be improved on the basis of field visits.

This confirms that what has just been described is a pre-selection step, intended to support another approach, more local, closer to the reality of the territory and more participatory.

## 4 THE LOCAL CONSULTATION WITH THE INHABITANTS: AN ESSENTIAL STEP

In this method to identify the quiet areas in Paris, it was decided to talk as soon as possible with the inhabitants, users and local organisations as they are the stakeholders of the territory.

They truly know the daily noise nuisances, the feelings regarding the different noise sources and the expectations in terms of quiet and life quality.

At this step, we begin taking into account not only acoustic factors but also perceptive ones, such as vegetation, landscape, aesthetics, cleanliness, luminosity, security, uses of the place... in the appraisal of a quiet area. It is inadequate to assess the “quiet” aspect of a site from an acoustic point of view if it is for instance unavailable to the public, insalubrious, insecure or unsuitable for recreational and leisure activities. These discriminating factors determine the implementation of the acoustic assessment of the place. However, all this essential information is rarely available except among the users of the neighbourhoods, parks and squares of Paris.

Three complementary tools have been used to gather the local feelings: an online questionnaire, an interactive map and consultation meetings in the field.

### 4.1 The online questionnaire

The original objective of this questionnaire available on the website of the City of Paris was to ask Parisians their suggestions for actions to reduce the noise nuisances related to transport infrastructures, in order to confirm the orientations taken when drawing up the action plan. A part on quiet areas was included in order to consult them on the typologies of urban spaces that would best correspond for them to the definition of a “quiet area.”

The analysis of the 1,816 answers to this questionnaire, a success considering the response rate, confirmed the decisions taken on the emblematic areas (75% of the website users consider the main Paris parks as quiet areas), the importance of local areas like nearby gardens and the will not to restrict the definition to green spaces. For 30 to 40% of the respondents, pedestrian spaces, shopping streets or inner courtyards available to everybody can be accepted as quiet areas.

### 4.2 The interactive map

A more precise approach then consisted in giving everybody the possibility to point at the areas of their neighbourhood, their district or the areas close to their working place that they consider as a space that needs preserving for its quiet or pleasant aspect. As a complement to the questionnaire, a “Google map” was available online for 10 months and gathered the suggestions of the website users and the comments on the uses of the places. In the end, 184 direct suggestions from the population were collected this way. In addition to being usually well argued, they have the advantage of being georeferenced and easily crossed with the pre-selected areas of the first step. These suggestions have positively completed the technical reflection as they sometimes correspond to the already identified potential quiet areas.

### 4.3 Consultation meetings

These meetings are part of a consultation approach larger than quiet areas that aims to associate local authorities – district halls and neighbourhood councils – and Parisians to the reflection and the enrichment of the draft action plan. This way, it was possible to explain and illustrate the notion of quiet areas. The presentation of these elements helped the participants better understand the pre-selection process of the potential sites. These sites, obtained from the analysis of the noise maps and the interactive map, were named on a map so that everybody could locate them in the district and express an opinion on its quiet aspect.

**9 meetings** took place in the Paris districts that wanted to participate in this action. Elected representatives, inhabitants and associations were able to express themselves, validate or turn down the proposals and give new suggestions.

The discussions were very rich and constructive. The inventory of the potential quiet areas in a neighbourhood or a district sometimes evolved significantly.


*Fig. 6 – Map of quiet areas after the local consultation in the 2nd district.*

## 5 A MULTI-CRITERIA ANALYSIS

After the first two steps, the inventory of the quiet areas present in Paris, emblematic and local, shows about 380 spaces. This number is reassuring for the quality of life in Paris as it means there are many places where everybody can isolate themselves to read a book or stroll peacefully.

But in the spirit of the European directive, the objective is to preserve these existing areas. The authority will draw up a series of protective measures that will guarantee that the amenity quality and the sound atmosphere will not deteriorate in time. The commitments of the City of Paris will concern a limited number of sites, a hundred at most, to be effective. With the feedback gained in the next few years, it will probably be possible to increase the number of these spaces.

### 5.1 What selection criteria?

The final multi-criteria analysis combines all the acoustic and perceptive criteria for the remaining areas. The spreadsheet used is the result of both the calculated exposure to noise and the general feeling of the population on criteria related to perceptive factors like sound comfort or human dimension like conviviality. But a whole series of references in relation to perception can be quantified.

Finally, the analysis must absolutely take into account the territorial dynamics the quiet areas will be part of. These elements are often available from the local stakeholders provided enough time is dedicated to gather them.

We had to choose the criteria considered as essential and a priority and focus on the following elements:

- Strong obstacles like insalubrity, insecurity and incivilities.
- Emblematic landscape and environmental criteria: vegetation, water, the historical dimension of the landscape and the cultural heritage, and the significant presence of biodiversity.
- The uses of the sites, especially the presence of festive establishments and industrial activities.
- The functional aspects, the accessibility, nearby big works or the presence of enough urban furniture like benches.
- The city projects of public space sharing: the development of areas limited to 30 km/h, the expansion of “Paris breathes” which opens part of the public road network to the public during weekends and the programme “Paris pedestrians” to put pedestrians back at the heart of the urban development policy.

### 5.2 Rich discussions and necessary field visits

Obtaining all this information required rallying a network of local stakeholders complementary to the inhabitants already questioned. The decentralised services of the Paris administration in particular have been consulted, as well as the guidance documents of the city policy, documents on biodiversity, mobility or urban development. In addition, local associations were invited with the district halls to a specific workshop on quiet areas to collect their contributions.

Many field visits completed the approach. When the multi-criteria analysis was complete enough in a district to identify a reasonable number of sites in regards to the imposed constraints, the eco-educators of the House of Air, a city facility dedicated to the awareness of environmental topics, confirmed the relevance of the analysis in the field and completed by the observation of the site the gaps and uncertainties of the information gathered.

Progressively, with the feedback from the field, the multi-criteria analysis helped classify the sites and highlight a list of areas meeting, if not perfectly, a large part of the selection criteria. A homogeneous spatial distribution on the territory was sometimes a decisive criterion, in order to meet the requirements of closeness and of homogeneous coverage of the Paris territory. As a last resort, the definitive validation was up to the district mayors, the local authorities that will be able to promote these areas in the long term and to include them in their neighbourhood projects.

## 6 CONCLUSION

This first inventory of quiet areas showed the interest of a multi-criteria approach associating the elements coming from the analysis of the strategic noise maps then from participatory democracy. This way, the identified spaces are closer to the sound reality of the territories.

The next two stakes are: implement effective preservation measures against any deterioration of the existing sound atmosphere and develop tools to evaluate then promote these policies. Acoustic measurements on some pilot sites or perception surveys with the users are being considered.

The review every five years of the list of quiet areas will give us the opportunity to make the approach evolve from the feedback, from its social acceptability and from its assimilation by the population. It will also give us the chance to include other criteria (greenways, water areas...) within a more comprehensive reflection on the correlation between the urban environment and the needs and expectations of the inhabitants.