DELIVERABLE 5.2.1

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Work Package 5	Validation
5.2	Parks embedded in Q-Zones - Göteborg
	Validation report on the concept of embedded parks in Q-Zones

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Nature of Deliverable

R	Report	✓
P	Prototype	
D	Demonstrator	
O	Other	

SEVENTH FRAMEWORK PROGRAMME

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0 EXECUTIVE SUMMARY

0.1 OBJECTIVE OF THE DELIVERABLE

The concept of parks embedded in Q-Zones will be validated in a number of actual case studies for both Stockholm and Gothenburg. Previously developed evaluation methods as well as newer approaches are evaluated in this deliverable. This deliverable addresses possible opportunities to use a more detailed noise mapping tool in cases of parks and recreation areas.

0.2 DESCRIPTION OF THE WORK PERFORMED SINCE THE BEGINNING OF THE PROJECT

Evaluation methods for outdoor recreation areas such as parks have been developed in previous stages of the CityHush project. Evaluation of parks could be made using a straightforward approach using only the average sound level inside the park. Methods for a more detailed evaluation of parks have also been developed, where the number of park visitors and their distribution inside the park are included. Previously developed relationship for outdoor road traffic annoyance enables quantification of the annoyance in the park.

Previous work also shows the benefits of Q-zones and gives a view of the potential improvements by introducing zoning in urban areas.

0.3 MAIN RESULTS ACHIEVED SO FAR

The developed methods for evaluating outdoor noise in parks and recreation areas have been evaluated for six different parks. Two parks are located in Gothenburg and four parks are located in Stockholm. The processed evaluation methodology results in some deviations in comparison with a more straightforward evaluation. This deviation is a result of improvements made with the proposed evaluation method, which have made it possible to include additional information. The results show no consistent exaggeration or understatement of the resulting annoyance in urban parks. Consequently all parks are specific and resulting annoyance inside that park may deviate either way depending on several factors such as size, visitor distribution inside the park, topography and number of nearby residents.

As well as getting a better idea of the annoyance or/and perceived soundscape quality in urban recreation areas and urban parks, the potential benefits of Q-zone implementation could be evaluated.

0.4 EXPECTED FINAL RESULTS

Performed comparisons of the developed evaluation methods should explore the advantages and disadvantages of the methods and be included in future work in the field of outdoor noise and its effect on people.

0.5 POTENTIAL IMPACT AND USE[1]

In the perspective of the EU Environmental Noise Directive (END), it is essential to assess the effect of environmental noise in the outdoor situation on residents, especially as the urban population increases. The END supports the maintenance and creation of quiet areas, and stresses the need for supplementary noise indicators for quiet areas. So far, the assessment impact from noise on residents is only based on façade levels of dwellings as obtained from the noise maps. Therefore, measures directed towards a quiet outdoor situation is important. Annoyance in parks and recreation areas are not reflected in façade levels, and will not show up in health assessment indicators. The expected effects of urban quiet areas on residents and visitors of parks may be quantified using one or a combination of these noise score rating models.

0.6 PARTNERS INVOLVED AND THEIR CONTRIBUTION

ACL has performed analyses of existing park areas in both Gothenburg and Stockholm. A comparison of approaches has been made and the impact of Q-zone implementation is carried out for a selection of parks.

0.7 CONCLUSIONS

It is important to include noise levels outdoors to get an overview of the total noise exposure that affects the population of a city. In the current situation, the focus is only on the noise levels in residential buildings.

Analyses of outdoor environments such as recreation areas and parks according to developed methods will help the assessment of environmental noise in the outdoor situation on residents.

The performed comparisons shows that the quality of the noise evaluation could be more precise when including factors like distribution of people inside the park. When comparing the level of annoyance using the average noise inside the park with the distribution based method, results differ up to 8 % in this study, which could be of great importance. Deviations in the results, point out the importance of including the use of the area, the number of people making use of the area at a given time and the distribution of the people to predict the overall annoyance response.

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1 *including the socio-economic impact and the wider societal implications of the project so far*

1 BACKGROUND

The concept of Q-zones is a major part of the CityHush project and different uses of zoning has been evaluated throughout the project. The previous results regarding Q-zone concepts and embedded parks are to be used in Work Package 5.2 (WP5.2) in order to validate the concept of embedded parks and possible evaluation methods.

Recreation areas and parks in central parts of a city are often exposed to high sound levels. Parks and recreation areas are very important for the city's inhabitants and it is therefore important to develop evaluation methods and see new solutions to the densification problem many cities face today.

Since the concept of embedded parks previously had been tested for parks in Gothenburg and Stockholm these test sites were chosen for validation. However, the exemption was made to expand the number of parks to interpret variations between the different parks.

2 ANNOYANCE PREDICTION

The CityHush deliverable 2.1.1 *Preliminary noise score rating model for the outdoors* discusses the importance of choosing the appropriate noise indicator for outdoor noise to predict annoyance or the perceived soundscape quality. It also raises the problem of lack of exposure-response relationships for outdoor noise. Based on that reasoning annoyance is predicted using the L_{de} noise level. Even though it is not proven to be the best noise indicator to predict annoyance it is an approximation of the day time LAeq, which has shown consistent correlation with annoyance.

The work carried out by Krog & Engdal show an annoyance pattern that resembles the EU-curve for aircraft noise at the dwelling by Miedema & Oudshoorn. In order for the exposure-resoponce curves to meet, a correction was applied to the EU-curve through a five dB shift.

Since the aim of the validated methods is to evaluate the urban recreational areas with road traffic, the −5 dB correction was applied to the EU-curve for road traffic. Both the pattern found by Krog & Engdahl and the EU-curve for road traffic noise at the dwelling including the correction is showen in Figure 2.1.

The verification of noise score methods for the outdoors have been made using the tentative relationship for outdoor road traffic noise annoyance as suggested in CityHush deliverable 2.1.1.

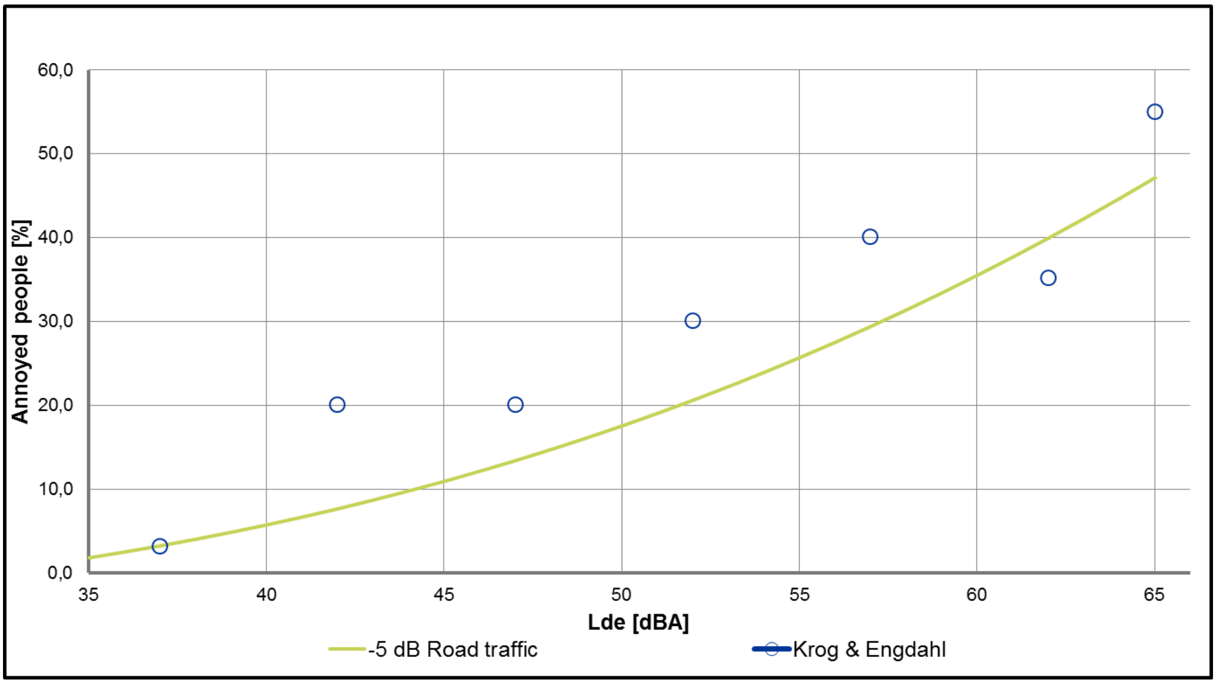

Figure 2.1 Tentative relationship for outdoor road traffic noise annoyance.

3 EVALUATED PARKS

A total of six parks have been evaluated within WP 5.2. Two parks were chosen for the test cite in Gothenburg where the park Trädgårdsföreningen is located inside the Q-zone stated in Deliverable 1.1. Four parks have been evaluated in Stockholm with the park Mariatorget located inside previously investigated Q-zone.

The various parks possess different qualities and uses. The parks vary in size and number of visitors. Park locations in Gothenburg can be seen in Figure 3.1 and in Stockholm Figure 3.2.

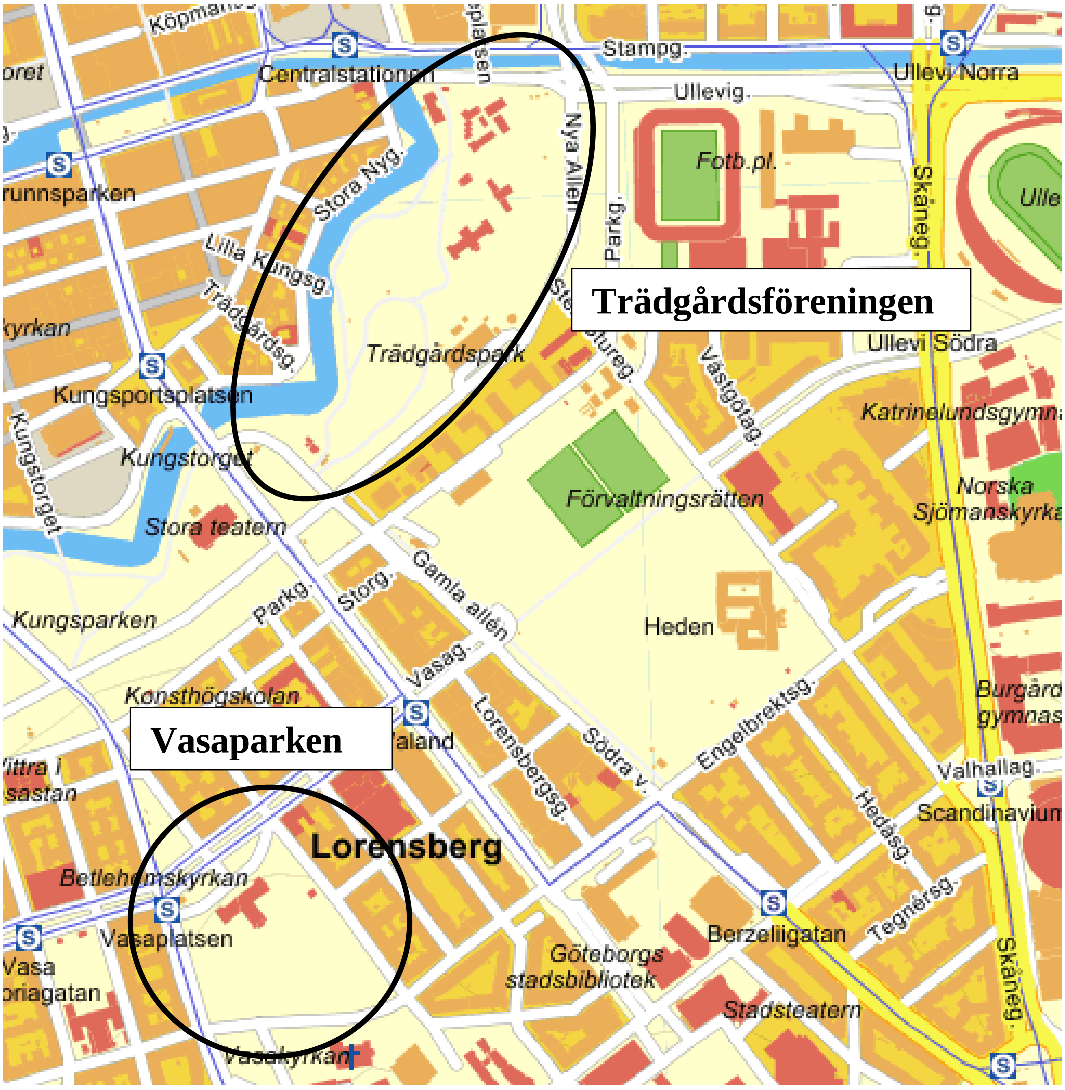

Figure 3.1

Evaluated parks in Gothenburg.

Figure 3.2

Evaluated parks in Stockholm.

3.1 TRÄDGÅRDSFÖRENINGEN - GÖTEBORG

Trädgårdsföreningen in central Gothenburg is one of Europe's most well preserved 1800-century parks. Trädgårdsföreningen is roughly 0.08 km². The park is equipped with plenty of plants and cafes, see Figure 3.3.

Figure 3.3
Trädgårdsföreningen in Gothenburg.

3.2 VASAPARKEN - GÖTEBORG

A park in the area Vasastaden, where the University of Gothenburg is located, see Figure 3.4. Vasaparken in Gothenburg is an about 0.04 km² large oasis in central Gothenburg where trams and road are the general sources of noise.

Figure 3.4
Vasaparken in Gothenburg.

3.3 MARIATORGET - STOCKHOLM

Mariatoget is a city park on the island of Södermalm in Stockholm, see Figure 3.5. The park with an area of 7500 m² was constructed in the 1760's and nowadays the surrounding area offers a wide range of cafés and bars. To the left in the picture you can see Hornsgatan which is a highly trafficked road, the other surrounding streets have fairly low traffic flow.

Figure 3.5 Mariatorget in Stockholm.

3.4 STIGBERGSPARKEN - STOCKHOLM

Stigbergsparken is a rather small park with an area of 5500 m² located in the northeast part of the island Södermalm in Stockholm. The park's northwest corner is a paved seating area and a playground with swings and various playground equipment for small children, see Figure 3.6.

Figure 3.6 Stigbergsparken in Stockholm.

3.5 VASAPARKEN – STOCKHOLM

Vasaparken is a park in the district Vasastaden in central Stockholm, see Figure 3.7. Vasaparken was established in 1885 and reaches an area of 0.05 km².

Figure 3.7 Vasaparken in Stockholm.

3.6 HUMLEGÅRDEN - STOCKHOLM

Humlegården is a park in Östermalm in Stockholm, see Figure 3.8. Since 1878 the Swedish National Library is located in the 0.11 km² large park.

Figure 3.8 Humlegården in Stockholm.

4 METHOD

City parks and recreation areas are important to the residents of a city. When noise surveys are carried out, it may be relevant to evaluate parks and recreation areas in a way that meets their objectives. The following sections describe different ways to evaluate parks and recreation areas. The evaluation methods deal with calculation and software methodology and the aspects of park usage assumptions.

All these evaluation methods require a calculated noise map.

The different methods have also been applied for two parks with traffic restrictions in form of a Q-zone. Based on work made in Work Package 1.1 *Tools for creating Q-zones,* one scenario was chosen for Gothenburg (G12) and one scenario was chosen for Stockholm (S12). The extent of these zone designs create embedded park situations for Trädgårdsföreningen in Gothenburg and Mariatorget in Stockholm. The restrictions applied to chosen Q-zone scenario are presented in Table 1. Comparisons are made between Q-zone and Base Case (BC).

Table 1. Previously calculated Q-zone scenarios, who have been evaluated using developed methods for further analyse regarding zoning effects on embedded parks.

	Policy	Low noise share outside, %	Low noise share inside, %	Zone size
BC	none	1	1	-
S12	Low noise vehicles only	20	100	large
G16	Low noise vehicles only	20	100	medium

4.1 AVERAGE NOISE LEVEL INSIDE PARK

The most straightforward way to determine the sound pressure level inside a park is to observe the average calculated noise level. The observed average noise level could be used together with the most relevant exposure-response relationship curve in order to further draw conclusions regarding e.g. annoyance.

4.2 NOISE SCORE RATING METHOD FOR THE OUTDOORS

The noise score rating method for the outdoors has been developed in Work Package 2 (WP2), Deliverable 2.1.1 *Preliminary noise score rating model for the outdoors.* The noise score rating method combines indicators for outdoor noise and information about the number of people using the park. The number of park visitors are estimated from the number of residents within radius of 400 m (5 minutes' walk), which has been shown to be adequate in previous studies.

4.3 VISITOR DISTRIBUTION BASED NOISE SCORE RATING METHOD FOR THE OUTDOORS

4.3.1 Background

When evaluating noise exposure in urban parks and recreational areas one of the obstacles that often arise is the estimation of the number of visitors to the specific park. Methods use map data of number of dwellings or number of residents in direct conjunction to or in the vicinity of the park. The estimation is often coarse and in some cases, where the park is the main objective of people visiting a city, the estimations fail.

Here, a way to solve the problem of bad estimations as well as adding another dimension to the evaluations of noise exposure in parks will be presented.

The aim of the method is to eliminate the need for visitor data, make use of the distribution of visitors in the park as well as making the method useful in planning new parks.

4.3.2 Input to the method

Input data for the method is based on the distribution of park visitors inside the park. Planning parks often include defining points of interest inside the park. Planners sometimes have elaborate thoughts and ideas of how the park will be used, sometimes the visual parameter takes lead in the planning process, generating solutions that can contradict the apparent noise exposure in the park.

By visual study or by interviewing people with good local knowledge the distribution of visitors can be estimated. When planning a park the ideas of the landscape architect can be used to derive distribution of visitors within the park, see Figure 4.2.

Most parks have designated points of interest. These can be ice cream stands, fountains, sunny slopes etc. To simplify the method visitors to the park can be distributed among the different points of interest as seen in Figure 4.1.

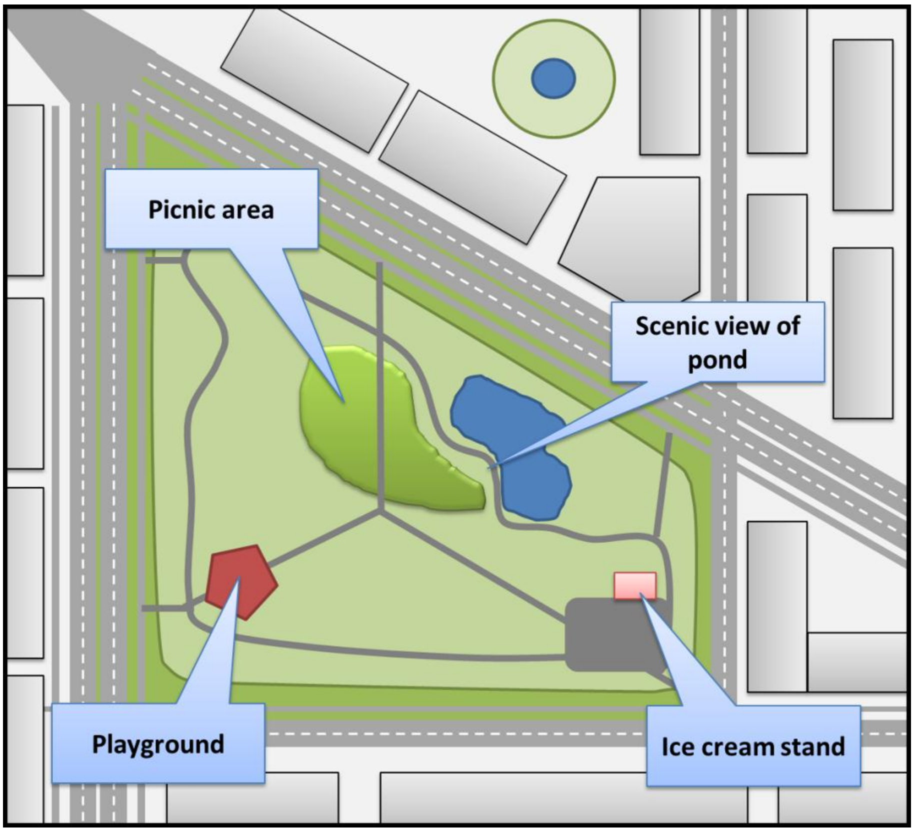

Figure 4.1

Park with designated points of interest.

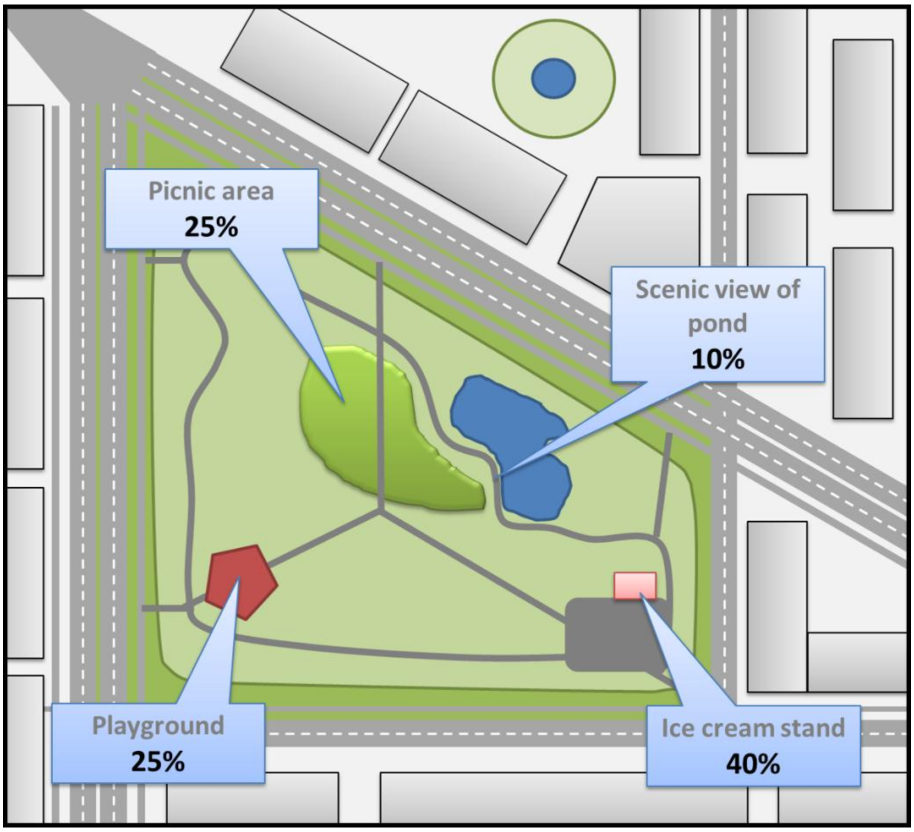

Figure 4.2

Distribution of visitors within the park.

The next piece of data that has to be acquired is the traffic noise levels in the park. The simplest way of doing this is by calculating a noise map of the park, se illustration in Figure 4.3. The noise levels should be an average over the time when the park is used. For example a park that is closed at night time the noise level should be calculated for day and evening (7am-10pm). If a park is used only at lunch time the noise levels should relate to the lunch hour traffic data (12pm-1pm).

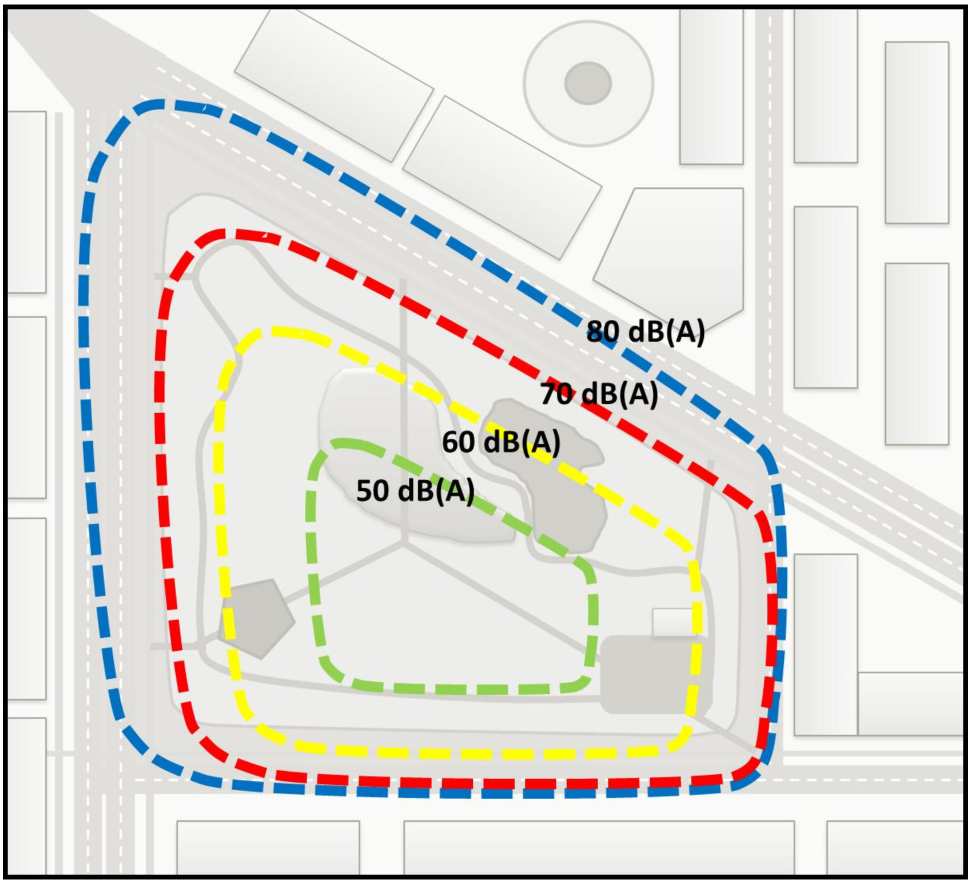

Figure 4.3

Traffic noise levels in the park.

The next step is to assign the visitors the noise levels that will dominate during their visit to the park. Instead of distributing visitors over the whole park, the points of interest now play an important role.

Visitors are summed into noise classes according to their assigned value in Figure 4.4.

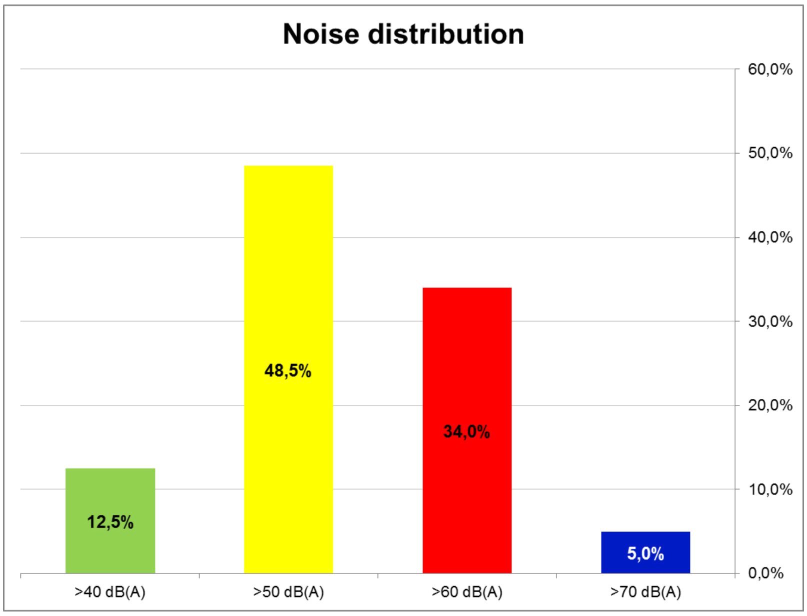

Figure 4.4 Distribution of visitors summed up in noise classes.

Using a noise mapping software the assigning process can be made automatically in 1-dB classes for improved results according to Figure 4.5.

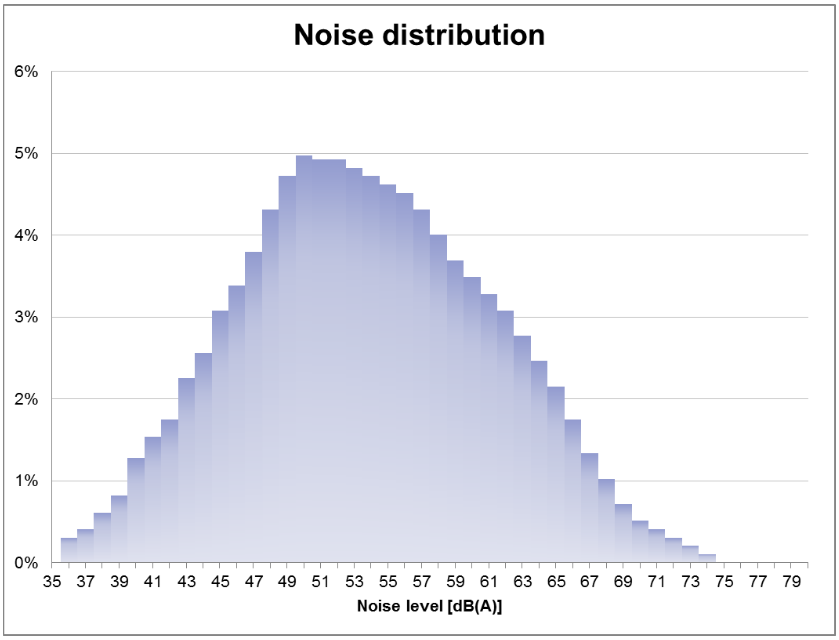

Figure 4.5 Distribution of visitors in 1-dB classes.

4.3.3 Results

In order to derive numbers of perceived sound quality in the park a number of different methods exist. The curves of annoyance fitted to be used in urban parks as described in deliverable D2.1.1 have been used for the comparison studies. In this example, the perceived soundscape quality curve from Mats Nilsson et al is used, see Figure 4.6. The distribution of visitors per noise class has been inserted in the equation and the percentage of the population that perceived the soundscape as good or very good is derived. The total percentage of visitors that perceived the soundscape to be good or very good amounts, in this test case, to 54%, and is illustrated as green bars in Figure 4.7.

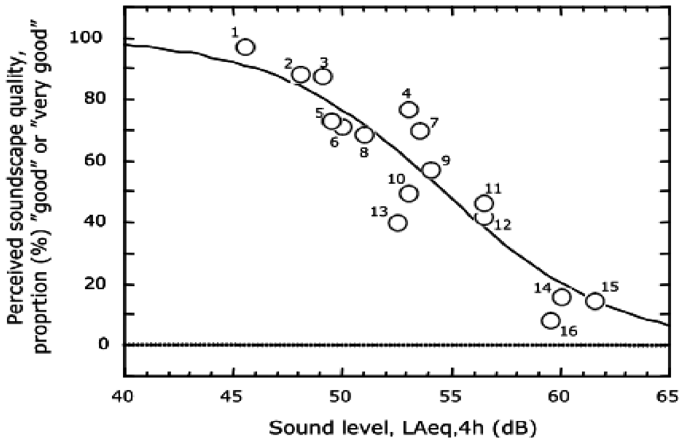

Figure 4.6

Perceived soundscape quality curve from Mats Nilsson et al

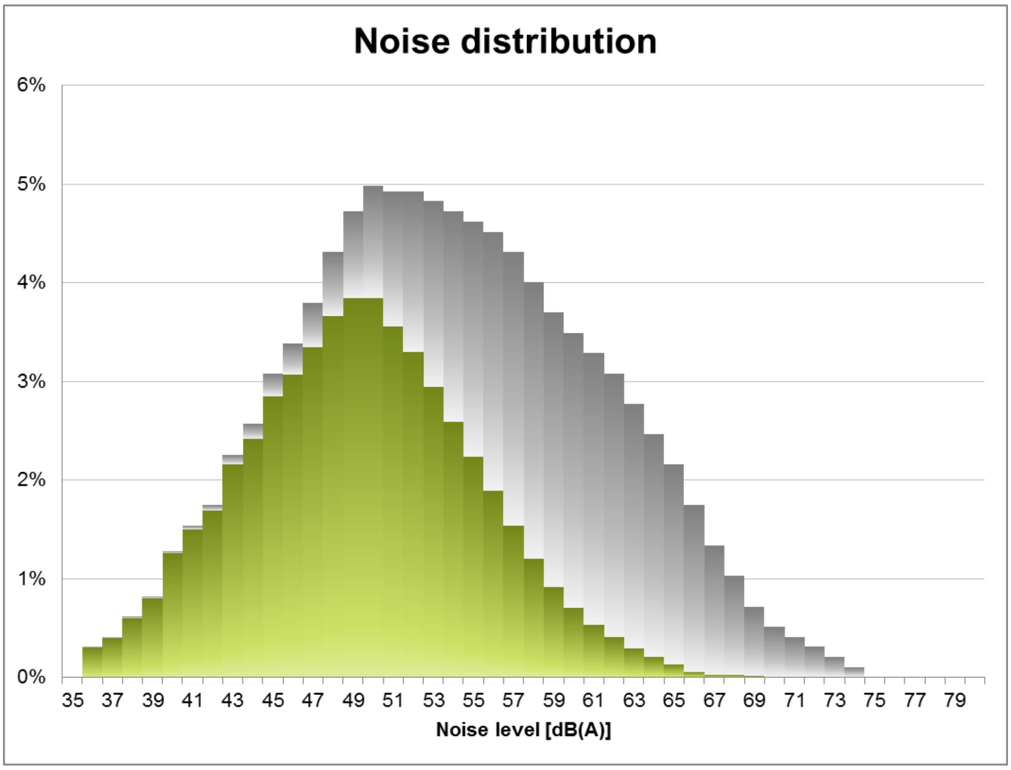

Figure 4.7

Green bars indicate distribution of people that perceives the sound quality as good or very good. The grey bars indicate the distribution of people inside the park also showed in Figure 4.5.

Measures to improve the sound quality in a park are much dependent of where it is having effect. For example, a noise barrier is constructed in the noisiest, North West corner, of the test case park, see Figure 4.8.

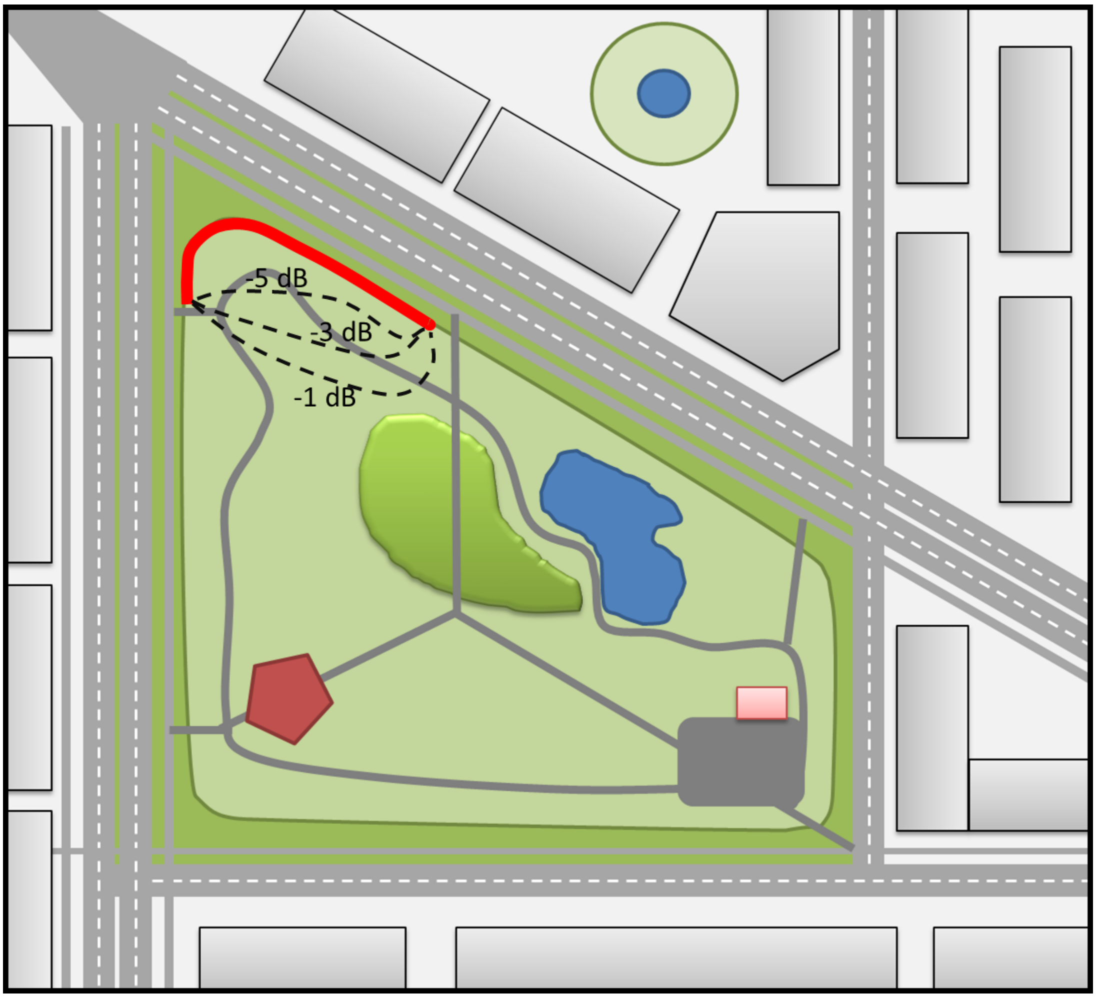

Figure 4.8

Introducing a noise barrier in the North West corner of the park.

This part of the park has very few visitors and the perceived soundscape quality is much the same as before thus exerting no effect on the percentage that perceives the park soundscape quality as good or very good.

In order to have an effect a local noise barrier is located near the ice cream stand. This part of the park is not the most exposed but have the highest percentage of visitors.

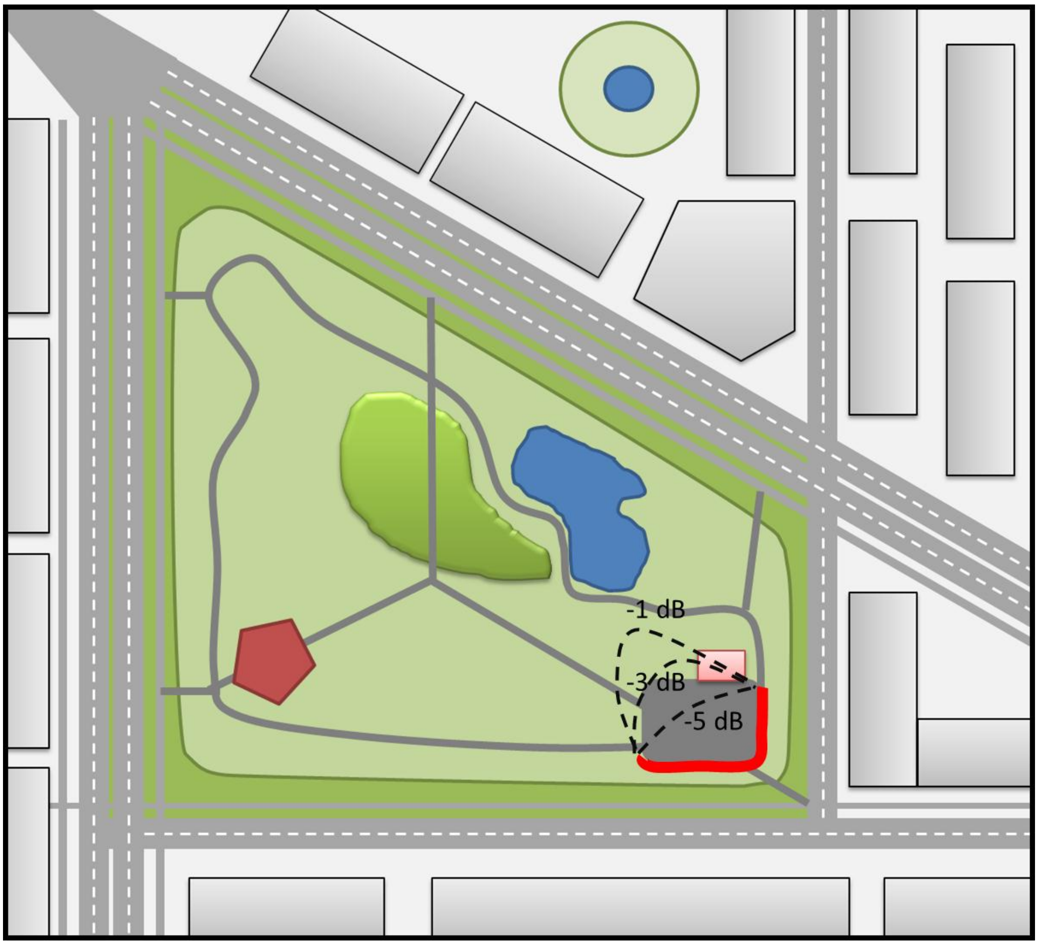

Figure 4.9
Introducing a noise barrier by the ice cream stand.

Evaluating the park the same way as before, after introducing the local noise barrier, the percentage of park visitors that perceive the soundscape as good or very good grows to 56% total.

The method takes into account where park visitors are located in the park. This parameter makes evaluation of noise abatement measures easier. It can also be used when planning parks taking into account the ideas and visions of the landscape architect.

In the CityHush project a number of parks have been validated using this method. Inspection of the parks generated the need to have many different points of interest. In the end a weighted visitor distribution of the park was used, see Figure 4.10 and Figure 4.11.

Figure 4.10

Mapping of the visitor density in Trädgårdsföreningen in Gothenburg.

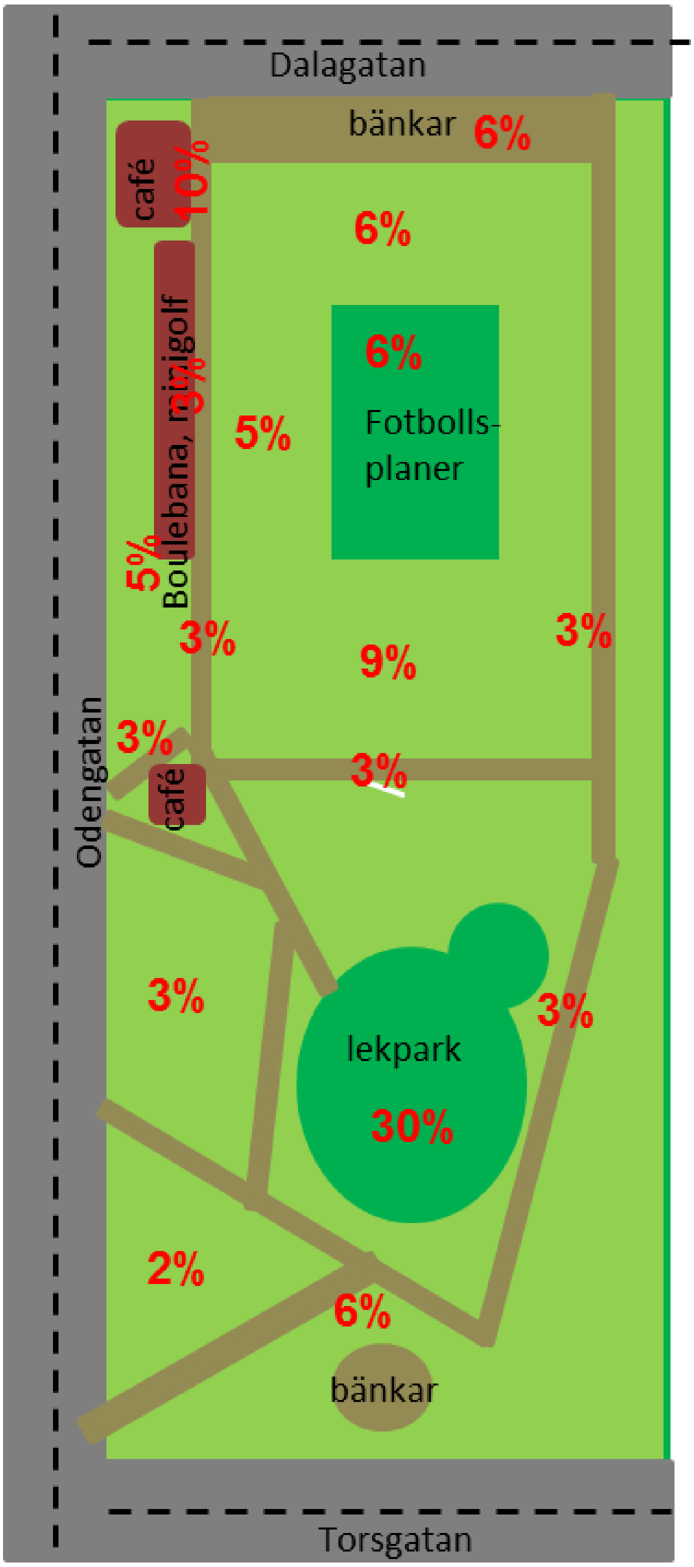

Figure 4.11

Mapping of the visitor density in Vasaparken in Stockholm.

5 RESULT

The results are divided into three parts, where Section 6.1 describes the results based on the proposed method. In order to compare the different methods, the results have been scaled in Section 6.2 to represent a comparable measure, in this case annoyance. Section 6.3, shows the results after Q-zones have been implemented.

5.1 INDIVIDUAL RESULT PRESENTATION

Results extracted from the average noise level is more or less just a number describing the arithmetic average sound pressure level inside the park. The developed Noise score rating method for the outdoors generates the number of annoyed people. Finally the Visitor distribution based noise score rating method for the outdoors was designed to extract results regarding weather people observes the sound environment as good or very good. Each method has a different way of presenting the result.

5.1.1 AVERAGE NOISE LEVEL INSIDE PARK

Results describing the arithmetic average noise level in the park are presented in Table 2. The largest sound level deviation between parks reaches 4 dB-units. Three of the evaluated parks exhibit a noise level of 63 dBA.

Table 2. Arithmetic average sound pressure level inside the park.

Park	Arithmetic average of park grid L_{de} [dBA]
Mariatorget	60
Stigbergsparken	59
Trädgårdsföreningen	63
Vasaparken GBG	63
Humlegården	63
Vasaparken STHLM	62

5.1.2 NOISE SCORE RATING METHOD FOR THE OUTDOORS

Results based on the *noise score rating method for the outdoors* present the number of annoyed visitors in the park, see Table 3. The method assumes an even distribution of park visitors inside the park and the number of park visitors is based on residents within 400 meters from the park. The result from this method gives a figure on the number of people who feel annoyed when they are staying in the park.

If we isolate the issue to just the number of annoyed people this method reveals that Vasaparken in Stockholm suffers the largest number of annoyed people and the minimum number is found in Stigbergsparken.

Table 3. Annoyed visitors based on the noise score rating method for the outdoors.

Park	Annoyed visitors	Highly Annoyed visitors	Park visitors	Park Area [m²]
Mariatorget	8185	3866	18098	8000
Stigbergsparken	3150	1398	13204	7800
Trädgårdsföreningen	5318	2543	13292	80000
Vasaparken GBG	6151	2941	14984	40000
Humlegården	10930	4523	25000	110000
Vasaparken STHLM	7908	3933	20000	50000

5.1.3 VISITOR DISTRIBUTION BASED NOISE SCORE RATING METHOD FOR THE OUTDOORS

Results based on the *Visitor distribution based noise score rating method for the outdoors* are showed in Table 4. The perceived soundscape quality is based on observed park visitor distribution inside the park and the proportion is extracted using the traffic-noise exposure response curve by Mats E Nilsson.

Three different parks show similar results regarding perceived soundscape quality and the estimated soundscape quality is highest for Stigbergsparken in Stockholm.

Table 4. Perceived soundscape quality based on the Visitor distribution based noise score rating method.

Park	Perceived soundscape quality proportion "good" or "very good" [%]
Mariatorget	22
Stigbergsparken	35
Trädgårdsföreningen	12
Vasaparken GBG	12
Humlegården	12
Vasaparken STHLM	15

5.2 COMBINED RESULT DESCRIPTION

The combined results where all evaluation methods are described using annoyance is shown in Table 5. The results of columns showing %A is coloured whereas the result columns indicating %HA are left white for each evaluation method.

The general difference in annoyance between the evaluation methods vary between 0 %A to 7 %A. The only park showing corresponding percentages of annoyed park visitors is Vasaparken in Stockholm.

Table 5. Annoyance rating for the different parks and various evaluation procedures.

	VISITOR DISTRIBUTION BASED NOISE SCORE RATING METHOD FOR THE OUTDOORS		NOISE SCORE RATING METHOD FOR THE OUTDOORS		AVERAGE NOISE LEVEL INSIDE PARK	
Park	**%A**	**%HA**	**%A**	**%HA**	**%A**	**%HA**
Mariatorget	38	18	42	21	35	16
Stigbergsparken	30	13	24	11	33	15
Trädgårdsförenin gen	42	21	40	19	42	21
Vasaparken GBG	44	23	41	20	42	21
Humlegården	43	21	44	18	42	21
Vasaparken STHLM	40	20	40	20	40	19

Figure 5.1 is presenting the same results as Table 5 but leaves out %HA and is plotted in bars for a clearer representation of the differences and similarities of the evaluation methods for each park.

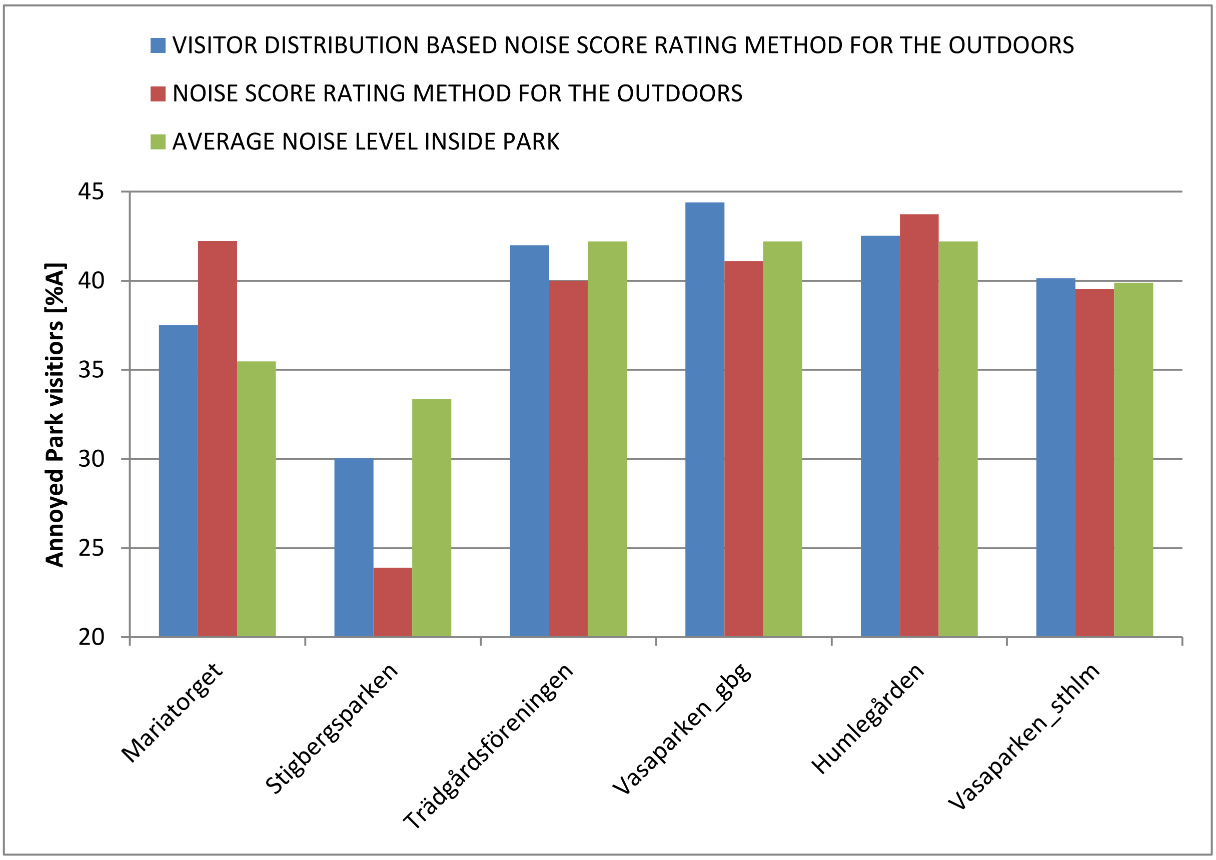

Figure 5.1

Distribution of % annoyed and % highly annoyed for the evaluated parks in Stockholm and Gothenburg.

5.3 Q-ZONE IMPLEMENTATION

The arithmetic average sound pressure level for the embedded parks in Stockholm and Gothenburg are seen in Table 6. The noise level in the park Mariatoget is reduced by 2 dBA-units and the noise level inside Trädgårdsföreningen is reduced by 3 dBA-units when introducing specified Q-zone design.

Table 6. Arithmetic average sound pressure level inside embedded park.

Park	Arithmetic average of park grid L_{de} [dBA]
Mariatorget	58
Trädgårdsföreningen	60

Results based on the *noise score rating method for the outdoors,* applied to the embedded park scenarios are presented in Table 7. By introducing the specified Q-zone design the number of annoyed people in the Mariatorget reduces by 1386 persons and correspondingly 784 persons for Trädgårdsföreningen in Gothenburg

Table 7. Annoyed visitors inside the embedded park based on the noise score rating method for the outdoors.

Park	Annoyed visitors	Highly Annoyed visitors	Park visitors	Park Area [m^2]
Mariatorget	6799	3444	18098	8000
Trädgårdsföreningen	4534	1979	13292	80000

Results of the two embedded parks based on the *Visitor distribution based noise score rating method for the outdoors* are shown in Table 8. The perceived soundscape quality has increased by 7 % for Mariatorget and for Trädgårdsföreningen, the corresponding increase in soundscape quality reaches 8 %.

Table 8. Perceived soundscape quality in the embedded park based on the Visitor distribution based noise score rating method.

Park	Perceived soundscape quality proportion "good" or "very good" [%]
Mariatorget	29
Trädgårdsföreningen	20

The combined results, where all evaluation methods are described using the annoyance percentage is showed in Table 9. The result columns showing %A are coloured whereas the result columns indicating %HA are remained white for each evaluation method.

The general difference of annoyance between the evaluation methods varies between 2 %A to 7 %A for the embedded park scenarios and the overall reduced annoyance are between 3 %A and 7 %A.

Table 9. Annoyance rating for the two embedded parks and various evaluation procedures.

	VISITOR DISTRIBUTION BASED NOISE SCORE RATING METHOD FOR THE OUTDOORS		NOISE SCORE RATING METHOD FOR THE OUTDOORS		AVERAGE NOISE LEVEL INSIDE PARK	
Park	**%A**	**%HA**	**%A**	**%HA**	**%A**	**%HA**
Mariatorget	35	16	38	19	31	14
Trädgårdsföreningen	37	17	34	15	36	16

A comparison showing resulting annoyance with and without Q-zone for the three different evaluation methods has been performed. The park in Gothenburg show approximately equal annoyance levels regardless of the evaluation method, se Figure 5.2. The reason for the very similar result is the design of the park, which makes the traffic noise rather evenly distributed over the entire park area.

Larger differences of the calculated annoyance are visualised for Mariatorget in Stockholm when using the different evaluation methods. The comparison of evaluation methods and park embedment of Mariatorget in Stockholm is presented in Figure 5.3. Since there are larger variations in the sound pressure level inside the park Mariatorget the noise score rating methods, which includes distribution respond with a different annoyance percentage within the park.

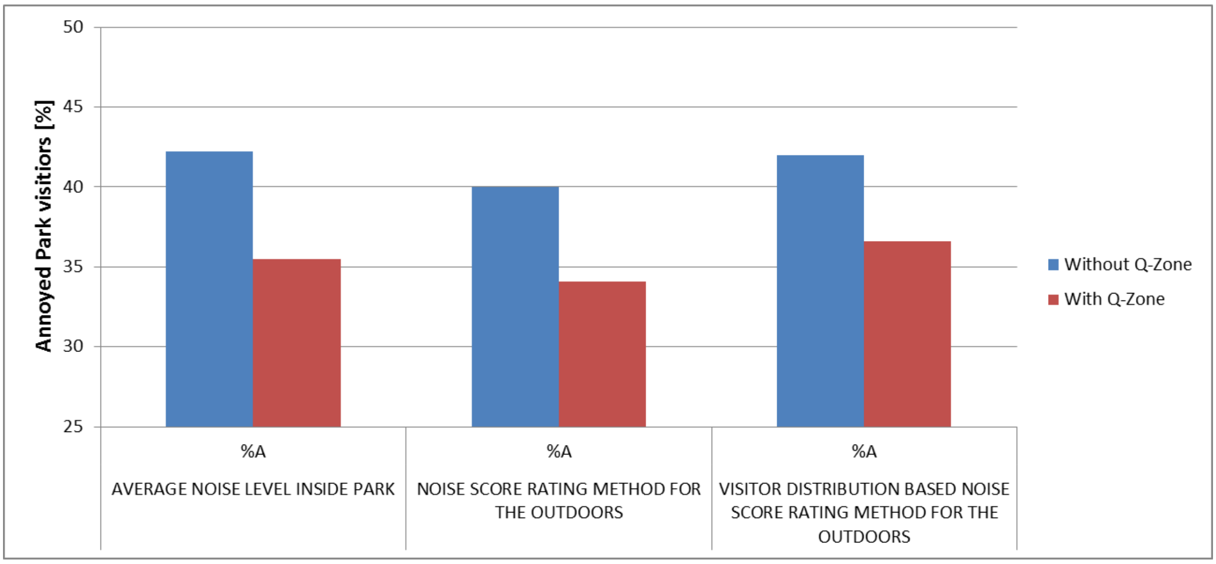

Figure 5.2 Comparison of park evaluation methods with and without the implementation of a Q-zone for Trädgårdsföreningen in Gothenburg.

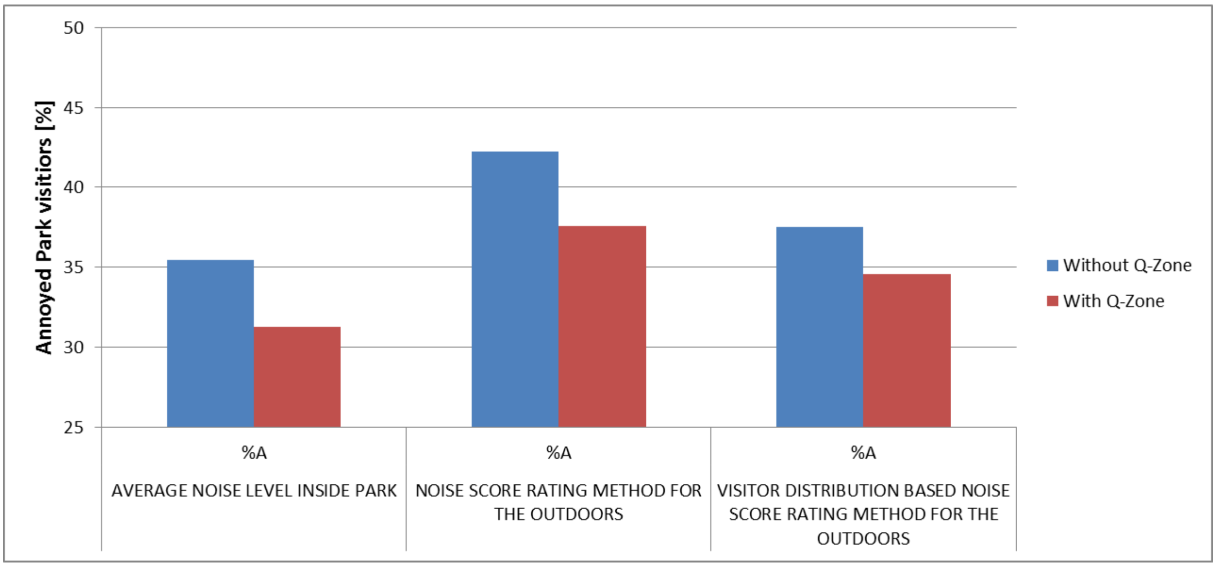

Figure 5.3

Comparison of park evaluation methods with and without the implementation of a Q-zone for Mariatorget in Stockholm.

6 DISCUSSION

Urban environments are characterized by a great traffic load, which continuously increases with the condensation of our cities. As the urban city areas grow, the population effected by road traffic noise also increases. Building sustainable cities is a must in the future, but there is no prescription for how to get there. The outdoor open spaces in urban areas should provide opportunities for relaxation and stress recovery.

A starting point with respect to sound is to quantify the effect of sound pollution in cities. Up to now the assessment of noise impact on residents is only based on facade levels of dwellings leaving out the impact of the city soundscape, which has been shown to be an important factor. Quantifying the effects of urban quiet areas on residents and visitors is a condition for obtaining a complete picture of the problematic noise situation that is getting increasingly complex, especially in cities.

The methods evaluated here are still just tools to approximate different scenarios, E.g. in parks or recreation areas. Efforts to document the impact of noise in large areas require generalizations and access to both easily accessible data as well as information that can be very difficult to obtain. For example, only assuming park visitors depending on the number of residents within a 400 m radius is sometimes a too crude generalization, certainly in cases where the park is a key point destination for many more citizens and tourists. Generalization regarding distribution of park visitors could also be very uncertain information. It is suggested that the distribution of people in the park varies during the day or over different days of the week. Still, using points of interest in a park as indicative benchmarks in the distribution of park visitors can be a great tool in planning new parks and actions of existing parks with respect to annoyance.

7 CONCLUSION

It is important to include noise levels outdoor to get an overview of the level of noise that affects the population of a city. In the current situation, the focus is only on the noise levels in residential buildings. Used response curve for traffic noise annoyance makes it possible to calculate the number of annoyed visitors in a given outdoor area.

Analyses of outdoor environments such as recreation areas and parks according to developed methods will help the assessment of environmental noise in the outdoor situation on residents.

Comparisons made in this project show that the quality of the noise evaluation could be more precise including factors like distribution of people inside the park. Comparing the amount of annoyance using the average noise inside the park and distribution based method could differ up to 8 %, which could be of great importance. Deviations in results point out the importance of including the use and purpose of the area and the number of people making use of the area at a given time i.e. the distribution of the people to predict the overall annoyance response.

Evaluation based on the arithmetic average noise level inside the park is acceptable if the noise level is evenly distributed in the park. It is important to include aspects of visitor distribution and number of visitors when evaluation parks and recreation areas in order to quantify the number of people annoyed. If the park holds both noisy and quiet areas, points of interest like cafés or for example, a playground the importance of the visitor distribution increases.

Even though both embedded parks, Mariatorget in Stockholm and Trädgårdsföreningen in Gothenburg, are located in the Q-zone boundary the annoyance drops with the introduction of the Q-Zone. The calculated reduced annoyance corresponds in both Gothenburg and Stockholm to 1000 less annoyed park visitors. The concept of embedded parks, evaluation tools comparable to the response curve and distribution based noise score evaluation are important tools for designing and preserving existing and future green areas.

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