Service Contract:

# Definition, Identification and Preservation of Urban & Rural Quiet Areas

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Final Report

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**Report on the Definition, Identification and Preservation of Urban and Rural Quiet Areas**

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## 1. INTRODUCTION

1.1 In support of Directive 2002/49/EC on the Assessment and Management of Environmental Noise (END), the European Commission (EC) has established a number of Working Groups. The Working Group on the assessment of exposure to noise (WG AEN) has the task of providing guidance for the implementation of the requirements of the END relating to strategic noise mapping. Part of this task includes providing guidance on the identification and protection of quiet areas, both urban and rural, which will assist the Commission Services in the development of guidelines for the preservation of good environmental noise quality. The work of this service contract is to provide a report that will assist WG AEN with the task of providing guidance on the identification and protection of quiet areas.

1.2 In April 2003, an interim report was completed for consideration by DG Environment and WG AEN. The content of that report was intended to provide a clear indication of our thinking and an idea of the scope and depth of the issues that need to be addressed in respect of quiet areas and the END. By this means it was hoped that the interim report would be a valuable opportunity for WG AEN to reassure itself that the project is moving in the right direction, and for Symonds Group Limited to receive feedback from the Working Group. Since that time several members of the Working Group have provide constructive comments upon the interim report, and, in May, Dr Fillery of Symonds Group Limited was given the opportunity to discuss the project with members of WG AEN at an informal meeting held during Euronoise 2003.

1.3 This final report of the service contract for the definition, identification and preservation of Urban and Rural Quiet Area starts with a discussion of the requirements of the Environmental Noise Directive in respect of relatively quiet areas.

1.4 It is our view that the issues of urban quiet and countryside quiet are sufficiently different to require separate consideration. Although they each pose a range of similar questions, the different nature of the urban and the

countryside environments requires a different set of possible answers to those questions. Therefore we have devoted a separate section to each.

1.5 Section 2 examines the definition, identification and protection of relatively quiet areas in urban locations while Section 3 deals with relatively quiet areas in the countryside. Within Sections 2 and 3 we have tried to present objective analysis of the issues and where appropriate we have made a number of specific recommendations. These recommendations are summarized in Section 4. During the course of this project it became apparent that the body of research on quiet areas was comparatively small and there is a need for further research in many areas of quiet area acoustics and planning. Accordingly we have provided suggestions for further research in Section 5.

1.6 In each section it has been the intention to present the issues, consider the alternatives and present pragmatic and practical means of complying with END in respect of relatively quiet areas. It is unlikely that all member states will choose to adopt the same solutions to the protection of relatively quiet areas so the report in Sections 2 and 3 gives in outline of a number of possible methods. Across the multicultural and geographically diverse countries of the EU there can be no single "one-size-fits-all" approach to this problem. Each member state will need to develop action plans in relation to relatively quiet areas that are suitable to their national needs and wishes. The purpose of the report of this contract has been to provide WG AEN and thereby member states with a review of ideas and information that will help in the development of EU policy, in the formulation of national action plans and in the signposting of future research efforts.

**The Environmental Noise Directive**

1.7 The Environmental Noise Directive (END) [1] has focussed attention on the need for long term strategic planning to tackle the problem of increasing levels of environmental noise. As part of that planning there is a realisation that there is a need to protect environmental noise quality where it is good. This recognition of the value of good environmental noise quality is to be welcomed and, from this, it follows that there is a necessity to identify

and protect areas of relative quiet. In respect of relatively quiet areas END has endorsed the recommendation of the World Health Organisation that '*Existing large quiet outdoor areas should be preserved …*'[2].

1.8 In the past environmental noise control has emphasised the need to tackle the problems associated with high noise levels. This is natural and understandable, as all societies with limited resources have to prioritise their efforts and will concentrate on the most pressing or the most severe problems. However paying attention to the most immediate problems has resulted in short term solutions whilst the lack of long term planning has led to a gradual decline in the general noise environment. Part of this gradual decline in the quality of the noise environment has been a progressive erosion of the area of land that benefits from low noise levels – the quiet areas. Thus it is not before time that proactive steps are being considered to identify and protect quiet areas.

**The Environmental Noise Directive and Quiet Areas.**

1.9 Article 1 of Directive 2002/49/EC states that the aim of the Directive is to define a common approach that will avoid, prevent or reduce the harmful effects due to exposure to environmental noise. In support of that aim it lists a series of actions required for progressive implementation of the Directive and within that list, under Article 1 c, it requires member states to adopt action plans based upon the results of noise mapping. These action plans should prevent and reduce environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and should preserve environmental noise quality where it is good.

1.10 Further references to action plans are found in Article 8 'Action Plans,' and in Article 11 'Review and Reporting' of the END.

1.11 In Article 8, there is a requirement for member states to draw up action plans for a) major transport infrastructures and b) agglomerations with more than 250,000 inhabitants. The plans for b) are specifically charged with

the "*aim to protect quiet areas against an increase in noise."* These action plans are to be prepared by 18 July 2008.

1.12 Article 11 requires the European Commission to report no later than 18 July 2009 to the European Parliament and Council on the implementation of the Directive and amongst the various issues the report is asked to propose, if appropriate, implementation strategies for the *"protection of quiet areas in the countryside."*

1.13 Thus in respect of the planned actions of END there is a need to develop action plans for quiet areas in urban areas by 18 July 2008 and to develop strategies for quiet areas in the countryside by 18 July 2009.

1.14 The distinction between quiet areas in urban and rural areas is clearly made in Article 2 of END which states 'This Directive applies to environmental noise perceived by humans in and near their homes, in public parks or other relatively quiet areas in an agglomeration, in relatively quiet areas in the open country, in and near schools in the case of pupils, in and near a hospital in the case of patients and in other noise-sensitive buildings and areas.

1.15 Article 3 explains the distinction between relatively quiet areas in an agglomeration and relatively quiet areas in the open country. "Relatively quiet areas in an agglomeration", means an area, delimited by the competent local authority, which is not exposed to a value of $L_{den}$ greater than a certain value, to be declared by the Member State. "Relatively quiet areas in the open country" means an area, delimited by the competent national or regional competent authority, that is undisturbed by noise from traffic, industry or recreational activities and where natural quiet can be experienced.

1.16 This explicit distinction between quiet areas in urban and rural areas must be borne in mind when formulating action plans. Accordingly in structuring this report urban quiet areas and rural quiet areas have been treated separately.

1.17 Before moving on to specific treatment of urban and rural quiet areas, there is a general issue that should be considered. The wording of the title of the project reflects the wording of the END and uses the term quiet areas. Literally ‘quiet’ implies the absence of sound indicated by low noise levels and thus it should be possible to describe and define such environments in purely acoustic terms and quantities. If the purpose of quiet areas is to provide areas of peaceful benign calm that are conducive to relaxation and enjoyment then there will be the need to factor other environmental qualities, such as land use or visual attractiveness, into the description of the area. In short should we be interested in quiet or in the broader concept of tranquillity? If it is the latter then the process of definition and assessment will need to be expanded to encompass these other factors that might contribute to the overall ambiance of an area. Consideration of the question has been the subject of no little amount of deliberation. Pragmatically at the moment there are not the tools to include the many factors that might be important in determining tranquillity into a robust measurable model. Therefore the recommendations within the report have been restricted to instances where it is possible to give concrete advice that is quantified and can be objectively determined. Nevertheless it is important that the less easily defined qualities of a good acoustic environment should not be forgotten and member states should be encouraged to go beyond the dictates of the END and to seek out ways of achieving sustainable and enduring methods for the preservation and improvement of the noise soundscape in their countries.

1.18 As a final note the structure of this report treats the definition identification, and protection of quiet areas as separate topics. This is a false separation and, in developing the ways and means of preserving quiet areas, member states will need to take a holistic approach that combines each stage of definition, identification and protection into an integrated programme.

## 2. RELATIVELY QUIET AREAS IN URBAN LOCATIONS

2.1 This section will consider the three elements below as they apply to relatively quiet areas on urban locations.

(i) Definition and added values of quiet areas

(ii) Identification (Mapping) of quiet areas

(iii) Protection of quiet areas

**The Definition of Urban Quiet Areas.**

2.2 Within the context of urban areas, END Article 3 describes a 'relatively quiet area in an agglomeration', as 'an area, delimited by the competent local authority, which is not exposed to a value of $L_{den}$ greater than a certain value, to be declared by the Member State'.

2.3 Here the straightforward interpretation of the Article is that a quiet area is defined in terms of an $L_{den}$ limit with the value of the limit to be set by the Member State. A more forensic reading of the Article suggests that the competent local authority may have the freedom to include other criteria than the noise limit alone when delimiting the area.

**The Choice of a noise index for Urban Quiet Areas**

2.4 Considering the use of $L_{den}$ first. There are advantages and disadvantages in using $L_{den}$ for the identification and classification of quiet areas within urban locations. The main advantages are;

(i) Firstly, despite variation from day to day and from season to season, the noise climate within towns and cities when averaged over time will be relatively uniform. The $L_{den}$ will represent the long-term average noise level and it should be possible to relate the $L_{den}$ to an acceptable standard for delimiting relatively quiet areas.

(ii) Secondly, when providing information to the public it would be best to restrict the number of different noise indices used to avoid confusion and allow valid comparison between noise climates. As $L_{den}$

is the primary noise indicator chosen for END there would need to be compelling reasons for the choice of an alternative noise index.

(iii) Thirdly, noise mapping of agglomerations will produce predictions for the geographical distribution of noise in terms of $L_{den}$. Delimiting relatively quiet areas in terms of $L_{den}$ could result in the noise maps that clearly indicating the location of those quiet areas.

2.5 There are a number of possible disadvantages to the use of $L_{den}$ that all arise from the long-term nature of the averaging applied to $L_{den}$.

2.6 Being an annual average, $L_{den}$ would disguise seasonal, weekly or daily periods of quiet in otherwise noisy locations. For example some areas near an airfield may be subject to overflights for 75% of the time but for the 25% of the time, when the wind direction takes the planes into another airspace, these normally noisy areas become quiet.

2.7 At some locations there may be significant quiet periods at useful times of the day whilst overall the area may be quite noisy. An area zoned for entertainment might be very noisy at night whilst being relatively quiet during the day. Conversely the night time noise level within a park would be irrelevant for normal recreational use.

2.8 Regular daily variations in noise levels could be indicated by looking at the levels for the separate day, evening and night time periods ($L_d$, $L_e$, and $L_n$) produced during the noise mapping process. Daily or seasonal variation in noise levels could be linked to an identifiable land use of the area, for example summer-only recreational use of powerboats, winter-only use of ski lifts, evening-only noise from an entertainment area and day time noise from a factory.

2.9 The simple nature of $L_{den}$, or any other long-term average that is represented by a single numerical value, cannot on its own give a clear idea of the nature of the soundscape or the characteristics of the dominant noise sources.

2.10 Despite the reservations over the long term averaged nature of $L_{den}$ there are no ready alternatives that present themselves, neither in availability of data nor in offering a simple or more precise indication of quiet areas. In strategic terms, the noise predictions will be based upon the various forms of transportation noise models that are to be found in Europe. All these models utilised basic information of traffic flow and composition to generated source noise levels that are then adjusted for distance and other propagation factors. The resulted predicted noise levels are then expressed in a number of different noise indices such as $L_{10}$ or $L_{Aeq,T}$ for different time periods during the day. For the preparation of the noise maps there will be a requirement to translate these transportation noise indicators into $L_{den}$ values. Thus unless a noise indicator for quiet is to be determined by a complete different means it must be linked to $L_{den}$ by some simple relationship.

2.11 The reasons for recommending $L_{den}$ as the general noise indicator for urban quiet areas can be summarized as:-

(i) $L_{den}$ is the primary noise indicator for strategic planning within the END and unless there is a superior indicator, better suited to describing quiet areas, then the use of $L_{den}$ has the advantages of simplicity and conformity.

(ii) There are no ready alternatives better suited for the description of quiet areas.

(iii) All noise prediction methods to be used within END ultimately result in $L_{den}$ values.

2.12 Within urban areas, there locations where there are daily variations in noise levels such that the noise climate varies between quiet to noisy in a predictable manner. For such areas the use of the ancillary noise indicators, $L_d$, $L_e$ and $L_n$, may give a clearer indication of the temporal variation of the noise climate.

**Recommendation 1: For the initial stages of the END the general noise indicator for urban quiet areas should be $L_{den}$, however for some areas the use of the ancillary noise indicators $L_d$, $L_e$, and $L_n$ may be more appropriate.**

**Setting an appropriate $L_{den}$ limit for Urban Quiet Areas**

2.13 Before setting the level for $L_{den}$ for quiet areas, the purpose and use of quiet areas needs to be established. Putting the requirements of END to one side, one should start by examining the need for quiet areas within our towns and cities. If we ask the question 'What beneficial purpose does an area of quiet within a busy urban soundscape serve?' then the probable response from most people would be that the area of quiet provides a space for peaceful relaxation, for natural contemplation and for gentle conversation. It should provide a breathing space away from the hurly burly of city life. (As part of any on-going research into quiet areas it would be beneficial if public attitudes to quiet were investigated)

2.14 If these factors are seen as desirable attributes then the challenge we face as acousticians is to convert these descriptions into meaningful acoustic indices that can be defined and measured.

2.15 ***Peaceful relaxation and natural contemplation*** ~ these qualities can be partially described by the absence of intrusive noises which in turn will imply the absence of man-made sounds. Desirable as this may be, the absence of man-made sounds within an urban environment is unlikely. The best that can be achieved would be for the man-made sounds to be at a sufficiently low level that the natural sounds are not masked. Reducing the level of man made sounds will make the natural sounds more audible and increase the feeling of quiet. (An alternative approach of artificially increasing the level of natural sounds by electronic means has been suggested by more than one consultee).

2.16 Thus one means of establishing the appropriate level for ambient man-made noise would be to set the level below the level of natural sounds within the designated quiet area. In the Netherlands several provinces have adopted a yearly-averaged level of 40dB $L_{Aeq,24hour}$ as a reasonable estimate for the level of natural sounds [3]. Taking this 24 hour level the daytime $L_{Aeq}$ level can be estimated as 42 dB. To provide sufficient headroom for the natural sounds to dominate the noise climate the level of the man made sounds would need to be less than the level of 42 dB. For a natural sounds to man-made noise

difference of at least 5 dB would suggest a level for man-made sounds of no more than 37 dB $L_{Aeq,\ day}$. Converting this to an $L_{den}$ would indicate a level of around 40 dB for noise immissions [4].

2.17 ***Gentle Conversation*** ~ A quiet area can be defined in terms of a space conducive to peaceful conversation. There are a number of methods for defining the masking effect of background noise on speech clarity. In 1999 the World Health Organisation issued Guidelines for Community Noise that contained advice on speech communication [2]. The WHO advocates a signal-to-noise ratio of 15dB for good speech intelligibility. This would require the intrusive noise level to be as low as 35 dB if speech is assumed to be around 50 dB. This is consistent with further advice given in the WHO document that states that, for a speaker-to-listener distance of about 1m, 'speech in relaxed conversation is 100% intelligible in background noise levels of about 35 dBA and can be fairly well understood in background levels of 45 dBA.' Thus for reasonable speech communication 45dBA would be desirable but is unlikely to be achieved in many urban landscapes. The Speech Interference Level (SIL) defines the maximum level of background noise for speech intelligibility in terms of the speakers voice level and distance between the speaker and listener. For quiet female voice at a distance of 1m the speech interference level would be around 44dB. Converting this into an $L_{den}$, with the major noise source being traffic, gives a value of around 53 dB. For a quiet male voice this would increase to around 58 dB $L_{den}$. Thus for reasonable speech communication in urban areas where the masking noise is predominantly road traffic the background noise levels should be between 53dB and 58 dB $L_{den}$. Thus an $L_{den}$ of 53 dB would set a good standard that would allow most people to converse in the open without difficulty using normal speech levels.

**Annoyance Criterion**

2.18 Of the various dose response relationships the annoyance response is perhaps the most robust. In defining quiet areas we should seek to avoid annoyance at the very least. For daytime activities the WHO Guidelines state that few people are seriously annoyed by activities with $L_{Aeq}$ levels below 55 dB or moderately annoyed with $L_{Aeq}$ levels below 50 dB. The Guidelines go

on to state that 'during the evening and night the levels should be 5 –10 dB lower than during the day'. Converting these levels following the method developed by TRL [4], we get the moderate annoyance limit of 52 dB $L_{den}$ for the day time period.

### Other Factors

2.19 Within towns and cities there are other factors that will contribute to the desirability of a quiet area. These include the nature of the landscape (sylvan parks vs derelict industrial wasteland), water features (lakes, rivers and canals), open vistas, accessible green space (parks, commons, and woodlands), type of vegetation (woods, flowers, grassland, cultivated or wild), and the nature of the soundscape (prevalence of natural sounds over man-made noises). Whist recognising the value of these factors as yet there are no robust methods for utilising these features into a coherent means of qualifying or quantifying the acoustic soundscape.

**Table 2:1 Summary of Criterion for Quiet Areas Noise Limits**

| **Criterion** | **Description** | **Level** | **Resultant $L_{den}$** |
|---|---|---|---|
| WHO | Clarity for Speech at 1m | 45 dB $L_{Aeq,T}$ | 47 dB |
| WHO | Moderate Annoyance Limit | 50 dB $L_{Aeq,T}$ | 52 dB |
| Speech Interference Level | Quiet female voice at 1 m | 44 dB SIL | 53 dB |
| Natural Sounds dominate | Natural Sound 5 dB above Man-made immissions | 37 dB $L_{Aeq,T}$ | 40 dB |
| Other Factors | Landscape, Water, Natural sounds, Vegetation, Access etc | No quantified index available | ? |

2.20 Table 2.1 lists the criteria discussed so far. The first three are all close to 50dB $L_{den}$, whilst the fourth at 40 dB $L_{den,}$ where natural sounds are dominant, provides an aspirational target for all urban landscapes.

**Recommendation 2: $L_{den}$ 50 dB should be the upper limit for relatively quiet areas in Urban locations. If a higher 'gold standard' level is to be defined for urban area then it would be sensible to strive for 40 dB $L_{den}$.**

2.21 The question of relative quiet in areas of high noise levels needs to be addressed. If a location is very noisy say with an ambient noise level around 65 dB then a simple barrier may reduce the level to 55 dB, which is not quiet by the above criterion but would be welcomed. Within the area protected by the barrier it would be relatively quiet and potentially of great benefit to any residents of the area. Whilst such improvements are to be welcome we do not feel that this type of situation should form part of the analysis of quiet areas. The consideration of such improvements will logically fall within the remit of the action plans required to reduce the noise exposure of those worst affected.

**The Added Value of Urban Quiet Areas**

2.22 The WHO Guidelines for Community Noise [2] is one of a number of surveys of the harmful effects of noise (for a review of these surveys see [5]). The introduction to the WHO document mentions scientific studies that report that complete silence can have harmful effects because of sensory deprivation. However the remainder of the Guideline only reports on the harmful effects of high noise levels and concludes with a table of noise levels that should not be exceeded. Nowhere in that Guide, nor in any of the similar noise health surveys, is there any reference to positive beneficial effects that arise from a low level noise environment. This is not to be unnecessarily critical of the authors of the WHO report since there is scant evidence in the scientific literature of any systematic investigation into the life enhancing properties of quiet environments.

2.23 For rural locations, quiet is frequently cited in attitude studies as being fundamental to the enjoyment of the countryside (this is discussed in a later section). For urban situations it is highly likely that to access quiet areas would be seen as beneficial by the majority of the public but at the moment there is no firm evidence to support this supposition. It is vital to the case for quiet that public support for urban quiet areas is established and recognised by the decision makers.

2.24 The lack of hard evidence for the positive benefits of quiet areas is a worry. When action plans are being formulated there is the strong possibility that actions will be prioritised according to the experimental evidence of harm. Such an approach would leave quiet areas at the bottom of every priority list.

2.25 It must be recognized that there is a risk that quiet areas will be overlooked in strategic environmental noise planning. If the case for quiet areas can be made with conviction and imagination, then there is real hope that the result will be positive action to identify and protect quiet areas

**Recommendation 3: Consideration of Quiet areas should be integral to the formulation of action plans and must not be treated as an add-on to be addressed once other issues have been resolved.**

**The Financial Value of Quiet Areas**

2.26 Without evidence of the positive benefits of quiet environments, it is difficult to establish the added value of relatively quiet areas. However, there have been some attempts to put a value on the results of noise reduction. Popp [7] in Germany has developed methods for costing the monetary benefits of environmental noise reduction. The methods examine both the effect of noise levels upon property values and upon local property taxation revenues. A monetary benefit can arise in two ways. For the property owner a reduction in the prevailing noise level can lead to an increase in the market value of their real estate. For governments, the rise in property values following a decrease in noise level can be used to justify an increase in property taxation. Between member states there will be different means by which their governments raise taxes on properties so the increased taxation revenues generated by a lowering of the noise level that Popp quotes for his German examples cannot be simply translated into other countries. Nevertheless the basic principles for calculating the monetary benefit of a reduction in noise levels could be applied to other member states. In each instance allowances for the different tax regimes that apply would be required to estimate the likely increase in tax revenue.

2.27 To give an illustrative figure of the cost of noise, in Germany it has been established that the average lowering of property value is 0.5% for each 1 dB(A) increase in noise levels over and above a starting level of 50 dB(A).

2.28 An alternative means of costing the benefits of quiet areas has been to ask the public the value that they put upon a reduction in their noise environment. Often this has been put as the question of the form 'How much would you pay to have your noise level reduced?' A recent study in the UK by the Department of Transport arrived at a value of 25 euros per dB per year as the value that the public would be prepared to pay for lower noise levels – a value felt by some to be too low.

2.29 In March 2003 a draft position paper on 'Valuation of Noise' was issued by EC Working Group on the Health and Socio-Economic Aspects. This paper concurs with the valuation given above and recommends for road transport the (interim) use of the median value change in noise perceived by households of 25 euros per dB ($L_{den}$), per household per year [8].

**Identification of Relatively Quiet Areas within an Urban Context.**

2.30 It has been pointed out in Section 1, that the specific action required of members states for Urban Quiet areas, by the Environmental Noise Directive is the formulation of action plans for agglomerations with more than 250 000 inhabitants. Such action plans are specifically charged with the "*aim to protect quiet areas against an increase in noise"*. Further, the action plans are to be based upon the results of the strategic noise maps of the agglomerations.

2.31 The strategic noise mapping for the EU environmental noise directive (END) will concentrate upon major agglomerations, and transport infrastructures. For the first round of mapping, using interim methods, the Directive requires computation of the $L_{den}$ values above 75 dB down to a lower limit of 55dB and for the night time index $L_{night}$ the lower limit is set at 50 dB. In the future these lower values may be brought down to 50dB for $L_{den}$ and 45dB for $L_{night}$.

2.32 If the computations are made solely within these limits then the noise maps will only indicated the variation in the noise climate for the noisier areas, above $L_{den}$ 55dB in the first round. For the areas below 55 dB $L_{den}$ the maps would provide no detail and the identification of relatively quiet areas will be difficult due to the lack of detail of the soundscape.

2.33 It should be appreciated that there are problems with assuming that $L_{den}$ levels as provided by noise mapping will yield reliable indications of quiet areas. As the noise levels fall the influence of low-level noise sources, such as minor roads, will become significant. Low-level sources, such as minor roads are not included in the strategic noise maps and so such maps may not be reliable indicators of quiet areas. This aspect of the reliability of noise maps for identification of quiet areas requires careful examination.

2.34 If ownership of the strategic maps is passed to local stakeholders then it is possible the input of local knowledge will increase the accuracy of the mapping. This could include details of the traffic flows on minor roads and

other low level noise sources, and details of other factors that may affect the viability of potential quiet areas such as land use and access. However for this refinement of the noise maps to be effective the initial noise mapping needs to be extended beyond the minimum requirements of the END.

**Recommendation 4: Despite the acknowledged problems of accuracy in mapping to low levels, members states should be strongly advised that the $L_{den}$ limit for the first round of strategic noise mapping should be lowered from 55 dB to 45 dB $L_{den}$ and for the night time index the value should be lowered to 40 dB from 50dB.**

2.35 Without this additional range to the noise maps then

(i) only the higher noise areas would be mapped,

(ii) by default all areas below 55 dB $L_{den}$ would be implicitly quiet.

(iii) the quiet areas below 50 dB $L_{den}$ would be without any detail,

(iv) it would be impossible to evaluate the possible effect on quiet areas arising from the experimentation with different what-if scenarios using the noise maps,

(v) the maps could not be improved by the addition of local knowledge of low level noise sources

2.36 It is recognized that the additional range for the noise maps will incur greater costs in terms of increased processing, data requirements for minor roads and information of land use. However it is felt that the additional cost would be a price worth paying for the additional benefits that would accrue to the cause of identifying and protecting quiet areas.

**Protection of urban quiet areas**

2.37 The protection of urban quiet areas is a matter of urgency. Unless the need to protect urban quiet areas is made a clear priority in the first round of strategic action plans there is a strong possibility that other issues will take precedence and many existing quiet areas will be lost.

2.38 Detailed maps are required to fully reveal the consequences of action plans. There is a real danger that in striving to reduce the numbers of people exposed to high noise levels that quiet areas will be sacrificed.

2.39 There needs to be a positive engagement by the noise constituency (acousticians, noise consultants, environmentalists, politicians, local authorities, the media, pressure groups and interested members of the public) to recognise the need to protect urban quiet.

2.40 There are a number of possible methods that will create and protect urban quiet areas. These include:

2.41 The development and creation of open quiet spaces. This will be both existing open spaces such as parks or recreational areas and new spaces that can result from the work of urban regeneration and development of out-moded industrial areas. Open quiet spaces need to be developed to provide ready access to their local communities.

2.42 Strategic traffic plans should route traffic away from open quiet areas and existing through-routes in parks should be closed wherever possible. The only traffic access to parks and recreational spaces should be to car parking located at the edge of the quiet area.

2.43 Many cities have already developed ‘green corridor’ routes. These are relatively continuous areas of open space that lead through the build environment and link together existing open spaces. These ribbons of green often consist of disused railway embankments and cuttings, canals, parks, playing fields, and rivers. These green corridors are often walking or cycling routes with all motorised transport excluded and provide a haven for animals

and plant life. These routes may already be quiet, but in the development of these green corridors the issue of quiet must feature prominently upon the environmental agenda.

2.44 Creative urban design can create quiet spaces within the urban soundscape. For example the Sony Center in Berlin uses a ring of tower blocks to create a central quiet piazza. Although not modern, the various Inns of Court in London demonstrate how tranquil spaces can be created within a busy city. There are many other examples of architectural developments that have been successful in providing quiet spaces within the confines of inner city developments. The concept of providing at least one 'Quiet Façade' for all residential properties should be adopted by all local planning authorities.

2.45 The possible use of enclosed spaces to provide oases of quiet within the urban landscape should be examined. Courtyards, atria, stadia, museums and churches are places where quiet can be found in even the noisiest city. The problems lay both in making the public aware that such places exist and can serve as a valuable resource, and in widening access to such spaces.

2.46 There are instances of proactive initiatives that award the improvement of the urban environment. For example the Clearzones project [9], within the UK, awards city zones that have made quantifiable improvements in the local environment. The improvements can be in a number of environmental factors, such as air quality, street cleanliness, reduction in traffic flow, pedestrianisation as well as noise. It is necessary for quiet to be cemented into all such frameworks as a cornerstone requirement. The cost of such schemes need not be funded solely by the taxpayer. For headline schemes there is the opportunity to engage with corporate sponsorship. There is the opportunity for major noise producers, such as airlines to pay back something into the community by sponsoring quiet area projects.

2.47 There are already examples of the cities and towns banning traffic from defined areas on weekends or special days. These schemes are very effective in reducing traffic noise and have the potential to link in with green corridor schemes and/or tourist heritage routes. Automatic traffic management

systems implemented for security or congestion charging could be used to control such traffic free zones with a high degree of flexibility and control.

2.48 As part of the strategic planning for cities there should be opportunities for interactive management of the urban soundscape. This would be a two way process for exchanging ideas and information between the public and the local authorities. Attitude surveys and other consultation processes will be required to inform the local authorities as to the public expectations for quiet areas. In return there is a need for effective communication channels to inform the public of the nature, extent and access to quiet areas. It has been shown [10] that telling the public what type of soundscape to expect is an effective tool for the management of the quiet areas. This will require clear simple descriptions of the soundscape in language that is readily understood by the public.

## 3. RELATIVELY QUIET AREAS IN RURAL LOCATIONS

### The Definition of Relatively Quiet Areas in Rural Locations

3.1 Quiet in the countryside will have the same objective as quiet in agglomerations. Both will aspire to provide areas of peace and tranquillity but in countryside the standards for assessing and evaluating quiet will be different and can be more ambitious. The standards will be different due to the fundamental difference in the noise climate found in the countryside and since our expectations for quiet in the countryside will be greater, the standards we set will be higher.

3.2 The rural soundscape in rural areas will vary widely across Europe. Some areas of Scandinavia are sparsely populated with little man made noise and ambient noise levels around 30 dB $L_{Aeq, 24hour}$ [11] whereas other countries such as the UK are densely populated and are crisscrossed by a highly developed transport network of roads, railways and aircraft routes to the virtual exclusion of rural quiet areas. In addition to transport, there are a numerous other sources of noise within the countryside. Modern agriculture is heavily dependant upon machinery for all types of farm work. The numbers and size of farm machinery is ever increasing and as a result the noise from farming is ever louder. Even hill farms that once only echoed to the sound of the shepherd whistling to his sheep dog are now overrun with quad bikes ore hill and dale. Mountain and moorland, the closest that Europe gets to wildernesses, often suffer from noise from quarries and open cast mining. These remote areas are also often subject to military noise. Artillery practice, field exercises and low-level jet aircraft are all examples of loud military noise sources found in the countryside. Power stations are often located in the countryside well away from towns and cities and the noise from wind power generators should not be forgotten. All this is in contrast to urban areas where the noise climate will be similar in all major agglomerations.

3.3 With the greater variation in the nature of the rural soundscape across Europe it is more difficult to arrive at precise definitions of rural quiet that will apply to all countries. In formulating action plans for rural quiet areas

member states are not restricted in the same way, as the Directive [1] requires for urban quiet areas. This freedom means that it is possible for member states to take on board common ideas but then to develop solutions that are relevant to their own needs, their available resources and the infrastructure of their own countryside areas.

3.4 Natural quiet has been defined in a number of similar ways. The EU Directive definition defines an area of relative quiet in the countryside as being "*undisturbed by noise from traffic, industry or recreational activities.* This definition is in line with the definition of natural quiet that has been used by Grand Canyon National Park" *an area which is largely free of intrusive noise",* with any audible human sound considered to be an intrusion [12]. Overall most authorities define natural quiet as the absence of man–made noise. Similarly the Council for the Protection of Rural England [13] defines Tranquil Areas as *"places that are sufficiently far away from the visual or noise intrusion of development or traffic to be considered unspoilt by urban influences."* The Environmental Protection Agency of Ireland prefaces their report [14] with the statement that " *Tranquil areas are part of our natural resource; they provide places for recreation, solitude and reflection where one can experience a symphony of sounds and a sense of place. The natural soundscape is an indicator of environmental quality; it is part of our heritage and environment, important for wildlife and biodiversity*."

3.5 The END definition of relative quiet in the countryside as being "*undisturbed by noise from traffic, industry or recreational activities"* is problematic in that the onset of disturbance is so subjective that it becomes impossible to define the intrusive noise level below which an area can be considered to be undisturbed.

3.6 Looking at the different definitions we have arrived at a definition of relative quiet in the countryside as being **"***an acoustic soundscape where the benign natural sounds dominate over man made and other unwanted sounds*." This is a far more demanding definition than any that might be used within urban areas, nevertheless we ought to be looking to set very high standards

both to protect those areas that are currently at a high standard and to set an aspirational target for other areas to work towards. We are aware that this definition is very subjective and will be difficult to translate into objective criteria. Nevertheless it is a pragmatic definition in that it does not require the complete absence of man- made sounds, as do many other definitions of natural quiet. True natural quiet is only likely to be found in remote wilderness regions of which there are few within Europe.

3.7 Benign natural sounds would include the sounds of birds, wildlife, water and tree rustle but would exclude the sounds of farm animals poultry and game birds. Some natural sounds may be undesirable; a rookery in the early morning will disturb sleep; frantic cicadas at noon can disrupt a woodland picnic.

**The Choice of the noise index for Rural Quiet Areas**

3.8 As a result of the many and varied noise sources within the countryside the noise climate is complex and constantly changing. Many of the noise sources are transitory; varying in the duration, frequency and time of day in their occurrence. Other noise sources will occur only seasonally or vary with the weather. Thus the soundscape of the countryside is not bland, placid and unvarying but is a complex mix of both man-made and natural noises constantly changing from minute to minute, from hour to hour, from day to day and from season to season.

3.9 Miller et al [15] identified four issues that are important when trying to quantify sounds in natural environments. These are;

(i) The difficulty in separating natural sounds from intrusive (man-made) sounds.

(ii) The possible variation in noise climate over an area of natural quiet.

(iii) The noise climate may vary widely from week to week and from season to season.

(iv) For some remote areas the noise levels may be extremely low.

3.10 The selection of a suitable indicator for the relatively quiet area in the countryside is a more difficult problem than choosing an index for quiet areas in agglomerations. In the countryside the ambient noise levels will be low. This will make any intrusive noises more audible and more obvious. Intrusive man-made sounds are more likely to be intermittent and variable in level and duration. Thus the use of $L_{den}$, or any other long-term average, on its own will only give part of the picture. Miller et al [15] used a method for quantifying noise intrusion in National Parks in the US that rated areas for intrusion sensitivity using a combination of intrusion noise level over background and percentage time of the intrusions. This form of rating is worthy of further study as it allows both the nature and frequency of the intrusion to be weighed

against the relative loudness of the intrusion. For quiet in the countryside a single noise descriptor is unlikely to be as useful as a multifaceted appraisal method.

3.11 The desirable soundscape of a quiet rural area will be distinguished by a low level of background noise from man-made sources and by a low incidence of higher-level noise incursions. The low background level will allow natural sounds to come to the fore and limiting the number of noise incursions will reduce the disturbance. Thus any noise index or noise indices used to quantify the noise climate should be able to reflect both low background level and number of noise incursions.

3.12 For background noise levels the statistical $L_{90}$ is often used. This is the level exceeded for 90 % of the time. Although the use of $L_{90}$ is well established as an indicator of background noise levels, there is little evidence of its' use in quiet areas. One index that has an established track record is $L_{Aeq,24\ hours}$. This has been used in the Netherlands for a number of years in the context of delineating quiet areas. There has been some research carried out into the attitudes of visitors to quiet areas that demonstrated that the perception of quiet correlated best when the noise levels were expressed in terms of $L_{Aeq,\ 24hours}$ and that areas below 50 dB were valued greater than noisier areas (n.b. $L_{den}$ was not tested for correlation with the perception of quiet). Many of the provinces within the Netherlands have adopted a yearly averaged level of 40 dB $L_{Aeq,\ 24hours}$ as a value to be aimed at for their designated quiet areas [3]. This level of 40 dB is taken to be a considered estimate of the summation of the natural sounds. That is, the baseline noise for the natural sounds over a day is 40dB and an increase upon this value would be due to the effect of man- made sounds. Monitoring and validation of predictive modelling carried out in different Dutch provinces would appear to support this as a reasonable value. However it was noted during monitoring that incidental audible events frequently occurred. These events, due to transitory man-made sounds, did not lead to an exceedance of the 40 dB annual average $L_{Aeq,\ 24hours}$ but they were potentially disturbing.

3.13 This last observation illustrate the problem of using any long-term average is that brief events, sufficiently loud to disrupt a quiet area, are lost in the averaging process. There are a number of ways to deal with this difficulty. The description could be in the form of multiple or combined indices or a matrix of descriptors. The matrix would be an extension of the method used by Miller and Menge [16] in the US. Their model used a grid that plotted number of incursions on one axis against the loudness of the incursion on the orthogonal axis. This could be used to incorporate other factors; a version of this is described later (Table 3.3, [17]) which uses a number of descriptors to identify a series of tranquil zones. A combined index would incorporate the averaged noise level with an expression of the number or frequency of noise incursion. This would be along the line of the Noise and Number Index (NNI) used for aircraft noise back in the sixties. The problem with combine indices is that they often prove to be only valid for limited range of circumstances. Multiple indices would use a basic index to express the long-term average level and then one or more additional indices to express the variant nature of the noise climate. For example an $L_{Aeq,24\ hour}$ level plus the average number of noise incursions over 50 dB in the 24 hour period. This latter option has the virtue of simplicity but as yet there have been no instance of its use anywhere.

3.14 Periods of natural quiet can be quantified by the number of noise free intervals occurring during a typical day. A noise free interval (NFI) is defined as a fifteen-minute period when there is no mechanical or domestic noise present. This should be a useful index as it should be readily understood by the public. The use of NFIs is mentioned in the synthesis report on the work carried out for the Environmental Protection Agency in Ireland but as yet they have not published the data for the incidence of NFIs in quiet areas [14].

3.15 An interesting suggestion for a method for indicating the degree of noise incursions is a noise index that gives the percentage of the time when a noise limit has not been exceeded. This in essence would give the fraction of undisturbed time in a given period. It is a form of inverted exceedance level. Thus a value of 75 on this index would indicate that for 75% of the time the noise limit had not been exceeded. Although it would need to be carefully

labelled to avoid confusion with the traditional exceedance level, $L_N$, such an index would be useful in quantifying the frequency of disturbances to be expected in a given area. Managing expectations has been shown to be a useful tool in ensuring visitor satisfaction in countryside areas [10]. As with the other possible compound noise indices there is little factual evidence or experience of such units. In the early nineties Porter et al advocated the need for a compound noise descriptor for environmental noise assessment but there has been little progress with this ideas since that time [18].

3.16 The development of a new compound noise index for quiet areas is an interesting proposition and worthy of a thorough investigation. Such an index may prove to be too unmanageable and too difficult for the layperson to understand, as have other such specialist indices in the past. There is also the danger that any delay in providing positive guidance on the noise levels for quiet area, both rural and urban, will lead to inaction and further erosion of existing quiet areas. So it is perhaps necessary to suggest crude and simplistic guidance that will serve to draw a line in the sand and thereby halt the decline in environmental noise quality.

**Recommendation 5: That the noise index for rural quiet areas should be an annual $L_{Aeq,24\ hour}$ , or its equivalence in $L_{den}$.**

3.17 The rationale for Recommendation 5 is that annoyance is not the evoked response that has to be reflected by the noise index. Rather, when visiting rural quiet areas, we are more interested in 'the enjoyment of tranquility and relaxation'. This enjoyment should be independent of the time of day and so should not be a function of the time period. Therefore an index which is independent of the time period is more appropriate than an index, such as $L_{den}$, which includes weighting of different time periods because such a weighting is chosen to reflect the (extra) annoyance people will experience when exposed to noise in and around their homes during the evening and night. From a limited study in the Netherlands there were found indications that an annual $L_{Aeq,\ 24\ hour}$ correlated best with the public perception of quiet

(discussed in 3.12 above). In the Netherlands, the $L_{Aeq,\ 24\ hour}$ index is used for monitoring the noise in rural quiet areas. Whilst an annual $L_{Aeq,24\ hour}$ may lack finesse and may lack the depth of information that a multi-factor index would provide, it does have the virtue of simplicity and expediency.

3.18 To date the method for converting current noise indices into $L_{den}$ have concentrated upon traffic noise and by default upon noise levels above 50dB. At the moment there are no plans in Holland or elsewhere to develop the means of converting an annual $L_{Aeq,24\ hour}$ for rural noise soundscapes into $L_{den}$ but in time this should be possible and then the noise index should be $L_{den}$. This would ensure consistency with the preferred noise indicator for the END.

**Recommendation 6: The upper noise limit criterion for rural quiet areas should be 40 dB $L_{Aeq,24\ hour}$ or its equivalence in $L_{den}$.**

**The Added Value of Rural Quiet Areas**

*3.19* The value of access to the quiet areas in the countryside is generally acknowledged. There is much legislative control of noisy developments in the countryside and the consideration of the potential noise impact of large developments is a key factor in Environmental Impact Assessment. Governments generally are supportive of moves to protect quiet in the countryside. In 1979 the Dutch Government passed a Noise Act (Wet Geluidhinder) [19] that required that consideration should be given to the preservation of quietness in certain areas. In the UK the Rural White Paper of November 2000 [20] stated "*There will always be sources of noise in the countryside, and many of these – such as noise from harvesting and livestock – are them selves representative of activities that are central to the rural way of life. But protecting the countryside from further intrusion of noise is not a luxury. It is about preserving and promoting a feature that is genuinely valued by residents and visitors alike. Noise can also disturb the breeding of vulnerable species and thereby undermine biodiversity."*

## Methods of Identifying Relatively Quiet Areas in the Countryside

3.20 There have been a number of methods employed for identifying and mapping areas of relative quiet in the countryside. These methods vary in their sophistication and encompass both direct monitoring in the field and desktop prediction methods.

### Direct Monitoring ~ Baseline Survey

3.21 A baseline survey is often a fundamental component of an Environmental Noise Impact Assessment. The noise monitoring of an area for development is made over a period of time to establish the nature of the existing noise climate. Whilst this initially may appear an attractively simple basis for identifying relatively quiet areas the magnitude of the task for most member states will be unrealistically demanding in terms of time and personnel.

3.22 Several studies of the noise climate in National Parks in the United States have utilised direct measurement of noise intrusions [12] [15][16][21][22]. These studies have shown that with current technology the only practical means of differentiating between natural and man-made sounds is to take attended measurements where the observer keeps a second-to-second log of all audible sources. A similar experience has been reported in the Netherlands [3]. Within the province of Gelderland surveys were carried out to check out the noise mapping predictions of noise levels within designated quiet areas. Although the surveys showed reasonable agreement with the predicted noise levels, there were many audible 'incidental' man-made sounds. These sounds were outside the capabilities of the noise prediction programme (URBIS) and, due to their unpredictability, were difficult to model. Therefore to be able to truthfully interpret the noise log of a sound level meter and to differentiate between natural and man-made noise events, all measurement points would require an attentive observer at all times. If we then consider the number of measurements positions and the time period required to give indicative results then the manpower resource needed for a nationwide survey

becomes prohibitive.

3.23 Rather than surveying the whole country a possible approach would be to survey a number of indicative sites and from the noise levels recorded at these sites infer the extent of possible quiet areas. A rationale for deciding where, when and how many sites to monitor will not be easy to settle, or to validate. Despite these possible difficulties, a baseline study has been carried out by Waugh and others in rural Ireland over the period February 2000 until February 2002 [23]. The final main report of that survey, which was due in the spring of 2003, is yet to be published. However we have managed to review a draft copy of the Synthesis Report [14] for the project (3rd July 2003). The project carried out an extensive noise monitoring programme throughout Ireland and it was the intention to use the monitored data to elaborate on and recommend Environmental Quality Objectives (EQOs) and Environmental Quality Standards (EQSs) for noise in relation to relatively quiet areas. In addition it was planned that anthropogenic noise modelling would be undertaken at representative sites, and integrated within a Geographic Information System (GIS). These are an ambitious set of objectives and it will be interesting to see if they can be realised in practice.

3.24 From the synthesis report [14] it is difficult to judge the effectiveness of the project in meeting its objectives. It is understood that it is not planned to recommend Environmental Quality Objectives (EQOs) and Environmental Quality Standards (EQSs) when the main report is published.

**Population Density Modelling**

3.25 This is a very simple means of establishing background noise levels using population densities. The basic premise is that everyday human activity will generate some noise and where there are more people then the greater this activity noise will be. The concept was originally developed by the US Environmental Protection Agency in 1974 [24] and has been more recently validated in the US by Stewart et al [25]. This research developed a relationship for the day-night level, $L_{dn}$ to population density. Expressed in SI units the relationship is

$$\mathbf{L_{dn} = 17.9 + 10 \log (\rho)}$$

where $\rho$ = population density in people per square kilometre.

The $L_{dn}$ noise level is then converted into the daytime median sound level, the $L_{50}$ by use of another experimentally derived relationship [26]

$$\mathbf{L_{50} = L_{dn} - 5\ dB}$$

which gives the working relationship

$$\mathbf{L_{50} = 12.9 + 10 \log (\rho)}$$

3.26 As an example, this relationship is applied to a map of Europe (Figure 3.1) showing population density. From this we can estimate the daytime $L_{50}$ for the different areas shown on the map (Table 3.1). Note that the derived $L_{50}$ levels are exclusive of noise from major transport sources. The results appear to give believable estimates but at the large scale of the European map the population density distribution lacks resolution, as does verifiable data of the existing noise levels. Dr Fillery of Symonds Group Limited has attempted a trial verification of this model using data from the UK National Noise Incidence Survey 2000 [27] and local authority population data. The trial is in its early stages but results so far are encouraging and it is hoped to publish the findings by the end of the year.

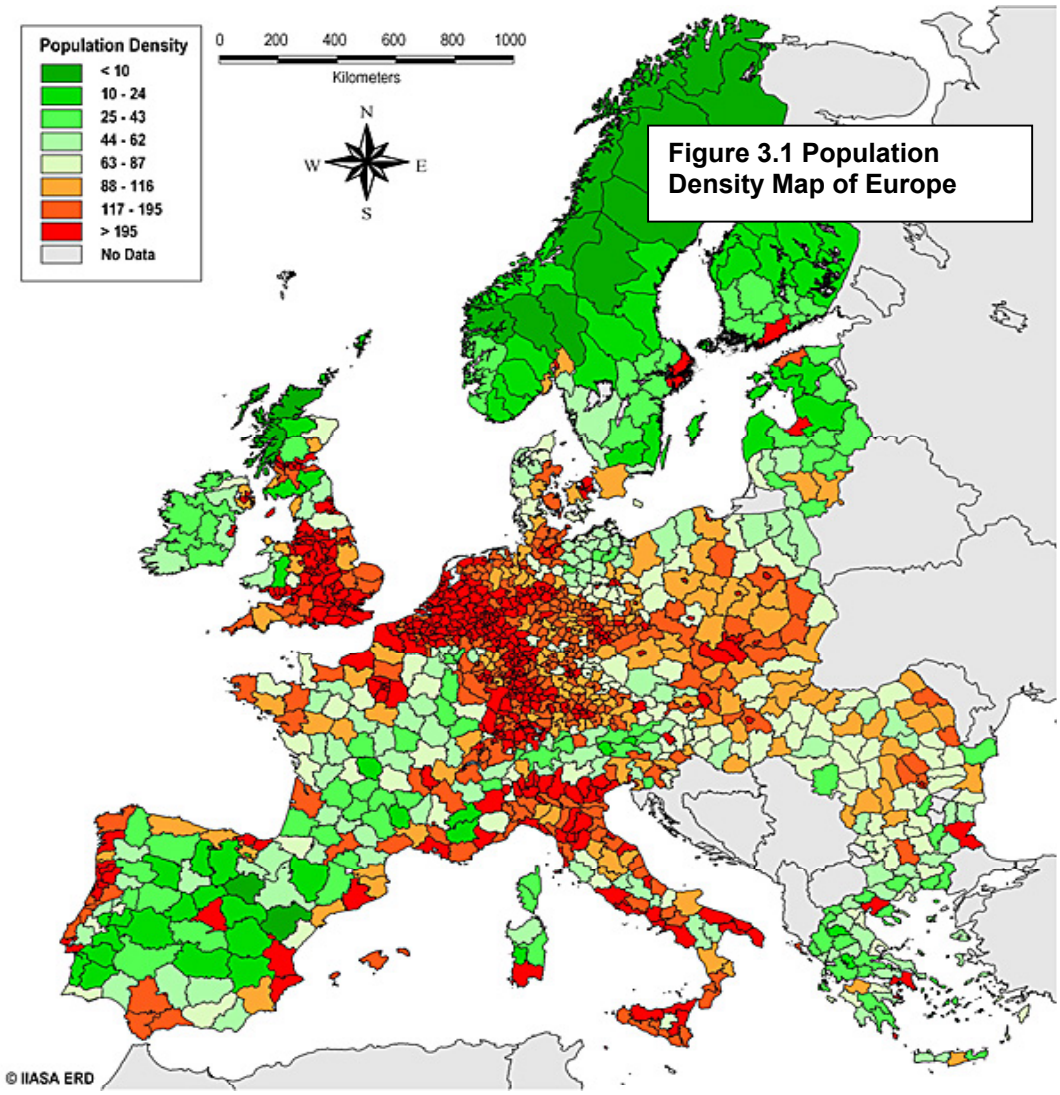


**Figure 3.1 Population Density Map of Europe**

## Table 3.1 Predicted Noise Levels from Population Densities

| European Population Density ; Background Noise Prediction | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Population density | | | | L50 day | |
| n/km2 | n/km2 | | dB | dB | dB |
| lower | upper | | lower | upper | Median |
| | | | | | |
| 1 | 10 | | 13 | 23 | 18 |
| 10 | 24 | | 23 | 27 | 25 |
| 25 | 43 | | 27 | 29 | 28 |
| 44 | 62 | | 29 | 31 | 30 |
| 63 | 87 | | 31 | 32 | 32 |
| 8 | 116 | | 22 | 34 | 28 |
| 117 | 195 | | 34 | 36 | 35 |
| 195 | 1400 | | 36 | 44 | 40 |

**Noise Source Avoidance Modelling.**

3.27 This is a simple method of strategic noise mapping that does not require the calculation of any of the sound attenuation factors that are utilised in most sound propagation models. In essence the method is very straightforward. Based upon field experience each different source of man-made noise is assigned a set distance for the extent of its noise impact. The total noise affected area is determined by plotting out the distance of impact from every noise source. The areas that do not fall within the noise affected area are considered to be quiet.

3.28 Perhaps the best known example of this approach was a joint project the Council for the Protection of Rural England, CPRE and the Countryside Commission who commissioned Ash Consulting Group in 1995 to map the Tranquil Areas of England [13]. Note that in this survey visual intrusion was also considered a relevant feature in determining Tranquillity.

3.29 Using the criteria that Tranquil Areas are places which are sufficiently far away from the visual or noise intrusion to be considered unspoilt by urban influences, the Tranquil Areas were determined by distances from the various disturbing factors listed below;

(i) 4 km from the largest power stations.

(ii) 3 km from the most highly trafficked roads such as major motorways; from larger towns ;and from major industrial areas.

(iii) 2 km from minor motorways and major trunk roads and from the edge of smaller towns.

(iv) 1 km from medium disturbance roads i.e. roads which are difficult to cross in peak hours (taken to be roughly equivalent to greater than 10,000 vehicles per day) and some main line railways.

3.30 A Tranquil Area also lies beyond military and civil airfield/airport noise lozenges as defined by published noise data (where available) and beyond very extensive opencast mining.

3.31 Deciding on the distances was an iterative process of comparison between each type of disturbance in the field. The resulting maps provided a broad-brush picture of areas in the countryside that were free from urban intrusion. This allowed CPRE to estimate of the change in Tranquil Areas between the 1960s and the 1990s (see Table 3.2).

3.32 Tranquil Areas were drawn with a minimum radius of 1 km. This criterion eliminates local effects. Linear elements including low disturbance roads, 400kV and 275kV power lines and busy railways were treated as lines 1km wide of low level disturbance. Within Tranquil Areas various sites also fall into this lower level of disturbance category, including large mining or processing operations, groups of pylons or masts, settlements greater than 2,500 in population, some half abandoned airfields and most wind power developments.

**Table 3.2 Results of Tranquil Area Mapping of England**

| | 1960s | 1990s | Change |
|---|---|---|---|
| Area of tranquility in England (sq km) | 91,880 | 73,012 | 21% loss |
| Percentage of England that is Tranquil | 70% | 56% | 14% reduction |
| Average size of Tranquil area in England (sq km) | 193 | 52 | 73% reduction |

3.33 Following the production of the large scale maps (1:250,000) for Tranquillity in England, the originator of the method Simon Rendel went on to develop both regional and local maps at a scale of 1:50,000. These smaller maps were able to include local effects and smaller noise sources than the large scale maps, and plotted out contours of intrusion using five levels of tranquillity [17] [28] [29] (see Table 3.3)

3.34 A similar approach using distance criteria to avoid man-made noise sources was used in the Irish Environmental Protection Agency project to identify the quiet sites to be used in the baseline survey. In this instance the distances used were greater than those used in the CPRE predictions [14].

**Table 3.3 Local tranquillity zones related to regional maps**

| Local nomenclature | Local description | Regional description | Regional nomenclature |
|---|---|---|---|
| Zone E | Almost traffic free.<br><br>Light passive recreation occurs. | N/A | Tranquil |
| Zone D | All public roads passing through zone are comfortable for walking.<br><br>Moderate passive recreation occurs. | The broad Scottish definition of Tranquillity.<br><br>Countryside free of any substantial disturbance in daytime.<br><br>Night-time sky may be affected by light reflection. | Tranquil. |
| Zone C | Some roads passing through are uncomfortable for walking.<br><br>Boundary of zone somewhat disturbed by traffic noise.<br><br>Intensive passive recreation occurs. | The broad English definition of Tranquillity.<br><br>Countryside somewhat disturbed by light traffic noise, small settlements, etc. | Tranquil |
| Zone B | As regional | Countryside subject to significant traffic intrusion and other equivalent disturbance. | Semi-tranquil |
| Zone A | Very substantial traffic disturbance throughout zone. | N/A | Disturbed |

3.35 The use of a number of zones at the local level is an idea worthy of development. The classification of the zones can encompass both quantified noise levels and other descriptors as above. This could be a valuable means of labeling the noise climate of an area for the benefit of visitors.

**Recommendation 7: Competent local authorities should explore means of visitor-friendly labelling of quiet zones at the local level for rural quiet areas.**

**Noise Mapping of Quiet Zones**

3.36 There are a number of examples of noise mapping applied to quiet zones. These include;

3.37 In Sweden a pilot project [30] was initiated by the National Road Administration Southeast, aided by Ingemanssons consultancy. The limit to what is counted as silent was set as an equivalent sound pressure level of 30 dBA. The method progressively works from the major noise sources such as major roads, rail and aircraft noise down to minor roads and then adds the influence of local noise sources, such as industry and recreational, until the refined map indicates the quietest areas. The method is logical and demonstrates what may be done. The approach may be applicable to those countries with really quiet areas but for the major industrial countries mapping down to 30dBA will probably remain a desirable but unobtainable target.

3.38 In the Netherlands two noise prediction models have been used for the mapping of quiet areas developed for quiet areas [3]. The national model for

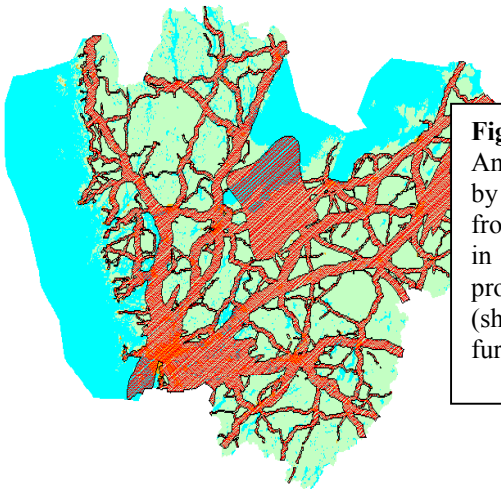

**Figure 3.3.**
An example of the mapping work carried out by Ingemanssons. The map shows the result from the west part of Sweden with Gothenburg in the lower left corner is shown. The noise propagation from airports, roads and railroads (shaded areas) reveals the undisturbed areas for further investigation.

noise mapping is called EMPARA (Environmental Model for Population Annoyance and Risk Analysis). In a similar approach to the Swedish mapping method, EMPARA calculates and accumulates the contributions from each of the major noise sources, road, rail and aircraft. The EMPARA map for the Netherlands is shown as Figure 3.4. Another model has been developed by the Netherlands Institute for Applied Research, TNO. This model called RURIS takes the noise from industrial and recreational activities into account as well as transportation noise. RURIS also calculates temporal distributions of the noise levels which allows the model to determine the probability of hearing man-made sounds when in a quiet area. The predictions of these models have been shown to give reliable results for the relatively continuous noise sources. It is random intermittent sources that are difficult to model.

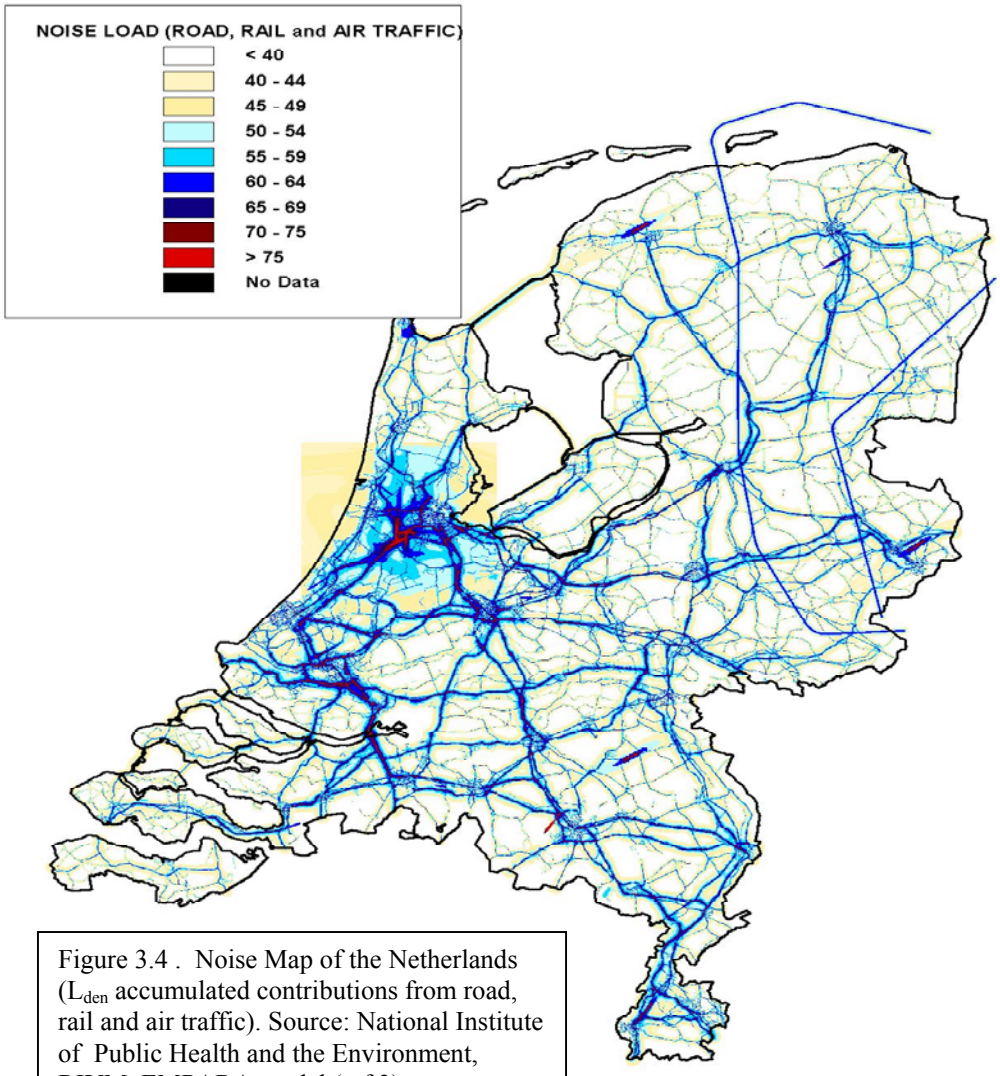


Figure 3.4 . Noise Map of the Netherlands ($L_{den}$ accumulated contributions from road, rail and air traffic). Source: National Institute of Public Health and the Environment, RIVM, EMPARA model (ref 3)

3.39 Finally there will be the different national noise prediction models used for the first round of strategic noise maps for the END. Whilst it should be possible to extend the range of the mapping into the realm of quiet areas the major uncertainty will be over the accuracy of the prediction of low noise levels since many of the prediction models were developed in the first instance to deal with higher noise levels at the level of annoyance.

**The Protection of Rural Quiet Areas**

3.40 There is an overarching need to establish the concept that all quiet areas are a valuable environmental resource that needs to be protected. Unless the dangers are properly recognized then there will be a continual erosion of the few remaining really quiet areas. There are a number of possible methods for enacting protection for rural quiet areas. These include;

3.41 The use of National Parks and similar conservation areas to establish quiet areas. Within these areas there needs to be a proactive pursuit of noise reduction as an integral part of the environmental protection programme. This could include;

(i) Tough noise limits on all new development.

(ii) Review of existing noise limits and a programme of progressive noise reduction implemented.

(iii) Noise Management of the Parks that involve both regular consultations with the park users such as attitude surveys, and the provision of adequate information of the soundscape that visitors will experience.

(iv) Education. Park Rangers and others involved in the management of these areas need to be educated in environmental acoustics to enable them to develop noise control regimes appropriate for their individual circumstances.

3.42 The progressive implementation of quieter agricultural machinery into the countryside. This could be achieved by the use of grants, tax breaks or other fiscal means combined with tough noise limits on new farm machinery. This is already happening through the Physical Agents Directive that requires a reduction in the noise and vibration levels of all machinery for Health and Safety purposes [31].

3.43 For many existing quiet areas there is an increasing pressure to expand the recreation uses of the areas. This in turn will lead to an increase in the noise levels both from the recreational activities themselves and the associated transport noise as the visitors travel to and from the recreational area. One possible way of managing these areas is to programme Noisy and Quiet days. On Noisy days all the noisy recreational sports would be programmed together whilst on Quiet days only low noise activities such as walking or cycling would be allowed. The establishing of such a regime would not be easy but it would allow noisy recreations to use the countryside whilst still maintaining quiet use on other days.

3.44 The issue of commercial aircraft overflying is likely to be a major obstacle for quiet areas throughout Europe. With the increasingly crowded airspace over Europe, it will be very difficult to avoid overflying by commercial aircraft for many rural quiet areas. The re-routing solutions employed by the United States for their National Parks will not be possible for most member states due to a lack of space.

3.45 For military aircraft there is often a national security need for pilot training at low altitude. To avoid major disturbance and for safety reasons, the low altitude flights take place over areas of low population density which invariably means the remote areas of countryside. Thus there is a conflict between preserving the quiet of these remote areas and their use for military low altitude flying. In addition there are many other military uses of the countryside that create considerable noise such as artillery practice and field exercises. This conflict is unlikely to disappear and the way forward must be to seek greater cooperation with the national military authorities in ways of managing the noise impact of their training activities.

3.46 The development of noise maps for rural quiet areas. The current noise mapping methods were developed for noisy areas and higher noise levels. Work is needed to ensure that the methods can be adapted to give accurate results for rural quiet areas. In addition attention should be given to the best ways of presenting the predictions to the public.

3.47 The development of the transport infrastructure is likely to increase within Europe. This will require the building of new road and rail routes. The impact of such routes is likely to have a major impact upon quiet areas and the need to protect the quiet areas from additional noise should be a significant factor in the choice of any new route.

## 4. RECOMENDATIONS

**Recommendation 1: For the initial stages of the END the general noise indicator for urban quiet areas should be $L_{den}$ , however for some areas the use of the ancillary noise indicators $L_d$, $L_e$, and $L_n$ may be more appropriate.**

**Recommendation 2: $L_{den}$ 50 dB should be the upper limit for relatively quiet areas in Urban locations. If a higher 'gold standard' level is to be defined for urban area then it would be sensible to strive for 40 dB $L_{den}$.**

**Recommendation 3: Consideration of Quiet areas should be integral to the formulation of action plans and must not be treated as an add-on to be addressed once other issues have been resolved.**

**Recommendation 4: Despite the acknowledged problems of accuracy in mapping to low levels, members states should be strongly advised that the $L_{den}$ limit for the first round of strategic noise mapping should be lowered from 55 dB to 45 dB $L_{den}$ and for the night time index the value should be lowered to 40 dB from 50dB.**

**Recommendation 5: That the noise index for rural quiet areas should be an annual $L_{Aeq,24\ hour}$ or its equivalence in $L_{den}$.**

**Recommendation 6: The upper noise limit criterion for rural quiet areas should be 40 dB $L_{Aeq,24\ hour}$ or its equivalence in $L_{den}$.**

**Recommendation 7: Competent local authorities should explore means of visitor-friendly labelling of quiet zones at the local level for rural quiet areas.**

## 5. RESEARCH TOPICS

The following is a list of possible research areas that need to be addressed. The topics are merely indicative and will require critical evaluation before they can be presented as fully developed research proposals.

(i) Investigations into the Public Attitudes and Expectations of Quiet Areas, both rural and urban.

(ii) Cost benefit analysis of quiet areas especially the cost implications in different member states with differing taxation regimes.

(iii) Investigation into the health and other benefits of quiet areas.

(iv) Quantification of the financial gains of the reduction in ambient noise levels that lead to increases in property values. Especially in respect of low noise levels (relatively quiet areas).

(v) Investigation into the possible means of quantifying the noise climate of rural quiet area especially the means of measuring and predicting the number of noise incursions.

(vi) Development of the means for lucid and simple descriptions of the noise climate of relatively quiet areas.

(vii) Investigations into appropriate and reliable means of mapping quiet areas

(viii) Development of the means of the incorporation additional environmental descriptors into definitions of tranquil areas.

## 6. REFERENCES:


1. EU Directive 2002/49/EC of 25th June 2002 of the European Parliament and Council relating to the assessment and management of environmental noise.

2. B Bergland, T Lindvall and D H Schwela, *'Guidelines for Community Noise'* World Health Organization,1999.

3. T Dassen, '*A brief overview of the Dutch policy and research on the area of 'quiet zones'*, RIVM, Bilthoven, October 2002.

4. HM Government, Department for Environment, Food and Rural Affairs, '*Converting the UK Traffic Noise Index to EU noise indices for noise mapping*', http://www.defra.gov.uk/environment/noise/crtn/index.htm.

5. Porter N D, Flindell IH, Berry BF, '*Health Effect-based Noise Assessments: A review and feasibility study.'* National Physics Laboratory Report CMAM 16, 1998

6. The Mayor of London, *'City Soundings. The Mayor's Draft London Ambient Noise Strategy*' Greater London Authority, ISNB 185261 444 7, www.london.gov.uk.

7. Christian Popp, *'Influence of noise impact on the tax income of municipalities. A German Example –'*, Proceedings of 5th European Conference on Noise Control, May 2003.

8. Working Group on Health and Socio-Economics, *'Valuation of Noise'*, European Commision – DG Environment.

9. Clearzone- technology for liveable cities, http://www.clearzones.org.uk.

10. G.R.Cressford, *'Recreational noise issues and examples of protected areas in New Zealand'*, Noise Control Eng.J., 47(3), 1999.

11. Pensonen Kari, '*On noise assessment and noise control engineering problems caused by seasonal variations of noise emission and excess attenuation',* Inter-noise 2000, Nice, August 2000.

12. Louis C Sutherland, *'Natural Quiet: An endangered environment: How to measure, evaluate and preserve it'*, Noise Control Eng.J., 47(3) 1999

13. Council for the Protection of Rural England, *'The Tranquil Areas of England'*, http://www.cpre.org.uk/policy/rural/tranquil/

14. SWS Environmental Services, Project-Environmental Quality Objectives Noise, Draft Synthesis Report June 2003. Report prepared for the Environmental Protection Agency (Ireland), June 2003

15. N.P. Miller. *'A proposal for acoustic data collection in parks and wilderness areas*'. Inter-Noise 2001, The Hague. Netherlands.

16. N P Miller and C W Menge. '*Status of the I-INCE Initiative on Recreational Noise and Progress on Quantifying Noise Intrusions in Parks*' Proceedings of Noise-Con 2001, October 2001.

17. S Bell, *'Tranquillity Mapping as an Aid to Forest Planning'*, Information Note, Forestry Commission, March 1999.

18. Porter N, Flindell IH and Berry B, '*An Acoustic Feature Model for the Assessment of Environmental Noise,'* Acoustic Bulletin November/ December 1993.

19. Wet Geluidhinder, Staatscourt, (Netherlands), 1979

20. HMG, '*Our Countryside; the future – A fair deal for Rural England'* Command 4909.' The Stationery Office, November 2000.

21. US National Park Service, *'Report on effects of aircraft overflights on the National Park system*.' September 1994.

22. US National Park Service, *Report on the Effects of Aircraft Operations on the National Park System,* Washington D.C., July 1995.

23. D Waugh, '*Development of a methodology to evaluate environmental noise baseline levels and establish quality objectives for noise in relatively quiet areas'*, Proceedings of IOA Autumn Conference 2001, November 2001.

24. US Environmental Protection Agency '*Population Distribution of the United States as a Function of Outdoor Noise Level*,' Report 550/9-74-009, June 1974.

25. Stewart C M , Russell W A, Luz G A, *'Can population density be used to determine ambient noise levels?*' 137th Meeting Acoustical Society of America, Berlin, Germany March 1999.

26. Wye Laboratories, 'Community Noise' EPA Report NTID300.3, December 1971

27. P Wright, CJ Skinner, CJ Grimwood, '*The National Noise Incidence Survey 2000/2001 (England and Wales)*.' BRE Client Report No:203938f

28. Simon Rendel, '*A New Technique',* Landscape Design, February 1997

*29.* Pickering T, Armstrong M, Kennedy S, Whiteley N, Madoc-Jones N, *'The Tranquil Area Report',*
http://www.geog.leeds.ac.uk/people/s.carver/student_work/student%20webpages%2000.

30. T. Appelberg and H. Runström, '*Definition and location of silent environment'*, 17th International Congress on Acoustics, Rome, 2001.

31. Directive 2003/10/EC on the minimum health and safety requirements regarding exposure of workers to the risks arising fro Physical agents (noise), European Commission, www.hse.gov.uk/noise/issues.

The following documents were used in the compilation of this report but are not specifically referenced.

32. Department for Environment, Food and Rural Affairs, *'Towards a National Ambient Noise Strategy, A Consultation paper from the Air and Environmental Quality Division*', November 2001.

33. M Fillery, *Tranquillity and Relatively Quiet Areas*, Proceedings of IOA Autumn Conference 2002, November 2002. www.ioa.org.uk

34. R Murray Schafer, *'The Soundscape: Our Sonic Environment and the Tuning of the World',* Destiny Books, 1994, ISBN 89281 455.1

35. UK Quiet Pages, http://www.ukquietpages/tranquilareas

36. Rimmer C, *'The Diurnal Variation in Environmental Noise Levels,*' MSc Project Report, University of Derby, 2002

37. Fillery M, Griffiths J and Bermond R, *'The strategic role of relatively quiet areas'*, Proceedings of Euronoise 2003, Naples, 2003.

38. Miller NP, *'Status of the I-INCE initiative on recreational noise and progress on quantifying noise intrusions in parks'*, NOISE-CON 2001. Portland, Maine, 2001.

## 7. APPENDIX 1: QUIET AREAS INTEREST GROUP

Following on from a workshop at Euronoise 2003 an international interest group on quiet areas has been form. Membership of the group has expanded from the original attendees at the workshop and is open to all. Dr Mike Fillery is the groups convener and can be contacted at mike.fillery@symonds-group.com. A web based database has also been established and this can be accessed on www.symonds-projects.com/onlinesurvey.