A Method to Determine Reasonableness and Feasibility Of Noise Abatement at Special Use Locations

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I. INTRODUCTION

Most states have policies in place that determine whether noise abatement is necessary and reasonable/feasible for Type I projects. These policies mirror federal guidance and apply to various land uses near the proposed project. Special land use facilities such as parks, churches and schools are included in the policy as far as when abatement may be necessary (i.e. the Federal Highway Administration Noise Abatement Criteria), but the determination of whether the abatement is reasonable and/or feasible is not adequately addressed. A survey of state Departments of Transportation (DOT) indicated that states are dealing with this need for reasonable/feasible determination for special land uses, but do not have formal policy in place to address the issue. Often, it may be feasible to provide abatement for these special land uses but is it reasonable to use limited funds for noise abatement? A systematic procedure is needed to eliminate arbitrary decisions.

The purpose of this research was to develop a methodology for the Florida Department of Transportation (FDOT) that would aid FDOT in the development of a procedure for special land use cases. The proposed procedure will provide guidance for those individuals preparing environmental documents allowing a decision process using a systematic approach to determine whether abatement is reasonable for special land uses. The development process of the Reasonableness Matrix for special land uses is explained and an overview of the finalized policy along with details concerning the development of the methodology is presented. ***The update to this report was required to reflect the changes in cost reasonable factors currently used by FDOT and changes to the Census data for Florida. No other changes to the report were made that did not reflect the two factors noted above.***

II. TECHNICAL SUMMARY

Survey

The first phase of methodology development was to assess the current state policies concerning special land use. This was accomplished by mailing a survey to noise representatives from each state DOT. Additional surveys were mailed to other groups and individuals to develop more insight of the problem. For non-responding state DOTs, follow up telephone calls were made requesting completion of the survey. The survey was designed to determine whether any formal policies concerning special land use

existed. If there were none, the survey sought to ascertain what the respondents considered to be key items for a policy of this type. For example, question 7 of the survey asked the respondees to choose from a list of items those items they considered to be of importance when determining abatement feasibility and reasonableness. Question 8 asks the respondees to rank the items they chose in question 7. Question 8 was later used as a key indicator of which items should be included in the feasible/reasonable determination for special land uses. The survey also asked the respondees to provide some methodology for the items they chose as most important for this task. This information was invaluable in development of a matrix and methodology to assess the feasibility/reasonableness of a special land use site. The survey used for this research effort is included in Appendix A, while the list of responses is shown in Appendix B.

Survey Response

The content of the Reasonableness Matrix required a research effort to determine if any state currently had a Special Land Use Reasonableness policy. The appendix contains a listing of responses to each survey question. While all responses are included in Appendix B, only the most important responses are discussed. Thirty five states responded to the survey along with three environmental professionals. Results from two survey questions are summarized in Table 1.

Table 1. State Survey Responses

Question	**Yes**	**No**
Has your state had difficulty in determining reasonableness for special land uses?	18	17
Does your state have a policy for special land uses?	4[a]	31

[a]These policies were determined to be for residences

Table 1 indicates that about one-half of the states are dealing with the problem while the other one-half are having difficulties. Table 1 also shows there is a need for a formal noise abatement policy for special land uses. Four states reported they had a formal policy for special land uses, but upon review of their policies it was found that the policies were actually for residences. No states currently have a formal policy for special land uses and the majority of states responding have had difficulty in determining reasonableness for these land uses. Twenty seven respondents did not answer the question of how they determined reasonableness/feasibleness of special land uses. The remainder of the respondents generally stated that they evaluated special land use sites on a case by case basis.

Question 8 of the survey asked the respondees to list what they believed to be the top three criteria for determining abatement reasonableness. Table 2 contains a summary of the responses to this question.

Table 2. Top Criteria for Abatement Reasonableness (DOT Response)

Criteria	Responses
Cost	25
Approach or exceed Noise Abatement Criteria (NAC) levels	18
Noise Level Increase	15
Type of Use	9
Amount of Use	7
Development after Highway date of public knowledge	6

Table 2 indicates that the respondents consider abatement cost to be the most important criteria for reasonableness. The second highest number of survey responses pertained to whether the site approached or exceeded the noise abatement criteria levels. Noise level increase at the site received the third highest response rate. The type of use of the site and the amount of use that the site received were also mentioned by several respondees as important items. Several respondents stressed the importance of development of the site after date of public knowledge of the transportation project and its relevance to reasonableness. Question 9 asked the respondents to suggest a methodology to determine reasonableness for the top items they selected in Question 8. These top items and the suggested methodologies were incorporated in the first draft feasible/reasonable decision process as described below.

Reasonableness Matrix First Draft

The results shown in Table 2 and the suggested methodologies from Question 9 were used as a starting point to develop the first Reasonableness Matrix . In addition, fifteen states provided their reasonable/feasible policies for residences. The residence policies of the fifteen states were reviewed and summarized along with the responses to other survey questions. These state policies identified several common themes among states such as barrier cost per benefited receiver. In other cases, some state policies included reasonableness items similar to those needed for the special land use policy. The guidance of existing state and federal policies, the survey responses, and the guidance provided by the FHWA regulations (Code of Federal Regulations part 772; 23CFR772), were used along with the guidance of FDOT and the author's experience to develop the first draft Reasonableness Matrix for special land uses.

The first draft Reasonableness Matrix was designed to include the top criteria items chosen by the DOT survey respondents along with other items that were considered to be

important for reasonableness. The decision matrix was designed so that the top items shown in Table 2 were given higher weighting than other matrix items in the decision process. This methodology produced the first draft Feasible/Reasonableness matrix shown in the Figure below. The matrix includes items that are given higher weighting than others such as whether the site is used daily as opposed to weekends only. The final answer was a numeric score. A high positive value represented a very reasonable and feasible project. A score near zero represented a transitional area if abatement was reasonable or feasible. A low negative value showed the abatement not to be reasonable and/or feasible. The matrix was prefaced by several notes to the preparer that provided information on how to complete the matrix and perform the noise analysis for the site. The matrix also included several "FATAL" items that direct the preparer to stop the analysis since abatement is deemed not feasible or unreasonable at that point. This draft matrix was submitted to the Florida Department of Transportation Noise Task Team for review.

Comments Received on First Draft Reasonableness Matrix

The FDOT Noise Task Team reviewers suggested several useful modifications to the original Reasonableness Matrix. These modifications included better clarification of the barrier cost matrix items and a different method of scoring the matrix responses. Table 3 lists the important review comments from the Noise Task Team.

Table 3. Noise Task Team Review Comments

Noise Task Team Review Comments
Owner's opinion and owner's desires are the same item
Who are the owners in question?
Remove item about traffic volume
Clarify the barrier cost calculation
Replace the dB(A) increase items with dB of insertion loss (IL) values
Revise weighting of weekend vs. weekday use
Date of public knowledge item is weighted too lightly and it addresses two issues, antiquity and local controls
Cost as percentage of total project was considered inappropriate
Percentage of land protected by abatement requires more detail or should be deleted
"cost" of barrier aesthetics is not discernible in a barrier cost since this is an average value

Figure 1. Draft Reasonableness Matrix

***Analysis notes to preparer:**

1. Place receptors only at areas of frequent human use, for example a park bench or pavilion. This excludes areas such as the edge of the property when not used, bar ditches, etc.
2. Parking lots are not to be considered valid receptors locations.
3. Complete the matrix to determine if the special land use is reasonable and feasible.
4. If Reasonableness Matrix score is negative, then abatement is not reasonable and feasible. A positive score indicates that the project may be reasonable and feasible. The degree of the number indicates the degree of strength of the evaluation (i.e., a positive 4 is considered more reasonable and feasible that a value of positive 1). Any FATAL item results in an immediate exit from the matrix and is not considered to be reasonable and/or feasible.

Special Use Facility Reasonable/Feasible Matrix

Item	Criteria	Yes	No
1	Can abatement provide 5 dB(A) protection for benefited receivers?	0	FATAL[1]
2	Is the NAC level approached or exceeded at site?	+1 (goto #4)	-1 (goto #3)
3	Is the dB(A) increase >10 dB(A)?	+1	FATAL[1]
4	Do the owners want abatement?	+1	FATAL[1]
5	Does the owner consider abatement to be of substantial benefit?	+1	FATAL[1]
6	Is the site a cemetery?	FATAL[1]	0
7	Does time of use correspond to peak traffic volumes?	0	see below[2]
8	[3]Is barrier cost/receptor hour< $1000	+1	-1
9	dB(A) Increase < 5 dB(A)	-1	0
10	dB(A) Increase 5- 10 dB(A)	+1	0
11	dB(A) Increase >10 dB(A)	+1	0
12	dB(A) Increase > 15 dB(A)	+1	0
13	Is the site used daily?	+2	0
14	Is the site used more than 2 days per week?	+1	-1
15	Is the site used weekends only?	-1	0
16	Site Developed after date of public knowledge?	-1	0
17	Is barrier cost<=10% of total project cost?[4]	0	-2
18	Does abatement detract from aesthetics?	-1	+1
19	Will barrier aesthetics increase cost?	-1	+1
20	Is the site NAC category A?	+2	0
21	Is the site NAC category B?	+1	0
22	Is the site NAC category C?	-10	0
23	Is the site NAC category D?	-12	0
24	Is the site NAC category E and indoor noise levels are of extreme importance? (i.e., school, church)	+2	0
25	Is percentage of impacted land that can be provided 5 dB(A) of abatement >10 % ?	+1	-1
26	Amount of land exceeding NAC where activity exists > 10%?	+1	-1
	Site Score (sum all answers unless FATAL item noted)		

[1]Fatal = Exit Matrix, abatement not reasonable and/or feasible.
[2]Perform analysis with traffic volume corresponding to time of use for all following questions.
[3]Calculated by dividing the amount of time for special facility use, on day of use, by abatement cost.
[4]This applies to Type I projects only.

Development of Final Draft Methodology

The matrix was revised to address the comments listed in Table 3 as considered appropriate. The draft matrix of Figure 1 attempted to include both feasibility and reasonability issues in the same matrix and present varying degrees of reasonable/feasible by the change of the final answer around zero. This appeared to cause some confusion and for this reason the feasibility items, known as the "FATAL" items were taken out the of matrix and put into a separate flow chart format. The flow chart format provided a visual depiction of the feasibility issues. If certain criteria are not met in the Feasibility Flowchart, such as minimum barrier insertion loss, the flowchart directs the preparer to stop the analysis and declares abatement not feasible. The flowchart and its items are discussed in detail later in this report.

The Feasibility Flowchart also addresses the issue of off peak use of the site and instructs the preparer to subtract a decibel value from the predicted receptor levels if the site is operated during off peak hours. Questions 9-12 of the draft matrix assessed reasonableness based on the noise level increase at the site. This issue is now addressed in the Feasibility Flowchart. Questions 4 and 5 of the draft matrix which addressed opinions and desires of the "owners" of the site are now also addressed in the Feasibility Flowchart as is the date of public knowledge reasonableness item, question 16.

The items included in questions 13-15 evaluated site usage during the week. These questions are included in the Feasibility Flowchart which subtracts a value from the predicted noise level at the receptor if the site is operated primarily during off peak traffic hours.

"Abatement cost factor"

Abatement cost had the highest priority according to the survey when considering reasonableness. The first draft Matrix contained a cost value that included many considerations and concepts such as amount of use at the special facility, size of a barrier necessary to abate the traffic noise and activity areas protected. This led to a cost scheme that takes into account the time that people actually use the site, the areas receiving significant abatement, and equates a cost to the barrier size. The results were development of a special land use "abatement cost factor".

The methodology of determining the "abatement cost factor" uses currently accepted residential abatement cost scenarios and extrapolates that information into a cost for special land use sites. Development of the "abatement cost factor" followed these steps:

1. Use FDOT accepted barrier cost per residence ($42,000).
2. Assume residences are used 24 hours/day.
3. Determine average frontage of a residence (100 ft; 30.5m).
4. Determine the average height of a barrier (14 ft; 4.3m).

5. Use the average frontage of a residence and barrier height to determine the area of a hypothetical barrier per residence frontage.
6. Determine state average number of people per dwelling unit.
7. Use these data to determine a criteria barrier cost per hour of usage and area of barrier.

The values shown were chosen from current FDOT policy, FDOT guidance, Census data, and the experience of the authors.

The "abatement cost factor" derivation process begins by applying the anticipated FDOT accepted cost of abatement per benefited residence of $42,000 per residence. Next, steps are taken to translate this cost from a residential scenario to one that can be applied to other land uses. The concepts of site usage and the overall size of the barrier are important aspects of whether the barrier is considered reasonable. The "abatement cost factor" derivation quantifies typical residential usage and considers a hypothetical barrier section that would occupy the frontage of a typical residence. Note that this is purely a hypothetical situation and does not imply that this barrier section would provide adequate abatement at the residence, rather it estimates the size of a barrier that would occupy the frontage property of a typical residence.

The typical residential usage and hypothetical barrier size per residence are combined with the FDOT barrier cost per residence to provide a basis for the "abatement cost factor" based on person hours of usage and barrier area. Assumptions were made on input values specific for Florida that may not be sufficient for other states. If better data are available replacement may be made depending on administrative decision. Individual states may also change values to be state specific.

The typical residence usage is derived from 2000 Census data for the state of Florida which reports that the number of persons per residence averages 2.46 persons per residence. This average value of 2.46 persons per residence was used to derive the person-hours of usage for a typical residence. It was assumed that the residences are in use 24 hours per day. It was also assumed that all individuals should receive equal treatment. These data and assumptions lead to the residence usage of 2.46 persons per residence per day and these persons use the residence for 24 hours per day. The FDOT barrier cost per benefited residence is divided by the number of persons per residence per day and the hours of usage per day which gives a preliminary "abatement cost factor" based on hours of usage. This calculation is depicted below in English units.

$$\textbf{preliminary "cost factor"} = \frac{\$42k}{residence} * \frac{\text{residence}}{2.46\text{persons}} * \frac{\text{useage}}{24\text{hours}} = \textbf{\$711.38 /person-hr} \quad (1)$$

Equation (1) provides a preliminary "abatement cost factor" based on hours of usage only. Notice that if this "abatement cost factor" were derived for a special land use site using the hours of usage in Equation (1), a lower "cost factor" occurs as the number of on site usage hours increases. This preliminary "abatement cost factor" varies inversely with hours of usage. The preliminary "abatement cost factor" must be adjusted to

account for actual size of the proposed barrier otherwise a barrier of any size will be deemed reasonable as long as the site has high usage.

Barrier size is included in the "abatement cost factor" by first determining the hypothetical size of a barrier that would occupy the frontage of a residence. The assumption is made that a typical residence has 100 feet (30.5 m) of frontage and that an average barrier has a height of 14 feet (4.3 m) in Florida. These two values are used to obtain the surface area of this hypothetical barrier and are then applied to the "abatement cost factor" equation as shown below in English units.

"abatement cost factor" =

$$\frac{\$42k}{residence} * \frac{\text{residence}}{2.46\text{persons}} * \frac{\text{useage}}{24\text{hours}} * (14\text{ft}*100\text{ft}) = \mathbf{\$995{,}935\ /\text{person-hr/ft}^2} \quad (2)$$

This further derived "abatement cost factor" contains additional units of square feet (or square meters) and now considers actual barrier size. **Once again, this "abatement cost factor" is simply a derivation of a value that can give a comparative measure of cost associated with the proposed abatement. This "abatement cost factor" should not be confused with having any direct relation to real barrier costs such as a dollar value per square foot of a barrier.**

At this point we have taken the FDOT barrier cost per residence and translated this cost into a factor that accounts for site usage and actual barrier size. This "criteria abatement cost factor" can now be compared to an "abatement cost factor" derived for special land use sites.

Abatement cost is considered reasonable if the calculated "abatement cost factor" is below the "criteria abatement cost factor" of Equation (2) [\$995,935 /person-hr/ft^2 or \$92,647 /person-hr/m^2].

This revised abatement cost criteria combines several related Reasonableness Matrix items in a simplified fashion.

It is important to note that the revised Reasonableness Matrix retains the percentage of land protected by abatement criteria by including only those individuals that receive at least a 5 dB(A) benefit from abatement. This percentage is based on total land use area of the site. Abatement at the site is more reasonable when the protected land area encompasses greater numbers of persons using the site. The section "Receiver Placement for Noise Impact Analysis" contains a detailed explanation of two methods of determining the number of "benefited" receivers.

The revised Reasonableness Matrix has a worksheet format that prompts the user to enter site specific values and perform calculations. The worksheet leads the user to a final reasonableness decision.

III. PROPOSED FINAL DRAFT METHODOLOGY

As previously noted, the process of determining abatement feasibility/reasonableness for a special land use is divided into two parts. The first is to assess feasibility of abatement for the site, the second part of the analysis is abatement reasonableness. This methodology uses a worksheet/matrix process whereby the preparer can systematically perform a step by step analysis of the special land use site. The preparer first establishes feasibility of abatement with a simple flowchart. The results of the Feasibility Flowchart either specify that the preparer cease the analysis and that no abatement is required or possible. If the barrier is feasible, the preparer should complete the Reasonableness Matrix. The Reasonableness Matrix leads the preparer through a list of questions and calculations that establish if abatement is reasonable based on criteria such as cost and usage of the site. The Feasibility Flowchart/Reasonableness Matrix are designed to be completed with a minimum of effort and extra information.

The Feasibility Flowchart follows the criteria for feasibility already established for Type I projects. It is assumed that feasibility issues such as safety, constructability, drainage and other items from Part 2, Chapter 17 of the FDOT Project Development and Environment Manual are addressed separately. The Feasibility Flowchart also contains additional items such as the Federal Highway Administration NAC that if not exceeded are considered “FATAL” which immediately ends the Feasibility/Reasonableness process. The Feasibility Flowchart also instructs the preparer to end the analysis and deem abatement infeasible if the responses to these questions do not follow previously established FDOT guidelines.

The second part of the site assessment is to determine reasonableness of providing abatement at the site. Reasonableness is the key to the whole process for special land uses. The Reasonableness Matrix assesses site specific criteria to determine if abatement is reasonable at the special land use site. The Reasonableness Matrix leads the preparer through a calculation of an “abatement cost factor” which is based on dimensions of the proposed barrier and usage of the site. This calculated special land use “cost” is evaluated along with other items to decide if abatement at the site is reasonable.

The Feasibility Flowchart and Reasonableness Matrix are shown in Figures 2a and 2b.

IV. ANALYSIS DEFINITIONS AND EXAMPLES

This section provides some detailed explanations of items necessary to complete the Feasibility Flowchart and Reasonableness Matrix.

Figure 2a. Feasibility Flowchart

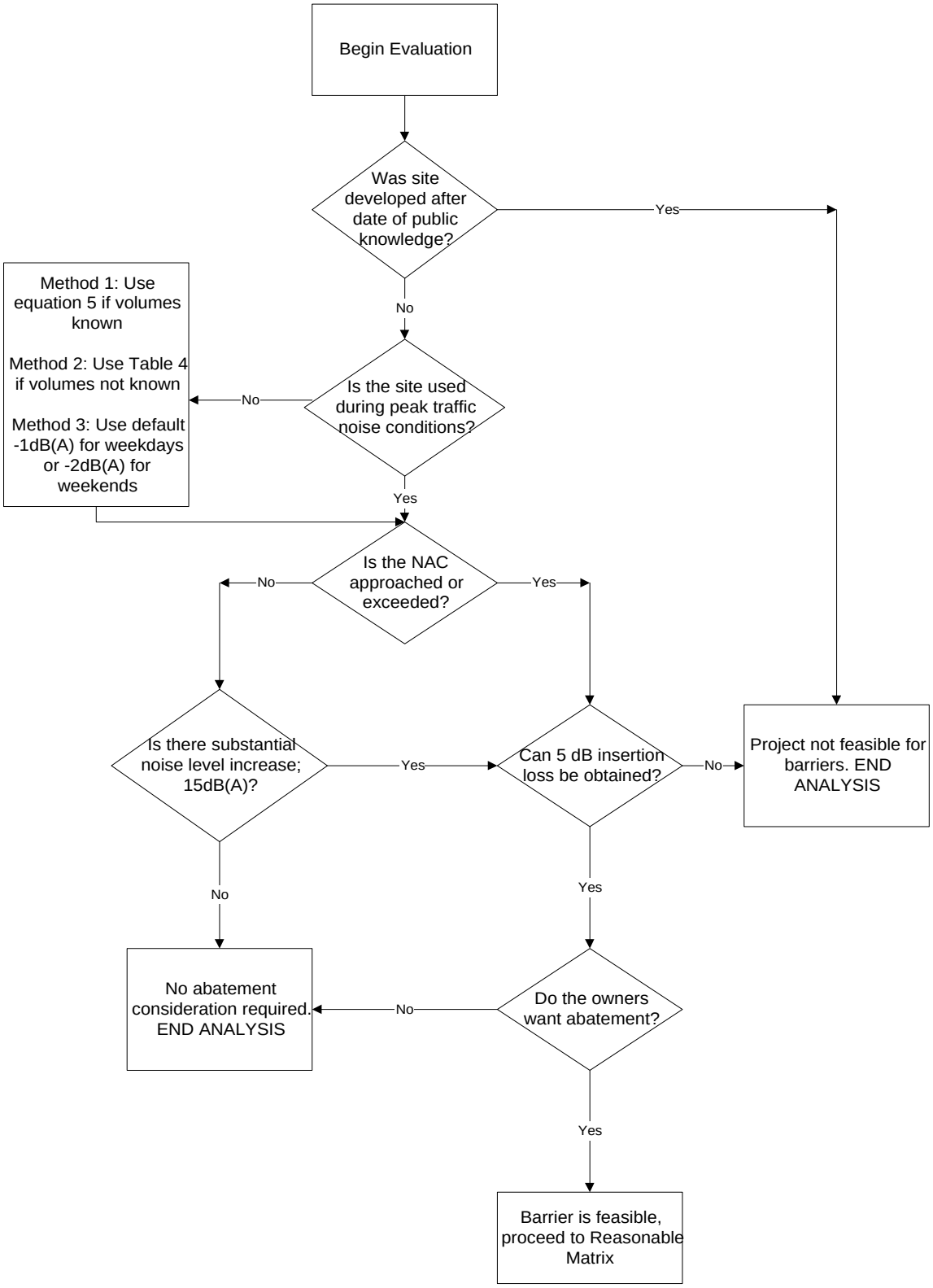


Figure 2b. Reasonableness Matrix

Item	Criteria	Input (English units)	Input (SI Units)
1	Enter length of proposed barrier	ft	m
2	Enter height of proposed barrier	ft	m
3	Multiply item 1 by item 2	ft^2	m^2
4	Enter the average amount of time that a person stays at the site per visit	hours	hours
5	Enter the average number of people that use this site per day that will receive at least 5 dB(A) benefit from abatement at the site	people	people
6	Multiply item 4 by item 5	person-hr	person-hr
7	Divide item 3 by item 6	ft^2/person-hr	m^2/person-hr
8	Multiply $42,000 by item 7	$/person-hr/$ft^2$	$/person-hr/$m^2$
9	Does item 8 exceed the "abatement cost factor" of: English units = $995,935/person-hr/$ft^2$? or SI units = $92,647/person-hr/$m^2$?		
10	If item 9 is no, abatement is reasonable		
11	If item 9 is yes, abatement is not reasonable		

Definition of Special Land Use

The term "Special Land Use" applies to those land uses that are not residential. This type of land use does not include dwelling residences or land use category C as defined by 23 CFR Part 772. Land use category D would only be evaluated if unusual land uses occur. Some examples of special land uses are shown below.

- church
- school
- park
- amphitheater

Receiver Placement for Noise Impact Analysis

Receiver placement for special land use sites is similar to that of the residential analysis. Receivers should be placed at the closest location to the highway right of way (ROW) line where outdoor activity normally occurs to determine if the NAC is exceeded. In addition, receivers should be placed at locations away from the ROW line to determine the extent of impact and to consider sensitive receptors if the NAC are exceeded at the ROW line. The definition of a noise sensitive receiver is "any property where frequent exterior human use occurs and where a lowered noise level would be of benefit. In those situations where there are no exterior activities affected by the traffic noise, the interior of the building shall be used to identify a noise sensitive receiver."[1].

In some cases, the decision to place receivers may be simple, as in the case of an amphitheater. In the case of a park, it may be more complex since people can use the park over a wide range of area. The reasonableness methodology must address this concern because it asks questions concerning sound levels at all site receivers. The following general guidance may be used to determine receiver placement and the number of receivers that receive 5 dB insertion loss (IL) with a barrier in place at special land use sites.

a. Parking lots should not be considered for receiver placement.

These are not noise sensitive areas.

b. Define the areas of frequent human activity for the special land use site and place receivers.

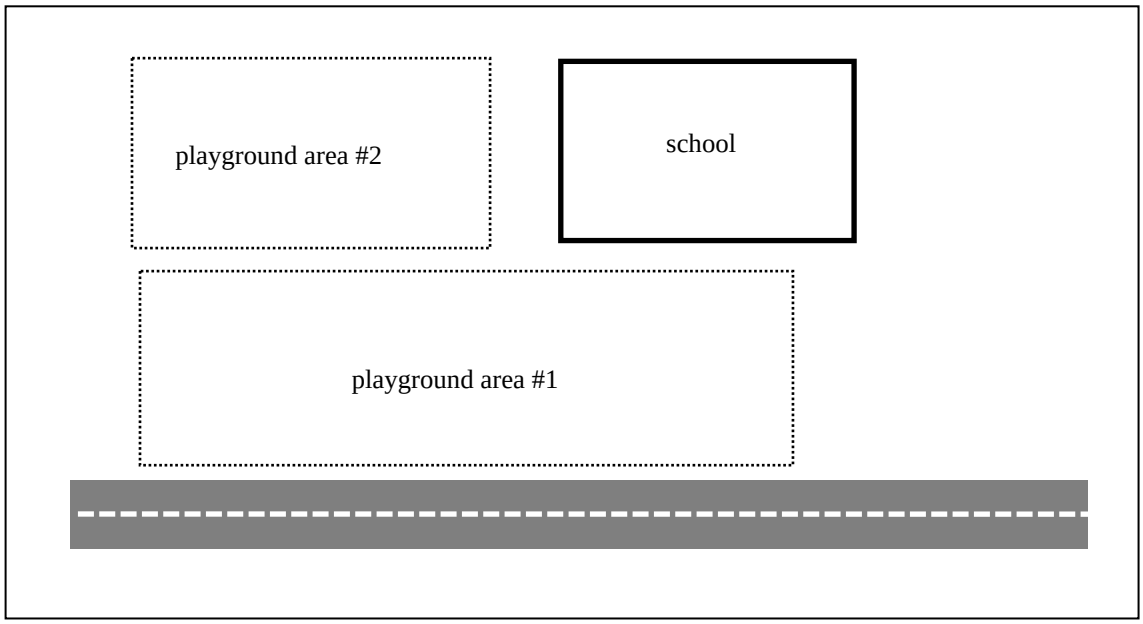
This includes areas that people use for a significant period of time. This does not usually include transition areas from parking facilities to other facilities.

In some cases, this demarcation is obvious such as playgrounds at schools and pavilions or beaches at parks. The following examples illustrate the demarcation of frequent use areas at special land use sites.

Consider the school site shown in Figure 3.

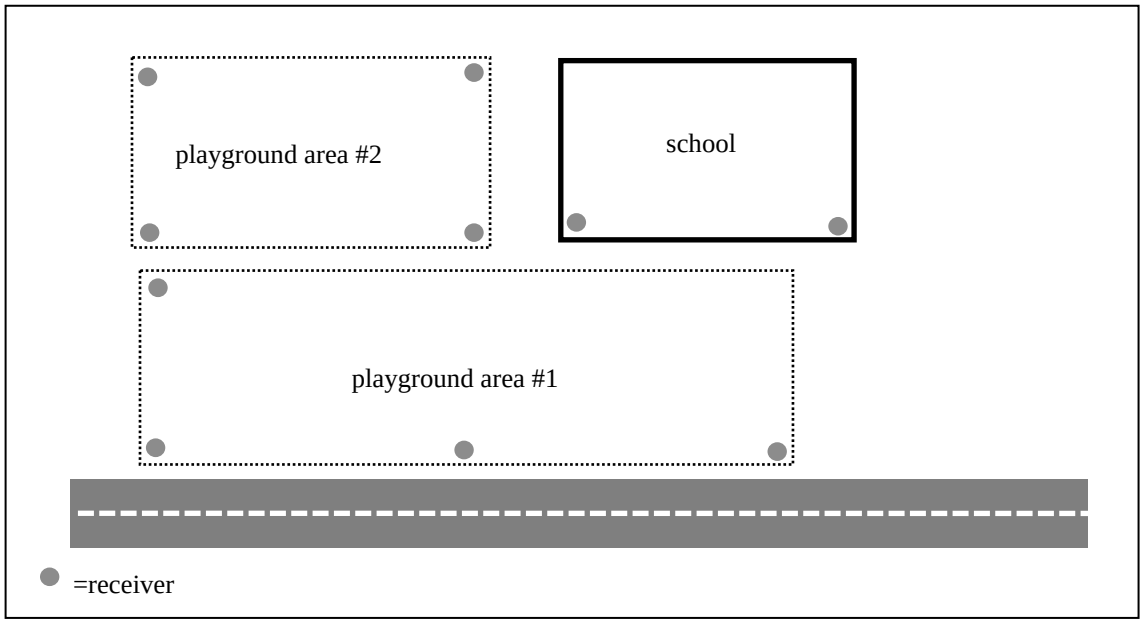
[1] Florida Department of Transportation Project Development and Environment Manual, Part 2, Chapter 17.

Figure 3. Areas of Frequent Human Activity at a School



In the above example, both playground areas are deemed to have frequent human activity (see Figure 3) and so both of them are marked (marked with a dashed boundary) as areas where receivers can be placed. The next step is to place the receivers, first near the ROW line to determine if the NAC is approached or exceeded and if so, at greater distances from the roadway to determine the extent of exceedance. This is shown in Figure 4.

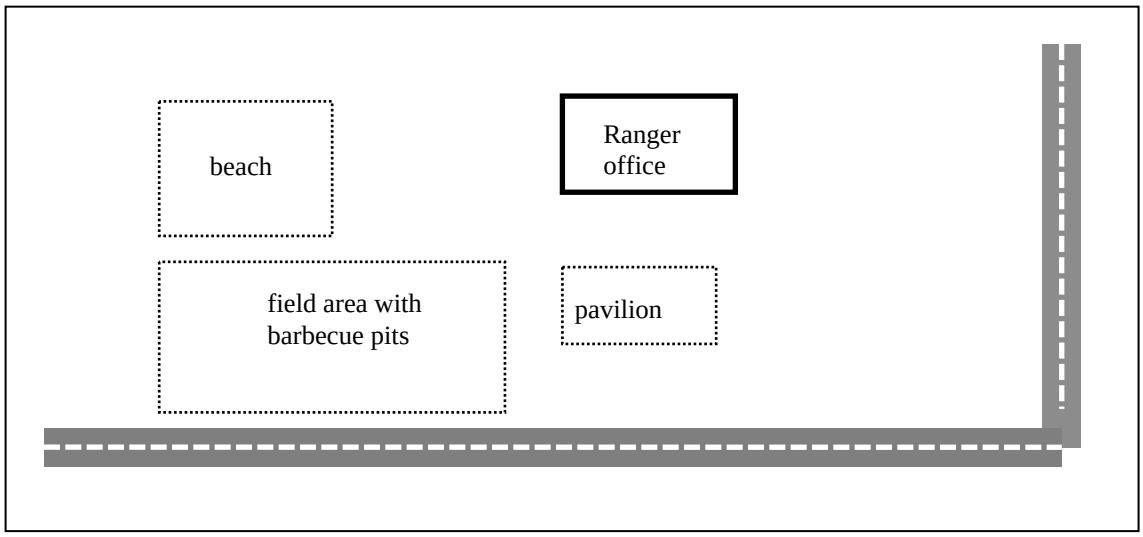
Figure 4. Receiver Placement at a School



It should be noted that the receivers in Figure 4 at the boundaries of the nearest frequent activity area and closest to the ROW line were evaluated first to determine if the NAC is exceeded. If indoor use was considered, receivers should be placed at the building and transmission loss considered. The analysis is conducted with these receivers to determine impact from the nearby road, the interior receiver sound levels are further abated by the building and the common value of 20 dB(A) attenuation is used in this case.

Receiver placement for the case of a public park is now discussed. The park example shown in Figure 5 indicates that we have chosen three areas that meet the criteria of frequent human activity. These areas include a pavilion area , beach and a large open area equipped with barbecue pits. Notice that in both examples, the school and the park, we have not designated parking lots as potential receiver areas. Now that we have designated the areas of the site where frequent activity exists, we can proceed to the next step of specifying the receiver locations.

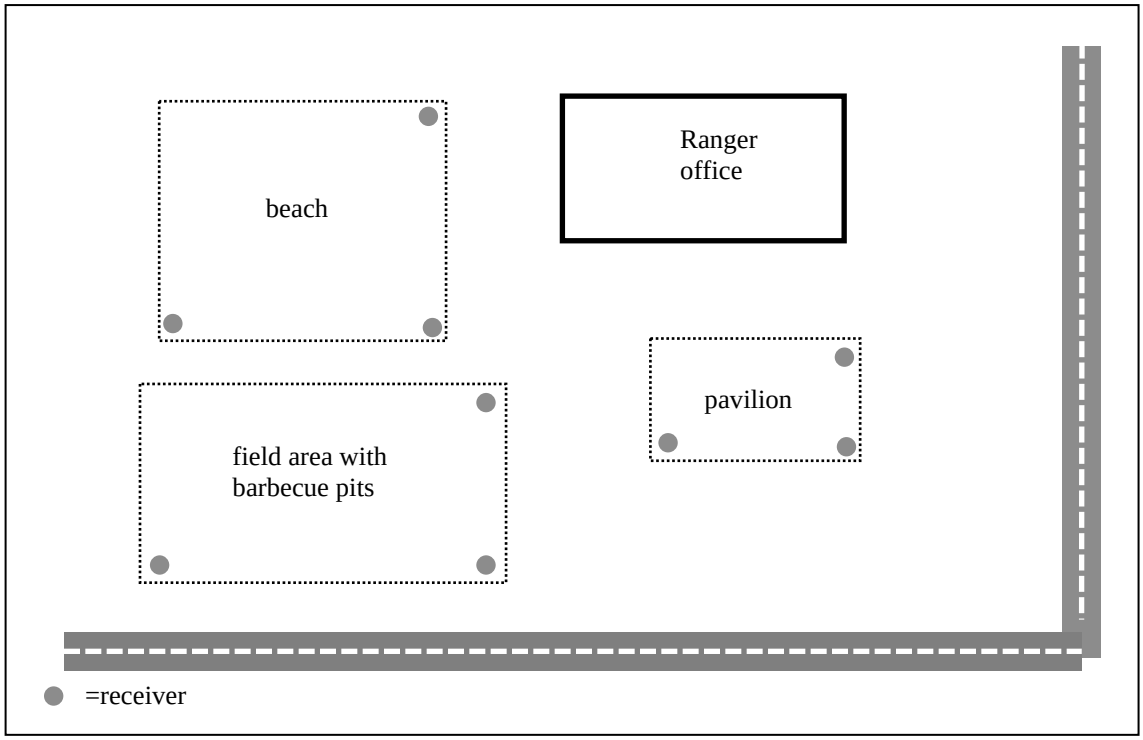
Figure 5. Areas of Frequent Human Activity at a Park



The park example of Figure 5 has two roadways as noise sources and requires additional receivers as shown in the Figure. The receivers are again placed at the boundaries of the frequent activity areas near the ROW line to determine if the NAC is approached or exceeded. The other receiver locations are then only needed if an exceedance occurs to determine the extent of impact.

Figure 6 shows the receiver placement for the public park example of Figure 5.

Figure 6. Receiver Placement at a Park



We now discuss receiver placement for the case of a church. The church example shown in Figure 7 indicates that we have chosen one area that meets the criteria of frequent human activity.

Figure 7. Area of Frequent Human Activity at a Church

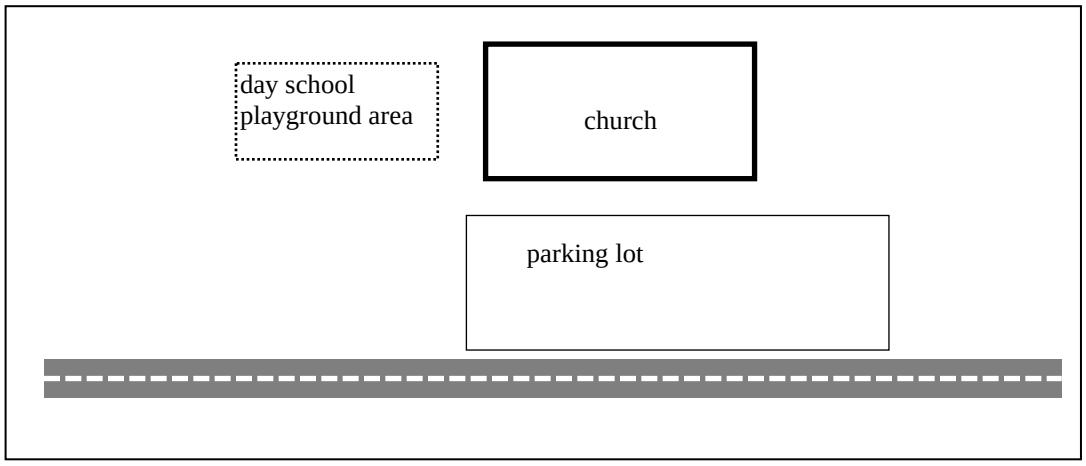
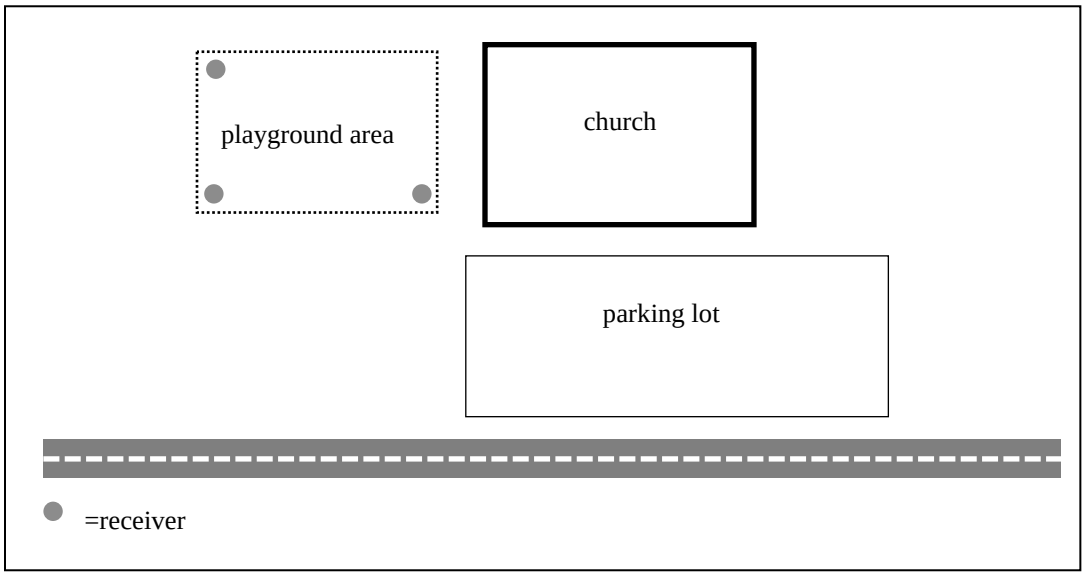


Figure 7 shows that the only area of frequent outside human activity is the playground area. This church site also contains a large parking lot which we do not consider for receiver placement since it is not a noise sensitive area.

The next step is to place receivers on the designated areas. Figure 8 depicts the receiver placement for this church site. Receivers are placed first near the ROW line to determine if the NAC is approached or exceeded and if so, at greater distances from the roadway to determine the extent of exceedance. Figure 8 shows two receivers at the boundary of the playground area closest to the ROW line and a receiver further back to evaluate extent of impact.

Figure 8. Receiver Placement at a Church

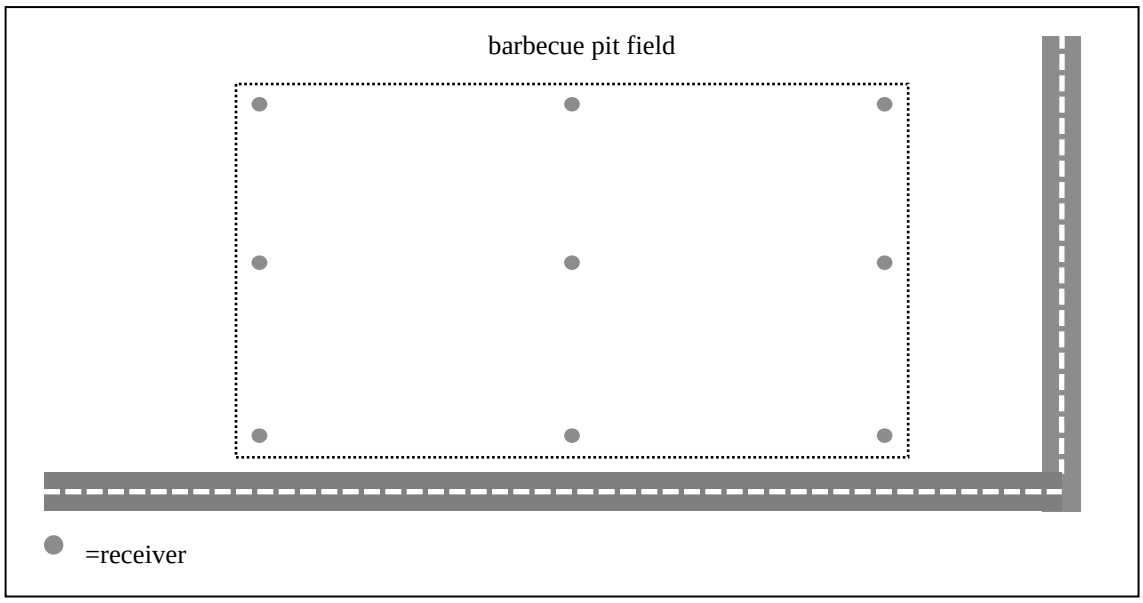


We have discussed receiver placement to determine the extent of noise impact on a site. Once impact (whether NAC levels are approached or exceeded) has been assessed and confirmed, abatement is proposed. At this point there is a further need to evaluate receivers that will benefit from proposed abatement. Benefited receiver determination is based on the amount of people that use areas protected by abatement. This topic is discussed in the next section.

c. Place Receivers to Evaluate Barrier Insertion Loss

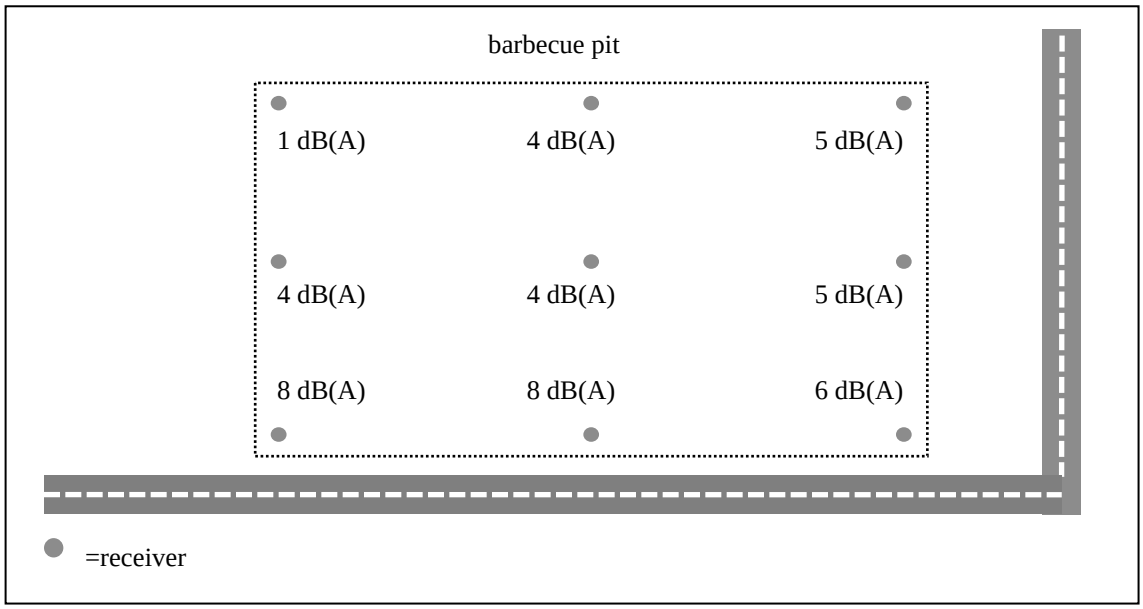
The process of adding additional receivers placed at successive distances from the noise source to evaluate insertion loss is needed for determination of the "benefited receivers" mentioned in the Reasonableness Matrix item 5. A benefited receiver is a receiver that receives at least a 5 dB(A) noise level reduction with the proposed abatement in place. Receivers placed in a "grid" fashion is the most effective method but requires the most receiver placement. Using noise contours is also very effective. An example of receiver placement to establish the number of benefited receivers is shown in the Figure below.

Figure 9. Receiver Placement to Evaluate Barrier Insertion Loss



The grid of receivers shown in Figure 9 can provide an indication of the portion of the area of frequent human use that receives at least 5 dB(A) insertion loss from a proposed barrier. Let us assume that a noise impact assessment for this site predicted the insertion loss values noted in Figure 10.

Figure 10. Insertion Loss at Receiver Locations



The insertion losses shown in Figure 10 indicate that five of the nine receivers meet the 5 dB(A) insertion loss criteria. To relate this information back to the number of actual receivers in the park we need to know the average daily persons that use this field area. If exact numbers of people are known by location, these should be used. If there is no

information on use areas, a default "Approximate Method" would be to assume equal usage throughout the area.

d. Approximate Method of Benefited Receiver Determination

Assume usage of the site is evenly distributed. As such, that portion of the site receiving more than 5 dB(A) insertion loss is protected and that fraction of people receiving protection is equal to the fraction of land protected. With that assumption we can determine the number of benefited receivers to be:

$$\text{Benefited Receivers} = PLP * ADP \quad (3)$$

where: PLP = fraction of total land area protected [5 dB(A) IL or more]
ADP = average daily persons using the area

The fraction of land use is derived by evaluation of the receiver grid such as that shown in Figure 10. A more exact method of determining benefited receivers can be used if more information is known about the site.

e. More Exact Method of Benefited Receiver Determination

The percentage of land protected, that is receiving 5 dB(A) or more of insertion loss, is determined from the receiver grid evaluation shown in Figure 10. A more exact number of benefited receivers can be determined if the amount of people that use the protected areas is known. The number of benefited receivers can then be determined by summing the number of people per day that use the protected areas of the special land use site.

$$\text{Benefited Receivers} = \Sigma \text{ persons using protected areas} \quad (4)$$

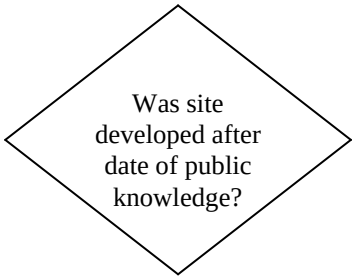
This number of benefited receivers, whether by exact location or fraction of total land protected and average daily persons using the site, is then used for item 5 of the Reasonableness Matrix.

Flowchart/Matrix Items

The following discussion provides additional information for each of the Feasibility Flowchart and Reasonableness Matrix items.

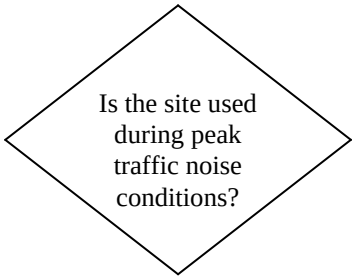
FEASIBILITY FLOWCHART ITEMS

Feasibility Item #1



It is less reasonable to provide abatement for a site that was developed after public knowledge of the roadway construction. The developers were aware of the increased noise and chose to build at the site regardless.

Feasibility Item #2:



If the site is operated primarily during off peak traffic conditions it is not reasonable to predict sound levels based on peak traffic conditions. There are three possible ways to adjust for off peak traffic volumes and they depend on the amount of information known by the preparer.

Method #1: Direct Calculation if Off Peak Volumes are known. The peak hour levels can be adjusted by use of the following formula if the off peak volumes are known:

$$\text{Leq (off peak hour)} = \text{Leq (peak hour)} + 10\log\frac{N}{N_o} \qquad (5)$$

where: N_o = peak hour traffic volume
N = off peak traffic volume

Method #2: Adjustment Table if Off Peak Volumes not known. Table 4 contains a list of adjustment factors for peak traffic volume data using quick response techniques when the reduced traffic volume is not known.

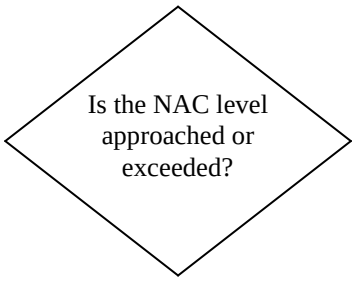
Table 4. Traffic Volume Adjustment Factors for Weekdays[2]

time	hr/peak hr	10*log(hr/peak hr) dB(A)
5-9 am	0.55	-2.6
9 am-2 p.m.	0.64	-1.9
2 p.m.-8 p.m.	1.00	0
8 p.m.-12 p.m.	0.29	-5.4

It should be noted that this correction should not be used for Interstate highways because of the high truck volumes and relatively constant noise levels.

Method #3: Default dB(A) Offset for Off Peak Use. Realizing that only peak traffic data may be available, a default correction can be applied by subtracting 1 dB(A) from predicted levels if the site is operated off peak during the week or 2 dB(A) from predicted levels if the site is operated primarily on the weekend. If a site is operated off peak during the week and also on weekends, subtract 1 dB(A) from predicted noise levels. **It should be noted that this correction should not be used for Interstate highways because of the high truck volumes and relatively constant noise levels.**

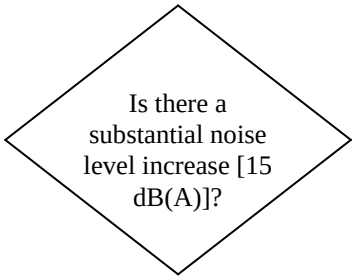
Feasibility Item #3:



23CFR772.5(g) states that traffic noise impacts are those that approach or exceed the Noise Abatement Criteria for the site or when the predicted noise levels substantially exceed the existing noise levels and in these cases abatement must be considered. Feasibility Flowchart items #4 and #5 address this requirement. If the predicted noise levels at the site approach or exceed the NAC then the preparer proceeds to flowchart item #5, if not then the preparer must answer the substantial increase criteria question located in flowchart item #4.

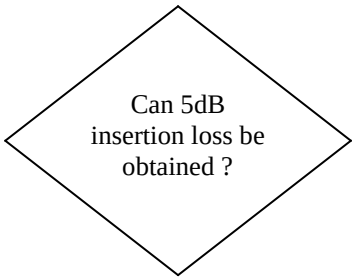
[2]Supporting data for off peak traffic volume found in "An Analysis of Urban Area Travel by Time of Day", January 1972, FH-11-7519.

Feasibility Item #4:



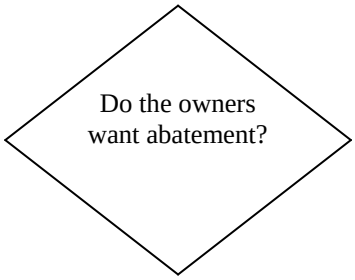
This item completes the "or" statement of 23CFR772.5(g) that states that traffic noise impacts are those that approach or exceed the Noise Abatement Criteria for the site or when the predicted noise levels substantially exceed the existing noise levels. If the predicted sound levels for the site are greater than 15 dB(A) over the existing levels then the preparer continues the Feasibility analysis, otherwise the site is deemed not appropriate for abatement.

Feasibility Item #5:



This item is included in Chapter 17 of the FDOT PD&E manual. In addition, 23CFR772.11(d) states that "when noise abatement measures are being considered, every reasonable effort shall be made to obtain substantial noise reductions." The PD&E manual interprets "substantial noise reduction" as an effort to reduce traffic noise impacts at benefited receptors by 10 decibels or more if possible, with a minimal acceptable level of reduction at no less than 5 decibels. If this 5 dB criteria cannot be met the analysis is finished because abatement is not feasible.

Feasibility Item #6:



The owners of the property (i.e. church administrators or State Park officials) are those persons that most closely fit the title of owners of the property. If the abatement measure is unwanted there is no further analysis required. This flowchart item is meant to include

all issues of owner opinion about abatement. If the owners are in favor of the abatement measure this flowchart item directs the preparer to proceed to the Reasonableness Matrix.

REASONABLENESS MATRIX ITEMS

The Reasonableness Matrix asks the preparer to input site specific data into the worksheet and perform simple calculations that result in an "abatement cost factor" for the site that is compared to a criteria value. Abatement at the site is reasonable if the "abatement cost factor" is below \$995,935 /person-hr/ft^2 or \$92,647 /person-hr/m^2 otherwise it is deemed not reasonable. **This abatement cost factor does not relate to the actual cost of constructing the barrier but is simply a number that normalizes the analysis, permitting comparisons.**

Reasonableness Item #1:

Item	Criteria	Input (English units)	Input (SI Units)
1	Enter length of proposed barrier	ft	m

The user is instructed to enter the length of the proposed barrier in the space provided. The user can enter dimensions in either English or Metric units.

Reasonableness Item #2:

The user is instructed to enter the height of the proposed barrier in the space provided. The user can enter dimensions in either English or Metric units.

Item	Criteria	Input (English units)	Input (SI Units)
2	Enter height of proposed barrier	ft	m

Reasonableness Item #3:

Item	Criteria	Input (English units)	Input (SI Units)
3	Multiply item 1 by item 2	ft^2	m^2

Multiply the input values from items 1 and 2 to determine the area of the proposed barrier.

Reasonableness Item #4:

Item	Criteria	Input (English units)	Input (SI Units)
4	Enter the average amount of time that a person stays at the site per visit	hours	hours

This item is the first of two items that determine the amount of use that a site receives. Enter the average time that a typical person would stay on site. The examples that follow give some estimates of average time that people may spend at certain sites.

Reasonableness Item #5:

Item	Criteria	Input (English units)	Input (SI Units)
5	Enter the average number of people that use this site per day that will receive at least 5 dB(A) benefit from abatement at the site	people	people

This item can be evaluated in two different ways. An exact number of "benefited" receivers can be determined if the user has detailed information about the locations of frequent human use and the number of people that typically use these areas. An approximate number of "benefited" receivers can be made if little information is known about the site and the population density of the site. This approximate method is discussed in detail in the section of this report entitled "Receiver Placement for Noise Impact Analysis" and is summarized below.

Approximate Method of Benefited Receiver Determination. Assume usage of the site is evenly distributed. As such, that portion of the site receiving more than 5 dB(A) insertion loss is protected and that fraction of people receiving protection is equal to percent of land protected. With that assumption we can determine the number of benefited receivers to be:

$$\text{Benefited Receivers} = PLP * ADP \quad (3)$$

where: PLP = fraction of total land area protected [5 dB(A) IL or more]
ADP = average daily persons using the area

The percent of land use is derived by evaluation of the receiver grid such as that shown in Figure 10. A more exact method is presented next.

More Exact Method of Benefited Receiver Determination. The percentage of land protected, that is receiving 5 dB(A) or more of insertion loss, is determined from the receiver grid evaluation shown in Figure 10. A more exact number of benefited receivers can be determined if the amount of people that use the protected areas is known. The number of benefited receivers can then be determined by summing the number of people per day that use the protected areas of the special land use site.

$$\text{Benefited Receivers} = \Sigma \text{ persons using protected areas} \quad (4)$$

This number of benefited receivers, whether by exact location or fraction of total land protected and average daily persons using the site, is then used for item 5 of the Reasonableness Matrix.

Reasonableness Item #6:

Item	Criteria	Input (English units)	Input (SI Units)
6	Multiply item 4 by item 5	person-hr	person-hr

Multiplying items 4 and 5 together produces the daily person hours of use that site receives.

Reasonableness Item #7:

Item	Criteria	Input (English units)	Input (SI Units)
7	Divide item 3 by item 6	ft^2/person-hr	m^2/person-hr

Dividing item 3 by item 6 produces the barrier size per hours of site usage value which will be used to compute the "abatement cost factor" for this site.

Reasonableness Item #8:

Item	Criteria	Input (English units)	Input (SI Units)
8	Multiply $42,000 by item 7	\$/person-hr/ft^2	\$/person-hr/m^2

Multiply item 7, which is either ft^2/hr or m^2/hr, by $42,000 and this produces the "abatement cost factor" for the site. All that is left now is to compare this value to the Reasonableness criteria value.

Reasonableness Item #9:

Item	Criteria	Input (English units)	Input (SI Units)
9	Does item 8 exceed the "abatement cost factor" of: English units = \$995,935 /person-hr/ft^2 ? or SI units = \$92,647 /person-hr/m^2 ?		

This step compares the derived "abatement cost factor" for the site to the "criteria abatement cost factor" used to determine reasonableness. The user should enter a "yes" or "no" answer in the appropriate input column which depends on the system of units. Recall the equation for the criteria barrier "cost factor" and the derivation in English units:

"abatement cost factor" =

$$\frac{\$42k}{residence} * \frac{\text{residence}}{2.46\text{persons}} * \frac{\text{useage}}{24\text{hours}} * (14\text{ft} * 100\text{ft}) = \mathbf{\$995{,}935\ /person\text{-}hr/ft^2}$$

Reasonableness Item #10 and #11:

Item	Criteria	Input (English units)	Input (SI Units)
10	If item 9 is no, abatement is reasonable		
11	If item 9 is yes, abatement is not reasonable		

These items determine if abatement is reasonable by the answer to item 9 which asked if the derived "abatement cost factor" was greater than the "criteria abatement cost factor".

Selected Example Calculations

Traffic Volume Determination

Church Example

Consider a church site similar to that found in Figure 7. Peak traffic data for the roadway is 1000 vehicles per hour. The primary use of the church occurs at from 9 am - noon on Sunday. Application of the Traffic Volume Adjustment Factor for this site is as follows:

Traffic Volume = peak volume * adjustment factor
= 1000 vehicles/hr * 0.32 = 320 vehicles per hour
dB offset = 10 * log(0.32) = -4.9 dB(A)

This example could also have followed the Feasibility Flowchart and subtracted 2 dB(A) from the predicted receiver levels depending on data availability. The calculation shown above confirms that 2 dB(A) is a conservative value for weekend use.

A traffic volume of 320 vehicles per hour would now be used to predict existing noise levels if the preparer chose to use actual traffic volume instead of the dB offset. Future traffic volume would also be estimated in this manner.

"Abatement cost factor" Calculations

Examples of the use of the "abatement cost factor" follow.

Park Example

Consider a park similar to the one described in Figure 5. We wish to determine the "abatement cost factor" to complete Reasonableness Matrix. The following data are known about the park and the proposed barrier and are used as input to the "abatement cost factor" Equation (2).

Input Parameters:

1. # people/week = (5 days * 200/day) + (2 days * 500/day) = 2000 people
2. Proposed Barrier Height = 14 feet
3. Proposed Barrier Length = 600 feet
4. Average time spent per visit = 2.0 hours
5. Number of benefited receivers = 1250 receivers
6. Number of daily benefited receivers = 1250/7 = 179 receivers

Notice that the number of benefited receivers differs from the number of people that visit the park. This value is determined from the noise impact analysis where a grid of receivers is used to determine the percentage of area receiving at least 5 dB(A) insertion loss from the proposed barrier. See the section on "Receiver Placement for Noise Impact Analysis" for more guidance.

Now we shall enter the required parameters in the Reasonableness Matrix shown in Figure 11.

Figure 11. Reasonableness Matrix for Park Example

Item	Criteria	Input (English units)	Input (SI Units)
1	Enter length of proposed barrier	600 ft	m
2	Enter height of proposed barrier	14 ft	m
3	Multiply item 1 by item 2	8400 ft^2	m^2
4	Enter the average amount of time that a person stays at the site per visit	2.0 hours	hours
5	Enter the average number of people that use this site per day that will receive at least 5 dB(A) benefit from abatement at the site	179 people	people
6	Multiply item 4 by item 5	358 person-hr	person-hr
7	Divide item 3 by item 6	23.5 ft^2/person-hr	m^2/person-hr
8	Multiply $42,000 by item 7	987,000 $/person-hr/$ft^2$	$/person-hr/$m^2$
9	Does item 8 exceed the "abatement cost factor" of: English units = $995,935/person-hr/$ft^2$? or SI units = $92,647/person-hr/$m^2$?	NO	
10	If item 9 is no, abatement is reasonable	√	
11	If item 9 is yes, abatement is not reasonable		

The Reasonableness Matrix analysis indicates that abatement for this site is reasonable.

Church Example

Consider the church site of Figure 7. We wish to determine the "abatement cost factor" to complete the Reasonableness Matrix. The following data are known about the church and the proposed barrier and are used as input to the "abatement cost factor" equation.

Input Parameters:

1. # people/week = (Sunday * 200/day) + about 100 people during the week = 300 people
2. average time per person spent at church = 2 hours
3. Proposed Barrier Height = 13 feet
4. Proposed Barrier Length = 1000 feet

5. Number of benefited receivers = 250 receivers
6. Number of daily benefited receivers = 250/7 = 36 receivers

Now we enter the required parameters in the Reasonableness Matrix shown below.

Figure 12. Reasonableness Matrix for Church Example

Item	Criteria	Input (English units)	Input (SI Units)
1	Enter length of proposed barrier	1000 ft	m
2	Enter height of proposed barrier	13 ft	m
3	Multiply item 1 by item 2	13,000 ft^2	m^2
4	Enter the average amount of time that a person stays at the site per visit	2.0 hours	hours
5	Enter the average number of people that use this site per day that will receive at least 5 dB(A) benefit from abatement at the site	36 people	people
6	Multiply item 4 by item 5	72 person-hr	person-hr
7	Divide item 3 by item 6	181 ft^2/person-hr	m^2/person-hr
8	Multiply $42,000 by item 7	7,602,000 $/person-hr/$ft^2$	$/person-hr/$m^2$
9	Does item 8 exceed the "abatement cost factor" of: English units = $995,935/person-hr/$ft^2$? or SI units = $92,647/person-hr/$m^2$?	YES	
10	If item 9 is no, abatement is reasonable		
11	If item 9 is yes, abatement is not reasonable	√	

The Reasonableness Matrix analysis indicates that abatement for the church site is NOT reasonable.

School Example

Consider the school site shown in Figure 4. We wish to determine the "abatement cost factor" to complete the Reasonableness Matrix. The following data are known about the school and the proposed barrier and are used as input to the "abatement cost factor" equation.

Input Parameters:

1. # people/week = 600 people
2. average time per person using playground = 1 hour
3. Proposed Barrier Height = 13 feet
4. Proposed Barrier Length = 1000 feet
5. Number of benefited receivers = 300 receivers
6. Number of daily benefited receivers = 300/7 = 43 receivers

Now we enter the required parameters in the Reasonableness Matrix shown below.

Figure 13. Reasonableness Matrix for School Example

Item	**Criteria**	**Input (English units)**	**Input (SI Units)**
1	Enter length of proposed barrier	1000 ft	m
2	Enter height of proposed barrier	13 ft	m
3	Multiply item 1 by item 2	13,000 ft^2	m^2
4	Enter the average amount of time that a person stays at the site per visit	1.0 hours	hours
5	Enter the average number of people that use this site per day that will receive at least 5 dB(A) benefit from abatement at the site	43 people	people
6	Multiply item 4 by item 5	43 person-hr	person-hr
7	Divide item 3 by item 6	302 ft^2/person-hr	m^2/person-hr
8	Multiply $42,000 by item 7	12,684,000 $/person-hr/$ft^2$	$/person-hr/$m^2$
9	Does item 8 exceed the "abatement cost factor" of: English units = $995,935/person-hr/$ft^2$? or SI units = $92,647/person-hr/$m^2$?	YES	
10	If item 9 is no, abatement is reasonable		
11	If item 9 is yes, abatement is not reasonable	√	

The Reasonableness Matrix analysis indicates that abatement for the school site is NOT reasonable.

V. CONCLUSIONS

This research has shown that there is a need among State Departments of Transportation for a formal noise abatement decision policy concerning special land uses such as churches, parks and schools. This policy needs to include a formal process to evaluate if abatement is reasonable and feasible. This research has established a method to determine if abatement is reasonable and/or feasible for special land uses. The methodology was derived based on:

- an extensive survey that included responses from 35 states
- telephone interviews
- personal contacts
- existing State and Federal policies
- guidance by FDOT
- the expertise of the authors

This resulted in a phase I methodology that underwent a thorough review by the Florida Department of Transportation Noise Task Team. Based on these comments, a final procedure was developed that includes a flow chart to determine feasibility and a matrix to determine reasonableness. The final report defines this process and provides several examples.

VI. RECOMMENDATIONS

The derived methodology included in this report is ready for immediate implementation. It is recommended that the methodology be included as a supplement to Chapter 17 of the FDOT Project Development and Environment Manual. Training courses and appropriate transmittals should be developed by the FDOT to promulgate this information to the Districts for immediate use.

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Florida Department of Transportation or the U.S. Department of Transportation. Prepared in cooperation with the State of Florida Department of Transportation and the U.S. Department of Transportation.

APPENDIX A: SURVEY

WE NEED YOUR HELP!

The Florida Department of Transportation is working with the University of Central Florida to determine when noise abatement is reasonable and feasible for special land uses. In this document, reasonable and feasible are as defined by FHWA and discussed in 23CFR772. Special land uses include schools, churches, parks, etc.

We would like to ask you, or someone in your agency, to complete the following questionnaire. The questionnaire has been developed to be quick and as painless as possible. To expedite this research, we request that you send the reply by October 15, 1996. If you have any questions, please contact:

Dr. Roger L. Wayson tel: tel: (407) 823-2480
University of Central Florida fax: fax: (407) 823-3315
Civil & Environmental Engineering email:
wayson@pegasus.cc.ucf.edu
P.O. 162450
Orlando, FL 32816-2450

We appreciate your help. To show our appreciation, check below if you would like a copy of the final report.

Yes! Send me a copy.

Please provide us your name. [This information is for internal use and will not be released.]

Name: _____

Address: _____

_____

_____

Telephone Number: _____

Thanks in advance for your help.

Sincerely,

Win Lindeman, Environmental Administrator

1. Has your agency had trouble identifying the appropriate procedure for determining if abatement is reasonable and feasible for special land uses in the past?

YES (continue)

NO (skip to question number 7)

2. In your opinion, what are the key details in determining if abatement is reasonable and feasible for special land uses? [Attach extra pages if needed.]

_____

_____

_____

_____

3. Has any formal policy been established by your agency to determine if special land use noise abatement is reasonable and/or feasible?

YES (continue)

NO (skip to question number 7)

4. Would you supply a copy of this document to the research team?

YES (please return with this questionnaire; skip to question 6)

NO (this is not possible because

_____

_____; continue)

5. What is the name of this document?

_____

_____

6. How has your agency handled determination of reasonable and feasible noise abatement for special land uses? [Attach extra pages if needed.]

_____

_____

_____

_____

7. In your opinion, what are reasonable and feasible indicators for determining if noise abatement is needed for special land uses? [Check all that apply.]

Cost	Noise Abatement Criteria
Land Use	Noise Level Increase
Facility Type	New Developments
Time of Use	Amount of Use
Type of Use	Developed After Highway
Other (please describe)	

_____

_____

_____

_____

8. Which are the most important three items listed in Question number 7?

_____ _____
_____

9. For the items checked or listed in Question number 7, how would these be used in determining reasonable and feasible abatement strategies for special land uses? [Attach extra pages if needed.]

ITEM	Methodology
_____	_____
	_____
_____	_____
	_____
_____	_____

_____

_____ _____

_____

_____ _____

_____

_____ _____

_____

_____ _____

_____

10. Are you aware of any information (studies, documents, reports, etc.) that may be helpful in determining if abatement is reasonable and/or feasible for special land uses?

_____

_____

11. Who should be contacted if we have questions?

Please do not contact anyone
You may contact Person completing this survey

Other ==> Name: _____

Phone Number: _____

THATS ALL! Please enclose in the postage paid envelope and send the questionnaire and any other documents that may be helpful to our research.

APPENDIX A: SURVEY RESULTS

Question #1: Has your agency had trouble identifying the appropriate procedure for determining if abatement is reasonable and feasible for special land uses in the past?

AL DOT - yes
AR DOT- yes
AZ DOT- no
CA DOT - yes
CO DOT- yes
CT DOT- no
HI DOT - yes
IA DOT- no
ID DOT- no
IN DOT- no
KY DOT- no
KAN DOT - no
LA DOT- yes
MA DOT - yes
MO DOT - yes
ME DOT- no
MI DOT-yes
MN DOT- yes
MT DOT- no
MS DOT- no
NC DOT - no
NE DOT- yes, just city parks.
NH DOT - no
NJ DOT- yes
NV DOT - yes
NY DOT - yes
OK DOT - yes
PA DOT- no
SC DOT - no
TN DOT- no
UT DOT - yes
WI DOT- no
WY DOT - no
OH DOT - yes
TX DOT - yes

Others:

Austria- no
Wakefield Acoustics- yes
TN EPO - no

Question #2: In your opinion, what are the key details in determining if abatement is reasonable and feasible for special land uses?

AL DOT - see attached policy
AR DOT- sensitive nature of use, time of development of facility & use, amount of noise increase due to proposed highway construction

AZ DOT- no answer
CA DOT - no answer

CO DOT - Determining whether these lands fit into Cat. A or B of NAC. Once that is determined the DOT guidelines are applied(residences)

CT DOT- no answer

HI DOT - Arrive at max cost per benefited residences, determine number of benefited residences. How do we consider second row of houses? how do we consider view of residents?

IA DOT- no answer
ID DOT- no answer
IN DOT- no answer
KY DOT- no answer

LA DOT- normal cost per receptor calculations are not valid. cost, severity of impact, type of use, time of use (compared to peak noise hour), complaints received and public involvement are crucial.

MA DOT - no answer

ME DOT- no answer

MI DOT- noise sensitive outside areas, openable building windows, interior noise levels, is reduced interior noise level desirable?

MN DOT- cost, which came first- the source or the land use?, effectiveness (will noise be reduced?), level of impact, land owners desire (is it acceptable to community?)

MO DOT- no answer
MS DOT- no answer
NE DOT- would noise abatement detract from the use of the park or it's look
NH DOT - no answer
NJ DOT- public property, extent of use, cost, benefits of lowered noise levels

NV DOT - effectiveness of any mitigation. number of people affected or impacted. cost of mitigation per person

NY DOT - Active Recreational Parks: Would a lowered noise level be a benefit?
Regular Parks: Use percentage of land protected(usually low, <%10 not reasonable)
Schools: State law for insulation Churches: Time of use (Sunday am only?)

OK DOT - Is the worst case hour for noise actually affecting use and purpose of the special land use? Shouldn't evaluation be done for the case that has the most effect on the church/school etc.?

PA DOT- no answer
SC DOT - no answer
TN DOT- see attached noise policy

UT DOT - Date of development must be earlier than the highway
Fixed developed sites of frequent human use within 300m of ROW, this excludes dispersed recreation sites(fishing , Xcountry skiing areas), including their parking facilities, also excluded are roadside facilities, rest areas....

WI DOT- no answer
WY DOT - no answer

Others:

Austria- no answer

Wakefield Acoustics- schools - interior noise exceeds level for speech interference

churches - no policy, but interference with speech and quiet reflection

parks - no policy, but significant increase in background noise, masking of natural sounds

TN EPO - no answer

Question #3: Has any formal policy been established by your agency to determine if special land use noise abatement is reasonable and/or feasible?

AL DOT - yes
AR DOT- no
AZ DOT- no
CA DOT - no, but we do have a legislative requirement to provide noise protection for schools
CO DOT - no. policy no, guidelines yes
CT DOT- no answer
HI DOT - no
IA DOT- no answer
ID DOT- no answer
IN DOT- no answer
KY DOT- no answer
LA DOT- no
MA DOT - no
ME DOT- no answer
MI DOT- no
MN DOT- no
MO DOT-no answer
MS DOT- no answer
NE DOT- no
NH DOT - no answer
NJ DOT- no
NV DOT - yes
NY DOT - no
OK DOT - no. evaluated on a case by case basis
PA DOT- no answer
SC DOT - no answer
TN DOT- yes
UT DOT - yes
WI DOT- no answer
WY DOT - no answer
OH - no
MT - no
NC - skip
KAN - skip

Others:

Austria- no answer
Wakefield Acoustics- yes
TN EPO - no answer

Question #4: Would you supply a copy of this document to the research team?

AL DOT - yes
AR DOT- no answer
AZ DOT- no answer
CA DOT - yes
CO DOT - yes
CT DOT- no answer
HI DOT - no answer
IA DOT- no answer
ID DOT- no answer
IN DOT- no answer
KY DOT- no answer
LA DOT- no answer
MA DOT - no answer
ME DOT- no answer
MI DOT- no answer
MN DOT- no answer
MO DOT- no answer
MS DOT- no answer
NE DOT- no answer
NH DOT - no answer
NJ DOT- no answer
NV DOT - yes
NY DOT - no answer
OK DOT - no answer
PA DOT- no answer
SC DOT - no answer
TN DOT- yes
UT DOT - yes
WI DOT- no answer
WY DOT - no answer

Others:

Austria- no answer
Wakefield Acoustics- yes
TN EPO - no answer

Question #5: What is the name of the document?

AL DOT - ALDOT- Highway Traffic Noise Analysis and Abatement
AR DOT- no answer
AZ DOT- no answer
CA DOT - sec 216 California Statute, sec 3-150.40 of DOT project development procedure manual

CO DOT - Colorado DOT-Noise Analysis and Abatement Guidelines
CT DOT- no answer
HI DOT - no answer
IA DOT- no answer
ID DOT- no answer
IN DOT- no answer
KY DOT- no answer
LA DOT- no answer
MA DOT - no answer
ME DOT- no answer
MI DOT- no answer
MN DOT- no answer
MO DOT- no answer
MS DOT- no answer
NE DOT- no answer
NH DOT - no answer
NJ DOT- no answer
NV DOT - no answer
NY DOT - Actually, would you want to see the Chapter of State Law on public school insulation?
OK DOT - no answer
PA DOT- no answer
SC DOT - no answer
TN DOT- no answer
UT DOT - no answer
WI DOT- no answer
WY DOT - no answer

Others:

Austria- no answer

Wakefield Acoustics- “Revised Policy for Mitigating the Effects of Traffic Noise from Freeways and Expressways”, Nov-1993.

TN EPO - no answer

Question #6: How has your agency handled determination of reasonable and feasible noise abatement for special land uses?

AL DOT - see policy
AR DOT- project basis for individual site conditions

AZ DOT- no answer
CA DOT - no answer
CO DOT - Most often these land uses are classified as Cat B of the NAC. Guidelines are applied. Number of affected persons is hard to determine at parks. Schools and churches are easier but exposure duration is questioned

CT DOT- no answer
HI DOT - no answer
IA DOT- no answer
ID DOT- no answer
IN DOT- no answer
KY DOT- no answer
LA DOT- no answer
MA DOT - see attachment A
ME DOT- no answer
MI DOT- no answer
MN DOT- see attached pages. available at www.pca.state.mn.us
MO DOT- no answer
MS DOT- no answer
NE DOT- no answer
NH DOT - no answer
NJ DOT- no answer
NV DOT - After identifying which land uses fall into NAC land use categories, determine degree of impact affecting speech(instructional or conversational)

NY DOT - see above; but “reasonable” can be subjective and it is applied in that manner
OK DOT - no answer
PA DOT- no answer
SC DOT - no answer
TN DOT- see attached noise policy
UT DOT - see #2
WI DOT- no answer
WY DOT - no answer
KAN - skip
NC - skip
OH - skip
MT - some policy exists

Others:

Austria- no answer

Wakefield Acoustics- Ten years after project completion, daytime noise levels inside classrooms will exceed Leq(1 hr) 47 dB(A) and will have increased by 3 dB(A) or more over pre-projected levels, see attached policy

TN EPO - no answer

Question #7: In your opinion, what are reasonable and feasible indicators for determining if noise abatement is needed for special land uses?

Choices:

Cost	Noise Abatement Criteria (NAC)
Land Use	Noise Level Increase
Facility Type	New Developments
Time of Use	Amount of Use
Type of Use	Developed After Highway
Other (please describe)	

AL DOT - cost, land use, noise abatement criteria, noise level increase

AR DOT- cost, land use, time of use, type of use, noise abatement criteria, noise level increase, developed after highway

AZ DOT- noise abatement criteria, noise level increase

CA DOT - all items checked

CO DOT - all items checked except noise level increase

CT DOT- cost, noise abatement criteria, noise level increase, developed after highway, other: # of households that will benefit(up to 300' from highway), views of affected residents, input from local gov't and ability to construct abatement.

HI DOT - cost, land use, facility type, type of use, noise abatement criteria, noise level increase, other: substantial noise reduction

IA DOT- all boxes checked.

ID DOT- cost, land use, noise abatement criteria, noise level increase, new developments, developed after highway, other: date of public knowledge.

IN DOT- cost, noise abatement criteria, noise level increase, developed after highway

KY DOT- cost, facility type, time of use, noise abatement criteria, noise level increase, new developments, amount of use, developed after highway

LA DOT- cost, facility type, time of use, type of use, noise abatement criteria, noise level increase

MA DOT - all items checked

ME DOT- all checked except amount of use

MI DOT- cost, land use, facility type, time of use, type of use, noise abatement criteria, noise level increase, other: interior or exterior criteria

MN DOT- all items checked, other: community desire

MO DOT- cost, land use, facility type, time of use, type of use, noise abatement criteria, new developments, other: affected residents

MS DOT- cost, facility type, noise abatement criteria, noise level increase, developed after highway, other: impact on activities at subject property.

NE DOT- cost, land use, time of use, type of use, noise level increase, amount of use

NH DOT - cost, land use, time of use, noise abatement criteria, noise level increase, amount of use, developed after highway

NJ DOT- all items checked, other: position of prop. owner on abatement, amt. of noise reduction

NV DOT - all items checked

NY DOT - cost, land use, facility type, time of use, type of use, other: lowered noise not a benefit, % of park area protected

OK DOT - land use, time of use, type of use, NAC, noise level increase, amount of use, developed after highway

PA DOT- cost, land use, facility type, time of use, noise abatement criteria, amount of use

SC DOT - cost, land use, type of use, noise level increase, developed after highway, other: public acceptability

TN DOT- cost, land use, facility type, noise abatement criteria, noise level increase, new developments, developed after highway

UT DOT - all items checked, other: location of centers of frequent human use

WI DOT- cost, land use, facility type, time of use, type of use

WY DOT - cost, land use, noise abatement criteria, noise level increase

KAN: Barrier IL

MT: all items selected and Community Desires

OH: Cost, Land Use, NAC, dB increase

NC: Cost, NAC, Time of use, Type of use, dB Increase

Others:

Austria- cost, land use, facility type, time of use, type of use, NAC

Wakefield Acoustics- all items checked except time of use, developed after highway not eligible

TN EPO - cost, land use, facility type, time of use, NAC, noise level increase, amount of use, developed after highway

Question #8: Which are the most important three items in Question #7?

AL DOT - cost, NAC
AR DOT- cost, land use, noise level increase

AZ DOT- noise abatement criteria, noise level increase
CA DOT - cost, amount of use, type of use
CO DOT - cost, absolute noise level as compared to NAC, amount of use (equiv. receptors)
CT DOT- cost, NAC, noise level increase
HI DOT - cost, NAC, noise level increase
IA DOT- developed after highway
ID DOT- date of public knowledge, cost, noise level increase
IN DOT- cost, noise level increase, developed after highway
KY DOT- cost, facility type, noise level increase
LA DOT- cost, facility type, time of use
MA DOT - cost, NAC, type of use
ME DOT- noise abatement criteria, noise level increase, cost
MI DOT- cost, type of use, noise abatement criteria
MN DOT- cost, noise level increase, NAC

MO DOT- cost, facility type, noise abatement criteria,
MS DOT- cost, noise abatement criteria, impact on activities at subject property.
NE DOT- type of use, noise level increase, amount of use
NH DOT - no answer
NJ DOT- facility type, cost, noise reduction
NV DOT - NAC, land use, noise level increase
NY DOT - cost, lowered noise not a benefit, % of park area protected
OK DOT - time of use, type of use, amount of use
PA DOT- cost, noise abatement criteria, amount of use
SC DOT - developed after highway, cost, type of use
TN DOT- cost, noise level increase, developed after highway
UT DOT - developed after highway, NAC, location of centers of frequent use
WI DOT- cost, facility type, time of use
WY DOT - NAC, land use, cost
KAN - Cost, Increase, date of public knowledge
NC - Cost, NAC, Type of Use
OH - Cost, NAC, NLI
MT - Cost, NLI, NAC

Others:

Austria- cost, NAC, facility type
Wakefield Acoustics- type of use, exceed threshold level, noise level increase
TN EPO - cost, NAC, noise level increase

Question #9

Note: Methodology refers to Q9 of survey, Reasonableness refers to policies that states supplied, so far all have been non-special land use policies (i.e. residences)

AL DOT-Mook

No Methodology

Reasonableness (Residences)
1. Noise reduction provided: 6-8 dB(A)
2. Cost: $20k/residence
3. Number of people protected(benefited): 5 dB(A)
4. Opinion of Impacted Residents:
5. Abs noise levels
6. Change in noise levels
7. Development along highways

8. Env impacts of wall construction

AZ DOT

ADOT has abated for all Cat. B land uses (including schools, churches, parks) that exceeded the FHWA NAC level or have had their levels increased by 15 dB(A). No criteria is used.

ARK DOT (Malgrough)

Q2
1. Sensitive nature of noise
2. time of development of facility
3. Amount of noise increase

CA DOT

No Methodology

- Park Land- $/foot highway frontage
- Church Land- $/church member
- Picnic, walking should be ranked higher than softball games (primary activity of park)
- CA 3-150.40 (School Noise Abatement) - Leq(h) exceeds 52 dB(A) Caltrans must abate for classrooms, school libraries

CO DOT
- uses $3000/receiver/decibel for reasonableness analysis

Q9. Criteria Methodology/Notes

1. Determining whether these lands fit into Cat. A or B of NAC. Once that is determined the DOT guidelines are applied(residences)
2. Most often these land uses are classified as Cat B of the NAC. Guidelines are applied. Number of affected persons is hard to determine at parks. Schools and churches are easier but exposure duration is questioned.

Reasonableness (Residences) Guidelines
1. Build Level: >70dBA v. reasonable, <63 dB(A) unreasonable
2. Build Level over existing: >10 dB(A) vreas, <3 unreas
3. Cost/impacted receiver: <$3000 reas, >$3500 unreas
4. Opinion of Impacted Persons: >75% vreas, <40% unreas.
5. Development Type: >70% residential, schools, parks vreas., <25% unreas.

6. Timing: >75% developments predate vreas., <30% unreas.
7. Development Existence: >75% there for 15 yrs vreas., <30% unreas.
8. Land Use: strong controls, vreas., weak controls unreas.

Conn. DOT (Delpapa)

1. NAC: Leq=67 dB(A)
2. Increase: 15 dB's or approaching NAC within 1 dB
3. Cost: 15k-50k per residence. All residences within 300 ft and anticipated to achieve a 3 dB or greater traffic noise reduction are considered in determining cost/res. index. An equivalent house count (Heq) can be applied to cost/residence index. The number of persons per household residing in all residences compared to the average persons per household. 1990 Census data 2.62 persons/household.

Example Heq calc.
4 res * 4 persons/res.= 16 persons
Heq = 16 persons/2.62 = 6.1 residences
6.1 residences * 50k/res. = $305,000 barrier cost
-compare this to $200,000 if using 4 residences (4*50k)

Hawaii DOT

1. Arrive at max cost per benefited residences
2. determine number of benefited residences
3. How do we consider second row of houses?
4. how do we consider view of residents?
5.

Q9. Criteria Methodology/Notes

1. Cost: estimate total cost divided by benefited residences
2. NAC: determine amount that projected noise level exceeds NAC
3. Increase: determine greatest increase
4. Reduction: determine min heights of wall required to obtain substantial noise reduction

- total cost of abatement/benefited receivers
- greatest increase in noise level

Idaho Trans. Dept (Jost)

Q9. Criteria Methodology

1. Cost: Cost/benefit ratio, who benefits (#) and degree of benefit
2. Land use, NAC, Increase: assist in determining the severity of projected traffic noise impacts

3. New developments, date of public knowledge, developed after highway: Who created the problem? are the noise impacts a result of highway development or local development regs.

INDOT (Polit)
Q9. Criteria Methodology
1. Cost: spending a certain amount of money for a certain benefit
2. NAC/Increase: not used for reasonableness strategies, only used for determining the existence of noise impacts.
3. Developed after Highway:

Iowa DOT (Ridnour)
Q9. Criteria Methodology
1. all the listed items should be considered in the context of the specific situation. There is no recipe for weighting each factor, but a "best public interest" decision should consider the precedent setting implications that might be involved.

KY Trans. Cabinet (Adkins)
Q9. Criteria Methodology
1. Facility Type: insulation/air conditioning not used for abatement of interior levels except in schools
2. Time/Amount of Use: In past cases, we have successfully argued against insulating/air conditioning churches due to time of use and frequency of use
3. Developments after highway: abatement not considered when development occurred after date of public knowledge.

Reasonableness (residences)
1. Reasonableness will be based primarily on severity of impact and cost effectiveness, the cost effectiveness will be determined by a calculation expressed in:

$/dB(A) reduction/person protected/dB(A) noise increase

- dB(A) reduction=amount of attenuation achieved by the barrier
- person protected=total number of benefited receivers
- dB(A) noise increase=amount of noise directly attributed to the Type I project

experience indicates that a value of $150/dB(A)/person/dB(A) is a reasonable max threshold, values below usually receive abatement, values above usually do not unless other circumstances override.

Kansas DOT

Q9. Criteria Methodology
1. Barrier cost
2. Noise level increase of 10 dB must consider abatement

3. KDOT will not participate in barrier construction when development was not planned prior to the point of public knowledge

KANSAS DOT (Eisenbath)
Q9. Criteria Methodology

1. Cost: cost are used by KDOT in making decisions about barrier feasibility
2. Increase: abatement analysis required for impacts > 10 dB(A) above the existing
3. Developed after date of public knowledge: KDOT will not participate in construction of barriers where development was not planned prior to the point of public knowledge.

Louisiana DOT (Pizzolato)
Q2. normal cost per receptor calculations are not valid. Cost, severity of impact, type of use (interior/exterior), time of use (compared to worst case hour), complaints received and public involvement are crucial.

*Q9. Criteria Methodology
1. Cost: since cost/receptor criteria is not valid. Total cost or cost as percentage of project would be considered, would cost be reimbursable for insulation of structures, would current use be impaired, involvement of Dept. Interior if resources are protected by section 4(f) constructive use guidelines.
2. Time of use: does predominant use occur during peak or worst hour
3. Type of use: would consider whether interior or exterior activity and whether current use would be impaired
4. NAC: severity of impact
5. Increase: severity of impact and impairment of current use

Mass. Highway Dept.

MHD has rejected requests for noise abatement for special land uses on all TypeI projects. Reason being that they can't justify spending the money on park, playground, cemetery, church when there are residential areas that have been deemed marginally feasible for a barrier. There is no criteria to allow for equal consideration of special land use case versus residential areas.

The only time abatement is offered to special land use area is when it is surrounded by a residential area that has been deemed reasonable/feasible for a barrier.

MHD has attempted to consider special land use cases with study (MHD TypeII Noise Attenuation Study). Although there is still reluctance to build barrier for location if there are marginal residential areas also on the list.

MHD relies heavily on cost/dBIL/residence protected

Notes:
1. Cost: consider instead of $/dBIL/unit to use $/dBIL/person hour where person hour is a measure of how frequent the facility is used.

Special Land Use Priority Primary Rating System

1. 5 points accrue for each year of noise impact.
2. Residences:
   - 68-72 dB(A) each residence 1 pt
   - 73-77 dB(A) 5 pts
   - >77 dB(A) 25 pts
3. Places of Worship
   - 68-72 dB(A) each place 5 pts
   - >72 dB(A) 25 pts
4. Schools, hospital, nursing home, library
   - 68-72 dB(A) each place 10 pts
   - >72 dB(A) 50 pts

Primary rating system is the sum of all such points for all noise-sensitive activities n the barrier study zone.

Maine DOT (Rollins)

Q9. Criteria Methodology

1. Cost: 20k per benefited receiver
2. Land Use: Land use control must be exercised by local authorities with control over under-developed lands adjacent to highway to prevent further development of incompatible activities.
3. NAC: any impacted receiver that approaches or exceeds the NAC for the type of land use.
4. Increase: exceeds the existing level by 15 dB(A)
5. *Number units protected: only sites with six or more impacted receivers subject to adverse highway traffic noise impacts will be eligible.*
6. Relative age of highway: more consideration given to receptors that predate initial highway construction.
7. View of residents: barriers will not be built if the residents don't want the barrier
8. Noise barriers: barriers will not be considered unless they provide at least 10 dB(A) atten.

MI DOT (DeFrain)
Q9. Criteria Methodology
1. cost: difficult to determine
2. Land use: each case would need to be evaluated, no general rules

3. Facility type: need to examine activities, times, user concerns
4. Time of Use: relate these times to calculated/measured highway noise.
5. NAC: need to look at tasks/activities to be held on routine basis
6. Increase: noise impact is generally related to change in level rather than baseline values.

Miss DOT (Holloway)
Q9. Criteria Methodology

1. We have not considered abatement strategies for special land uses in detail for any projects. We have not developed procedures for determining reasonable/feasible guidelines.

Mo DOT (Jett)
Q9. Criteria Methodology

1. cost: 30k/receptor
2. Land use: residential = reasonable ; farm land<>reasonable
3. Facility type: commercial <> not reas. ; Res, school, hosp.=reasonable
4. Time of use: school/church may not be reasonable
5. Type of use: same as land except parks may be reasonable
6. NAC: >=NAC=reasonable
7. New developments: unreasonable
8. Affected residents: >50% = reasonable

MN DOT (Kennedy)
Q9. Criteria Methodology

1. Cost: max cost per decibel
2. Land use: identify qualifying land uses
3. NAC: establish min level of effectiveness, 5 dB (reductions?)
4. Increase: Rank severity of impact with increase
5. Residents view: poll residents for opinion
6. New developments: built after date of public knowledge not reasonable
7. Time/Type/Amount of use: define criteria for severity

Montana DOT

Q9. Criteria Methodology
1. Land use: outdoor activity has priority over indoor
2. Time of Use: facility dependent, churches and schools may be more affected by noise at certain times

3. Type of Use: If the site is sacred, it is more sensitive to noise than a church or school (Indian grounds)
4. Increase: the greater the overall increase in noise the more it will be considered in determining reasonableness/feasibility.
5. Amount of use: a church is used less than a school and would probably not be as likely to prove reasonable to abate noise

Neb DORoads (Otterman)
Q9. Criteria Methodology
1. Type of use: Parks-a barrier would deter its use and looks
2. Increase: is the level too high to enjoy the park?
3. Amount of use: Is the park used on weekends only?

NJDOT (Billera)
Q9. Criteria Methodology
1. Cost and Noise reduction: cost/benefit analysis
2. Land use/Facility Type: normally only public lands or buildings eligible
3. *Type of use/Amount: is the abatement a benefit?, (i.e. time of use does not coincide with worst hour)*
4. NAC: per 23CFR772
5. Developed after highway: not eligible

Nevada DOT
Reasonableness (Residences)
1. Cost per resident
2. Barrier cost compared to project cost: 2% to 6% is the range
3. Do impacted residents want the barrier
4. will the barrier block the view of billboards
5. absolute levels: 60-70 dB(A) range
6. perceivable levels: 3 - 10 dB(A) range
7. future build levels compared to no build levels (increase): 1-5 dB(A)
8. development time vs. highway
9. zoning changes
10. any dominant noise sources that a barrier won't mitigate

Q9. Criteria Methodology comments
1. Effectiveness of any mitigation
2. Number of people affected or impacted
3. cost of mitigation per person
4. After identifying which land uses fall into NAC land use categories, determine degree of impact affecting speech(instructional or conversational)

NYSDOT

Reasonableness (Residences)
1. Active Recreational Parks: Would a lowered noise level be a benefit?
2. Regular Parks: Use percentage of land protected(usually low, <%10 not reasonable)
3. Schools: State law for insulation
4. Churches: Time of use (Sunday am only?)

Q9. Criteria Methodology
1. cost: subjective, is it reasonable?
2. Land use: helps determine options such as insulation, lowered noise, %
3. Type: Public schools (only) are eligible for insulation
4. Time: Helpful for churches if used Sunday mornings only
5. Type of use: are there meetings, day care?
6. %: less than 5-10% area benefited not justified

N.C. DOT

Q9. Criteria Methodology
1. Cost: cost versus type of development, i.e. large schools may justify more monies than a small church
2. NAC: those whose levels substantially exceed criteria versus those that only approach
3. Type: school playgrounds versus recreation facilities

NC DOT (Walker)
Q9. Criteria Methodology

1. Cost: cost versus type of development (i.e. larger schools may justify more monies than a smaller church)
2. NAC: Those whose levels substantially exceed criteria versus those that only approach
3. Type of Use: School playgrounds versus recreational facilities used for training.

New Hampshire DOT
Reasonableness (Residences, I think)
1. Future Noise levels
    - >66 dB(A) Reasonable
    - <66 dB(A) not Reasonable
2. Build vs. No Build (Increase)
    - >15 dB(A) Reasonable
    - <15 dB(A) not Reasonable
3. Cost Effectiveness Index (CEI) $/unit
   first floor families in general, except if demonstrated that ground level activity takes place for upper level families
    - <$25k/unit Reasonable

- >$30k/unit not reasonable

4. Development vs. highway timing
   - >80% homes prior to build Reasonable
   - <50% not Reasonable

No Methodology

Ohio DOT

Reasonableness (Residences)
1. Proximity of users to roadway
2. cost per dB(A) reduction
3. relativity to current cost criteria

Q9. Criteria Methodology
1. Cost: cost per decibel decrease
2. Land use: area of frequent human use must be protected by abatement (3-5 dB(A) minimum)
3. NAC: abatement must provide decrease in levels that bring Leq below NAC
4. Increase: increase must result in an exceedence of NAC or 10 dB(A) above the existing

OH DOT (Pinckney)
Q9. Criteria Methodology

1. Cost: cost per decibel decrease
2. Land use: area of frequent human use must be protected by abatement. 3-5 dB(A) min.
3. NAC: abatement must provide enough of a decrease in noise levels to bring noise levels below the NAC.
4. Increase: Increase must result in an exceedence of NAC or 10 dB(A) above the existing

Oklahoma DOT (Sullivan)

Q9. Criteria Methodology
Is the worst case hour for noise actually affecting use and purpose of the special land use? Shouldn't evaluation be done for the case that has the most effect on the church/school etc.?

1. Time of use: Compare expected noise levels to NAC for time of use
2. Type of Use: develop categories for uses that are most sensitive to noise(same comment for NAC and Increase)
3. Amount of use: compare impacts expected to actual amount of use
4. Developed after highway: should be a negative for reasonableness

5. Land use: if dominating noise sources are present in the area this should be taken into account

PA Turnpike Comm (Willis)

Q9. Criteria Methodology

1. Cost: cost per special land use category protected
2. Land Use: there would have to be a distinction made between type of receptor, i.e. structural (school, church) and other land use (parks). Even though both may be valued for being quiet, the structural receptors afford some noise reduction whereas none is provided in an open setting.
3. Facility type: related to land use as noted above
4. Time of use: time of use should be evaluated against the projected noise levels for that time period, especially for schools/churches. I would estimate that much of their use occurs in off-peak hours.
5. Amount of use: the more a special land category is used, the greater the consideration for abatement

PennDOT (Osborne)

Q9. Criteria Methodology

1. Cost: must not exceed $50k/residence for TypeI
2. Land use: must be residential, no abatement for industrial/commercial
3. NAC: abatement must be based on existing and future noise levels
4. Increase: a comparison of existing and future levels
5. Developed after highway: no abatement for areas that do not pre-date the highway, no retrofit

Reasonableness (Residences)

1. abatement benefits: number of units and people receiving at least 3 dB(A) protection, and the average community noise reduction provided. Unit is defined as a dwelling unit or area of frequent human activity, church or school. If the unit is large, it should be subdivided into areas of frequent habitation. The average community noise reduction is the sum of the reduction provided per unit receiving at least 3 dB(A) reduction divided by the total number of units receiving at least 3 dB(A) protection.
2. desires of affected persons: survey of those closest to the barrier
3. comparison of existing to future noise levels:
    - does the project increase noise levels to approach or exceed 67 dB(A)?
    - does the project cause a substantial increase over existing levels?
    - do existing levels approach/exceed 67 dB(A)?
    - will the project decrease current levels while still approaching/exceeding 67 dB(A)?
4. development trends and land use controls: zoning changes or has zoning controlled noise sensitive land uses from building within the corridor, implies high community noise sensitivity

5. cost per residence: 50k/residence receiving 5 dB(A)
6. cost/dB(A)/unit protected

Penn DOT Worksheet Notes (Andrew Klecrita)

1. Benefits provided: # units protected, # people,
2. % people benefiting from abatement
3. NAC
4. Land Use
5. Cost/residence
6. Barrier Specifics

S.C. DOT

Q9. Criteria Methodology

1. cost: cost should fall within the guidelines of the states policy. Since a cost/receiver ratio may not apply in a special land use situation could use the following:
    - total cost of the abatement wrt total cost of highway project
    - what are the ROW and maintenance costs/considerations associated with abatement?
2. Land Use: land use should not fit into any of the other categories prescribed for 23CFR772. If the surrounding land use contains a predominating noise source, then traffic abatement is not to be considered.
3. Type of Use: Outdoor activity would be the main consideration or structures without air conditioning or land use that derives its value from quite or serene surroundings.
4. Increase: Future "build" levels shall approach or exceed the NAC before abatement will be considered.
5. Developed after Highway: Noise abatement is considered not reasonable if the development occurred after the date of public knowledge of the location of the proposed highway project.

Reasonableness (Residences)

1. Cost: 15k/benefited receiver (5dBA)
2. exposed height of wall<=25 ft
3. change in noise levels from existing to build case not more than 4 dB(A)
4. no abatement for businesses, prefer visibility
5. no abatement for isolated residences
6. not considered reasonable to abate for non-controlled or partial controlled access facilities
7. barrier will be located beyond clear recovery zone or incorporated into safety devices.
8. walls not to be constructed on shoulders (drainage, trash, safety)
9. vegetative barrier may be considered even though acoustical barrier not justified
10. not reasonable if residents don't want it, survey.
11. developments after date of public knowledge-not reasonable

Tenn EPO (Rasmussen)

Q9. Criteria Methodology

1. Cost: must be considered
2. Land use : changing land use must be considered
3. Facility type: uncontrolled access, no Type II program
4. Time of use: churches, mainly Sundays, interior levels
5. NAC: approach , equal or exceed criteria
6. Increase: over 15 dB(A) increase
7. Amount of use: at least 10% of day

Tenn DOT (Smith)

No Methodology

Reasonableness (residences)

1. abatement should produce a 10 dB(A) reduction with a minimum of 7 dB(A) reduction for first row of houses and at least 5 dB(A) for other receptors such as second row houses.
2. barriers will not normally be constructed when height requirements exceed 15 feet
3. TDOT will consider public views of abatement
4. TDOT will give greater consideration to
    - residential areas along highways on new location
    - residential areas that were constructed before an existing highway
    - residential areas have been in place along an existing highway for an extended period of time
    - TDOT gives less consideration to res. areas that have been developed along the highway without proper consideration of traffic noise impacts by the developer
5. abatement not reasonable for commercial or industrial areas or where zoning is changing from sensitive (parks, churches) to non-sensitive (commercial)

TexDOT

Reasonableness (Residences)

1. cost:25k/receiver (5dBA)
2. views of residents
3. zoning-prior complaints in the area?

Utah DOT

Criteria/Reasonableness for special land use:

1. Date of development must be earlier than the highway
2. Fixed developed sites of frequent human use within 300m of ROW, this excludes dispersed recreation sites(fishing , Xcountry skiing areas), including their parking facilities, also excluded are roadside facilities, rest areas....
3. Centers of human activity must be impacted by highway noise

4. Time of use may be a factor, churches used only for Sunday worship do not qualify since the peak traffic hours do not coincide with “frequent human use: criteria.
5. Activity Type: for schools, these are divided into indoor and outdoor activities. Many times the outdoor areas are shielded by the building. The school building indoor is examined for noise penetrating the building if the outdoor NAC is exceeded during time of use.
6. Building material is a factor only if the outdoor NAC is exceeded during time of use. If a school has solid brick or masonry block structure facing the highway, no further shielding is needed. Or if the widows are double or triple glazed or glass block and the walls are brick or masonry block, no further shielding is needed.
7. Noise abatement must comply with the usual criteria for dwellings(5 dB(A) reduction, cost not exceeding limit per dwelling.
8. Can place imaginary dwellings if there is a site without dwellings to see if the cost is reasonable.

COST PER DWELLING FORMULA:

$$\text{Cost} = C/SD$$

C=Total cost of abatement

D=number of impacted dwellings that receive 3dB reduction within 300m of ROW

S=severity factor (Type II S=1)

Type I

NAC exceeded	Increase in level			
	0-9	10-19	20-29	30+
Yes	1	2	3	4
No	-	1	2	3

<u>WisDOT (Waldschmidt)</u>

<u>Q9. Criteria Methodology</u>

1. Cost: how bad do you want the project approved by the Feds? 30k/dwelling is normally used
2. Facility type/Time of use: Churches are normally dismissed because of time of use. Every opportunity is used to show it is not an impact because of the time of use issue.Other than impact vs. no impact, cost is the only issue when determining reasonable/feasible in Wis.

<u>Wyoming DOT</u>

Reasonableness (Residences)

1. Amount of noise reduction provided (7dBA or greater)
2. all benefited receivers should be included in the analysis regardless or whether they were identified as impacted(each unit in a multi-family building should be counted as one residence)
3. Cost: $15k/resident or less
4. Opinion of impacted residents:surveys or open house to determine

5. Future noise levels: >70 dB(A) or 20 dB(A) increase
6. Timing: Consider those residences that existed before the project or along a highway for an extended period of time

British of Columbia MoTH

Notes:
1. 55 dB(A) is the threshold of concern, above this consider mitigation (Leq24)
2. 65 dB(A) is interpreted as twice as noisy and speech/sleep interference expected
3. Mitigation warranted if levels 10 years after project:
    - 55-65 dB(A) with increase shown in graph
    - >65 dB(A) and increase >3dBA
4. Must be able to achieve at least 5 dB(A) reduction
5. Schools abate: L10 worst hour >50 dB(A) inside or 60-70 dB(A) outside, 5 dB reduction must be achieved
6. Rural areas: alignment efforts should be made if levels are below 55 dB(A) but have increased by 10 dB over pre-project levels
7. Cost: $15k/directly facing residential unit

Austria (Fahrensteiner)
1. Land use/Facility Type: The type of land use with its standardized max noise level determines the necessary decrease of noise level depending on the surroundings.
2. cost: will limit the possible solutions but should not prevent the most effective solution.

Italy-Gervasio
Important items
1. build versus no-build noise levels
2. number of exposed persons
3. cost

Question #10: Are you aware of any information (studies, documents, reports, etc.) that may be helpful in determining if abatement is reasonable and/or feasible for special land uses?

AL DOT - no answer
AR DOT- no answer
AZ DOT- no
CA DOT - no
CO DOT - no answer
CT DOT- no
HI DOT - no answer

IA DOT- no
ID DOT- no. specific land uses haven't been an issue in this jurisdiction.
IN DOT- yes. the June 12, 1995 memo from FHWA in IV E, p.27. also the Audible Landscape.
KY DOT- no
LA DOT- no
MA DOT - no, but I am considering developing guidelines for MHD. I would like to be further assistance in this study.

ME DOT- US CFR 23-772, Highway Traffic Noise Analysis and Abatement Policy and Guidance- June 1995

MI DOT- no
MN DOT- no answer
MO DOT- no
MS DOT- no
NE DOT- no answer
NH DOT - no
NJ DOT- no
NV DOT - no
NY DOT - only on previous project reports
OK DOT - no answer
PA DOT- no
SC DOT - no
TN DOT- no
UT DOT - no
WI DOT- no
WY DOT - no

Others:

Austria- please see enclosed examples of literature
Wakefield Acoustics- no answer
TN EPO - no answer