Inventory and Priority Rating of Potential Type II Noise-Abatement Sites in Georgia

DAVID M. CONNER

Type II abatement is a federal-aid project for noise abatement on highway sections that have existing noise impacts and are not part of proposed federal-aid construction or reconstruction. The Federal-Aid Highway Manual lists three basic requirements for type II abatement: an inventory of potential type II sites within the state, a list of these sites in order of priority, and a detailed design noise study report. The first two are given in this paper, and the design noise study report will be performed on a project-by-project basis. The greatest number of sites was found in the Atlanta metropolitan area. They were put in order of priority by using four criteria: present noise level, estimated cost per dwelling for abatement, existence of the dwelling before or after building of the highway, and public involvement. Categories were used instead of a rigid priority list in order to allow some flexibility in the order in which abatement projects are carried out. The categories were arranged in 10 site groups; priorities ranged from category 1 (highest) to category 5 (lowest).

The Federal-Aid Highway Program Manual (1) established a means by which to obtain federal aid for noise abatement on highway sections that have existing noise impacts and are not part of proposed federal-aid construction or reconstruction and were constructed prior to May 14, 1976. These projects are identified as type II projects in the manual and will be referred to as such throughout this paper. These noise-abatement projects are not mandatory requirements of the Federal-Aid Highway Act of 1970 [P.L. 91-605, Title 23, U.S. Code, Section 109(i)] and are therefore not required by the manual. Instead, they offer states the opportunity to mitigate existing noise problems with the aid of federal funding. Few, if any, states could afford the high costs of noise abatement without such assistance.

The Georgia Department of Transportation (GDOT) recognized the need for type II abatement. Therefore, the purpose of this paper is to partly fulfill certain requirements that would allow GDOT the flexibility to propose and implement type II abatement. Among these requirements are an inventory of potential sites within the state, a list of these sites in order of priority, and a detailed design noise study report of sites actually proposed for type II abatement. In this paper, the inventory and priority listing are given. The subsequent design noise studies will offer detailed information on length, height, and position of barriers and on costs and attenuation. Social, economic, and environmental effects of the proposed abatement will also be included in the design noise study report.

The results of this paper and subsequent approval by the Federal Highway Administration (FHWA) are in no way indicative of a commitment by GDOT or FHWA to provide type II abatement at the sites listed nor is the listing intended to be all-inclusive. The list of sites will be continually updated. Proposed abatement will be coordinated with public involvement in mind.

INVENTORY OF POTENTIAL TYPE II SITES

To identify potential type II sites for the state, an inventory was performed. However, because of the monumental scope of such a task, empirical, analytical, and site-observation analyses were performed. By using this approach, the system was then reduced to a workable size. The steps taken and methods used will be described.

The first and largest reduction of the system was the elimination of free-access facilities. The reason for this exclusion was the difficulty of effective noise-barrier construction along free-access routes. With few exceptions, the need for access eliminates the use of physical barriers. Access would also necessitate breaks in the barrier, which in turn would reduce its effectiveness to an unacceptable level.

The system was further reduced by eliminating those portions of roadway in the work program for which an environmental assessment was to be performed in the near future. These portions were excluded because the noise analysis performed as a normal part of the environmental analysis identifies the need for abatement. The remaining system consisted of the Interstate network of Georgia minus those portions in the work program.

To identify those sites that had the greatest need for abatement, a further refinement of the system was performed. This consisted of an in-house analysis by using the FHWA Traffic-Noise-Prediction Model to eliminate those portions of the rural Interstate system that have low traffic volumes and are not likely to exceed the design noise standard. Due to the variability of urban rights-of-way, only rural Interstate highways were considered for this analysis. The FHWA model was run for different amounts of average annual daily traffic (AADT) to determine a minimum volume that would result in noise levels in excess of the design noise standard at a given distance. Any portion of rural Interstate that had volumes lower than this value was eliminated from further consideration. The following input data were used for this analysis:

1. Traffic volume: variable,
2. Percentage of trucks: 15 (11 percent heavy trucks, 4 percent medium trucks),
3. Peak-hour percentage: 10,
4. Speed: 55 mph,
5. Distance: 200 ft,
6. Topography: flat,
7. α-Value: 0.5, and
8. Angle of exposure: -90° to 90°.

These values were used because they are typical for rural Interstate highways. The analysis indicated that any AADT less than 22 500 vehicles was not likely to produce an impact [71 dB(A) or higher] for rural conditions. The Traffic Map for the State Highways of Georgia prepared by GDOT in cooperation with the U.S. Department of Transportation was then used to eliminate those portions of the rural Interstate system that had current AADTs less than 22 500 vehicles. The portion of roadways in Georgia that had to be visually inspected was reduced to approximately 525 miles of Interstate. Figure 1 is a map of the system inventoried.

The final step of the inventory was to visually inspect the remaining network and identify potential sites along these routes. To perform this function, representatives of GDOT rode each section of roadway. To ensure uniformity of the sites chosen, each team was given a set of criteria to use in

Figure 1. Inventoried portion of Georgia's roadway system.

qualifying a site for further consideration. These criteria included the type and number of structures, the topography, the density of impacts, and the feasibility of abatement at the site. Information was then gathered at each site to aid in further analysis and priority rating of the sites. Typical information included a detailed decription of the location, photographs, a written description, cross-section sketches, and ambient noise readings at the site.

The results of the inventory showed that the greatest number of sites was located in the Atlanta metropolitan area. Figure 2 shows the location of the sites for the rest of the state, and Figure 3 shows the sites in the Atlanta area.

PRIORITY RATING OF TYPE II SITES

The final analysis for this report was the priority rating of the 48 sites identified in the inventory. Five priority categories were established; there were 10 sites in each category except category 5, which had only 8. Category 1 consisted of the highest abatement need; category 5, the lowest. The method used to rate the sites provides individual priority values; however, it was felt that a group of 10 sites would be more appropriate because of the number of input values and assumptions used. This would also allow some flexibility to the order in which abatement projects would be implemented; i.e., any category 1 project may be chosen for implementation, since they are all assumed to be equal in value.

The final decision for abatement will come from the administrative level and will be based on the priority list, the existing construction program, the funds available, the ease of implementation, and public interest. Decisions for abatement will be discussed in the design noise study report.

The Federal-Aid Highway Manual suggests some factors to consider in rating type II abatement sites. A list of 17 such factors is given below:

1. Applicable state law,
2. Type of development to be protected,
3. Magnitude of traffic noise impact,
4. Benefit/cost ratio,
5. Population density of affected area,
6. Day and night use of property,
7. Feasibility and practicability of noise abatement at site,
8. Availability of funds,
9. Existing noise levels,
10. Achievable noise reduction,
11. Intrusiveness of highway noise,
12. Attitude of public,
13. Efforts by local governments to control land use adjacent to highway,
14. Date of construction of adjoining development,
15. Increase in traffic noise since development was constructed,
16. Local noise ordinances, and
17. Feasibility of abating noise by using traffic-control measures.

These priority factors were applied in this paper or will be applied in the design noise study as follows: for the inventory, factors 3, 4, 5, 6, 9, 11, 12, 14, and 15; for the priority rating, factors 2 and 7; and for the design noise study, factors 8,

Figure 2. Sites outside Atlanta area.

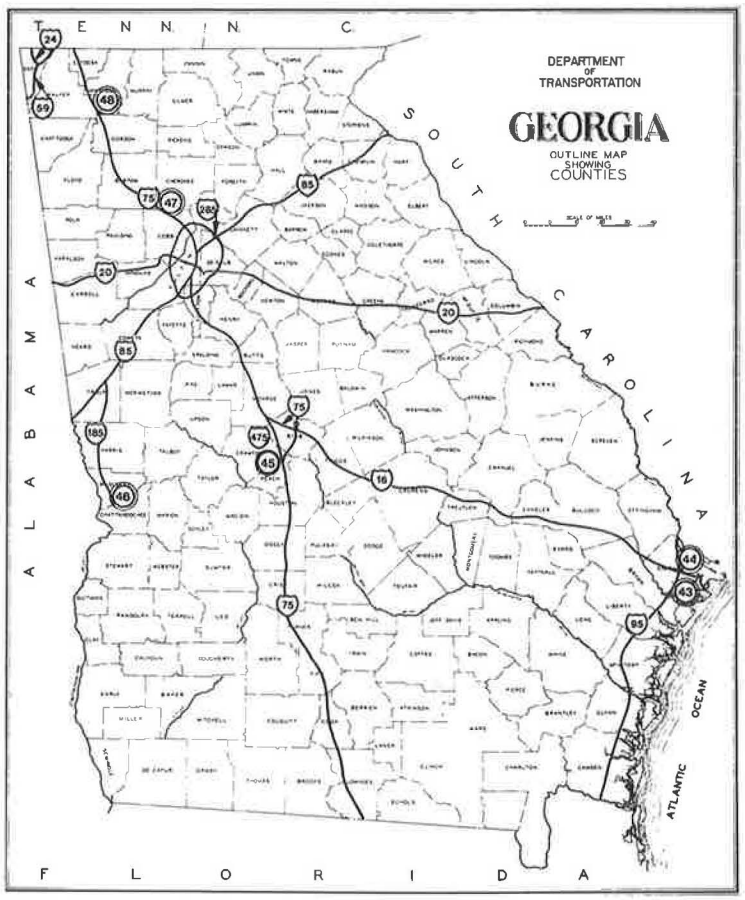
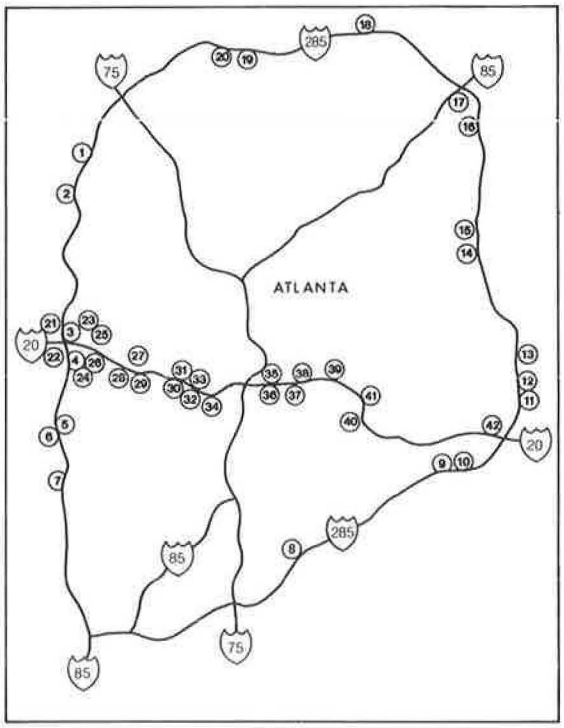


Figure 3. Sites in Atlanta area.



10, and 17. Factors 1, 13, and 16 were not applicable.

Four major variables were used to establish the priority list. These were the predicted present L10 noise levels, the estimated cost per dwelling for abatement, existence of the dwelling before or after building of the highway, and public participation. These variables were assigned a range of weighting values based on relative importance and impact; the sum of the four equaled the priority standing. (An explanation of the method used will follow.) All other factors for the inventoried sites were assumed of equal importance. This equality was based on the uniformity of the inventory criteria and the assumption that any discrepancies would be corrected in the design noise study report.

Noise Level

Noise level was the most important factor in considering the potential for type II abatement at a site, since noise level is the basis for impact determination. A value from 0 to 100 was assigned to each site according to the magnitude of the predicted noise level. L10 noise levels were predicted by using the FHWA Traffic-Noise-Prediction Model. To determine these levels, AADTs were obtained from the 1979 Georgia State Highway System Traffic Map. Peak-hour and truck percentages for the various sites were provided by the GDOT Project Analysis Bureau. The model was run for each site by using the same input data as those used for eliminating sections of rural Interstate highway

from the study (listed in the previous section) except for distance, which varied in this analysis.

The resulting L10 dB(A) noise levels at the 48 sites ranged from 69 dB(A) to 74 dB(A). A linear interpolation was used to produce the following weighting values for each noise level:

L10 [dB(A)]	Weighting
69	0
70	20
71	40
72	60
73	80
74	100

Cost per Dwelling

The cost per dwelling for abatement was also an important factor. Consideration of the finite source of funds available for abatement aided in maximizing the number of persons for whom abatement could be provided. A value of 0 to 75 was assigned to each site dependent on the cost per dwelling for abatement for each barrier site. Several assumptions were made to compute the barrier costs. With the exception of sites 34 and 35, an average barrier height of 14 ft was assumed and an in-place cost of $10/ft^2, or $140/linear ft. Sites 34 and 35 were public housing projects that had three-story buildings; therefore, a barrier height of 20 ft was assumed and an in-place cost of $15/ft^2, or $300/linear ft. These values were based on literature that pertained to barrier heights and costs throughout the United States. The barrier length for each site was then estimated from field inspection or aerial photography. End overlap was also included in the estimates of barrier length. The cost per foot of barrier was then multiplied by the barrier length to obtain total barrier cost. This value was divided by the number of dwellings protected to produce the cost per dwelling for abatement. The highest cost per dwelling ($70 000) was assigned a weighting value of 0, whereas the lowest cost per dwelling ($10 500) was assigned a value of 75. A linear interpolation was performed to provide the weighting values for the intermediate cost per dwelling by using the following equation:

$$X = \{[(70\,000 - 10\,500) - (Y - 10\,500)]/(70\,000 - 10\,500)\} \times 75 \quad (1)$$

Table 1. Summary of data.

Site No.	L10 Noise Level	No. of Dwellings	Barrier Length Required (ft)	Barrier Cost ($000s)	Barrier Cost per Dwelling ($)	Weighting Value: Noise Level	Cost per Dwelling	Existence Before or After Highway	Public Involvement	Total	Category
1	69	7	3000	420	60 000	0	10	0	0	10	5
2	69	17	2000	280	16 471	0	70	0	0	70	5
3	72	28	3250	455	16 250	60	70	0	0	130	4
4	70	11	1500	210	19 091	20	65	50	0	135	3
5	70	28	4500	630	22 500	20	60	0	0	80	5
6	70	39	5500	770	19 744	20	65	0	0	85	4
7	74	5	1500	210	42 000	100	35	0	0	135	3
8	70	11	2000	280	25 455	20	55	0	0	75	5
9	71	22	4000	560	25 455	40	55	0	0	95	4
10	71	7	2250	315	45 000	40	30	0	0	70	5
11	73	6	550	77	12 833	80	70	50	25	225	1
12	74	7	800	112	16 000	100	70	50	25	245	1
13	73	25	2500	350	14 000	80	70	50	25	225	1
14	73	23	2500	350	15 217	80	70	50	25	225	1
15	73	23	2100	294	12 783	80	70	50	25	225	1
16	72	7	2500	350	50 000	60	25	50	25	160	2
17	71	21	1600	224	10 667	40	75	50	25	190	2
18	70	11	3500	490	44 545	20	30	0	25	75	5
19	73	6	800	112	18 667	80	65	0	0	145	3
20	71	6	1500	210	35 000	40	45	0	0	85	4
21	72	40	3000	420	10 500	60	75	0	0	135	3
22	71	25	3200	448	17 920	40	65	0	0	105	4
23	69	5	1800	252	50 400	0	25	50	0	75	5
24	69	8	1000	140	17 500	0	65	50	0	115	4
25	71	12	1600	224	18 667	40	65	50	0	155	2
26	71	9	1000	140	15 556	40	70	50	0	160	2
27	72	10	1500	210	21 000	60	60	50	25	195	1
28	72	8	2250	315	39 375	60	40	50	0	150	3
29	72	6	1500	210	35 000	60	45	50	0	155	2
30	72	13	2000	280	21 538	60	60	50	0	170	2
31	72	50	4500	630	12 600	60	70	50	0	180	2
32	72	10	3000	420	42 000	60	35	50	0	145	3
33	72	6	3000	420	70 000	60	0	50	0	110	4
34	73	40	1600	480	12 000	80	75	0	0	155	3
35	74	60	2100	630	10 500	100	75	0	0	175	2
36	74	7	2400	336	48 000	100	30	50	0	180	2
37	74	16	1500	210	13 125	100	70	50	0	220	1
38	74	5	1200	168	33 600	100	45	50	0	195	1
39	74	27	3000	420	15 556	100	70	50	0	220	1
40	74	16	3000	420	26 250	100	55	0	0	155	2
41	70	34	5400	756	22 235	20	60	0	0	80	4
42	69	22	2700	378	17 182	0	65	0	0	65	5
43	69	56	4300	602	10 750	0	75	50	0	125	4
44	69	48	4200	588	12 250	0	75	50	0	125	4
45	71	36	4500	630	17 500	40	65	50	0	155	3
46	73	40	4000	560	14 000	80	70	0	0	150	3
47	74	45	4000	560	12 444	100	75	50	0	225	1
48	72	10	1000	140	14 000	60	70	0	0	130	3
Total		974		17 686							

Note: Average cost per unit for abatement, $18 158; average cost of noise-abatement barrier, $368 458.

where X is the weighting factor and Y is the cost per dwelling to abate. The values produced from this formula were rounded to the nearest fifth increment so as to ease computation and not overstate the level of significance of the answer.

Existence Before or After Highway

Whether the dwelling was in existence before or after the highway was built was also an important factor. This factor considered the intrusiveness of the highway noise as well as the noise increase experienced by a receptor because of the highway. High noise increases and intrusiveness are associated with new-alignment highways. Persons who build adjacent to an existing facility move into a noise environment and usually become accustomed to it. New highways, however, invade an existing environment and usually cause sharp noise increases in a short time. Therefore, those receptors in existence prior to the building of the highway deserve greater consideration for abatement than do those that were built adjacent to an existing highway. A weighting value of either 0 or 50 was assigned this consideration; 0 was assigned to those sites developed adjacent to an existing highway and 50 was assigned to those in existence prior to the highway.

Public Involvement

The final weighting factor considered was public involvement. This factor is equal to either 0 or 25, based on correspondence and contacts by citizens with the department. This factor was determined important because those communities that made contact had reached an annoyance level that caused them to take action.

It is apparent that the above factors were not given equal importance. The total weighting value (or priority number) can now be calculated as the sum of the four factors above. The lowest value would be 0 and the highest value would be 250, for example:

Noise level (100) + cost per unit (75) + existence before or after highway (50) + public involvement (25) = 250.

Table 1 provides a complete summary of the data for this analysis. The priority categories and the sites that fall into each are listed below:

Category	Site
1	11, 12, 13, 14, 15, 27, 37, 38, 39, 47
2	16, 17, 25, 26, 29, 30, 31, 35, 36, 40
3	4, 7, 19, 21, 28, 32, 34, 45, 46, 48
4	3, 6, 9, 20, 22, 24, 33, 41, 43, 44
5	1, 2, 5, 8, 10, 18, 23, 42

The relative importance assigned each area above was a subjective decision of GDOT. However, the department felt that these weightings were reasonable based on past experiences and experiences of other states.

CONCLUSIONS

This paper provided a relative priority listing of potential type II abatement sites for the state of Georgia. The list was not intended to set a rigid priority but rather to serve as a guide for further considerations. The total cost of abatement ($17 686 000) prohibited the implementation of noise abatement for all sites.

The priority list will be updated on a continuous basis as warranted. This may result in the addition, deletion, or shift in priority of a site.

Any request for type II abatement funding will be accompanied by a design noise study report that justifies the site choice and refers to this paper.

REFERENCE

1. Federal-Aid Highway Program Manual. Federal Highway Administration, U.S. Department of Transportation, Vol. 7, Chapter 7, Section 3, 1976.

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Simplified Traffic-Noise-Prediction Model for Transportation and Land Use Planning

CHRISTOPHER N. BLAIR AND SUSAN D. LUTWAK

An empirical model for the estimation of Leq noise levels along urban and suburban streets has been developed. The only required data inputs are classified traffic counts, and the computational technique is appropriate for a hand calculator. In addition to a description of the model, a brief history of its development and experimental verification is included. Advantages and limitations of the model are depicted. Suggested applications by land use and transportation planning staffs are described.

Planners and engineers who work in small cities are continuously faced with the need to understand and to analyze large amounts of data for a multitude of different purposes. Data will flow into offices from applicants who seek to develop a housing site, petitioners who desire to widen a street, and residents who are lobbying to relocate an industrial plant or move the offending access road. If there are enough staff, time, funds, and the proper tools, a considered analysis of requests can be made. However, there never seems to be adequate funds, staff, or time. Coupled with this inflow are the professionals' other duties, which include the fulfillment of state and federal data requests and the submission of applications for federally funded programs. Requests for zoning variances, reviews of environmental-assessment forms, and attendance at community meetings consume other portions of the