MASTER

NOISE POLLUTION FROM EXPRESSWAYS

ENVIRONMENTAL POLLUTANTS and the URBAN ECONOMY

Argonne National Laboratory
Energy and Environmental Systems Division

The University of Chicago
Center for Urban Studies

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by

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NOISE POLLUTION FROM EXPRESSWAYS

The Problems of Expressway Noise

Noise has been an integral part of urban life for as long as cities have existed. The problem of neighborhood noise—the noise level experienced on sidewalks in residential and commercial areas—has become more serious with increased automobile traffic and higher residential densities. A recent national survey revealed that noise is the most frequently cited neighborhood problem.

As household incomes have risen to allow more resources to be spent in securing a pleasant environment, and as awareness of environmental factors has sharpened, attention has been focused upon strategies to deal with unwanted sound.

Until recently, the problem had been tackled through prohibition of certain activities that violate public nuisance statutes. For example, airports have been prevented from operating at night in order not to disturb nearby residents. However, the cost of an injunction may exceed the cost of the noise itself, and an injunction is particularly ill-suited to deal with the problem of noise from a large number of sources. The U. S. Environmental Protection Agency (EPA) has turned to the consideration of alternative policies, including a number aimed at reducing noise emissions or interrupting the path of noise. This paper provides an economic analysis of three noise abatement strategies designed to interrupt the path of noise between highways and residential areas, and makes some abatement policy suggestions.

By estimating the noise level surrounding Chicago's expressways, it was possible to conclude that the total cost of expressway noise was \$1.1 million annually.

The Cost of Expressway Noise in Chicago

The value of noise attenuation policies depends upon the costs imposed by the noise. There is little or no information on the medical or psychological impact of noise levels as low as those experienced near expressways (65-75 dBA); therefore, the nuisance cost of noise was estimated by determining the decline in property values that could be attributed to the noise level in a neighborhood. Noise levels were measured at 233 locations in the city of Chicago outside homes whose sale price was known. These locations were selected at random from a much larger number of possible locations which varied widely with respect to both the distance to the nearest freeway and the local noise level. The noise index used corresponds to the EPA measure of Equivalent Sound Level.

The results of the analysis suggest that there is no appreciable nuisance value to noise levels below 50 dBA and that the level of damage is related to the price of the home. Table 1 shows the calculated damage from different noise levels for residences of various prices. These estimated damages, measured as net reduction in property value due to the specified noise levels, were obtained from multiple regression techniques holding all other factors constant.

Using census block data, it was calculated that in Chicago expressway noise affected 5,000 owner-occupied dwellings with a median value of \$17,600, and 16,000 rental units with a median value of \$10,500. By estimating the noise level surrounding Chicago's expressways, it was possible to conclude that the total cost of expressway noise was \$1.1 million annually. When alternative assumptions concerning the distribution of homes near expressways and the noise levels were used, high and low damage estimates of \$1.8 and \$0.8 million annually were obtained.

Screening Expressway Noise

There are three basic methods for screening noise emissions from moving vehicles from nearby homes involving erection of a physical barrier adjacent to the expressway: (1) planting a strip of trees and shrubs 100 feet wide, (2) erecting an eight foot high earth berm, and (3) constructing an eight foot high supported concrete wall. The planting approach costs approximately \$66,000 for one city

TABLE 1. Damage Estimates at Various Noise Levels and Dwelling Unit Values (\$/year)*

Dwelling Unit Value in Dollars	Sound Pressure Level Noise Index in dBA										
	50	52.5	55	57.5	60	62.5	65	67.5	70	72.5	75
10,000	0	16	33	50	67	85	102	121	139	158	176
15,000	0	25	50	75	101	127	154	181	208	236	265
20,000	0	33	66	100	134	169	205	241	278	315	353
25,000	0	41	83	125	168	212	256	301	347	394	441
30,000	0	49	99	150	202	254	307	361	416	473	529
35,000	0	57	116	175	235	296	358	422	486	551	618

*Capitalized costs were converted to annual costs assuming a 10% discount rate.

block length (660 ft) and reduces the noise level by 5 dBA. Constructing an earth berm costs \$17,500 (or \$29,000 if the soil must be shipped to the site) for the same length and reduces the noise level by 10 dBA. Building a concrete wall costs \$42,900 and reduces the noise by 10 dBA.

Using the damage estimates in Table 1, it is possible to compute the number of houses, at several price levels, that must be affected by noise for each of these three abatement measures to be cost beneficial -- that is, for the benefits of the abatement measure to equal or exceed the costs. Table 2 shows the critical residential densities for each noise-screening method, assuming different initial noise levels. It is clear that the high cost and limited effectiveness of a shrubbery strip make it unlikely to prove cost-beneficial. However, both the berm and wall will be cost beneficial for relatively low densities. For reference, the average city residential block in Chicago may contain as many as 45 or 50 single family homes.

Highway noise also can be reduced by constructing depressed highways, which results in noise levels 5 to 10 dBA lower than those from an expressway that is level with the surroundings. The additional costs of excavation should be weighed against the benefits of the noise reduction.

TABLE 2. Residential Densities, per Block, Necessary to Make Noise Abatement Measures Cost Effective, by Housing Price and Initial Noise Level

House Value	Measure	Initial Noise Level (dBA)		
		65	70	75
\$10,000	Planting	186	181	177
	Berm*	25 42	24 40	24 39
	Wall	62	60	58
\$15,000	Planting	124	121	118
	Berm	17 28	16 27	16 26
	Wall	41	40	39
\$20,000	Planting	94	91	88
	Berm	13 21	12 20	12 20
	Wall	31	30	29
\$25,000	Planting	75	73	71
	Berm	10 17	10 16	9 16
	Wall	25	24	23
\$30,000	Planting	62	60	58
	Berm	8 14	8 13	8 13
	Wall	21	20	19

*The first entry indicates the break-even (i.e., benefits equal costs) density for the low cost berm constructed with on-site soil, while the second indicates break-even density for a berm constructed from soil shipped to the site.

Policy Implications

Two principal conclusions can be reached from the results of this analysis:

1. No general principles concerning the appropriateness of screening devices can be established. Each section of an expressway should be examined with respect to both the number and value of properties affected by noise and the opportunities for noise attenuation. The extremely high cost and low efficiency of shrub plantings indicate that this approach would only rarely provide a cost-beneficial solution for noise abatement. The relatively high effectiveness of earth berms and walls promises many opportunities for cost-beneficial noise reduction programs.
2. Depressed expressways result in reduced noise levels in surrounding communities. The value of this reduction should be included in expressway planning.

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