REFERENCES

1. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. U.S. Environmental Protection Agency, Rept. 550/9-74-004, March 1974.
2. T.J. Schullz and W.J. Galloway. Noise Assessment Guidelines--Technical Background. Office of Policy Development and Research, U.S. Department of Housing and Urban Development, BBN Rept. 3319 R, 1979.
3. E.J. Rickley, D.W. Ford, and R.W. Quinn. Highway Noise Measurements for Verification of Prediction Models. Federal Highway Administration, U.S. Department of Transportation, Rept. DOT-TSC-FHWA-78-1, Jan. 1978.

Publication of this paper sponsored by Committee on Transportation-Related Noise.

Comparison of Sound-Level Predictions by SNAP 1.0 and STAMINA 1.0 Highway Traffic-Noise-Prediction Programs

GLENDA J. SISSON AND WILLIAM BOWLBY

A comparison is made of the sound-level predictions by two highway traffic-noise-prediction programs—the Simplified Noise-Analysis Program (SNAP 1.0) and the Standard Method in Noise Analysis (STAMINA 1.0). These programs were published in 1979 by the Federal Highway Administration. The purpose of the study was to determine whether the two programs yield the same Leq and L10 sound-level predictions given the same simple site parameters. To accomplish this, computer runs were formulated to compare the handling of angular adjustments, dropoff rate as distance was changed, barrier attenuations, and nonparallel roadway segments by the two programs. Based on the data compiled for this paper and the resulting changes planned to be made to the programs, the user may feel confident that the SNAP and STAMINA programs will yield the same Leq values if given the same site parameters in almost all cases. The L10 predictions also agree well except in cases in which ratios of number of vehicles and distance to speed occur that are below 30 m/km.

The Simplified Noise-Analysis Program (SNAP 1.0) and Standard Method in Noise Analysis (STAMINA 1.0) program were published in 1979 by the Federal Highway Administration (FHWA) for predicting highway traffic-noise levels (1,2). SNAP 1.0 is designed for quick sound-level predictions on sites that involve simple site geometries. STAMINA 1.0, developed from the TSC MOD-04 prediction program, is able to handle more-complex site geometries than can SNAP 1.0 and allows the user to change parameters without having to make separate computer runs. Previous noise-level-prediction programs, given the same site parameters, were found to produce different predictions. In hopes of correcting this and other problems, the FHWA Highway Traffic-Noise-Prediction Model (3) and the resulting SNAP 1.0 and STAMINA 1.0 computer programs were developed. The purpose of this study is to determine how well the levels predicted by these two new programs agree when given the same simple site geometries.

PROCEDURE

Due to the limitations of SNAP 1.0, only the Leq and L10 levels of simple site geometries were considered in this study, and International System (metric) units were used. The sites were level and roads were parallel to the tops of barriers. Both hard (pavement, packed dirt, etc.) and soft (grass, vegetation, etc.) sites ($\alpha = 0, 1/2$) were included.

A road or barrier length of 4000 m was considered to be infinite for the receiver locations used. A traffic speed of 100 km/h and traffic flow of 2275 vehicles/h that consisted of 2000 automobiles, 75 heavy trucks, and 200 medium trucks were used for most data and will be referred to as standard traffic in this report.

The Cartesian coordinate system is used by both SNAP 1.0 and STAMINA 1.0 to define site geometry and was used here for simplicity. The x-axis runs parallel to the road and the y-axis perpendicular to it. Because STAMINA 1.0 prints out levels to 0.1 dB and SNAP 1.0 to 0.01 dB, the output of SNAP 1.0 was rounded for data comparison.

A series of basic runs was made followed by more-specific runs to investigate discrepancies. Several runs were made on SNAP 1.0 by using a berm and on STAMINA 1.0 by using absorptive strips. In some cases, additional calculations for comparison were made manually by using the charts and figures in the FHWA Highway Traffic-Noise-Prediction Model.

Basic Runs

Handling of angular adjustment was compared for the two programs as follows:

1. The angle included at the receiver between roadway end points was varied by changing the roadway length. As shown in Figure 1, the receiver was located 60 m from the roadway at a height of 1.5 m and centered with respect to the roadway segments. Roadway lengths considered were 100, 200, 400, 800, 1600, and 4000 m, which yielded included angles of 80°, 118°, 146°, 162°, 172°, and 177°, respectively. Both hard and soft sites were considered by using standard traffic. In addition to SNAP 1.0 and STAMINA 1.0, manual computations were compared.
2. The included angle was varied by changing the receiver x-coordinate as shown in Figure 2. Both hard and soft sites were considered by using standard traffic; manula computations were also made.

3. A series of 20° included angles was run by using different roadway-receiver orientations. Manual computations were included.

Figure 1. Angular adjustments for varying roadway lengths.

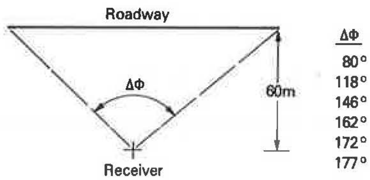
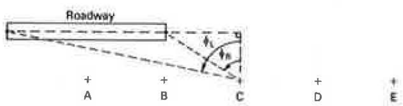
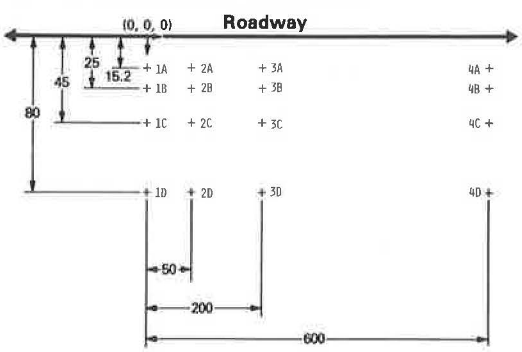


Figure 2. Angular adjustments for varying receiver x-coordinates.



Angle	Receiver				
	A	B	C	D	E
ϕ_L	−59°	−73°	−79°	−81°	−83°
ϕ_R	59°	0°	−59°	−73°	−79°

Figure 3. Receiver locations for barrier runs.



Next, the dropoff rate on hard and soft sites was compared for the two programs by changing the receiver's distance from an infinite roadway. Receivers at a height of 1.5 m were located 15.2, 20, 30, 40, 50, 60, 70, 80, 90, and 100 m from the roadway.

The third set of basic runs was made to compare the barrier-attenuation predictions under numerous barrier situations and the angular adjustments of shielded and unshielded roadway segments. All initial runs were made on a hard site that had an infinite roadway and standard traffic. The receivers were located as shown in Figure 3. Barriers were positioned 5, 10, 30, and 60 m from the roadway at heights of 2, 5, and 10 m. Barrier lengths of 200, 400, 800, 1600, and 4000 m were used. This is illustrated in Figure 4.

Barrier attenuation as a function of Fresnel number was compared by using an infinite barrier 5 m from the roadway at heights of 0, 2, 4, 8, 16, 32, and 64 m. (These extreme heights were used to find the limiting value and were not intended to represent a real-world situation.) A receiver 15.2 m from the roadway was used on an infinite roadway that carried 2000 automobiles at 100 km/h. Manual computations were also made and included in the comparisons.

The last basic run was made to check handling of nonparallel roadway segments. A run was made that simulated a curved roadway that carried standard traffic on hard and soft sites.

Additional Runs

Runs were formulated to study the relationship between the adjustment of L10 and Leq and the ratio of number of vehicles and distance to speed (ND/S) for both SNAP 1.0 and STAMINA 1.0 programs. ND/S is determined by the following calculation:

ND/S = (number of vehicles/hour) X distance
to receiver ÷ speed of vehicles.

In some of the barrier cases, inconsistent predictions were obtained from the SNAP 1.0 program. To investigate this, additional runs were made by using the SNAP 1.0 eight-table output,

Figure 4. Barrier problems.

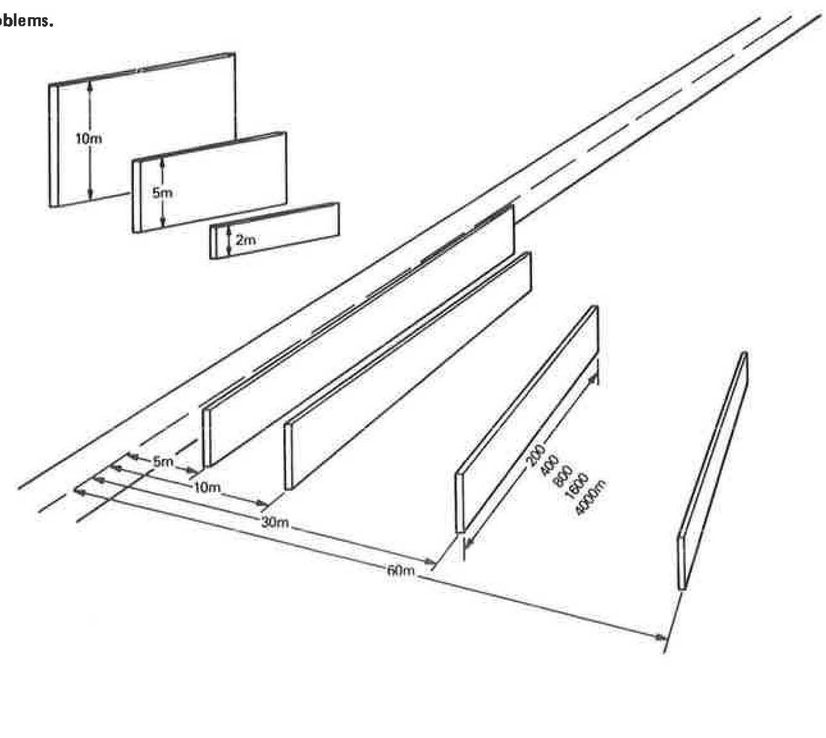


Table 1. Leq and L10 levels for two barriers.

	Barrier A				Barrier B			
	Leq[dB(A)]		L10[dB(A)]		Leq[dB(A)]		L10[dB(A)]	
Receiver	SNAP	STAMINA	SNAP	STAMINA	SNAP	STAMINA	SNAP	STAMINA
1A	66.6	63.7	69.1	66.7	61.8	59.5	64.3	63.0
B	66.5	65.8	69.4	68.7	61.1	59.9	63.9	62.7
C	66.9	66.6	69.9	69.2	60.9	60.1	63.9	62.2
D	66.8	66.6	69.7	69.1	60.9	60.2	63.8	62.1
2A	67.7	64.9	70.3	68.1	61.8	59.5	64.3	63.0
B	67.7	67.0	70.5	70.1	61.1	59.9	64.0	62.8
C	67.9	67.6	70.8	70.7	61.0	60.2	63.9	62.4
D	67.4	67.2	70.3	70.0	61.0	60.3	63.9	62.2
3A	78.2	78.3	80.7	81.9	62.7	60.2	65.2	63.6
B	75.9	76.0	78.8	79.5	62.1	60.2	65.2	63.6
C	73.2	73.2	76.2	76.5	62.2	61.5	65.1	64.2
D	70.4	70.3	73.3	73.3	62.2	61.7	65.1	64.2
4A					78.2	78.3	80.7	81.9
B					76.0	76.0	78.9	79.5
C					73.3	73.3	76.3	76.6

Note: Barrier A was 200 m long, 10 m from roadway, and 10 m high; barrier B was 800 m long, 10 m from roadway, and 10 m high.

which separates the contributions from shielded and unshielded roadway segments. Shielded-segment levels are also given with and without barrier attenuation. Both hard and soft sites were studied for receivers 1A, B, C, and D. The barrier was located 10 m from the road at heights of 2, 5, and 10 m. Barrier lengths of 200 and 400 m were used.

SNAP 1.0 runs were made for barrier attenuations that approached the maximum attainable value of 20 dB(A) for thin-screen barriers and 23 dB(A) for berms to investigate unusual results obtained from the basic barrier-attenuation runs described above.

Barrier attenuation as a function of receiver height was compared for hard and soft sites. An infinite barrier 10 m from the roadway and 5 m high was used; the receiver was located behind the barrier 15.2 m from the road.

A run was made for a soft site that had no barrier and one that had a barrier of zero height on both SNAP 1.0 and STAMINA 1.0 to investigate the change from soft to hard site for receivers behind a barrier but not shielded by it.

A limited analysis was made regarding the absorptive-strip function of STAMINA 1.0. Situations were run that varied location, width, and length of the strips. Also varied were receiver height and location relative to the strip centerline. Both hard and soft sites were used.

RESULTS

Discussion of Comparisons of Leq

Angular Adjustments

The angular-adjustment problems run compared favorably for Leqs on hard and soft sites. In almost all cases, the difference was less than 0.2 dB(A). In the few cases in which differences greater than 0.5 dB(A) were encountered between the two programs and the manual method, the problem was attributed to the difficulty in reading the manual figures and tables.

Dropoff Rate

When receiver distance was varied to compare the dropoff rate when distance from the receiver increased, the Leq predictions of the two programs agreed excellently. The difference did not exceed 0.1 dB(A) for both hard and soft sites.

Barrier Distance from Roadway

To compare cases in which the barrier distance from the roadway was varied as shown in Figure 4, an infinite barrier 2 m high was used. The road was also infinite; it carried 2000 automobiles that traveled 100 km/h. Receiver 1D was used (Figure 3). The Leq predictions of the three methods used compared favorably. The greatest difference was 0.4 dB(A) for the barrier located 60 m from the road.

Barrier Length and Distance from Roadway

On runs in which barrier length and distance from the roadway were varied, good Leq prediction agreement [within 0.4 dB(A)] was obtained for a barrier height of 2 m.

When heights of 5 and 10 m were used, agreement was good [within 0.2 dB(A)] for receivers not located directly behind the barrier but varied significantly for those that were. This was more pronounced for a barrier height of 10 m.

The difference between the predictions was as great as 2.9 dB(A) (Table 1) for receiver 1A. In general, SNAP 1.0 predicted higher levels than STAMINA 1.0 did for receivers behind the barrier; the greatest difference was for those receivers closest to the barrier and the amount tapered off as distance increased. For example, Table 1 also shows data for a barrier 800 m long, 10 m from the road, and 10 m high. Note that for receivers 1A, B, C, and D, the SNAP 1.0 Leq levels were higher by 2.3, 1.2, 0.8, and 0.7 dB(A), respectively. However, this pattern of decreasing difference as distance increased did not always occur.

Discrepancies in SNAP 1.0 in Segment Contributions

Data from the barrier 200 m long and 5 m from the road were separated into three roadway segments (left of barrier, shielded, and right of barrier). It was discovered that SNAP 1.0 changed its sound-level predictions before barrier attenuation for identical roadway segments as the barrier height increased. A run was made that used the same roadway segments and receivers but no defined barrier height for additional comparison. The resulting data are shown in Table 2.

It was found that, when there was no barrier attenuation, the SNAP 1.0 Leq predictions for the shielded segment of the road on hard and soft sites

Table 2. Leq levels for barriers 200 m long, 10 m from road, and different heights.

Receiver	Barrier Height (m)	Type of Site: Hard, Type of Barrier: Shielded	Hard, Unshielded	Soft, Shielded	Soft, Unshielded
1A	None	78.15	59.68	77.08	51.89
	2	78.15	59.81	77.08	52.06
	5	78.12	60.72	77.07	53.31
	10	78.01	62.95	77.03	56.41
1B	None	75.71	62.53	73.74	55.82
	2	75.71	62.52	73.74	55.82
	5	75.70	62.65	73.74	55.99
	10	75.65	63.17	73.71	56.72
1C	None	72.55	63.60	69.57	57.33
	2	72.55	63.60	69.57	57.32
	5	72.55	63.62	69.56	57.35
	10	72.52	63.72	69.55	57.50
1D	None	68.96	63.70	65.00	57.42
	2	68.96	63.70	65.00	57.42
	5	68.96	63.70	65.00	57.42
	10	68.95	63.72	64.99	57.45

became slightly lower for receivers closest to the road (15.2 m) as barrier height increased. Since these represent the levels for no barrier, the values should have been identical. The effect virtually disappeared for receivers at greater distances from the road (45 and 80 m).

The changes in predictions were more substantial on the unshielded roadway segments. For example, the Leq for receiver 1A's unshielded segment was 59.7 dB(A) for the run in which no barrier was defined. When a barrier that was 5 m high was used, the Leq for this same segment was 1.0 dB(A) higher. A barrier height of 10 m produces a level of 63.0 dB(A). These three levels should have been identical.

On the soft site, the Leq for receiver 1A's unshielded segment also increased as barrier height increased. The 10-m case yielded 4.5 dB(A) more than the no-barrier case. Again, these values should have been identical, and the effect became less noticeable on more-distant receivers. In all cases, this variation was consistent among the three types of vehicles.

The barrier length was doubled for the hard-site case, and it was found that the contributions from the shielded segment that had no barrier changed less and the unshielded, more. For example, on receiver 1A's unshielded segment, the sound-level prediction was 3.1 dB(A) higher for the barrier 10 m high than for the one that was 2 m high.

This discrepancy did not cause significant changes in the Leq prediction for the total problem since the contribution of the unshielded road segment was at least 10 dB(A) less than that of the shielded segment. This discrepancy would be of concern to users who were examining the noise that reached the receiver from around the ends of a barrier. The solution to this problem is discussed in the last section of this paper.

Barrier Height, Attenuation, and Fresnel Number

Barrier height was varied and the resulting barrier attenuation was plotted as a function of Fresnel number as shown in Figure 5. The plots of the two programs agreed within 0.5 dB(A) until the maximum level was approached. Note that, in Figure 5, the SNAP 1.0 plot terminates at an attenuation of 18.7 dB(A) and Fresnel number of 20. When runs were made by using the higher barriers (16, 32, and 64 m), SNAP 1.0 yielded no barrier attenuation. When additional runs were made, this peculiar behavior was found to be not related to the Fresnel number alone. On all runs made in this study, SNAP 1.0 approached but never produced the maximum attainable field-insertion loss of 20.00 dB(A) for thin-screen barriers or 23.00 dB(A) for berms.

Discussion of Comparisons of L10

The L10 predictions of SNAP 1.0 and STAMINA 1.0 did not compare well. The adjustment of L10 minus Leq was plotted against the ND/S ratio and it was found that SNAP 1.0 agreed quite well with the manual method except for an ND/S ratio of 1.00, at which there was a difference of 0.9 dB(A).

STAMINA 1.0, however, arrives at the adjustment of L10 minus Leq in a different manner. To examine the results, runs were made by using an infinite roadway that had no barrier but other variables that changed. Figure 6 plots the results from SNAP 1.0 and STAMINA 1.0 for ND/S versus L10 minus Leq on a soft site at which S = 100 km/h, D = 15.2 m, and the number of automobiles varies. It is evident that STAMINA 1.0 adjustment of L10 minus Leq varies greatly from that of SNAP 1.0. In particular, STAMINA 1.0 never predicts an L10 level lower than the Leq level as the SNAP 1.0 program and manual method do for low ND/S ratios.

Barrier Attenuation Compared with Receiver Height

Barrier attenuation was examined as receiver height was increased from zero to 17 m for a barrier 5 m high and 10 m from the road. Table 3 shows that the barrier-attenuation prediction of STAMINA 1.0 and SNAP 1.0 on a hard site is within 0.5 dB(A) for receivers without a direct line of sight to the source. For receivers too high to be shielded by the barrier, STAMINA 1.0 gave no barrier attenuation. SNAP 1.0 continued to give some attenuation for these heights although the values were unrealistic. When this same situation was run on a soft site, there was poorer agreement. SNAP 1.0 yielded negative attenuations for unshielded receivers because it automatically switches to the propagation rate for hard sites when a barrier is defined, whether or not it would actually attenuate the levels. This phenomenon is discussed further in the next section.

Soft Site With and Without Barrier

By using no barrier, it was found that SNAP 1.0 changed the shielded segment to a hard site even if the barrier did not block the receiver's line of sight to the source. Because of the resulting loss of excess ground attenuation, the levels that resulted when there was a barrier were higher than those when there was no barrier. STAMINA 1.0 did not change its predictions when there was no barrier present, as shown below:

Condition	SNAP 1.0 Leq [dB(A)]	SNAP 1.0 L10 [dB(A)]	STAMINA 1.0 Leq [dB(A)]	STAMINA 1.0 L10 [dB(A)]
No barrier	68.2	71.5	68.2	71.5
With barrier	72.3	75.2	68.2	71.5
Insertion loss	-4.1	-3.7	0.0	0.0

Nonparallel Roadways

In most cases, nonparallel roadway segments run on hard and soft sites yielded agreement for Leq within 0.1 dB(A).

Figure 5. Barrier attenuation versus Fresnel number.

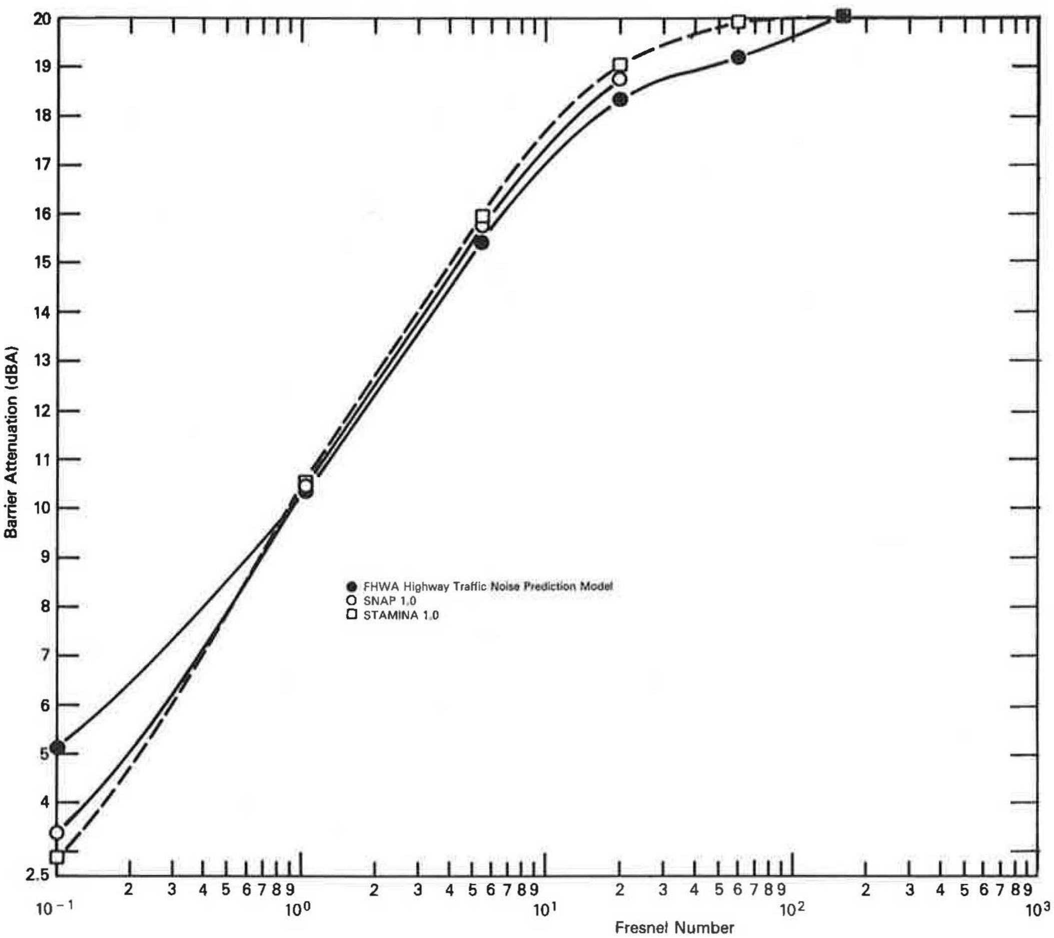


Figure 6. Adjustment of L10 minus Leq for soft site.

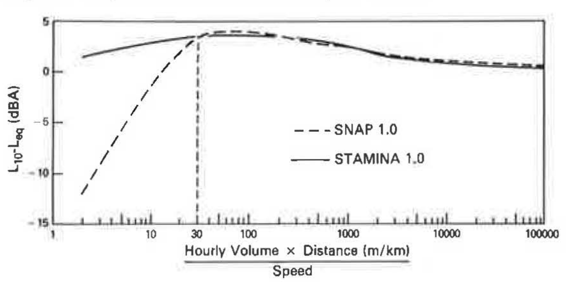


Table 3. Receiver height and barrier attenuation.

Receiver Height (m)	Barrier Attenuation [dB(A)]			
	$\alpha = 0$		$\alpha = ½$	
	SNAP	STAMINA	SNAP	STAMINA
0	17.1	17.6	15.9	16.6
1.5	16.0	16.3	14.7	15.4
2	15.4	15.8	14.2	14.7
3	13.8	14.2	12.6	13.1
4	11.9	12.2	10.7	11.1
5	9.4	9.6	8.1	8.3
6	6.7	6.9	5.4	5.5
7	4.7	4.8	3.4	3.2
8	2.6	1.1	1.1	-0.3
9	0.5	0.0	-1.0	0.0
10	0.1	0.0	-1.5	0.0
11	0.1	0.0	-1.6	0.0
12	-0.1	0.0	-1.7	0.0

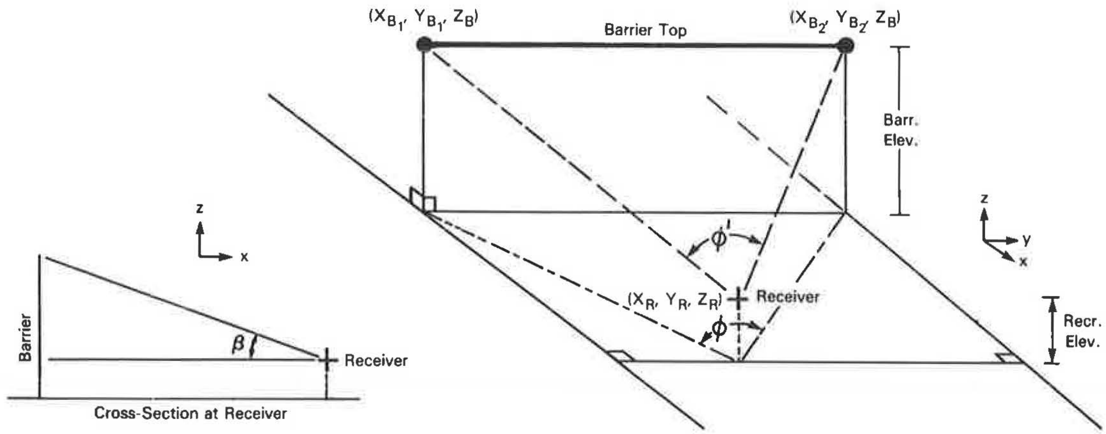
Absorptive-Strip Function of STAMINA 1.0

The data obtained by using the absorptive-strip function of STAMINA 1.0 yielded reasonable results, although no field results were available for comparison. The program appeared to make correct angular adjustments for strips of finite lengths for hard and soft sites and the strip attenuation went to zero for receivers that had a clear line of sight over the strip to the roadway (the program assumes a height of 6 m for trees and 3 m for shrubbery). The location of a strip of a given width between the roadway and the receiver caused no difference in the results except in those cases in which the receiver was located inside a strip's boundaries. For example, when a receiver was located 80 m from the road and separated from the road by strips of trees wider than 80 m, the receiver continued to gain attenuation until a width of 160 m was reached. This should not occur since the additional width did not occur between the receiver and the roadway but beyond the receiver. When a width of 160 m was reached, the attenuation went to zero even though 80 m of the strip was still located between the receiver and the source. Zero attenuation occurred because the centerline of the strip was no longer between the receiver and the source.

CONCLUSIONS AND RECOMMENDATIONS

In general, SNAP 1.0 and STAMINA 1.0 yield

Figure 7. Angles used by SNAP 1.0 in determining barrier and shielded-road sizes.



acceptably close predictions. However, there were some areas of disagreement. Their methods of computing the L10 levels differ and are causing significant disagreement in the results. Adjustments of L10 minus Leq by SNAP 1.0 depend solely on the ND/S ratio and α-value and coincide rather closely with those of the FHWA Highway Traffic-Noise-Prediction Model. STAMINA 1.0 takes factors other than this ratio into account to compute its L10 levels. STAMINA 1.0 never produced an Leq higher than the L10. The data suggest that one or the other of these two methods should be changed to yield more-consistent results.

Some disagreements among the Leq predictions appeared to be caused by problems in SNAP 1.0. Specific problems include the following:

1. The current method by which SNAP 1.0 changes shielded areas to a hard site automatically changes the α-value to zero for shielded areas without checking to see whether the barrier is actually high enough to offer any attenuation to the receiver. High receivers that have a direct line of sight to the noise source over a barrier were given negative barrier attenuations on hard and soft sites. On the soft site, this problem could have been caused by the program's flip to the hard propagation rate for shielded receivers. On the hard site, the cause was not determined, but the difference was only 0.1 dB(A).
2. The barrier field-insertion-loss limit should be revised to 20.00 dB(A) for thin-screen barriers and 23.00 for berms. The program now flips to a value of zero field-insertion loss when the maximum should have been attained.
3. Predictions change for unshielded segments and shielded segments without barrier attenuation when barrier height is altered and all other parameters remain constant. This defect may have been at least partly responsible for some of the other Leq discrepancies (as discussed in the section on Results). Data compiled for this report were not sufficient to draw a conclusion.

However, a discussion with F.F. Rudder, author of the SNAP 1.0 program manual (1), revealed that the cause of some of the problems encountered may have been determined. Situations in which the Leq levels for shielded and unshielded road segments without barrier attenuation were changing as the barrier height was varied may have been caused by the manner in which the SNAP 1.0 program determines the size of the shielded segment of the road. SNAP 1.0 uses the three-dimensional angle ϕ' (Figure 7) for attenuation calculations and also for determining the size of the shielded roadway segment. This angle and hence the size of both the shielded and the unshielded roadway segments are dependent on the height of the barrier. This is determined by $\phi' = \arctan(\tan\phi \cos\beta)$ where β is the angle between the horizontal plane and the normal from the receiver to the top of the barrier. This could also cause the program to see roadway segments when none were defined by the user. To avoid this, there are plans to revise the program so that it uses the horizontal projection (ϕ) of ϕ' to determine the size of the shielded roadway segment while it uses ϕ' for the barrier-attenuation calculations.

Also discussed were the barrier situations in which SNAP 1.0 predicted higher Leq levels than STAMINA 1.0 did for receivers closest to the barrier (1A and 1B). It was determined that this discrepancy could also have been caused by the way in which SNAP 1.0 computes the barrier attenuation. SNAP 1.0 assumes that the maximum path-length difference is located along the normal from the receiver to the barrier and computes all other path-length differences as a function of the cosine of the angle between the rays and the normal. This method varies from that of the STAMINA 1.0 program, which actually computes each path-length difference separately.

Data obtained from use of the STAMINA 1.0 absorptive strips indicates that user discretion is required. In cases in which the receiver is located inside a strip, either no strip attenuation or excessive strip attenuation may be predicted depending on the location of the strip centerline. It was found that the program considers a soft site to be more effective in reducing the sound level than are tree strips up to about 30 m wide. It should also be noted that the tree-strip attenuations of STAMINA 1.0 do not coincide with the general guidelines for the FHWA Highway Traffic-Noise-Prediction Model [5 dB(A) for the first 30 m, 5 dB(A) for the second 30 m, and 10 dB(A) maximum] but were found to agree well with limited field measurements in a study conducted by Pennsylvania State University for FHWA (4).

Thanks to data compiled for this paper and the resulting changes to be made to the programs, the user may feel confident that the SNAP 1.0 and STAMINA 1.0 programs will yield the same values given the same site parameters except for L10 values in cases in which ratios of ND/S occur below 30 m/km.

ACKNOWLEDGMENT

The opinions, findings, and conclusions expressed in this paper are ours and not necessarily those of the Federal Highway Administration.

REFERENCES

1. F.F. Rudder, Jr., and D.F. Lam. User's Manual: FHWA Highway-Noise-Prediction Model, SNAP 1.0. Federal Highway Administration, U.S. Department of Transportation, Rept. FHWA-RD-78-139, Jan. 1979.
2. F.F. Rudder, Jr., D.F. Lam, and P. Chueng. User's Manual: FHWA Level 2 Highway Traffic-Noise-Prediction Model, STAMINA 1.0. Federal Highway Administration, U.S. Department of Transportation, Rept. FHWA-RD-78-138, May 1979.
3. T.M. Barry and J.A. Reagan. FHWA Highway Traffic-Noise-Prediction Model. Federal Highway Administration, U.S. Department of Transportation, Rept. FHWA-RD-77-108, Dec. 1978.
4. J. Borthwick, H. Halverson, G.M. Heisler, O.H. McDaniel, and G. Reethof. Attenuation of Highway Noise by Narrow Forest Belts. Federal Highway Administration, U.S. Department of Transportation, Rept. FHWA-RD-77-140, March 1978.

Publication of this paper sponsored by Committee on Transportation-Related Noise.

STAMINA 1.0 Experiences on the Dulles Access Highway Extension Project

LOUIS F. COHN, WILLIAM BOWLBY, AND LEONARD W. CASSON

In anticipation of the construction of the long-awaited and controversial Dulles Access Highway Extension project between Route 123 and I-66 in Fairfax County, Virginia, the Federal Highway Administration (FHWA) sought to evaluate potential noise impacts by using the most advanced tools available. Accordingly, the project was analyzed by using the Standard Method in Noise Analysis program (STAMINA 1.0), the level 2 computer program version of the FHWA Highway Traffic-Noise-Prediction Model. This paper discusses that analysis in terms of project impacts and provides an evaluation of STAMINA 1.0 performance. Insight is also given into use of STAMINA 1.0 as a tool to optimize the cost-effectiveness of noise barriers.

In its effort to provide the best-possible analysis of noise impacts from the proposed Dulles Access Highway Extension (DAHE) project, the Federal Highway Administration (FHWA) made an early decision to use the most-advanced prediction methodology available. This methodology is the STAMINA 1.0 computer program (1), which is the level 2 version of the FHWA Highway Traffic-Noise-Prediction Model (2).

In the course of the DAHE noise analysis, much was learned about the strengths and limitations of STAMINA 1.0 as well as about the impacts of the project itself. This paper presents conclusions in each of these areas.

DAHE PROJECT BACKGROUND

The proposed DAHE project in Fairfax County, Virginia, is a four-lane controlled-access expressway owned by the Federal Aviation Administration (FAA). It is being designed by FHWA as a direct federal project under an agreement with FAA. The section analyzed for noise impacts in this study extends from VA-123 (Dolley Madison Boulevard) to Interstate 66, a distance of approximately 2 miles (Figure 1). The project is the last link in the Dulles Access Highway that connects the federally owned and operated Dulles Airport with the Washington, D.C., metropolitan area. DAHE was not constructed as part of the original highway in the 1960s because its usefulness was fully dependent on the implementation of I-66, which was delayed because of litigation; approval for construction by the Virginia Department of Highways and Transportation was finally given by the Secretary of Transportation on January 6, 1977 (3). A condition to that approval was that peak-hour, peak-direction traffic be limited to Dulles Airport traffic, carpools, buses, and emergency vehicles. In addition, trucks are to be banned from DAHE and I-66 at all times.

Completion of the DAHE project will provide the following services (3):

1. Improved access to and from Dulles Airport,
2. Direct, safe, and efficient access between I-66 and the northern half of I-495 (Capital Beltway),
3. Direct access to and from I-66 and Metro transit facilities for express commuter buses from the northwest quadrant of Fairfax County and eastern Loudoun County,
4. Improved access to and from Wolf Trap Farm Park for the Performing Arts, and
5. Improved traffic circulation in the areas adjacent to the project.

Even though the DAHE project was not scheduled for construction at the same time as the portion west of the Capital Beltway, right-of-way was purchased and set aside for the entire project shortly after the Dulles Airport location was selected in 1957. In the intervening years, residential development has occurred adjacent to most of the DAHE corridor (Figures 2 and 3). From the perspective of noise impacts, this virtual encroachment on the right-of-way is quite critical. Existing Leq noise levels for most of the residences are low [typically 50-55 dB(A)], which contributes to the quiet environment provided by the densely vegetated right-of-way zone. Construction of DAHE in that zone will introduce a new major noise source and increase noise levels at most receptors along the highway right-of-way.

Even though potential homeowners in the project