ROUTE 29

CORRIDOR STUDY

CITY OF CHARLOTTESVILLE AND ALBEMARLE COUNTY

TECHNICAL MEMORANDUM
FOR ENVIRONMENTAL IMPACT STATEMENT

NOISE ANALYSIS

6029-002-122, PE 100

U.S. Department of Transportation
Federal Highway Administration
and
Virginia Department of Transportation

April 1990

ERRATA - May 17, 1990

Route 29 Corridor Study
Noise Analysis Technical Memorandum dated April, 1990

Because of changes to alternatives made after this report was printed, the following corrections should be made:

Figure 4

Site 1 should be on west side of Alternatives 10, 11, and 12 rather than east side.

Page 13, table 2.

Site 1 description should read "250' left (west) of Station 544".

Site 2 description should read "400' left (west) of Station 578".

Site 3 description should read "200' right (east) of Station 608".

Page 25, table 4.

Site 1 build noise level should be 66 dB(A) and source-receptor distance should be 250' instead of 350'.

Site 2 build noise level should be 65 dB(A) and source-receptor distance should be 400' instead of 180'.

Site 3 build noise level should be 64 dB(A) and source-receptor distance should be 200' instead of 280'.

Page 33, second line from bottom.

19 sites (rather than 20) would equal or exceed the NAC, site 2 should not appear in this list.

Page 39, table 5, Alternate 10.

For site 2, the number of receptors equaling or exceeding the NAC and the number experiencing both types of impacts should be 0 rather than 1 and the totals for the two columns should be 4 rather than 5.

Page 40, table 5, Alternate 11.

For site 2, the number of receptors equaling or exceeding the NAC and the number experiencing both types of impacts should be 0 rather than 1 and the totals for the two columns should be 14 rather than 15.

Page 40, table 5, Alternative 11.

For site 2, the number of receptors equaling or exceeding the NAC and the number experiencing both types of impacts should be 0 rather than 1 and the totals for the two columns should be 3 rather than 4.

Page 41, table 6, row B.

St. Anne's Belfield School Soccer Field - design year noise level should be 66 rather than 65.

Page 53, table 7.

Barrier 2B should be deleted.

Page 60, figure 6.

Barrier 2B should be deleted.

NOISE ANALYSIS

TECHNICAL MEMORANDUM FOR ENVIRONMENTAL IMPACT STATEMENT

ROUTE 29 CORRIDOR STUDY

STATE PROJECT:	6029-002-122, PE 100
FEDERAL PROJECT:	F-
FROM:	ROUTE 250
TO:	NORTH FORK RIVANNA RIVER

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

REGION 3

AND

VIRGINIA DEPARTMENT OF TRANSPORTATION

April 1990

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I. INTRODUCTION

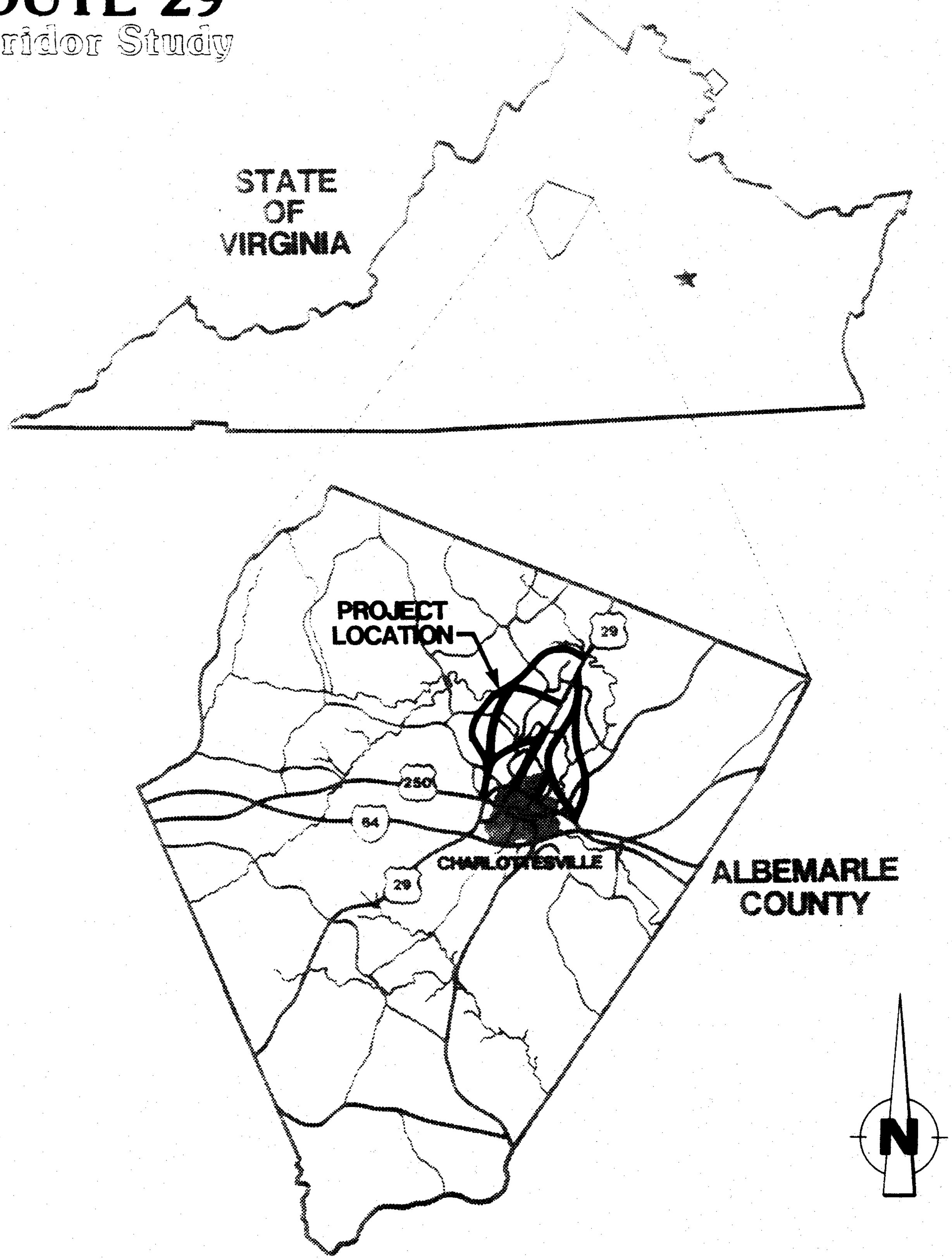
A. Project Description

U.S. Route 29 north of Charlottesville is currently a four-lane divided highway with at-grade, signalized intersections. The signal system is synchronized to provide progressive traffic movement. The existing right-of-way varies but is generally 165 to 180 feet wide. The median is nominally 55 to 60 feet wide but is narrower at intersections where left turn lanes have been added.

Commercial and residential growth in the area have caused increased traffic volumes on Route 29 which, in turn, have resulted in congested conditions and travel delays during peak traffic periods. These problems led to initiation of the Route 29 Corridor Study.

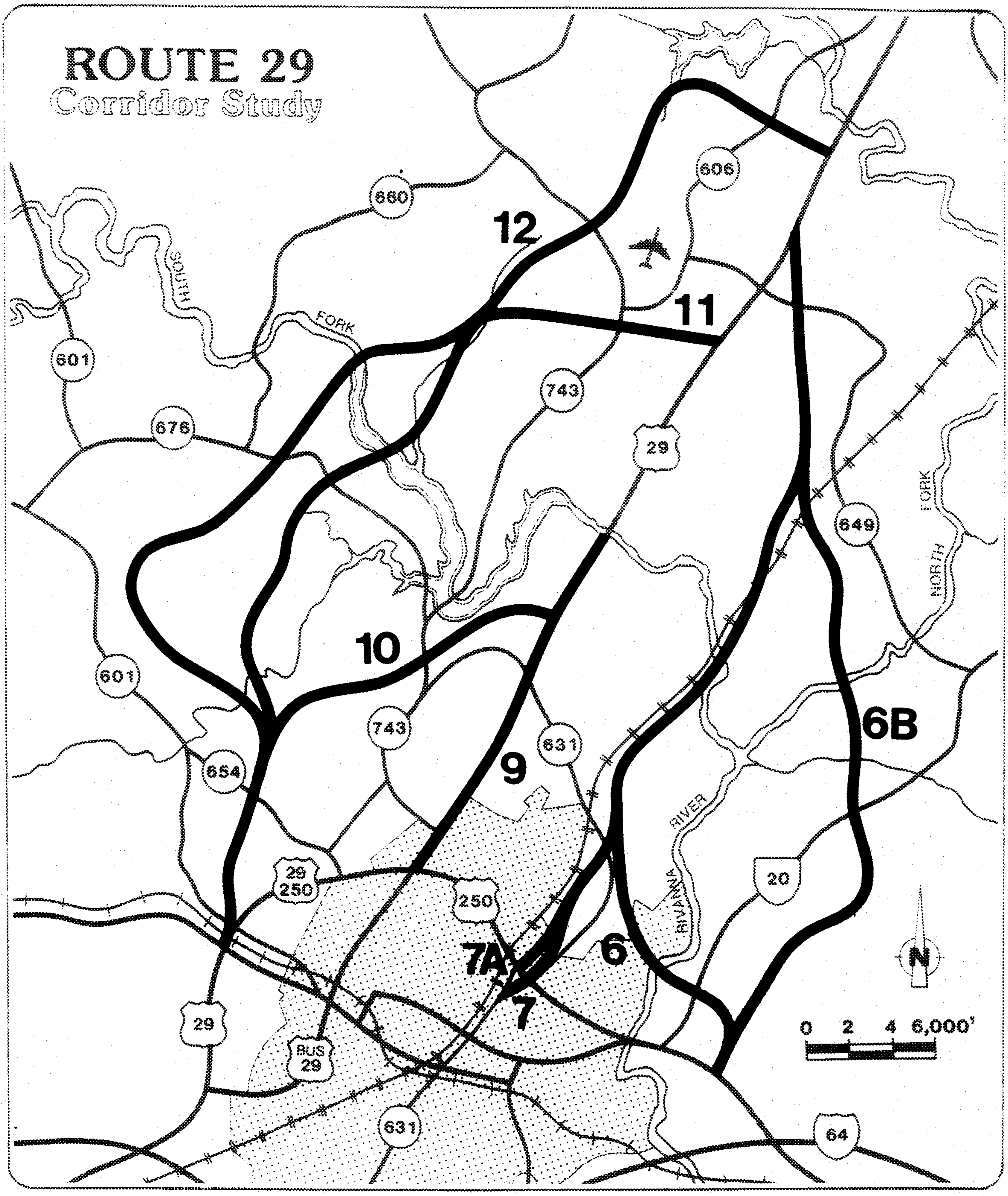
The Route 29 Corridor Study was undertaken to identify and evaluate transportation alternatives to improve traffic conditions along the Route 29 Corridor in Charlottesville and Albemarle County. Figure 1 shows the project location within the state while Figure 2 shows the study area and the proposed candidate build alternatives. The initial phases of the study in late 1987 and early 1988 identified a large number of potential highway corridors in the study area. Through a process of comparison, refinement, and public participation, the potential alignments were screened using factors such as traffic, social and natural environmental impacts, engineering, and costs. The alternatives remaining after the screening process are the candidate build alternatives which are discussed in detail in the Environmental Impact Statement. The candidate

ROUTE 29
Corridor Study



Project Location

Figure No. 1



Study Area and Project Alternates

Figure No. 2

build alternatives include seven new location bypass alternatives (three west and four east of existing Route 29) and an expressway alternative within the median of existing Route 29. In addition to the candidate build alternatives, a no-build alternative is being considered. However, it is not strictly a no-build alternative since it would involve upgrading existing Route 29 to provide a six-lane facility.

The proposed new location alternatives feature four 12-foot lanes, a graded median 84 feet wide, and a limited access right-of-way 300 feet wide. The expressway alternative features four 12-foot express lanes in the existing median separated by concrete barriers from six 12-foot local lanes. Opposing lanes on the expressway would be separated by a concrete median barrier. The construction of slip ramps at various intervals would allow expressway entrance and exit.

B. Overview of Noise Analysis

In accordance with the Federal-Aid Highway Act of 1970, the Federal Highway Administration (FHWA) established noise standards to protect public health and welfare. These standards, along with procedural guidance for analysis of traffic noise impacts and potential abatement measures, are contained in Volume 7, Chapter 7, Section 3, of the Federal-Aid Highway Program Manual (FHPM 7-7-3).

Contained in the standards are noise abatement criteria for various land uses as shown in Table 1. The criteria are sound levels that represent a balance between desirable levels and achievable levels. They apply only to areas subject to regular human use and where lowered sound levels are desirable.

When projected sound levels for the design-year-build condition approach or exceed the abatement criteria, or substantially exceed existing noise levels, abatement measures must be considered. In considering these measures, their benefits must be weighed against their adverse social, economic, and environmental effects to determine their reasonableness and feasibility.

This report is divided into several sections. Section I being the project description, Section II provides background information on noise, how it is measured, and what constitutes an impact. Section III provides descriptions of study procedures, including locations of study sites and how noise levels were determined. Section IV provides the results of the study showing the locations and magnitudes of noise impacts for each alternative. Section V describes abatement measures considered and whether they appear to be reasonable and feasible. Section VI is a discussion of construction noise.

Table 1

FHWA NOISE ABATEMENT CRITERIA

Activity Category	Leq (h)*	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are are of extraordinary significance and serve an important public need. Also where the preservation of those qualities is essential if the area is to continue for its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in categories A or B as described.
D	--	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

* Hourly A-weighted sound level (dB(A)

Source: FHPM 7-7-3

II. BACKGROUND

A. Noise, Basic Theories of Measurement

What humans hear as sound are pressure variations generated by a source, transmitted through a medium (usually air), and converted by the ear to messages to the brain. These pressure variations may be referred to as sound waves with different frequencies, wavelengths, and intensities.

The human ear is sensitive to a broad range of sound intensities or loudness. Because of this broad range, a logarithmic scale of measurement called decibels (dB) is used to describe loudness. One decibel represents roughly the smallest change in loudness perceptible by the human ear. An increase of five decibels represents a readily perceptible increase in loudness and a 10 decibel increase represents a doubling of perceived loudness. Figure 3 shows common indoor and outdoor sounds and their respective sound level representations in decibels.

The human ear is more sensitive to sound waves with middle to high frequencies. Therefore, these frequencies must be given greater weight than others in averaging sound contributions to arrive at a total noise level value in noise studies. This technique is called A-weighting. Sound levels measured in this manner are designated dB(A).

Figure 3
TYPICAL A-WEIGHTED SOUND LEVELS

At a given distance from source	decibels	Environmental
	140	
50 hp.Siren (100′)		
	130	
Jet takeoff (200′)		
	120	
Riveting machine	110	Casting shakeout area
Cut-off saw Pneumatic peen hammer	100	Electric furnace area
Textile weaving plant Subway train (20′)	90	Boiler room Printing Press room
	80	Tabulating room Inside sports car (50 mph)
Freight train (100′) Vacuum cleaner (10′) Speech (1′)	70	
	60	Traffic near freeway Large store Accounting office
Large transformer (200′)	50	Private business office Light traffic (100′) Average residence
	40	Min. levels-residential area in Chicago at night
Soft whisper (5′)	30	Studio (speech)
	20	Studio (sound pictures)
	10	
Threshold of hearing Youths - 1000-4000 Hz	0	

Source: HANDBOOK OF NOISE MEASUREMENT - General Radio Corp.

Since sound levels fluctuate over time, a time descriptor is necessary for measurement data to be meaningful. A descriptor that has been adopted by the FHWA is the equivalent sound level (L_{eq}). The equivalent sound level is the constant sound level that, over a given time period, would contain the same acoustic energy as the actual varying sound level over the same time period.

Unless otherwise noted, the time period used in this study is the period of peak traffic noise, usually rush hour. All sound levels given in this study are hourly equivalent values {L_{eq}(h)} on the dB(A) scale.

Two methods are used for determining sound levels. One is to actually measure them with a sound level meter. The other is to use computer models to calculate sound levels based on traffic volumes. Both were used in this study.

B. Definition of Impact

Two types of traffic noise impacts are recognized. One occurs when predicted design-year-build noise levels approach or exceed the noise abatement criteria. The other occurs when predicted design-year-build noise levels substantially exceed existing noise levels. Under current Virginia Department of Transportation policy approved by the Federal Highway Administration (FHPM 7-7-3), a substantial increase is defined as an increase of 10 decibels or more. To the human ear, impacts of noise are activity interference (verbal communication) and general annoyance.

III. STUDY PROCEDURES

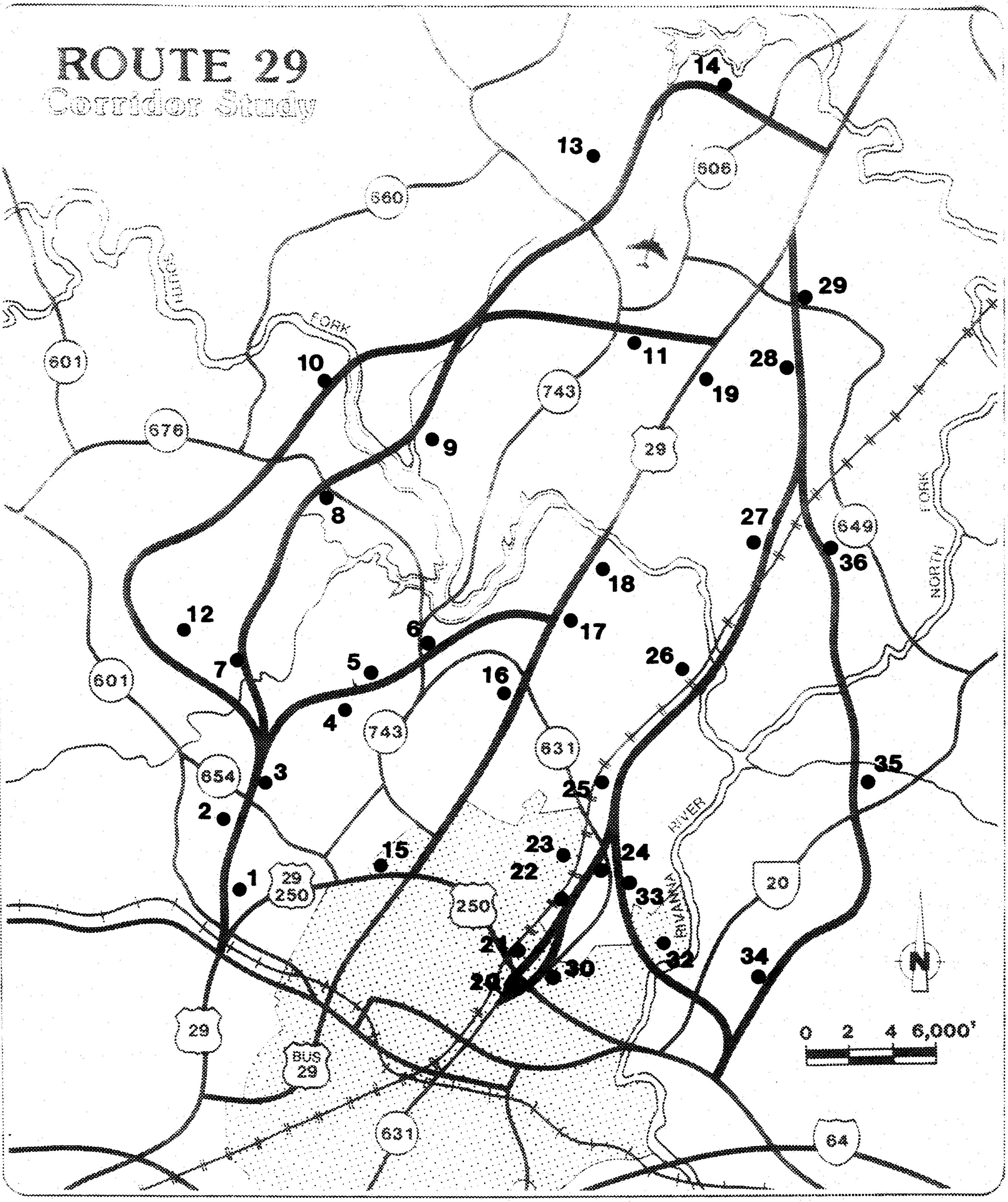
A. General Approach

The noise study consisted of the following general steps. First, land use activities that may be affected by noise from each alternative were identified. These included existing developed lands such as residential areas and planned developments for which approvals have been granted by the local jurisdictions. Next, existing noise levels were determined at representative sites near all the proposed alternatives. Then, future noise levels for the design year, 2010, were estimated using a traffic noise prediction model and impacts were identified. Finally, at those sites where impacts were identified, abatement measures were examined and evaluated.

B. Site Selection

Noise sensitive areas along each alternative were divided into study areas that would experience relatively uniform noise conditions based on changes in traffic volumes, land use, and roadway configurations. Each study area is represented by the noise-sensitive receptor site (usually a building) within that area which is closest to the roadway and would, therefore, experience the greatest noise impact.

Figure 4 shows the locations of the 35 study sites and Table 2 describes the site locations and the areas they represent. The reader will note that site number 31 is missing. This is because inspection of the site in the field disclosed no noise sensitive activities at that location. However, rather than change the numbering of the other sites on computer files and other data already developed, the site was simply deleted.



Noise Site Locations

Figure No. 4

Table 2

SITE AND STUDY AREA LOCATIONS

Site	Location	Area Represented
1	Soccer field at St. Anne's Belfield School 350' right (east) of Station 544 Alternates 10, 11, 12	Residential receptors from Route 250 to 3000' south of Barracks Road
2	2 Story Brick Dwelling Falcon Drive Colthurst Subdivision 180' left (west) of Station 570 Alternates 10, 11, 12	Residential receptors from 3000' south of Barracks Road to Barracks Road
3	2 Story Frame Dwelling Magnolia Drive Montvue Subdivision 280' right (east) of Station 599 Alternates 10, 11, 12	Residential receptors from Barracks Road to Mary Greer Elem. School
4	Playground at Mary Greer Elementary School 250' right (east) of Station 653 Alternate 10	Playground at Mary Greer Elementary School
5	One Story Frame Dwelling 200' left (west) of Station 672 Alternate 10	Residential receptors from Mary Greer Elementary School to Miller Road
6	2 story frame dwelling Squirrel Path Squirrel Ridge Subdivision 180' left (west) of Station 713 Alternate 10	Residential receptors from Miller Road to U.S. Route 29
7	2 story frame dwelling Stillhouse Road Ivy Farm Subdivision 165' left (west) of Station 666 Alternate 11	Residential receptors from Barracks Road to 2000' south of Route 676
8	2 story frame dwelling Wyngate Road Wyngate Subdivision 190' right (east) of Station 744 Alternate 11	Residential receptors from 2000' south of Route 676 to Route 676

Table 2 (Cont.)

Site	Location	Area Represented
9	Dwelling Willowbrook Road (cul-de-sac) Ardwood Subdivision 275′ right (east) of Station 802 Alternate 11	Residential receptors from Route 676 to Miller Road
10	2 story frame dwelling Dundee Road Arbor Park Subdivision 290′ left (west) of Station 864 Alternate 12	Residential receptors from Route 676 to Miller Road
11	2 story frame dwelling North of Rivanna Subdivision 200′ right (south) of Station 936 Alternate 11	Residential receptors on both sides of alignment from Miller Road to U.S. Route 29
12	1 story frame dwelling west of Ivy Farm Subdivision 310′ right (east) of Station 720 Alternate 12	Residential receptors on both sides of the alignment from Route 601 to Route 676
13	1 story frame dwelling Hunter Ridge Road Earlysville Heights 500′ left (west) of Station 1070 Alternate 12	Residential receptors on both sides of alignment from Miller Road (Route 743) to 1000′ west of Chris Greene Lake Road (Route 850)
14	1 story frame dwelling Chris Greene Lake Road Lake Acres Subdivision 160′ left (north) of Station 1124 Alternate 12	Residential receptors on both sides of alignment from 1000′ west of Chris Green Lake Road (Route 850) to U.S. Route 29
15	2 story brick apartment end of Middlesex Drive, North side of Route 250/29 Bypass. 120′ left (north) of Sta. 85 + 50. Alternate 9	Residential receptors on both sides of Route 250/29 Bypass
16	Dwelling on Commonwealth Circle Berkley Subdivision U.S. Route 29 340′ left (west) of Station 65 Alternate 9	Receptors on sides of the alignment from Route 250/29 Bypass to Rio Road

Table 2 (Cont.)

Site	Location	Area Represented
17	1 Story brick dwelling Woodbrook Subdivision 360′ right (east) of Station 126+50 Alternate 9	Residential receptors on both sides of the alignment from Rio Road to Carrsbrook Drive
18	1 story brick dwelling Carrsbrook Subdivision 260′ right (east) of Station 157 Alternate 9	Residential receptors on both sides of the alignment from Carrsbrook Drive to Route 643
19	1 story frame dwelling Hollymead Subdivision 100′ right (east) of Station 944 Alternate 9	Residential receptors on both sides of the alignment from Route 643 to Route 649
20	McIntire Park Tennis courts near intersection of McIntire Road and Route 250 Bypass 60′ right (east) of Station 396+70 Alternates 7 & 7A	Residential and recreational receptors at intersection of McIntire Road & Route 250 Bypass
21	Tee #2 McIntire Park Golf Course 170′ left (west) of Station 409 Alternate 7A	Recreational receptors in McIntire Park (golf course)
22	Charlottesville High School Softball Field 260′ left (west) of Station 438 Alternates 7 & 7A	Recreational receptors for playing fields at Charlottesville High School
23	1 story brick dwelling Kenwood Lane 470′ left (west) of Station 451 Alternatives 7 & 7A	Residential receptors on both sides of alignment from Melbourne Road to Rio Road
24	1 story frame dwelling Rio Road 460′ right (east) of Station 471 Alternate 7	Residential receptors along Rio Road
25	1 story frame dwelling 165′ left (west) of Station 474 South of Free State Road Alternates 6, 7, 7A	Residential & recreational receptors from Rio Road to Free State Road

Table 2 (Cont.)

Site	Location	Area Represented
26	1 story frame dwelling Huntington Road East of Westmoreland Subdivision 500′ left (west) of Station 515 Alternates 6, 7, 7A	Residential receptors from Free State Road to Route 643
27	2 story frame dwelling East of Powell Creek North of Route 643 590′ left (west) of Station 611 Alternates 6, 7, 7A	Residential receptors from Route 643 to 4,200′ north of Route 643
28	Undeveloped lots Creek Drive Road Forest Lake Subdivision 180′ left (west) of Station 677 Alternates 6, 6B, 7, 7A	Residential receptors on both sides of alignment from intersection of Alt. 6 & Alt 6B to Creek Drive Road
29	Mount Ephraim Pentecostal Church 180′ right (east) of Station 704+60 Alternates 6, 6B, 7, 7A	Church and residential receptors on both sides of alignment from Creek Drive Road to U.S. Route 29
30	Dwelling 170′ right (east) of Station 430 Alternate 7	McIntire Park and residential receptors from McIntire Road to Melbourne Road
32	Pen Park golf course 165′ right (east) of Station 380 Alternate 6	Recreational receptors in Pen Park & Rivanna Park & residential receptors from Route 250 to Pen Park Road
33	Townhouse in River Run Subdivision 180′ right (east) of Station 421 Alternate 6	Residential receptors at River Run Subdivision
34	3 story frame dwelling Franklin Drive Franklin Subdivision 200′ left (west) of Station 362 Alternate 6B	Residential receptors from Route 250 to Route 20
35	1 story frame dwelling North of Route 20 250′ right (east) of Station 481 Alternate 6B	Residential receptors from Route 20 to North Fork of Rivanna River

Table 2 (Cont.)

Site	Location	Area Represented
36	1 story brick dwelling Bentivar Drive North of Bentivar Subdivision 540′ right (east) of Station 587 Alternate 6B	Residential receptors from North Fork of the Rivanna River to inter-section of Alt. 6 & Alt. 6B

Note: Site 31 had no noise-sensitive activities and was deleted from the study. Therefore, it does not appear in this table.

C. Monitoring Procedures

1. Equipment Used

Noise monitoring was performed with a Metrosonics model db-307 noise dosimeter and integrating sound level meter. The meter, operated on a nine-volt battery, computes sound level, L_{max}, L_{eq}, and test duration with A-weighted frequency response and slow averaging response. A Metrosonics model cl-302 acoustical calibrator was used to calibrate the meter before and after each monitoring session. Prior to any actual monitoring, the calibrator was sent to Metrosonics, Inc. for calibration and certification.

2. Sites Monitored

An initial review of the study sites was made to identify those sites where existing noise levels are not dominated by traffic noise from nearby roadways. At those sites, existing noise levels were monitored. Monitoring locations were as close as possible to the analysis sites considering access or private property intrusion. Sites listed in Table 4 as having "ambient" noise sources were monitored.

3. Monitoring Procedures

Monitoring was performed during the fall of 1988 and spring of 1989 without regard to time of day between the hours of 8 a.m. and 5 p.m. At each site, the noise meter was set on a tripod approximately five feet above the ground. Sampling time was a minimum of 20 minutes. Experience in noise studies has shown that longer sampling periods do not substantially change the sampling results.

Site and weather data were recorded on data sheets. Also recorded was information on background noise sources (e.g., birds, airplanes, traffic, etc.) and any unusual events. At the end of each sampling period, L_{max}, L_{eq}, and length of sampling period were recorded.

D. Modeling Procedures

1. Model Used

At those sites where traffic noise dominates, a computer model was used to calculate noise levels based on traffic volumes. The model used in this study was the STAMINA 2.0 model developed by the Federal Highway Administration. A detailed discussion of the model is presented in Report Number FHWA-DP-58-1, Noise Barrier Cost Reduction Procedure STAMINA 2.0/OPTIMA: Users Manual. Development of the model is discussed in FHWA-RD-77-108, FHWA Highway Traffic Noise Prediction Model.

The model calculates noise levels for each noise receptor resulting from a series of straight-line roadway segments (the source). Source characteristics are defined by speed-dependent reference noise emission levels and vehicle volumes by vehicle type (automobiles, medium trucks, and heavy trucks). The model considers three-dimensional site geometry of the source-receiver path to include the effects of the heights of specific noise sources, intervening barriers, topography, and ground and atmospheric absorption. The model has an accuracy of $\pm$ 2 dB(A).

2. Sites Modeled

Sites along each alternative alignment were evaluated for both build and no-build conditions. Since the model only estimates traffic noise, it can only be used where traffic noise dominates, or will dominate. Under the build condition for each alternative, future noise levels were calculated with the model at all sites since traffic will be the primary source of noise if that alternative is selected. Under the no-build condition, future noise levels were assumed to be the same as existing levels at sites where traffic is not currently a major noise source. At sites where traffic is a major source, both existing and future no-build noise levels were calculated with the model.

3. Model Inputs

Inputs to the model included coordinates for the site-roadway geometry and traffic data. Traffic data included volumes and speeds of automobiles, medium trucks, and heavy trucks. The data were developed from existing traffic counts, origin-destination studies, and land use and population projections. Maximum volumes (peak-hour) were used to produce worst case conditions except for church and school sites where lower volumes were used to more fairly represent conditions during normal activity times for these facilities. Speeds used were representative of the analysis hour, in most cases, the peak hour. Table 3 shows the traffic data used in the modeling.

TABLE 3

EXISTING AND DESIGN YEAR TRAFFIC DATA

EXISTING TRAFFIC

ROUTE	FROM	TO	%AUTOS	%MT	%HT	1987 ADT	PHT	PHS
250 BYPASS	250 BUSINESS	US 29N	94	1	5	18342	2201	55
SR 743	SR 676	HYDRAULIC ROAD	94	1	5	8202	984	45
SR 743	SR 606	SR 643	94	1	5	5103	612	55
SR 676	SR 660	SR 743	94	1	5	2460	295	55
MCINTIRE ROAD	HARRIS STREET	250 BYPASS	94	1	5	16645	1997	30
250 BYPASS	MCINTIRE ROAD	PARK STREET	94	1	5	39473	4737	45
250 BYPASS	MCINTIRE ROAD	MCINTIRE PARK	94	1	5	30000	3600	45
PARK STREET	250 BYPASS	MELBOURNE ROAD	94	1	5	12363	1484	35
RIO ROAD	PEN PARK ROAD	HUNTINGTON ROAD	94	1	5	14460	1735	40
250 BYPASS	VA 20	I-64	94	1	5	22870	2744	55
US 29N	250 BYPASS	RIO ROAD	94	1	5	50680	6082	40
US 29N	RIO ROAD	SR 643	94	1	5	25800	3096	45
US 29N	SR 643	SR 649	94	1	5	23970	2876	55
US 29N	SR 649	N FORK RIVANNA	94	1	5	25976	3117	55

DESIGN YEAR TRAFFIC

ROUTE	FROM	TO	%AUTOS	%MT	%HT	2010 ADT	PHT	PHS
NO BUILD ALTERNATIVE								
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	64700	7764	35
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	61000	7320	36
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	52100	6252	38
US 29N	WOODBROOK DR.	CARRSBROOK DR.	94	1	5	47800	5736	40
US 29N	CARRSBROOK DR.	SR 643	94	1	5	42000	5040	55
US 29N	SR 643	SR 649	94	1	5	36900	4430	55
250 BYPASS	250 BUSINESS	US 29N	94	1	5	37900	4548	55
MCINTIRE RD.	250 BYPASS	HARRIS ST.	94	1	5	33600	4032	35
SR 743	RT. 606	RT. 643	94	1	5	13600	1632	55
SR 743	SR 676	HYDRAULIC RD.	94	1	5	18900	2268	45
SR 676	SR 660	SR 743	94	1	5	8300	996	55
250 BYPASS	MCINTIRE RD.	PARK ST.	94	1	5	63500	7620	45
250 BYPASS	MCINTIRE RD.	MCINTIRE PARK	94	1	5	48400	5808	45
PARK ST.	250 BYPASS	MELBOURNE RD.	94	1	5	8600	1032	35
RIO ROAD	PEN PARK RD.	HUNTINGTON RD.	94	1	5	29800	3576	40
250 BYPASS	VA 20	I-64	94	1	5	52200	6264	55
EXPRESSWAY ALTERNATIVE								
EXPRESSWAY	250 BYPASS	HYDRAULIC RD.	91	1	8	19600	2352	55
EXPRESSWAY	SPERRY DR.	GREENBRIER DR.	91	1	8	43200	5184	55
EXPRESSWAY	RIO RD.	WOODBROOK DR.	91	1	8	35500	4260	55
EXPRESSWAY	WOODBROOK DR.	CARRSBROOK DR.	91	1	8	48500	5823	55
EXPRESSWAY	CARRSBROOK DR.	S. FORK RIVANNA	91	1	8	40100	4812	55

TABLE 3 (CONT.)

ROUTE	FROM	TO	%AUTOS	%MT	%HT	2010 ADT	PHT	PHS
EXPRESSWAY ALTERNATIVE (CONT.)								
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	55600	6672	37
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	30100	3612	40
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	26400	3168	40
US 29N	WOODBROOK DR.	CARRSBROOK DR.	94	1	5	14300	1715	45
US 29N	CARRSBROOK DR.	S. FORK RIVANNA	94	1	5	9600	1152	55
US 29N	S. FORK RIVANNA	SR 649	94	1	5	40800	4896	55
250 BYPASS	BARRACKS RD.	250 BYPASS	94	1	5	45900	5508	55
ALTERNATIVE 6								
ALT 6	US 29N	SR 643	91	1	8	22300	2676	55
ALT 6	SR 643	INT AT RIO	91	1	8	25000	3000	55
ALT 6	INT AT RIO	250 BYPASS	91	1	8	13400	1608	55
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	63500	7620	35
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	58900	7068	36
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	47000	5640	38
250 BYPASS	VA 20	I-64	94	1	5	36300	4356	55
ALTERNATIVE 6B								
ALT 6B	US 29N	SR 643	91	1	8	22300	2676	55
ALT 6B	SR 643	US 20	91	1	8	5400	648	55
ALT 6B	US 20	250 BYPASS	91	1	8	5000	600	55
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	62700	7524	35
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	58400	7008	36
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	50100	6012	38
250 BYPASS	VA 20	I-64	94	1	5	44900	5390	55
ALTERNATIVE 7								
ALT 7	US 29N	SR 643	91	1	8	23200	2784	55
ALT 7	SR 643	RIO RD.	91	1	8	24200	2904	55
ALT 7	RIO RD.	250 BYPASS	91	1	8	36400	4368	55
ALT 7	250 BYPASS	MCINTIRE RD.	91	1	8	50600	6072	54
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	62000	7440	36
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	58300	6996	36
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	47200	5664	38
MCINTIRE RD.	250 BYPASS	HARRIS ST.	94	1	5	45400	5520	35
PARK ST.	250 BYPASS	MELBOURNE RD.	94	1	5	7700	924	35
RIO RD.	PEN PARK RD.	HUNTINGTON RD.	94	1	5	17700	2124	40
ALTERNATIVE 7A								
ALT 7A	US 29N	SR 643	91	1	8	22700	2724	55
ALT 7A	SR 643	RIO RD.	91	1	8	23400	2808	55
ALT 7A	RIO RD.	250 BYPASS	91	1	8	33900	4068	55
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	64000	7680	35
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	59600	7152	36
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	47800	5736	38
MCINTIRE RD.	250 BYPASS	HARRIS ST.	94	1	5	34400	4130	35
250 BYPASS	MCINTIRE RD.	PARK ST.	94	1	5	65100	7810	35

TABLE 3 (CONT.)

ROUTE	FROM	TO	%AUTOS	%MT	%HT	2010 ADT	PHT	PHS
ALTERNATIVE 7A (CONT.)								
250 BYPASS	MCINTIRE RD.	MCINTIRE PARK	94	1	5	49750	5970	35
RIO RD.	PEN PARK RD.	HUNTINGTON RD.	94	1	5	16900	2028	40
ALTERNATIVE 10								
ALT 10	US 29N	SR 743	91	1	8	17400	2088	55
ALT 10	SR 743	SR 601-BARRACKS	91	1	8	17900	2148	55
ALT 10	SR 601-BARRACKS	250 BYPASS	91	1	8	17900	2148	55
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	54100	6492	37
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	50100	6012	38
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	38100	4572	39
250 BYPASS	250 BUSINESS	US 29N	94	1	5	24500	2940	55
SR 743	SR 676	HYDRAULIC RD.	94	1	5	16300	1960	45
ALTERNATIVE 11								
ALT 11	US 29N	SR 743	91	1	8	19300	2316	55
ALT 11	SR 743	SR 676	91	1	8	14200	1704	55
ALT 11	SR 676	SR 601-BARRACKS	91	1	8	12200	1464	55
ALT 11	SR 601-BARRACKS	250 BYPASS	91	1	8	14600	1752	55
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	57300	6876	37
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	53200	6384	37
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	46900	5628	38
250 BYPASS	250 BUSINESS	US 29N	94	1	5	28300	3396	55
SR 743	SR 606	SR 643	94	1	5	9200	1104	55
SR 676	SR 660	SR 743	94	1	5	7330	880	55
ALTERNATIVE 12								
ALT 12	US 29N	SR 743	91	1	8	11400	1368	55
ALT 12	SR 743	SR 676	91	1	8	15100	1812	55
ALT 12	SR 676	SR 601-BARRACKS	91	1	8	9500	1140	55
ALT 12	SR 601-BARRACKS	250 BYPASS	91	1	8	12600	1512	55
US 29N	250 BYPASS	HYDRAULIC RD.	94	1	5	57300	6876	37
US 29N	SPERRY DR.	GREENBRIER DR.	94	1	5	53200	6384	37
US 29N	RIO RD.	WOODBROOK DR.	94	1	5	46900	5628	38
250 BYPASS	250 BUSINESS	US 29N	94	1	5	31100	3732	55
SR 767	SR 660	SR 743	94	1	5	7330	880	55

%MT=PERCENT MEDIUM TRUCKS (2-AXLE 6 TIRE; 3-AXLE)
%HT=PERCENT HEAVY DUTY TRUCKS
ADT=AVERAGE DAILY TRAFFIC
PHT=PEAK HOUR TRAFFIC (12% OF ADT)
PHS=PEAK HOUR SPEED (MILES PER HOUR)

IV. RESULTS AND DISCUSSION

A. Existing Noise Levels

Existing noise levels at 25 of the 35 sites studied have no single dominant source of noise. Typical noise sources at these sites include animals, aircraft, children, distant traffic, lawnmowers, etc. Sites near the Charlottesville-Albemarle Airport such as sites 11 and 14, or near flight paths to and from the Airport such as site 9, receive substantial noise contributions from aircraft. Sites near the Southern Railroad such as site 26 receive periodic noise contributions from passing trains.

Existing noise levels at the other 10 sites are dominated by highway traffic noise. These sites are within the City of Charlottesville or adjacent to existing major highways such as Route 29, Route 250, McIntire Road, Park Street, and Rio Road.

Table 4 shows the existing noise level for each site. Existing noise levels approach or exceed the Federal Highway Administration's Noise Abatement Criteria at 4 sites:

Site 15 Along Route 250 Bypass
Site 19 Along Route 29
Site 20 Along McIntire Road
Site 24 Along Rio Road

Table 4

EXISTING AND DESIGN YEAR NOISE LEVELS

Site No.	Condition	Noise Source	Source-Receptor Distance (feet)	Noise Level L_{eq} dB(A)
1	Existing	Route 250	Bypass 900	52
	No-Build	Route 250	Bypass 900	55
	Build	Route 250 Bypass Alternates 10,11,12	Bypass 900 350	65
2	Existing	Ambient	N/A	51
	No-Build	Ambient	N/A	51
	Build	Bypass Alternates 10,11,12	180	67
3	Existing	Ambient	N/A	49
	No-Build	Ambient	N/A	49
	Build	Bypass Alternates 10,11,12	280	63
4	Existing	Ambient	N/A	49
	No-Build	Ambient	N/A	49
	Build	Bypass Alternate 10	250	61
5	Existing	Ambient	N/A	54
	No-Build	Ambient	N/A	54
	Build	Bypass Alternate 10	200	67
6	Existing	Ambient	N/A	49
	No-Build	Ambient	N/A	49
	Build	Bypass Alternate 10	180	66

Table 4 (cont.)

Site No.	Condition	Noise Source	Source-Receptor Distance (feet)	Noise Level L_{eq} dB(A)
7	Existing	Ambient	N/A	54
	No-Build	Ambient	N/A	54
	Build	Bypass Alternate 11	165	68
8	Existing	Ambient	N/A	48
	No-Build	Ambient	N/A	48
	Build	Bypass Alternate 11	190	67
9	Existing	Ambient	N/A	57
	No-Build	Ambient	N/A	57
	Build	Bypass Alternate 11	275	68
10	Existing	Ambient	N/A	48
	No-Build	Ambient	N/A	48
	Build	Bypass Alternate 12	290	64
11	Existing	Ambient	N/A	50
	No-Build	Ambient	N/A	50
	Build	Bypass Alternate 11	200	70
12	Existing	Ambient	N/A	49
	No-Build	Ambient	N/A	49
	Build	Bypass Alternate 12	310	62

Table 4 (cont.)

Site No.	Condition	Noise Source	Source-Receptor Distance (feet)	Noise Level L_{eq} dB(A)
13	Existing	Ambient	N/A	49
	No-Build	Ambient	N/A	49
	Build	Bypass Alternate 12	500	59
14	Existing	Ambient	N/A	55
	No-Build	Ambient	N/A	55
	Build	Bypass Alternate 12	160	68
15	Existing	Route 250 Bypass	120	74
	No-Build	Route 250 Bypass	120	77
	Build	Route 250 Bypass	120	78
16	Existing	Route 29	340	65
	No-Build	Route 29	340	66
	Build	Route 29 & Expressway	340	68
17	Existing	Route 29	360	60
	No-Build	Route 29	360	61
	Build	Route 29 & Expressway	360	65
18	Existing	Route 29	260	61
	No-Build	Route 29	260	62
	Build	Route 29 & Expressway	260	66
19	Existing	Route 29	100	68
	No-Build	Route 29	100	70
	Build	Route 29	100	70

Table 4 (cont.)

Site No.	Condition	Noise Source	Source-Receptor Distance (feet)	Noise Level L_{eq} dB(A)
20	Existing	McIntire Road Route 250 Bypass	60 325	74
	No-Build	McIntire Road Route 250 Bypass	60 325	76
	Build	McIntire Road (Alternate 7A) Route 250 Bypass	60 325	76
21	Existing	Ambient	N/A	53
	No-Build	Ambient	N/A	53
	Build	Bypass Alternate 7A	170	73
22	Existing	Ambient	N/A	47
	No-Build	Ambient	N/A	47
	Build	Bypass Alternate 7,7A	260	69
23	Existing	Ambient	N/A	52
	No-Build	Ambient	N/A	52
	Build	Bypass Alternate 7,7A	470	64
24	Existing	Rio Road	65	69
	No-Build	Rio Road	65	72
	Build	Bypass Rio Road Alternates 7,7A	65 460	71
25	Existing	Ambient	N/A	48
	No-Build	Ambient	N/A	48
	Build Alternates 6,7,7A	Bypass	165	71

Table 4 (cont.)

Site No.	Condition	Noise Source	Source-Receptor Distance (feet)	Noise Level L_{eq} dB(A)
26	Existing	Ambient	N/A	46
	No-Build	Ambient	N/A	46
	Build	Bypass Alternates 6,7,7A	500	62
27	Existing	Ambient	N/A	53
	No-Build	Ambient	N/A	53
	Build	Bypass Alternates 6,7,7A	590	61
28	Existing	Ambient	N/A	49
	No-Build	Ambient	N/A	49
	Build	Bypass Alternates 6,6B,7,7A	180	70
29	Existing	Route 649	50	59
	No-Build	Route 649	50	65
	Build	Route 649 Bypass Alternates 6,6B,7,7A	50 180	69
30	Existing	Park Street	100	66
	No-Build	Park Street	100	69
	Build	Park Street Bypass Alternate 7	100 170	71
32	Existing	Ambient	N/A	47
	No-Build	Ambient	N/A	47
	Build	Bypass Alternate 6	165	69

Table 4 (cont.)

Site No.	Condition	Noise Source	Source-Receptor Distance (feet)	Noise Level L_{eq} dB(A)
33	Existing	Ambient	N/A	58
	No-Build	Ambient	N/A	58
	Build	Bypass Alternate 6	180	67
34	Existing	Ambient	N/A	48
	No-Build	Ambient	N/A	48
	Build	Bypass Alternate 6B	200	63
35	Existing	Ambient	N/A	45
	No-Build	Ambient	N/A	45
	Build	Bypass Alternate 6B	250	61
36	Existing	Ambient	N/A	45
	No-Build	Route 643	175	58
	Build	Bypass Alternate 6B	540	63

B. Design-Year Noise Levels

Design-year noise levels were estimated for each site for both no-build and build conditions. For those sites where no single noise source dominates, design-year-no-build noise levels were assumed to be the same as existing levels. Design-year-no-build noise levels for sites presently dominated by traffic noise were calculated with the computer model using projected future traffic volumes. Design-year-build noise levels for all of the sites were calculated with the model.

As previously noted, two types of traffic noise impacts can occur: when the noise abatement criteria are equalled or exceeded, or when noise levels increase substantially (10 or more decibels over existing levels). Identification of traffic noise impacts requires three comparisons of noise levels:

- Comparison of existing noise levels with design-year-build noise levels shows changes that would occur between the present and the year 2010 if the project is built.

- Comparison of design-year-build and design-year-no-build noise levels shows what changes can be attributed to the project.

- Comparison of design-year-build noise levels with the noise abatement criteria shows whether future noise levels will be compatible with present land use if the project is built.

Table 4 shows existing noise levels, design-year-no-build noise levels, and design-year-build noise levels for each site enabling a quick comparison among the three. Each site represents the worst case impact within a particular segment of roadway. To assess the impacts of each alternative as a whole, the numbers of noise-sensitive receptors represented by sites along the alternative were totalled. Receptors may be residences, platted and recorded residential lots, parks, playing fields, or other areas with outdoor activities.

As could be expected, introduction of a major new transportation route will greatly influence noise levels along the selected route, especially in rural areas where existing noise levels are low. Comparing existing noise levels with design-year-build noise levels in Table 4, increases of two to 23 decibels would occur. Ten of the sites, 15-20, 24, 27, 30, and 33, would experience increases of two to nine decibels. Twenty-five sites, 1-14, 21-23, 25, 26, 28, 29, 32, and 34-36, would experience increases of 10 or more decibels. Sites experiencing increases of 10 or more decibels are considered to be impacted under the substantial increase criterion. Looking at the site locations, it is evident that most of the substantial increases would occur in outlying rural areas while most of the smaller increases would occur near existing roads and developed areas.

Comparing existing noise levels with design-year-no-build noise levels in Table 4 shows little or no changes in most cases. Noise levels would increase from one to three decibels at sites 1, 15, 16, 17, 18, 19, 20, 24, and 30. This would be due to increases in traffic volumes on existing roads. In two cases, the increases would be greater. Site 29 on Route 649 would experience an increase of six decibels and site 36 on Route 643 would experience an increase of 13 decibels. These greater increases would be due to substantially greater traffic volumes using these routes as a result of both increased development and efforts to escape congestion on Route 29.

Comparison of no-build and build conditions readily shows that most major changes in noise levels would be attributable to the project alternates due to introduction of major new noise sources represented by the alternates.

At some sites there will be little difference between no-build and build case noise levels. At sites 15-20, 29, 30, and 36, the differences range from 0 to 5 decibels. At site 24, the no-build noise level will actually be 1 decibel higher than the no-build noise level. These small differences can be attributed to the fact that with or without the project, the highways adjacent to these sites will continue to serve major traffic volumes. In the case of site 24, no-build traffic volumes on Rio Road will be higher than build traffic volumes, which in turn will cause higher noise levels under the no-build condition.

Comparison of design-year noise levels with the noise abatement criteria (NAC) shows the second type of impact. Those sites currently experiencing noise levels equalling or exceeding the NAC (15, 19, 20, and 24) will also experience them under the design year no-build condition. Noise levels at site 30 would also increase to exceed the NAC under the no-build condition. However, under the build condition, noise levels at 20 sites would equal or exceed the NAC (2, 5, 7, 8, 9, 11, 14, 15, 16, 19, 20, 21, 22, 24, 25, 28, 29, 30, 32, and 33).

The worst impact would occur at site 15 where the noise level will exceed the NAC by 11 decibels under the Expressway Alternate. The next worst impact would be at site 20 where the noise level will exceed the NAC by 9 decibels under Alternate 7A. At both of these sites, existing noise levels exceed the NAC by 7 decibels and no-build noise levels will exceed the NAC by 9 to 10 decibels which shows that the project alternates are not entirely the causes of impacts at these two sites. Similarly, at sites 16, 19, 24, and 30, where noise levels will exceed the NAC by 1 to 4 decibels, there are little or no differences among existing, no-build, and build noise levels. At the remaining impacted sites, noise levels will exceed the NAC by 0 to 6 decibels. These impacts can be attributed to the project alternates.

Table 5 presents the total impacts by site and by alternative for the two types of impacts. The table shows that Alternate 7A would have the greatest noise impact because it would impact the greatest number of receptors. In order of decreasing impact, the other alternates are:

Alternate 7
Alternate 6
Alternate 10
Alternate 6B
Alternate 9 (Expressway)
Alternate 12
Alternate No-Build
Alternate 11

Aside from the impacts discussed above, special consideration is given to impacts on public use and nonprofit institutional facilities such as schools, churches, parks, and recreation areas. For schools and churches, additional consideration is given to interior noise levels since activities in these facilities are considered to be particularly sensitive to noise. Table 6 presents a list of facilities along with the alternates they are affected by and the expected exterior and, where applicable, interior noise levels. Figure 5 shows the locations of these facilities.

All of the facilities with indoor activities are air conditioned and can therefore maintain closed window conditions year round. Projected interior noise levels with closed windows at all of these locations are less than the interior NAC.

Exterior noise levels will increase substantially over existing noise levels at the Belfield School soccer field, Greer Elementary School playground, and Charlottesville High School ball fields, at the Ivy Creek Methodist Church, and at Rivanna, McIntire, Pen, and Chris Greene Lake Parks.

The exterior NAC will be equalled or exceeded at Belfield School, Charlottesville High School ball fields, Union Ridge Baptist Church (there do not appear to be any exterior activities here that would be affected), Pleasant Grove Baptist Church, McIntire tennis courts, McIntire Park, Rivanna Park, and Pen Park.

***

Table 5

NOISE RECEPTORS IMPACTED BY SITE AND ALTERNATE

NO-BUILD ALTERNATE

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
15	12	0	0	12
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	32	0	0	32
TOTALS	44	0	0	44

ALTERNATE 6

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
32	3	33	3	33
33	1	0	0	1
25	3	14	3	14
26	2	64	2	64
27	0	0	0	0
28	14	22	14	22
29	4	3	3	4
TOTALS	27	136	25	138

*Total number of receptors where design-year noise levels equal or exceed FHWA NAC and/or will be 10 or more dB(A) higher than existing levels. Some receptors will experience a substantial increase and will also equal or exceed the noise abatement criteria. Therefore, the totals column is not necessarily the sum of the two impact types.

Table 5 (Cont.)

ALTERNATE 6B

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
34	0	11	0	11
35	0	6	0	6
36	0	10	0	10
28	14	22	14	22
29	4	3	3	4
TOTALS	18	52	17	53

ALTERNATE 7

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
20	2	0	0	2
30	27	1	1	27
22	1	1	1	1
23	12	33	12	33
24	5	0	0	5
25	3	14	3	14
26	2	64	2	64
27	0	0	0	0
28	14	22	14	22
29	4	3	3	4
TOTALS	70	138	36	172

* Total number of receptors where design-year noise levels equal or exceed FHWA NAC and/or will be 10 or more dB(A) higher than existing levels. Some receptors will experience a substantial increase and will also equal or exceed the noise abatement criteria. Therefore, the totals column is not necessarily the sum of the two impact types.

Table 5 (Cont.)

ALTERNATE 7A

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
20	11	0	0	11
21	20	23	20	23
22	1	1	1	1
23	12	33	12	33
24	5	0	0	5
25	3	14	3	14
26	2	64	2	64
27	0	0	0	0
28	14	22	14	22
29	4	3	3	4
TOTALS	72	160	55	177

* Total number of receptors where design-year noise levels equal or exceed FHWA NAC and/or will be 10 or more dB(A) higher than existing levels. Some receptors will experience a substantial increase and will also equal or exceed the noise abatement criteria. Therefore, the totals column is not necessarily the sum of the two impact types.

Table 5 (Cont.)

ALTERNATE 9 (EXPRESSWAY)

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
15	12	0	0	12
16	4	0	0	4
17	0	0	0	0
18	0	0	0	0
19	32	0	0	32
TOTALS	48	0	0	48

ALTERNATE 10

1	1	3	1	3
2	1	8	1	8
3	0	7	0	7
4	1	1	1	1
5	1	10	1	10
6	1	27	1	27
TOTALS	5	56	5	56

* Total number of receptors where design-year noise levels equal or exceed FHWA NAC and/or will be 10 or more dB(A) higher than existing levels. Some receptors will experience a substantial increase and will also equal or exceed the noise abatement criteria. Therefore, the totals column is not necessarily the sum of the two impact types.

Table 5 (Cont.)

ALTERNATE 11

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
1	1	3	1	3
2	1	8	1	8
3	0	7	0	7
7	6	7	6	7
8	1	8	1	8
9	4	4	4	4
11	2	6	2	6
TOTALS	15	43	15	43

ALTERNATE 12

Site	Equals or Exceeds Noise Abatement Criteria	Substantial Increase	Both	Total Impacted*
1	1	3	1	3
2	1	8	1	8
3	0	7	0	7
10	0	14	0	14
12	0	6	0	6
13	0	4	0	4
14	2	4	2	4
TOTALS	4	46	4	46

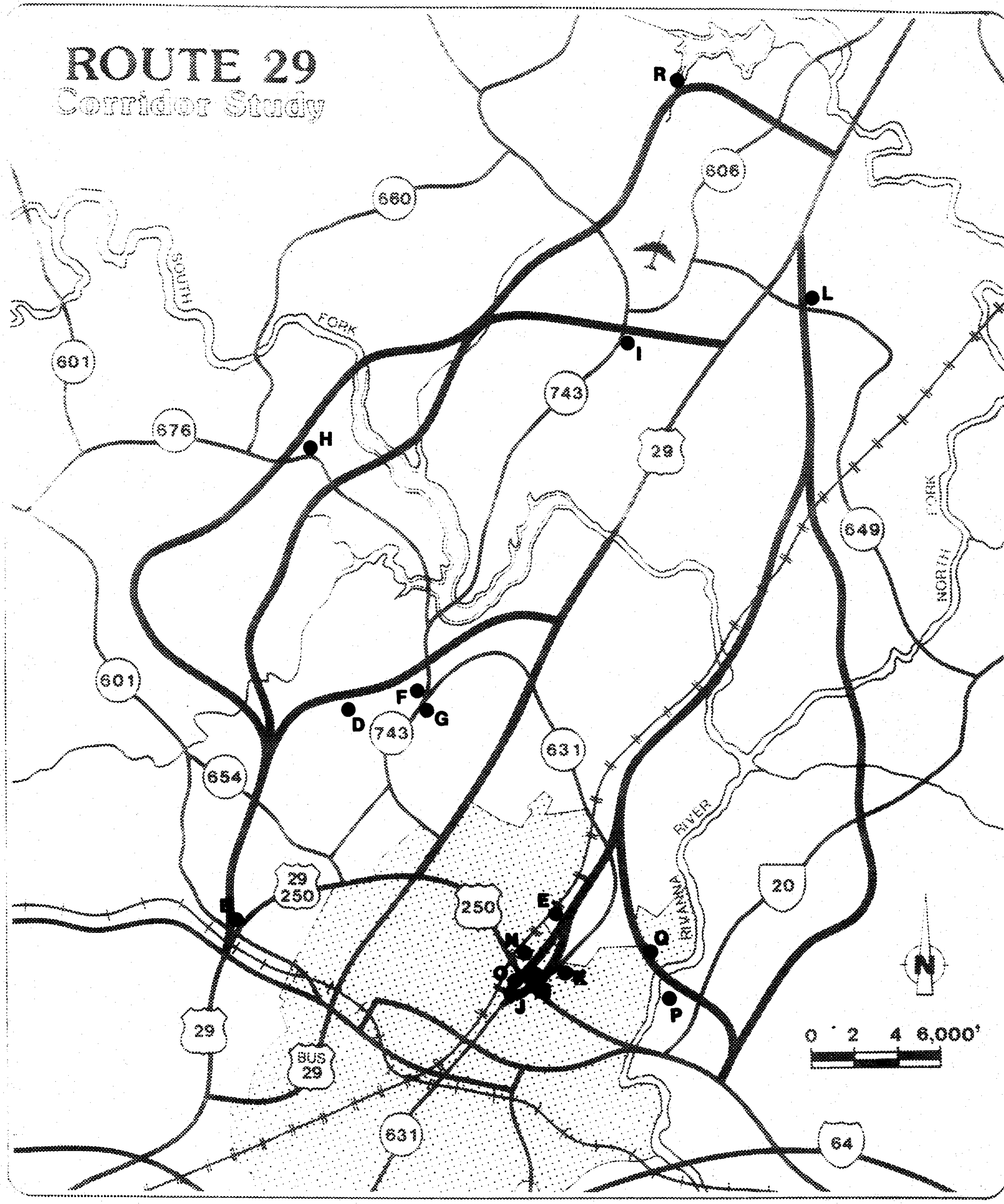
* Total number of receptors where design-year noise levels equal or exceed FHWA NAC and/or will be 10 or more dB(A) higher than existing levels. Some receptors will experience a substantial increase and will also equal or exceed the noise abatement criteria. Therefore, the totals column is not necessarily the sum of the two impact types.

Table 6
NOISE LEVELS AT PUBLIC USE OR NONPROFIT INSTITUTIONAL FACILITIES

				Exterior L_{eq}		Interior Design Year L_{eq}	
Facility	Air Conditioned	Outside Activities	Alternate	Existing	Design Year	Open Windows	Closed Windows
A. St. Anne's Belfield School	Yes	Yes	9 (Expressway) No Build	65 65	69 68	59 58	49 48
B. St. Anne's Belfield School Soccer Field	N/A	Yes	10,11,12	52	65	N/A	N/A
C. Mary Greer Elementary School	Yes	Yes	10	49	56	46	36
D. Mary Greer Elementary School Playground	N/A	Yes	10	49	61	N/A	N/A
E. Charlottesville High School Ball Fields	N/A	Yes	7,7A	47	69	N/A	N/A
F. Church of Jesus Christ of Latter-Day Saints	Yes	No	10	59	63	53	43
G. Union Ridge Baptist Church	Yes	No	10	67	69	59	49
H. Ivy Creek United Methodist Church	Yes	Yes	12	48	59	49	39
I. Pleasant Grove Baptist Church	Yes	Yes	11	60	67	57	47
J. First Baptist Church	Yes	Yes	7	57	62	52	42
K. Park Street Christian Church	Yes	Yes	7,7A	55	64	54	44
L. Mt. Ephraim Pentecostal Church	Yes	Yes	6,6B,7,7A	56	64	54	44
M. YMCA	Yes	Yes	7A	60	65	55	45
N. McIntire Park	N/A	Yes	7,7A	53	73	N/A	N/A

Table 6 (Cont.)

			Exterior L_{eq}		Interior Design Year L_{eq}		
Facility	Air Conditioned	Outside Activities	Alternate	Existing	Design Year	Open Windows	Closed Windows
O. McIntire Tennis Cts	N/A	Yes	7,7A	74	76	N/A	N/A
P. Rivanna Park	N/A	Yes	6	47	69	N/A	N/A
Q. Pen Park	N/A	Yes	6	47	69	N/A	N/A
R. Chris Greene Lk Pk	N/A	Yes	12	49	63	N/A	N/A



Public Use and Nonprofit Institutional Facilities

Figure No. 5

V. ABATEMENT ANALYSIS

A. Types of Abatement Considered

At those sites where noise impacts are identified, measures to reduce traffic noise must be considered. Examples of such measures include shifting alignments, building sound barriers, depressing the roadway, rerouting trucks, or providing insulation or air conditioning for buildings with noise-sensitive interior activities. The benefits of such measures are weighed against their social, economic, and environmental effects to determine their reasonableness and feasibility.

To be meaningful, abatement measures must provide a minimum noise reduction of five decibels. A two to three decibel reduction would be barely noticeable and efforts to achieve such a minor reduction are generally not justifiable.

B. Abatement Analysis

1. Rerouting Through Trucks

Since heavy trucks usually contribute the largest component of highway noise, rerouting them is sometimes an effective way to reduce noise levels. However, for this project, such a rerouting is not practical. There are no alternate routes within the project corridor comparable to Route 29. Furthermore, one major purpose of the project is to expedite the flow of through traffic, especially trucks, through or around Charlottesville.

22. <u>Depressing the Roadway</u>

Depressing the roadway, thereby creating a rock or earth noise barrier, is sometimes an effective noise reduction measure. Based on a review of preliminary vertical profiles of the project alternates, this measure is not feasible at most locations for the following reasons:

- Roadway grades must conform with safety and engineering standards.
- The need to have interchanges with existing roads presents limitations at some locations.
- At some locations, depressing the road would put it below the elevations of streambeds, thereby disrupting natural drainage patterns.

At sites where it did appear feasible an analysis of this measure was performed with the following results:

- Site 2, Alternates 10, 11, and 12 - Depressing the road at this location sufficiently to achieve a meaningful noise reduction would require excavation of roughly 83,000 additional cubic yards of material. The additional cost would be approximately $396,000 to protect six receptors ($66,000 per receptor) which is not considered reasonable.

- Site 4, Alternate 10 - Cut required to achieve proper grade here will be sufficient to protect the school playground without additional excavation.

- Site 5, Alternate 10 - Cut required to achieve proper grade here will protect 4 receptors. Additional excavation to protect remaining receptors is not feasible due to location of stream bed.

- Site 6, Alternate 10 - Cut required to achieve proper grade in the Woodburn Road area would protect 10 receptors. Additional excavation to protect one additional receptor would cost over $150,000 which is not considered reasonable.

- Site 7, Alternate 11 - Additional excavation of 29,000 cubic yards at a cost of $138,000 would protect one receptor which is not considered reasonable.

- Site 9, Alternate 11 - Cut required to achieve proper grade would protect two receptors. A deeper cut to protect the other two is not feasible due to the locations of stream beds of tributaries to Naked Creek.

- Site 10, Alternate 12 - Cut required to achieve proper grade will protect the four impacted receptors in the Arbor Park subdivision without additional excavation.

- Site 12, Alternate 12 - Cut required to achieve proper grade will protect one receptor without additional excavation.

- Site 14, Alternate 12 - Cut required to achieve proper grade will protect two receptors in Lake Acres subdivision. Additional excavation to protect two other receptors is not feasible due to steep terrain.

- Site 25, Alternates 6, 7, and 7A - To protect receptors here would require additional excavation of approximately 159,000 cubic yards at a cost of approximately $757,000. For the 14 receptors protected, this amounts to approximately $54,000 per receptor which is not considered reasonable.

- Site 26, Alternates 6, 7, and 7A - Additional excavation here of roughly 300,000 cubic yards would protect 44 receptors. This amounts to approximately $1.4 million or $32,000 per receptor which is not considered reasonable.

- Site 28, Alternate 6, 6B, 7, and 7A - Additional excavation here of approximately 65,000 cubic yards would protect 22 receptors at a cost of approximately $309,000. This amounts to approximately $14,000 per receptor which appears to be reasonable. This abatement measure will receive further consideration and is likely to be implemented at this location if Alternative 6, 6B, 7, or 7A is chosen.

- Site 29, Alternates 6, 6B, 7, and 7A - Cut required to achieve proper grade here will protect four receptors without additional excavation.

- Site 30, Alternate 7 - Cut required to achieve proper grade will partially protect seven receptors. Additional excavation here is not feasible because of the need to connect with existing roads.

To summarize, normal excavation to achieve proper grades will provide noise abatement at sites 4, 5, 6, 9, 10, 12, 14, and 29 for a total of 26 receptors. At site 28, additional excavation to provide abatement for 22 receptors appears to be cost effective and is likely to be done.

Much of the Expressway Alternate (Alternate 9) will be depressed to provide grade separation at major cross streets. Therefore, if this alternative is selected, the resulting noise levels will be somewhat less than those predicted for this study since those were based on assuming level road and level terrain for worst case noise levels.

3. Shifting Alignments

Noise levels can be reduced by moving the source away from the receptor, i.e., shifting proposed alignments. As a rough rule of thumb, the distance between the source and the receptor must be approximately doubled to attain a noise reduction of approximately 4.5 decibels (assuming vegetated or soft earth ground surface).

An analysis of potential alignment shifts at all impacted sites showed that none are practical for the following reasons:

- Sensitive receptors lie on both sides of the proposed alignments. Shifts away from some receptors would increase noise impacts to other receptors.
- Some potential shifts would increase displacements of homes or businesses.
- Some shifts would increase impacts to other resources such as water bodies and historic sites.
- Some shifts would increase encroachment on other facilities such as the airport, parks, and recreation areas.
- Some shifts are constrained for engineering reasons such as steep terrain and interchanges with existing roads.

4. Sound Barriers

Sound barriers could be built to reduce noise levels at most impacted locations. However, they could not be used along existing roads where access to adjacent properties would be blocked. To be effective, sound barriers must be continuous and not have openings for access. Further, in accordance with Virginia Department of Transportation policy, approved by the Federal Highway Administration, sound barriers costing more than $20,000 per protected receptor (except for parks and schools) are not considered cost-effective. Barriers to protect parks and schools are evaluated on a case-by-case basis. Table 7 summarizes the sound barriers considered which are located as shown in Figure 6. It should be noted that the barrier configurations are based on preliminary data and costs are approximate. Below is a summary evaluation of potential sound barriers at parks and schools:

- McIntire Park - A barrier costing approximately $733,500 would protect three holes of a nine-hole golf course here. Because of the small benefit achieved, construction of this barrier is not considered reasonable.

- Rivanna Park and Pen Park - Barriers along both sides of the road to protect these parks would cost a total of approximately $3 million. The barriers would protect the soccer fields and tennis courts in Rivanna Park and four holes of the nine-hole golf course in Pen Park. These barriers are very expensive in relation to the benefits provided and are therefore not considered reasonable.

- Chris Greene Lake Park - A barrier costing approximately $272,000 would protect the small part of the park impacted. Since this is a remote finger of the park which appears to receive little use, construction of this barrier is not considered reasonable.

- St Anne's Belfield School - A barrier costing approximately $163,000 would protect a children's play area outside the school. Since existing noise levels are already relatively high here, and since the impact is only a slight exceedance of the NAC rather than a substantial increase, and since this area will be impacted even under the no-build alternate, construction of this barrier is not considered reasonable.

- St Anne's Belfield School Soccer Field - A barrier here would cost approximately $318,000. As a result of the noise generating activities occuring here, the benefits provided in relation to the high cost make this barrier unreasonable.

- Greer Elementary School - The grade of Alternate 10 through this area is such that the cut slope will serve as an effective sound barrier. Therefore, a structural barrier need not be considered.

- Charlottesville High School Ballfield - A barrier here costing approximately $279,300 would protect a baseball field and a soccer field. As a result of the noise generating activities occurring here, the benefits provided in relation to the high cost make this barrier unreasonable.

- McIntire Tennis Courts - The 11 tennis courts here cannot be protected by a barrier along McIntire Road because access to the courts would be blocked.

None of the barriers evaluated for residential areas or parks and schools have been found to be reasonable and; therefore, they will not receive further consideration.

Table 7

SOUND BARRIERS CONSIDERED

Barrier Number	Location	Description	Cost (rounded to nearest $100)
1A	West of Alt 10 Sta. 542 to Sta. 552+60	length: 1060′ height: 16′-19′ attenuation: 5 dBA receptors: 1	Total: $290,500 per receptor: $290,500
1B	East of Alt. 10 Sta. 534+30 to Sta. 559+80	length: 2550′ height: 13′-16′ attenuation: 5 dBA receptors: 2	Total: $636,400 per receptor: $318,200
1C	Along north side of Route 250 Bypass at Belfield School	length: 850′ height: 12′ attenuation: 5 dBA receptors: 1	Total: $163,200 per receptor: $163,200
2A	West of Alt. 10 Sta. 566+70 to Sta. 584+90	length: 1820′ height: 13′-19′ attenuation: 5 dBA receptors: 6	Total: $474,000 per receptor: $79,000
2B	East of Alt. 10 Sta. 558+50 to Sta. 570	length: 1150′ height: 13′ attenuation: 5 dBA receptors: 2	Total: $239,200 per receptor: $119,600
3A	East of Alt. 10 Sta. 592 to Sta. 618	length: 2600′ height: 13′-19′ attenuation: 5-6 dBA receptors: 6	Total: $675,600 per receptor: $112,600
4A	East of Alt. 10 Sta. 648 to Sta. 658	length: 1000′ height: 14′ attenuation: 5 dBA receptors: 1	Total: $224,000 per receptor: $224,000
5A	West of Alt. 10 Sta. 662+50 to Sta. 697	length: 3450′ height: 11′-17′ attenuation: 5-7 dBA receptors: 8	Total: $856,800 per receptor: $107,100
5B	East of Alt. 10 Sta. 673+70 to Sta. 684+40	length: 1070′ height: 11′-17′ attenuation: 5 dBA receptors: 1	Total: $233,400 per receptor: $233,400

Table 7 (Cont.)

Barrier Number	Location	Description	Cost (rounded to nearest $100)
5C	East of Alt. 10 Sta. 685+70 to Sta. 695	length: 930' height: 14' attenuation: 5 dBA receptors: 1	Total: $208,300 per receptor: $208,300
6A	West of Alt. 10 From entrance to Squirrel Ridge Subdivision to Sta. 722	length: 1920' height: 12'-15' attenuation: 5-10 dBA receptors: 14	Total: $464,200 per receptor: $33,200
6B	West of Alt. 10 Sta. 741 to Sta. 755	length: 1400' height: 15'-18' attenuation: 5-6 dBA receptors: 8	Total: $356,100 per receptor: $44,500
6C	East of Alt. 10 Sta. 736 to Sta. 748	length: 1200' height: 15'-18' attenuation: 5 dBA receptors: 4	Total: $308,100 per receptor: $77,000
6D	East of Alt. 10 Sta. 716+50 to Sta. 730	length: 1350' height: 15' attenuation: 5 dBA receptors: 1	Total: $324,000 per receptor: $324,000
7A	West of Alt. 11 Sta. 664+20 to Sta. 667+20	length: 300' height: 9' attenuation: 6 dBA receptors: 1	Total: $43,200 per receptor: $43,200
7B	East of Alt. 11 Sta. 670+30 to Sta. 673+30	length: 300' height: 9' attenuation: 6 dBA receptors: 1	Total: $43,200 per receptor: $43,200
7C	West of Alt. 11 Sta. 713 to Sta. 716	length: 300' height: 9' attenuation: 6 dBA receptors: 1	Total: $43,200 per receptor: $43,200
7D	East of Alt. 11 Sta. 719+40 to Sta. 731+20	length: 1180' height: 9' attenuation: 6 dBA receptors: 3	Total: $169,900 per receptor: $56,600

Table 7 (Cont.)

Barrier Number	Location	Description	Cost
7E	East of Alt. 11 Sta. 676+60 to Sta. 685+60	length: 900' height: 11' attenuation: 5 dBA receptors: 1	Total: $158,400 per receptor: $158,400
8A	East of Alt. 11 Sta. 743+20 to Sta. 754+80	length: 1030' height: 19' attenuation: 5-12 dBA receptors: 4	Total: $313,300 per receptor: $78,300
8B	West of Alt. 11 Sta. 743 to Sta. 753+30	length: 1030' height: 19' attenuation: 5 dBA receptors: 2	Total: $313,300 per receptor: $156,700
9A	East of Alt. 11 Sta.801 to Sta. 817	length: 1600' height: 11' attenuation: 6 dBA receptors: 4	Total: $281,600 per receptor: $70,400
10A	East of Alt. 12 Sta. 823 to Sta. 839	length: 1400' height: 16' attenuation: 5 dBA receptors: 2	Total: $358,400 per receptor: $179,200
10B	West of Alt. 12 Clearview Knolls Subdivision Sta. 825 to Sta. 847	length: 2200' height: 16' attenuation: 5 dBA receptors: 7	Total: $563,200 per receptor: $80,500
10C	West of Alt. 12 Arbor Park Subdivision Sta. 855+10 to Sta. 871+40	length: 1630' height: 19' attenuation: 5-8 dBA receptors: 5	Total: $495,900 per receptor: $99,200
11A	Along east side of Route 743 south of Alt. 11 interchange	length: 300' height: 13' attenuation: 5 dBA receptors: 1	Total: $62,400 per receptor: $62,400
11B	South of Alt. 11 & east of Rte 743 Sta. 930+40 to Sta. 945+35	length: 1495' height: 19' attenuation: 5-10 dBA receptors: 4	Total: $454,500 per receptor: $113,600

Table 7 (Cont.)

Barrier Number	Location	Description	Cost
12A	East of Alt. 12 Sta. 677 to Sta. 692+15	length: 1515' height: 16'-19' attenuation: 5 dBA receptors: 1	Total: $416,600 per receptor: $416,600
12B	East of Alt. 12 Sta. 712 to Sta. 724+50	length: 1215' height: 13'-16' attenuation: 5 dBA receptors: 1	Total: $281,600 per receptor: $281,600
12C	West of Alt. 12 Sta. 727 to Sta. 741	length: 1515' height: 16'-19' attenuation: 5 dBA receptors: 1	Total: $416,600 per receptor: $416,600
12D	West of Alt. 11 Sta. 616+50 to Sta. 631+50	length: 1500' height: 16'-19' attenuation: 5 dBA receptors: 1	Total: $412,000 per receptor: $412,000
13A	West of Alt. 12 Earlysville Hghts Subdivision Sta. 1053 to Sta. 1077+20	length: 2420' height: 17' attenuation: 5 dBA receptors: 4	Total: $658,200 per receptor: $164,600
14A	North of Alt. 12 Lake Acres Subdv. Sta. 1121+30 to Sta. 1135+70	length: 1440' height: 11' attenuation: 5 dBA receptors: 2	Total: $253,400 per receptor: $126,700
14B	South of Alt. 12 Lake Acres Subdv. Sta. 1121+30 to Sta. 1135+70	length: 1440' height: 11' attenuation: 5 dBA receptors: 2	Total: $253,400 per receptor: $126,700
15A	North of U.S. Route 250 Bypass Sta. 75 to Sta. 100+40	length: 2540' height: 11' attenuation: 5-9 dBA receptors: 12	Total: $447,000 per receptor: $37,250
16A	West of U.S. Route 29, Berkley Subdv. Sta. 61 +10 to Sta. 67+90	length: 930' height: 15' attenuation: 5 dBA receptors: 4	Total: $223,200 per receptor: $55,800

Table 7 (Cont.)

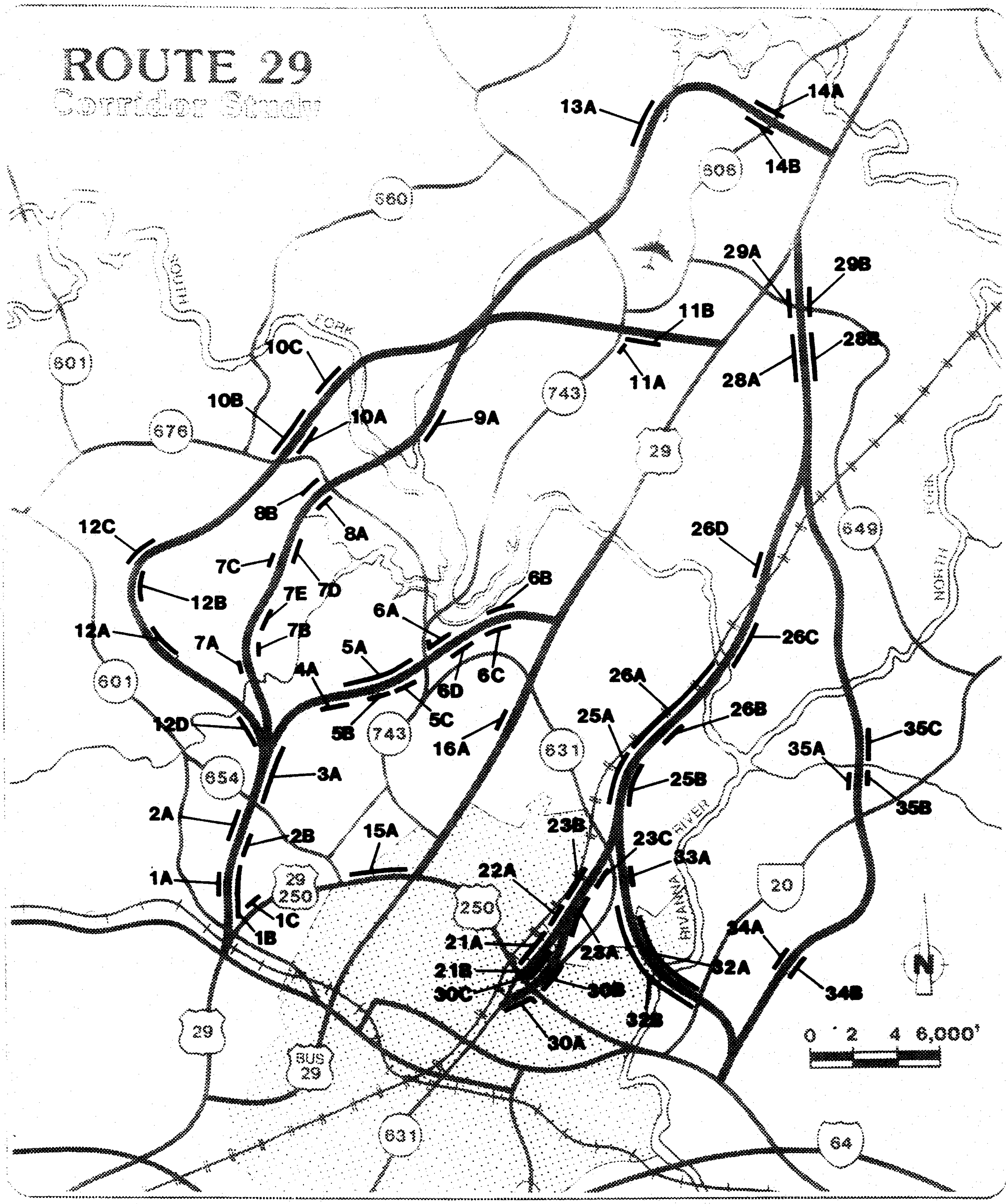
Barrier Number	Location	Description	Cost
21A	West of Alt. 7A at McIntire Park Sta. 400+60 to Sta. 422+20	length: 2160′ height: 16′-22′ attenuation: 5-13 dBA receptors: 1	Total: $733,500 per receptor: $733,500
21B	East of Alt. 7A Sta. 400+60 to Sta. 422+20	length: 2160′ height: 16′-22′ attenuation: 5-9 dBA receptors: 22	Total: $733,500 per receptor: $33,300
22A	West of Alt 7 & 7A Ch'ville High Sch playing fields Sta. 429+60 to Sta. 443	length: 1340′ height: 13′ attenuation: 5 dBA receptors: 1	Total: $279,300 per receptor: $279,300
23A	East of Alt 7 & 7A Sta. 424+70 to Sta. 448	length: 2330′ height: 16′-19′ attenuation: 5-13 dBA receptors: 17	Total: $656,700 per receptor: $38,600
23B	West of Alt 7 & 7A Greenbriar Park Subdivision Sta. 443 to Sta. 461	length: 1800′ height: 13′-19′ attenuation: 5 dBA receptors: 11	Total: $441,200 per receptor: $40,100
23C	East of Alt 7 & 7A Sta. 457+40 to Sta. 471+60	length: 1470′ height: 15 attenuation: 5 dBA receptors: 5	Total: $352,800 per receptor: $70,600
25A	West of Alt 6, 7, & 7A Sta. 462 to Sta. 487+70	length: 2570′ height: 19′ attenuation: 5-14 dBA receptors: 6	Total: $780,500 per receptor: $130,100
25B	East of Alt. 6, 7, & 7A Sta. 462 to Sta. 487+70	length: 2570′ height: 19′ attenuation: 5-13 dBA receptors: 8	Total: $780,500 per receptor: $97,600
26A	West of Alt. 6, 7, & 7A Northfields Subdv. Sta. 487+70 to Sta. 546	length: 5830′ height: 19′ attenuation: 5 dBA receptors: 48	Total: $1,772,300 per receptor: $36,900

Table 7 (Cont.)

Barrier Number	Location	Description	Cost
26B	East of Alt. 6, 7, & 7A Sta. 503 to Sta. 515	length: 1200' height: 13'-16' attenuation: 5 dBA receptors: 1	Total: $278,400 per receptor: $278,400
26C	East of Alt. 6, 7, & 7A Sta. 554 to Sta. 577	length: 2300' height: 16' attenuation: 5 dBA receptors: 14	Total: $588,800 per receptor: $42,100
26D	West of Alt. 6, 7, & 7A Sta. 576+40 to Sta. 586+40	length: 1000' height: 16' attenuation: 5 dBA receptors: 1	Total: $256,000 per receptor: $256,000
28A	West of Alt. 6, 6B 7 & 7A Forest Lakes Subdv Sta. 671+90 to Sta. 691	length: 1910' height: 19' attenuation: 5-11 dBA receptors: 15	Total: $580,600 per receptor: $82,900
28B	East of Alt. 6, 6B 7 & 7A Forest Lakes Subdv Sta. 671+90 to Sta. 691	length: 1910' height: 19' attenuation: 5-10 dBA receptors: 7	Total: $580,600 per receptor: $38,700
29A	West of Alt. 6, 6B 7 & 7A Sta. 695+30 to Sta. 707+30	length: 1200' height: 11' attenuation: 5 dBA receptors: 2	Total: $211,200 per receptor: $105,600
29B	East of Alt. 6, 6B 7 & 7A Sta. 698 to Sta. 710	length: 1200' height: 11' attenuation: 5 dBA receptors: 2	Total: $211,200 per receptor: $105,600
30A	East of Alt. 7 Sta. 400 to Sta. 417+50	length: 2050' height: 14' attenuation: 5-8 dBA receptors: 13	Total: $459,200 per receptor: $35,300
30B	East of Alt. 7 Sta. 423+50 to Sta. 439+80	length: 1630' height: 20' attenuation: 3-6 dBA receptors: 11	Total: $521,600 per receptor: $47,400

Table 7 (Cont.)

Barrier Number	Location	Description	Cost
30C	West of Alt. 7 McIntire Park Sta. 420 to Sta. 438	length: 1800′ height: 10′ attenuation: 5 dBA receptors: 1	Total: $288,000 per receptor: $288,000
32A	East of Alt. 6 Rivanna Park and Pen Park Sta. 349+50 to Sta. 400	length: 5050′ height: 17′-19′ attenuation: 5-11 dBA receptors: 2	Total: $1,516,800 per receptor: $758,400
32B	West of Alt. 6 Rivanna Park and Rivanna Hgts Subdv Sta. 349+50 to Sta. 413	length: 6350′ height: 17′-19′ attenuation: 5-11 dBA receptors: 31	Total: $1,912,000 per receptor: $61,700
33A	East of Alt. 6 River Run Subdv Sta. 417+50 to Sta. 424+60	length: 760′ height: 14′ attenuation: 5 dBA receptors: 1	Total: $170,200 per receptor: $170,200
34A	West of Alt. 6B Franklin Subdv Sta. 358 to Sta. 370	length: 1200′ height: 16′ attenuation: 5-9 dBA receptors: 6	Total: $306,200 per receptor: $51,000
34B	East of Alt. 6B Franklin Subdv Sta. 360+60 to Sta. 372+60	length: 1200′ height: 16′ attenuation: 5-9 dBA receptors: 5	Total: $306,200 per receptor: $61,200
35A	West of Alt. 6B Sta. 473+40 to Sta. 482+90	length: 950′ height: 13′ attenuation: 5 dBA receptors: 1	Total: $196,300 per receptor: $196,300
35B	East of Alt. 6B Sta. 476+60 to Sta. 486+10	length: 950′ height: 13′ attenuation: 5 dBA receptors: 2	Total: $196,300 per receptor: $98,200
35C	East of Alt. 6B Sta. 487+10 to Sta. 498+90	length: 1240′ height: 16′-19′ attenuation: 5 dBA receptors: 3	Total: $347,800 per receptor: $115,900



Potential Sound Barrier Locations

Figure No. 6

VI. CONSTRUCTION NOISE

Noise receptors that would be sensitive to highway traffic noise would also be sensitive to noise from construction equipment while the project is being built. To minimize the effects of construction noise, the Virginia Department of Transportation's Road and Bridge Specifications contain noise control provisions. Following are some of the major elements of these provisions:

- "Equipment shall in no way be altered so as to result in noise levels which are greater than those produced by the original equipment."

- "The contractor's operations shall be performed in such a manner that the exterior noise levels measured at a noise sensitive activity shall not exceed 80 dB(A) during periods of such activity."

- The Department reserves the right to prohibit or restrict to certain portions of the project, any work which produces objectionable noise during normal sleeping hours, 10 p.m. to 6 a.m., unless other hours are established by local ordinance in which case the local ordinance shall govern."