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NOISE MEASUREMENTS

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NEW JERSEY STATE DEPARTMENT OF TRANSPORTATION

FINAL REPORT

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16. Abstract

Traffic noise levels measured at six sites adjacent to New Jersey highways after construction were compared to existing noise levels measured before construction. Traffic noise levels measured at other sites were compared to levels predicted by current computer methods. Measurements were made from hourly noise samples recorded over 24 hour periods at various site microphone positions. Traffic data was simultaneously recorded. Before and after construction measured noise level comparisons were done with analyses of variance and t-tests for different time periods of the day. Traffic noise level predictions were made with both the Transportation Systems Center (TSC) and the Michigan Computer Programs. Noise predictions were compared to noise measurements using t-tests, linear regressions and step-wise multiple regression. In general, the TSC program overpredicted and the Michigan program underpredicted observed traffic levels.

Differences between observed and predicted levels were found to be due to turck emission levels and ground attenuation rates assumed by the two programs. These differences were multiply regressed against traffic and receiver variables. The regression equations can be used to correct predicted noise levels.

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1. Introduction

1.1 Project Objectives

This is the final report for a six year traffic noise study having two distinct objectives:

1) The establishment of baseline levels of noise adjacent to typical roads in order to detect subsequent changes in noise levels. Noise measurement surveys were conducted along a) roadways prior to construction or reconstruction or before opening to traffic and b) the same roadways after construction or reconstruction and opening to traffic.

2) The comparison of actual noise levels at locations having variations in traffic, roadway, and topographical parameters with theoretical predictions utilizing the Transportation Systems Center Traffic Noise Prediction Program (TSC program) and the Michigan Traffic Noise Prediction Program (Michigan program).

1.2 Project Execution

The overall project was undertaken under three major work programs after each of which a report was produced. During the work program for Fiscal Years (FY) 1972 and 1973, the before construction existing noise measurements were taken at twelve sites, corresponding to objective 1a) above. During the work program for FY 1974 and 1975, traffic L_{10} noise levels were measured and compared to predicted noise levels at six other sites, corresponding to objective 2) above. During the work program for FY 1976 and 1977, the after construction existing noise measurements were retaken at six before sites, corresponding to objective 1b) and compared to the before construction levels, completing objective 1). In addition, supplemental traffic L_{eq} noise levels, predicted and measured, were compared for the sites of work program FY 1974

and 1975, further developing objective 2). The project may be summarized in terms of work program tasks accomplished during each phase.

1.3 Before Measurements

The First Interim Report documents work accomplished during Fiscal Years 1972 and 1973 to acquire before construction noise measurements. The following tasks were accomplished.

1) New equipment, including microphones, tape recorders, sound level meters, graphic level recorder, and statistical distribution analyzer, required to conduct noise surveys was ordered and received.

2) A methodology for determining duration and frequency of sampling times for a 24-hour period was developed.

3) The above methodology was field tested at each of the three sites having varied traffic volumes for three consecutive 24-hour periods at each site.

4) A computer program was developed to analyze the noise data collected at three sites for the purpose of determining sampling times.

5) The computer analysis of the data yielded probabilities for estimating noise levels within given tolerances for various sample durations and frequencies for the different traffic volume situations.

6) A list of possible sites for measurement of noise before construction or reconstruction of a highway facility was compiled.

7) A computer program for analyzing noise sample cumulative distribution data for the purpose of obtaining appropriate noise levels was developed.

8) Field measurements of noise were made before construction at

twelve sites and the data analyzed as follows:

a) New construction - rural - 2 sites

b) New Construction - suburban - 2 sites

c) New Construction - urban - 3 sites

d) New Construction - interchanges - 3 sites

e) Reconstruction - 2 sites

The measurement procedure involved taking 30 to 55 minute samples of existing noise per hour of the twenty-four hour measurement day at all positions in each site. The noise samples were reduced by the statistical distribution analyzer to obtain noise level distributions from which desired noise levels could be computed using the technique of spline fitting.

1.4 Measurement and Prediction Comparison

The Second Interim Report documents work accomplished during Fiscal Years 1974 and 1975 to compare measured and predicted traffic noise levels adjacent to existing roadways. The following tasks were accomplished.

1) Six noise measurement sites were selected.

2) Noise levels were tape recorded and analyzed at various positions at each site. Traffic data was simultaneously recorded.

3) The sites were surveyed using standard surveying techniques to determine distances and elevations of microphone positions and barriers relative to the roadway, for input into the prediction programs.

4) Noise level predictions were made for each site using the Michigan program and the TSC program (MOD-02).

5) The measured and predicted L_{10} noise levels were statistically compared to determine the accuracy of the programs. To accomplish this, the Annandale and Netcong sites below were divided into subsites which are

considered as sites for a computerized statistical analysis. Thus comparisons of noise levels were made for the following nine analysis sites.

a) Route 29, Section 13A (Residential) - Urban residential area along at-grade four lane divided roadway.

b) Route 29, Section 13A (Stacy Park) - Metropolitan park along at-grade four lane divided roadway.

c) Route I-78, Section 2G (Clinton) - Rolling grass along transition between depressed and at-grade six lane divided roadway.

d) Route I-78, Section 2M & 3E (Annandale) microphone positions 1, 2, 3 and 4 - Rolling grass along depressed six lane divided roadway.

e) Route I-78, Section 2M & 3E (Annandale) microphone positions 5, 6, 7 and 8 - Light woods and rolling grass along transition between depressed and elevated six lane divided roadway.

f) Route I-78, Section 2M & 3E (Annandale) microphone positions 9, 10, 11 and 12 - Open grass along elevated six lane divided roadway.

g) Route I-287, Section 1E, 4B and 5B (Bridgewater) - Open grass between high school parking lot and dense woods along at-grade four lane divided roadway with partially raised median.

h) Route I-80, Section 1B & 2L (Netcong) microphone positions 1, 2 and 4 - Wooded area along elevated six lane divided roadway with up to 2% grade at interchange with Route 206.

i) Route I-80, Section 1B & 2L (Netcong) microphone positions 5 and 8 - Wooded area around highway maintenance yard along Route 206, an at-grade four lane divided roadway with variable median and up to 4% grade, at interchange with Route I-80.

6) A method to produce corrections to predicted levels was developed and applied to the above sites. The method uses multiple regression equations which regress differences between measured and predicted levels against significant traffic and geometry variables. The significant variables are determined by step-wise regression.

1.5 After Measurements

The Final Report documents work performed during Fiscal Year 1976 to acquire after construction noise measurements and compare them to before construction measurements, which were documented in the First Interim Report. It details work performed to supplement the noise prediction and measurement comparison of the Second Interim Report. The Final Report also summarizes and integrates the previous reports in terms of the overall project objectives. The following tasks were accomplished.

1) The following six sites were selected for after construction measurements, because they were the only ones of the original twelve open to traffic at the time of the after surveys:

a) Route I-195, Section 1B (Hamilton Township) - new construction, urban.

b) Route 440, Section 1D & 3A (Perth Amboy) - new construction, urban.

c) Route 33F, Section 1A & 2A (Freehold Township) - new construction, interchange.

d) Route 9, Section 12C & 22D (Howell Township- reconstruction.

e) Route I-295, Section 8B & 9A (Lawrence Township) new construction, rural.

f) Route 174, Section 1A (Lawrence Township) - new construction, surburban.

2) Noise levels were tape recorded and the data analyzed at various positions at each site. Traffic data was simultaneously recorded.

3) A statistical method based on analysis of variance and t-tests was computerized to compare before and after levels at each site.

4) The before and after noise levels at each site were grouped with respect to peak, daytime off-peak, and nighttime hours (determined by traffic

volume) and microphone position then compared using the statistics program.

Another work requirement for the Final Report was added after the review of the Second Interim Report. The L_{eq}'s (equivalent noise levels) predicted only the TSC program, were to be compared to those observed in the field.

During the time since the Second Interim Report predictions, the TSC program (MOD-02) had been updated at the NJDOT facility. This circumstance necessitated revision of the original noise level predictions to reflect the update. Thus these additional major work tasks were undertaken.

5) Noise level predictions were made for Second Interim Report sites with the updated TSC program (MOD-03).

6) The measured and predicted equivalent noise levels were compared to determine the accuracy of the updated TSC program. The findings of the Second Interim Report were revised to reflect the updated TSC program results.

2. Conclusions

2.1 Before and After Comparison

As expected, existing noise levels rise when a new highway is built. There were very significant increases in after highway construction existing noise levels from before construction existing noise levels for three of the six sites located adjacent to Routes 174, I-195, I-295. These three sites were all new construction with no previous highway traffic. Significant increases in measured noise levels ranged from 3 to 12 dBA at these sites during daytime, peak and off-peak hours. Only Route 174, registered significant nighttime increases. Such rises in average existing noise levels may be controllable by noise abatement measures.

Existing noise levels may not always rise, if noise abatement is built in. There was no significant difference in before and after existing noise levels at Route 440. This was due to the depressed roadway configuration and the higher urban noise levels at the site. There was a significant decrease in existing noise levels within a 400 foot distance after highway reconstruction of Route 9. This was probably due to less traffic, traffic redistribution, a center barrier, and a smoother road surface afterward.

The site adjacent to Route 33F interchange was an anomaly because Route 33F was not complete at the time of the after survey and did not carry traffic past the microphones. As a consequence, although there was a significant difference between before and after construction existing noise levels, the difference was due to a decrease in after construction noise levels at half the microphone positions. This occurred because the ramps constructed at the interchange acted as a noise barrier between these microphone positions and existing Route 79, a two lane road.

A summary of the before and after highway construction data for all sites is presented in Table 1. The table gives mean levels at measured distances from the major noise generator at each site for each of the three major groups of hours during the day.

2.2 Measurement and Prediction Comparison

For the TSC program, L_{10} noise levels were predicted by the original version (MOD-02) of the program and L_{eq} levels were predicted by the updated version (MOD-03). Only L_{10} levels were predicted by the Michigan program, as it does not compute L_{eq} levels. Conclusions about the TSC program were drawn from the updated L_{eq} comparison measured and predicted noise levels; those about the Michigan program, from the L_{10} comparison.

TABLE 1

Before and After Mean L_{10} Levels For All Sites

Significant Increase	Site	Distance to Near Lane	Mean L_{10} (dBA) Peak Hours		Mean L_{10} (dBA) Off-Peak Hours		Mean L_{10} (dBA) Nighttime Hours	
			Before	After	Before	After	Before	After
	Route 174 New Construction, Suburban (Four Lane, with center barrier)	100'	52.8	65.2	51.2	63.2	51.1	61.4
		200'	49.8	58.4	51.4	56.7	47.7	54.4
		400'	50.9	57.4	49.6	55.2	49.8	55.5
	Route I-195 New Construction, Urban (Four Lanes with median)	95'	67.9*	70.4	55.3	66.6	50.8	55.7
		72'	50.8	65.2	54.0	62.7	49.5	55.5
	Route I-295 New Construction, Rural (Six Lanes with median)	200'	51.9	60.1	50.8	57.5	52.0	53.4

* Only one sample (8 min.) stopped because of construction noise.

TABLE 1 (cont.)

Before and After Mean L_{10} Levels For All Sites

	Site	Distance to Near Lane	Mean L_{10} (dBA) Peak Hours		Mean L_{10} (dBA) Off-Peak Hours		Mean L_{10} (dBA) Nighttime Hours	
			Before	After	Before	After	Before	After
No Increase	Route 440 New Construction, Urban (Six lanes with center barrier in 25' cut)	200' (135' to cut)	62.2	64.1	64.1	62.9	55.6	54.7
		300' (235' to cut)	63.3	63.4	62.4	61.9	54.6	53.1
	Route 9 Reconstruction (Two lanes to four lanes with center barrier)	100'	67.5	65.9	66.4	64.1	61.5	58.2
		200'	65.4	60.4	62.7	58.0	58.3	52.3
		400'	58.3	55.4	56.8	53.2	51.9	49.7
	Route 33F Interchange (Two lane county road, major generator)	650'	54.1	51.2	53.8	51.5	49.3	44.3
		380'	59.6	55.5	59.3	54.9	54.7	53.3
		640'	58.1	53.4	56.7	54.4	52.6	49.8
		450'	54.2	56.2	53.2	54.2	48.8	52.0
		220'	57.3	60.6	56.8	58.8	50.8	55.1
		580'	55.1	56.3	54.3	56.5	48.9	49.0

There were significant differences between observed and TSC program predicted noise levels at five out of nine analysis sites. At these five sites, the updated TSC (MOD-03) program predicted approximately 5 dB above observed levels. There were significant differences between observed and Michigan program predicted noise levels at eight of nine analysis sites. The Michigan program, based on NCHRP Reports 117 and 144, predicted approximately from 5 dB below to 4 dB above observed levels at these eight sites.

The TSC program shows a general tendency to overpredict observed noise levels. Step-wise regression on differences versus influencing factors shows that the overprediction is correlated with distance. Thus the program does not adequately consider the attenuation of intervening terrain. The updated TSC (MOD-03) program approximates the attenuation of earth mound type barriers better than the earlier version (MOD-02) however.

The statistical analysis shows the overprediction is also correlated to truck volume. It is probably due to the one high average truck noise emission level applied by the MOD-03 version of the program to all trucks equally. Furthermore, the data from Route I-78 (Annandale) sites can be interpreted to indicate that the actual truck noise attenuation rate irrespective of ground attenuation may be different from that assumed by the program.

The following paragraph concerns a side issue. The L_{eq} predictions of the updated TSC MOD-03 program were significantly improved over L_{10} prediction of the original TSC MOD-02 (described in the Second Interim Report) for two analysis sites having elevated and depressed roadways at Route I-78 (Annandale). By inspection of average differences between observed and updated

TSC predicted L_{10} and L_{eq} levels, improvement in prediction appeared to be largely due to the use of the updated version of the TSC program rather than the use of L_{eq} levels instead of L_{10} levels. Average differences between observed and predicted L_{eq} levels usually changed within two decibels relative to the L_{10} differences. The variance in differences between observed and predicted L_{eq} noise levels from the L_{10} differences using the updated TSC program was reduced, but not enough to explain gross variations in predicted from observed levels - in particular, for two sites. At one site, Route I-287 (Bridgewater), a high school along an at-grade divided highway, the noise levels observed farthest from the roadway were much lower than could be accounted for by noise attenuation in the propagation path from the closest position. At the other site, Route I-78 (Clinton), in a rolling field along a transition from depressed to at-grade roadway, there were suspiciously higher noise levels for certain hours. This could have been due to idling trucks in the vicinity of the site.

The Michigan program, within the stated range, shows a general tendency to underpredict observed noise levels from roadways. Statistical analysis on differences shows that the underprediction is correlated with truck volume and distance from the road. This characteristic is probably due to the program's assumption of lower average truck noise emission levels than is appropriate for all truck traffic mixes generally encountered on the highway and greater attenuation with distance than is applicable to all types of intervening terrain. A counter tendency in the Michigan program is to overpredict noise levels affected by extended earth mound barriers. This is due to the approximation of all barriers by a knife-edge - the same approximation the TSC program uses.

However, the greater assumed attenuation with distance for the Michigan program seems to compensate somewhat for the overprediction. The Michigan program also shows a counter tendency to overpredict for low truck volumes above a certain cutoff which varies with distance from the roadway. However, the program follows the general trend of underprediction at positions close by the roadway for greater truck volumes, unaffected by barriers.

Investigations were also made by linear regression between predicted and observed levels. The ideal straight line relationship of unit slope and zero intercept with high correlation and the little scatter was sought.

Comparing predicted to observed levels for both programs, the ideal relationship was not found at all. Even an overall constant offset of predicted from observed levels was not found from linear regression at any of the sites for either program except at Route I-287 (Bridgewater) for the TSC program. The regressions of predicted versus observed levels generally shows a fair amount of scatter with just fair correlation, especially when depressions, elevations, barriers and terrain in the sound propagation path influenced the prediction.

The two programs (TSC MOD-02 and Michigan), when compared to one another using L_{10} levels in the Second Interim Report, were found to produce L_{10} noise levels highly consistent with each other for the same roadway input. That is, the regressions between the two programs levels generally had very little scatter and high correlation. The actual differences between absolute levels of the two programs were found to be significantly different nonetheless. Neither did the regressions demonstrate the ideal relationship nor a constant offset between levels.

3. Recommendations - Measurement and Prediction Comparison

Two factors were found to influence the deviation of program predictions from observed traffic noise levels. They were distance from the observer to the roadway and truck volume. The distance factor relates to the terrain and barriers in the propagation path. The truck volume factor relates to the distribution of types of trucks and their noise emission levels.

Based on the conclusions it is recommended that the prediction methods be modified:

1) A distinction should be established between heavy tractor-trailers and medium trucks with different noise emission levels in the inputs of the programs.
2) Distance attenuation should be a function of terrain in the program and chosen by either the program or the user.
3) Earth mound barriers should be approximated by more complex structures than knife-edges. Barrier thickness should be considered.

The results of the prediction methods can be "corrected" by means of the input variables. This was the approach of the Kentucky Department of Transportation in Reference 6, which used regression to determine significant variables. In this report, step-wise regression is a method which separates the effect of many variables and generates a multiple regression equation on differences between observed and predicted levels.

The multiple regression equations can be applied to obtain the differences between measured and predicted levels by means of significant

input variables. Then the differences can be added to the predicted levels to obtain corrected levels.

It is further recommended that:

1) New Jersey apply the prediction methods and correction equations which are indicated for the sites below to similar sites where predictions are required:

a) Route 29, Section 13A (Residential) - TSC program without correction.

b) Route 29, Section 13A (Stacy Park) - TSC program with correction.

c) Route I-78, Section 2G (Clinton) - No recommendation.

d) Route I-78, Section 2M & 3E (Annandale) microphone positions 1, 2, 3 and 4 - TSC program without correction.

e) Route I-78, Section 2M & 3E (Annandale) microphone positions 5, 6, 7 and 8 - Michigan program with correction.

f) Route I-78, Section 2M & 3E (Annandale) microphone positions 9, 10, 11 and 12 - TSC program with correction.

g) Route I-287, Section 1E, 4B and 5B (Bridgewater) - Michigan program with correction.

h) Route I-80, Section 1B & 2L (Netcong) microphone positions 1, 2 and 4 - TSC program without correction.

i) Route I-80, Section 1B & 2L (Netcong) microphone positions 5 and 8 - TSC program without correction.

2) New Jersey and other states which have the means of implementation used the method of obtaining correction equations for sites which are not similar to the sites in this report. The prediction matrix of site characteristics in Section 7 can be used as a guide in applying prediction methods to sites with different mixes of characteristics.

4. Before and After Comparison

4.1 General

The before and after noise measurement surveys were conducted to determine the change, due to newly constructed highways, in the existing acoustic environment of the area traversed by the highway. The change is defined by the difference between diurnal hourly noise levels measured on representative days before and after construction or opening to traffic.

Twelve sites were originally selected for before measurements. Of these, after measurements were possible at six sites which were open to traffic. The remainder of the original sites were either not constructed or open to traffic at the time of the after surveys. Thus, the comparison between before and after noise levels will be made for the following six sites only. At least one of the sites fall into each of the five types of sites set forth in the First Interim Report. The list of sites by type is:

a) New Construction - Rural

   Route I-295, Section 8B & 9A (Lawrence Township)

b) New Construction - Suburban

   Route 174, Section 1A (Lawrence Township)

c) New Construction - Urban

   Route I-95, Section 1B (Hamilton Township)

   Route 440, Section 1D & 3A (Perth Amboy)

d) New Construction - Interchange

   Route 33F, Section 1A & 2A (Freehold Township)

e) Reconstruction

   Route 9, Section 21C & 22D (Howell Township)

The sites will be treated in the chronological order of the after measurement surveys for the rest of the report. The order will be Routes I-195, 440, 33F, 9, I-295, and 174. General descriptions of each site during before and after measurements appear in Section 4.4. More specific descriptions, diagrams and photographs of the sites appear in Appendix A, along with measured data for the sites.

4.2 Data Acquisition

The noise measurements were obtained during twenty-four hour noise surveys conducted at the sites before and after construction or opening to traffic. The equipment used in the surveys, the noise data recording methods and data analysis are described in detail in the First Interim Report. Noise samples of less than one hour were taken to represent each hour. A detailed study of probabilities for various sampling schemes in estimating the full hourly levels is also described in the First Interim Report. During the before surveys, sample times ranged from 30 to 55 minutes per hour. In the after surveys, most samples were 50 minutes per hour. The data produced from the surveys are the noise levels by hour over the entire twenty-four time period.

These levels are taken to be indicative of the acoustic environment at the site. The specific noise levels output from a data analysis computer program are:

L_{10} (dBA) = The sound pressure level in decibels, A-weighted, exceeded 10% of the sample time. This represents the average peak level of the noise sample.

L_{50} (dBA) = The sound pressure level in decibels, A-weighted, exceeded 50% of the sample time. This represents the average noise level of the noise sample.

L_{90} (dBA) = The sound pressure level in decibels, A-weighted, exceeded 90% of the sample time. This represents the background noise level of the sample.

L_{NP} (dBA) = The noise pollution level in decibels, A-weighted. This equals the equivalent sound level L_{eq}, plus 2.56 times the standard deviation around the sample mean. The L_{eq}, is the equivalent steady state sound pressure level, in decibels A-weighted, which would contain the same acoustic energy as the time varying sound level during the sample time.

Std. Dev. (dBA) = The statistical standard deviation of the noise sample level distribution. This represents the variation in noise levels of the sample.

Traffic and weather data were collected concurrently with the hourly noise recordings. Wind speed, wind direction, and ambient temperature measurements were recorded for each hour, and notes kept on precipitation. Classified traffic counts consisting of cars and trucks (over 10,000 pounds gross vehicle weight) were made during each hour using automatic traffic counters and hand counters. No speed data was obtained.

Noise level, traffic, and weather data appear in Section 6 of the First Interim Report for the before surveys. The data appear in Appendix A of this report for the after surveys.

4.3 Comparison

4.3.1 Before and After Noise Level Comparison

The data gathered from each of the six sites for the comparison consisted of noise levels observed for each hour at a particular position over a period of twenty-four hours. Of the different noise levels obtained from the noise data analysis, the L_{10} was chosen for comparison purposes.

The L_{10} (dBA) noise descriptor for each hour noise measurement represents the average peak noise generated on the highway during the measurement period.

This is also one of the two design noise levels in the Federal Highway Administration noise standards. When referring to "noise levels" in this section, the L_{10} (dBA) is implied. The after L_{10} levels were computed, using the technique of spline fitting, explained in the First Interim Report, to the nearest tenth decibel. The before L_{10} levels were recomputed to the nearest tenth decibel for the comparison.

The primary objective of comparison was to determine the effect of the highway on noise levels at each site keeping site parameters fixed and taking into account the effect of time during the day and distance from the highway. To achieve fixed site parameters, the after measurements were taken during the same season as the before measurements, where deciduous trees affected sound attenuation. Before and after measurements were taken during mid-week days only, when traffic patterns are most consistent. To account for time and distance variation, the before and after levels were stratified by time period and microphone position.

1) Time Period - The after levels can be grouped into three major time periods of the day represented by a) peak hours, b) daytime off-peak hours; and c) night-time hours. The determination of which hours to place in each of the three catagories was done on the basis of total hourly traffic volume. The total volume was computed from the passenger car equivalent weighted sum of auto and truck volume. The truck volume was in all cases weighted double the auto volume. The total hourly volume was plotted against hour of the day for each site. From this plot sets of peak hours could be determined. Approximately three hours for each group of peak hours could be selected. At the six sites surveyed, there were morning and afternoon peak periods. There were no peak hours during the night hours. The nighttime period was in all cases

considered to extend from 10:00 P. M. (2200) through 5:00 A. M. according to the suggestion in NCHRP Report No. 117, Reference 5, page 31. The remaining hours were considered the off-peak. The particular hours within the peak and off-peak groups differed from site to site, depending on the traffic conditions after construction. At a given site, however, the before construction noise levels were placed in the same groups as the after levels.

2) Microphone Position - The grouping of noise levels by microphone was fixed for each site. The positions had been systematically chosen to detect any change in the acoustic environment about the roadway after construction. They may be considered to be the important noise levels as a function of distance from the roadway and to actually define the site. Standard microphone height above ground was changed from four feet before construction to five feet after construction. The height variation was due to modification of noise measurement procedures. Since the variation is within allowable limits for existing noise measurement, it does not constitute a significant change in this site parameter.

The before and after hourly L_{10} noise levels are presented by site and grouping in Appendix B.1.

4.3.2 Analysis of Variance (References 6, 7, 8)

The inference of whether the after noise levels are significantly different from before noise levels at a site is made from analysis of variance. The "null hypothesis," tested by analysis of variance, is that no significant difference in existing noise levels at a given site exists due to the highway construction. The alternative hypothesis is that there is a difference - an effect on existing noise levels due to highway construction.

The analysis of variance is also used to check differences in existing noise levels during different time periods and at different microphone positions separately. Significant differences can be determined from the effects of time period and microphone position factors. A significant microphone position effect implies a dependence of noise level on position with respect to roadway distance. A significant time period effect indicates that the grouping of noise levels follows the rise and fall of the traffic pattern. No effects would indicate a homogeneity in noise levels.

The particular method employed is analysis of variance for a three factor classification, fixed effects model, with replication (unequal sample sizes), discussed in Reference 8 . The technique essentially compares the means of samples of noise levels taken under various treatments - combinations of different levels of factors influencing the noise levels. In this case there are three factors: 1) highway construction, 2) time period, and 3) microphone position. Each of the factors has levels. The highway construction factor has two levels, before construction and after construction. The time period factor has three levels, peak hours, off-peak hours, and nighttime hours. The microphone position factor has as many levels as there are microphone positions at a site. In all there are 2 X 3 X m treatments, possible combinations of factors for a site, where m is the number of microphone positions. By fixed effects is meant that the experimental model includes all important levels of the factors. By replication is meant that each treatment has more than one noise level in its sample. However, due to the grouping of noise levels by time period, unequal sample sizes occur and must be permitted by this method.

The overall effect of the highway construction factor is determined by comparison with before highway noise levels considering the separate effects of time period and microphone position factors. Furthermore, replication makes it possible to estimate the effect of the interaction between combinations of factors. In the present context, there are four possible interactions, a) highway-time period, b) highway-microphone position, c) time period-microphone position, and d) highway-time period-microphone position. Interaction effects can be significant if the separate effects of the factors are not strictly additive; that is, a given factor does not change the noise measured by the same amount between given levels of the other factors at all levels of the given factor.

The analysis of variance requires computation of the variance in noise levels (estimated by the mean square deviation about the overall mean noise level) associated with each of the effects. The null hypothesis of no effects is tested by comparing these variances to the variance, due to chance only, about the overall mean noise level. The chance variance is estimated by the average mean square deviation of noise levels within each treatment about the treatment's mean noise level, described as the "within treatments" variance.

The comparison of variances is done by forming the ratio of the mean square deviation of each effect to the "within treatments" mean square deviation. The ratio is distributed as the F-statistic. When the F-statistic is greater than the critical value of the F distribution at a given level of significance, the null hypothesis is rejected. The minimum level of significance used was 5%.

4.3.3 t-Tests

When the analysis of variance procedure detects a significant difference in noise before and after highway construction, the assumption is that this difference is additive, that is, the same at all microphone positions and at all

time periods. In the presence of interaction effects, this interpretation of the effect of the highway construction factor cannot be made. Therefore, the differences in noise before and after construction was further studied using t-tests on differences between mean before and mean after noise levels for all microphone positions at all time periods. This auxilliary test procedure was used to pinpoint where significant differences occured at the sites and where they did not at a minimum level of significance of 5%.

4.3.4 Statistical Analysis Program

4.3.4.1 Program Description

A computer program was developed to process the site noise level data. The program incorporated a statistical algorithm to compute the required mean square deviations and F-statistics for the analysis of variance and the t-statistics. The program was written in FORTRAN IV and was run on the interactive terminal facility of the NJDOT IBM 370/145 computer.

4.3.4.2 Input

The input for the program was a card deck for each site containing the L_{10} noise levels. One card was keypunched for each noise level along with fields to identify it as before or after highway construction, the time period containing it, the corresponding microphone number, and the replication number.

4.3.4.3 Output

The output from the program was a listing of:

1) the mean square deviations for each factor, their interactions, and within treatments.
2) The F-statistic and degrees of freedom for each factor and their interaction.

3) The t-statistics and pertinent data on differences in means between the before and after noise level samples for each combination of time period and microphone position.

Appendix B.2 contains tables tabulating this output for all sites. The maximum level of significance for each computed statistic compared to the critical values is indicated in the tables. The range is 5% minimum to 0.05% maximum for the F-test and 5% minimum to 0.1% maxium for the two-tailed t-test. Statistics less than 5% are not significant and those at 5% are marginally significant. Statistics at higher levels are very significant.

4.4 Results

4.4.1 Format

The following section discusses the results for each site separately. The format for each site will be:

A. Site Description - A description before and after construction or opening to traffic. Site maps and photographs appear in Appendix A.

B. Time Periods - The particular grouping of the hours of the day according to total traffic after construction.

C. Comparison - Interpretation of analysis of variance and t-tests.

4.4.2 Route I-195, Section 1B (Hamilton Township)

Site Description

The site was in an urban residential location. Two microphones were located approximately 1200 feet apart above a cut along proposed Route I-195. Existing noise was influenced by local traffic in the area.

Route I-195 was constructed in the cut as a four lane, bituminous concrete surface, divided highway with median. The roadway was completely visible from the microphone positions in the after construction survey. The positions, 1 and 2, were 95 feet and 72 feet from the roadway edge, respectively.

A mobile noise survey, described in the First Interim Report, was conducted at this site due to widely spaced microphone positions. The procedure essentially involved taking a 30 minute noise sample during the hour at one position, then moving to the next position for a 30 minute noise sample during the next hour, and so on. This procedure provides only half as many noise samples for a day than the stationary noise survey for two closely spaced positions. As a result the treatment samples' size averaged less than four samples, whereas for a stationary survey it would have been eight.

Time Periods

The traffic pattern after construction of Route I-195 had peak hours consisting of six hours total: 700, 800, 900, 1500, 1600 and 1700. The nighttime hours consisted of all hours from 2200 through 500. The rest of the hours were daytime off-peak.

Comparison

The analysis of variance indicated a very significant difference in before and after construction levels. The t-test on mean before versus after levels for each time period and microphone position showed a significant increase after construction at Position 1 for peak and off-peak periods and at Position 2 for off-peak. There were no significant differences at night at either position.

The mean increase in noise levels, ranging from 2.5 dB to 14.4 dB, is definitely due to traffic visible in the cut. However, traffic volume was drastically reduced at night, accounting for the lack of significant difference in nighttime before and after levels.

There were significant time period and microphone position effects indicated for this site. The effect of time period would be expected because levels were different between daytime and nighttime hours. The effect of microphone position was due to the difference in distance from the roadway. There were also significant interaction effects between time period and the two other factors, but no interaction effect when time period was not involved. This is probably due to the nature of the mobile survey; the microphone positions are not measured simultaneously for the same traffic conditions, but on alternate hours.

4.4.3 Route 440, Section 1D & 3A (Perth Amboy)

Site Description

This site was located in an urban area. The microphones were located on a street between a church and a school. Local traffic and activities were the source of ambient noise.

Route 440 was constructed as a six lane Portland Cement Concrete divided highway with center barrier. The road is in a 25 foot cut, which intercepts the line of sight to the microphone positions. The positions were located 200 feet and 300 feet from the roadway edge in the after noise survey.

Time Periods

The traffic pattern for Route 440 had peak hours consisting of four hours total - 700, 800, 1600 and 1700. The nighttime hours consisted of all hours from 2200 through 500. The rest of the hours were the daytime off-peak.

Comparison

The analysis of variance indicated no significant difference in before and after noise levels. The t-test on mean before versus after levels for each time period and microphone position also showed no significant differences. The fact that the highway has no effect on existing levels at this site may be attributed to the depressed roadway configuration and urban environment. The depression acts as an effective noise barrier and the existing levels are inherently higher in the urban noise setting.

The effect of time period was significant from the analysis of variance indicating a difference between daytime and nighttime levels. All other effects from microphone position and interactions were not significant.

4.4.4 Route 33F, Section 1A & 2A (Freehold Township)

The site is located in a suburban area adjacent to existing Route 79. The area is flat with high grass. Route 79 is the major contributor to the existing noise level. It is an at-grade, two lane, bituminous concrete surfaced road. Seven microphones were positioned throughout the area to detect before existing noise around the proposed interchange with Route 33F.

The interchange was constructed at the time of the after construction noise survey. However, Route 33F was not constructed beyond Route 79 and did not carry traffic past the microphone. The two ramps (SW and EN in the site diagram) affecting the site were constructed connecting the northbound lane of Route 79 to the westbound lane of Route 33F. Ramp SW was not heavily used and EN was not used at all.

Time periods

The traffic pattern for Route 79 determined the time period division.

It had peak hours consisting of six hours total - 700, 800, 900, 1500, 1600, and 1700. The nighttime hours consisted of all hours from 2200 through 500. The rest of the hours were the daytime off-peak.

Comparison

The analysis of variance was done for six positions at the site, exclusive of Position 3. Position 3 was eliminated because gaps in before and after measurements were such that the hourly samples coincided only at one hour. No reliable conclusions could be drawn from such data.

The analysis of variance indicated a significant difference in before and after construction noise levels. The t-test on differences in sample means before and after construction showed different changes for different groups of microphone positions at the site. Postion 6 was relatively close to and in full view of Route 79. This position exhibited a significant increase (2 to 4.3 dB) in levels after construction during off-peak and nighttime hours due to the increase in traffic on Route 79 plus the ramp traffic. Positions 1, 2 and 4 had views obstructed to Route 79. The ramps apparently acted as a noise barrier causing significantly lower noise levels (-2.3 to -4.7 dB) for this group of positions. Finally, Postions 5 and 7 were more exposed to Route 79, the ramp traffic, and noise from a nearby highway maintenance yard supplying power to the noise survey. This group exhibited overall non-significant, but positive increases in mean before and after noise levels.

The analysis of variance showed significant effects from time period, microphone position and all interactions. All interaction effects were probably due to the extensiveness and complexity of the site.

4.4.5 Route 9, Section 21C & 22D (Howell Township)

Site Description

The site is in a rural location with flat sandy terrain and scrub woods. The major noise source was Route 9 prior to reconstruction. This was an at-grade, Portland Cement Concrete two-lane roadway with a bumpy surface. Three microphone positions were placed in a line perpendicular to the roadway at approximately 145, 245 and 445 feet from the old roadway edge.

Route 9 was reconstructed as an at-grade, four lane, bituminous concrete surfaced, divided highway with center barrier. The microphone positions were at 100, 200 and 400 feet from the new roadway edge in the after reconstruction noise survey.

Time Periods

The traffic pattern after reconstruction of Route 9 had peak hours consisting of six hours total - 700, 800, 1400, 1500, 1600 and 1700. The nighttime hours included all the hours from 2200 through 500. The rest of the hours were daytime off-peak. Route 9 before reconstruction noise measurements were made on two separate days. Position 1 was recorded on both days and Positions 2 and 3 on separate days. It is noteworthy that the noise levels at Position 1 were consistent for corresponding hours of the two days and effectively doubled the number of noise level samples for this position.

Comparison

The analysis of variance indicated a very significant difference in before and after reconstruction noise levels. The t-test on mean before versus after levels for each time period and microphone position showed that the noise levels actually decreased after reconstruction. The decrease was barely significant at the 5% level for Position 1, closest to the roadway.

The decrease was significant only for off-peak hours at Position 3, 400 feet from the new roadway.

The mean decrease in noise levels, ranging from -1.6 dB to -5 dB, may be attributed to a decrease in traffic afterward, revealed by cursory comparison with before reconstruction traffic volumes. A second reason for noise reduction is the dispersion of the traffic from a two lane undivided highway to a four-lane divided highway with center barrier. A third reason may be that the old roadway was noticeably bumpy as indicated in the site description. The elimination of bumps in the new roadway may have significantly quieted rattling of passing trucks.

An increase in noise levels afterward might be expected since the northbound lanes of the new roadway are 45 feet closer to the microphone positions than the old roadway. However, this increase is evidently more than offset by the noise reduction. In this instance, reconstruction did not worsen the existing acoustic environment.

The effect of microphone position was significant at the site, indicating a dropoff of noise level with increasing distance from the road. The effect of time period was significant as well, as the mean noise level decreased from peak to off-peak to nighttime hours. There was significant interaction effect between the highway construction factor and the microphone position factor. This may be due to the non-linear effect of reconstruction - the traffic is distributed differently before and after reconstruction with respect to the microphones.

4.4.6 Route I-295, Section 8B & 9A (Lawrence Township)

Site Description

The site was in a rural area which was flat and grassy with woods. Four

microphone positions were laid out, but before data from only Position 2, located in the wooded area, were valid. Existing noise before construction primarily due to local activities with audible traffic noise from Route 1 about 2000 feet away.

Route I-295 was constructed as an at-grade, six lane, bituminous concrete surface, divided highway with median. The microphone was located 200 feet from the roadway edge.

Time Periods

The traffic pattern after construction of Route I-295 had peak hours consisting of five hours total - 700, 800, 1600, 1700 and 1800. The nighttime hours consisted of all hours from 2200 through 500. The rest of the hours were daytime off-peak.

Comparison

The analysis of variance indicated a very significant difference in noise levels before and after construction of Route I-295. The t-test on mean before versus after levels for each time period of the single microphone position showed a significant increase in peak and off-peak periods, but no increase in nighttime levels.

The mean increase in noise level, ranging from 6.7 dB to 8.2 dB, is due to the traffic volume during the day. However, the traffic volume was low at night, accounting for the lack of a significant difference in nighttime before and after levels.

The analysis showed a significant effect of time period. This result is due to the variations in traffic volume. There was also a significant interaction between highway construction and time period, because the existing noise was fairly constant at all times before construction.

4.4.7 Route 174, Section 1A (Lawrence Township)

Site Description

The site is located directly behind a suburban area in woods. The new roadway was partially constructed at the time of the before construction noise survey. Existing noise levels were influenced by local activities and audible traffic on Route 1, about 2,000 feet distant.

Route 174 was constructed as an at-grade, four lane, bituminous concrete surface, divided highway with center barrier. The microphone positions were 100, 200 and 400 feet from the roadway edge in the after construction noise survey.

Time Periods

The traffic pattern for Route 174 had peak hours consisting of five hours total - 700, 800, 900, 1600 and 1700. The nighttime hours consisted of all hours from 2300 through 500. The rest of the hours were the daytime off-peak.

Comparison

The analysis of variance indicated a very significant difference in before and after construction noise levels. The t-test on before versus after levels showed significant increases in mean noise levels at all combinations of time period and microphone position, ranging from 5.3 dB to 12.3 dB.

The analysis showed a significant effect of time period, probably due to high daytime and low nighttime traffic volumes. There was a significant effect of microphone position due to the attenuation of sound level with distance from the road. Interaction effects were significant for all combinations of factors. This was due to fairly constant ambient noise levels at all times and positions before construction.

5. L_{10} Measurement and Prediction Comparison

5.1 General

The objective of this part of the study was to compare noise levels measured adjacent to existing roadways to noise levels predicted from the observed traffic data by the TSC and the Michigan noise prediction programs. A byproduct of this objective was a method to correct predicted levels based on multiple regression with traffic variables and site parameters. This effort is documented in detail in the Second Interim Report. The report described data acquisition, noise level prediction, and comparisons. An analysis was performed to identify sources of discrepancies between measured and predicted levels. The procedure to develop correction equations to the predicted levels was an outcome of this analysis. Another aspect of the analysis was comparison of the two prediction programs to each other directly for the same traffic data.

Six sites were selected for noise measurement surveys. For comparison purposes, two of the six sites, Annandale and Netcong, were subdivided by grouping microphone positions into three and two subsites, respectively. In all, nine analysis sites were statistically analyzed.

5.2 Data Acquisition

Field noise surveys were conducted at the six survey sites to acquire hourly noise levels over the entire twenty-four hour period at various microphone positions. Classified traffic volume data were collected during the surveys. Traffic radar speed data were fully collected at the last two of the six survey sites. Posted speed limits were assumed to represent speeds at previous sites. Meterological data was simultaneously monitored during the surveys. Description of the instrumentation and procedures for the data collection and reduction appear in the Second Interim Progress Report, Section 5.

5.3 Prediction

Two separate computerized traffic noise prediction methods were used to predict the observed noise levels from corresponding traffic, geometry, and receiver data. They were the Transportation Systems Center (TSC) Traffic Noise Prediction Model MOD2 Computer Program and the Michigan Department of State Highways Traffic Noise Level Predictor Computer Program Version No. 6. Both programs were written in Fortran IV and adapted for use on the New Jersey Department of Transportation IBM 370/145 computer.

The version of the TSC program used in the Second Interim Report was the original program supplied to the Department in 1973. Since then, the TSC program was updated by the authors. The updated version was installed at the Department in July, 1976. This updated version was used to predict revised noise levels in the study reported in Section 6 comparing measured and predicted levels.

Required input for the programs, in addition to the hourly traffic data gathered during the noise surveys, was the roadway, site, and receiver geometry. These data were obtained from highway plans and field surveys with tape, rod, and transit.

The output of the programs were the noise levels by hour for each microphone position at a site. The TSC program produced a number of levels including L_{10}, L_{50}, L_{90}, and L_{eq} (equivalent sound level), and all computed using full octave band truck and auto spectra. The Michigan program produced only L_{10} and L_{50} noise levels. The L_{10} level, common to both programs was initially chosen to represent noise levels for this study. After the Second Interim Report was finished, the L_{eq} level generated only by the TSC Program was used in the later study reported in Section 6.

In order to utilize the programs for this study, other programs had to be developed in-house to handle the programs' input and in the volume required for statistical analysis. Full descriptions of all the prediction and input programs appear in the Second Interim Report, Section 6. Tables of measured or observed L_{10}'s labelled "O", TSC predicted L_{10}'s labelled "T", and Michigan predicted L_{10}'s labelled "M", appear in Appendix B of the Second Interim Report.

5.4 Comparison

The comparisons between observed and predicted noise levels were done for L_{10} levels and is described in the Second Interim Report, Section 7.1. These comparisons were possible:

1) Observed and TSC (OT)

2) Observed and Michigan (OM)

3) TSC and Michigan (TM)

The comparisons were done for two arrangements of data at an analysis site - a) all hours at a particular position and b) all hours at all positions taken together at the analysis site (whole site). The differences between paired levels were compared against the ideal zero difference using the Student's t-test. The absolute levels were also linearly regressed and tested against the ideal straight line relationship with unit slope and zero intercept. Then, the correlation and scatter of compared levels can be seen in the regression by the correlation coefficient and standard error of estimate, respectively. Example plots of whole site observed and predicted levels with linear regression lines are given in Figures 1 through 4. These plots were requested to supplement the Second Interim Report.

Figure 1

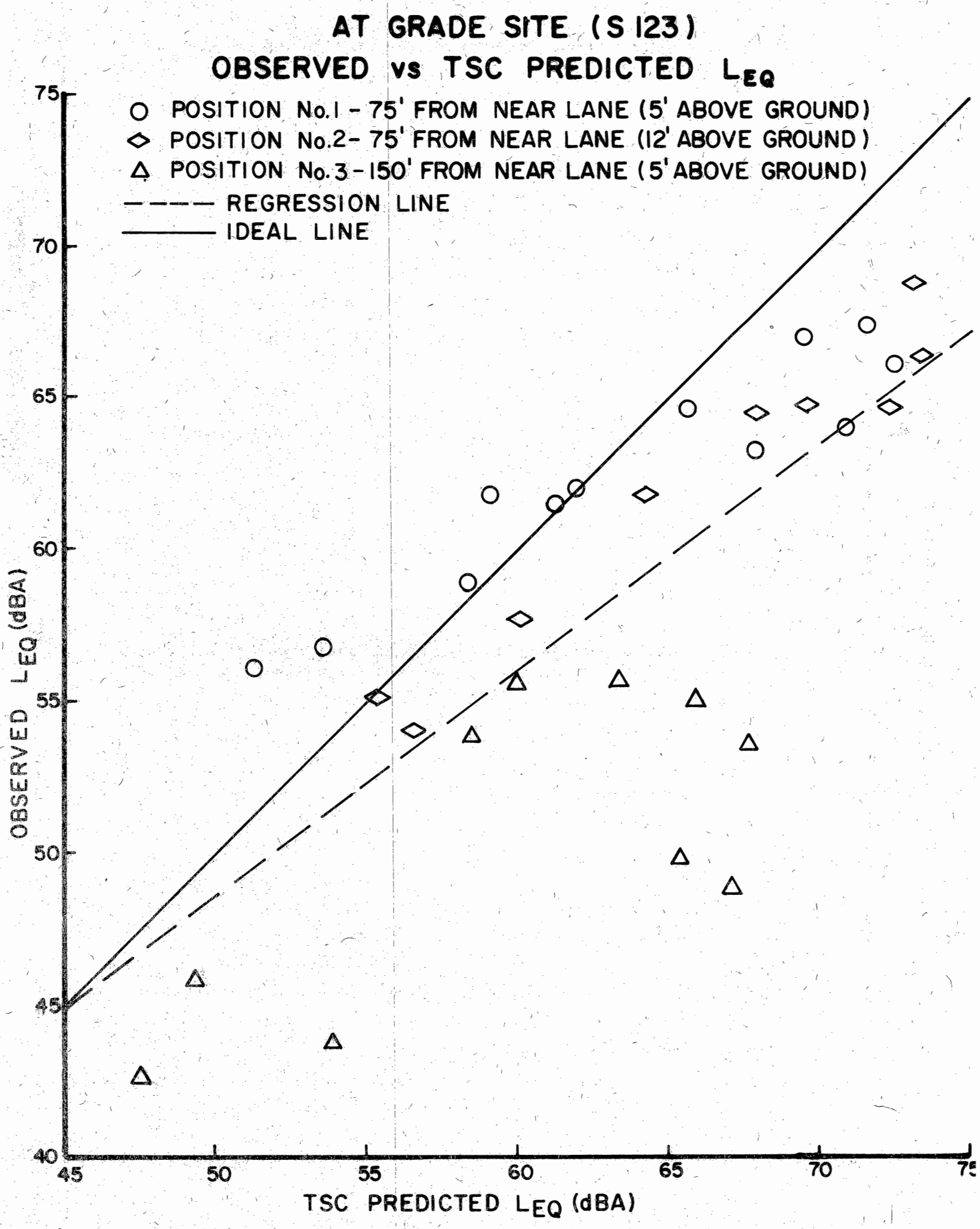

AT GRADE SITE (S 123)
OBSERVED vs TSC PREDICTED L_{EQ}
POSITION No.1 - 75' FROM NEAR LANE (5' ABOVE GROUND)
POSITION No.2 - 75' FROM NEAR LANE (12' ABOVE GROUND)
POSITION No.3 - 150' FROM NEAR LANE (5' ABOVE GROUND)
REGRESSION LINE
IDEAL LINE
OBSERVED L_{EQ} (dBA)
TSC PREDICTED L_{EQ} (dBA)
75
70
65
60
55
50
45
40
45
50
55
60
65
70

Figure 2

AT GRADE SITE (S 123)
OBSERVED vs TSC PREDICTED L_{10}

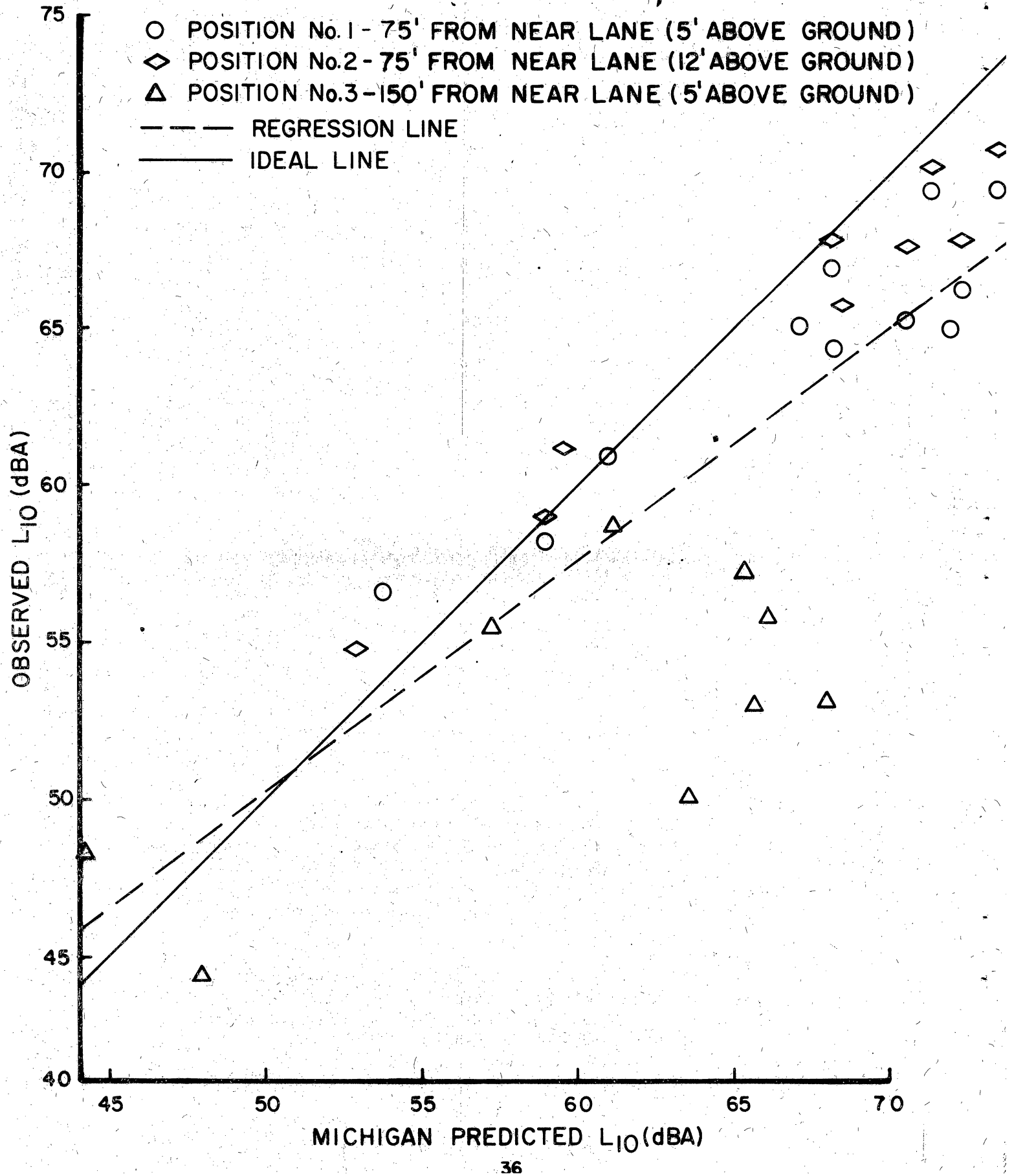


Figure 3

DEPRESSED SITE (A1234)
OBSERVED vs TSC PREDICTED L_{EQ}

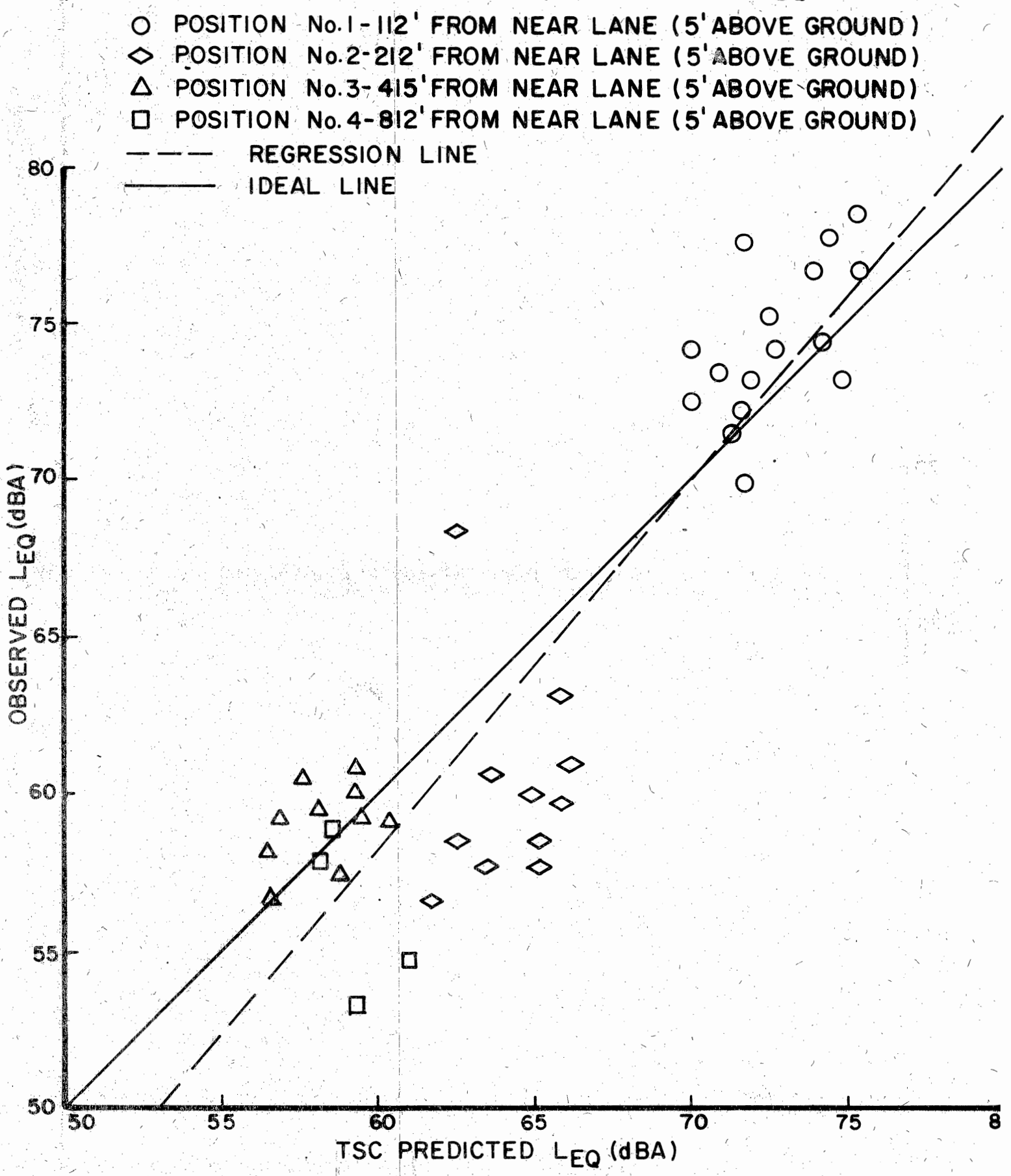
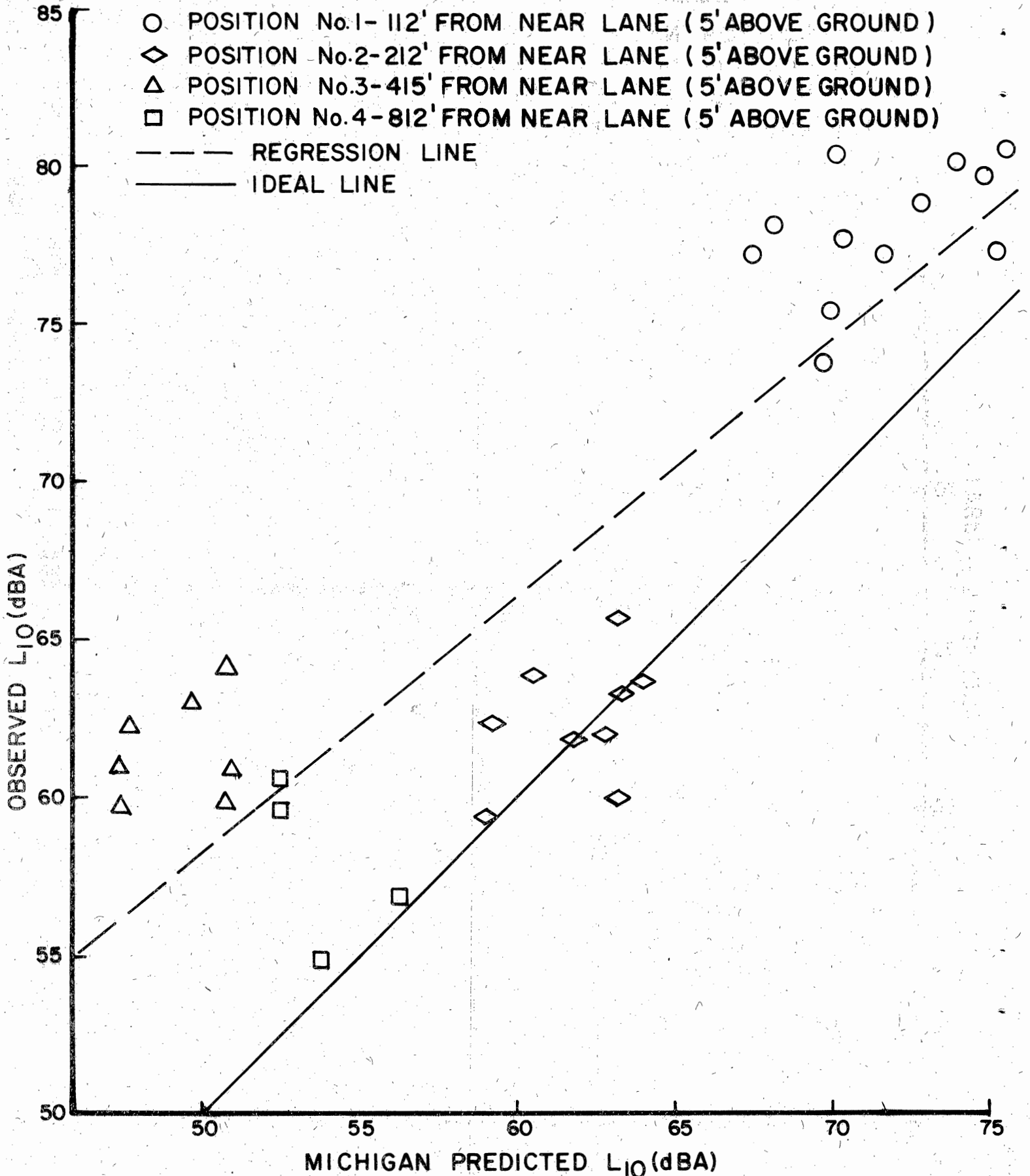


Figure 4

DEPRESSED SITE (A1234)
OBSERVED vs TSC PREDICTED L_{10}



In order to determine which variables, among traffic and geometry data input to the prediction programs, influenced discrepancies in compared levels, step-wise regression was applied to the whole site data. The variables for each site were selected in order of importance and entered in a multiple linear regression against the differences in compared levels.

The entire statistical analysis was implemented using STATPACK, an interactive terminal, software facility on the Department's computer, **(Reference 9).** The implementation of the programs required development of in-house programs to handle the data input for, and the execution of STATPACK. A complete description of this work is found in the Second Interim Report, Section 7.2. The statistical tables appear in Appendix B of the Second Interim Report.

5.5 Corrections

The multiple regression equations derived from step-wise regression in the comparison section can be used to correct predictions made by the programs for a specific site, if valid. The procedure for determining this is presented in the Second Interim Report, Section 7.1.4. The validity of the multiple regression equation as a correction is basically determined by a multiple correlation greater than 0.8 and a standard error of estimate less than 3 dB. The correction is supplied by substituting the significant variables for a given site into the multiple regression **equation,** computing the difference, and then adding the difference to the corresponding predicted level.

5.6 Results for L_{10} Comparison

5.6.1 General

A site description and summary of results for each analysis site is given in Section 5.6.2 through 5.6.10 for the comparisons between TSC predicted and Michigan predicted levels versus observed levels. The full discussion appears in Section 7.3 of the Second Interim Report.

Site maps and photographs to supplement the Second Interim Report are found in Appendix D.1 of this report.

The comparison briefly reviews the results of the whole site t-test on differences between observed and predicted levels, and simple linear regression between observed and predicted levels. Tables of these statistics may be found in Appendix C of this report. The summary also includes the multiple regression equations, which can be used as correction equations, from step-wise regression of differences (d_{OT} for the TSC program, d_{OM} for the Michigan) between observed and predicted levels versus influencing factors at the site. The factors considered were total auto volume, total truck volume, observer-near lane distance, observer height, average auto speed, average truck speed, total volume, truck percentages, auto/truck ratios and truck/auto ratios. The nine analysis sites are taken in chronological order and referenced by a unique letter-number code.

The results of direct comparison of TSC predicted L_{10} levels to Michigan predicted L_{10} levels is given in Section 6.6.11. The results are given for all sites taken together.

It must be emphasized that the TSC regression equations are for the original program and not the present updated version. However, the results for L_{10} levels did not differ much between the two versions except at sites A1234 and A9101112, the depressed and elevated roadways significantly affected by the barrier approximation. The TSC program L_{10} levels were not reworked for this report with the updated program, because the same general results would be obtained.

5.6.2 Route 29, Section 13A (Residential)- R12

Description

This is a site within a residential community adjacent to metropolitan Trenton. Route 29 is the major noise generator for the site. Its traffic noise is attenuated along the path to the microphones by two rows of two and three story residential dwellings. Microphone positions 1 and 2 were located 430 feet from the roadway edge at five and twelve feet above ground. Light local traffic contributed to the overall noise level.

Comparison

Both programs were successful in predicting the observed levels, on the average, for this site. Both programs' predicted noise levels were adjusted with a constant attenuation for the houses in the propagation path. The Michigan program overpredicted low truck volumes above a cutoff volume. The multiple regression equations were:

TSC $d_{OT} = 2.83687 - 0.05603$ (Truck Volume) $- 0.00073$ (Total Volume)

Michigan $d_{OM} = 2.03501 - 0.00156$ (Total Volume)

5.6.3 Route 29, Section 13A (Stacy Park) - S123

Description

This site is a typical metropolitan park, an open area with occasional trees. The terrain slopes down from Route 29, the major noise generator, toward the Delaware River with about 4% grade. Three microphones positions were used. Positions 1 and 2 were 75 feet from the roadway edge at heights of five and twelve feet. Position 3 was 150 feet distant at five foot height.

Comparison

Both programs significantly overpredicted the observed levels, as indicated by the t-test. The Michigan program overpredicted for low truck volumes above a cutoff. There was no constant offset of predicted from observed levels, as indicated by simple linear regression. The multiple regression equations were:

TSC $d_{0T} = 7.84599 - 0.10427$ (Truck Volume) $- 0.11292$ (Distance)
$+ 0.00222$ (Auto/Truck Ratio)

Michigan $d_{0M} = -2.02038 - 0.12266$ (Truck Volume) $+ 0.28421$ (Height)
$+ 0.86426$ (Truck Percentage)

5.6.4 Route I-78, Section 2G (Clinton) - C1234

Description

This site is west of Clinton on Route I-78 in a rural area. The major noise generator, I-78, is partially depressed at this site. The terrain is grassland with rolling hills. Microphone positions 1, 2, 3, and 4 were placed at 100, 200, 400, and 800 feet from the roadway edge.

Comparisons

The observed noise levels were inconsistent with the traffic volume actually passing. Because of this, conclusions drawn from the data are not valid. However, the data was analyzed and it showed that the TSC program overpredicted and the Michigan program underpredicted observed levels on the average, indicated by the t-test. There was a constant offset of predicted from observed levels in the TSC but not Michigan program. The multiple regression equations were:

TSC $d_{0T} = 3.89126 - 0.01629$ (Truck Volume) $- 0.00469$ (Distance)
$+ 0.52396$ (Truck/Auto Ratio)

Michigan $d_{0M} = 5.16611 - 0.02121$ (Truck Volume) $+ 0.00764$ (Distance)
$+ 0.59897$ (Truck/Auto Ratio)

5.6.5 Route I-78, Section 2M & 3E (Annandale) - A1234

Description

The site is located east of Annandale on Route I-78 in a rural area. The roadway is depressed at this point. A large earth mound barrier slopes gradually away from the depression. The terrain is open rolling grass.

Four microphone positions, 1, 2, 3, and 4, measured on different days with different traffic, were located at 112, 212, 415, and 812 feet from the road. Position 1 was on top of the depression with an unobstructed view of the roadway, the other positions were behind the earth mound barrier.

Comparison

The TSC program significantly overpredicted observed noise levels on the average, indicated by the t-test, but the Michigan program underpredicted them. The TSC program slightly underpredicted noise levels at the first position, where there was no barrier effect and significant tractor trailer truck volume. There was no constant offset of predicted from observed levels for either program as indicated by simple linear regression. The multiple regression equations were:

TSC $d_{OT} = 3.94032 - 0.01183$ (Distance) $- 0.01986$ (Truck Volume)

Michigan $d_{OM} = 10.42150 - 0.00806$ (Total Volume)

5.6.6 Route I-78, Section 2M & 2E (Annandale) - A5678

Description

The site is located east of Annandale on Route I-78 in a rural area. The roadway undergoes a transition from depressed to at-grade at this point. A large earth mound barrier slopes gradually away from the depression. The terrain is light woods on the earth mound and open grass elsewhere. Four microphone positions, 5, 6, 7, and 8, were located at the base of the mound at 99, 199, 403, and 784 feet from the roadway. Data at the positions were recorded on different days with different traffic.

Comparison

The TSC program significantly overpredicted observed noise levels on the average, while the Michigan program significantly underpredicted them, as indicated by the t-test. There was no constant offset of predicted from observed levels by either program. The multiple regression equations were:

TSC d_{OT} = -4.59749 + 0.00368 (Distance) - 0.00309 (Total Volume)

Michigan d_{OM} = 1.85296 + 0.00864 (Distance) - 0.00392 (Total Volume)

5.6.7 Route I-78, Section 2M & 3E (Annandale) - A9101112

Description

The site is located east of Annandale on Route I-78 in a rural area. The roadway is elevated at this point. The terrain is open grass and sharply slopes down from the roadway. Four microphone positions 9, 10, 11, and 12 were located at 98, 198, 413, and 758 feet from the roadway. The microphone positions were recorded on different days with different traffic.

Comparison

The TSC program significantly overpredicted observed noise levels on the average, while the Michigan program significantly underpredicted them, as indicated by the t-test. The TSC program accurately predicted the noise levels at the two positions closest the roadway. These positions were directly influenced by the edge barrier of the elevated roadway. However, the TSC program overpredicted the position far from the roadway, which was unaffected be either the elevated roadway or ground attenuation. This may indicate a problem in describing the attenuation of the noise source model of the program. There was no constant offset of predicted from observed levels for either program, as indicated by simple linear regression. The multiple regression equations were:

TSC d_{OT} = 6.57787 - 0.01592 (Distance) - 0.01404 (Truck Volume)

Michigan d_{OM} = 5.79443 - 0.01821 (Truck Volume) + 0.00189 (Distance)

5.6.8 Route I-287, Section 1E, 4B and 5B (Bridgewater) - B123

Description

The site is located in the vicinity of the intersection of Routes 22, 206

and I-287. The microphone positions 1, 2, 4 and 3 were located adjacent to the parking lot of the Bridgewater-Raritan High School East at 100, 200 and 400 feet from Route I-287. A dense growth of trees and brush were located east of the line of microphones. Ambient noise was influenced by parking lot traffic during the day.

Comparison

Only the first two positions were analyzed, because the noise levels for the farthest position were inexplicably low. The TSC program significantly overpredicted observed noise levels on the average, as indicated by the t-test. The Michigan program underpredicted observed noise levels by less than one decibel on the average. There was a constant offset between predicted from observed levels for the Michigan but not the TSC program, as indicated by simple linear regression. The multiple regression equations were:

TSC d_{OT} = -26.20389 - 0.04517 (Distance) + 0.53210 (Truck Speed)
- 0.00404 (Truck Volume)

Michigan d_{OM} = -31.75734 - 0.00913 (Truck Volume) + 0.02117 (Distance)
+ 0.69697 (Truck Speed)

5.6.9 Route I-80, Section 1B & 2L (Netcong) - N124

Description

The site is at the interchange of Route I-80 and 206 east of Netcong. Traffic noise from Route I-80 was the major noise source for microphone positions 1, 2, and 4 located 202, 377, and 772 feet from the roadway, in a wooded area. The roadway was elevated with up to 2% grade.

Comparison

The TSC program predicted observed levels on the average and the Michigan program underpredicted by a decibel on the average, as indicated by the t-test. The attenuation for woods was explicitly added to TSC program levels in this case.

There was no constant offset of predicted from observed levels for either program, as indicated by simple linear regression. The multiple regression equations were:

TSC d_{OT} = 11.87212 + 0.00539 (Distance) - 0.34045 (Truck Speed)

Michigan d_{OM} = -1.15973 - 0.00129 (Total Volume) + 0.00477 (Distance)

5.6.10 Route I-80, Section 1B & 2L (Netcong) N58

Description

The site is at the interchange of Route I-80 and 206 east of Netcong. Traffic noise from Route 206 was the major noise generator for microphone positions 5 and 8 located 249 and 504 feet from the roadway. Position 8 was located at the edge of the NJDOT maintenance yard in the area and was influenced by ambient noise in the yard. The roadway was at-grade with respect to topography with up to 4% grade. The roadway configuration went from a single roadway to divided with variable median.

Comparison

The TSC program significantly overpredicted observed levels on the average, while the Michigan program underpredicted them, as indicated by the t-test. There was no constant offset of predicted from observed levels for either program, as indicated by simple linear regression. The multiple regression equations were:

TSC d_{OT} =-1.55901 - 0.12554 (Truck Volume) + 0.00421(Auto/Truck Ratio)

Michigan d_{OM} = 2.54739 - 0.10060 (Truck Volume) + 0.01756 (Distance)

- 0.00918 (Auto Volume)

5.6.11 Comparison Between Programs

A unique aspect of this phase of the noise study was the simultaneous prediction of noise levels for the same site by two different methods.

This permits the direct comparison of the TSC programs and the Michigan program predictions. This was done for all sites in the same manner as the observed to predicted level comparisons.

There was a significant difference on the average between the programs at all sites except R12 and N124. The agreement at these two sites is attributed to the explicit consideration of noise attenuation (houses at R12 and woods at N124) in the sound propagation path for the TSC program. The levels for the two programs were generally highly correlated however, which shows that the programs were consistent in their predictions for the same input data, if not statistically equal.

The influencing factors on differences between TSC predicted and Michigan predicted noise levels were generally distance and truck volume in that order. These results are to be expected since the two programs basically differ in the assumptions of attenuation with distance and average truck noise emission level. The TSC program assumes 3 dB attenuation of noise level with doubling of distance, the Michigan program assumes 4.5 dB. The TSC program assumes an average truck noise emission level of 87 dBA, the Michigan program assumes 82 dBA.

6. L_{eq} Measurement and Prediction Comparision

6.1 Introduction

At the request of the reviewing agency, a follow-up study of the measurement and prediction comparison of the Second Interim Report was performed and included in the Final Report. The equivalent sound level, L_{eq} (dBA), was requested to be studied for the same sites in the Second Interim Report in hopes that greater clarification of the data might be obtained.

The study would involve no new data collection, but a reapplication of the L_{10} measurement and prediction comparison to L_{eq} levels. The L_{eq} is the equivalent steady state sound pressure level which would contain the same acoustic energy as the time varying sound level during the sample time.

The L_{eq} comparison could only be done with the TSC program since it alone produced L_{eq} values. However, during the time since the Second Interim Report, changes were made to the TSC program, so the original site data was rerun to obtain new L_{eq} levels. The original noise measurement data was also rerun to print out the observed L_{eq} levels.

Tables of observed and TSC predicted L_{eq} levels for each site are presented in Appendix D.1 along with site maps and photographs requested to supplement the Second Interim Report.

The observed and TSC predicted L_{eq} levels were run through the same statistical analysis as the L_{10} levels, and tables of statistics for whole site and individual position data appear in Appendix D.2. The discussion of Section 5 of this report concerning the analysis of L_{10} levels applies here to the analysis of the L_{eq} levels.

6.2 Results of the L_{eq} Statistical Analysis

6.2.1 General

There are nine analysis sites referenced by the same site letter and position number code in Section 5.5. They are discussed in regard to the L_{eq} comparison according to the following format:

Analysis Site

A. Comparisons - Elementary Statistics and Regression

A.1 Whole Site Statistics

A.1.1 t-test on differences between observed and predicted L_{eq} for TSC program.

A.1.2 Linear regression and correlation between observed and predicted levels for TSC program.

A.2 Individual Position Statistical Data

A.2.1 t-test on differences for TSC program.

A.2.2 Linear regression and correlation for TSC program.

B. Influencing Factors - Step-Wise Regression

B.1 Multiple regression equation

B.2 Multiple correlation coefficients and standard errors of estimate

B.3 Discussion of factors

Two statistics are used to characterize the simple linear and multiple regressions - the correlation coefficient and the standard error of estimate. The correlation coefficient and standard error of estimate are described in terms of the following arbitrary tables.

Table 2

Interpretation of the Correlation Coefficient (Reference 10)

Correlation Coefficient	Relationship Demonstrated
1.0	Perfect
0.9	Very Good
0.8	Good
0.7	Fair
0.6	Poor
0.5 or less	Very Poor

Table 3

Interpretation of the Standard Error of Estimate (Reference 4)

Standard Error of Estimate	Description
0 dB - 1.5 dB	Small
1.5 dB - 3 dB	Reasonable
3 dB or more	Large

The standard error of estimate is also compared to the standard error of estimate obtained by simple linear regression between observed and predicted levels. If the former estimate is smaller than the latter, the multiple regression model is considered to successfully reduce the error in predicted noise levels by using prediction program input variables.

The regressions will be assumed to be valid if the F-test on the variance accounted for by regression is passed at the 5 percent level of significance. If a particular regression fails the F-test, a comment will be made in the discussion, otherwise, no mention of the results of the F-test will be made. In addition, those linear regression coefficients which are statistically equal to unity will be mentioned in the discussion as showing a constant offset of compared noise levels. The relative importance of the variables chosen by step-wise regression is determined by the "partial correlation coefficients" of the variables. The larger the magnitude of the "partial correlation coefficient" of the variable, the more an influence it was on the differences between observed and predicted levels. These coefficients are not true partial correlation coefficients (defined in **Reference** 7, page 176) but are really measures of the absolute variance reduced in the dependent variable by individual independent variables.

6.2.2 Route 29, Section 13A (Residential)-R12

Comparisons - Elementary Statistics and Regression

For the whole site data, the t-test on differences between observed and TSC predicted L_{eq} levels, showed the program predicted the observed levels. The correlation between observed and predicted levels was very good and the simple linear regression standard error of estimate was reasonable.

For individual position data, the t-test on differences and the linear regression between observed and predicted levels was comparable to the whole site results.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed and TSC predicted L_{eq} levels against input variables is:

$d = 2.66428 - 0.06093$ (Truck Volume)

The multiple correlation coefficient was good; the standard error of estimate was reasonable and the same as that for simple linear regression between levels.

Truck volume was a stronger factor in the updated TSC program than in the original program. Microphone height was included in the step-wise regression but failed to appear as a significant variable. This was due to the small difference in height (7 feet) between the two microphone positions relative to the large distance (430 feet) from the microphone to the roadway.

This was the only site where houses lay in the propagation path of noise. The TSC program requires that the attenuation from these types of attenuators be used to reduce levels after they are predicted by the program. Since the TSC program actually predicts observed levels with this adjustment, the attenuation used was apparently correct. The TSC program demonstrated a tendency to overpredict at the other sites due to trucks. However, low truck percentages characteristic of

Route 29 probably minimized the TSC program tendency to overpredict, further enhancing its accuracy. The observations show that if propagation path attenuation and truck noise levels are more finely specified, the program could accurately predict complex roadway configurations.

6.2.3 Route 29, Section 13A (Stacy Park) - S123

Comparisons - Elementary Statistics and Regression

For the whole site data, the t-test on differences between the observed and TSC predicted L_{eq} levels showed the program significantly overpredicted the observed levels. Simple linear regression did not show a constant offset of predicted from observed levels. The correlation coefficient was fair and the standard error of estimate large in the linear regression.

For individual position data, the t-test on differences and the linear regressions produced results in line with whole site results.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed and TSC predicted L_{eq} levels versus input variables is:

$$d = 6.91255 - 0.08536 \text{ (Truck Volume)} - 0.08770 \text{ (Distance)}$$

The multiple correlation coefficient was very good; the standard error of estimate was reasonable and much smaller than that for simple linear regression between levels.

Truck volumes were low, but evenly split between heavy tractor trailers and medium trucks at this site. Thus the high truck emission levels assumed by the TSC program, for all trucks, were a major factor in overprediction. Distance appeared as a factor in the overprediction probably because the sloping terrain significantly attenuated observed levels more than the TSC program could account for. Microphone height was included at this site but it did not appear as a significant factor in the differences.

6.2.4 Route I-78, Section 2G (Clinton) - C1234

Comparisons - Elementary Statistics and Regression

For the whole site, the t-test on differences between observed and TSC predicted L_{eq} levels showed the program overpredicted the observed levels. Simple linear regression did not show a constant offset of predicted from observed levels. The correlation coefficient was fair, and the standard error of estimate was large in the linear regression.

The individual position t-tests showed significant overprediction at all positions. The linear regressions failed the F-test on variance accounted for by linear regression and the correlations were nearly zero at all positions. The regression coefficients were even negative for all but Position 2, indicating measured levels decreased as predicted levels increased.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed and TSC predicted L_{eq} levels versus input variables is:

$$d = 0.57900 - 0.01733 \text{ (Truck Volume)} + 0.49311 \text{ (Truck/Auto Ratio)}$$

The multiple correlation coefficient was poor; the standard error of estimate was reasonable and smaller than that from simple linear regression between levels.

The significance of the truck volume and truck/auto ratio factors in the step-wise regression is probably related to high and fairly constant volumes of tractor trailer trucks throughout the whole day, while auto volumes dwindled during early morning hours. However, the extremely poor linear regressions of observed to predicted noise levels at all positions is not typical of sites included in the study. Inspection of observed noise levels

and truck volumes shows inconsistencies over the measurement day, as the step-wise regression indicates. These observations were made with the L_{10} data in the Second Interim Report, as well. The L_{eq} analysis failed to clarify the results.

The inconsistencies are unexplainable in terms of the available field data. They may have been due to trucks stopping at night with engines idling within the measurement site.

6.2.5 Route I-78, Section 2M & 3E (Annandale) - A1234

Comparisons - Elementary Statistics and Regression

For the whole site data, the t-test on differences between observed and TSC predicted L_{eq} levels showed the program predicted observed levels. The correlation between observed and the predicted levels was very good, but the standard error of estimate was large.

For individual position data, the t-test on differences showed slight underprediction at Position 1, where there was no barrier and significant tractor trailer volumes. The program predicted Positions 3 and 4 behind the depressed roadway and overpredicted Position 2. The individual position linear regressions failed the F-test for all but Position 1, where the linear regression showed a constant offset of predicted from observed levels.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed and TSC predicted L_{eq} levels versus input variables is:

$$d = 2.92800 - 0.01582 \text{ (Truck Volume)}$$

The multiple correlation coefficient was very poor and the standard error of estimate was large.

The truck volume was the only factor affecting the TSC program predictions, but was not sufficient to explain the differences. The combination of the earth mound barrier and truck source height may further explain the differences. The earth mound barrier seemed to be accounted for quite well at Position 3.

The updated TSC program did much better in accounting for the presence of the earth mound barrier than in the previous version used in the Second Interim Report.

6.2.6 Route I-78, Section 2M & 3E (Annandale) - A5678

Comparisons - Elementary Statistics and Regression

For the whole site data, the t-test on differences between observed and TSC predicted L_{eq} levels showed the program significantly overpredicted observed levels. Simple linear regression did not show a constant offset of predicted from observed levels. The correlation between observed and predicted levels was good and the standard error of estimate was reasonable.

Individual position results were in line with the whole site results.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed and TSC predicted L_{eq} levels versus input variables is:

$$d = -6.87914 - 0.00536 \text{ (Distance)}$$

The multiple correlation coefficient was very poor; the standard error of estimate was reasonable and larger than that for simple linear regression between levels.

The differences between observed and predicted levels were affected primarily by distance at this transition zone between a depressed and elevated section. The differences decreased steadily with distance from the roadway with the least difference at the farthest position. The program predicted levels better farther from the roadway and was probably affected by the edge effect of the earth mound barrier at closer positions.

6.2.7 Route I-78, Section 2M & 3E (Annandale) - A9101112

Comparison - Elementary Statistics and Regression

For the whole site data, the t-test on the differences between observed and TSC predicted L_{eq} levels showed the program significantly overpredicted observed levels. Simple linear regression did not show a constant offset of predicted from observed levels. The linear regression failed the F-test.

Individual position t-tests on differences showed the TSC program slightly overpredicted Position 9, the closest position and overpredicted progressively more at the farther positions. The individual position linear regressions were in line with whole site data except at Position 10 which had very good correlation and exceptionally small standard error of estimate, although no constant offset of predicted from observed levels.

Influencing Factors - Step-Wise Regression

The multiple regression for differences in observed and TSC predicted L_{eq} levels versus input variables is:

$$d = 1.93488 - 0.00814 \text{ (Distance)} - 0.01435 \text{ (Truck Volume)}$$

The multiple correlation coefficient was good; the standard error of estimate was reasonable and less than that from simple linear regression between observed and predicted levels.

The primary influence on differences was distance with truck volume secondary. Differences did increase toward the rearward positions. Position 9, closest to and affected most by the elevated roadway barrier, was predicted within two decibels by the program. The other positions were overpredicted more. The combination of distance and truck volume factors at this elevated site may indicate that the TSC program overpredicts because of the line source model for trucks at far positions. The attenuation with distance due to terrain is of little effect at this site, due to the roadway elevation.

The attenuation with distance then would be due to source characteristics primarily. However, greater attenuation with distance is measured than predicted by the TSC program at the farthest position, for which barrier attenuation is least significant, especially for tractor trailers at this site. Thus the trucks may be better represented by a source model with greater attenuation with distance.

6.2.8 Route I-287, Section 1E, 4B and 5B (Bridgewater) - B123

The whole site analysis and step-wise regression for observed versus predicted levels consisted only of Position 1 and 2. Position 3 was not included because its observed levels were too low to be explained by any obvious noise attenuator at the site. Since clean data was obtained at the site, the low levels at Position 3 may have been due to some peculiarity of the area. This same observation was made in the L_{10} data of the Second Interim Report. Use of L_{eq} failed to clarify the results.

Comparisons - Elementary Statistics and Regression

For the whole site data, the t-test on differences between observed and TSC predicted L_{eq} levels showed the program significantly overpredicted the observed levels. Simple linear regression did show a constant offset of predicted from observed levels over the first two positions. The correlation coefficient was fair and the standard error of estimate was reasonable.

Individual position t-tests showed the TSC program overpredicted progressively more for Positions 1 through 3. Linear regression showed no constant offset of predicted from observed levels. The correlation coefficients steadily decrease from fair to very poor and nearly zero at Position 3. The plot of observed against predicted levels for Position 3 shows an increasing trend of observed levels with increasing predicted levels, then an abrupt drop of observed levels with the highest predicted levels. A parabolic fit is more

applicable to the data than straight line regression. This type of behavior is evident for Position 2 to a lesser degree. The higher predicted levels correspond to higher truck volumes at a particular position, so there may be a problem in the treatment of trucks by the TSC program.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed and TSC predicted L_{eq} levels versus input variables is:

$$d = -21.50954 - 0.04758 \text{ (Distance)} - 0.00713 \text{ (Truck Volume)} + 0.47312 \text{ (Truck Speed)}$$

The multiple correlation coefficient was very good; the standard error of estimate was small and much less than that from simple linear regression of observed and predicted levels.

The distance variable explains most of the differences in observed and predicted levels from Positions 1 and 2 and is probably due to excess ground attenuation. Truck volume and truck speed both were important variables. This was the first site where speed was able to be measured. The fact it appears as a significant variable at this site indicates that it might have explained some of the variance in the data at preceeding sites for which exact speed data was not obtained. It further indicates that the truck noise source model may not be adequate for prediction by the TSC program. The emission levels may be too high and the attenuation with distance too low.

6.2.9 Route I-80, Section 1B & 2L (Metcong) - N124

Comparisons - Elementry Statistics and Regression

For the whole site data, the t-test on differences between observed and TSC predicted L_{eq} levels showed the program predicted observed levels. Simple linear regression between observed and predicted levels did not show constant offset but it had good correlation and reasonable standard error of estimate.

Individual position t-tests on differences showed the program overpredicted Position 1, predicted Position 2, and underpredicted Position 3. Simple linear regressions at all positions showed a constant offset of observed from predicted levels but the correlations were poor.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences in observed from TSC predicted L_{eq} levels versus input variables is:

$$d = 22.6072 + 0.00587 \text{ (Distance)} - 0.49768 \text{ (Truck Speed)} - 0.01218 \text{ (Truck Volume)}$$

The multiple correlation coefficient was fair; the standard error of estimate was reasonable and less than that for simple linear regression between levels.

Distance was the most significant variable affecting differences and is due to the rough and wooded terrain at the site. The attenuation due to woods was explicitly added to the TSC predicted levels as specified in Reference 3. This is a crude procedure, but it did appreciably reduce the TSC program's overprediction at the site.

This was the second site for which complete radar speed data was obtained. The truck speed and truck volume appeared as significant variables in explaining the differences. The truck source model emission levels may be too high and the attenuation with distance too low.

6.2.10 Route I-80, Section 1B & 2L (Netcong) - N58

Comparisons - Elementary Statistics and Regression

For whole site data, the t-test on differences between observed and TSC predicted L_{eq} levels showed the program predicted the observed levels. The standard deviation of the differences was the largest of all sites, however.

The linear regression between observed and predicted levels had very poor correlation and reasonable standard error of estimate.

For individual position data, the t-test on differences and the simple linear regressions produced results in line with the whole site results.

Influencing Factors - Step-Wise Regression

The multiple regression equation for differences between observed and TSC predicted L_{eq} levels is:

d = 6.81857 - 0.86484 (Truck Percentage) - 0.01162 (Auto Volume)

The multiple correlation coefficient was very good; the standard error of estimate was reasonable but much greater than that from simple linear regression of observed versus predicted levels.

This was the only site where truck percentage and auto volume appeared as significant variables. These traffic noise source variables probably were due to the difference in roadway alignment passing each position at this site. The roadway went from an undivided highway by Position 8 to a widely divided highway by Position 5. The absence of distance as an influencing factor in the TSC program may be due to the explicit consideration of the attenuation by woods.

6.3 Overall Results

The updated TSC program predicted observed L_{eq} noise levels on the average at four of the nine sites. This performance is 100% better than the previous version of the program used for the L_{10} noise levels. Significant improvement was noted in the program's barrier approximation for earth mounds at A1234. A significant increase in predicted levels at microphone positions close to the elevated roadway barrier was noted at A9101112, while positions far from the barrier experienced a decrease in levels. At other sites, predicted levels generally improved, but changed only within a two decibel range.

The overall site variance of differences between observed and predicted L_{eq} noise levels was generally smaller than the differences between the L_{10} noise levels.

The average differences between measured and updated TSC predicted L_{10} and L_{eq} noise levels were compared for representative microphone positions at the sites. This was done to determine if improvement in prediction was due to the use of L_{eq} instead of L_{10} noise levels or the updated TSC program instead of the old TSC program. The average differences for L_{10} and L_{eq} descriptors were about the same by inspection. Thus, most of the improvement was due to the use of the updated TSC program rather than the L_{eq} noise descriptor. A small improvement in prediction was due to the overall reduction in variance between observed and predicted levels by using L_{eq} instead of L_{10}.

However, the inconsistencies in the microphone position data at sites C1234 and B123 were not resolved by the use of the L_{eq} noise descriptor instead of the L_{10}. That is, the inconsistencies noted in the Second Interim Report for the L_{10} noise levels carried over into the L_{eq} levels even with the updated TSC program.

7. Prediction Matrix

Because of the use of the updated TSC program, the conclusions in the Second Interim Report concerning the preferability of using a particular prediction method at a particular site were reviewed. Since differences in observed and predicted levels were noted to be comparable for the L_{10} and L_{eq} levels with the updated TSC program, observations about TSC L_{eq} differences apply to TSC L_{10} differences. The results of the Michigan program L_{10} predictions in the Second Interim Report can then be compared directly to the results of the updated TSC program L_{eq} predictions presented in this report for this purpose.

As it turned out, the same conclusions reached in the Second Interim Report were reached in the review, and the same recommendations apply.

To provide more readily useable recommendations, the reviewers suggested a matrix be developed to recommend prediction methods to use based on site characteristics. Therefore, each of the nine analysis sites were described by a subset of a general set of site characteristics. Each characteristic was polled to determine which method of prediction was most recommended for those sites sharing that characteristic.

Table 4 summarizes these conclusions about which prediction program with or without corrections provided the best results for the particular combinations of characteristics found at the analysis sites in the first row. Corrections are required if there is a significant difference between the observed and predicted levels and the correction equations are at the same time valid. One of the four possible methods are recommended for each site. They are coded in the table as follows:

T: TSC prediction program

M: Michigan prediction program

T-C: TSC program with correction equation

M-C: Michigan program with correction equation

In addition, site characteristics were identified for the sites and are divided into two major groups pertaining to 1) source and 2) propagation path. The source characteristics describe the roadway and traffic found at the site. The propagation path characteristics refer to the ground cover and terrain between source and receiver. The characteristics listed in Table 4 are self-explanatory.

Each characteristic (row) and site (column) element in the table is marked with the code for the method of prediction appropriate to it. Each row was evaluated to determine which possible method is most frequently used for the characteristic in that row. The best method for that row is indicated in the last column.

TABLE 4

PREDICTION MATRIX

		Sites (Recommendation)									
		R12 (T)	S123 (T-C)	C123 (NR)	A1234 (T)	A5678 (M-C)	A9101112 (T-C)	B123 (M-C)	N124 (T)	N58 (T)	Characteristic Recommendation
Source Characteristics	Elevated Roadway						T-C		T		T-C
	At-Grade Roadway	T	T-C					M-C			T-C
	Transition Roadway			NR		M-C					M-C
	Depressed Roadway				T						T
	Low Truck Volume	T	T-C							T	T
	Higher Truck Volume			NR	T	M-C	T-C	M-C	T		T
	Profile Grade								T	T	T
Propagation Characteristics	Earth Mound Barrier			NR	T	M-C					T
	Open, Grass		T-C	NR			T-C	M-C			T-C
	Woods					M-C			T	T	T
	Houses	T									T

T = Transportation Systems Center Program
T-C = Corrected Transportation System Center Program
M = Michigan Program
M-C = Corrected Michigan Program
NR = No Recommendation

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APPENDIX A

AFTER CONSTRUCTION NOISE SURVEYS BY SITE

SITE DESCRIPTION

Location

Route and Section: Route I-195, Section 1B

Street: Spicer Street

Municipality: Hamilton Township County: Mercer

Facility: Mobile survey van

Sound Propagation Path Characteristics

Roadway: Depressed but visible to microphone

Barriers: None

Terrain: Vertical concrete retaining wall

Road Description

Pavement Type: Bituminous Concrete

Pavement Quality: Normal

Number of Lanes: Near lanes 2 Far lanes 2

Lane Width: 12 feet

Grade: Near lanes -1% Far lanes +1%

Center Barrier: None

Median: Grass, 36 feet wide

SITE DESCRIPTION

Microphone Location

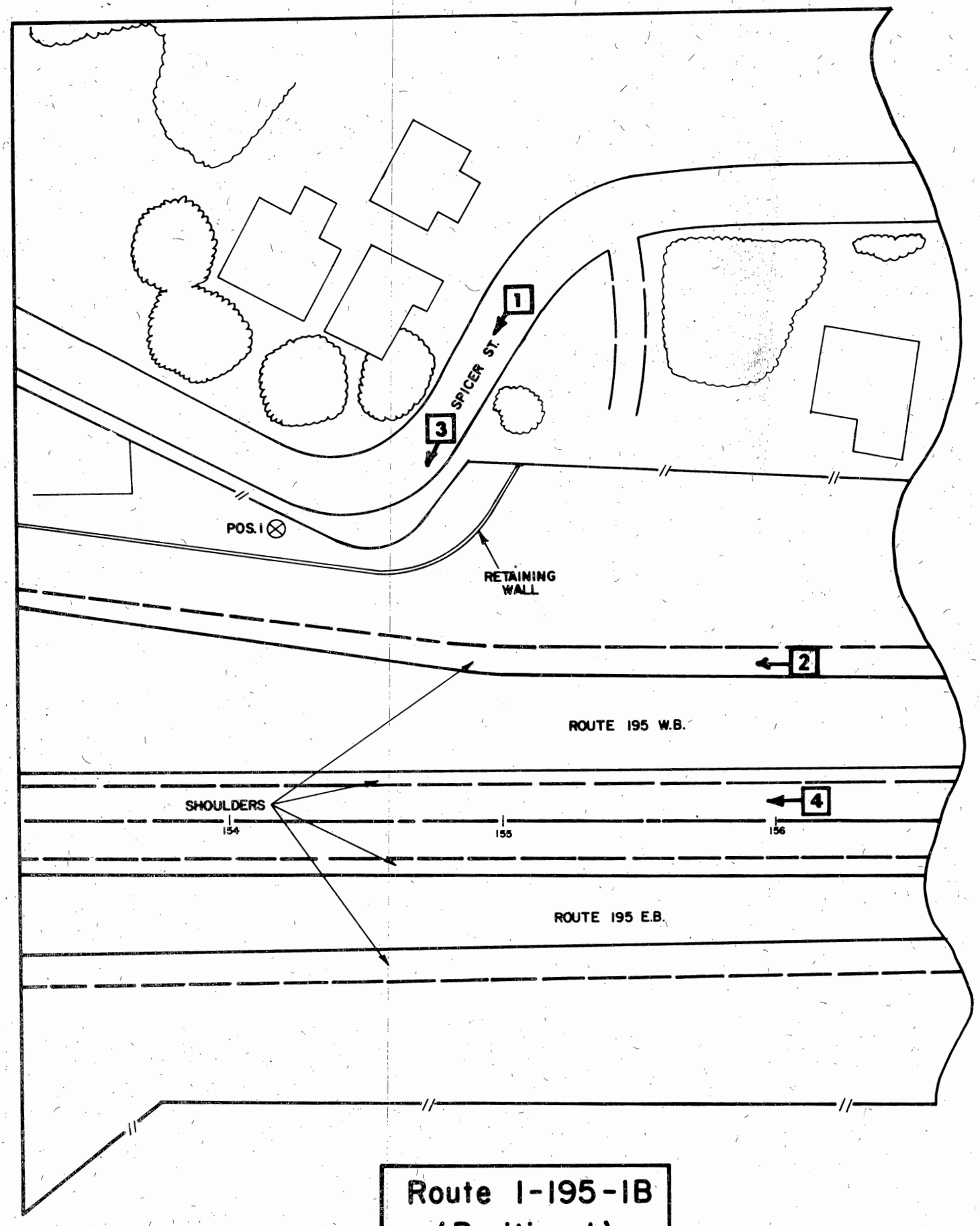
	Position 1
Height of Microphone above ground	6'
Height of microphone with respect to near lane	31'
Distance to near lane	95'

Traffic Data Collection

Hand Counters

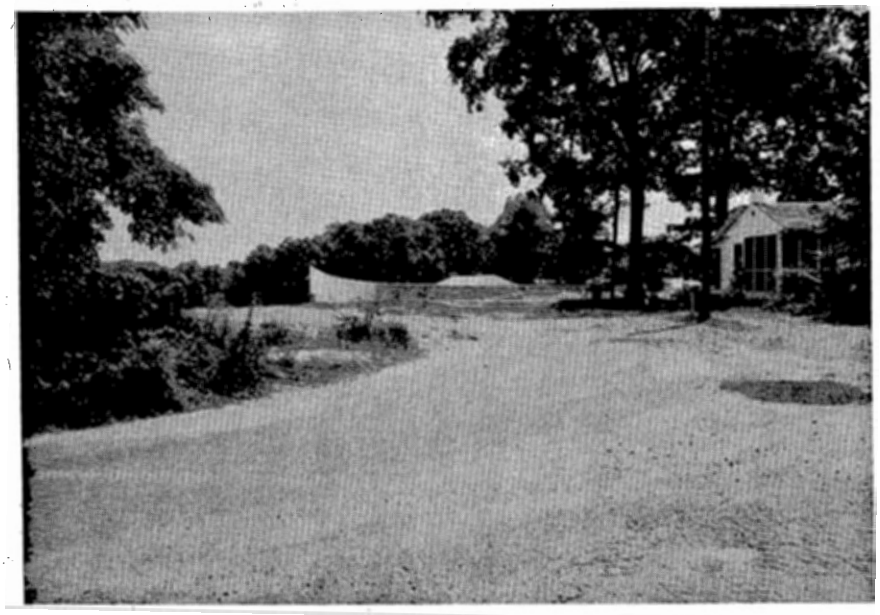
Noise Contributions from Other Sources

Ramp traffic in front of microphone. Very light traffic on residential roads. Intermittent heavy traffic on Route 524, 2000 feet south of position.

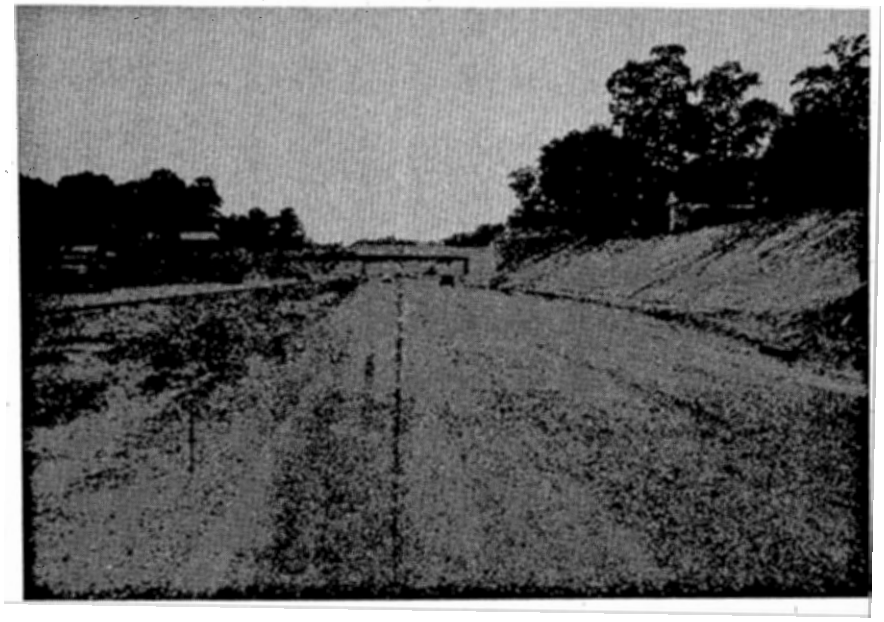


Route 1-195-1B
(Position 1)

RT. I-195 SECTION 1B
POSITION 1 (SPICER STREET)
BEFORE



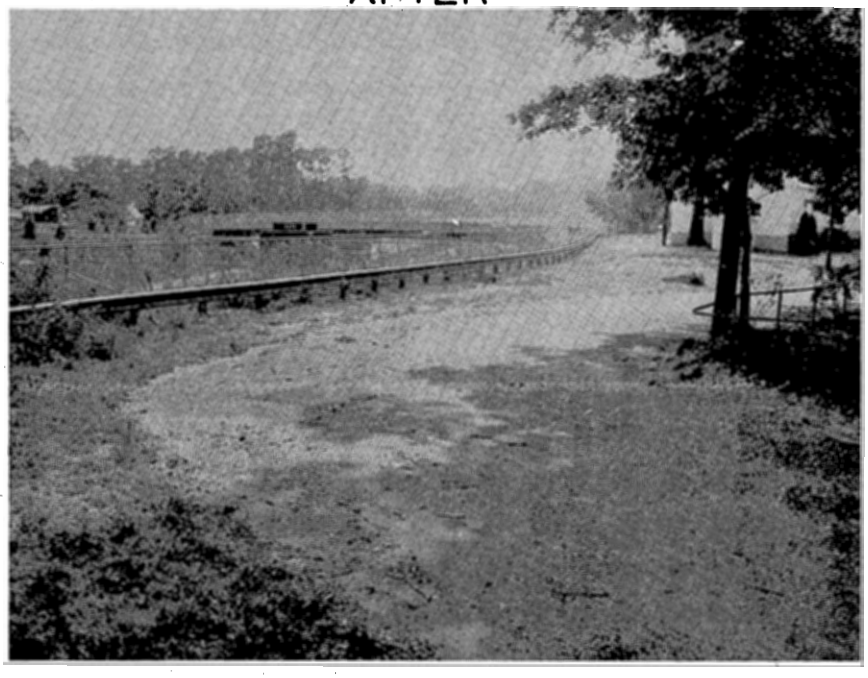
1



2

ROUTE I-195, SECTION IB
POSITION 1 (SPICER STREET)

AFTER



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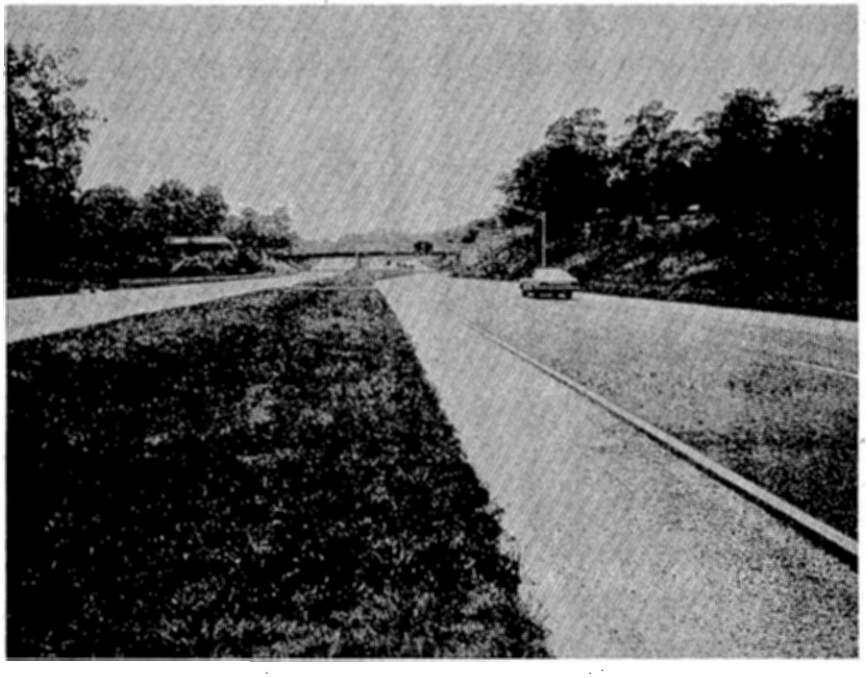


4

SITE DESCRIPTION

Location

Route and Section: Route I-195, Section 1B

Street: Walnut Street

Municipality: Hamilton Township County: Mercer

Facility: Mobile survey van

Sound Propagation Path Characteristics

Roadway: Depressed but visible from microphone

Barriers: None

Terrain: Grass slope

Road Description

Pavement Type: Bituminous Concrete

Pavement Quality: Normal

Number of lanes: Near lanes 2 Far lanes 2

Lane Width: 12 feet

Grade: Near lanes -0.6% Far lanes +0.6%

Center Barrier: None

Median: Grass, 36 feet wide

SITE DESCRIPTION

Microphone Location

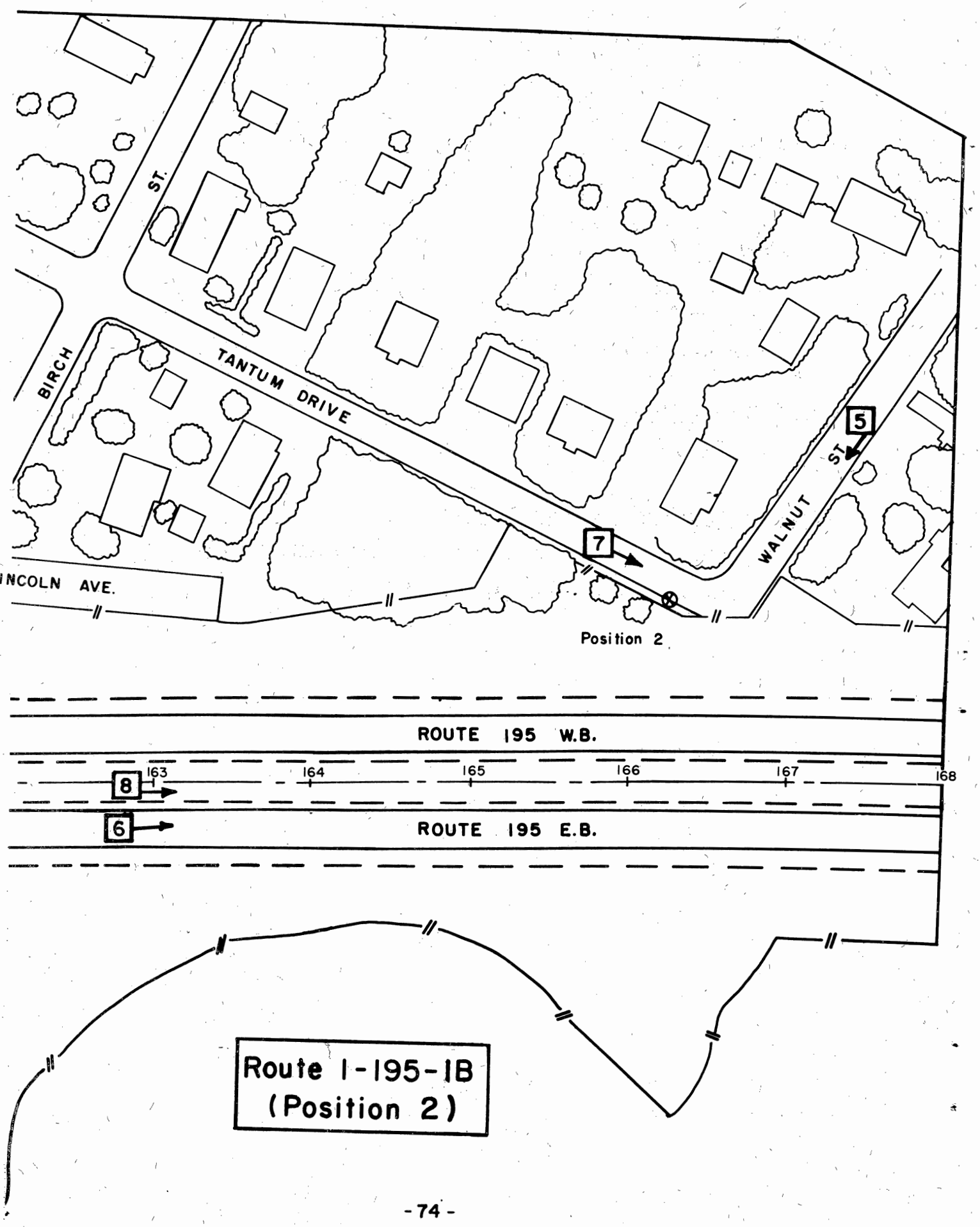
	Position 2
Height of microphone above ground	6'
Height of microphone with respect to near lane	21'
Distance to near lane	72'

Traffic Data Collection

Hand Counters

Noise Contributions from Other Sources

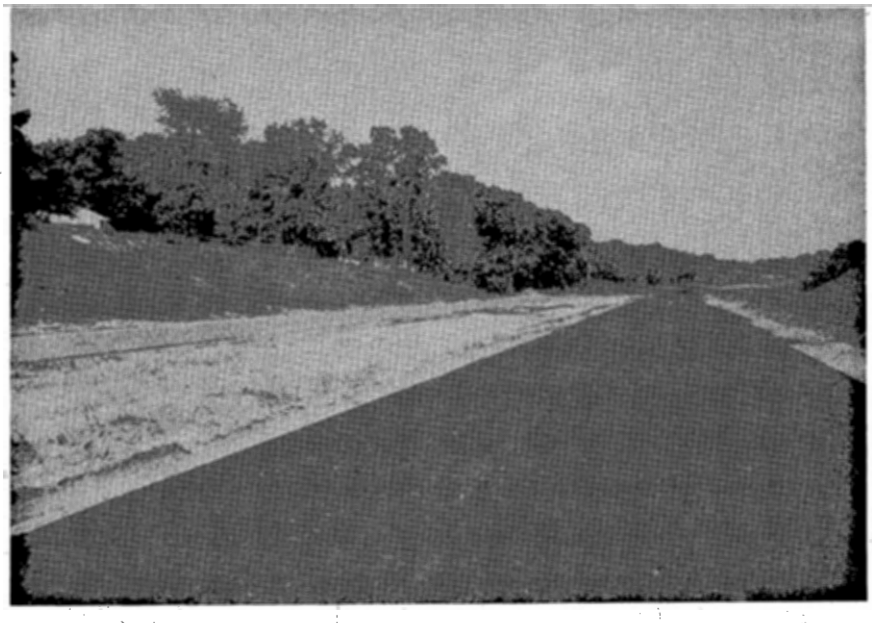
Very light urban residential traffic. Intermittent heavy traffic on Route 524, 2000 feet south of position.



Route 1-195-1B
(Position 2)

RT. I-195 SECTION IB
POSITION 2 (WALNUT STREET)
BEFORE

5



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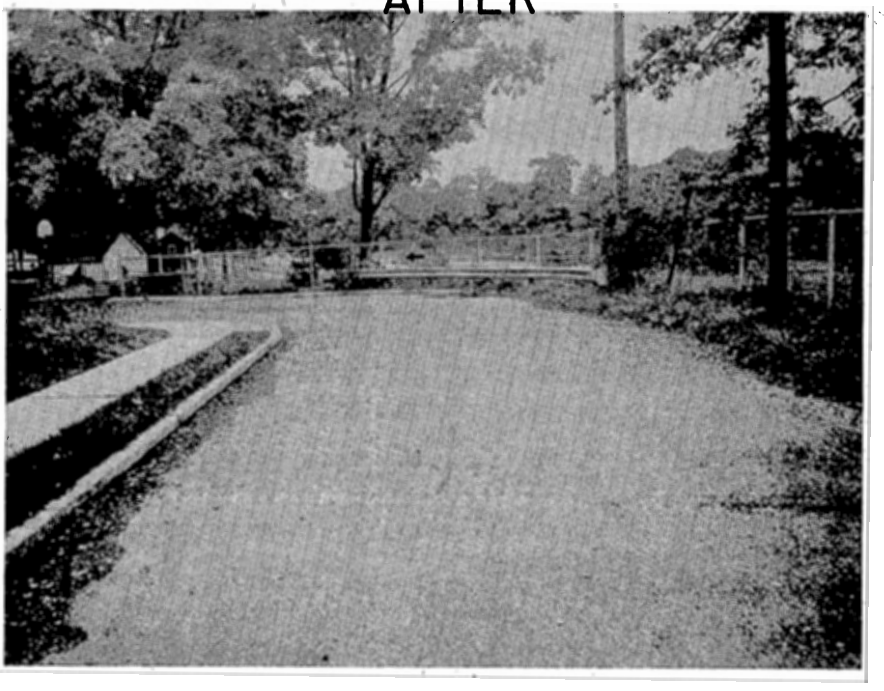
ROUTE I-195, SECTION 1B
POSITION 2 (WALNUT ST.)
AFTER



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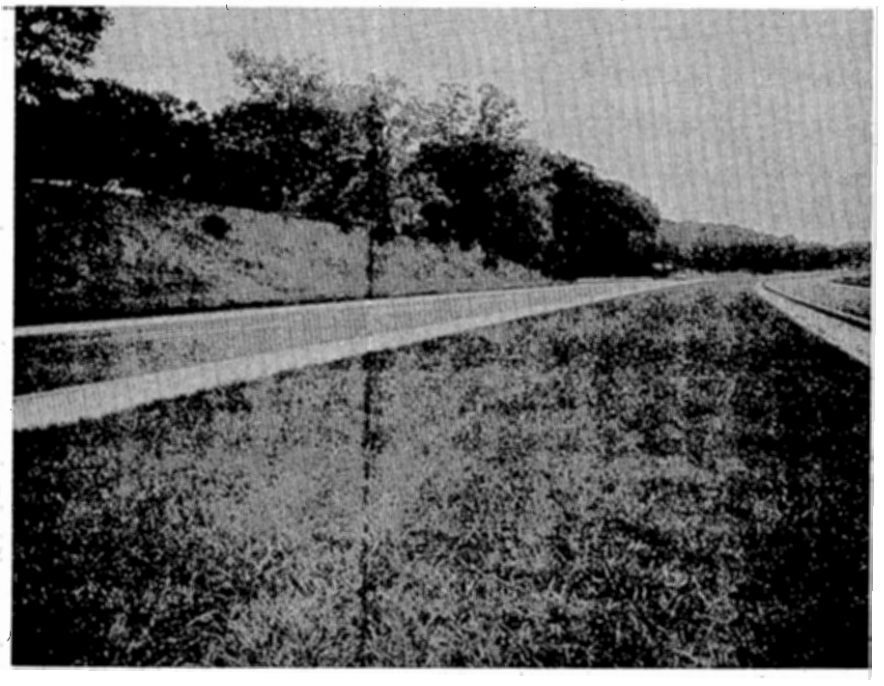


8

NOISE MEASUREMENT DATA

ROUTE I-195 SECTION 1B (HAMILTON TOWNSHIP)

MICROPHONE POSITION 1

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1700	30	09/09/75	70.1	63.1	53.7	83.1	6.4
1900	30	09/09/75	65.7	54.9	47.4	82.0	7.2
2100	30	09/09/75	63.5	50.8	45.7	77.7	7.0
2300	30	09/09/75	62.9	49.9	44.0	80.2	7.5
0100	30	09/10/75	54.5	43.5	40.2	73.4	6.6
0300	30	09/10/75	53.3	43.3	40.2	72.6	6.2
0500	30	09/10/75	52.1	44.9	41.2	70.7	5.7
0700	30	09/10/75	70.6	61.2	52.3	85.1	7.0
0900	30	09/10/75	70.7	59.2	47.7	89.1	8.7
1100	30	09/10/75	68.8	56.9	45.2	89.4	9.1
1300	30	09/10/75	68.5	56.7	46.8	86.1	8.3
1500	30	09/10/75	70.2	59.6	48.2	89.0	8.4

NOISE MEASUREMENT DATA

ROUTE I-195 SECTION 18 (HAMILTON TOWNSHIP)

MICROPHONE POSITION 2

HOUR ****	SAMPLE SIZE (MIN.) ****	DATE ****	L10 (DBA) *****	L50 (DBA) *****	L90 (DBA) *****	LNP (DBA) *****	STD DEV (DBA) *****
1800	30	09/09/75	62.2	53.8	46.9	77.6	6.1
2000	30	09/09/75	60.5	51.7	46.1	70.8	5.6
2200	30	09/09/75	60.4	50.8	46.3	71.5	5.5
0000	30	09/10/75	59.4	48.9	44.8	72.7	6.0
0200	30	09/10/75	50.6	43.9	40.6	63.7	5.0
0400	30	09/10/75	51.4	39.3	36.6	67.8	6.6
0600	30	09/10/75	59.6	49.0	43.0	75.1	6.7
0800	30	09/10/75	66.1	58.9	50.0	79.8	6.4
1000	30	09/10/75	65.4	55.4	47.5	81.9	7.2
1200	30	09/10/75	66.1	55.4	47.2	81.8	7.4
1400	30	09/10/75	62.2	51.2	44.5	77.1	7.0
1600	30	09/10/75	64.3	56.2	48.0	78.5	6.5

TRAFFIC AND WEATHER DATA

Route I-195, Section 1B (Hamilton Township)

Hour	Date	Westbound Auto Volume Veh/Hr	Westbound Truck Volume Veh/Hr	Eastbound Auto Volume Veh/Hr	Eastbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
1700	09/09/75	468	24	324	24	0-.5	031	72	37
1800	09/09/75	184	8	152	-	0-.5	320	72	38
1900	09/09/75	104	12	120	4	0-.5	354	71	40
2000	09/09/75	120	4	64	4	0-.5	320	68	48
2100	09/09/75	100	-	56	4	0-.5	320	67	48
2200	09/09/75	84	4	84	-	0	-	59	67
2300	09/09/75	60	-	72	4	0	-	54.5	71
0000	09/10/75	36	-	28	4	0	-	54.5	76
0100	09/10/75	20	-	12	-	0	-	52.5	87
0200	09/10/75	12	-	20	-	0	-	50	87
0300	09/10/85	16	8	12	-	0	-	50.5	87
0400	09/10/75	12	4	-	16	0	-	50	87
0500	09/10/75	12	4	16	-	0	-	48.5	85
0600	09/10/75	16	8	72	12	0	-	50	80

TRAFFIC AND WEATHER DATA

Route I-195, Section 1B (Hamilton Township)

Hour	Date	Westbound Auto Volume Veh/Hr	Westbound Truck Volume Veh/Hr	Eastbound Auto Volume Veh/Hr	Eastbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
0700	09/10/75	120	16	260	36	0	-	54	85
0800	09/10/75	348	20	208	32	0	-	57	75
0900	09/10/75	192	16	204	32	0	-	60	58
1000	09/10/75	164	52	92	24	0	-	65	52
1100	09/10/75	116	28	100	24	0-3	0	65	42
1200	09/10/75	168	20	156	24	0	-	67	40
1300	09/10/75	136	20	140	20	0-2	270	71.5	33
1400	09/10/75	148	24	124	20	0-.5	330	73	37
1500	09/10/75	200	52	200	12	0-.5	295	75	29
1600	09/10/75	276	32	248	16	0-.5	003	74.2	27

SITE DESCRIPTION

Location

Route and Section: Route 440, Section 1D & 3A

Street: Brace Avenue

Municipality: Perth Amboy County: Middlesex

Facility: Holy Spirit Church

Sound Propagation Path Characteristics

Roadway: Depressed

Barriers: Florida Grove Road Overpass

Terrain: Grass slope

Road Description

Pavement Type: Portland Cement Concrete

Pavement Quality: Normal

Number of Lanes: Near lanes 3 Far lanes 3

Lane Width: 12 feet

Grade: Near lanes +1.2 to -2.7% Far lanes +2.7 to -1.2%

Center Barrier: Concrete, 32 inches high

Median: 12 feet wide

SITE DESCRIPTION

Microphone Location

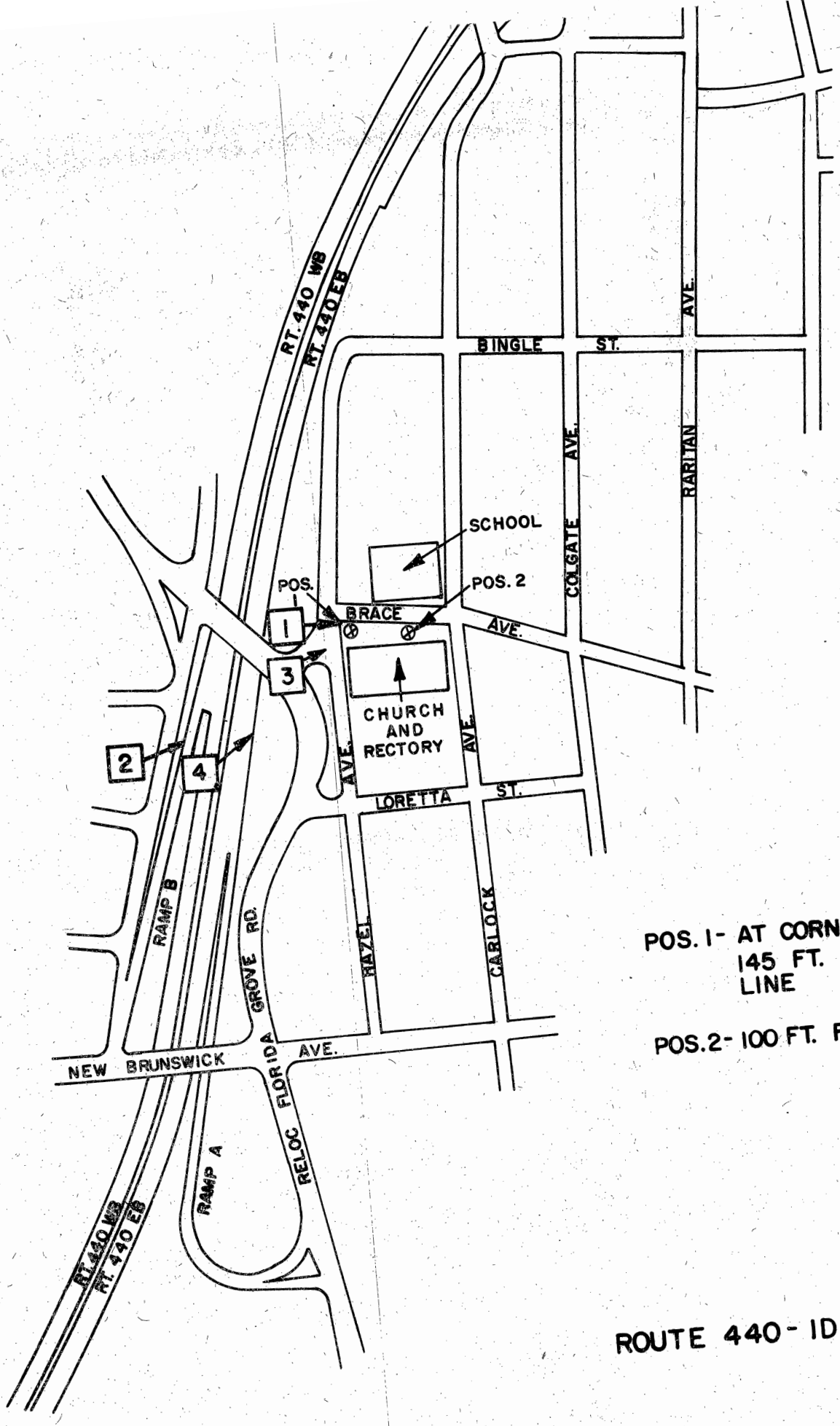
	Position 1	Position 2
Height of microphone above ground	5'	5'
Height of microphone with respect to near lane	30'	30'
Distance to near lane	200'	300'
Distance to cut	135	235

Traffic Data Collection

Hand counters

Noise Contributions from Other Sources

Urban residential traffic.

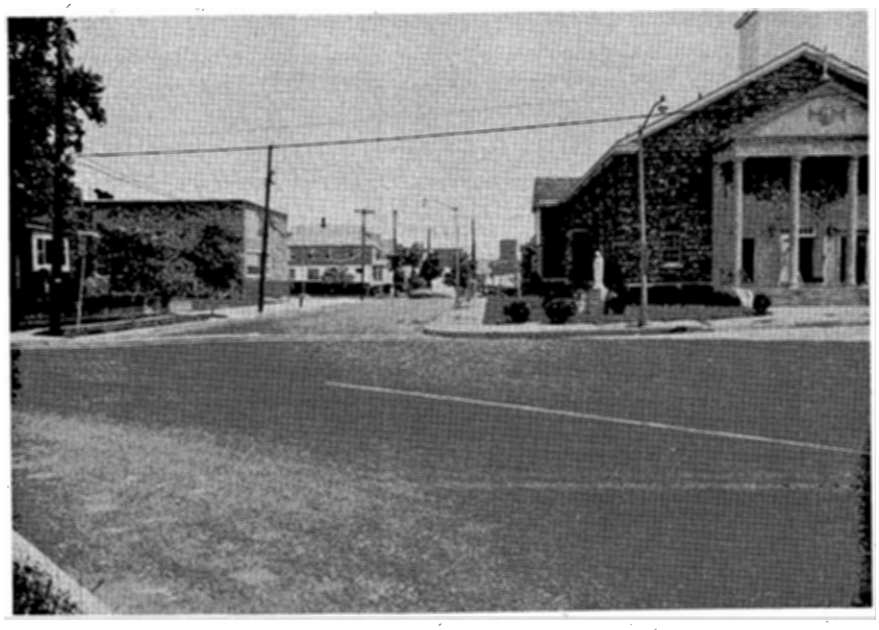


POS. 1- AT CORNER OF LAWN, 145 FT. FROM R.O.W. LINE

POS. 2- 100 FT. FROM POS. 1

ROUTE 440 - 1D & 3A

RT. 440 SECTION 1D & 3A
BEFORE



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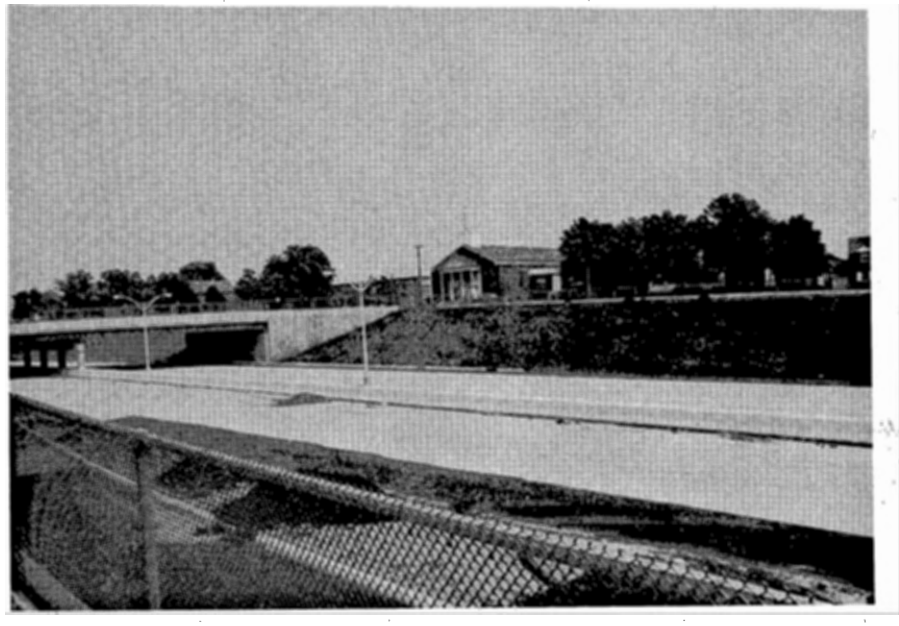

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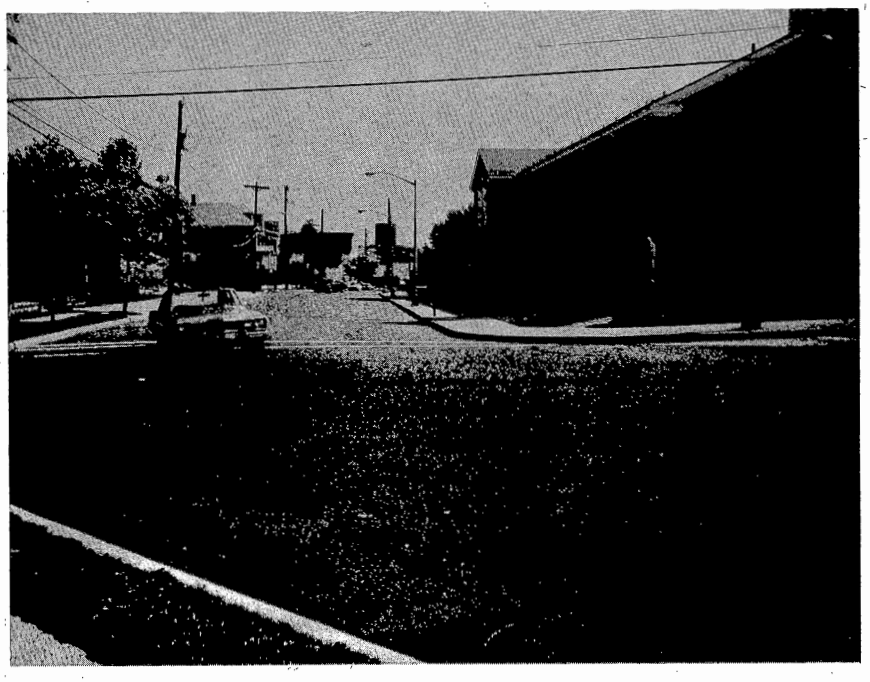
ROUTE 440, SECTION 1D & 3A

AFTER



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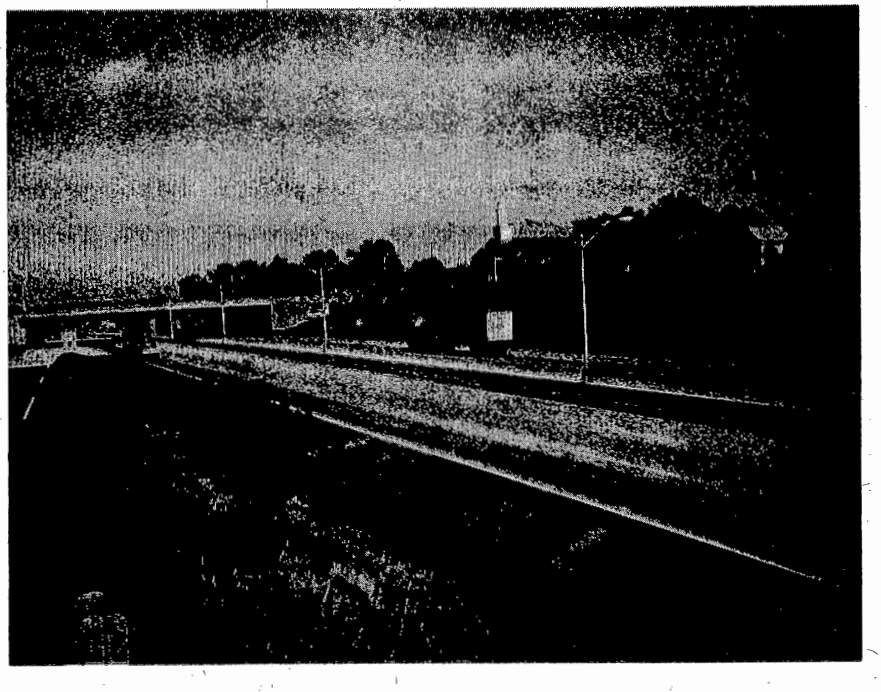


4

NOISE MEASUREMENT DATA

ROUTE 440 SECTION 1D & 3A (PERTH AMBOY)

MICROPHONE POSITION 1

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1200	50	09/16/75	67.8	62.4	56.6	76.4	4.6
1300	50	09/16/75	64.0	58.0	52.8	72.4	4.5
1400	50	09/16/75	63.4	57.8	52.4	72.1	4.6
1500	50	09/16/75	65.6	58.6	52.8	76.5	5.2
1600	50	09/16/75	64.5	57.9	52.3	74.2	4.9
1700	50	09/16/75	64.3	57.8	52.0	73.4	4.9
1800	50	09/16/75	64.8	57.7	51.3	76.0	5.5
1900	50	09/16/75	62.4	56.3	50.6	71.9	4.8
2000	50	09/16/75	60.7	54.1	48.3	69.6	4.8
2100	50	09/16/75	57.4	49.1	44.0	67.9	5.3
2200	50	09/16/75	60.6	50.7	45.1	71.9	6.1
2300	50	09/16/75	57.9	48.5	43.2	69.2	5.8
0000	50	09/17/75	55.2	46.4	41.5	70.3	5.7
0100	50	09/17/75	53.1	44.1	40.5	64.7	5.4
0200	50	09/17/75	51.2	44.7	41.3	61.3	4.4
0300	50	09/17/75	50.7	47.3	44.0	60.6	3.9
0400	50	09/17/75	54.2	48.1	44.8	62.8	4.3
0500	50	09/17/75	54.3	48.8	45.8	61.4	3.7
0600	50	09/17/75	60.6	56.6	52.3	67.2	3.5
0700	50	09/17/75	63.3	58.9	55.8	68.9	3.2
0800	50	09/17/75	64.3	58.9	54.4	71.9	4.1
0900	50	09/17/75	62.4	56.7	51.6	70.8	4.4
1000	50	09/17/75	63.7	57.2	51.1	74.2	5.1
1100	50	09/17/75	62.5	56.2	49.8	71.7	5.0

NOISE MEASUREMENT DATA

ROUTE 440 SECTION 1D & 3A (PERTH AMBOY)

MICROPHONE POSITION 2

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1200	50	09/16/75	67.6	61.7	53.2	79.4	5.9
1300	50	09/16/75	60.1	54.3	48.6	69.2	4.7
1400	50	09/16/75	61.7	54.5	48.4	73.9	5.4
1500	50	09/16/75	64.8	57.1	49.9	78.1	6.1
1600	50	09/16/75	63.5	55.4	48.6	75.3	5.8
1700	50	09/16/75	63.3	54.8	47.7	74.5	5.9
1800	50	09/16/75	62.0	53.4	46.0	75.1	6.4
1900	39	09/16/75	61.5	54.3	47.6	73.1	5.6
2000	42	09/16/75	58.6	49.5	42.7	70.6	6.2
2100	50	09/16/75	57.9	47.4	42.0	70.3	6.1
2200	42	09/16/75	61.0	48.8	40.8	76.3	7.7
2300	40	09/16/75	57.3	45.0	40.8	70.7	6.5
0000	50	09/17/75	51.9	43.3	38.7	69.7	6.0
0100	50	09/17/75	50.3	47.7	45.5	60.0	3.3
0200	26	09/17/75	50.0	44.3	41.2	58.1	3.9
0300	50	09/17/75	49.3	44.7	41.3	57.3	3.7
0400	28	09/17/75	52.1	47.7	44.4	60.7	3.9
0500	45	09/17/75	52.9	48.4	45.6	60.9	3.6
0600	50	09/17/75	60.1	55.1	51.3	67.4	3.8
0700	50	09/17/75	62.8	58.4	55.6	68.8	3.2
0800	50	09/17/75	64.0	57.3	50.8	74.2	5.2
0900	50	09/17/75	62.9	55.7	50.3	72.7	5.1
1000	50	09/17/75	63.6	55.3	48.5	75.4	5.9
1100	50	09/17/75	61.5	54.9	48.0	71.6	5.2

TRAFFIC AND WEATHER DATA

Route 440, Section 1D & 3A (Perth Amboy)

Hour	Date	Eastbound Auto Volume Veh/Hr	Eastbound Truck Volume Veh/Hr	Westbound Auto Volume Veh/Hr	Westbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
1200	09/16/75	346	90	432	88	0	-	70	50
1300	09/16/75	304	56	360	108	0	-	69	54
1400	09/16/75	406	78	472	90	0	-	69	56
1500	09/16/75	546	98	860	108	0	-	69	56
1600	09/16/75	790	42	1766	50	0	-	71	63
1700	09/16/75	860	22	1004	56	0	-	69	68
1800	09/16/75	512	20	572	30	0	-	66	71
1900	09/16/75	324	4	432	26	0	-	68.5	71
2000	09/16/75	168	12	238	10	0	-	66	75
2100	09/16/75	244	6	220	4	0	-	67	80
2200	09/16/75	238	2	208	10	0	-	64.5	82
2300	09/16/75	226	12	196	4	0	-	64	84
0000	09/17/75	178	8	138	10	0	-	63.5	82
0100	09/17/75	56	4	28	8	0	-	62.5	83
0200	09/17/75	44	12	26	6	0	-	60.5	68

TRAFFIC AND WEATHER DATA

Route 440, Section 1D & 3A (Perth Amboy) (cont.)

Hour	Date	Eastbound Auto Volume Veh/Hr	Eastbound Truck Volume Veh/Hr	Westbound Auto Volume Veh/Hr	Westbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
0300	09/17/75	20	4	28	8	0	-	60.5	69
0400	09/17/75	22	6	12	14	0	-	60	69
0500	09/17/75	58	6	44	6	0	-	59	72
0600	09/17/75	230	46	210	28	0	-	58	72
0700	09/17/75	686	58	630	52	0	-	60	77
0800	09/17/75	732	62	634	62	0	-	64.5	74
0900	09/17/75	348	124	412	104	0	-	67	58
1000	09/17/75	360	58	504	148	0	-	69	58
1100	09/17/75	400	158	456	188	0	-	70	55

SITE DESCRIPTION

Location

Route and Section: Route 33F, Section 1A & 2A

Station: Ramp EN

Municipality: Freehold Township County: Monmouth

Facility: Willowbrook Maintenance Yard

Sound Propagation Path Characteristics (Route 79)

Roadway: At-Grade

Barriers: Ramps SW and EN

Terrain: Flat, three foot high grass

Road Description (Route 79)

Pavement Type: Bituminous Concrete

Pavement Quality: Normal

Number of Lanes: Near lanes 1 Far lanes 1

Lane Width: 10 feet

Grade: Near lanes 0% Far lanes 0%

Center Barrier: None

Median: None

Flow Interruption: Traffic signal at Routes 9 & 79. Stop sign at Route 79 and Willowbrook Road. Both south of interchange.

SITE DESCRIPTION

Microphone Location

Position	1	2	3	4	5	6	7
Height of microphone above ground (feet)	5	5	5	5	5	5	5
Height of microphone with respect to Near Lane (feet)	5	5	5	5	5	5	5
Distance to near lane (feet)	650	380	120	640	450	220	580
Distance to flow interruption device (feet)	800	875	1000	850	975	1050	1175

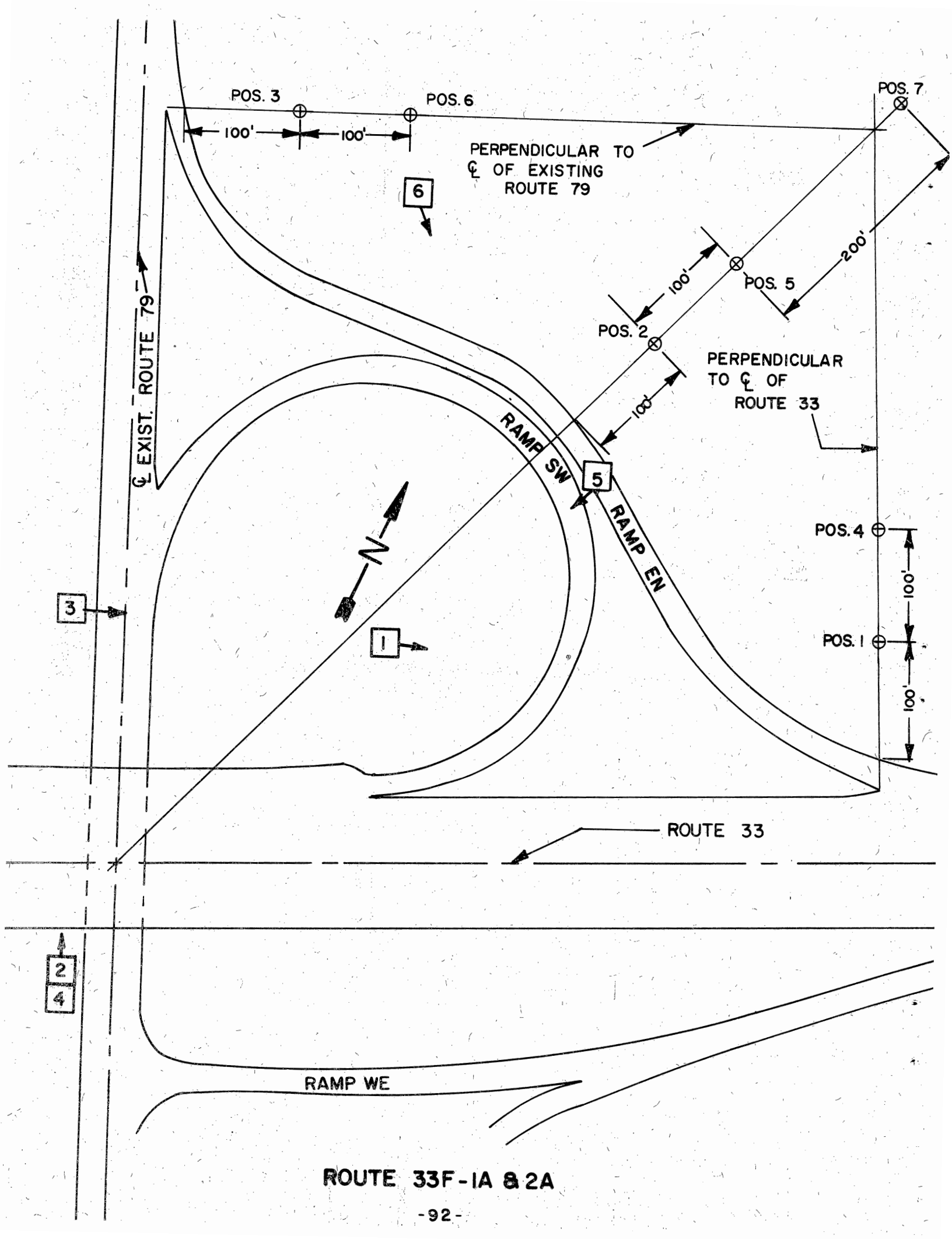
Traffic Data Collection

Hand Counters

Noise Contributions from Other Sources

Large shopping center along Route 74 directly across from survey area.

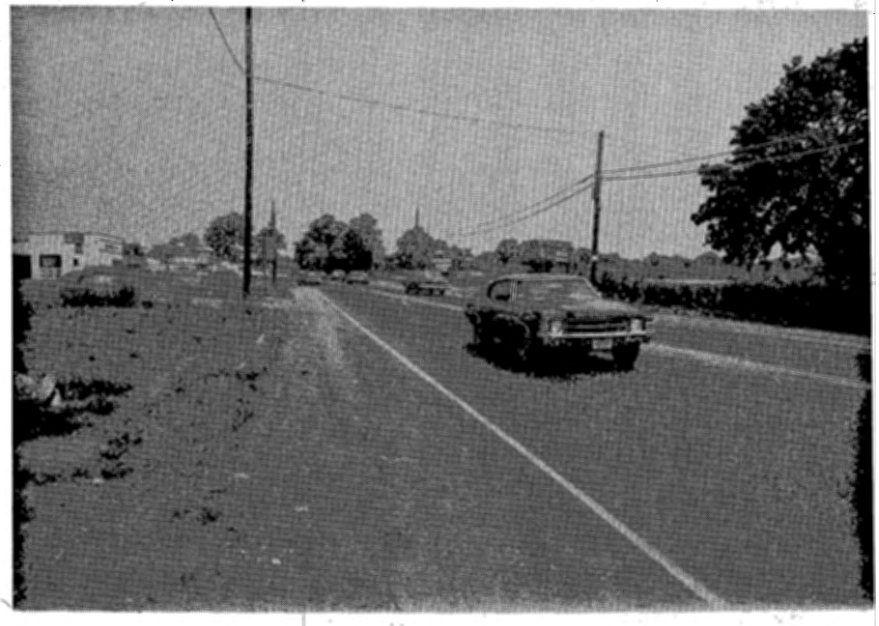
Very little traffic on ramp SW. No traffic on ramp EN.



ROUTE 33F-1A & 2A

RT. 33F SECTION 1A & 2A
BEFORE

1



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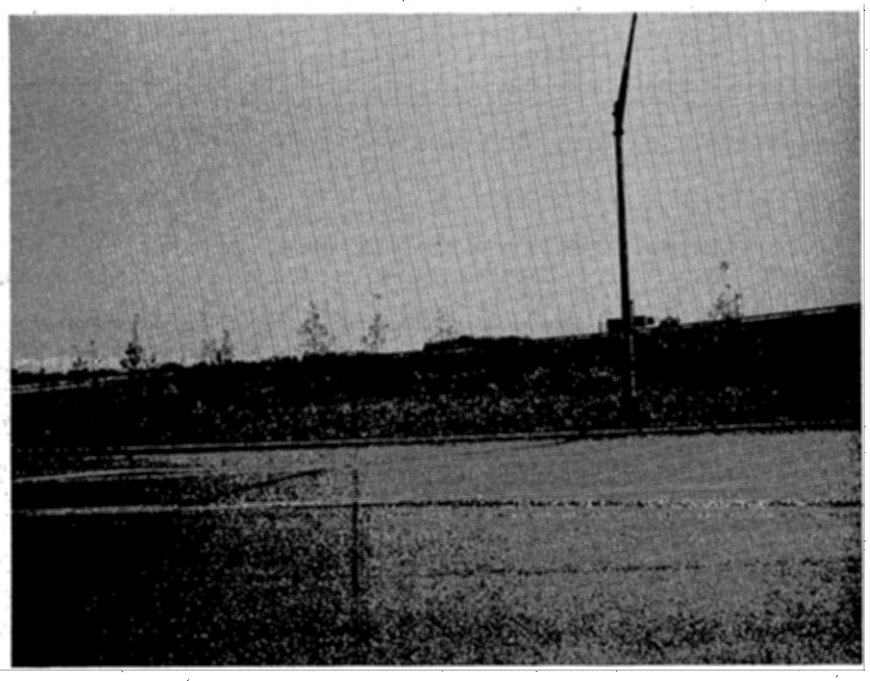
ROUTE 33F, SECTION 1A & 2A

AFTER



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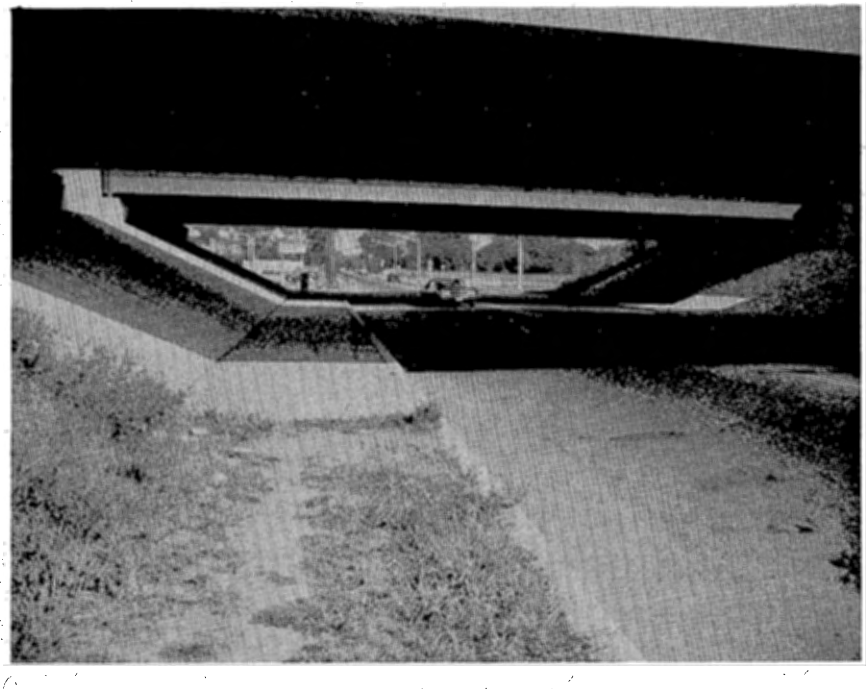

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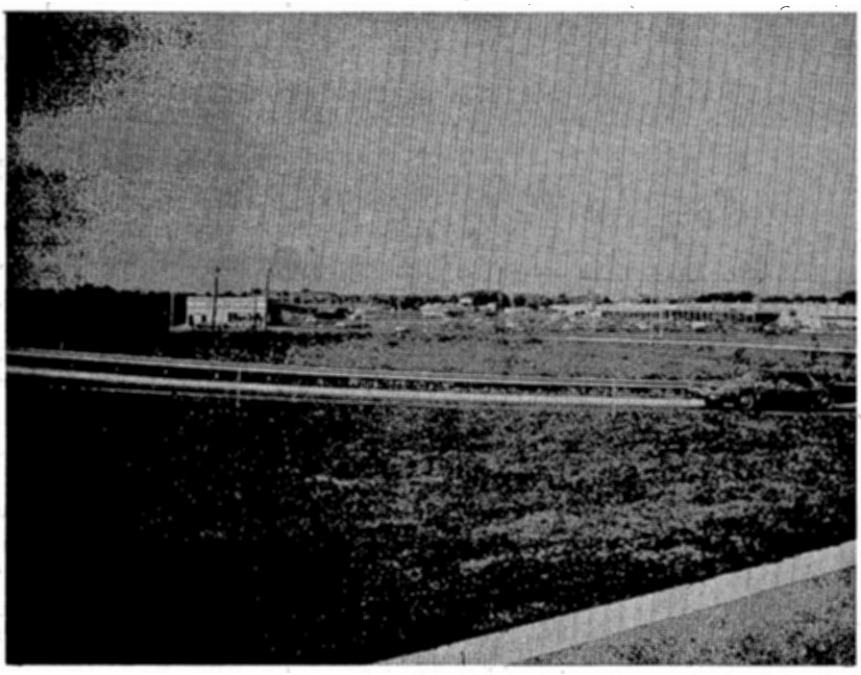
ROUTE 33F, SECTION 1A & 2A

AFTER



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6

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 1

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1500	50	11/19/75	49.8	44.1	41.1	57.3	3.8
1600	50	11/19/75	51.6	45.8	41.7	64.7	5.0
1700	50	11/19/75	48.7	43.7	40.9	59.6	4.2
1800	50	11/19/75	49.2	44.1	41.1	58.5	3.9
1900	35	11/19/75	51.0	44.4	41.2	63.0	4.9
2000	50	11/19/75	52.2	44.7	41.2	66.2	5.4
2100	50	11/19/75	53.0	42.8	39.2	65.6	5.7
2200	50	11/19/75	44.7	40.6	36.6	51.2	3.4
2300	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0000	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0100	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0200	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0300	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0400	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0500	45	11/20/75	43.8	39.3	35.9	49.2	3.2
0600	46	11/20/75	44.1	40.1	36.0	49.9	3.3
0700	50	11/20/75	51.6	48.3	45.9	55.5	2.3
0800	0	11/20/75	NO DATA - NONREPRESENTATIVE NOISE				
0900	33	11/20/75	54.1	49.5	45.1	60.7	3.7
1000	50	11/20/75	54.0	49.1	44.2	62.1	4.1
1100	50	11/20/75	54.4	47.6	42.6	64.2	4.9
1200	50	11/20/75	50.3	46.1	42.0	57.8	3.7
1300	50	11/20/75	53.0	47.8	44.0	63.5	4.4
1400	50	11/20/75	53.3	47.4	43.3	64.5	4.8

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 2

HOUR ****	SAMPLE SIZE (MIN.) ****	DATE ****	L10 (DBA) *****	L50 (DBA) *****	L90 (DBA) *****	LNP (DBA) *****	STD DEV (DBA) *****
1300	0	11/18/75	NO DATA - NONREPRESENTATIVE NOISE				
1400	45	11/18/75	57.0	53.2	50.2	62.8	3.1
1500	45	11/18/75	55.7	52.3	48.9	63.4	3.5
1600	45	11/18/75	51.9	48.3	45.8	58.7	3.0
1700	50	11/18/75	55.2	52.7	50.5	59.4	2.2
1800	50	11/18/75	55.2	52.6	50.2	60.0	2.4
1900	50	11/18/75	54.6	52.2	49.6	59.5	2.5
2000	32	11/18/75	55.0	52.0	48.5	60.9	3.0
2100	45	11/18/75	55.5	52.5	49.6	61.1	2.9
2200	0	11/18/75	NO DATA - OPERATOR ERROR				
2300	45	11/18/75	54.2	49.8	46.2	61.7	3.5
0000	45	11/19/75	55.1	49.3	45.9	63.0	3.9
0100	45	11/19/75	52.3	47.5	43.5	61.4	4.1
0200	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0300	40	11/19/75	45.4	42.1	38.5	53.5	3.5
0400	45	11/19/75	51.4	47.9	45.2	58.6	3.3
0500	45	11/19/75	53.4	48.6	45.2	60.7	3.7
0600	45	11/19/75	56.7	53.3	50.7	62.1	2.7
0700	45	11/19/75	58.2	54.0	51.0	63.3	2.9
0800	16	11/19/75	55.7	52.9	50.4	61.3	2.7
0900	45	11/19/75	56.3	49.8	46.1	66.9	4.7
1000	45	11/19/75	53.5	48.1	44.2	63.1	4.3
1100	0	11/19/75	NO DATA - OPERATOR ERROR				
1200	45	11/19/75	51.9	47.3	43.4	66.2	4.7

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 3

HOUR ****	SAMPLE SIZE (MIN.) ****	DATE ****	L10 (DBA) *****	L50 (DBA) *****	L90 (DBA) *****	LNP (DBA) *****	STD DEV (DBA) *****
1300	50	11/18/75	69.8	65.4	60.3	79.5	4.2
1400	50	11/18/75	70.6	66.4	61.7	78.4	3.9
1500	43	11/18/75	70.1	65.1	60.7	79.0	4.2
1600	50	11/18/75	66.1	62.5	59.2	75.9	3.7
1700	50	11/18/75	65.1	61.9	58.2	71.4	3.2
1800	50	11/18/75	65.5	61.8	57.7	73.0	3.6
1900	50	11/18/75	64.9	61.3	57.0	71.6	3.5
2000	28	11/18/75	65.5	60.4	55.7	75.8	4.5
2100	0	11/18/75	NO DATA - MICROPHONE MALFUNCTION				
2200	0	11/18/75	NO DATA - MICROPHONE MALFUNCTION				
2300	0	11/18/75	NO DATA - MICROPHONE MALFUNCTION				
0000	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0100	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0200	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0300	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0400	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0500	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0600	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0700	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0800	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0900	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
1000	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
1100	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
1200	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 4

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
1500	50	11/19/75	50.7	47.4	44.2	58.2	3.4
1600	50	11/19/75	54.1	48.6	45.9	63.0	4.0
1700	50	11/19/75	53.4	48.9	46.0	60.3	3.4
1800	50	11/19/75	53.6	49.4	46.2	59.8	3.1
1900	41	11/19/75	53.3	49.1	46.1	58.9	3.0
2000	50	11/19/75	54.6	51.2	47.2	62.0	3.4
2100	35	11/19/75	57.7	48.5	45.4	67.3	5.0
2200	50	11/19/75	49.8	46.9	43.4	54.6	2.8
2300	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0000	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0100	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0200	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0300	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0400	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0500	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0600	45	11/20/75	53.1	49.0	45.5	58.3	3.1
0700	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0800	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0900	25	11/20/75	55.2	51.5	47.4	60.9	3.2
1000	50	11/20/75	54.5	50.3	46.4	61.1	3.4
1100	50	11/20/75	55.2	49.0	45.7	63.1	4.1
1200	50	11/20/75	51.4	48.1	45.6	57.2	2.8
1300	50	11/20/75	54.6	49.0	45.9	61.9	3.7
1400	50	11/20/75	56.1	52.1	48.1	64.6	3.9

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 5

HOUR ****	SAMPLE SIZE (MIN.) ****	DATE ****	L10 (DBA) *****	L50 (DBA) *****	L90 (DBA) *****	LNP (DBA) *****	STD DEV (DBA) *****
1300	50	11/18/75	55.1	51.9	48.1	66.6	3.5
1400	50	11/18/75	57.1	53.4	50.7	62.7	2.9
1500	45	11/18/75	55.3	51.5	47.4	62.9	3.6
1600	50	11/18/75	57.0	53.3	50.6	63.2	3.0
1700	0	11/18/75	NO DATA - OPERATOR ERROR				
1800	50	11/18/75	55.1	52.6	45.0	63.1	3.7
1900	45	11/18/75	54.3	51.2	47.3	59.2	2.8
2000	32	11/18/75	54.9	51.6	47.8	60.6	3.1
2100	42	11/18/75	54.5	49.9	45.4	61.4	3.8
2200	0	11/18/75	NO DATA - MICROPHONE MALFUNCTION				
2300	42	11/18/75	52.9	48.8	45.6	59.2	3.1
0000	45	11/19/75	53.0	48.0	43.9	61.1	4.0
0100	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0200	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0300	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0400	45	11/19/75	51.1	47.6	44.5	58.6	3.4
0500	45	11/19/75	51.0	47.7	44.7	58.4	3.3
0600	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
0700	48	11/19/75	57.3	53.3	50.4	63.1	3.1
0800	50	11/19/75	55.0	52.0	48.5	62.5	3.3
0900	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
1000	47	11/19/75	51.8	46.6	42.2	61.2	4.3
1100	0	11/19/75	NO DATA - MICROPHONE MALFUNCTION				
1200	45	11/19/75	50.8	45.9	41.7	63.0	4.6

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 6

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1300	50	11/18/75	59.1	54.6	51.1	67.7	3.6
1400	50	11/18/75	60.2	56.2	52.0	66.8	3.5
1500	43	11/18/75	59.8	54.6	51.2	67.4	3.8
1600	50	11/18/75	60.2	57.1	53.6	69.0	3.5
1700	50	11/18/75	64.3	61.0	57.1	69.2	2.9
1800	50	11/18/75	59.6	55.5	51.6	65.3	3.2
1900	50	11/18/75	58.9	55.0	51.4	63.7	2.9
2000	28	11/18/75	59.2	54.2	50.9	65.9	3.5
2100	45	11/18/75	58.6	54.0	50.9	63.7	3.1
2200	0	11/18/75	NO DATA - MICROPHONE MALFUNCTION				
2300	45	11/18/75	56.1	52.0	47.8	65.2	3.8
0000	45	11/19/75	57.7	51.3	46.7	66.1	4.4
0100	45	11/19/75	56.1	51.3	46.8	66.9	4.4
0200	45	11/19/75	52.6	48.6	46.0	59.0	3.0
0300	40	11/19/75	54.6	48.8	45.9	64.6	4.2
0400	45	11/19/75	53.4	48.5	45.5	62.2	3.9
0500	45	11/19/75	55.0	49.1	45.3	63.5	4.3
0600	45	11/19/75	58.6	54.0	51.0	64.3	3.2
0700	45	11/19/75	59.8	56.6	52.8	66.5	3.2
0800	45	11/19/75	59.4	54.5	50.8	67.0	3.8
0900	45	11/19/75	60.3	53.4	49.7	69.2	4.5
1000	45	11/19/75	57.7	52.4	47.9	66.5	4.2
1100	45	11/19/75	59.5	53.1	48.9	70.7	4.8
1200	45	11/19/75	56.3	52.0	47.8	65.2	4.0

NOISE MEASUREMENT DATA

ROUTE 33F SECTION 1A & 2A (FREEHOLD TOWNSHIP)

MICROPHONE POSITION 7

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1500	50	11/19/75	52.2	48.3	45.5	58.8	3.2
1600	50	11/19/75	55.4	51.3	47.1	64.2	3.9
1700	0	11/19/75	NO DATA - EQUIPMENT PROBLEM				
1800	50	11/19/75	54.6	51.7	48.2	60.6	3.0
1900	50	11/19/75	59.8	56.9	53.6	66.2	3.1
2000	50	11/19/75	54.7	50.4	46.6	62.7	3.7
2100	50	11/19/75	55.5	50.1	46.3	65.2	4.3
2200	50	11/19/75	51.1	47.8	45.0	56.0	2.8
2300	41	11/19/75	45.3	42.9	40.8	48.4	1.8
0000	50	11/20/75	50.7	47.0	42.9	56.6	3.3
0100	0	11/20/75	NO DATA - OPERATOR ERROR				
0200	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0300	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0400	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0500	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0600	0	11/20/75	NO DATA - MICROPHONE MALFUNCTION				
0700	47	11/20/75	56.4	53.2	50.8	60.5	2.4
0800	50	11/20/75	59.5	57.2	54.5	63.3	2.2
0900	50	11/20/75	58.0	53.5	50.4	64.1	3.3
1000	50	11/20/75	55.6	52.6	49.8	61.5	2.9
1100	50	11/20/75	56.1	52.0	47.8	63.9	3.7
1200	50	11/20/75	55.5	52.0	48.2	62.0	3.3
1300	50	11/20/75	55.8	52.6	49.7	62.4	3.1
1400	50	11/20/75	60.8	57.4	54.0	68.0	3.4

TRAFFIC AND WEATHER DATA

Route 33, Section 1A & 2A (Freehold Township)

Hour	Date	Rt. 79 North & South Auto Volume Veh/Hr	Rt. 79 North & South Truck Volume Veh/Hr	Rt. 33 Ramp Auto Volume Veh/Hr	Rt. 33 Ramp Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
1300	11/18/75	898	52	46	6	0-3	310	67	43
1400	11/18/75	836	54	42	4	0-5	294	67.5	45
1500	11/18/75	1154	46	44	2	0-5	294	66	53
1600	11/18/75	1444	54	84	4	0-5	294	59	70
1700	11/18/75	1272	24	48	2	0-5	294	59	72
1800	11/18/75	548	24	28	4	0-5	294	48.5	90
1900	11/18/75	996	40	36	-	0	-	-	-
2000	11/18/75	548	22	32	-	0-5	294	44	93
2100	11/18/75	294	6	20	2	0-5	294	45	84
2200	11/18/75	212	14	16	2	0-5	292	45	81
2300	11/18/75	162	10	10	2	0-5	292	46	84
0000	11/19/75	284	6	10	6	0-5	292	47.5	90
0100	11/19/75	120	8	4	-	0-5	292	46	90
0200	11/19/75	104	6	6	-	0-5	302	45.5	93
0300	11/19/75	12	6	2	-	0-1	304	47	90
0400	11/19/75	16	6	2	-	0-1	302	46	-

TRAFFIC AND WEATHER DATA

Route 33, Section 1A & 2A (Freehold Township) (Cont.)

Hour	Date	Rt. 79 North & South Auto Volume Veh/Hr	Rt. 79 North & South Truck Volume Veh/Hr	Rt. 33 Ramp Auto Volume Veh/Hr	Rt. 33 Ramp Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
0500	11/19/75	44	8	6	2	0-1	303	46	-
0600	11/19/75	190	30	74	2	0-1	305	45	91
0700	11/19/75	474	44	182	-	0-1	304	49	91
0800	11/19/75	864	68	160	4	0-1	305	49.5	91
0900	11/19/75	608	62	66	4	0	-	54.5	78
1000	11/19/75	702	56	32	8	0	-	57	74
1100	11/19/75	744	76	52	8	0	-	59	63
1200	11/19/75	842	38	36	14	0	-	60	70
1500	11/19/75	980	36	52	4	0	-	-	-
1600	11/19/75	1216	52	76	12	0	-	59	71
1700	11/19/75	1190	12	48	4	0	-	48	71
1800	11/19/75	708	10	24	-	0	-	47	86
1900	11/19/75	852	18	30	4	0	-	48	73
2000	11/19/75	546	12	34	-	0	-	45	85
2100	11/19/75	326	4	24	-	0	-	39	92
2200	11/19/75	256	-	16	8	0	-	40	93

TRAFFIC AND WEATHER DATA

Route 33, Section 1A & 2A (Freehold Township) (cont.)

Hour	Date	Rt. 79 North & South Auto Volume Veh/Hr	Rt. 79 North & South Truck Volume Veh/Hr	Rt. 33 Ramp Auto Volume Veh/Hr	Rt. 33 Ramp Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
2300	11/19/75	-	-	-	-	0	340	41	93
0000	11/20/75	132	-	6	8	0	000	40	93
0100	11/20/75	-	-	-	-	0	000	40	93
0200	11/20/75	-	-	-	-	0	008	40	93
0300	11/20/75	-	-	-	-	0	008	45	100
0400	11/20 75	-	-	-	-	0	000	45	93
0500	11/20/75	-	-	-	-	0	000	45	93
0600	11/20/75	192	20	42	-	0	000	46	93
0700	11/20/75	594	60	160	-	0	000	44	96
0800	11/20/75	774	54	150	10	0	000	45	93
0900	11/20/75	596	56	50	2	0	000	52	81
1000	11/20/75	726	64	54	12	0	-	57	75
1100	11/20/75	842	38	46	12	0	-	60	63
1200	11/20/75	1008	40	46	4	0	-	64	52
1300	11/20/75	924	58	48	6	0	-	67	43
1400	11/20/75	1042	74	26	6	0	-	67	45

SITE DESCRIPTION

Location

Route and Section: Route 9, Section 21C & 22D

Station: 306 + 00 Northbound

Municipality: Howell Township County: Monmouth

Facility: Region #3, Bureau of Plant and Project Inspection Offices

Sound Propagation Path Characteristics

Roadway: At-Grade

Barriers: None

Terrain: Flat with slight upgrade toward Position 3. Scrub pine and oak to 20 foot and brush to three foot height.

Road Description

Pavement Type: Bituminous Concrete

Pavement quality: Normal

Number of Lanes: Near lanes 2 Far lanes 2

Lane Width: 12 feet

Grade: Near lanes + 0.5 to -3.7% Far lanes + 3.7 to -0.5%

Center Barrier: Concrete 32 inches high

Median: 12 feet wide

SITE DESCRIPTION

Microphone Location

	Position 1	Position 2	Position 3
Height of microphone above ground	5'	5"	5'
Height of microphone with respect to near lane	5'	7'	9'
Distance to near lane	100'	200'	400'

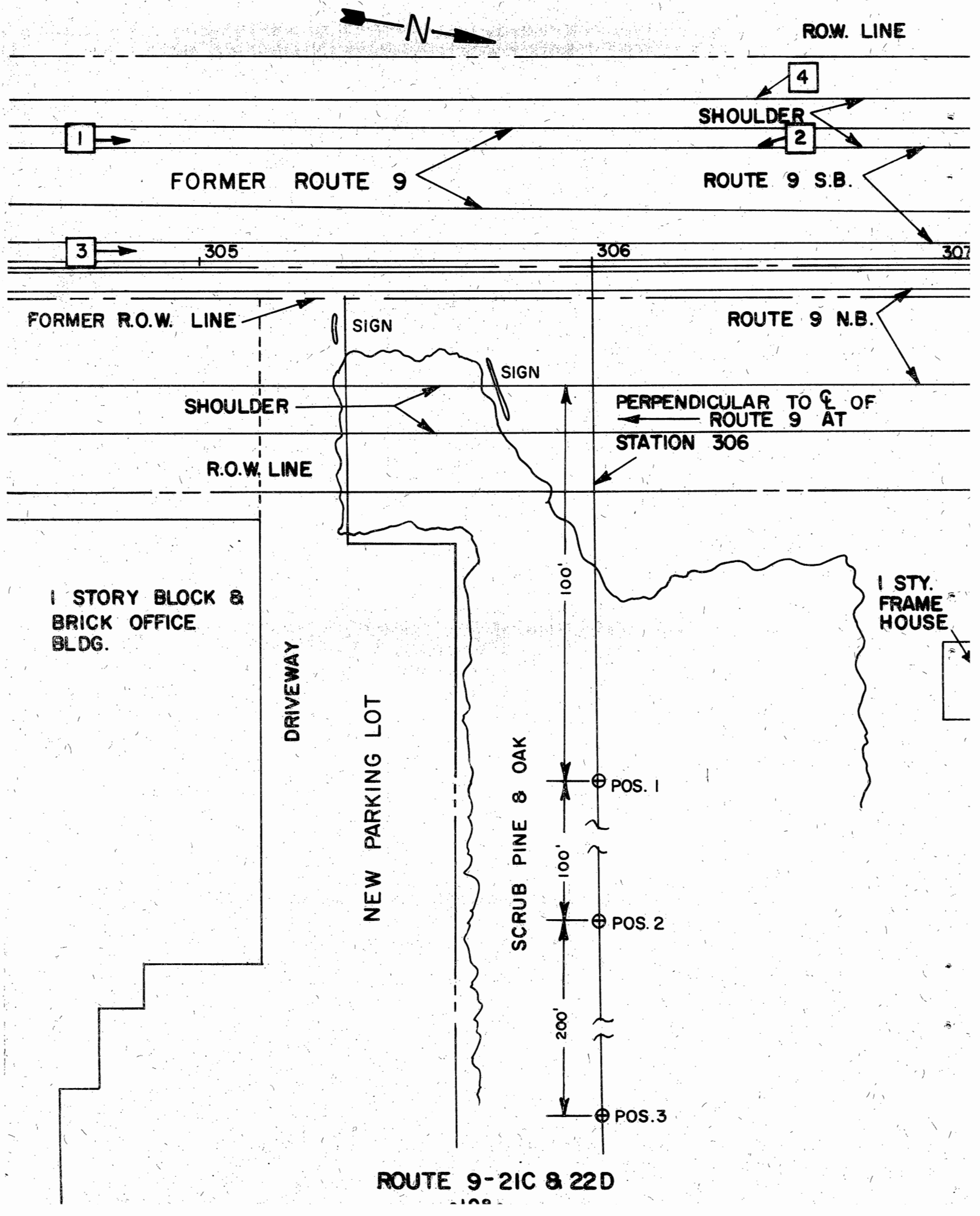
Traffic Data Collection

Hand counters

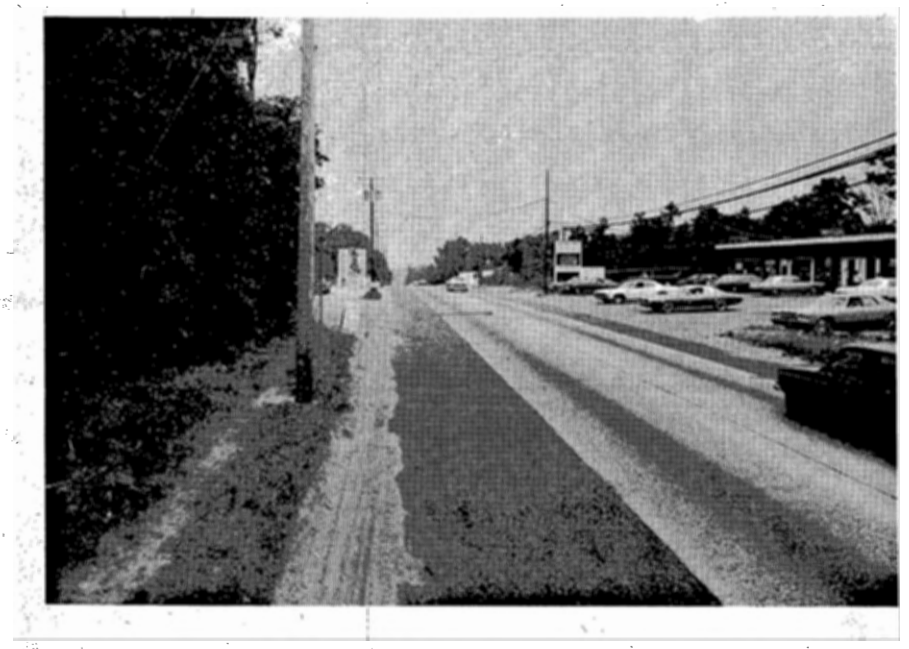
Noise Contributions from Other Sources

Parking lot for facility constructed adjacent to line of microphones.

Lot was present during after survey but not during before survey.


N
R.O.W. LINE
4
SHOULDER
1
2
FORMER ROUTE 9
ROUTE 9 S.B.
3
305
306
307
FORMER R.O.W. LINE
SIGN
ROUTE 9 N.B.
SIGN
SHOULDER
PERPENDICULAR TO ℄ OF ROUTE 9 AT STATION 306
R.O.W. LINE
1 STORY BLOCK & BRICK OFFICE BLDG.
DRIVEWAY
NEW PARKING LOT
100'
1 STY. FRAME HOUSE
SCRUB PINE & OAK
POS. 1
100'
POS. 2
200'
POS. 3
ROUTE 9-21C & 22D

RT. 9 SECTION 21C & 22D
BEFORE

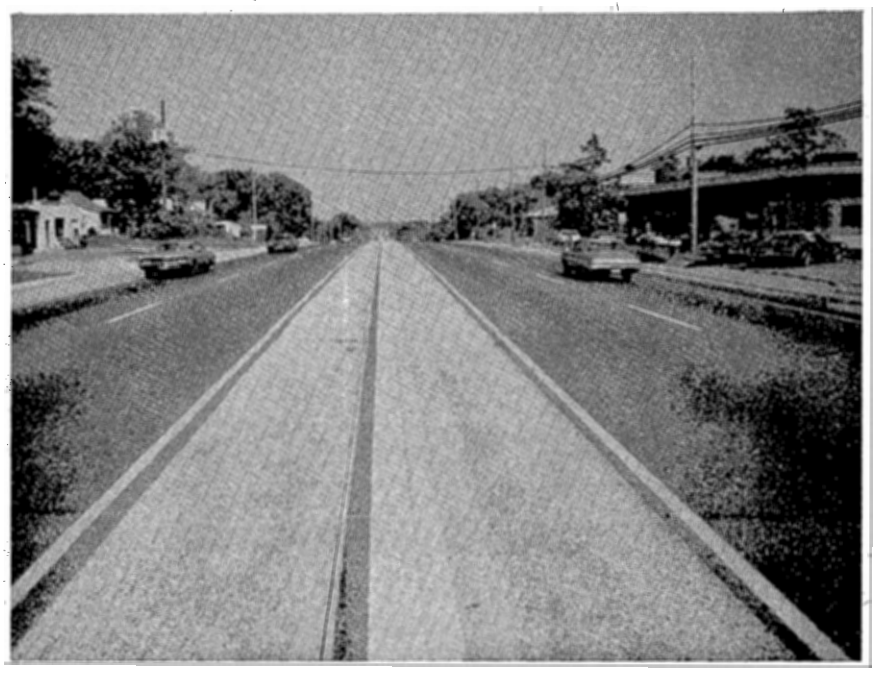


1

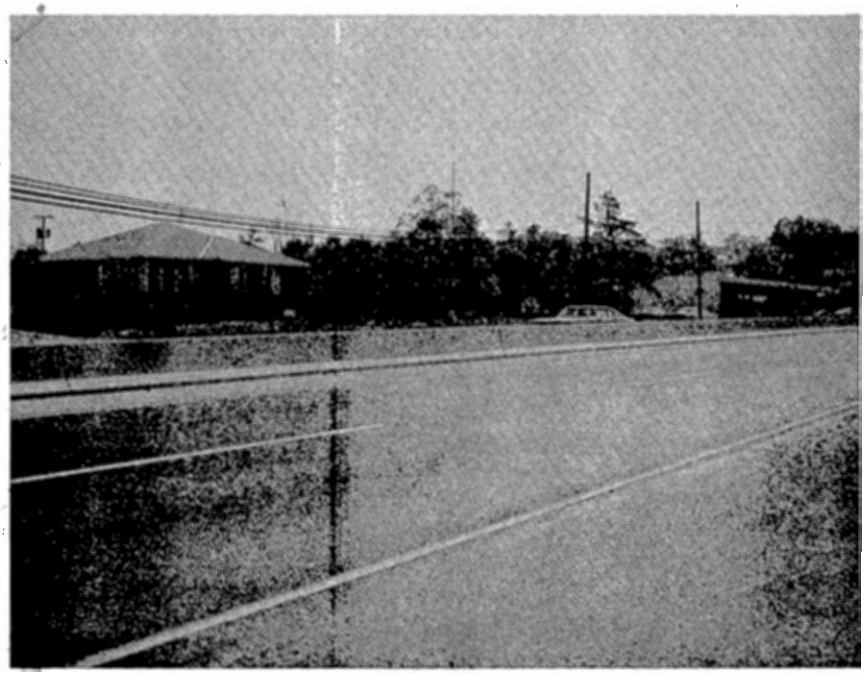
2

ROUTE 9, SECTION 21C & 22D

AFTER



3



4

NOISE MEASUREMENT DATA

ROUTE 9 SECTION 21C & 22D (HOWELL TOWNSHIP)

MICROPHONE POSITION 1

HOUR ****	SAMPLE SIZE (MIN.) ****	DATE ****	L10 (DBA) *****	L50 (DBA) *****	L90 (DBA) *****	LNP (DBA) *****	STD DEV (DBA) *****
1500	50	11/24/75	65.9	59.1	53.2	76.8	5.3
1600	50	11/24/75	64.8	58.7	53.7	74.2	4.7
1700	50	11/24/75	64.4	57.6	51.8	75.7	5.2
1800	50	11/24/75	63.4	56.4	49.6	74.8	5.6
1900	50	11/24/75	61.8	54.8	48.1	72.4	5.4
2000	50	11/24/75	60.2	51.8	44.6	72.9	6.1
2100	50	11/24/75	58.1	50.0	42.8	70.9	6.0
2200	50	11/24/75	59.0	50.1	42.2	73.4	6.7
2300	50	11/24/75	64.4	54.5	47.2	79.0	6.7
0000	50	11/25/75	57.5	46.8	39.7	73.2	7.1
0100	50	11/25/75	57.1	47.3	40.4	73.1	6.8
0200	50	11/25/75	52.5	43.4	37.1	70.0	6.5
0300	50	11/25/75	53.3	41.9	36.8	73.5	7.1
0400	50	11/25/75	58.6	45.5	38.0	78.5	8.2
0500	50	11/25/75	63.0	52.0	43.5	79.2	7.4
0600	50	11/25/75	68.4	59.8	51.0	81.8	6.7
0700	50	11/25/75	65.2	59.7	52.7	76.0	5.1
0800	50	11/25/75	68.0	60.5	53.8	78.6	5.6
0900	50	11/25/75	70.5	63.2	56.1	81.7	5.7
1000	49	11/25/75	64.6	57.2	49.6	76.6	6.0
1100	50	11/25/75	64.7	57.2	50.0	77.8	6.0
1200	50	11/25/75	64.7	57.0	50.6	76.3	5.7
1300	50	11/25/75	64.7	57.3	49.4	78.1	6.2
1400	50	11/25/75	66.9	60.8	53.1	79.5	5.7

NOISE MEASUREMENT DATA

ROUTE 9 SECTION 21C & 22D (HOWELL TOWNSHIP)

MICROPHONE POSITION 2

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1500	50	11/24/75	60.9	55.6	51.2	68.8	4.1
1600	50	11/24/75	60.0	55.5	51.4	66.6	3.6
1700	50	11/24/75	59.8	53.6	49.3	68.5	4.4
1800	50	11/24/75	58.4	52.4	47.4	67.3	4.5
1900	50	11/24/75	56.9	51.3	46.6	64.7	4.2
2000	42	11/24/75	56.3	49.1	45.8	66.0	4.4
2100	50	11/24/75	52.0	47.7	43.9	59.5	3.7
2200	50	11/24/75	52.8	47.6	43.1	61.0	4.1
2300	50	11/24/75	52.6	47.3	42.7	61.2	4.2
0000	50	11/25/75	52.2	45.9	41.7	63.5	4.7
0100	50	11/25/75	53.2	47.2	42.5	63.0	4.5
0200	50	11/25/75	50.0	45.7	41.6	59.1	3.9
0300	50	11/25/75	48.4	43.2	39.9	60.9	4.5
0400	50	11/25/75	53.1	46.9	42.3	63.7	4.7
0500	50	11/25/75	55.9	49.6	45.0	65.9	4.7
0600	0	11/25/75	NO DATA - NONREPRESENTATIVE NOISE				
0700	50	11/25/75	59.4	54.7	50.5	66.7	3.8
0800	0	11/25/75	NO DATA - NONREPRESENTATIVE NOISE				
0900	50	11/25/75	59.8	54.7	49.9	67.4	4.1
1000	50	11/25/75	59.9	53.4	48.0	69.7	4.9
1100	50	11/25/75	61.4	52.5	47.1	72.9	5.7
1200	50	11/25/75	59.2	54.1	50.3	66.4	3.8
1300	50	11/25/75	57.7	52.3	47.6	66.4	4.3
1400	50	11/25/75	62.0	56.6	51.2	72.6	4.8

NOISE MEASUREMENT DATA

ROUTE 9 SECTION 21C & 22D (HOWELL TOWNSHIP)

MICROPHONE POSITION 3

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1500	50	11/24/75	55.3	52.1	48.6	63.1	3.4
1600	50	11/24/75	55.1	52.2	49.1	60.1	2.7
1700	50	11/24/75	54.6	50.7	46.8	60.9	3.3
1800	50	11/24/75	52.7	48.7	46.0	59.2	3.1
1900	0	11/24/75	NO DATA - MICROPHONE MALFUNCTION				
2000	50	11/24/75	50.2	47.8	45.6	55.1	2.3
2100	50	11/24/75	49.9	47.6	45.4	54.7	2.3
2200	50	11/24/75	49.4	44.5	41.3	55.4	3.3
2300	50	11/24/75	49.6	45.5	41.7	55.9	3.3
0000	50	11/25/75	49.9	44.3	41.2	61.7	4.4
0100	50	11/25/75	50.7	45.1	41.4	59.1	4.0
0200	50	11/25/75	48.8	44.5	41.3	55.0	3.2
0300	50	11/25/75	47.7	43.6	41.0	55.7	3.3
0400	45	11/25/75	50.2	45.2	41.5	57.9	3.8
0500	50	11/25/75	51.5	48.0	45.2	58.9	3.3
0600	50	11/25/75	58.4	52.0	47.4	67.2	4.5
0700	50	11/25/75	54.4	50.1	46.4	60.2	3.2
0800	50	11/25/75	56.9	52.3	48.2	64.8	3.9
0900	50	11/25/75	55.0	49.1	45.6	63.2	4.1
1000	50	11/25/75	53.8	48.7	44.7	63.8	4.3
1100	50	11/25/75	53.0	47.9	44.2	60.9	4.0
1200	50	11/25/75	53.6	48.5	45.6	60.6	3.6
1300	50	11/25/75	52.1	48.0	44.8	59.0	3.4
1400	50	11/25/75	56.1	52.1	48.0	62.7	3.5

TRAFFIC AND WEATHER DATA

Route 9, Section 21C & 22D (Howell Township)

Hour	Date	Northbound Auto Volume Veh/Hr	Northbound Truck Volume Veh/Hr	Southbound Auto Volume Veh/Hr	Southbound Truck Volume Veh/Hr	Wind Wind Mph	Wind Direction Degree	Temp °F	Humidity %
1500	11/24/75	506	64	506	86	0	-	47	55
1600	11/24/75	440	72	892	30	0-2	000	50	63
1700	11/24/75	390	46	1028	36	0-2	008	49	63
1800	11/25/75	348	36	796	44	0-2	032	51	65
1900	11/24/75	326	26	556	46	0-2	006	44	66
2000	11/24/75	208	8	402	24	0	-	-	-
2100	11/24/75	198	16	368	14	0-3	030	39	59
2200	11/24/75	190	16	292	10	0-3	030	43	68
2300	11/24/75	214	8	190	14	0-3	360	42	68
0000	11/25/75	68	6	240	12	0-3	360	39	68
0100	11/25/75	34	10	182	4	0-3	355	40	60
0200	11/25/75	24	6	86	8	0	-	39	66
0300	11/25/75	28	10	24	2	0	-	40	66
0400	11/25/75	30	14	26	14	0	-	39	66

TRAFFIC AND WEATHER DATA

Route 9, Section 21C & 22D (Howell Township) (cont.)

Hour	Date	Northbound Auto Volume Veh/Hr	Northbound Truck Volume Veh/Hr	Southbound Auto Volume Veh/Hr	Southbound Truck Volume Veh/Hr	Wind Wind Mph	Wind Direction Degree	Temp °F	Humidity °
0500	11/25/75	214	38	24	18	0	-	39	70
0600	11/25/75	722	46	46	30	0	-	36	83
0700	11/25/75	1180	42	318	30	0	-	36	74
0800	11/25/75	874	58	364	52	0	-	38	74
0900	11/25/75	538	60	416	60	0	-	42	70
1000	11/25/75	556	54	446	70	0	-	43	70
1100	11/25/75	572	64	488	72	0	-	45	65
1200	11/25/75	466	74	492	60	0	-	45	65
1300	11/25/75	542	66	522	78	0-3	123	45.5	66
1400	11/25/75	602	72	624	52	0-3	210	46.5	55

SITE DESCRIPTION

Location

Route and Section: Route I-295, Section 8B & 9A

Station: 356 + 40 Southbound

Municipality: Lawrence Township County: Mercer

Facility: Condemned house in right of way

Sound Propagation Path Characteristics

Roadway: At-Grade

Barriers: None

Terrain: Flat with scattered deciduous trees to 15 foot and grass to three foot height.

Road Description

Pavement Type: Bituminous Concrete

Pavement Quality: Normal

Number of Lanes: Near lanes 3 Far lanes 3

Lane Width: 12 feet

Grade: Near lanes -0.5% Far lanes 0.5%

Center Barrier: None

Median: Grass 60 feet wide

SITE DESCRIPTION

Microphone Location

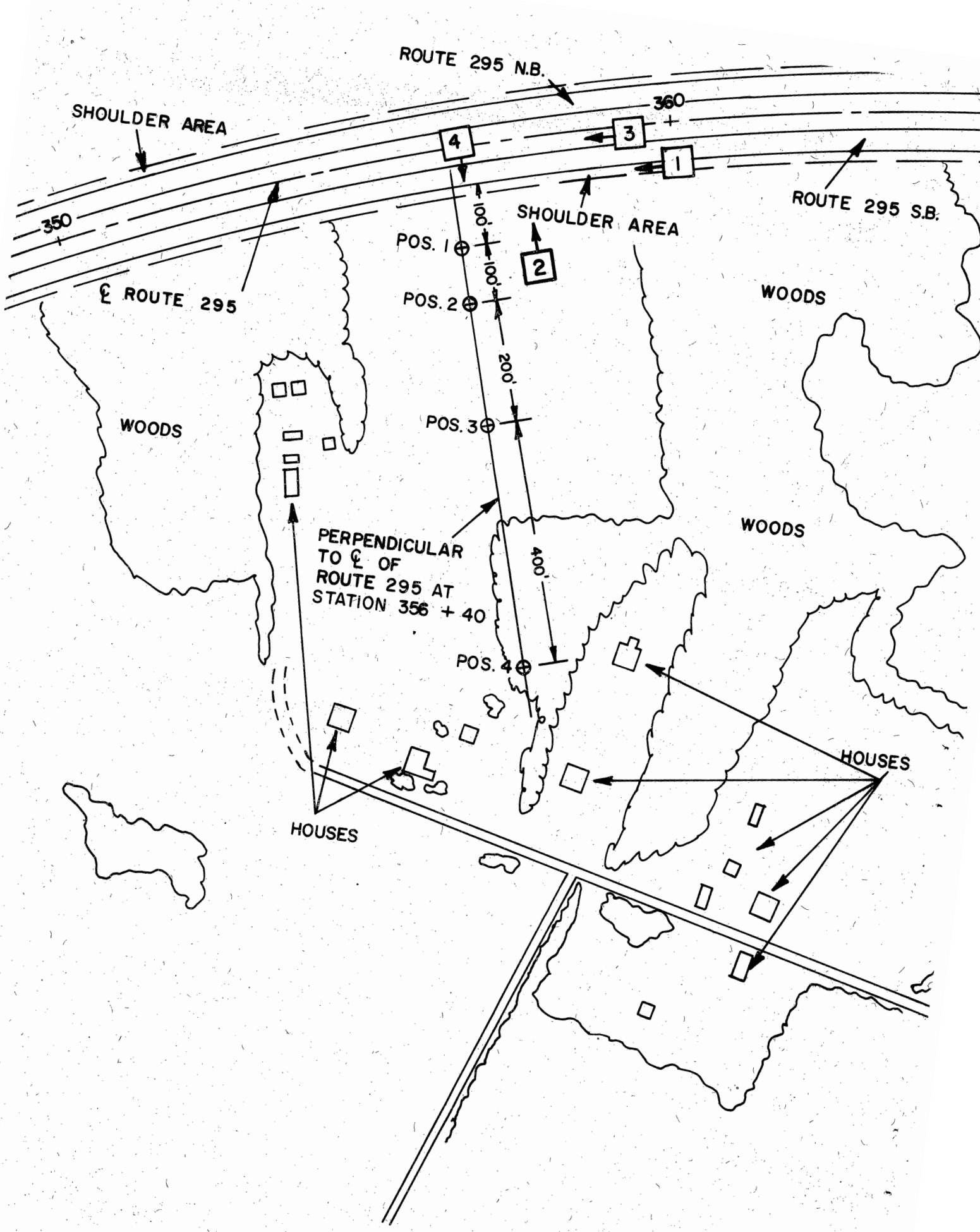
	Position 2
Height of microphone above ground	5'
Height of microphone with respect to near lane	-4'
Distance to near lane	200'

Traffic Data Collection

Hand Counters

Noise Contributions from Other Sources

Traffic on Route 1, 2000 feet south.



ROUTE 295 - 8B & 9A

RT. I-295 SECTION 8B & 9A
BEFORE

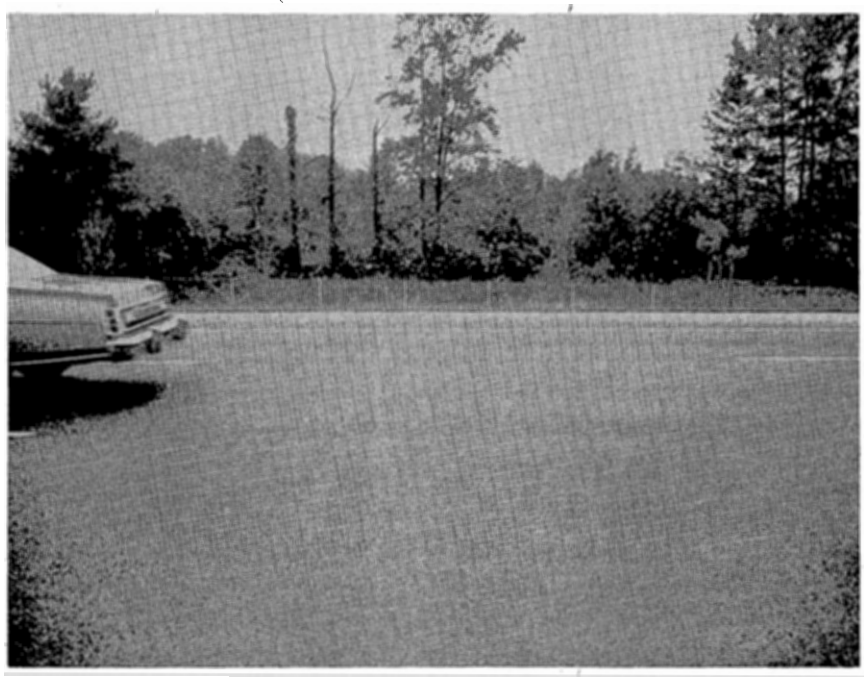
1

2

ROUTE I-295, SECTION 8B & 9A

AFTER

3



4

NOISE MEASUREMENT DATA

ROUTE I-295 SECTION 8B & 9A (LAWRENCE TOWNSHIP)

MICROPHONE POSITION 2

HOUR ****	SAMPLE SIZE (MIN.) ****	DATE ****	L10 (DBA) *****	L50 (DBA) *****	L90 (DBA) *****	LNP (DBA) *****	STD DEV (DBA) *****
1100	50	02/19/76	56.6	52.8	49.7	66.4	3.9
1200	50	02/19/76	56.8	53.1	50.4	63.9	3.3
1300	50	02/19/76	56.0	51.9	47.8	66.8	4.2
1400	50	02/19/76	56.8	52.8	49.6	65.8	3.8
1500	50	02/19/76	57.7	53.3	50.0	64.8	3.5
1600	50	02/19/76	60.4	56.9	53.0	66.4	3.2
1700	50	02/19/76	61.8	58.1	55.1	67.8	3.1
1800	49	02/19/76	59.5	54.9	50.8	67.2	3.8
1900	49	02/19/76	57.6	53.1	49.3	63.9	3.5
2000	50	02/19/76	59.2	54.5	50.7	65.4	3.5
2100	50	02/19/76	58.6	54.1	50.5	64.9	3.5
2200	50	02/19/76	57.2	52.6	48.4	65.7	4.0
2300	50	02/19/76	58.0	53.2	49.6	66.4	3.9
0000	50	02/20/76	55.9	49.6	45.6	65.9	4.6
0100	50	02/20/76	52.2	45.6	41.6	63.4	4.7
0200	50	02/20/76	51.8	45.2	41.2	62.3	4.6
0300	50	02/20/76	50.3	45.1	40.9	61.5	4.4
0400	50	02/20/76	51.3	47.5	43.9	60.1	3.7
0500	50	02/20/76	50.7	47.2	43.7	59.3	3.7
0600	50	02/20/76	55.5	51.5	47.3	62.4	3.5
0700	50	02/20/76	59.9	55.7	51.6	68.4	3.8
0800	50	02/20/76	58.9	54.3	51.1	65.1	3.3
0900	50	02/20/76	58.0	53.4	50.4	65.4	3.6
1000	50	02/20/76	59.6	54.2	50.9	67.2	3.8

TRAFFIC AND WEATHER DATA

Route I-295, Section 8B & 9A (Lawrence Township)

Hour	Date	Southbound Auto Volume Veh/Hr	Southbound Truck Volume Veh/Hr	Northbound Auto Volume Veh/Hr	Northbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
1100	02/19/76	234	30	142	32	0-5	210	60	45
1200	02/19/76	334	30	280	28	0-5	270	56	44
1300	02/19/76	316	26	294	20	0-5	286	56	41
1400	02/19/76	396	26	302	20	0-5	310	58.5	37
1500	02/19/76	500	32	300	40	0-5	302	58.5	37
1600	02/19/76	440	26	534	30	0-5	242	58.5	37
1700	02/19/76	1320	16	474	14	0-5	238	58	37
1800	02/19/76	480	28	398	4	0-5	214	55	46
1900	02/19/76	332	-	368	2	0-5	340	56	50
2000	02/19/76	350	6	228	2	0-5	0	-	69
2100	02/19/76	416	4	166	2	0-5	0	-	73
2200	02/19/76	286	14	174	-	0-5	150	50	73
2300	02/19/76	186	12	180	8	5-10	120	48	67
0000	02/20/76	108	8	46	6	5-10	0	-	65
1000	02/20/76	48	2	26	-	0-5	0	-	60
0200	02/20/76	30	4	18	2	0-5	0	-	62

TRAFFIC AND WEATHER DATA

Route I-295, Section 8B & 9A (Lawrence Township) (cont.)

Hour	Date	Southbound Auto Volume Veh/Hr	Southbound Truck Volume Veh/Hr	Northbound Auto Volume Veh/Hr	Northbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
0300	02/20/76	8	6	10	-	0-5	-	42	55
0400	02/20/76	4	2	4	10	0-5	-	39	73
0500	02/20/76	30	2	8	6	0-5	-	44	92
0600	02/20/76	52	6	172	4	0-5	-	43	92
0700	02/20/76	240	8	996	24	0-5	-	38.5	87
0800	02/20/76	428	30	1300	32	0-5	-	42	55
0900	02/20/76	216	22	340	30	0-5	320	53	59
1000	02/20/76	246	32	354	26	0-5	270	53	86

SITE DESCRIPTION

Location

Route and Section: Route 174, Section 1A

Station: 235 + 25 Southbound

Municipality: Lawrence Township County: Mercer

Facility: Resident Engineer's Office

Sound Propagation Path Characteristics

Roadway: At-Grade

Barriers: None

Terrain: Flat with thick woods and brush 50 feet back from road.

Road Description

Pavement Type: Bituminous Concrete

Pavement Quality: Normal

Number of Lanes: Near lanes 2 Far lanes 2

Lane Width: 12 feet

Grade: Near lanes +2% Far lanes -2%

Center Barrier: Concrete 32 inches high

Median: 8 feet wide

SITE DESCRIPTION

Microphone Location

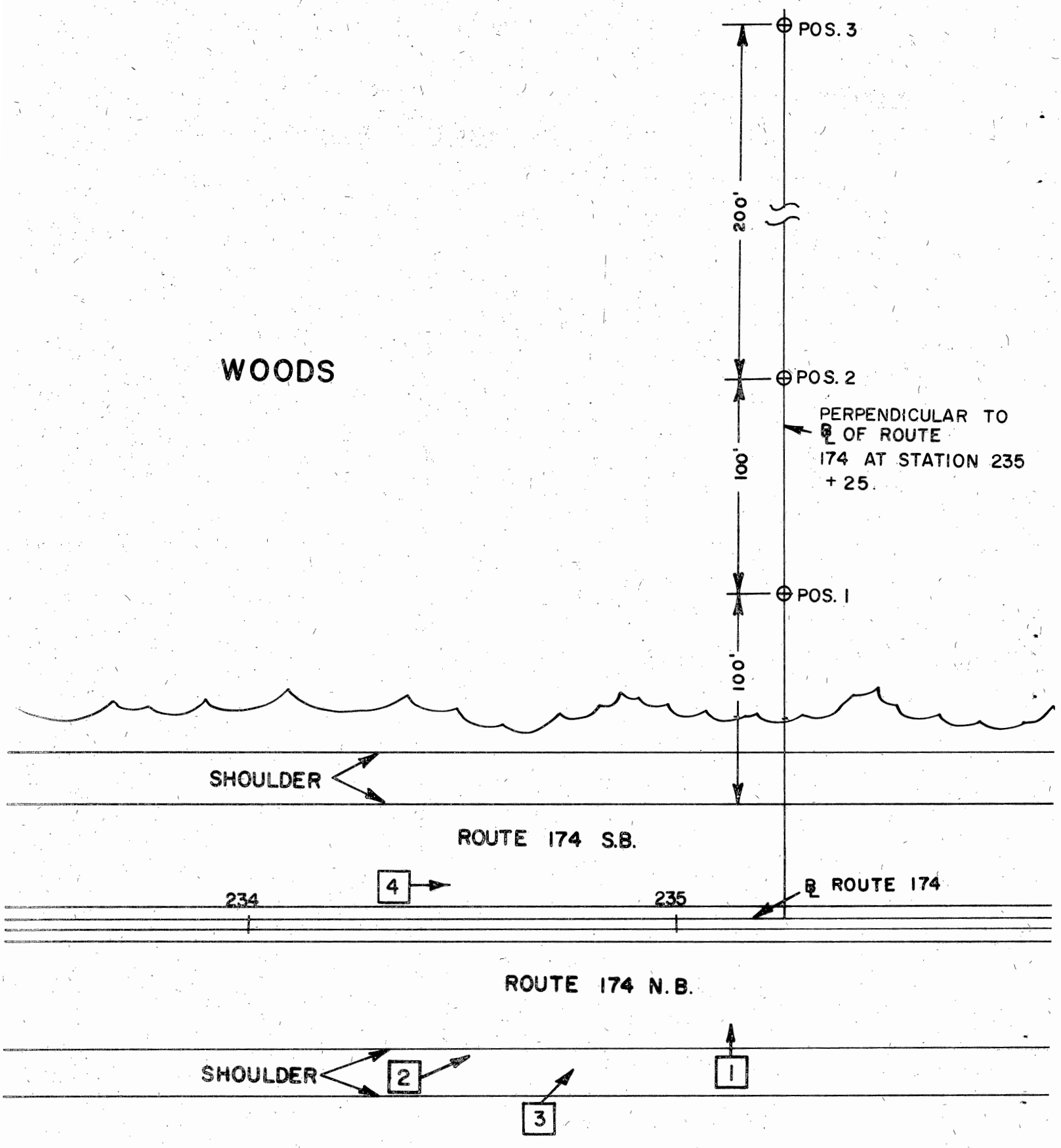
	Position 1	Position 2	Position 3
Height of microphone above ground	5'	5'	5'
Height of microphone with respect to near lane	8'	8'	8'
Distance to near lane	100'	200'	400'

Traffic Data Collection

Hand Counters

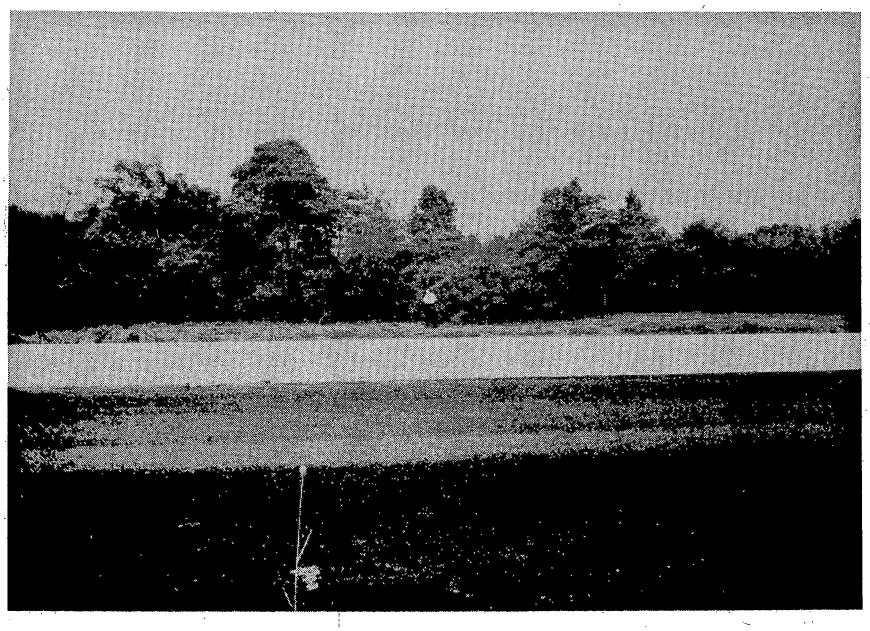
Noise Contributions from Other Sources

Traffic on Route 1, 2000 feet west.


POS. 3
200'
WOODS
POS. 2
PERPENDICULAR TO ℄ OF ROUTE 174 AT STATION 235 + 25.
100'
POS. 1
100'
SHOULDER
ROUTE 174 S.B.
4
234
235
℄ ROUTE 174
ROUTE 174 N.B.
SHOULDER
2
1
3

ROUTE 174-1A

RT. 174 SECTION 1A
BEFORE

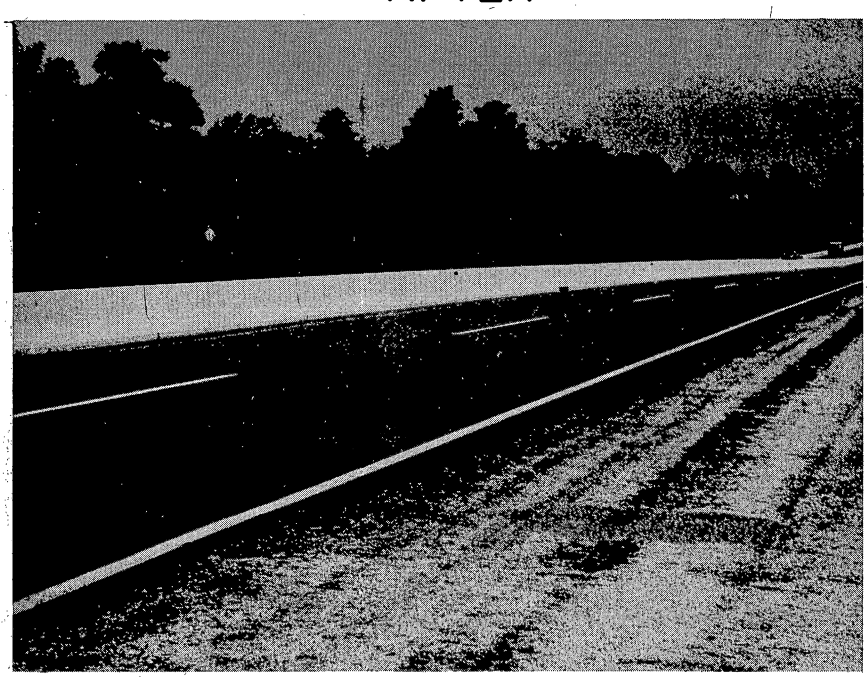


1

2

ROUTE 174, SECTION 1A

AFTER



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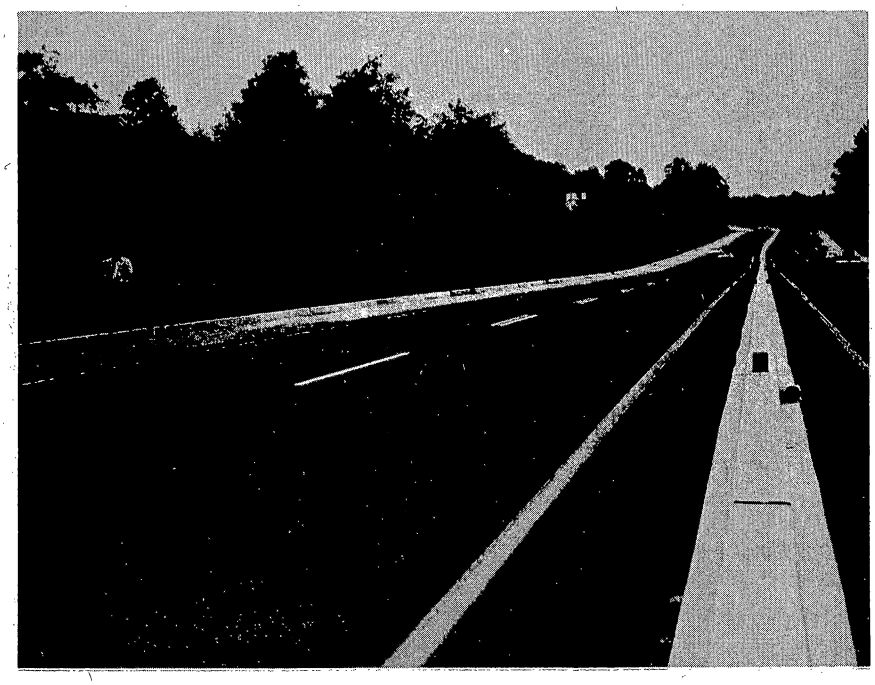


4

NOISE MEASUREMENT DATA

ROUTE 174 SECTION 1A (LAWRENCE TOWNSHIP)

MICROPHONE POSITION 1

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
1200	50	02/25/76	61.9	56.0	51.7	71.7	4.5
1300	50	02/25/76	61.9	55.2	50.5	72.9	5.0
1400	42	02/25/76	63.3	57.1	51.6	74.1	5.0
1500	50	02/25/76	61.6	55.9	50.2	70.8	4.7
1600	0	02/25/76	NO DATA - NONREPRESENTATIVE NOISE				
1700	0	02/25/76	NO DATA - NONREPRESENTATIVE NOISE				
1800	50	02/25/76	65.1	58.6	51.9	75.8	5.3
1900	50	02/25/76	64.3	57.5	49.8	75.9	5.7
2000	50	02/25/76	63.5	55.7	49.2	75.5	5.7
2100	50	02/25/76	61.8	56.7	47.2	75.6	5.9
2200	50	02/25/76	64.1	55.1	49.1	77.3	6.1
2300	50	02/25/76	62.9	55.4	48.8	74.8	5.7
0000	50	02/26/76	62.4	54.7	47.4	75.6	6.1
0100	50	02/26/76	60.0	50.4	47.0	71.6	5.4
0200	50	02/26/76	60.0	48.7	44.5	75.2	6.4
0300	50	02/26/76	60.0	47.7	44.2	76.8	6.7
0400	50	02/26/76	59.0	46.7	43.2	75.8	6.7
0500	50	02/26/76	63.1	50.8	47.3	79.9	6.7
0600	50	02/26/76	66.8	58.9	52.4	79.0	5.9
0700	50	02/26/76	66.4	61.5	56.9	75.6	4.3
0800	49	02/26/76	65.2	60.1	56.3	73.1	3.9
0900	50	02/26/76	63.9	57.2	51.9	73.9	5.0
1000	50	02/26/76	62.1	55.5	49.9	72.8	5.2
1100	50	02/26/76	62.8	55.4	49.6	75.3	5.6

NOISE MEASUREMENT DATA

ROUTE 174 SECTION 1A (LAWRENCE TOWNSHIP)

MICROPHONE POSITION 2

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1200	0	02/25/76	NO DATA - OPERATOR ERROR				
1300	0	02/25/76	NO DATA - OPERATOR ERROR				
1400	0	02/25/76	NO DATA - OPERATOR ERROR				
1500	0	02/25/76	NO DATA - OPERATOR ERROR				
1600	50	02/25/76	58.0	53.4	50.3	67.4	3.8
1700	50	02/25/76	58.8	54.3	50.9	64.4	3.2
1800	50	02/25/76	58.1	53.1	48.8	65.9	4.0
1900	50	02/25/76	57.4	52.5	48.2	65.7	4.0
2000	50	02/25/76	55.8	51.2	46.9	63.8	3.9
2100	50	02/25/76	54.2	49.4	46.0	62.7	3.8
2200	50	02/25/76	54.7	49.6	46.2	63.2	3.8
2300	50	02/25/76	56.2	48.9	45.8	63.5	4.1
0000	50	02/26/76	55.1	49.3	45.1	63.2	4.3
0100	50	02/26/76	50.9	46.3	42.0	58.0	3.7
0200	50	02/26/76	52.4	46.2	41.8	62.7	4.6
0300	50	02/26/76	53.2	44.9	41.3	65.3	5.2
0400	50	02/26/76	53.9	46.9	42.0	66.6	5.2
0500	50	02/26/76	58.6	49.7	45.8	68.7	5.2
0600	50	02/26/76	62.0	55.2	50.1	71.4	4.9
0700	50	02/26/76	61.1	57.2	53.4	67.9	3.5
0800	49	02/26/76	58.8	54.3	51.2	64.5	3.1
0900	50	02/26/76	55.4	50.6	46.6	62.8	3.7
1000	50	02/26/76	54.3	49.2	45.7	60.8	3.6
1100	50	02/26/76	54.9	49.1	45.7	62.3	3.9

NOISE MEASUREMENT DATA

ROUTE 174 SECTION 1A (LAWRENCE TOWNSHIP)

MICROPHONE POSITION 3

HOUR	SAMPLE SIZE (MIN.)	DATE	L10 (DBA)	L50 (DBA)	L90 (DBA)	LNP (DBA)	STD DEV (DBA)
****	****	****	*****	*****	*****	*****	*****
1200	50	02/25/76	53.5	49.6	46.3	57.4	2.6
1300	50	02/25/76	53.9	50.6	46.9	57.8	2.6
1400	47	02/25/76	54.7	52.6	50.6	57.0	1.5
1500	50	02/25/76	54.7	52.6	50.7	56.3	1.3
1600	0	02/25/76	NO DATA - OPERATOR ERROR				
1700	50	02/25/76	56.0	53.1	50.8	60.1	2.3
1800	33	02/25/76	55.3	52.9	50.8	58.3	1.8
1900	50	02/25/76	54.9	52.6	50.4	59.7	2.2
2000	50	02/25/76	54.8	52.5	50.2	58.5	2.1
2100	50	02/25/76	54.6	52.2	49.7	58.5	2.2
2200	50	02/25/76	54.9	52.7	50.6	57.7	1.7
2300	50	02/25/76	55.7	53.0	50.6	60.4	2.4
0000	50	02/26/76	55.3	52.5	49.6	60.1	2.7
0100	50	02/26/76	54.3	52.1	49.7	56.6	1.7
0200	50	02/26/76	54.7	52.4	50.2	57.6	1.9
0300	50	02/26/76	54.0	49.9	46.4	59.8	3.1
0400	50	02/26/76	54.2	50.0	46.4	60.3	3.2
0500	50	02/26/76	61.1	57.8	55.1	67.3	3.0
0600	50	02/26/76	60.8	55.2	51.3	67.7	3.8
0700	50	02/26/76	60.2	57.4	54.6	65.0	2.6
0800	50	02/26/76	58.1	54.1	51.1	62.0	2.6
0900	50	02/26/76	55.2	52.8	50.7	59.3	2.0
1000	50	02/26/76	54.9	52.7	50.7	58.0	1.7
1100	50	02/26/76	54.8	52.6	50.5	57.6	1.7

TRAFFIC AND WEATHER DATA

Route 174, Section 1A (Lawrence Township)

Hour	Date	Southbound Auto Volume Veh/Hr	Southbound Truck Volume Veh/Hr	Northbound Auto Volume Veh/Hr	Northbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
1200	02/25/76	300	42	322	44	0	-	62	50
1300	02/25/76	302	38	308	36	3	185	61	45
1400	02/25/76	294	38	270	28	0	-	63	38
1500	02/25/76	384	50	408	26	4	195	61	45
1600	02/25/76	674	36	562	26	3	250	60.5	40
1700	02/25/76	780	18	598	24	0	225	57	46
1800	02/25/76	382	20	254	14	0	-	52	63
1900	02/25/76	278	8	180	14	0	-	52	57
2000	02/25/76	216	24	154	6	0	-	48	66
2100	02/25/76	168	10	90	10	0	-	54.5	49
2200	02/25/76	138	6	88	10	0	-	52.5	55
2300	02/25/76	106	4	130	8	0	-	51	45
0000	02/26/76	102	4	62	6	0	-	47.5	67
0100	02/26/76	40	6	12	2	0	-	46	75
0200	02/26/75	20	4	24	4	0	-	42	80
0300	02/26/76	14	10	16	10	0	-	44.5	70

TRAFFIC AND WEATHER DATA

Route 174, Section 1A (Lawrence Township) (cont.)

Hour	Date	Southbound Auto Volume Veh/Hr	Southbound Truck Volume Veh/Hr	Northbound Auto Volume Veh/Hr	Northbound Truck Volume Veh/Hr	Wind Speed Mph	Wind Direction Degree	Temp °F	Humidity %
0400	02/26/76	4	10	14	8	0	-	38	100
0500	02/26/76	12	6	12	6	0	-	35	95
0600	02/26/76	48	10	176	40	0	-	37.5	91
0700	02/26/76	146	34	592	46	0	-	38.5	83
0800	02/26/76	686	42	726	38	0	-	45	66
0900	02/26/76	450	34	308	42	0	-	54	60
1000	02/26/76	364	36	342	32	0	-	55	65
1100	02/26/76	270	46	258	38	0	-	59	58

APPENDIX B

BEFORE AND AFTER MEASUREMENTS BY SITE

B.1 BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 195, Section 1B (Lawrence Township)

	Position 1		Position 2	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	67.9 (700)	70.6 (700)	45.7 (1600)	66.1 (800)
		70.7 (900)	55.9 (1700)	64.3 (1600)
		70.2 (1500)		
		70.1 (1700)		
Off-Peak	54.7 (1800)	68.8 (1100)	51.6 (600)	59.6 (600)
	55.9 (2000)	68.5 (1300)	51.6 (1000)	65.4 (1000)
		65.7 (1900)	60.2 (1100)	66.1 (1200)
		63.5 (2100)	52.2 (1200)	62.2 (1400)
			54.5 (1900)	62.2 (1800)
				60.5 (2000)
Nighttime	51.6 (2300)	62.9 (2300)	50.4 (2200)	60.4 (2200)
	49.7 (100)	54.5 (100)	49.7 (0000)	59.4 (0000)
	50.1 (300)	52.2 (300)	49.6 (200)	50.6 (2000)
	51.9 (500)	52.1 (500)	48.3 (400)	51.4 (400)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 440, Section 1D & 3A (Perth Amboy)

	Position 1		Position 2	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	57.6 (700)	63.3 (700)	60.3 (700)	62.8 (700)
	61.9 (800)	64.3 (800)	66.0 (800)	64.0 (800)
	67.1 (1700)	64.5 (1600)	63.6 (1700)	63.5 (1600)
		64.3 (1700)		63.3 (1700)
Off-Peak	59.7 (600)	60.6 (600)	53.8 (600)	60.1 (600)
	68.2 (1200)	62.4 (900)	73.0 (1200)	62.9 (900)
	64.9 (1400)	63.7 (1000)	62.5 (1300)	63.6 (1000)
	66.6 (1500)	62.5 (1100)	62.0 (1400)	61.5 (1100)
	64.8 (1800)	67.8 (1200)	62.2 (1500)	67.6 (1200)
	64.0 (1900)	64.0 (1300)	63.1 (1800)	60.1 (1300)
	62.2 (2000)	63.4 (1400)	62.3 (1900)	61.7 (1400)
	62.4 (2100)	65.6 (1500)	61.1 (2000)	64.8 (1500)
		64.8 (1800)	61.6 (2100)	62.0 (1800)
		62.4 (1900)		61.5 (1900)
		60.7 (2000)		58.6 (2000)
		57.4 (2100)		58.6 (2100)
Nighttime	66.0 (2200)	60.6 (2200)	64.2 (2200)	61.0 (2200)
	62.3 (2300)	57.9 (2300)	61.1 (2300)	57.3 (2300)
	60.4 (0000)	55.2 (0000)	58.8 (0000)	51.9 (0000)
	54.1 (100)	53.1 (100)	52.1 (100)	50.3 (100)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 440, Section 1D & 3A (Perth Amboy) (cont.)

	Position 1		Position 2	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Nighttime	51.5 (200)	51.2 (200)	51.5 (200)	50.0 (200)
	50.2 (300)	50.7 (300)	49.7 (300)	49.3 (300)
	50.2 (400)	54.2 (400)	49.7 (400)	52.1 (400)
	50.2 (500)	54.3 (500)	49.8 (500)	52.9 (500)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 33F, Section 1A & 2A (Freehold Township)

	Position 1		Position 2		Position 4	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	56.0 (700)	51.6 (700)	60.0 (700)	58.2 (700)	57.5 (700)	55.2 (900)
	55.5 (800)	54.1 (900)	60.7 (800)	55.7 (800)	59.8 (800)	50.7 (1500)
	54.6 (900)	49.8 (1500)	60.6 (900)	56.3 (900)	59.8 (900)	54.1 (1600)
	50.8 (1500)	51.6 (1600)	57.0 (1500)	55.7 (1500)	55.2 (1500)	53.4 (1700)
	53.3 (1600)	48.7 (1700)		51.9 (1600)		
	54.3 (1700)			55.2 (1700)		
Off-Peak	52.9 (600)	44.1 (600)	56.5 (600)	56.7 (600)	54.7 (600)	53.1 (600)
	55.3 (1000)	54.0 (1000)	61.7 (1000)	53.5 (1000)	59.5 (1000)	54.5 (1000)
	54.7 (1000)	54.4 (1100)	60.7 (1100)	51.9 (1200)	58.5 (1100)	55.2 (1100)
	55.4 (1200)	50.3 (1200)	60.1 (1200)	57.0 (1400)	58.9 (1200)	51.4 (1200)
	56.6 (1300)	53.0 (1300)	59.5 (1300)	55.2 (1800)	56.9 (1300)	54.6 (1300)
	53.7 (1400)	53.3 (1400)	57.8 (1400)	54.6 (1900)	55.5 (1400)	56.1 (1400)
	50.8 (1800)	49.2 (1800)	58.0 (1800)	55.0 (2000)	56.9 (1800)	53.6 (1800)
	50.6 (1900)	51.0 (1900)	60.2 (1900)	55.5 (2100)	55.2 (1900)	53.3 (1900)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 33F, Section 1A & 2A (Freehold Township) **(cont.)**

	Position 1		Position 2		Position 4	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Off-Peak		52.2 (2000)	59.2 (2000)		55.7 (2000)	54.6 (2000)
		53.0 (2100)	59.2 (2100)		55.4 (2100)	57.7 (2100)
Nighttime	48.0 (2200)	44.7 (2200)	56.8 (2000)	54.2 (2300)	58.2 (2200)	49.8 (2200)
	48.6 (2300)	43.8 (500)	55.6 (2300)	55.1 (000)	56.0 (2300)	
	50.8 (000)		57.2 (000)	52.3 (100)	52.9 (0000)	
	50.6 (100)		57.2 (0000)	52.3 (100)	52.9 (0000)	
	50.6 (100)		55.5 (100)	51.4 (400)	51.1 (100)	
	48.5 (200)		52.1 (200)	53.4 (500)	50.2 (200)	
	45.5 (300)		51.0 (300)		48.2 (300)	
	49.9 (400)		54.5 (400)		52.1 (400)	
	52.6 (500)		53.9 (500)		52.6 (500)	

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 33F, Section 1A & 2A (Freehold Township) (cont.)

	Position 5		Position 6		Position 7	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	56.6 (700)	57.3 (700)	57.3 (700)	59.8 (700)	54.4 (700)	56.4 (700)
	55.4 (800)	55.0 (800)		59.4 (800)	55.4 (800	59.5 (800)
	54.6 (900)	55.3 (1500)		60.3 (900)	56.3 (900)	58.0 (900)
	50.5 (1500)	57.0 (1600)		59.8 (1500)	54.4 (1500)	52.2 (1500)
	53.1 (1600)			60.2 (1600)	55.6 (1600)	55.4 (1600)
	54.9 (1700)				54.6 (1700)	
Off-Peak	52.6 (600)	51.8 (1000)	53.0 (600)	58.6 (600)	52.3 (600)	55.6 (1000)
	55.7 (1000)	50.8 (1200)	58.5 (1000)	57.7 (1000)	56.6 (1000)	56.1 (1100)
	54.9 (1100)	55.1 (1300)	57.6 (1100)	59.5 (1100)	56.3 (1100)	55.5 (1200)
	54.6 (1200)	57.1 (1400)	56.6 (1200)	56.3 (1200)	52.9 (1200)	55.8 (1300)
	55.5 (1300)	55.1 (1800)	58.2 (1300)	59.1 (1300)	41.8 (1300)	60.8 (1400)
	54.2 (1400)	54.3 (1900)		60.2 (1400)	55.2 (1400)	54.6 (1800)
	52.0 (1800)	54.9 (2000)		59.6 (1800)	54.5 (2000)	59.8 (1900)
	50.9 (1900)	54.5 (1200		58,9 (1900)	54.9 (2100)	54.7 (2000)
	50.5 (2000)			59.2 (2000)		55.5 (2100)
	51.2 (2100)			58.6 (2100)		

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 33F, Section 1A & 2A (Freehold Township) (cont.)

	Position 5		Position 6		Position 7	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Nighttime	52.0 (2200)	52.9 (2200)	51.8 (2200)	56.1 (2300)	57.1 (2200)	51.1 (2200)
	50.5 (2300)	53.0 (0000)	52.7 (2300)	57.7 (0000)	44.7 (2300)	45.3 (2300)
	50.3 (0000)	51.1 (400)	52.9 (0000)	56.1 (100)	50.5 (0000)	50.7 (0000)
	49.6 (100)	51.0 (500)	50.8 (100)	52.6 (200)	49.2 (100)	
	46.8 (200)		49.2 (200)	54.6 (300)	47.0 (200)	
	43.6 (300)		49.4 (300)	53.4 (400)	46.4 (300)	
	46.4 (400)		49.1 (400)	55.0 (500)	48.2 (400)	
	50.9 (500)		50.4 (500)		48.3 (500	

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 9, Section 21C & 22D (Howell Township)

	Position 1		Position 2		Position 3	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	67.0 (700)	65.2 (700)	65.3 (700)	59.4 (700)	63.9 (700)	54.4 (700)
	68.2 (700)	68.0 (800)	64.5 (800)	62.0 (1400)	55.5 (800)	56.9 (800)
	69.0 (800)	66.9 (1400)	66.5 (1400	60.9 (1500)	56.3 (1400)	56.1 (1400)
	66.2 (800)	65.9 (1500)	65.1 (1500)	60.0 (1600)	58.5 (1500)	55.3 (1500)
	69.3 (1400	64.8 (1600)	65.5 (1700	59.8 (1700)	59.2 (1600)	55.1 (1600)
	66.2 (1400)	64.4 (1700)			56.1 (1700)	54.6 (1700)
	68.2 (1500)					
	65.8 (1500)					
	66.7 (1600)					
	66.6 (1600)					
	68.2 (1700)					
Off-Peak	66.5 (600)	68.4 (600)	64.5 (600)	59.8 (900)	55.2 (900)	58.4 (600)
	66.8 (600)	70.5 (900)	65.4 (900)	59.9 (1000)	57.3 (1000)	55.0 (900)
	70.0 (900)	64.6 (1000)	63.3 (1000)	61.4 (1100)	55.9 (1100)	53.8 (1000)
	65.1 (900)	64.7 (1100)	62.3 (1100)	59.2 (1200)	55.9 (1200)	53.0 (1100)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 9, Section 21C & 22D (Howell Township) (cont.)

	Position 1		Position 2		Position 3	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Off-Peak	69.8 (1000)	64.7 (1200)	61.0 (1200)	57.7 (1300)	56.0 (1300)	53.6 (1200)
	67.9 (1000)	64.7 (1300)	63.5 (1300)	58.4 (1800)	58.5 (1800)	52.1 (1300)
	68.7 (1100)	63.4 (1800)	64.3 (1800)	56.9 (1900)	58.5 (1900)	52.7 (1800)
	66.2 (1200)	61.8 (1900)	62.2 (1900)	56.3 (2000)	55.3 (2000)	50.2 (2000)
	65.1 (1200)	60.2 (2000)	61.0 (2000)	52.0 (2100)	58.2 (2100)	49.9 (2100)
	67.4 (1300)	58.1 (2100)	59.8 (2100)			
	66.3 (1300)					
	68.1 (1800)					
	65.2 (1800)					
	67.1 (1900)					
	65.3 (1900)					
	61.8 (2000)					
	64.7 (2100)					
	64.0 (2100)					

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 9, Section 21C & 22D (Howell Township) (cont.)

	Position 1		Position 2		Position 3	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Nighttime	64.9 (2200)	59.0 (2200)	61.0 (2200)	53.8 (2200)	59.0 (2200)	49.4 (2200)
	63.3 (2200)	64.4 (2300)	58.8 (2300)	52.6 (2300)	50.3 (2300)	49.6 (2300)
	63.8 (2300)	57.5 (0000)	58.1 (0000)	52.2 (0000)	52.0 (0000)	49.9 (0000)
	63.0 (2300)	57.1 (100)	58.5 (1000)	53.2 (100)	51.8 (100)	50.7 (100)
	61.2 (0000)	52.5 (100)	56.3 (200)	50.0 (200)	46.4 (200)	48.8 (200)
	61.3 (0000)	53.3 (300)	55.7 (300)	48.4 (300)		47.7 (300)
	61.6 (100)	58.6 (400)	58.0 (400)	53.1 (400)		50.2 (400)
	60.8 (100)	63.0 (500)	59.9 (500)	55.9 (500)		51.5 (500)
	59.8 (200)					
	57.6 (200)					
	58.3 (300)					
	56.7 (300)					
	62.1 (400)					
	60.7 (400)					
	64.5 (500)					
	64.8 (500)					

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route I-295, Section 8B & 9A (Lawrence Township)

	Position 2	
	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	53.9 (700)	59.9 (700)
	54.0 (800)	58.9 (800)
	54.8 (1600)	60.4 (1600)
	46.2 (1700)	61.8 (1700)
	50.6 (1800)	59.5 (1800)
Off-Peak	53.2 (900)	55.5 (600)
	52.9 (1000)	58.0 (900)
	52.2 (1100)	59.6 (1000)
	52.9 (1200)	56.6 (1100)
	51.5 (1300)	56.8 (1200)
	55.3 (1500)	56.0 (1300)
	47.2 (1900)	56.8 (1400)
	46.1 (2000)	57.7 (1500)
	45.9 (2100)	57.6 (1900)
		59.2 (2000)
		58.6 (2100)
Nighttime	49.1 (2200)	57.2 (2200)
	50.5 (2300)	58.0 (2300)
	51.4 (0000)	55.9 (0000)
	54.1 (100)	52.2 (100)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route I-295, Section 8B & 9A (Lawrence Township) (cont.)

	Position 2	
	Before L_{10} (Hour)	After L_{10} (Hour)
Nighttime	55.9 (200)	51.8 (200)
	51.0 (300)	50.3 (300)
		51.3 (400)
		50.7 (500)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 174, Section 1A (Lawrence Township)

	Position 1		Position 2		Position 3	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Peak	54.2 (700)	66.4 (700)	50.4 (700)	61.1 (700)	50.8 (700)	60.2 (700)
	54.2 (800)	65.2 (800)	50.4 (800)	58.8 (800)	50.8 (800)	58.1 (800)
	52.0 (900)	62.9 (900)	53.1 (1600)	55.4 (900)	49.5 (900)	55.2 (900)
	50.7 (1600		45.2 (1700)	58.0 (1600)	53.0 (1600)	56.0 (1700)
	52.9 (1700)			58.8 (1700)	50.2 (1700)	
Off-Peak	50.4 (600)	66.8 (600)	47.6 (600)	62.0 (600)	51.5 (600)	60.8 (600)
	52.9 (1000)	62.1 (1000)	53.9 (1000)	54.3 (1000)	49.4 (1000)	54.9 (1000)
	51.6 (1100)	62.8 (1100)	50.2 (1100)	54.9 (1100)	49.8 (1100)	54.8 (1100)
	53.1 (1200)	61.9 (1200)	51.9 (1200)	58.1 (1800)	50.2 (1200)	53.5 (1200)
	51.6 (1300)	61.9 (1300)	54.1 (1300)	57.4 (1900)	48.4 (1300)	53.9 (1300)
	53.9 (1400)	63.3 (1400)	55.2 (1400)	55.8 (2000)	48.4 (1400)	54.7 (1400)
	50.0 (1500)	61.6 (1500)	51.2 (1500)	54.3 (2100)	49.1 (1500	54.7 (1500)
	50.0 (1800)	65.1 (1800)	52.0 (1800)		50.4 (1800)	55.3 (1800)

BEFORE AND AFTER CONSTRUCTION L_{10} BY POSITION AND TIME

Route 174, Section 1A (Lawrence Township) (cont.)

	Position 1		Position 2		Position 3	
	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)	Before L_{10} (Hour)	After L_{10} (Hour)
Off-Peak	49.1 (1900)	64.3 (1900)	49.7 (1900)		49.8 (1900)	54.9 (1900)
	49.6 (2000)	63.5 (2000)	49.7 (2000)		48.7 (2000)	54.8 (2000)
		61.8 (2100)	50.2 (2100)		49.4 (2100)	54.6 (2100)
Nighttime	49.7 (2200)	64.1 (2200)	49.8 (2200)	54.7 (2200)	49.6 (2200)	54.9 (2200)
	49.6 (2300)	62.9 (2300)	51.8 (2300)	56.2 (2300)	50.5 (2300)	55.7 (2300)
	53.3 (0000)	62.4 (0000)	49.4 (0000)	55.1 (0000)	49.7 (0000)	55.3 (0000)
	53.8 (100)	60.0 (100)	46.8 (100)	50.9 (100)	49.4 (100)	54.3 (100)
	51.8 (2000	60.0 (200)	47.4 (200)	52.4 (200)	50.4 (200)	54.7 (200)
	50.0 (300)	60.0 (300)	45.0 (300)	53.2 (300)	48.6 (300)	54.0 (300)
	50.3 (400)	59.0 (400)	45.3 (400)	53.9 (400)	50.1 (400)	54.2 (400)
	50.3 (500)	63.1 (500)	46.1 (500)	58.6 (500)	50.4 (500)	61.1 (500)

APPENDIX B

BEFORE AND AFTER MEASUREMENTS BY SITE

B.2 ANALYSIS OF VARIANCE AND t-TEST

ANALYSIS OF VARIANCE

Route 195, Section 1B (Hamilton Township)

Effect	Mean Square Deviation	Degrees of Freedom	F-Statistic	Level of Significance
Highway Construction	948.2	1	85.24	0.05%
Time Period	445.5	2	40.04	0.05%
Microphone Position	186.9	1	16.80	0.05%
Highway - Time Interaction	49.6	2	4.45	2.5%
Highway - Position Interaction	14.5	1	1.30	None
Time - Position Interaction	91.8	2	8.25	0.5%
Highway-Time-Position Interaction	56.0	2	5.03	2.5%
Within Treatments	11.1	30		

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route 195, Section 1B (Hamilton Township)

Mic. Pos.	Time Period	Before Highway Construction: Mean L_{10}	Before: Var.	Before: No. Samp.	After Highway Construction: Mean L_{10}	After: Var.	After: No. Samp.	Mean Increase After Const.	t-Stat.	Deg. Free.	Level Signif.
1	Peak	67.9*	0.0	1	70.4	0.1	4	2.5 dBA	7.59	3	0.1%
1	Off-Peak	55.3	0.7	2	66.6	6.3	4	11.3 dBA	5.90	4	1%
1	Night	50.8	1.2	4	55.7	24.0	4	4.9 dBA	1.94	6	None
2	Peak	50.8	52.0	2	65.2	1.6	2	14.4 dBA	2.78	2	None
2	Off-Peak	54.0	13.4	5	62.7	6.8	6	8.7 dBA	4.58	9	1%
2	Night	49.5	0.8	4	55.5	26.7	4	6.0 dBA	2.27	6	None

*Based on only one short sample (8 min.) stopped because of construction noise.

ANALYSIS OF VARIANCE

Route 440, Section 1D & 3A (Perth Amboy)

Effect	Mean Square Deviation	Degrees of Freedom	F-Statistic	Level of Significance
Highway Construction	0.0	1	.00	None
Time Period	713.5	2	48.04	0.05%
Microphone Position	22.2	1	1.49	None
Highway - Time Interaction	10.6	2	0.71	None
Highway - Position Interaction	0.7	1	0.04	None
Time - Position Interaction	2.8	2	0.18	None
Highway-Time-Position Interaction	2.1	2	0.14	None
Within Treatments	14.9	75		

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route 440, Section 1D & 3A (Perth Amboy)

Mic. Pos.	Time Period	Before Highway Construction			After Highway Construction			Mean Increase* After Const.	t-Stat.	Deg. Free.	Level Signif.
		Mean L_{10}	Var.	No. Samp.	Mean L_{10}	Var.	No. Samp.				
1	Peak	62.2	22.6	3	64.1	0.3	4	1.9 dBA	0.81	5	None
1	Off-Peak	64.1	7.2	8	62.9	7.1	12	-1.2 dBA	-0.95	18	None
1	Night	55.6	40.4	8	54.7	10.9	8	-0.9 dBA	-0.38	14	None
2	Peak	63.3	8.2	3	63.4	0.2	4	0.1 dBA	0.07	5	None
2	Off-Peak	62.4	23.7	9	61.9	7.1	12	-0.5 dBA	-0.32	19	None
2	Night	54.6	34.1	8	53.1	16.3	8	-1.5 dBA	-0.60	14	None

*Minus sign indicates L_{10} decrease after construction.

ANALYSIS OF VARIANCE

Route 33F, Section 1A & 2A (Freehold Township)

Effect	Mean Square Deviation	Degrees of Freedom	F-Statistic	Level of Significance
Highway Construction	31.7	1	7.61	1%
Time Period	452.2	2	108.82	0.05%
Microphone Position	146.6	5	35.29	0.05%
Highway - Time Interaction	33.1	2	7.96	0.05%
Highway - Position Interaction	88.3	5	21.25	0.05%
Time - Position Interaction	11.8	10	2.85	0.5%
Highway-Time-Position Interaction	10.3	10	2.49	1%
Within Treatments	4.2	197		

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route 33F, Section 1A & 2A (Freehold Township)

Mic. Pos.	Time Period	Before Highway Construction: Mean L_{10}	Before: Var.	Before: No. Samp.	After Highway Construction: Mean L_{10}	After: Var.	After: No. Samp.	Mean Increase* After Const.	t-Stat.	Deg. Free.	Level Signif.
1	Peak	54.1	3.5	6	51.2	4.2	5	-2.9 dBA	-2.47	9	5%
1	Off-Peak	53.8	4.8	8	51.5	9.4	10	-2.3 dBA	-1.78	16	None
1	Night	49.3	4.6	8	44.3	0.4	2	-5.0 dBA	-3.16	8	2%
2	Peak	59.6	3.0	4	55.5	4.2	6	-4.1 dBA	-3.25	8	2%
2	Off-Peak	59.3	2.3	10	54.9	2.7	8	-4.4 dBA	-5.80	16	0.1%
2	Night	54.7	4.2	8	53.3	2.2	5	-1.4 dBA	-1.33	11	None
4	Peak	58.1	4.8	4	53.4	3.7	4	-4.7 dBA	-3.23	6	2%
4	Off-Peak	56.7	2.9	10	54.4	3.0	10	-2.3 dBA	-2.99	18	1%
4	Night	52.6	10.3	8	49.8	0.0	1	-2.8 dBA	-0.83	7	None
5	Peak	54.2	4.6	6	56.2	1.4	4	2.0 dBA	1.66	8	None
5	Off-Peak	53.2	4.0	10	54.2	4.0	8	1.0 dBA	1.03	16	None
5	Night	48.8	8.2	8	52.0	1.2	4	3.2 dBA	2.15	10	None
6	Peak	57.3	0.0	1	60.6	3.3	6	3.3 dBA	1.69	5	None

*Minus sign indicates L_{10} decrease after construction

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route 33F, Section 1A & 2A (Freehold Township) (cont.)

Mic. Pos.	Time Period	Before Highway Construction: Mean L_{10}	Before Highway Construction: Var.	Before Highway Construction: No. Samp.	After Highway Construction: Mean L_{10}	After Highway Construction: Var.	After Highway Construction: No. Samp.	Mean Increase* After Const.	t-Stat.	Deg. Free.	Level Signif.
6	Off-Peak	56.8	5.0	5	58.8	1.2	10	2.0 dBA	2.35	13	5%
6	Night	50.8	2.5	8	55.1	30.	7	4.3 dBA	5.06	13	0.1%
7	Peak	55.1	0.6	6	56.3	7.7	5	1.2 dBA	1.00	9	None
7	Off-Peak	54.3	3.2	8	56.5	5.0	9	2.2 dBA	2.19	15	5%
7	Night	48.9	14.0	8	49.0	10.5	4	-0.1 dBA	0.04	9	None

*Minus sign indicates L_{10} decrease after construction

ANALYSIS OF VARIANCE

Route 9, Section 21C & 22D (Howell Township)

Effect	Mean Square Deviation	Degrees of Freedom	F-Statistic	Level of Significance
Highway Construction	890.3	1	151.03	0.05%
Time Period	529.6	2	89.83	0.05%
Microphone Position	1336.5	2	226.71	0.05%
Highway - Time Interaction	8.8	2	1.49	None
Highway - Position Interaction	69.7	2	11.82	0.05%
Time - Position Interaction	4.2	4	0.72	None
Highway-Time-Position Interaction	4.8	4	0.80	None
Within Treatments	5.9	139		

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route 9, Section 21C & 22D (Howell Township)

Mic. Pos.	Time Period	Before Highway Construction: Mean L_{10}	Before Highway Construction: Var.	Before Highway Construction: No. Samp.	After Highway Construction: Mean L_{10}	After Highway Construction: Var.	After Highway Construction: No. Samp.	Mean Increase* After Const.	t-Stat.	Deg. Free.	Level Signif.
1	Peak	67.5	1.7	11	65.9	1.9	6	-1.6 dBA	-2.40	15	5%
1	Off-Peak	66.4	4.3	18	64.1	13.1	10	-2.3 dBA	-2.18	26	5%
1	Night	61.5	6.3	16	58.2	17.2	8	-3.3 dBA	-2.47	22	5%
2	Peak	65.4	0.5	5	60.4	1.1	5	-5.0 dBA	-8.73	8	0.1%
2	Off-Peak	62.7	3.2	10	58.0	7.5	9	-4.7 dBA	-4.54	17	0.1%
2	Night	58.3	3.0	8	52.3	5.0	8	-1.0 dBA	-5.99	14	0.1%
3	Peak	58.3	9.8	6	55.4	0.9	6	-2.9 dBA	2.13	10	None
3	Off-Peak	56.8	1.9	9	53.2	6.5	9	-3.6 dBA	-3.69	16	1%
3	Night	51.9	20.8	5	49.7	1.3	8	-2.2 dBA	-1.31	11	None

*Minus sign indicates L_{10} decrease after construction

ANALYSIS OF VARIANCE

Route I-295, Section 8B & 9A (Lawrence Township)

Effect	Mean Square Deviation	Degrees of Freedom	F-Statistic	Level of Significance
Highway Construction	300.0	1	41.28	0.05%
Time Period	30.2	2	4.15	2.5%
Microphone Position	N/A	N/A	N/A	N/A
Highway - Time Interaction	41.5	2	5.71	1%
Highway - Position Interaction	N/A	N/A	N/A	N/A
Time - Position Interaction	N/A	N/A	N/A	N/A
Highway-Time-Position Interaction	N/A	N/A	N/A	N/A
Within Treatments	7.3	38		

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route I-295, Section 8B & 9A (Lawrence Township)

Mic. Pos.	Time Period	Before Highway Construction			After Highway Construction			Mean Increase After Const.	t-Stat.	Deg. Free.	Level Signif.
		Mean L_{10}	Var.	No. Samp.	Mean L_{10}	Var.	No. Samp.				
2	Peak	51.9	12.8	5	60.1	1.2	5	8.2 dBA	4.90	8	1%
2	Off-Peak	50.8	12.8	9	57.5	1.7	11	6.7 dBA	5.93	18	0.1%
2	Night	52.0	6.3	6	53.4	9.6	8	1.4	0.92	12	None

ANALYSIS OF VARIANCE

Route 174, Section 1A (Lawrence Township)

Effect	Mean Square Deviation	Degrees of Freedom	F-Statistic	Level of Significance
Highway Construction	2067.6	1	515.04	0.05%
Time Period	32.5	2	18.09	0.1%
Microphone Position	275.0	2	68.49	0.05%
Highway - Time Interaction	2.8	2	0.70	None
Highway - Position Interaction	105.3	2	26.21	0.05%
Time - Position Interaction	11.1	4	2.77	5%
Highway-Time-Position Interaction	10.6	4	2.65	5%
Within Treatments	4.0	117		

t-TEST ON BEFORE AND AFTER MEAN L_{10} INCREASE

Route 174, Section 1A (Lawrence Township)

Mic. Pos.	Time Period	Before Highway Construction			After Highway Construction			Mean Increase After Const.	t-Stat.	Deg. Free.	Level Signif.
		Mean L_{10}	Var.	No. Samp.	Mean L_{10}	Var.	No. Samp.				
1	Peak	52.8	2.2	5	65.2	1.6	3	12.4 dBA	11.92	6	0.1%
1	Off-Peak	51.2	2.7	10	63.2	2.7	11	12.0 dBA	16.60	19	0.1%
1	Night	51.1	2.8	8	61.4	3.6	6	10.3 dBA	11.61	12	0.1%
2	Peak	49.8	10.9	4	58.4	4.2	5	8.6 dBA	4.84	7	1%
2	Off-Peak	51.4	5.2	11	56.7	7.8	10	5.3 dBA	4.37	19	0.1%
2	Night	47.7	5.8	8	54.4	5.6	8	6.7 dBA	5.58	14	0.1%
3	Peak	50.9	1.7	5	57.4	5.0	4	6.5 dBA	5.47	7	0.1%
3	Off-Peak	49.6	0.9	11	55.2	3.7	11	5.6 dBA	8.68	20	0.1%
3	Night	49.8	0.4	8	55.5	5.4	8	5.7 dBA	6.66	14	0.1%

APPENDIX C

L_{10} MEASUREMENT AND PREDICTION STATISTICS SUMMARY

ELEMENTARY STATISTICS AND LINEAR REGRESSION

BETWEEN OBSERVED AND TSC PREDICTED L_{10}

Site	No. of Samples	Avg. Diff. $\overline{d}=L_{10}^{O}-L_{10}^{T}$	Std. Dev. Diff. $\overline{d}$	t-Test $\overline{d}$=0?	Linear Regression Coeff.(=+1?)	Intercept	Corr. Coeff.	Std. Error Estimate
R12	44	0.0	3.1	Yes	0.619(No)	19.550	0.941	1.6
S123	57	-7.2	6.1	No	0.616(No)	19.189	0.651	5.4
C1234	82	-2.9	3.2	No	1.009(Yes)	-3.514	0.698	3.2
A1234	60	-3.6	5.5	No	1.535(No)	-42.389	0.835	4.9
A5678	65	-5.1	2.5	No	0.694(No)	16.614	0.883	2.0
A9101112	75	-2.2	5.1	No	-0.180(No)	74.555	-0.235	2.7
B123	48	-5.1	2.7	No	1.317(No)	-29.326	0.790	2.7
N124	54	-0.7	2.6	Yes	0.712(No)	17.723	0.864	2.1
N58	24	-3.7	6.2	No	0.112(No)	48.584	0.422	1.7

ELEMENTARY STATISTICS AND LINEAR REGRESSION

BETWEEN OBSERVED AND MICHIGAN PREDICTED L_{10}

Site	No. of Samples	Avg. Diff. $\overline{d}=L_{10}^{O}-L_{10}^{M}$	Std. Dev. Diff. $\overline{d}$	t-Test $\overline{d}$=0?	Linear Regression Coeff.(=+1?)	Intercept	Corr. Coeff.	Std. Error Estimate
R12	44	-0.3	3.2	Yes	0.620(No)	19.367	0.911	1.9
S123	57	-3.9	4.5	No	0.730(No)	13.727	0.823	4.0
C1234	82	2.1	4.3	No	0.513(No)	34.214	0.758	2.9
A1234	60	5.6	4.8	No	0.810(No)	17.616	0.867	4.4
A5678	65	2.8	3.3	No	0.579(No)	29.343	0.900	1.8
A9101112	75	2.1	2.5	No	0.563(No)	28.599	0.681	2.1
B123	48	0.8	2.3	No	0.907(Yes)	7.305	0.845	2.3
N124	54	-0.8	2.8	No	0.711(No)	17.715	0.828	2.4
N58	24	3.5	5.2	No	0.162(No)	46.751	0.538	1.5

ELEMENTARY STATISTICS AND LINEAR REGRESSION

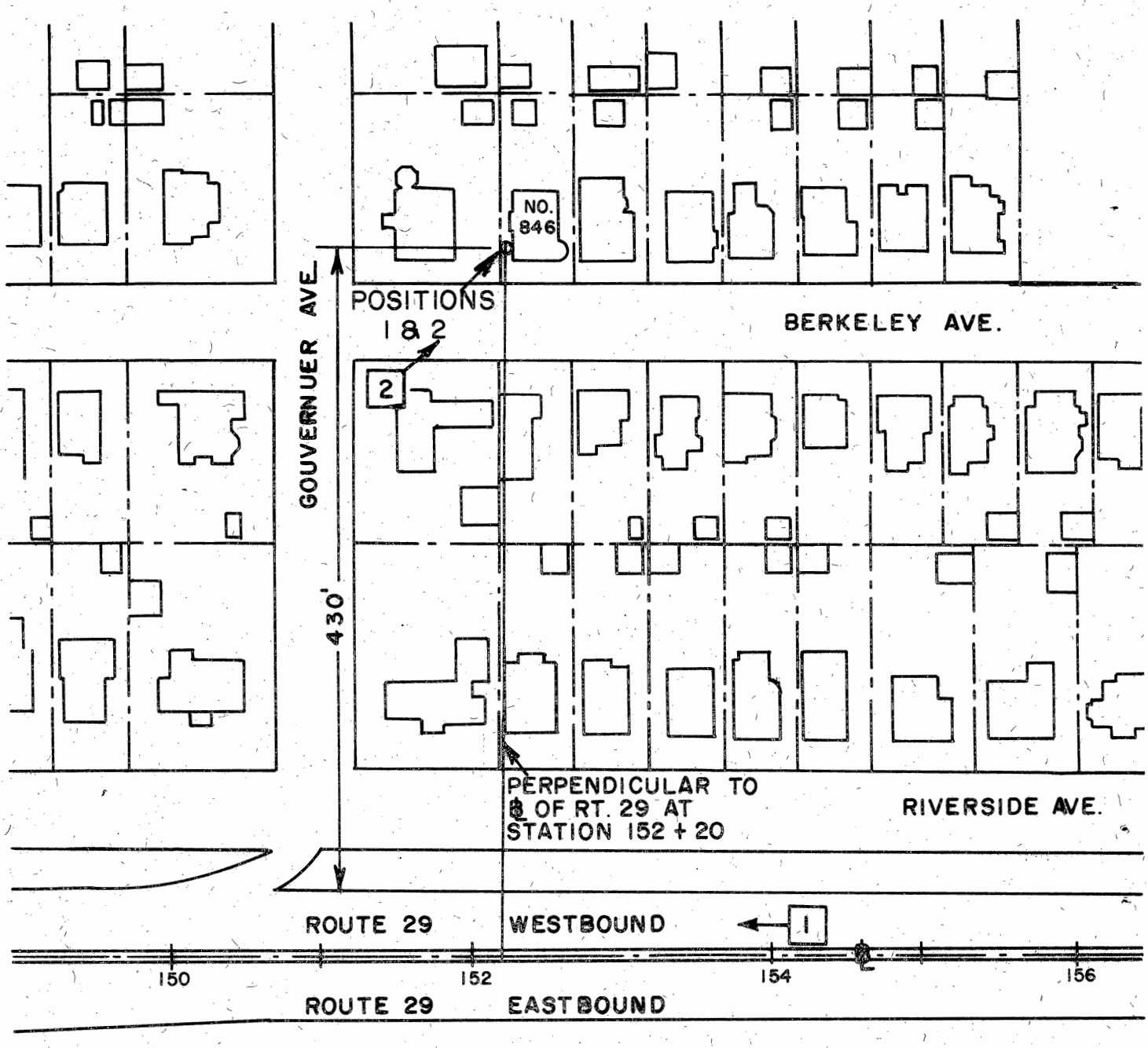
BETWEEN TSC PREDICTED AND MICHIGAN PREDICTED L_{10}

Site	No. of Samples	Avg. Diff. $\overline{d}=L_{10}^{T}-L_{10}^{M}$	Std. Dev. Diff. $\overline{d}$	t-Test $\overline{d}=0$?	Linear Regression Coeff.(=+1?)	Intercept	Corr. Coeff.	Std. Error Estimate
R12	46	-0.3	1.9	Yes	1.000(Yes)	-0.271	0.962	2.0
S123	69	3.4	3.4	No	0.821(No)	15.024	0.900	3.1
C1234	92	4.5	3.8	No	0.449(No)	41.254	0.975	0.7
A1234	103	10.3	4.3	No	0.544(No)	37.671	0.956	1.5
A5678	103	7.7	1.9	No	0.760(No)	22.777	0.971	1.2
A9101112	103	5.5	5.2	No	-0.051(No)	68.769	-0.051	3.6
B123	72	7.0	2.0	No	0.633(No)	31.7000	0.995	0.4
N124	72	-0.1	1.7	Yes	1.018(Yes)	-1.299	0.946	1.7
N58	30	6.5	4.0	No	0.836(Yes)	15.120	0.791	3.9

APPENDIX D

L_{eq} MEASUREMENT AND PREDICTION BY SITE

D.1 OBSERVED AND TSC PREDICTED L_{eq} LEVELS (SITE MAPS AND PHOTOGRAPHS)

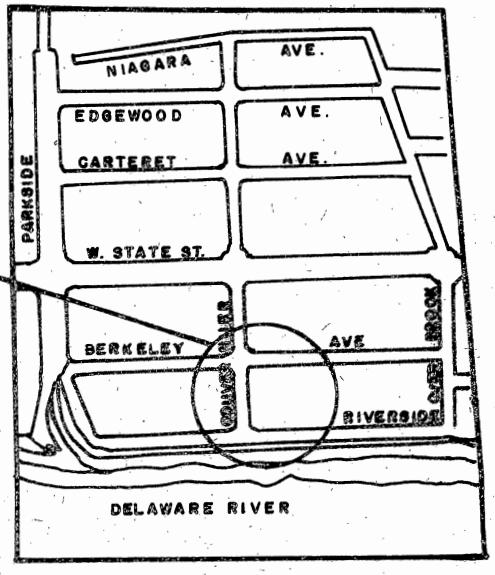


N

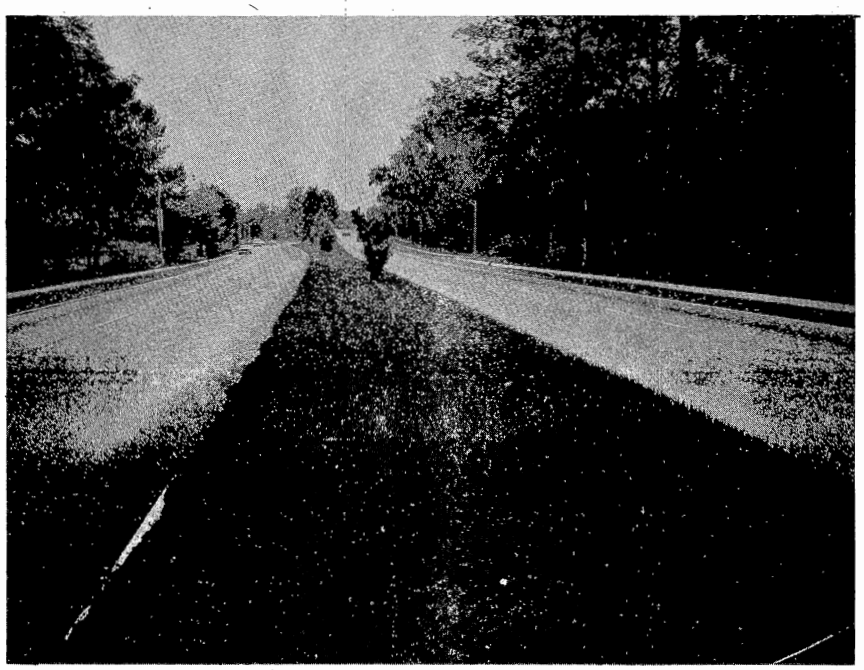
Rt. 29, Section 13A
(Residential)

1" = 100'

Area Of Enlargement



ROUTE 29, SECTION 13A (RESIDENTIAL)



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2

OBSERVED AND PREDICTED L_{eq} (dBA)

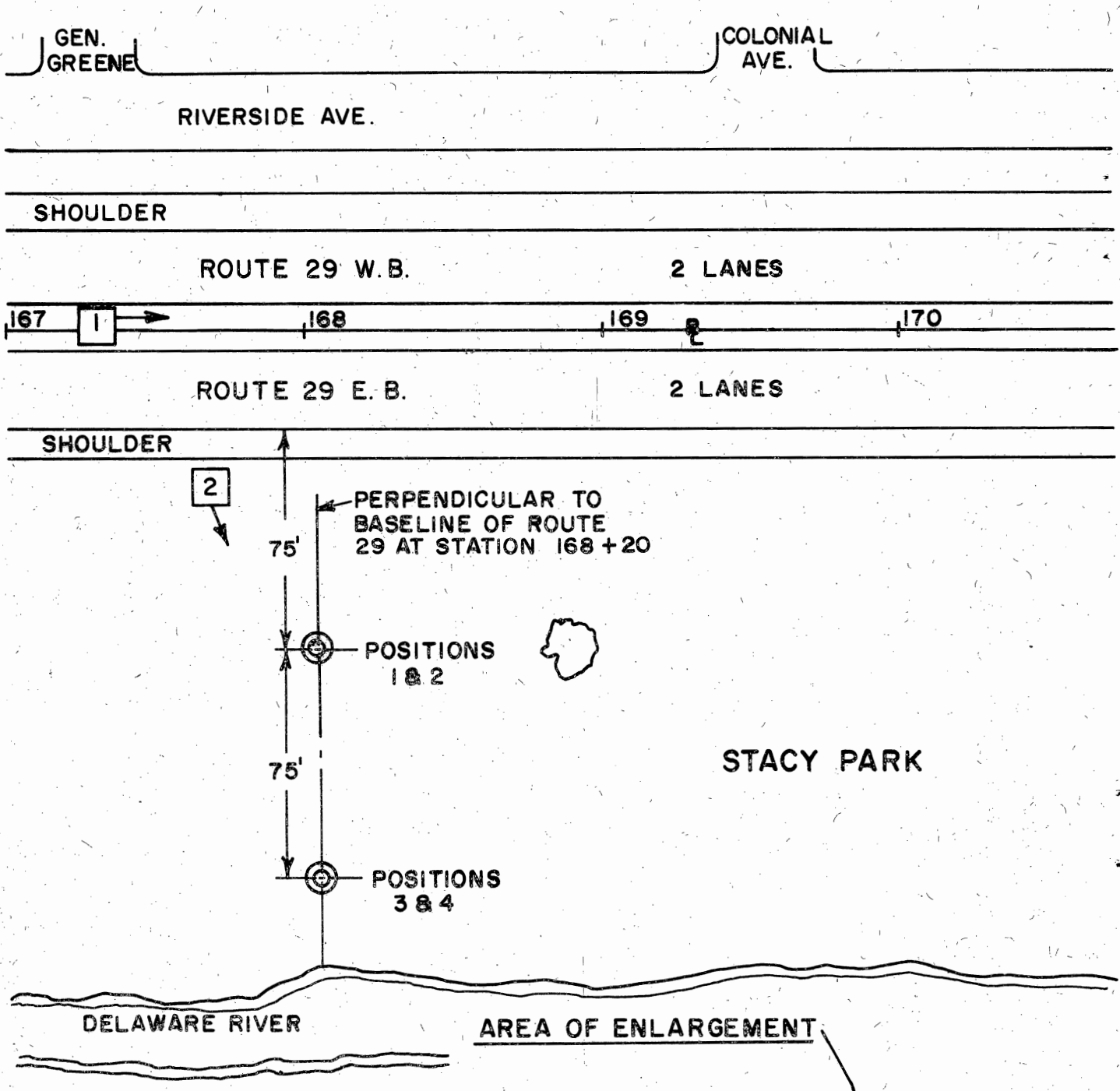
Route 29, Section 13A (Residential)

Hour	Date	Position #1		Position #2	
		OBS	TSC	OBS	TSC
1200	10/16/73	53.1	55.1	54.8	55.6
1300	10/16/73	50.4	55.3	52.6	55.8
1400	10/16/73	52.2	55.3	53.7	55.8
1500	10/16/73	53.2	-	54.8	-
1600	10/16/73	52.3	53.6	53.8	54.0
1700	10 16/73	53.7	53.8	54.7	54.2
1800	10/16/73	-	52.1	51.6	52.6
1900	10/16/73	49.8	50.3	52.6	50.7
2000	10/16/73	49.4	47.2	53.1	47.5
2100	10/16/73	48.5	46.0	50.4	46.2
2200	10/16/73	45.2	45.4	47.3	45.6
2300	10/16/73	45.6	44.4	47.4	44.6
0000	10/17/73	45.8	43.5	45.5	43.6
0100	10/17/73	41.1	39.6	42.5	39.9
0200	10/17/73	42.9	39.0	44.1	39.3

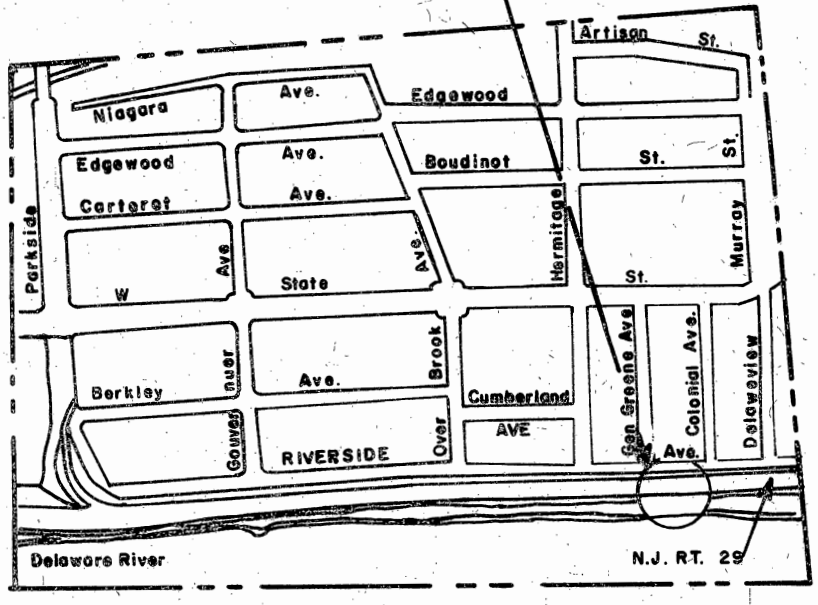
OBSERVED AND PREDICTED L_{eq} (dBA)

Route 29, Section 13A (Residential) (continued)

Hour	Date	Position #1		Position #2	
		OBS	TSC	OBS	TSC
0300	10/17/73	39.1	36.6	39.7	37.2
0400	10/17/73	44.4	39.3	42.8	39.9
0500	10/17/73	-	38.1	44.7	37.2
0600	10/17/73	45.9	44.9	48.3	45.1
0700	10/17/73	49.1	51.5	51.4	51.9
0800	10/17/73	54.3	53.7	54.7	54.3
0900	10/17/73	53.9	55.1	53.3	55.6
1000	10/17/73	52.6	54.7	52.5	55.2
1100	10/17/73	55.1	55.5	53.8	56.1



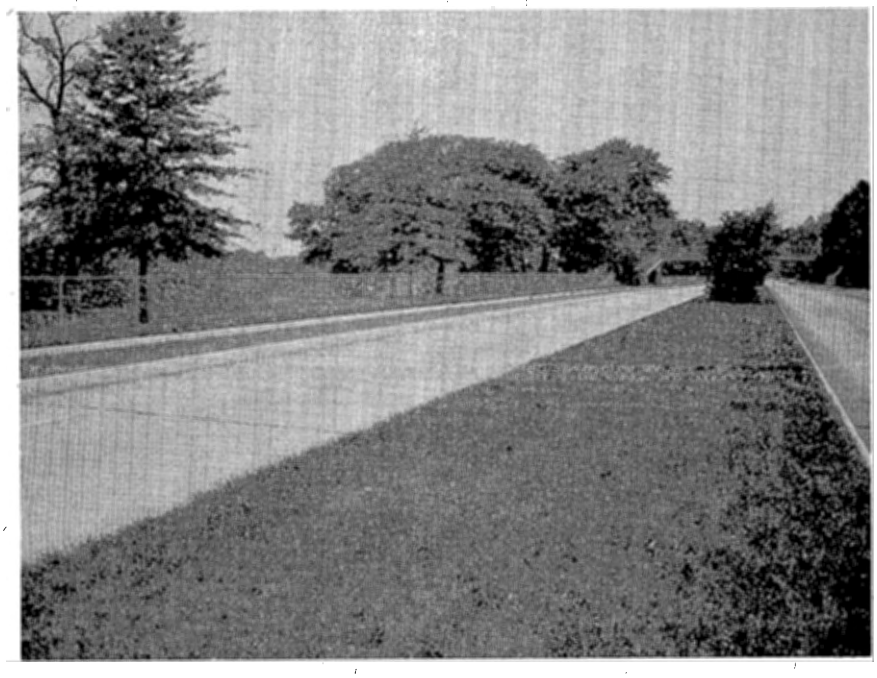
AREA OF ENLARGEMENT



Route 29 Section 13A
(Stacy Park)

1" = 50'

ROUTE 29, SECTION 13 A (STACY PARK)



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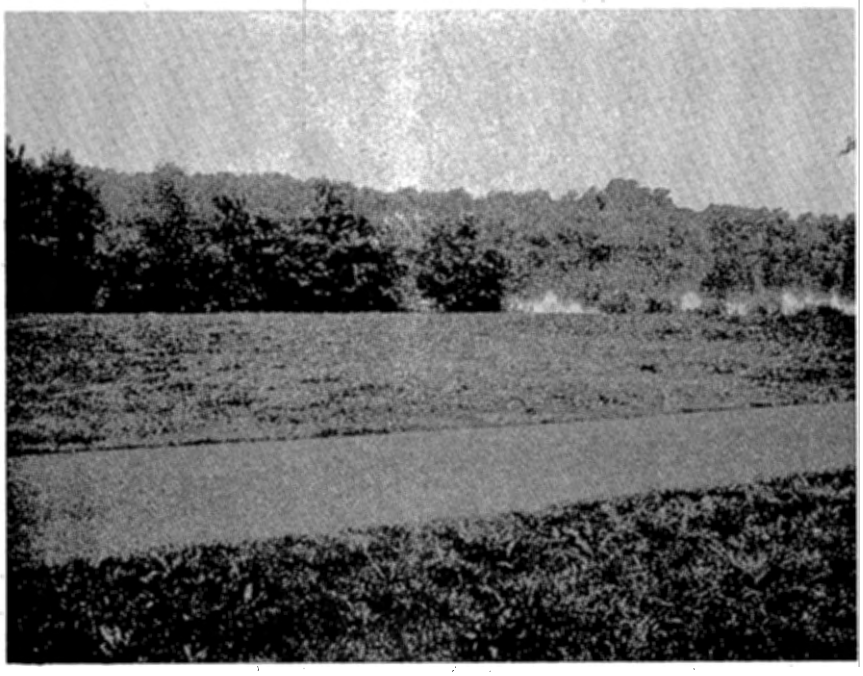

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OBSERVED AND PREDICTED L_{eq} (dBA)

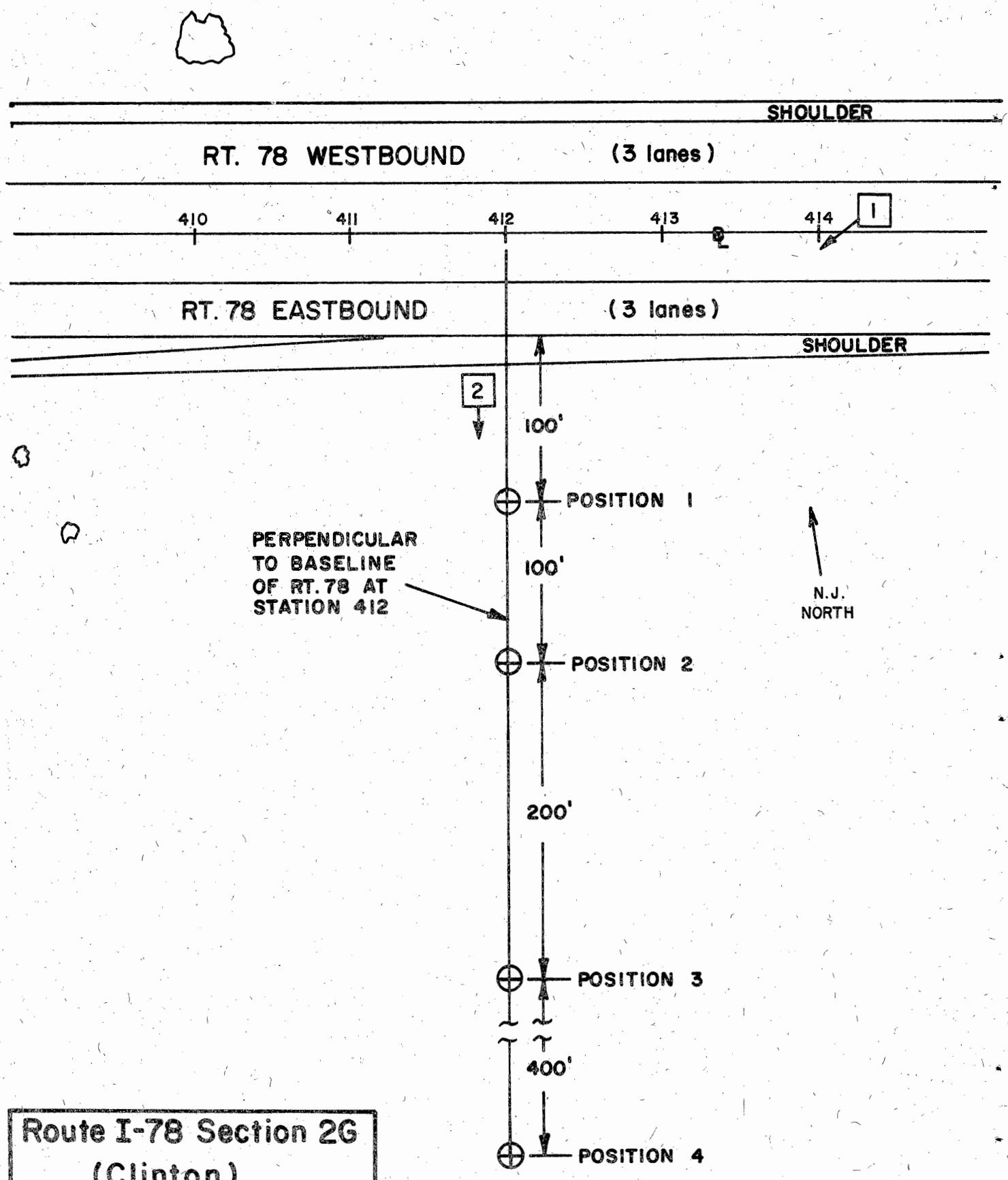
Route 29, Section 13A (Stacy Park)

Hour	Date	Position #1		Position #2		Position #3	
		OBS	TSC	OBS	TSC	OBS	TSC
1500	10/18/73	69.5	-	-	-	-	-
1600	10/18/73	67.4	71.6	68.8	73.1	-	67.0
1700	10/18/73	63.9	68.8	67.1	71.0	-	64.4
1800	10/18/73	63.3	67.9	64.7	69.6	55.7	63.4
1900	10/18/73	62.0	64.1	-	67.3	55.6	60.0
2000	10/18/73	-	65.3	-	67.3	-	60.8
2100	10/18/73	-	62.8	62.6	65.2	53.8	58.5
2200	10/18/73	61.5	61.3	61.8	64.3	-	57.2
2300	10/18/73	62.0	62.0	62.3	64.5	-	57.8
0000	10/19/73	61.8	59.1	62.2	61.9	-	55.0
0100	10/19/73	58.9	58.4	57.7	60.1	43.8	53.9
0200	10/19/73	56.1	51.3	55.1	55.4	42.6	47.6
0300	10/19/73	55.3	55.5	53.8	57.1	44.2	50.9
0400	10/19/73	56.8	53.6	54.0	56.6	45.8	49.4
0500	10/19/73	58.8	59.4	58.0	60.6	-	54.7

OBSERVED AND PREDICTED L_{eq} (dBA)

Route 29, Section 13A (Stacy Park) (cont.)

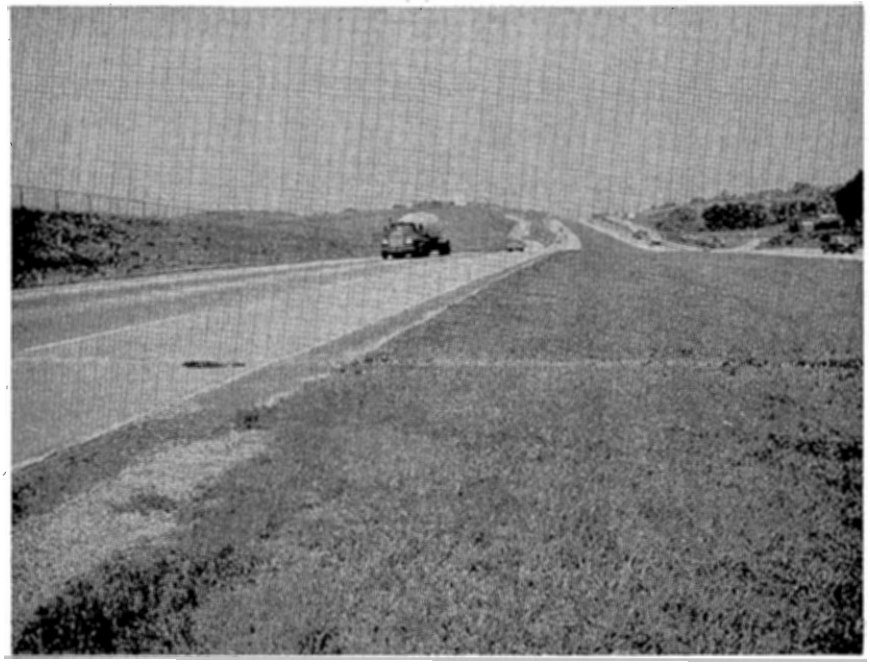
Hour	Date	Position #1 OBS	Position #1 TSC	Position #2 OBS	Position #2 TSC	Position #3 OBS	Position #3 TSC
0600	10/19/73	64.6	65.7	64.5	67.9	-	61.3
0700	10/19/73	67.0	69.5	67.8	71.2	48.5	65.0
0800	10/19/73	67.3	71.7	68.3	73.3	48.8	67.1
0900	10/19/73	64.0	70.9	64.7	72.3	50.5	66.3
1000	10/19/73	63.7	70.0	64.2	71.4	49.8	65.4
1100	10/19/73	66.1	72.5	66.4	73.4	53.6	67.7
1200	10/19/73	64.1	70.8	65.0	72.1	55.1	66.1
1300	10/19/73	64.0	71.2	65.0	72.2	54.9	66.5
1400	10/19/73	63.5	70.6	65.1	72.0	55.0	65.9



Route I-78 Section 2G
(Clinton)

1.2" = 100'

ROUTE I-78, SECTION 2G (CLINTON)



1

2

OBSERVED AND PREDICTED L_{eq} (dBA)

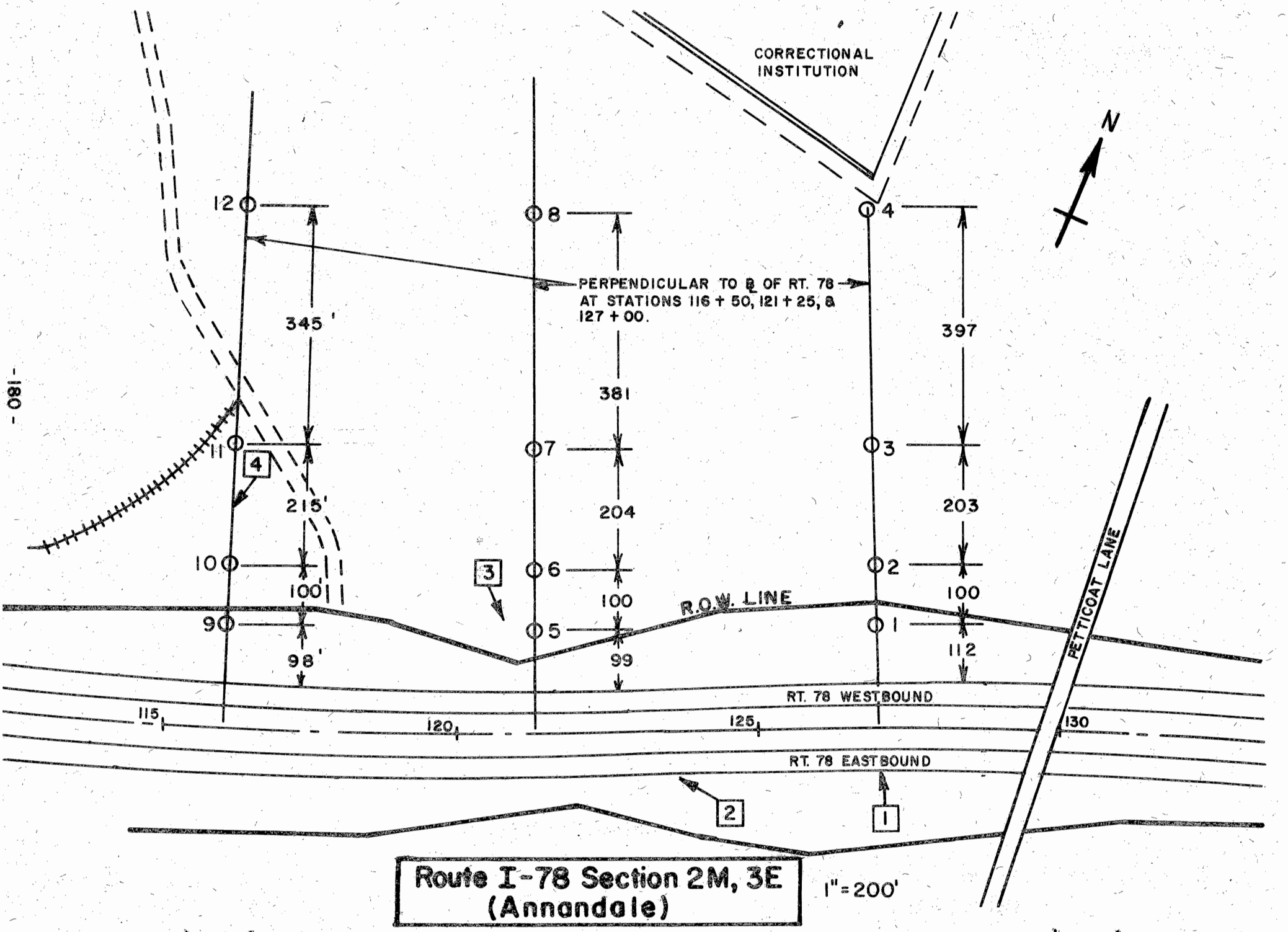
Route I-78, Section 2G (Clinton)

Hour	Date	Position #1		Position #2		Position #3		Position #4	
		OBS	TSC	OBS	TSC	OBS	TSC	OBS	TSC
1500	11/01/73					70.4	-	67.8	-
1600	11/01/73	70.4	75.4	68.3	71.4	68.6	67.2	63.5	64.6
1700	11/01/73	69.7	74.7	65.3	70.7	66.2	66.5	60.8	63.9
1800	11/01/73	71.4	74.4	-	70.4	66.2	66.2	61.3	63.7
1900	11/01/73	-	-	67.0	70.3	66.4	66.2	61.6	63.7
2000	11/01/73	67.9	72.6	66.2	68.6	64.1	64.4	61.3	61.8
2100	11/01/73	67.6	72.4	67.5	68.4	64.9	64.2	58.2	61.6
2200	11/01/73	70.5	73.8	66.5	69.6	65.7	65.3	59.0	62.6
2300	11/01/73	68.6	73.8	64.4	69.7	63.9	65.4	58.2	62.7
0000	11/02 73	68.7	74.3	-	70.1	64.1	65.6	58.2	62.9
0100	11/02/73	68.4	74.3	-	70.1	64.3	65.7	57.2	63.0
0200	11/02/73	-	74.8	67.0	70.6	66.0	66.2	59.9	63.4
0300	11/02/73	-	75.5	69.7	71.3	66.1	66.9	59.4	64.2
0400	11/02/73	-	76.9	73.1	72.6	67.3	68.1	61.6	65.3
0500	11/02/73	-	77.3	71.9	73.0	68.4	68.6	63.4	65.8

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2G (Clinton) (cont.)

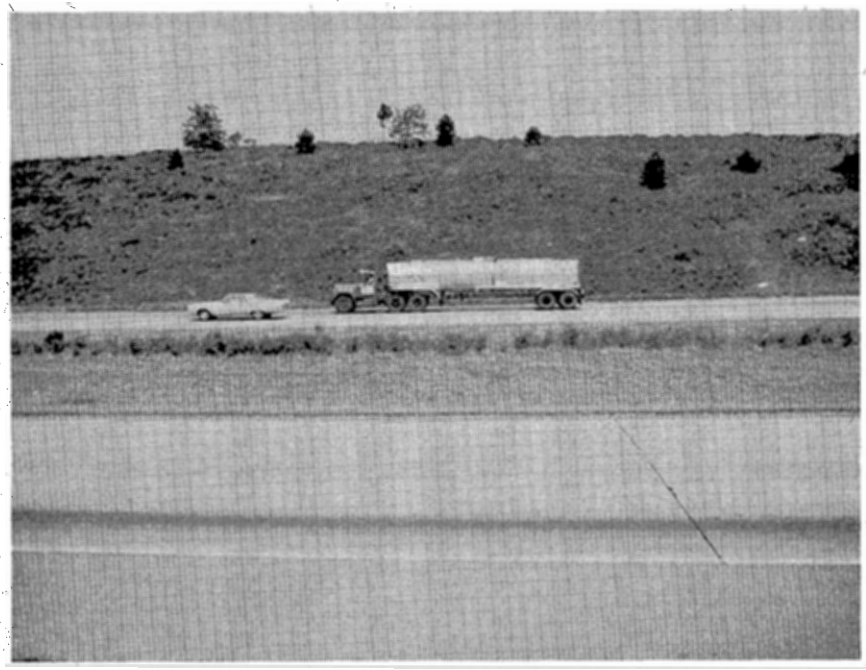
Hour	Date	Position #1		Position #2		Position #3		Position #4	
		OBS	TSC	OBS	TSC	OBS	TSC	OBS	TSC
0600	11/02/73	-	76.9	72.5	72.7	67.8	68.3	61.6	65.6
0700	11/02/73	-	77.5	69.1	73.4	65.3	69.0	59.9	66.3
0800	11/02/73	68.0	77.5	69.3	73.4	63.7	69.0	58.3	66.3
0900	11/02/73	68.5	76.8	67.6	72.8	62.8	68.5	56.3	65.8
1000	11/02/73	69.2	77.6	63.7	73.5	62.1	69.2	56.0	66.6
1100	11/02/73	68.3	77.6	63.7	73.5	60.6	69.3	56.2	66.7
1200	11/02/73	67.2	76.5	61.7	72.5	61.5	68.2	56.2	65.6
1300	11/02/73	68.4	77.2	64.2	73.2	64.1	69.0	59.7	66.4
1400	11/02/73	67.5	76.7	66.6	72.6	61.7	68.3	57.8	65.7



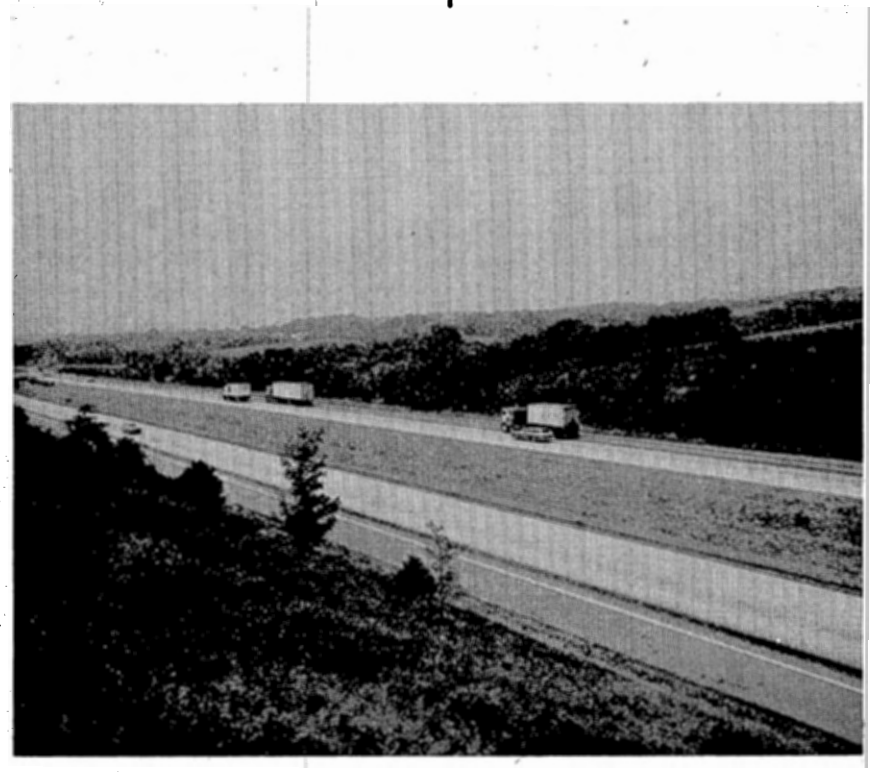
Route I-78 Section 2M, 3E (Annandale)

1" = 200'

ROUTE I-78, SECTION 2M & 2E (ANNANDALE)

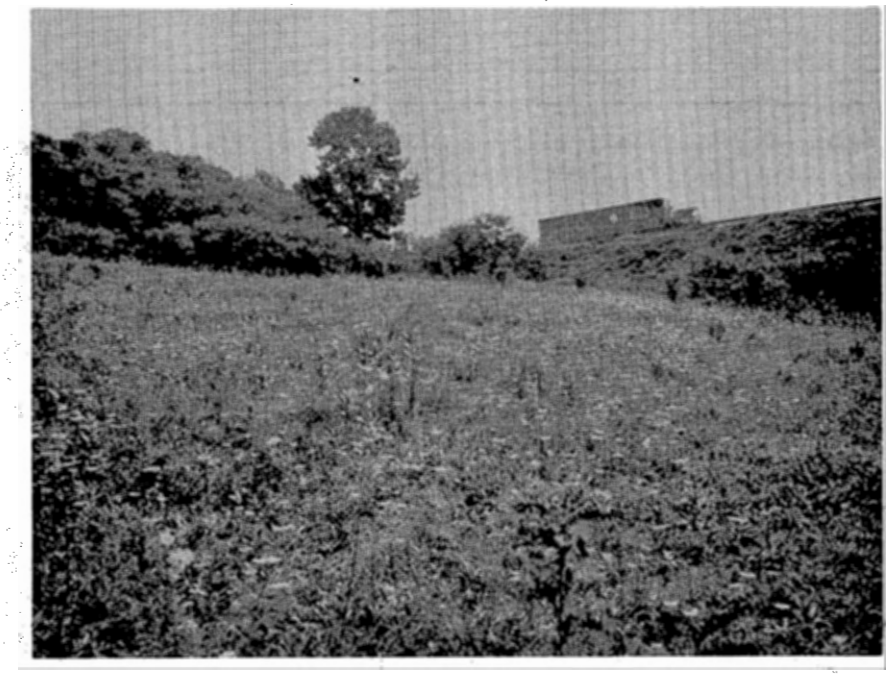


1

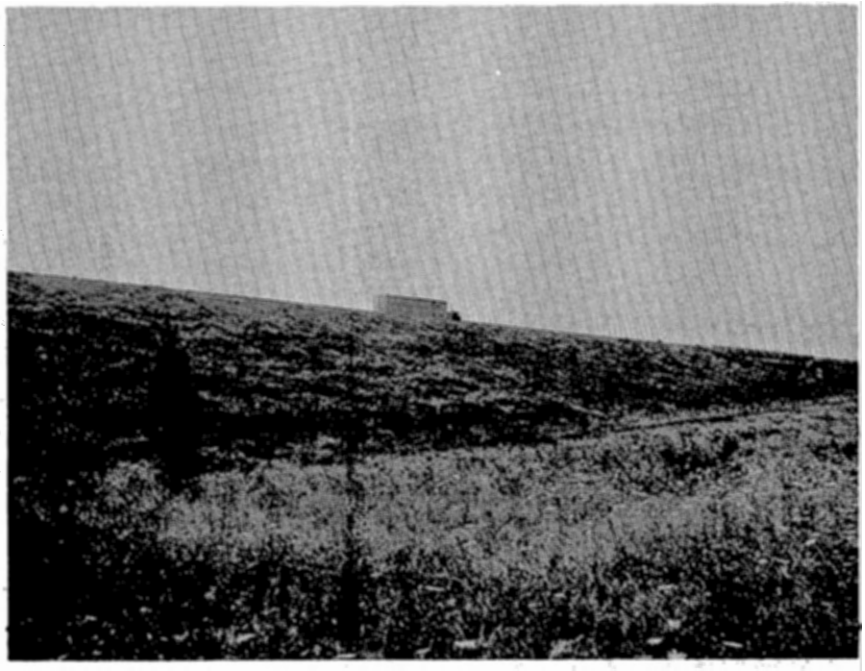


2

ROUTE I-78, SECTION 2M & 2E (ANNANDALE)



3



4

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 127+00 (Annandale)

Hour	Position #1			Position #2			Position #3		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
1400							01/29/74	-	60.8
1500							01/29/74	-	59.8
1600	12/04/73	76.8	-	12/11/73	57.7	65.2	01/29/74	-	59.5
1700	12/04/73	76.6	74.0	12/11/73	57.0	-	01/29/74	-	59.7
1800	12/04/73	74.1	72.8	12/11/73	57.7	63.5	01/29/74	-	59.0
1900	12/04/73	74.6	72.7	12/11/73	56.6	61.7	01/29/74	-	59.4
2000	12/04/73	73.4	71.0	12/11/73	56.7	62.1	01/29/74	56.7	56.6
2100	12/04/73	73.8	-	12/11/73	55.7	62.0	01/29/74	57.4	58.8
2200	12/04/73	73.0	-	12/11/73	-	62.5	01/29/74	58.2	56.5
2300	12/04/73	75.2	72.6	12/11/73	-	62.1	01/29/74	59.2	59.1
0000	12/05/73	74.1	70.1	12/12/73	-	61.8	01/30/74	59.2	56.9
1400	12/06/73	76.6	75.5						
1500	12/06/73	76.7	75.6						
1600	12/06/73	78.5	75.4						
1700	12/06/73	73.2	74.9						

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 127+00 (Annandale) (cont.)

Hour	Position #1			Position #2			Position #3		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
1800	12/06/73	74.4	74.3						
1900	12/06/73	75.4	72.5						
2000	12/06/73	73.2	72.0						
2100	12/06/73	-	71.0						
2200	12/06/73	72.5	70.1						
2300	12/06/73	72.2	71.7						
0000	12/07/73	71.4	71.4						
0100	12/07/73	71.7	71.1	12/12/73	68.3	62.5	01/30/74	60.5	57.6
0200	12/07/73	73.2	70.0	12/12/73	58.5	62.6	01/30/74	60.8	59.3
0300	12/07/73	69.9	71.8	12/12/73	60.6	63.7	01/30/74	59.5	58.1
0400	12/07/73	77.5	71.8	12/12/73	60.3	64.2	01/30/74	59 2	59 5
0500	12/07/73	74.2	73.3	12/12/73	59.2	64.9	01/30/74	60.0	58.4
0600	12/07/73	77.7	74.5	12/12/73	-	65.2	01/30/74	60.0	59.3
0700	12/07/73	76.5	75.1	12/12/73	63.1	65.9	01/30/74	58.9	59.3

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 127+00 (Annandale) (cont.)

Hour	Position #1			Position #2			Position #3		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
0800	12/07/73	76.1	74.4	12/12/73	59.6	65.4	01/30/74	59.1	60.4
0900	12/07/73	78.0	76.1	12/12/73	60.3	65.7	01/30/74	-	61.7
0000	12/07/73	77.6	76.2	12/12/73	62.3	-	01/30/74	-	61.2
1100	12/07/73	-	75.7	12/12/73	60.9	66.2	01/30/74	-	61.9
1200	12/07/73	-	-	12/12/73	59.1	-	01/30/74	-	62.7
1300	12/07/73	-	76.0	12/12/73	59.7	65.9	01/30/74	-	-
1400				12/12/73	59.6	65.7			
1500				12/12/73	58.5	65.2			

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 127+00 (Annandale)

Position #4				Position #4				Position #4			
Hour	Date	OBS	TSC	Hour	Date	OBS	TSC	Hour	Date	OBS	TSC
1200	02/28/74	-	58.8	2200	02/28/74	-	56.6	0800	03/01/74	-	60.1
1300	02/28/74	-	59.0	2300	02/28/74	-	54.7	0900	03/01/74	-	59.9
1400	02/28/74	-	59.0	0000	03/01/74	-	58.8	1000	03/01/74	-	60.0
1500	02/28/74	-	59.8	0100	03/01/74	-	59.2	1100	03/01/74	-	61.3
1600	02/28/74	-	60.8	0200	03/01/74	-	57.0	1200	03/01/74	-	60.1
1700	02/28/74	54.7	61.0	0300	03/01/74	-	59.8	1300	03/01/74	-	60.1
1800	02/28/74	53.3	59.3	0400	03/01/74	-	60.5	1400	03/01/74	-	60.7
1900	02/28/74	58.9	58.6	0500	03/01/74	-	58.7	1500	03/01/74	-	60.9
2000	02/28/74	57.9	58.2	0600	03/01/74	-	59.5	1600	03/01/74	-	61.1
2100	02/28/74	-	56.7	0700	03/01/74	-	60.6	1700	03/01/74	-	60.9

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 121+25 (Annandale)

Hour	Position #5			Position #6			Position #7		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
1400							01/29/74	58.2	67.1
1500							01/29/74	61.2	65.6
1600				12/11/73	65.4	70.5	01/29/74	59.6	65.7
1700	12/04/73	-	74.6	12/11/73	63.7	-	01/29/74	60.8	66.0
1800	12/04/73	-	74.1	12/11/73	64.3	68.8	01/29/74	59.1	64.7
1900	12/04/73	-	74.2	12/11/73	63.0	66.7	01/29/74	-	66.0
2000	12/04/73	-	72.2	12/11/73	58.6	67.5	01/29/74	60.2	62.4
2100	12/04/73	65.7	-	12/11/73	-	67.1	01/29/74	60.1	65.3
2200	12/04/73	-	-	12/11/73	-	67.5	01/29/74	61.3	61.5
2300	12/04/73	-	73.3	12/11/73	-	66.7	01/29/74	-	65.0
0000	12/05/73	58.5	70.2	12/12/73	-	66.5	01/30/74	59.7	61.7
1400	12/06/73	69.4	76.4						
1500	12/06/73	-	76.6						
1600	12/06/73	66.8	76.6						
1700	12/06/73	68.6	76.5						

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 121+25 (Annandale) (cont.)

Hour	Position #5			Position #6			Position #7		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
1800	12/06/73	68.2	75.6						
1900	12/06/73	67.1	73.9						
2000	12/06/73	67.1	73.0						
2100	12/06/73	65.3	72.2						
2200	12/06/73	64.4	69.7						
2300	12/06/73	66.0	72.3						
0000	12/07/73	64.3	71.6						
0100	12/07/73	65.5	71.0	12/12/73	-	67.2	01/30/74	60.6	63.6
0200	12/07/73	65.2	69.2	12/12/73	-	67.3	01/30/74	-	65.0
0300	12/07/73	65.6	70.8	12/12/73	-	68.2	01/30/74	61.5	62.7
0400	12/07/73	70.0	71.3	12/12/73	-	68.6	01/30/74	59.9	64.6
0500	12/07/73	69.8	73.5	12/12/73	-	69.2	01/30/74	63.1	64.1
0600	12/07/73	69.0	74.9	12/12/73	-	69.7	01/30/74	60.7	64.4
0700	12/07/73	70.3	75.4	12/12/73	-	70.3	01/30/74	61.4	64.7

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 121+25 (Annandale) (cont.)

Hour	Position #5			Position #6			Position #7		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
0800	12/07/73	66.1	74.3	12/12/73	-	70.1	01/30/74	62.9	65.6
0900	12/07/73	68.3	76.8	12/12/73	-	70.6	01/30/74	62.5	67.3
1000	12/07/73	68.0	77.1	12/12/73	-	-	01/30/74	62.3	66.6
1100	12/07/73	68.3	76.4	12/12/73	-	71.3	01/30/74	62.9	67.7
1200	12/07/73	67.0	-	12/12/73	-	-	01/30/74	63.7	69.0
1300	12/07/73	69.4	77.0	12/12/73	-	71.0	01/30/74	-	-
1400				12/12/73	-	70.7			
1500				12/12/73	-	70.7			

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 121+25 (Annandale)

Position #8				Position #8				Position #8			
Hour	Date	OBS	TSC	Hour	Date	OBS	TSC	Hour	Date	OBS	TSC
1200	02/28/74	-	62.1	2200	02/28/74	55.5	60.1	0800	03/01/74	-	63.0
1300	02/28/74	-	62.4	2300	02/28/74	-	60.4	0900	03/01/74	58.4	63.1
1400	02/28/74	-	62.9	0000	03/01/74	57.4	61.6	1000	03/01/74	-	63.7
1500	02/28/74	-	63.3	0100	03/01/74	59.6	62.4	1100	03/01/74	59.3	65.0
1600	02/28/74	66.2	64.4	0200	03/01/74	59.7	60.8	1200	03/01/74	58.6	63.9
1700	02/28/74	65.3	64.8	0300	03/01/74	59.5	62.3	1300	03/01/74	63.2	63.6
1800	02/28/74	-	63.1	0400	03/01/74	61.2	63.1	1400	03/01/74	58.2	64.4
1900	02/28/74	57.1	61.8	0500	03/01/74	56.1	61.9	1500	03/01/74	58.2	64.3
2000	02/28/74	-	61.0	0600	03/01/74	59.6	62.2	1600	03/01/74	-	64.8
2100	02/28/74	-	60.1	0700	03/01/74	65.3	63.2	1700	03/01/74	-	65.0

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 116+50 (Annandale)

Hour	Position #9			Position #10			Position #11		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
1400							01/29/74	58.1	66.9
1500							01/29/74	61.0	65.4
1600	12/04/73	64.5	-	12/11/73	61.5	66.7	01/29/74	58.6	65.6
1700	12/04/73	63.3	63.5	12/11/73	60.4	-	01/29/74	59.2	65.9
1800	12/04/73	64.0	63.0	12/11/73	61.4	65.2	01/29/74	-	64.4
1900	12/04/73	62.3	63.2	12/11/73	60.8	62.7	01/29/74	-	65.9
2000	12/04/73	63.5	61.1	12/11/73	60.4	63.8	01/29/74	66.3	62.1
2100	12/04/73	61.1	-	12/11/73	59.9	63.2	01/29/74	60.1	65.2
2200	12/04/73	-	-	12/11/73	58.5	63.5	01/29 74	-	61.1
2300	12/04/73	61.8	62.3	12/11/73	59.2	62.3	01/29/74	-	64.7
0000	12/05/73	-	-	12/12/73	57.9	62.0	01/30/74	57.4	61.1
1400	12/06/73	63.1	65.4						
1500	12/06/73	61.9	65.6						
1600	12/06/73	61.5	65.5						
1700	12/06/73	62.2	65.4						

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 116+50 (Annandale) (cont.)

Hour	Position #9			Position #10			Position #11		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
1800	12/06/73	61.3	64.5						
1900	12/06/73	61.5	62.8						
2000	12/06/73	61.8	61.9						
2100	12/06/73	62.4	61.1						
2200	12/06/73	57.5	58.7						
2300	12/06/73	58.9	61.3						
0000	12/07/73	60.6	60.6						
0100	12/07/73	58.2	60.0	12/12/73	59.1	62.8	01/30/74	-	63.3
0200	12/07/73	55.3	58.3	12/12/73	59.5	62.8	01/30/74	58.1	64.8
0300	12/07/73	60.3	60.0	12/12/73	60.5	63.5	01/30/74	-	62.0
0400	12/07/73	63.3	60.4	12/12/73	60.4	63.8	01/30/74	-	64.2
0500	12/07/73	62.5	62.5	12/12/73	59.8	64.2	01/30/74	60.4	63.8
0600	12/07/73	62.9	63.9	12/12/73	-	65.0	01/30/74	-	63.9
0700	12/07/73	62.7	64.4	12/12/73	-	65.3	01/30/74	-	64.3
0800	12/07/73	57.9	63.3	12/12/73	61.6	65.8	01/30/74	-	65.1

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 116+50 (Annandale) (cont.)

Hour	Position #9			Position #10			Position #11		
	Date	OBS	TSC	Date	OBS	TSC	Date	OBS	TSC
0900	12/07/73	60.7	65.8	12/12/73	62.7	66.5	01/30/74	-	67.0
1000	12/07/73	59.8	66.1	12/12/73	63.5	-	01/30/74	-	66.2
1100	12/07/73	59.6	65.4	12/12/73	63.3	67.4	01/30/74	61.5	67.4
1200	12/07/73	59.7	-	12/12/73	63.1	-	01/30/74	62.0	68.8
1300	12/07/73	59.4	66.0	12/12/73	62.2	67.0	01/30/74	60.4	-
1400				12/12/73	63.6	66.9			
1500				12/12/73	62.2	67.2			

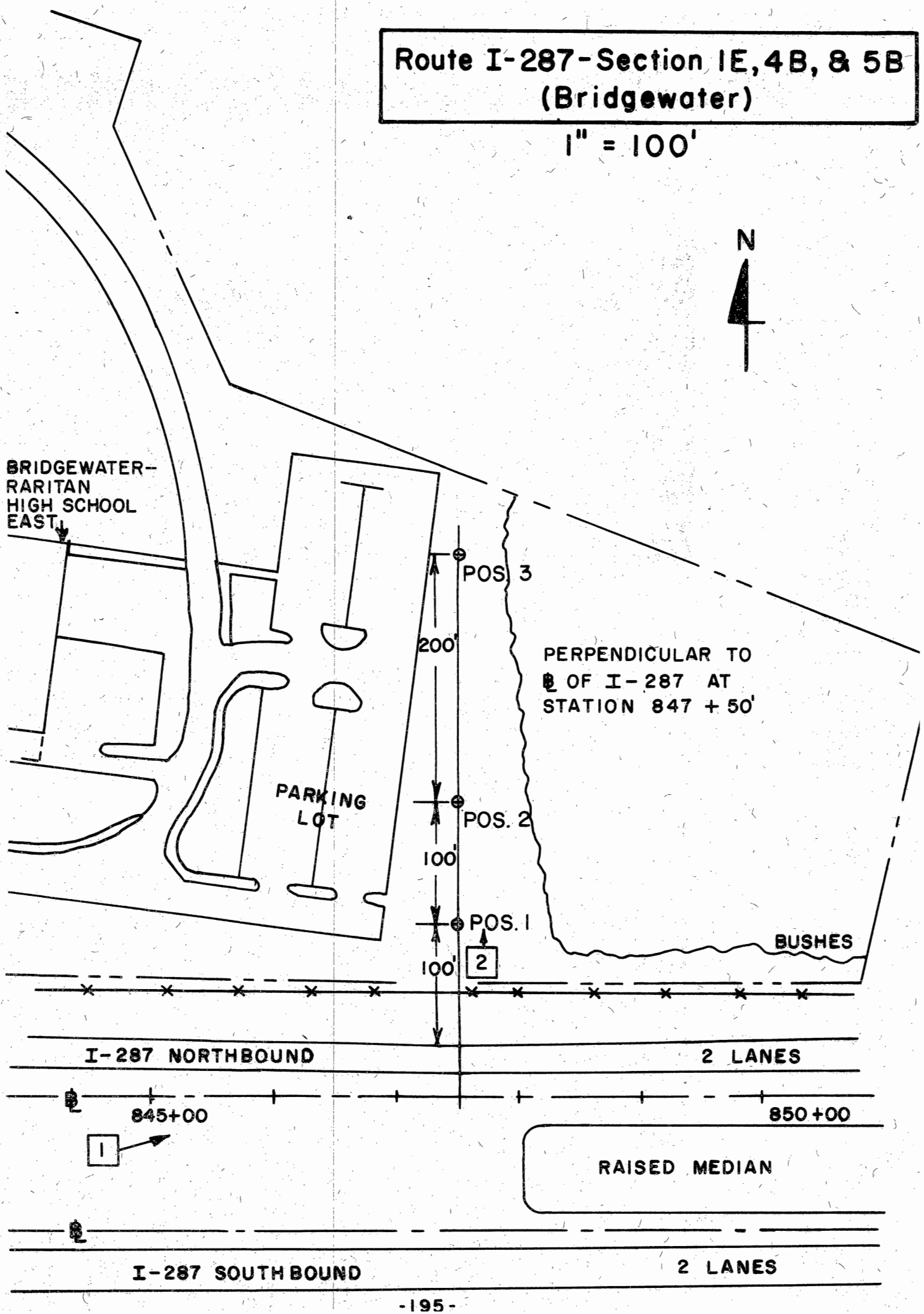
OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-78, Section 2M & 3E, Station 116+50 (Annandale)

Position #12				Position #12				Position #12			
Hour	Date	OBS	TSC	Hour	Date	OBS	TSC	Hour	Date	OBS	TSC
1200	02/28/74	-	63.5	2200	02/28/74	53.3	61.5	0800	03/01/74	58.0	64.3
1300	02/28/74	-	63.7	2300	02/28/74	-	58.9	0900	03/01/74	56.4	64.4
1400	02/28/74	-	64.2	0000	03/01/74	54.9	62.8	1000	03/01/74	55.6	65.2
1500	02/28/74	-	64 6	0100	03/01/74	56.8	63.7	1100	03/01/74	56.4	66.4
1600	02/28/74	57.9	65.8	0200	03/01/74	55.9	62.2	1200	03/01/74	55.0	65.3
1700	02/28/74	-	66.3	0300	03/01/74	57.2	63.4	1300	03/01/74	58.4	65.0
1800	02/28/74	-	64.5	0400	02/01/74	57.3	64.2	1400	03/01/74	54.6	65.8
1900	02/28/74	-	63.1	0500	03/01/74	57.2	63.2	1500	03/01/74	57.0	65.7
2000	02/28/74	-	62.3	0600	02/01/74	57.6	63.3	1600	03/01/74	56.7	66.3
2100	02/28/74	-	61.5	0700	02/01/74	55.9	64.3	1700	03/01/74	-	66.5

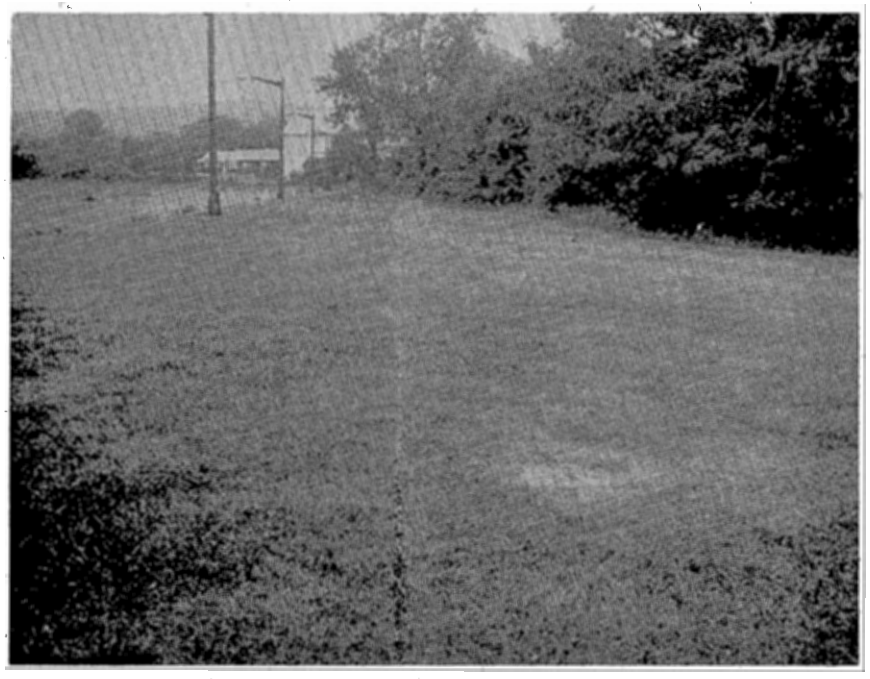
Route I-287-Section 1E, 4B, & 5B (Bridgewater)

1" = 100'



ROUTE I-287, SECTION 1E, 4B & 5B (BRIDGEWATER)

1



2

OBSERVED AND PREDICTED L_{eq} (dBA)

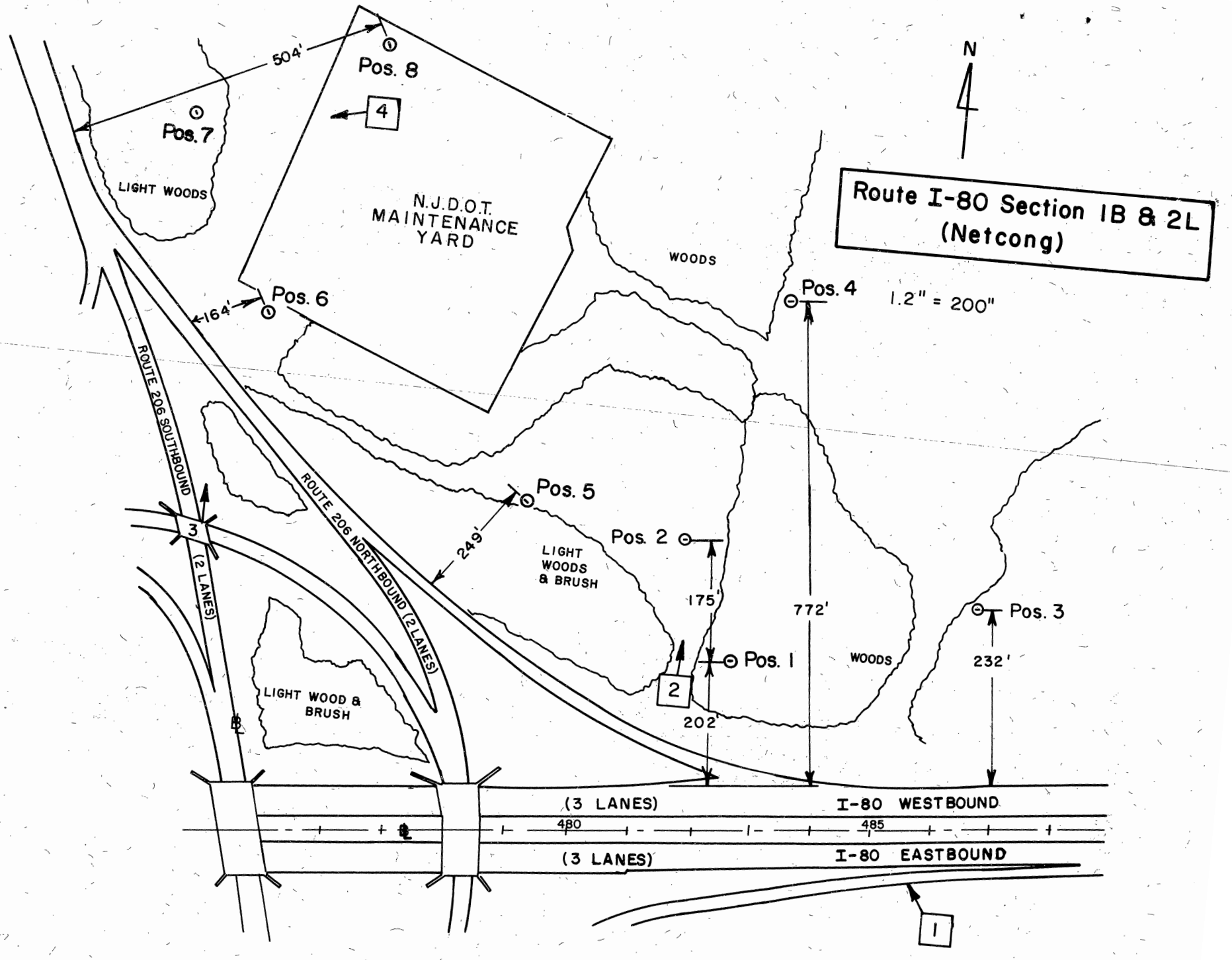
Route I-287, Section 1E, 4B & 5B (Bridgewater)

Hour	Date	Position #1 OBS	Position #1 TSC	Position #2 OBS	Position #2 TSC	Position #3 OBS	Position #3 TSC
1200	03/14/74	72.8	76.6	63.2	73.7	49.9	70.2
1300	03/14/73	72.6	76.1	64.3	73.2	48.7	69.7
1400	03/14/74	73.2	76.4	64.5	73.5	49.8	69.9
1500	03/14/74	72.6	75.8	64.9	72.8	50.6	69.3
1600	03/14/74	73.0	76.2	65.9	73.2	51.3	69.6
1700	03/14/74	72.7	75.2	65.1	72.2	50.9	68.6
1800	03/14/74	71.5	73.3	64.1	70.4	50.2	66.8
1900	03/14/74	71.1	73.8	63.6	70.8	49.7	67.1
2000	03/14/74	71.3	72.8	62.7	69.9	48.2	66.3
2100	03/14/74	70.0	71.2	62.4	68.3	52.9	64.8
2200	03/14/74	68.6	70.7	60.0	67.9	48.6	64.5
2300	03/14/74	70.4	71.0	62.4	68.3	49.3	65.0
0000	03/15/74	71.2	72.0	64.5	69.1	49.8	65.7
0100	03/15/74	68.5	70.6	61.9	68.0	47.0	64.7

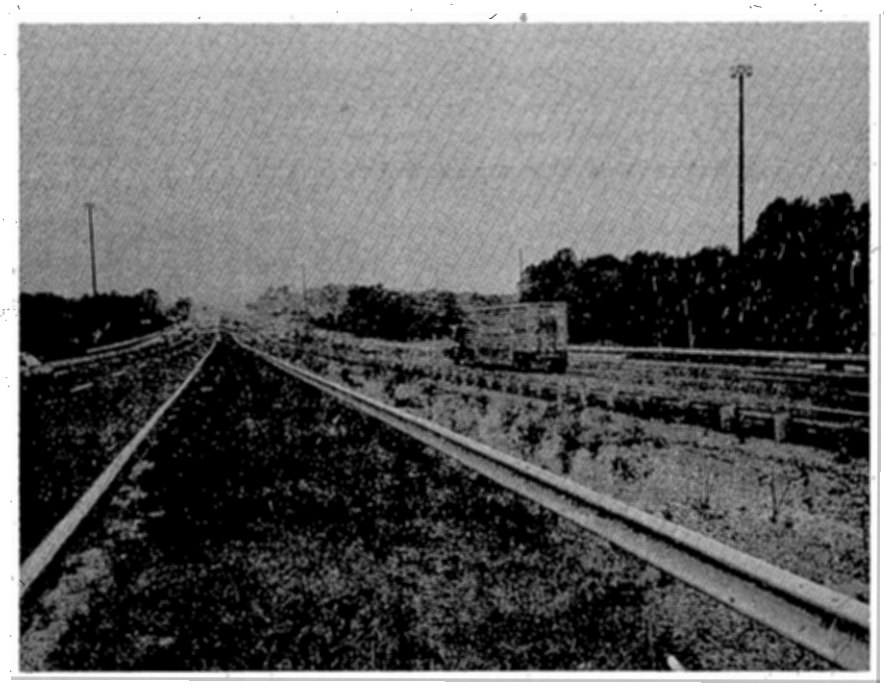
OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-287, Section 1E, 4B & 5B (Bridgewater) (cont.)

Hour	Date	Position #1		Position #2		Position #3	
		OBS	TSC	OBS	TSC	OBS	TSC
0200	03/15/74	67.9	71.3	60.0	68.5	45.8	65.1
0300	03/15/74	70.7	72.9	63.8	70.1	49.7	66.6
0400	03/15/74	71.6	73.0	65.2	70.4	51.6	67.1
0500	03/15/74	72.5	74.2	66.9	71.5	53.8	68.2
0600	03/15/74	73.0	74.0	65.7	71.3	51.6	68.0
0700	03/15/74	73.0	72.8	66.4	70.4	52.4	67.4
0800	03/15/74	71.3	75.5	63.2	72.7	46.7	69.4
0900	03/15/74	71.8	77.7	64.0	74.8	46.9	71.2
1000	03/15/74	72.7	77.4	64.8	74.4	47.0	70.9
1100	03/15/74	73.0	76.3	65.2	73.3	48.2	69.8


Route I-80 Section 1B & 2L
(Netcong)
N
1.2" = 200"
Pos. 8
Pos. 7
Pos. 6
Pos. 5
Pos. 4
Pos. 3
Pos. 2
Pos. 1
504'
164'
249'
175'
772'
232'
202'
LIGHT WOODS
N.J.D.O.T. MAINTENANCE YARD
WOODS
ROUTE 206 SOUTHBOUND
ROUTE 206 NORTHBOUND (2 LANES)
(2 LANES)
LIGHT WOODS & BRUSH
LIGHT WOOD & BRUSH
WOODS
(3 LANES)
I-80 WESTBOUND
480
485
(3 LANES)
I-80 EASTBOUND
1
2
3
4

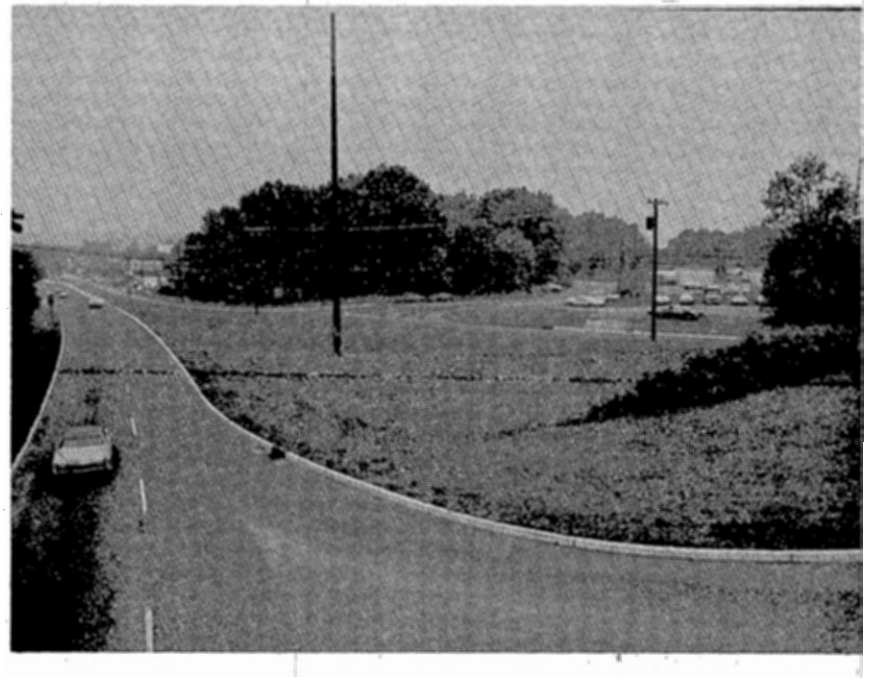
ROUTE I-80, SECTION 1B & 2L (NETCONG)



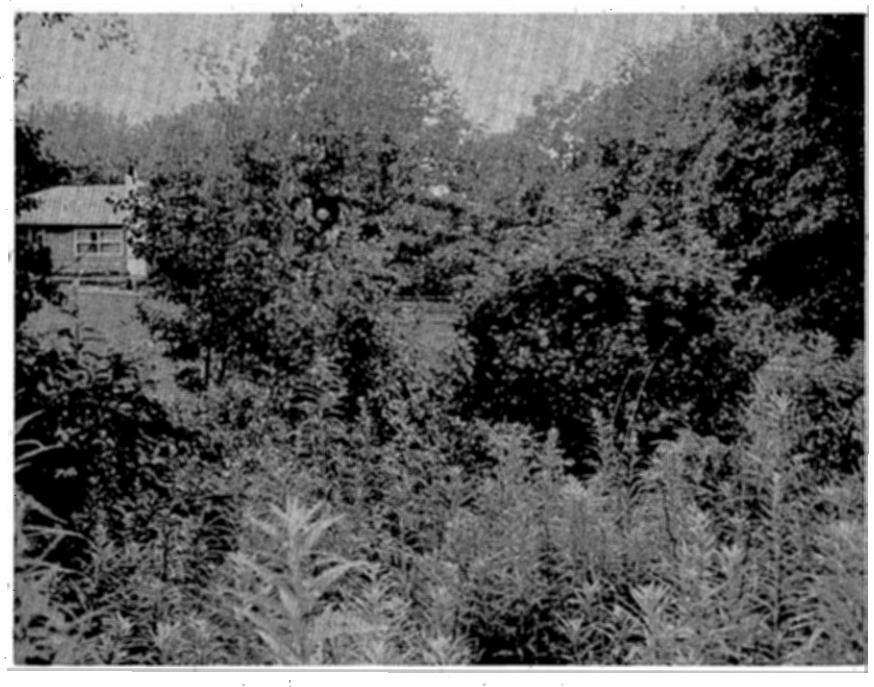
1

2

ROUTE I-80, SECTION 1B & 2L (NETCONG)



3



4

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-80, Section 1B & 2L (Netcong)

Hour	Date	Position #1		Position #2		Position 4	
		OBS	TSC	OBS	TSC	OBS	TSC
1700	04/02/74	64.0	67.2	57.4	59.9	-	55.4
1800	04/02/74	63.9	66.4	55.8	59.3	56.6	54.8
1900	04/02/74	64.4	64.0	58.2	57.0	54.1	52.5
2000	04/02/74	62.2	65.3	57.8	58.1	54.0	53.6
2100	04/02/74	65.9	65.4	-	58.2	56.7	53.8
2200	04/02/74	61.0	64.9	56.2	57.7	54.8	53.2
2300	04/02/74	66.9	66.9	58.7	59.6	55.0	55.1
0000	04/03/74	65.8	65.6	58.5	59.2	55.0	54.7
0100	04/03/74	-	65.5	-	58.9	56.2	54.4
0200	04/03/74	-	66.7	-	59.9	57.9	55.4
0300	04/03/74	-	65.4	-	58.8	56.9	54.3
0400	04/03/74	62.4	66.0	59.8	59.6	58.7	55.1
0500	04/03/74	64.1	65.8	61.3	59.0	59.5	54.6
0600	04/03/74	-	66.3	-	59.8	58.9	55.4

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-80, Section 1B & 2L (Netcong) (cont.)

Hour	Date	Position #1		Position #2		Position #4	
		OBS	TSC	OBS	TSC	OBS	TSC
0700	04/03/74	62.0	68.0	59.4	61.4	59.3	56.9
0800	04/03/74	64.7	68.5	58.7	61.6	57.4	57.1
0900	04/03/74	-	68.9	-	61.7	56.9	57.2
1000	04/03/74	-	70.1	-	63.0	57.9	58.5
1100	04/03/74	67.6	69.5	59.8	62.4	-	57.9
1200	04/03/74	69.0	68.6	61.4	61.4	59.8	56.9
1300	04/03/74	-	69.2	65.5	61.9	59.6	57.4
1400	04/03/74	-	68.9	64.7	61.8	60.6	57.3
1500	04/03/74	68.6	67.6	-	60.4	59.6	55.8
1600	04/03/74	68.7	67.9	65.4	60.8	60.8	56.3

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-80, Section 1B & 2L (Netcong)

Hour	Date	Position #5 OBS	Position #5 TSC	Position #8 OBS	Position #8 TSC
1500	04/04/74	56.4	62.9	52.7	63.7
1600	04/04/74	55.7	59.2	53.0	60.5
1700	04/04/74	-	56.4	53.0	57.2
1800	04/04/74	-	56.2	-	57.7
1900	04/04/74	51.4	58.0	52.4	58.6
2000	04/04/74	54.7	56.1	50.6	56.3
2100	04/04/74	50.4	45.0	50.2	45.7
2200	04/04/74	53.6	48.5	51.2	48.8
2300	04/04/74	52.6	42.2	51.8	43.1
0000	04/04/74	54.2	-	50.1	-
0100	04/05/74	55.1	-	51.4	-
0200	04/05/74	49.1	-	51.4	-
0300	04/05/74	47.7	-	51.7	-
0400	04/05/74	50.4	-	52.5	-

OBSERVED AND PREDICTED L_{eq} (dBA)

Route I-80, Section 1B & 2 L (Netcong) (cont.)

Hour	Date	Position #5		Position #8	
		OBS	TSC	OBS	TSC
0500	04/05/74	49.8	53.4	52.8	54.7
0600	04/05/74	50.6	51.6	53.4	53.1
0700	04/05/74	52.3	57.8	55.0	58.7
0800	04/05/74	-	62.5	54.7	63.2
0900	04/05/74	-	58.8	53.4	60.1
1000	04/05/74	50.7	56.9	-	58.9

APPENDIX D

L_{eq} MEASUREMENT AND PREDICTION BY SITE

D.2 OBSERVED AND TSC PREDICTED L_{eq} STATISTICS

SITE ELEMENTARY STATISTICS FOR DIFFERENCES

OBSERVED VS TSC PREDICTED L_{eq}

Site	Average Difference $\bar{d}$	Std. Dev. of Differences	t-Statistic for $\bar{d}=0$	Degrees of Freedom	$\bar{d}=0$?
R12	0.7	2.7	1.78	43	Yes
S123	-5.2	4.8	8.14	56	No
C1234	-4.5	3.3	12.33	81	No
A1234	-0.7	3.5	1.43	59	Yes
A5678	-4.8	2.7	13.98	64	No
A9101112	-4.3	3.2	11.72	76	No
B123	-4.9	2.9	11.58	47	No
N124	0.3	2.6	0.92	53	Yes
N58	-2.2	5.6	1.91	23	Yes

SITE LINEAR REGRESSION BETWEEN

OBSERVED AND TSC PREDICTED L_{eq}

Site	Regression Coefficient	Regression Coeff. = +1?	Intercept	F-test	Degrees of Freedom	Correlation	Std.Error of Estimate
R12	0.666	No	16.927	327.5	42	0.941	1.6
S123	0.744	No	11.30	72.8	55	0.755	4.5
C1234	0.694	No	16.636	82.4	80	0.712	3.0
A1234	1.173	No	-12.195	296.1	58	0.914	3.4
A5678	0.656	No	18.498	156.6	63	0.844	2.1
A9101112	0.160	No	49.489	1.3*	75	0.129	2.7
B123	1.155	Yes	-16.186	50.2	46	0.722	2.9
N124	0.697	No	18.531	145.1	52	0.858	2.1
N58	0.144	No	44.658	7.6	22	0.507	1.6

*The linear regression fails the F-test at the 5% level of significance

POSITION ELEMENTARY STATISTICS FOR DIFFERENCES

OBSERVED VS TSC PREDICTED L_{eq}

Position	Average Difference $\bar{d}$	Std. Dev. of Differences	t-Statistic for $\bar{d}=0$	Degrees of Freedom	$\bar{d}=0$?
R1	0.2	2.4	0.38	20	Yes
R2	1.2	2.9	1.99	22	Yes
S1	-2.6	3.7	3.17	20	No
S2	-4.1	2.4	8.00	20	No
S3	-10.4	4.9	8.21	14	No
C1	-6.6	2.3	11.40	15	No
C2	-4.4	3.3	5.98	19	No
C3	-2.3	3.0	3.70	22	No
C4	-5.2	3.0	8.31	22	No
A1	1.7	1.6	5.24	25	No
A2	-4.7	3.0	6.48	16	No
A3	0.7	1.3	1.83	12	Yes
A4	-3.1	3.6	1.72	3	Yes
A5	-6.7	2.2	14.66	22	No
A6	-5.6	2.3	4.81	3	No
A7	-3.9	2.0	8.60	19	No

POSITION ELEMENTARY STATISTICS FOR DIFFERENCES

OBSERVED VS TSC PREDICTED L_{eq} (cont.)

Position	Average Difference $\bar{d}$	Std. Dev. of Differences	t-Statistic for $\bar{d}$=0	Degrees of Freedom	$\bar{d}$=0?
A8	-3.0	2.7	4.77	17	No
A9	-1.9	2.5	3.84	27	No
A10	-3.8	0.8	20.17	18	No
A11	-4.9	3.4	4.77	10	No
A12	-7.9	1.6	21.18	18	No
B1	-2.5	1.4	8.59	23	No
B2	-7.3	1.9	18.92	23	No
B3	-18.1	3.1	29.00	23	No
N1	-1.7	2.2	3.05	15	No
N2	-0.1	2.5	0.21	15	Yes
N4	2.1	1.6	6.22	21	No
N5	-1.2	5.7	0.70	10	Yes
N8	-3.0	5.6	1.94	12	Yes

POSITION LINEAR REGRESSION BETWEEN

OBSERVED AND TSC PREDICTED L_{eq}

Position	Regression Coefficient	Regression Coeff. = +1?	Intercept	F-test	Degrees of Freedom	Correlation	Std. Error of Estimate
R1	0.691	No	15.186	205.4	19	0.957	1.4
R2	0.645	No	18.445	157.7	21	0.939	1.6
S1	0.487	No	30.767	104.8	19	0.920	1.4
S2	0.702	No	15.793	163.9	19	0.946	1.5
S3	0.481	No	21.168	14.5	13	0.726	3.4
C1	-0.114	No	77.359	0.4*	14	-0.172	1.2
C2	0.223	No	51.302	0.3*	18	0.124	3.1
C3	-0.299	No	84.977	1.1*	21	-0.221	2.2
C4	-0.217	No	73.435	0.5*	21	-0.156	2.3
A1	0.838	Yes	13.465	25.2	24	0.716	1.6
A2	0.413	Yes*	33.021	0.8*	15	0.225	2.9
A3	0.347	No	38.838	1.7*	11	0.368	1.1
A4	-1.375	Yes*	137.730	1.4*	2	-0.645	2.5
A5	0.646	No	19.360	15.1	21	0.647	2.0
A6	1.149	Yes*	-15.763	1.4*	2	0.640	2.8

POSITION LINEAR REGRESSION BETWEEN

OBSERVED AND TSC PREDICTED L_{eq}

Position	Regression Coefficient	Regression Coeff. = +1?	Intercept	F-test	Degrees of Freedom	Correlation	Std. Error of Estimate
A7	0.251	No	44.705	2.4*	18	0.343	1.4
A8	1.186	Yes	-14.741	6.2	16	0.527	2.8
A9	0.311	No	41.507	3.5*	26	0.342	2.0
A10	0.766	No	11.253	71.3	17	0.899	0.7
A11	-0.045	No	63.210	0.0*	9	-0.040	2.6
A12	0.259	No	39.712	1.4*	17	0.275	1.3
B1	0.536	No	31.857	33.8	22	0.778	1.0
B2	0.455	No	31.508	10.0	22	0.559	1.5
B3	-0.064	No	53.983	0.1*	22	-0.065	2.1
N1	0.885	Yes	5.959	5.6	14	0.536	2.2
N2	1.095	Yes	-5.844	7.5	14	0.590	2.5
N4	0.897	Yes	7.745	16.2	20	0.660	1.6
N5	0.156	No	44.131	2.2*	9	0.441	2.1
N8	0.139	No	44.844	7.4	11	0.634	1.1

*The linear regression fails the F-test at the 5% level of significance

STEP-WISE REGRESSION BY SITE BETWEEN

OBSERVED AND TSC PREDICTED L_{eq}

Site	Significant Variable	Partial Regression Coefficient	t-Statistic of Variable	Partial Correlation Coefficient	Intercept	F-test	Degrees of Freedom	Multiple Correlation Coefficient	Standard Error of Estimate
R12	Truck Volume	-0.06093	-8.80	-0.805	2.66428	77.6	1,42	0.805	1.6
S123	Truck Volume	-0.08536	-9.780	-0.608	6.91255	103.2	2,54	-0.890	2.2
	Distance	-0.08770	-9.772	-0.607					
C1234	Truck Volume	-0.01733	-7.03	-0.570	0.57900	30.2	2,79	0.658	2.5
	Truck/Auto	0.49311	2.90	0.246					
A1234	Truck Volume	-0.01582	-3.15	-0.383	2.92800	9.9	1,58	0.383	3.3
A5678	Distance	-0.00536	5.08	0.539	-6.87914	25.8	1,63	0.539	2.3
A9101112	Distance	-0.00814	-10.47	-0.677	1.93488	84.4	2,74	0.834	1.8
	Truck Volume	-0.01435	-6.34	-0.410					
B123	Distance	-0.04768	15.31	-0.825	-21.50954	100.2	3,44	0.934	1.1
	Truck Volume	-0.00713	-5.05	-0.288					
	Truck Speed	0.47312	4.35	0.248					

STEP-WISE REGRESSION BY SITE BETWEEN

OBSERVED AND TSC PREDICTED L_{eq}

Site	Significant Variable	Partial Regression Coefficient	t-Statistic of Variable	Partial Correlation Coefficient	Intercept	F-test	Degrees of Freedom	Multiple Correlation Coefficient	Standard Error of Estimate
N124	Distance	0.00587	5.82	0.571	22.60272	18.8	3,50	0.728	1.8
	Truck Speed	-0.49768	-3.80	-0.460					
	Truck Volume	-0.01218	-3.10	-0.372					
N58	Truck %	-0.86484	-6.93	-0.669	6.81857	26.6	2,21	0.900	2.6
	Auto Volume	-0.01162	-5.15	-0.498					