Louisiana Transportation Research Center

Technical Assistance Report 17-04TA-P

Assessing the Noise Attenuation Effects of Trees and Vegetation in Louisiana's Environment

by

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16. Executive Summary

The Louisiana Transportation Research Center (LTRC) was asked to conduct a study to determine the noise attenuation effects of vegetative barriers in response to a resolution by the Senate of the Legislature of Louisiana. The Senate's resolution urged and requested that the Department of Transportation and Development (DOTD) investigate the feasibility of planting bamboo cane or other sound-reducing vegetation along the outer right-of-way of Interstate 10 in Ascension Parish to provide a noise barrier and to reduce mowing, and to submit a written report of its feasibility investigation to the Senate Committee on Transportation, Highways, and Public works.

DOTD has erected sound walls at several locations in Louisiana for the purpose of attenuating roadway noise but has not attempted to use vegetative barriers for that purpose. Sound walls can be very expensive and become unsightly as they age; whereas, vegetative barriers, if effective, provide psychological benefits in that they are aesthetically more appealing than sound walls.

In this study, an extensive review of the literature was conducted to outline the sources and properties of noise produced by vehicles traveling on the roadways, discover previous studies on vegetative barriers, as well as conduct sound or noise measurements to determine the effectiveness of vegetative barriers.

To quantify the impact of vegetative barriers in Louisiana's environment, a sectional noise study was conducted to determine the effect of vegetative barriers as a means of attenuating highway traffic noise. Noise analysis tests were conducted at seven locations: five in East Baton Rouge Parish and two in Ascension Parish. In East Baton Rouge Parish, four of the testing locations were in the LSU AgCenter botanical gardens and one location was at an existing sound wall at the Interstate 10 (I-10) and Essen Lane exit ramp. In Ascension Parish, the two noise analysis locations were in the Bluff subdivision near the I-10 and LA 73 intersection.

The noise analysis was conducted by placing a sound measurement instrument at the edge of the I-10 right-of-way adjacent to the tree line or vegetative barrier. The other sound measurement instrument was placed within the vegetative barrier at various distances. Noise measurements were taken in the morning (6 a.m. to 9 a.m.) and evening (4 p.m. to 6 p.m.) in an effort to capture the noise during morning and evening rush hour traffic. All testing was conducted in accordance with FHWA and DOTD guidelines.

An extensive review of the literature was also conducted in this study to outline the sources and properties of noise produced by vehicles traveling on the roadways, discover previous studies on vegetative barriers, as well as conduct sound or noise measurements to determine the effectiveness of vegetative barriers.

Several state agencies and the Federal Highway Administration (FHWA) have conducted extensive studies on vegetative barriers. The California (CDOT), Virginia (VDOT), and Illinois (IDOT) departments of transportation have all concluded that vegetative barriers do not attenuate highway traffic noise and are, therefore, not used as a means to attenuate noise. The FHWA also has published that vegetative barriers are an ineffective means of mitigating highway traffic noise.

Similar to the conclusions of the CDOT, VDOT, IDOT, and FHWA, the results of LTRC's noise analysis study revealed that vegetative barriers are an ineffective means of attenuating highway traffic noise. The noise analysis testing results at the sound wall indicated that the sound wall did attenuate the highway traffic and its noise level complied with FHWA and DOTD guidelines.

The planting of bamboo on our roadsides would modify the Department's current roadside maintenance plan. Even if bamboo were planted, grass would remain within the right-of-way that would require mowing. Based on previous mowing contracts, there would be only a minimal reduction, if any, to the Department's mowing costs due to the fact that a major portion of the contractors mowing costs are for mobilization, insurance, bonding, and equipment, which would remain the same. Planting bamboo within the right-of-way would result in only minimal time and fuel-cost savings for the contractor as the bamboo would only reduce mowing in isolated areas. Management of bamboo on our roadsides would consist of mowing and other maintenance activities to contain growth of the bamboo, which would increase Department costs. In addition, planting bamboo on the roadside would be inconsistent with the Department's roadside vegetation management practice of encouraging sustainable native vegetation, constrict the Department's decreasing operating budget, and would not attenuate roadway traffic noise within the available space of the right-of-way.

In conclusion, there was no compelling evidence found to suggest that planting bamboo on the right-of-way would be beneficial to the state or in the best interest of DOTD.

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INTRODUCTION

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Literature Review

Mechanism of Roadway Noise

Noise generated by vehicles on roadways has been studied extensively internationally *[1, 2]*. As presented in Table 1, there are many sources of noise generated by light and heavy vehicles *[1, 2]*. There are noises generated by the vehicle itself (air intake, exhaust outlet, engine block, transmission, and cooling fan) as well as the tire-road surface contact. The amount of noise varies depending on vehicle type and travel speed. In higher speed situations, the tire-road contact may account for as much as 80 percent of the noise being generated.

Table 1
Vehicle noise *[1, 2]*

	Light vehicles %		Heavy vehicles %	
Source of noise (dBA)	Town	Open road	Town	Open road
Air intake inlet, exhaust outlet	15 to 35		15 to 60	
Exhaust pipe assembly	15 to 30			40 to 80
Engine block	20 to 30	20 to 70		
Gear box and transmission	5 to 30		30 to 80	
Cooling fan	-		10 to 50	
Tire-road surface contact	5 to 10	30 to 80	5	20 to 60

Note: Town-lower speeds and Open road- higher speeds

Unpleasant sounds are generally described as "noise." Though subjective, depending upon the individual, generalizations have been developed regarding noise as presented in Table 2 *[3, 4, 5]*. Equation (1) presents the relationship between sound pressure (μPA) and sound noise level (dBA).

Table 2
Facts about sound intensity *[3, 4, 5]*

EFFECTS:	TYPICAL SOUND SOURCE	SOUND PRESSURE (μPA)	SOUND NOISE LEVEL (dBA)
Serious hearing damage	Space rocket launch, in the vicinity of the launch pad	200,000,000	140
Hearing damage and pain	Jet engine (25 m/82 ft. distance)	63,245,555	130
Hearing damage after short exposure	Air-raid alarm (5 m/16 ft. distance)	20,000,000	120
Serious hearing damaged hazard	Rock music concert, close to stage	6,324,555	110
Hearing hazard	Jet plane take-off (300 m/984 ft.)	2,000,000	100
Some hearing hazard	Noisy industrial hall	632,456	90
Health effects	Heavy truck, 70 km/h; 44 mph (10 m/32.8 ft. distance)	200,000	80
Some health effects Severe annoyance	Car, 60 km/h; 37 mph (10 m/32.8 ft. distance)	63,246	70
Annoyance	Normal conversation (1 m/3.3 ft. distance)	20,000	60
Some annoyance	Quiet conversation (1 m/3.3 ft. distance)	6,325	50
Good environment	Subdued radio music	2,000	40
	Whispering	632	30
	Quiet bedroom	200	20
	Rustling leave	63	10
Uncomfortably "quiet"	Anechoic room for sound measurements	20	0

$$\text{Sound pressure } (\mu PA) = 17.808 * e^{0.1151x\ (dBA)} \quad (1)$$

In a report published by the FHWA, it was stated that most observers perceive a 10 dBA reduction in noise level as a halving of the loudness. Table 3 presents the perceived change in loudness relative to change (dBA) in noise level at various levels *[6]*.

Table 3

Decibel change versus relative perceived loudness change *[6]*

Noise level change (dBA)	Relative Loudness
0	Reference
-3	Barely Perceptible change
-5	Readily Perceptible change
-10	Half as loud
-20	1/4 as loud
-30	1/8 as loud

Noise Abatement Due to Vegetation

In this report, "vegetative barriers" refers to trees, shrubs, and underbrush either naturally occurring or planted along highway corridors. The FHWA has conducted numerous studies on both the abatement and analysis of highway traffic noise *[6]*. They report that vegetative barriers produce psychological benefits by providing visual screening, privacy, and aesthetic treatments, but do not attenuate highway traffic noise *[6]*. According to FHWA, in order for there to be an effective reduction in noise due to the vegetation, the width of vegetative barrier must be at least 200 ft. and must be high enough, dense enough, and opaque in order to contribute to the reduction of noise. Additionally, the effect of noise reduction may be seasonal due to the loss of leaves during the fall and winter months.

In a study sponsored by the CDOT, Hendriks reported that vegetative barriers are not an effective highway noise abatement measure *[7]*. This conclusion was based upon measurements taken from three sites where the width of the vegetative barriers ranged from 10- to 20- ft. The noise reductions due to the vegetation barriers ranged from 0- to 3- dBA.

The VDOT conducted a study to determine the attenuation of road noise by vegetative barriers. Based on the results of the study conducted at 15 sites, they concluded that no noise attenuation occurred regardless of tree density, tree age, tree height, percent live crown, species, or trunk diameter. They also reported that the measured noise reduction if any was due to increased distance from the roadway *[8]*.

The IDOT reported that vegetative barriers generally do not reduce highway traffic noise *[9]*. If any noise reduction is to occur, the vegetative barrier must range between 100- to 200- ft., with trees at least 16 ft. tall. The underbrush or understory must be very dense as well. They also reported that it is generally not feasible to plant this many trees or underbrush. Additionally, sufficient right of way is generally not available to accommodate widths of up to 200 ft. Therefore, vegetative barriers are not utilized as noise barriers.

DOTD's Highway Traffic Noise Policy

DOTD's highway traffic noise policy applies to all federal highway projects in the state of Louisiana that receive federal-aid funds or that are otherwise subject to FHWA approval with exceptions as described later *[10, 11]*. The policy also applies to the construction of new control of access highways that are funded through DOTD with no FHWA involvement.

DOTD has categorized projects into four types in its noise policy *[10]:*

Type I Project –

(1) The construction of a highway on new location; or

(2) The physical alteration of an existing highway where there is either:

(a) Substantial Horizontal Alteration (a project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition), or

(b) Substantial Vertical Alteration (a project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source by altering the vertical alignment of the highway or by altering the topography); or

(3) The addition of a through-traffic lane. This includes the addition of a through-traffic lane that functions as a HOV, HOT, bus, or truck climbing lane; or

(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or

(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or

(6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or

(7) The addition of a new or substantial alteration of a weight station, rest stop, ride-share lot or toll plaza.

**Note that if a project is determined to be a Type I project, then the entire project area as defined in the environmental document is a Type I project.*

Type II Project – a proposed project to provide noise abatement on an existing highway. DOTD does not have a Type II program.

Type III Project – a proposed project that does not meet the classification of a Type I or Type II project. Type III projects do not require a noise analysis.

Programs to provide noise abatement to Type II projects are voluntary and DOTD does not currently have a program to provide noise abatement for this type of project. I-10 in Ascension Parish would be considered a Type II project.

DOTD's Policy for Roadside Vegetation Management

DOTD's policy for "ROADSIDE VEGETATIVE MANAGEMENT" was given authority in ACT No. 682 for the regular session of the State Legislature of 1989 and published as a final rule in August 2000 *[12]*. The guidelines were intended to (1) provide for safety of the traveling public, (2) blend the roadside with adjacent land uses, (3) improve aesthetic quality, (4) reduce erosion, and (5) increase efficiency of maintenance operations.

The guidelines state that the clear distance from the edge of the traveled way for interstates shall be a minimum of 50 ft. on the mainline and 30 ft. for the ramps. Trees may be planted or remain with the 50 ft. clear distance on the mainline or 30 ft. on the ramps if they are protected by guardrail on non-traversable backslopes or other protected areas.

METHODOLOGY

Experiment Design

In order to determine the noise abatement characteristics of vegetative barriers in Louisiana, a comprehensive experiment was developed. The experiment consisted of taking sound measurements at seven locations, five were in East Baton Rouge Parish and the other two were in Ascension Parish as presented in Figures 1 to 4. Site 0, which has a sound wall, was considered the control site. It was located off the I-10 and Essen Lane exit ramp, as presented in Figure 1. Sites 1, 2, 2A, and 3 were located in the LSU AgCenter Botanical Garden's facility, 4560 Essen Lane, Baton Rouge, LA, 70809. Sites 4 and 5 were located in the Bluff subdivision near the I-10 and LA 73 area in Ascension Parish.

Figure 1
Sound wall Site 0

Figure 2
Sound measurement Sites, 1, 2, and 2A

Figure 3
Sound measurement Site 3

Figure 4
Sound measurement sites 4 and 5

Sound measurements were taken adjacent to the tree line at the edge of the roadway's right-of-way line and at different distances within the wooded areas, as presented in Table 4 and Figure 5. The distance of Instrument 1 from the roadway was based upon existing site conditions. Instrument 2 was placed based upon factors such as tree depth, site conditions within the wooded area and as requested by the DOTD Environmental Section's representative. The sound attenuation effect caused by the vegetation was determined by comparing the sound or noise level at Instrument 1 to the noise level at Instrument 2. However, the difference in noise level between Instruments 1 and 2 were also due to the increase in distance for Instrument 2 from the edge of the roadway. The effect of distance from the source of sound on noise attenuation will be discussed later in the "Noise Analyses" section.

Table 4
Distances of instruments relative to the roadway and each other

Site	No Trees/Vegatation (ft.)	Depth of Trees & Vegatation (ft.)	
	Distance from Edge of Road to Sound Instrument 1 (ft.)	Distance between Sound Instrument 1 and Sound Instrument 2 (ft.)	Distance from Edge of Road to Sound Instrument 2 (ft.)
Sound Wall Site 0	20	25	45
Site 1	44	95	139
Site 2 (A)	54	89	143
Site 2 (B)	54	153	207
Site 3	52	200	252
Site 4	27	97 (1)	124
Site 5	27	243	270

(1) Tree depth ≈ 25 ft.

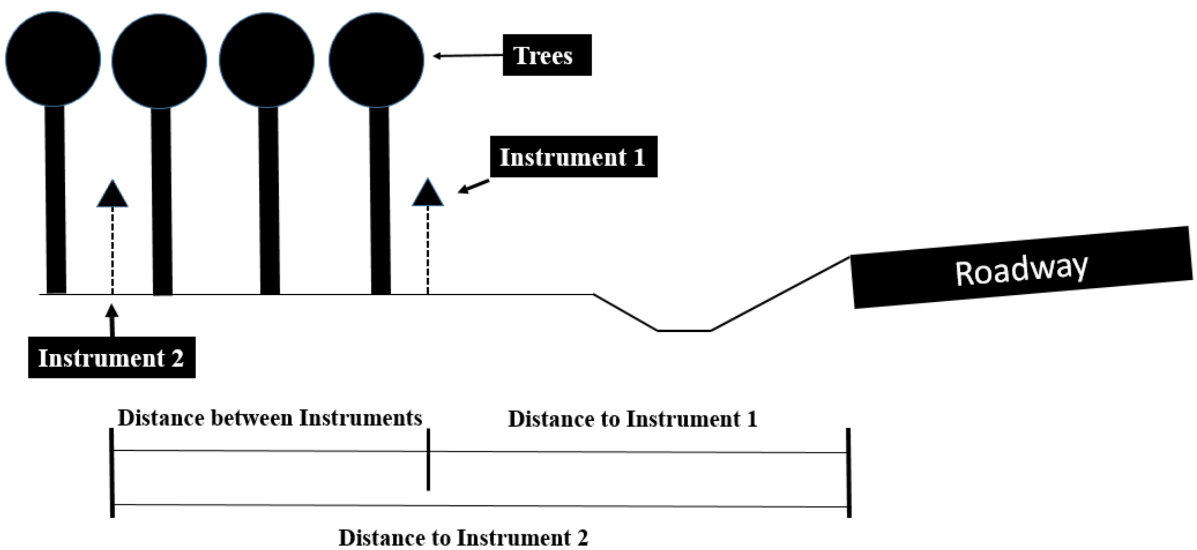

Figure 5
Instrument locations relative to the roadway

Noise Analyses

Pass-by Noise Measurements

Pass-by noise measurements “a weighted dBA” were conducted by setting up a microphones at the distances shown in Table 4 in general accordance with DOTD, FHWA, and AASHTO guidelines *[10-12]*. The microphone and associated accessories used in this study were a Larson-Davis model 824-9 and Rion sound level meter model NL-52. Sound readings were taken in the morning (≈ 6 a.m. to 9 a.m.) and afternoon (≈ 4 p.m. to 6 p.m.) at all sites. The sound noise level (Leq) in dBA was recorded at 1-minute intervals. In accordance with the noise measurement standards, 15-minute moving averages were calculated throughout the measurement time and the peak Leq in dBA from the peak hour was used to determine the differences in noise levels if any caused by the vegetation.

Sound Attenuation Due to Distance from Source

There is an idealized formula referred to as the inverse distance law that is used to predict or estimate the noise level reduction from a source due to distance. The formula assumes that there are no barriers present to abate the sound and no reflective surfaces to intensify the sound. It also assumes that the sound is emanating from a single source instead of multiple sources as the case would be on a heavily trafficked highway. Equation (2) is based upon the inverse distance law and can be used to predict the noise level dBA at location 2 (L_2) when the noise level dBA is known at location (L_1) or vice versa as presented in Figure 6 *[13, 14, 15]*.

$$L_2 = L_1 - \left| 20 * \log(d1/d2) \right| \tag{2}$$

where,

L_1 – sound level (dBA) at location 1

L_2 – sound level (dBA) at location 2

d1 – distance to location 1

d2 – distance to location 2

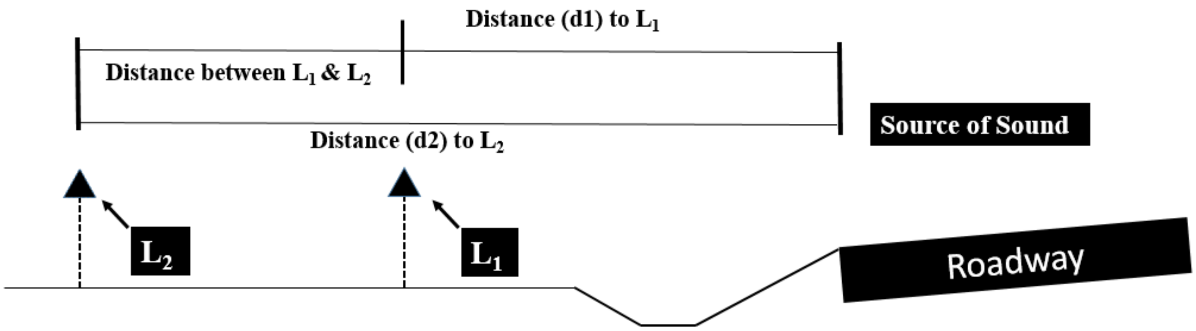

Figure 6
Sound measurement locations

Figures 7 and 8 were created to illustrate the case where noise measurements were taken at distances of 26 ft. and 250 ft. from the edge of the road and the depth of trees was 224 ft. The measured peak noise levels at instrument 1 and 2 were 78 dBA and 58.5 dBA. Using Equation (2), the theoretical noise level was 58.2 dBA. As presented in Figure 8, the measured noise level (58.5 dBA) was similar to the theoretical noise level (58.2 dBA), indicating that noise attenuation due to the presence of the trees did not occur. Had noise attenuation occurred due to the vegetation, then the measured noise level at location 2 would have been less than the theoretical noise level calculated by Equation (2).

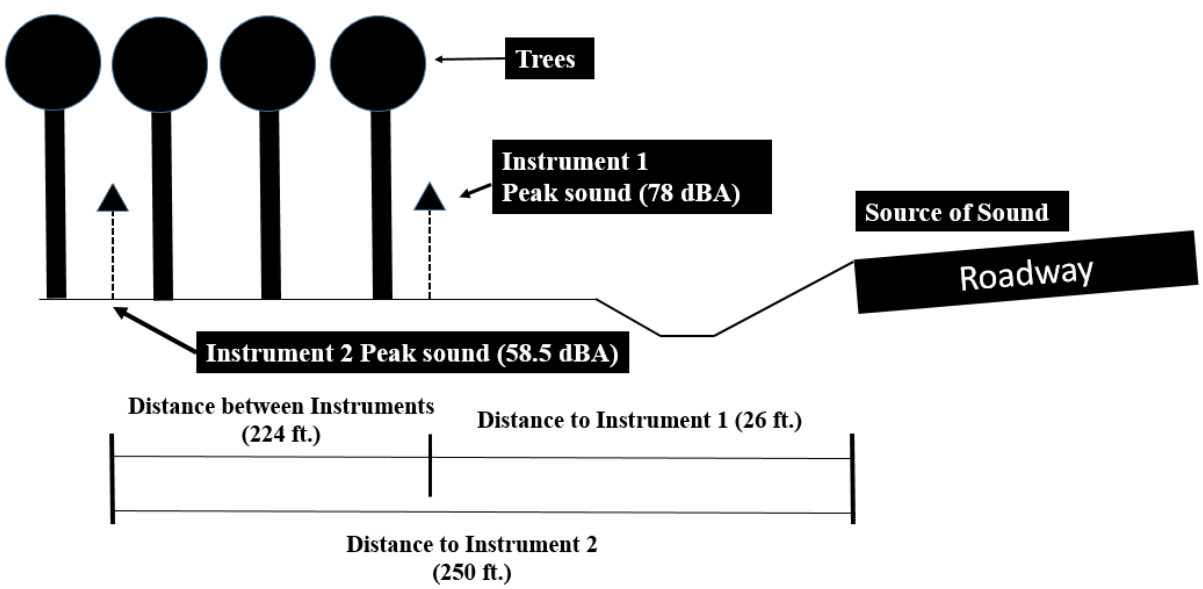

Figure 7
Example of noise measurement locations

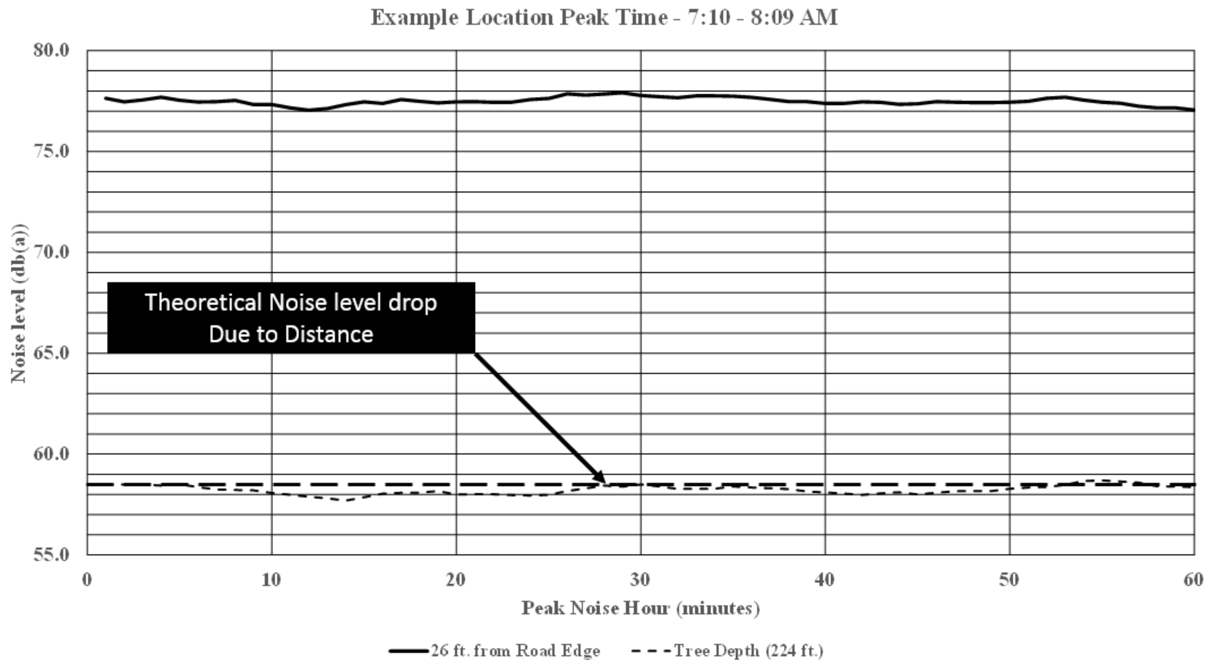

Figure 8

Example comparison between theoretical and measured noise attenuation

DISCUSSION OF RESULTS

Noise Analysis

LTRC conducted noise measurement tests at 7 locations, as presented in Figures 1 to 4 and Table 4. The results of the noise measurements are presented in Table 5. The theoretical sound level at a distance equivalent to where sound was measured at instrument 2 was calculated using Equation (2) for each site and is presented in Table 5.

Table 5
Noise analysis results

Site	Measured Peak Sound at Sound Instrument 1 (dba)	Measured Peak Sound at Sound Instrument 2 (dba)	Theoretical Sound at Sound Instrument 2 (dba)
Sound Wall Site 0	74.8	65.2	67.8
Site 1	72.7	69.8	62.7
Site 2 (A)	76.6	73.2	68.1
Site 2 (B)	76.3	69.8	64.6
Site 3	77.1	65.0	63.4
Site 4	79.6	68.0	66.4
Site 5	79.9	62.8	59.9

Site 0 (sound walls) Noise Measurement Results

The results of the noise measurements for the peak hour are presented in Figure 9. The peak noise level at instrument 1 was 74.8 dBA and 65.2 dBA at instrument 2. The theoretical noise level was 67.8 dBA. The results indicate that the sound walls reduced the noise level by 2.6 dBA.

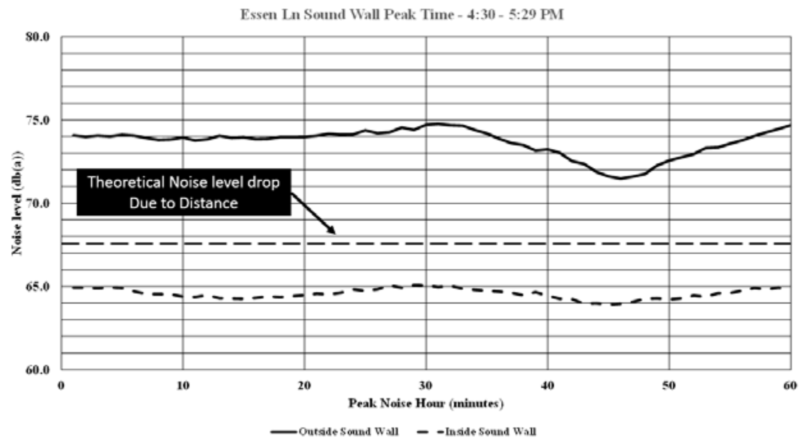

Figure 9
Noise levels at Site 0 (sound walls)

Site 1 Noise Measurement Results

The results for the noise measurements at site 1 is presented in Figure 10. The peak noise level at instrument 1 was 72.7 dBA and 69.8 dBA at instrument 2. The theoretical level was 62.7 dBA. The vegetative barrier was 95 ft. wide and did not attenuate the highway traffic noise. Theoretically, the noise level at instrument 2 (69.8 dBA) should have been closer to the 62.7 dBA. It is possible that there were noise sources other than highway traffic noise at this location or that there was some reflective surface amplifying the highway traffic noise. There were no apparent other noise sources present according to LTRC's field technicians.

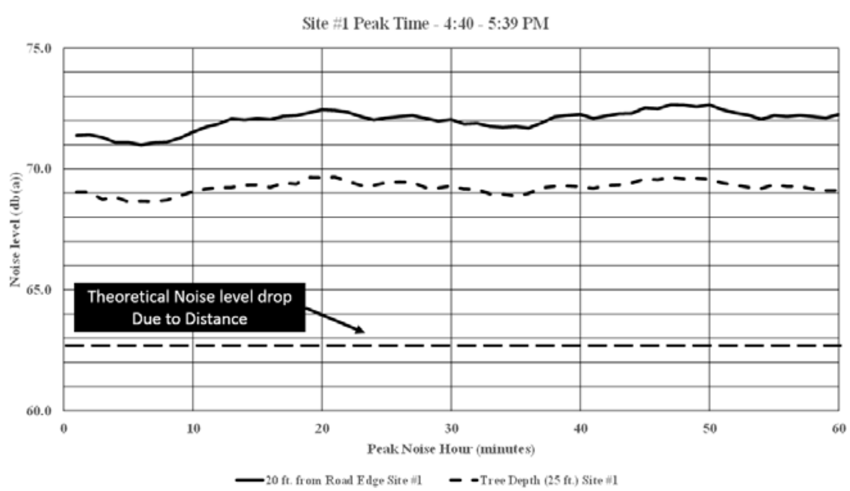

Figure 10
Noise levels at Site 1

Site 2A Noise Measurement Results

The results for the noise measurements at site 2A is presented in Figure 11. The peak noise level at Instrument 1 was 76.6 dBA and 73.2 dBA at Instrument 2. The theoretical level was 68.1 dBA. The 89-ft. wide vegetative barrier did not attenuate the noise level at this location. As with Site 0, the measured noise level at Instrument 2 (73.2 dBA) was greater than the theoretical noise level 68.1 dBA. The reason for this is unknown.

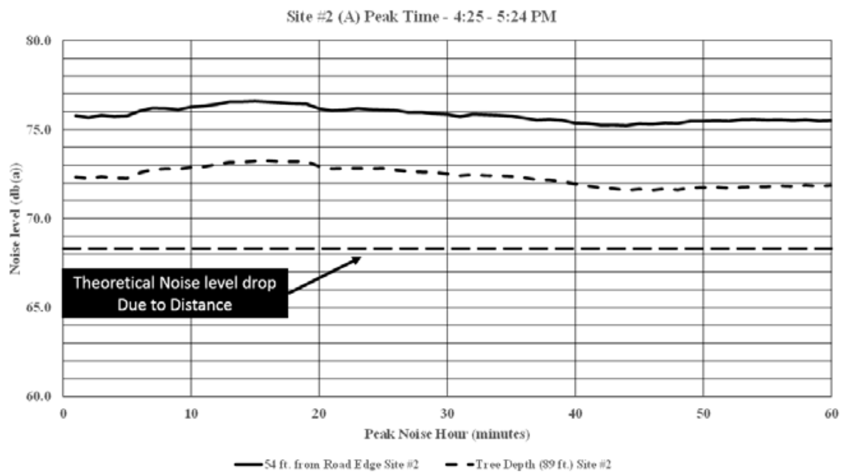

Figure 11

Noise levels at Site 2A

Site 2B Noise Measurement Results

The results for the noise measurements at site 2B is presented in Figure 12. The peak noise level at Instrument 1 was 76.3 dBA and 69.8 dBA at Instrument 2. The theoretical level was 64.6 dBA. The 153-ft. wide vegetative barrier did not attenuate the noise level at this location. As with Sites 1 and 2A, the measured noise level at Instrument 2 (69.8 dBA) was greater than the theoretical noise level 64.6 dBA. The reason for this is unknown.

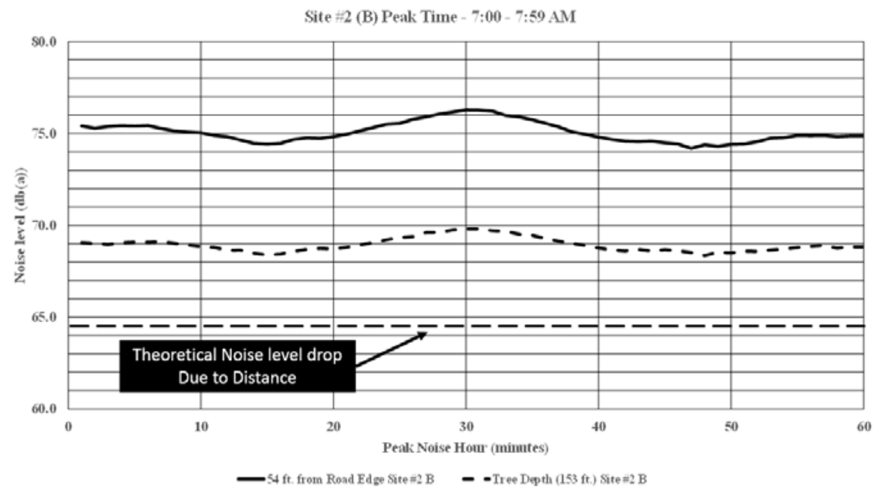

Figure 12
Noise levels at Site 2B

Site 3 Noise Measurement Results

The results for the noise measurements at Site 3 is presented in Figure 13. The peak noise level at Instrument 1 was 77.1 dBA and 65.0 dBA at Instrument 2. The theoretical level was 63.4 dBA. The 200-ft. wide vegetative barrier did not attenuate the noise level at this location. Unlike Sites 1, 2A, and 2B, the measured noise level at Instrument 2 (65.0 dBA) was closer to the theoretical noise level (63.4 dBA).

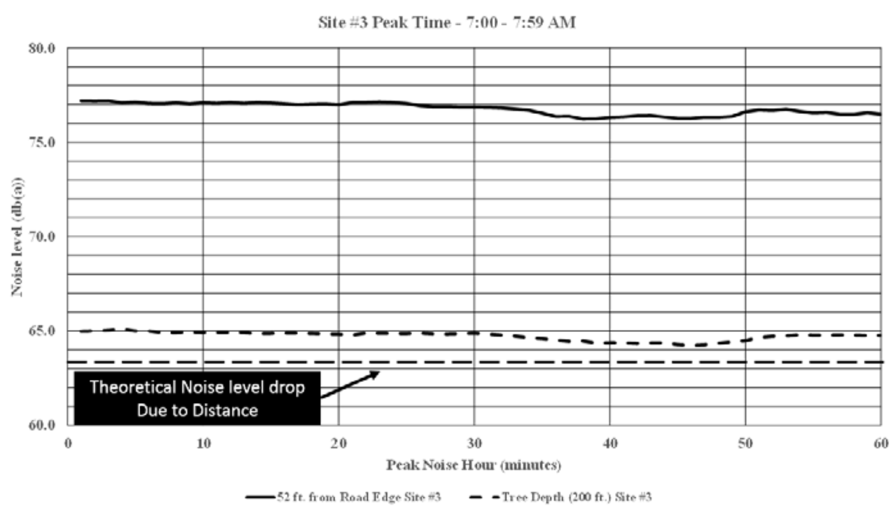

Figure 13
Noise levels at Site 3

Site 4 Noise Measurement Results

The results for the noise measurements at Site 4 is presented in Figure 14. The peak noise level at Instrument 1 was 79.6 dBA and 68.0 dBA at Instrument 2. The theoretical level was 66.4 dBA. The 25-ft. wide vegetative barrier did not attenuate the noise level at this location.

The measured noise level at Instrument 2 (68.0 dBA) was close to the theoretical noise level (66.4 dBA).

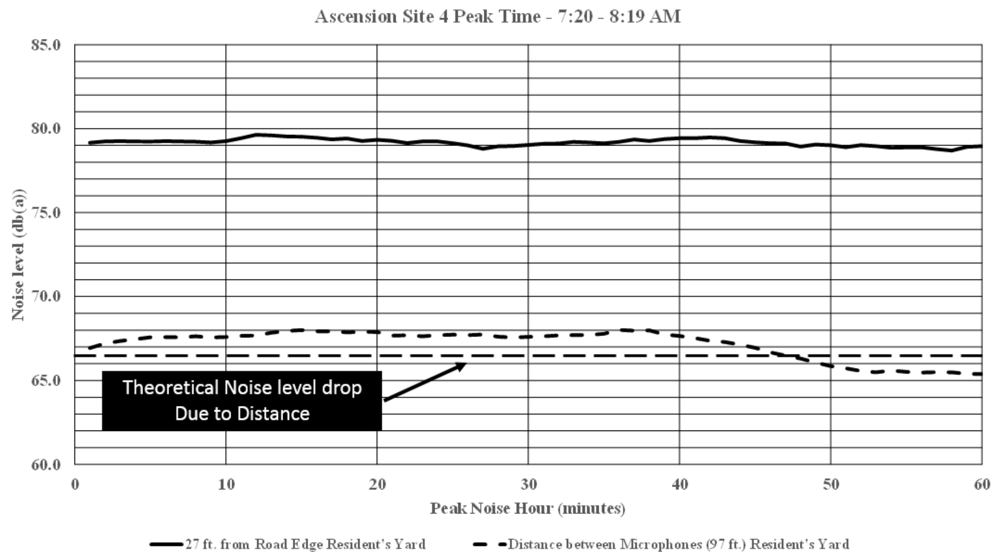

Figure 14

Noise levels at Site 4

Site 5 Noise Measurement Results

The results for the noise measurements at Site 5 is presented in Figure 15. The peak noise level at Instrument 1 was 79.9 dBA and 62.8 dBA at Instrument 2. The theoretical level was 59.9 dBA. The 243-ft. wide vegetative barrier did not attenuate the noise level at this location. The measured noise level at Instrument 2 (62.8 dBA) was close to the theoretical noise level (59.9 dBA).

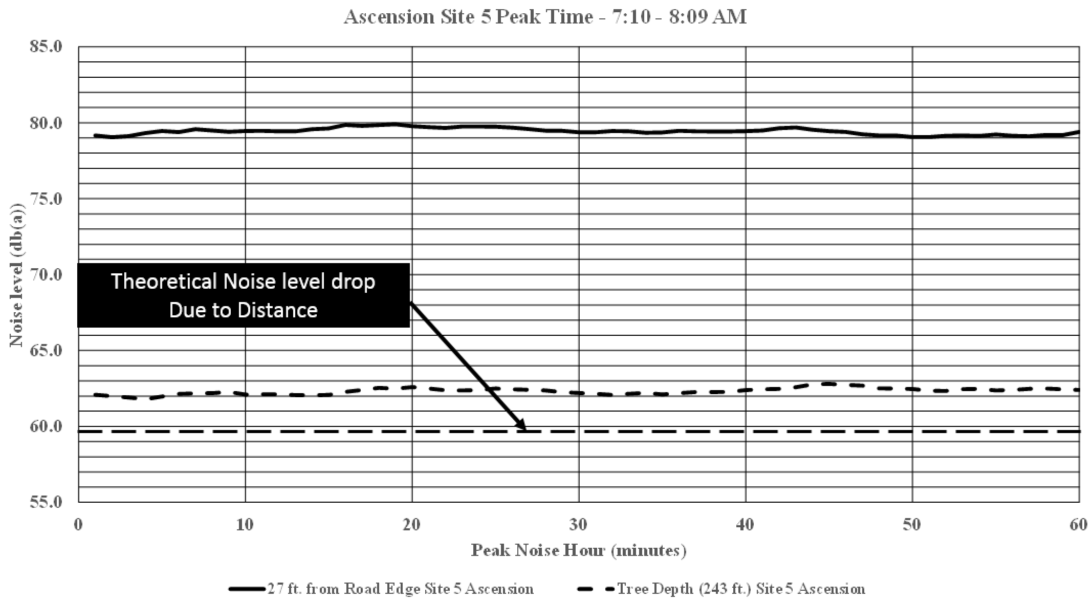

Figure 15
Noise levels at Site 5

Feasibility of Using Bamboo as a Vegetative Barrier

Planting bamboo on the roadside would be inconsistent with DOTD's roadside vegetation management practice of encouraging sustainable native vegetation *[12]*. Planting bamboo would also increase our maintenance costs and not reduce mowing.

Establishing sustainable roadside vegetation is widely recognized as an essential and cost-effective practice to improve the safety, efficiency, and effectiveness of roads and associated environment. In recent years, the FHWA has taken a leadership role in moving beyond regulation-driven mitigation approaches and into proactive environmental stewardship to promote healthy ecosystems. Native plants are a foundation of ecological health and function in natural environments. Revegetating roadsides with native plants is a key practice for managing environmental impacts and improving conditions for healthy ecosystems. In addition, native plants along roadsides offer economic, safety, and aesthetic advantages. Well-planned, sustainable native vegetation supports transportation goals for safety and efficiency by stabilizing slopes, reinforcing infrastructure, and improving the road user's experience by creating natural beauty and diversity along the roadside *[16]*.

There are two types of growth for bamboo. One type is "clumping" and the other is a "runner." The clumping variety rhizomes spreads slowly, similar to an ornamental grass, increasing the plant's mass. The runner needs to be controlled because of its aggressive behavior that could allow it to escape the roadside and become a pest. The Natural Resources Conservation Service (NRCS) states that "bamboo may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed."

Management of bamboo on our roadsides would consist of mowing to contain growth. The addition of bamboo or other vegetation would not reduce our mowing costs as a recent test area, utilizing reduced acreage cycles showed. Even though we reduced acreage on two cycles, there was no change in cost per cycle as the contractor's costs per cycle (insurance, bonding, payroll, equipment, fuel, etc.) remained the same. Also, as the Department does not have a landscape planting budget nor landscape maintenance budget, there is no funding available for this request. Planting a plant that would require extra maintenance management is inconsistent with current budgets.

Another issue of using vegetation to reduce noise or mowing is the available width of roadside right of way (ROW) in Ascension Parish or typically any other parish. The roadside width consists of the area between the fog line at the edge of the travel lane to the control of access fence inclusive of shoulders and auxiliary lanes. The criteria for interstate routes states that the clear distance from the edge of the traveled way to the face of the tree line shall be a minimum of 50 ft. on the mainline and 30 ft. for ramps. The setback is measured from the traveled way, which is the portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes. These distances apply to trees whose trunk diameter will be 4 in. or greater at maturity. Typically, the interstate roadside ROW in Ascension Parish is approximately 90 ft. wide. Subtracting the 50-ft. clear zone from the ROW leaves only 40 ft., which is not enough area to plant an effective vegetative sound barrier.

Therefore, planting bamboo on the roadside would be inconsistent with the Department's roadside vegetation management practice of encouraging sustainable native vegetation, constrict our decreasing operations budget, and would not attenuate roadway traffic noise.

CONCLUSIONS

The objective of this study was to determine if vegetative barriers attenuated highway traffic noise. This was accomplished by taking noise level measurements at seven locations. Noise levels [Leq (dBA)] were acquired using the pass-by noise procedures prescribed by FHWA.

One of the seven test locations (Site 0) had a sound wall. The results of the noise testing indicated that the sound wall attenuated the noise. Noise tests at the other six locations had vegetative barriers of depths ranging from 25 to 243 ft. The noise testing results indicated that the vegetative barriers did not attenuate the noise.

The literature review indicated that noise level testing in other states (California, Virginia, and Illinois) concluded that vegetative barriers do not attenuate noise. FHWA also does not consider vegetative barriers as an effective method to attenuate sound.

Planting bamboo on the roadside would be inconsistent with the Department's roadside vegetation management practice of encouraging sustainable native vegetation, constrict our decreasing operations budget, and would not attenuate roadway traffic noise.

RECOMMENDATIONS

As a result of the testing and analysis conducted in this study, it was determined that vegetative barriers do not attenuate noise. Based upon the parameters of noise attenuation, DOTD's roadside vegetative management practice, the available right of way width for planting and DOTD's diminishing operation budget, it is not recommended that bamboo cane nor any type of vegetative barrier be placed on the outer right-of-way of Interstate 10 in Ascension Parish for noise attenuation or maintenance cost reduction.

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