Appendix F

Noise Study

La Cholla Boulevard
Ruthrauff Road to River Road

Final Noise Report

July 2008

Pima County Department of Transportation

Work Order No. 4LCITR

HDR

July 23, 2008

Mr. Dean Papajohn, PE
Civil Engineering Manager
Pima County Department of Transportation
Public Works Building
201 N. Stone Avenue, 3rd Floor
Tucson, AZ 85701

RE: Final Noise Report
La Cholla Boulevard, Ruthrauff Road to Ina Road
Work Order No. 4LCITR
HDR Job No. 59914

Dear Mr. Papajohn:

We are pleased to submit this *Final Noise Report* for the above-referenced project. This report was prepared by Catherine Bolm, Environmental Planner, and was reviewed by Christine Jacobs-Donoghue, Senior Environmental Planner.

Please feel free to contact me at (520) 584-3632 if you have any questions.

Sincerely,

HDR Engineering, Inc.

Ted W. Buell

Ted Buell, PE
Project Manager

Attachments

HDR Engineering, Inc.

5210 East Williams Circle
Suite 530
Tucson, AZ 85711-4459

Phone: (520) 584-3600
Fax: (520) 584-3680
www.hdrinc.com

La Cholla Boulevard
Ruthrauff Road to River Road

Final Noise Report

July 2008

Prepared for:
Pima County Department of Transportation
201 N. Stone Avenue
Tucson, AZ 85701
Work Order No. 4LCITR

Prepared by:
HDR Engineering, Inc.
5210 E. Williams Circle, Suite 530
Tucson, AZ 85711-4459
HDR Project No. 59914

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 Introduction

1.1 Study Location and Scope

Pima County Department of Transportation (PCDOT) and Regional Transportation Authority propose to widen La Cholla Boulevard from Ruthrauff Road to River Road. The project area is located in unincorporated Pima County. The Oro Valley town limits are located approximately 5 miles north of the northern project limit (River Road) and the Tucson city limits are located approximately 1 mile south of the southern project limit (Ruthrauff Road). The project location is displayed in Figure 1 and the project vicinity is displayed in Figure 2.

Stage 1 engineering drawings and aerial photographs taken in June of 2007 were used for this noise analysis. Traffic volumes for 2030 were obtained from the *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road* (PCDOT 2008).

1.2 Existing Roadway Conditions and Land Use

La Cholla Boulevard is a major north-south arterial road between Oro Valley and Tucson. Within the Study Area, La Cholla Boulevard is a two-lane roadway with four-lane arterial street intersections. It is intersected by several two-lane collector streets. La Cholla Boulevard crosses the Rillito River as a two-lane bridge. North of the bridge, La Cholla Boulevard widens to a six-lane roadway approaching the River Road intersection.

Land use at the River Road and La Cholla Boulevard intersection is primarily commercial. A shopping plaza is located at the northeastern corner and a Circle K gas station is located at the southwestern corner. Commercial development is planned for the northwestern and southeastern corners.

The Rillito River passes under La Cholla Boulevard south of the River Road and La Cholla Boulevard intersection. Public use trails run adjacent to the river. A linear park is located on both sides of the Rillito River bridge, with access to the public use trails.

South of the river, Curtis Road intersects La Cholla Boulevard. Land use is primarily light commercial and industrial on the east side of La Cholla Boulevard at this intersection. Pima County-owned Curtis Park is located at the northwestern corner of the intersection. A vacant lot at the southwestern corner is the site of a closed landfill.

Between Ruthrauff Road and Curtis Road and south of the landfill and commercial properties, the adjacent land is zoned for multi-use and is primarily residential. Several medium- to high-density neighborhoods are located along this segment of La Cholla Boulevard. A Circle K gas station is located at the northeastern corner of the La Cholla Boulevard and Ruthrauff Road intersection. The Family Food store is located at the northwestern corner and a Valero gas station is at the southeastern corner. The southwestern corner is currently under construction with commercial development. South of Ruthrauff Road, the Flowing Wells Fire Station and Flowing Wells Junior High School are located on the west side of the street. Centennial Elementary School is west of La Cholla Boulevard on Wetmore Road.

Figure 1. Project location

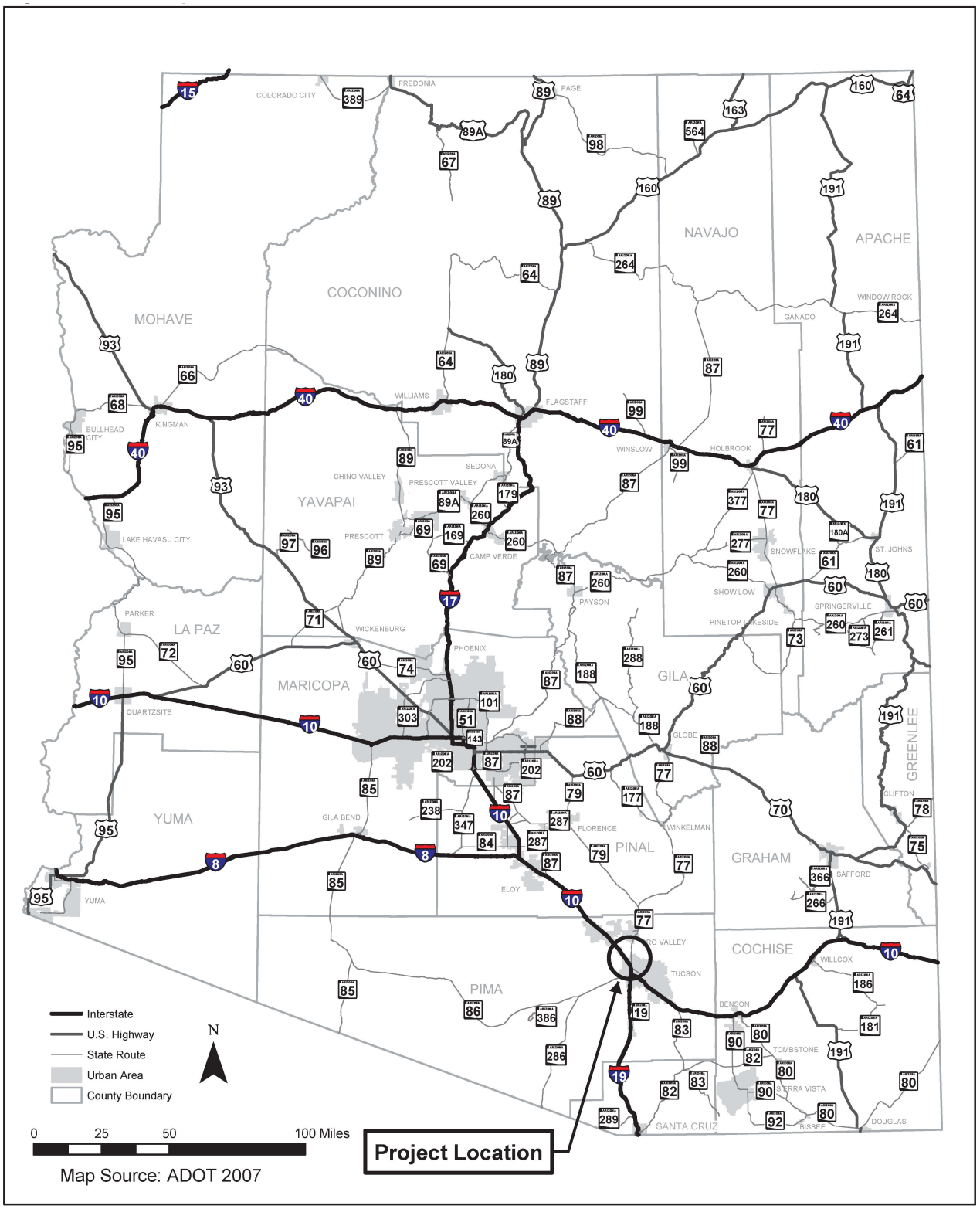
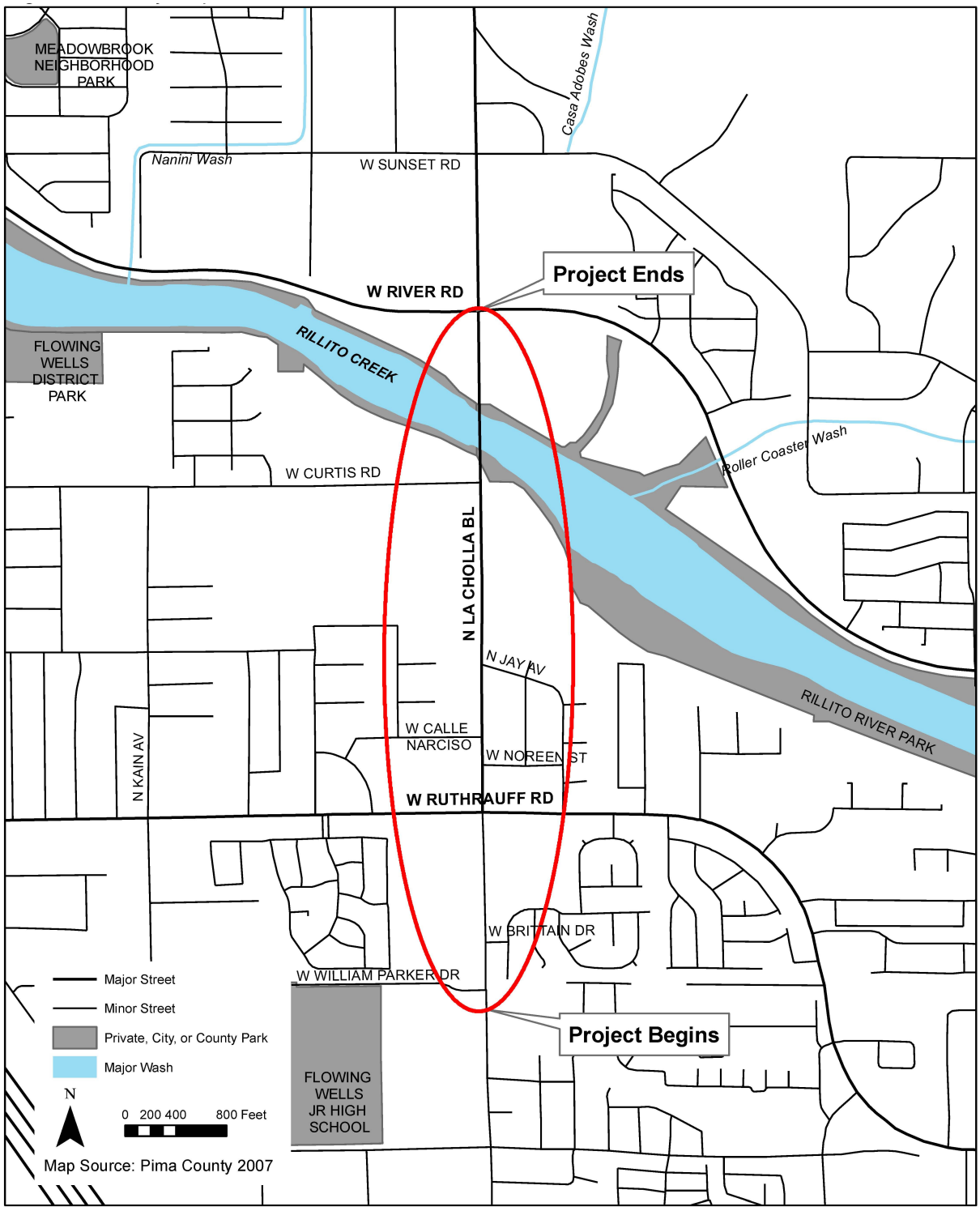


Figure 2. Project vicinity



1.3 Planned Project Improvements

The proposed project would widen La Cholla Boulevard between Ruthrauff Road and River Road from a two-lane undivided roadway to an urban six-lane divided roadway with dedicated turn lanes at the intersections. PCDOT recommends that frontage roads be constructed for the residential lots that directly access La Cholla Boulevard. However, the draft design concept report for this project includes alternatives that would eliminate one or both frontage roads and substitute residential property acquisitions. The potential property acquisitions and subsequent removal of homes along La Cholla Boulevard have been considered in this analysis.

2.0 Methodology

A new or expanded roadway will increase traffic-generated noise in the surrounding area. For this study, the methods for determining the future noise levels and identifying possible mitigation measures to address those increased noise levels included using the Federal Highway Administration (FHWA) Traffic Noise Model Version 2.5 (TNM 2.5) and following noise abatement criteria established by the governing agency, PCDOT.

To assess the potential change in noise levels, the existing noise environment was evaluated. Representative sites within the Study Area were chosen and the existing noise levels were measured at each site. The resulting measurements are the ambient noise levels. Roadway geometry and topography, traffic volumes, existing barriers, land features, and the representative sites were entered into TNM 2.5 to replicate the conditions under which the noise level measurements were taken. Noise levels were calculated and compared with the ambient levels. This process examines the accuracy of the traffic noise model in performing noise level calculations for this project. Discrepancies in the model's calculations were addressed prior to using it for predicting future noise levels. Four conditions were modeled using TNM 2.5. The model estimated the peak-hour traffic noise levels for:

- existing condition (2007)
- projected condition without noise mitigation (2030)
- projected condition with a credit of 3 dBA for the application of rubberized asphalt concrete (RAC) (2030)
- projected condition with noise barriers and a credit of 3 dBA for the application of RAC (2030)

The 2030 projected conditions were compared with the Pima County Noise Abatement Procedure to determine whether noise mitigation is warranted.

2.1 TNM 2.5 Modeling

The TNM 2.5 model translated the roadways in the Study Area into a series of endpoints on a three-dimensional X, Y, and Z coordinate system. This computer model was developed to comply with FHWA noise regulations and is considered the current standard for roadway noise analyses.

The TNM model requires input data regarding the geometry of roadways in the Study Area, vehicle mix, traffic volumes, and vehicle speeds. The proposed roadway and the surrounding arterial streets were defined by a series of roadway segment endpoints. Existing barriers, including residential privacy walls, were included in the model. Receivers were identified as single points and assigned an elevation of 5 feet above the ground to simulate the average height of human hearing. The sound levels were modeled using the A-weighted decibel (dBA), which is the measurement of sound that most closely approximates the sensitivity of the human ear. The noise level results—discussed in Section 3.0, *Existing Noise Environment*—are presented in $L_{Aeq1h,}$ the equivalent average sound level measured for 1 hour, approximating the sensitivity of the human ear.

The vehicles were classified as automobiles (four wheels), medium trucks (six wheels), and heavy trucks (eight or more wheels). Each of these vehicle types generates noise from a different height above the roadway, called the source height.

TNM 2.5 uses the above-described information to calculate the noise contribution from each roadway segment to each receiver and then determine the cumulative effect of all roadway noise sources for each receiver. Validation studies conducted at the Volpe National Transportation Systems Center, a facility of the United States Department of Transportation Research and Innovative Technology Administration, show that the TNM 2.5 model typically predicts noise levels within an acceptable range of accuracy.

2.2 Noise Abatement Criteria

The PCDOT Procedure Number 03-5, entitled "Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects," dated December 1, 2003, was developed to provide guidance for the development of noise mitigation for Pima County's major roadway projects. It contains procedures for traffic noise abatement, noise analysis methodology, and requirements for noise reports. The procedure is most commonly called the Pima County Noise Abatement Procedure (PC NAP). Numerous existing state and county transportation agency policies were evaluated during the development of PC NAP and analyzed to determine the appropriate criteria to use in Pima County.

Effective April 7, 2008, the Pima County "Revision of Traffic Noise Analysis and Mitigation Guidance for Major Road Projects" was implemented to address changes in the cost of noise mitigation measures. This report reflects the updated mitigation costs per benefited receiver and barrier construction cost per square foot.

According to the PC NAP, noise abatement should be considered if noise levels reach 66 dBA or higher at noise-sensitive properties. Additionally, mitigation measures will be considered for noise-sensitive properties if predicted traffic noise levels substantially exceed existing levels. "Substantially exceed" is defined as a 15-dBA increase between the existing noise levels and the future noise levels. The area at noise-sensitive properties from which the noise level is used to determine abatement consideration, is at an out-of-doors location assumed to be most frequented by the residents. For example, the noise levels used in consideration for abatement at a residence would be from a location outside of the house, but near the house. Noise abatement is only considered for the first floor of multi-floor units.

Noise-sensitive properties are all residences. Residences include single family or multi-family housing units. Each first floor apartment in an apartment complex or duplex is counted as a separate housing unit. Noise-sensitive properties may also include facilities such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries. Commercial properties are not considered for noise abatement unless they include a sensitive receiver, as defined above (for example, a shopping center that includes a preschool).

Table 1 presents the noise levels, in A-weighted decibels, produced by several common indoor and outdoor activities and noise sources.

Table 1. Common outdoor and indoor noise levels

Common outdoor noise levels	Noise level (dBA[a])	Common indoor noise levels
	110	rock band
jet flyover at 1,200 feet	100	
gas lawn mower at 3 feet, diesel truck at 50 feet	90	food blender at 3 feet
noisy urban daytime	80	garbage disposal at 3 feet
gas lawn mower at 100 feet	70	shouting at 3 feet, vacuum cleaner at 10 feet
commercial area	60	normal speech at 3 feet
quiet urban daytime	50	large business office, dishwasher next door
quiet urban nighttime	40	small theatre, large conference room (background)
quiet suburban nighttime	30	library
quiet rural nighttime	20	concert hall (background)
	10	broadcast and recording studio
	0	threshold of hearing

Source: American Association of State Highway and Transportation Officials, 1993

[a] A-weighted decibels

The PC NAP contains a provision allowing a credit of 3 dBA for the use of RAC. As part of the noise abatement procedure described in the PC NAP, this credit is applied during the mitigation determination process as described below.

According to the PC NAP, noise abatement measures must be feasible, reasonable, and desired by the affected individuals. The following discussion covers feasibility, reasonability and desirability of noise abatement.

Feasibility

Feasibility deals with the engineering considerations of noise abatement. It is the ability to provide abatement in a given location with consideration to the physical and acoustical limitations of the site. This takes into account topography, access, drainage, safety considerations, maintenance requirements and whether or not other noise sources are present

in the area. PCDOT requires a noise reduction of at least 5 dBA for first-row receivers for noise abatement to be considered feasible.

Reasonability

Reasonability means that PCDOT believes mitigation measures are prudent, based on consideration of the following conditions:

- The noise barrier will provide a minimum 5-dBA noise reduction without being more than 10 feet in height.
- The noise barrier will benefit more than one sensitive property.
- The cost of the noise abatement shall not exceed $35,000 per benefited receiver, at $25 per square foot of constructed barrier.

Desired

Although noise barriers may be reasonable and feasible, a majority of the owners for the benefited properties must approve the barrier in order for it to be constructed. Signatures from 50 percent plus one of the affected property owners indicating a desire for the barrier is considered a majority.

2.3 Level of Service Traffic and Noise Levels

Traffic engineers describe the flow of traffic with a series of conditions called levels of service (LOS). LOS A describes free-flowing traffic that is able to travel at or above the posted speed limit with little or no difficulty in changing lanes. The conditions become more congested as the LOS progresses through the alphabet to LOS F, which represents stop-and-go traffic. From a noise perspective, the LOS C condition usually represents the worst hourly traffic noise impacts because traffic speeds are at or near the posted speed limit and lane capacity is high. Although more vehicles may be accommodated when LOS D is achieved, the lower speeds drastically reduce tire noise, a major source of traffic noise.

Traffic volumes for 2030 were obtained from the *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road*, February 2008 (Appendix A). Peak-hour traffic data were used for the traffic analysis. These data approximate LOS E as current peak hour conditions and LOS B during the peak hour along the improved La Cholla Boulevard.

2.4 Noise Analysis Overview

Aerial photographs and field reconnaissance were used to determine the approximate locations and land use activities of potential sensitive receivers near the roadway. Field measurements were used to determine the existing noise levels throughout the Study Area, as described in Section 3.0, *Existing Noise Environment*. The TNM 2.5 model was used to predict the noise levels that would occur with the proposed improvements to La Cholla Boulevard. Standard English units of measurement were used for this study.

As noted earlier, traffic-generated noise levels are affected by traffic volumes, traffic speeds, and traffic mix (the percentage of cars, medium trucks, heavy trucks, buses, and motorcycles). These variables were used in the TNM 2.5 model to predict future noise levels at the sensitive

receiver locations. Traffic volumes and speeds used in the modeling for this project represent "worst case" peak-hour or LOS C traffic conditions.

Unmitigated noise levels for the 2030 traffic and roadway conditions were determined and compared with the appropriate noise abatement criterion to determine whether traffic noise mitigation should be considered. Generally, the mitigation considerations consist of noise barriers in the right-of-way (R/W). Although other mitigation considerations are possible, noise barriers are considered the most cost-effective and accepted technique when they are warranted. These barriers may consist of earth berms or concrete/masonry walls, or combinations of the two barrier types.

2.5 Potential Mitigation Strategies

A number of mitigation strategies are available that may be applied independently or in combination to achieve the desired results. These involve elements of the roadway design, roadway surface, and restrictions on the use of roadway, as well as construction of noise barriers. These mitigation strategies are introduced below and analyzed for reasonability, feasibility, and desirable qualities as they relate to this project in Section 5.0, *Traffic Noise Considerations and Mitigation Alternatives*.

Roadway Design

Roadway design measures include altering the roadway alignment or depressing roadway sections. Altering the roadway alignment could involve realigning the roadway along a new centerline to move the roadway away from a sensitive receiver. Depressing the roadway lowers the roadway below grade, also moving traffic farther away from affected receivers.

Rubberized Asphalt Concrete Surface

Rubberized asphalt pavement has been shown to reduce noise impacts, averaging 4 dBA or better, at adjacent properties when compared with standard concrete pavement (JHK and Associates 1996). Pima County uses RAC on all roadway projects and allows a noise analysis credit of 3 dBA to account for the noise reduction properties of the pavement. RAC will be used on the La Cholla Boulevard, Ruthrauff Road to River Road, project and the credit will be reflected in the noise analysis results.

Traffic Management

Traffic management measures include restricting truck traffic entirely or during certain hours of the day and reducing the posted speed limit. Both strategies would reduce the noise levels at adjacent properties because trucks produce more noise than automobiles and because higher vehicle speeds generate more noise than lower vehicle speeds (FHWA 1976).

Noise Barriers

Construction of noise barriers between the roadways and the affected receivers reduces noise levels by physically blocking the transmission of traffic-generated noise. Barriers can be constructed as walls or earthen berms. Noise barriers should be high enough to break the line-of-sight between the noise source and the receiver. They must also be long enough to prevent noise from transmitting around the ends of the barrier. Openings in a barrier, for driveways or sidewalks, can significantly reduce the barrier's effectiveness. Earthen berms

require more right-of-way than do walls. They are usually constructed at a 3-to-1 slope in each direction. Thus, a berm 8 feet high would slope 24 feet in each direction, for a total width of 48 feet.

2.6 Analysis Limitations

This noise analysis is based on design and traffic information available at the time of the analysis. The following assumptions were made to reach conclusions during the analysis phase:

- The project designs as evaluated in this report will not change.
- Future traffic volumes, vehicle mix and speed will remain consistent with those predicted in the traffic study for this project.
- The nature of the land use will remain consistent with current use and planned development (i.e., industrial businesses will not be constructed where retail and professional offices are currently planned)
- The area where people are most likely to spend time outside of their homes is in their yards, near their homes.

While the TNM 2.5 model has been calibrated and tested against actual noise measurements for several years, it should be noted that it is still a noise prediction model. The results of this analysis assume the predicting capabilities of TNM are sufficient.

Assumptions have been made to simplify the calculations for TNM.

- The receiver (representing human hearing) is 5 feet above ground.
- The angle of view from the receiver to the road is 180 degrees.
- The terrain between the roadway and the receiver is flat.
- The ground type is consistent throughout the project area.

The noise levels used in the predictions are measured in L_{Aeq1h}. As stated in Section 2.1, this is the A-weighted average that represents the steady level over 1 hour that would produce the same energy as the actual signal. The actual instantaneous noise levels fluctuate above and below the measured L_{eq} during the measurement period (e.g., a police siren, a particularly noisy truck, or unusually high traffic volumes). Therefore, the use of L_{Aeq1h} for predicting noise levels and conducting the noise evaluation does not consider the noise levels as they may occur in their full range. The fluctuation of instantaneous noise levels will result in sounds that temporarily exceed the noise levels as they have been presented in the noise evaluation. However, these instantaneous noise levels cannot be predicted. Therefore, they cannot be used in the noise analysis.

3.0 Existing Noise Environment

3.1 Description of Sensitive Noise Receiver Areas

Sensitive noise properties within the Study Area are mostly single-family residential properties. The linear park along the Rillito River is also considered a sensitive noise property.

Existing walls and fences within the Study Area were examined to determine whether they would reduce sound transmission. None of the existing fences were considered to provide adequate noise level reduction. Therefore, the existing fences were not included during the existing conditions noise model calculations.

Many of the residential properties have direct access onto La Cholla Boulevard. Direct-access driveways reduce the effectiveness of noise mitigation with barriers because gaps in noise barriers allow noise to travel beyond the barrier. If frontage roads are constructed or if the properties are acquired, the direct access to La Cholla Boulevard would be eliminated.

3.2 Roadway Geometry and Topography

The horizontal alignment for La Cholla Boulevard consists of one straight roadway segment. The vertical alignment follows the existing terrain with relatively mild grades. Immediately north of Ruthrauff Road, La Cholla Boulevard is two lanes across, with one lane in each direction. A dedicated northbound left-turn lane is located at the intersection with Curtis Road. North of the Rillito River bridge, La Cholla Boulevard widens from two lanes to six lanes with dedicated turn lanes at the River Road intersection.

The terrain within the Study Area is relatively flat, with elevations ranging from 2,280 to 2,260 feet above mean sea level, generally sloping to the northwest.

3.3 Existing Noise Levels

Field readings were taken at three monitoring sites within the Study Area to determine the existing noise levels (Table 2). These sites were selected to be representative of areas of differing land uses and traffic characteristics. The monitoring sites are described below and are shown in Appendix B, *Monitoring Sites, Receiver Locations, and Potential Barrier Locations*.

Existing noise levels were recorded at the monitoring sites with a Larson Davis Model 820 Type 1 integrating sound-level meter. The sound-level meter was placed approximately 5 feet above the ground at the monitoring sites. Three 10-minute-long sound level recordings were taken at each site.

The readings were taken during the peak-hour traffic flow on the following days:

- October 4, 2007, from 7 to 8:30 a.m. and from 4:45 to 6:15 p.m.
- October 10, 2007, from 7:30 to 8 a.m. and from 4:45 to 5:15 p.m.

Traffic data was also collected during each of the noise measurement readings, including the average speed, traffic volume traveling in both directions and the vehicle mix. Table 2 presents the total number of vehicles and the vehicle mix recorded at each monitoring location.

Table 2. Monitoring site vehicle counts and mix

Monitoring site	Total vehicles per hour	Percentage automobiles	Percentage medium trucks	Percentage heavy trucks
1. 4908 N. La Cholla Blvd.	2,864	97	1	2
2. 4981 N. La Cholla Blvd.	1,857	97	1	2
3. Rillito River Park at La Cholla Blvd.	1,988	97	1	2

The weather conditions during the October 4, 2007, readings were partly cloudy with temperatures at 78 degrees Fahrenheit in the morning and 91 degrees Fahrenheit in the evening. The relative humidity in the morning was 50%, with a breeze coming from the east averaging 3 mph. The evening had 32% relative humidity, with a breeze coming from the west averaging 3 mph and short wind gusts reaching 9 mph.

The weather conditions during the October 10, 2007, readings were clear skies with temperatures at 68 degrees Fahrenheit in the morning and 92 degrees Fahrenheit in the evening. The relative humidity in the morning was 36%, with a 1.5 mph breeze coming from the northeast. In the evening, the relative humidity was 15%, with a 1.5 mph breeze coming from the northeast.

The monitoring site conditions were modeled in TNM 2.5 to evaluate the accuracy of TNM 2.5 to predict noise levels for the Study Area. Ambient noise levels, as reflected in Table 3, are the average of the three noise level readings taken at each monitoring site during the morning and evening peak traffic hours. These levels were compared with predicted sound levels from the modeled conditions. This comparison was used to make any necessary adjustments to the model input to most accurately reflect site conditions.

Table 3. Ambient noise levels compared with modeled noise levels

Monitoring site	Ambient noise level (average dBA L_{Aeq1h})	Modeled noise level (dBA L_{Aeq1h})
1. 4908 N. La Cholla Blvd. – approximately 53 feet from the edge of pavement.	68	69
2. 4981 N. La Cholla Blvd. – approximately 66 feet from the edge of pavement.	66	66
3. Rillito River Park at La Cholla Blvd. – approximately 42 feet from the edge of pavement.	66	69

The ambient peak-hour noise levels ranged from 66 dBA L_{Aeq1h} to 68 dBA L_{Aeq1h} at the monitored sites, which ranged between 42 and 66 feet from the edge of pavement of La Cholla Boulevard. Monitoring site number 2 was equidistant from the road as the fenced yards at the adjacent properties. Monitoring sites 1 and 3 were at or near the R/W line for La Cholla Boulevard. Monitoring site 3 was located at Rillito River Park, near the bridge that crosses the Rillito River. The dominant noise source at each of the monitoring sites was traffic on La Cholla Boulevard.

Predicted existing peak-hour noise levels along La Cholla Boulevard ranged from 66 dBA $L_{Aeq1h\ to}$ 69 dBA L_{Aeq1h} at the receivers. TNM 2.5 calculated noise levels at or slightly higher than levels at the monitored locations, showing that the predictions are conservative. The modeled noise levels at monitoring site 3 shows a 3 dBA increase from the ambient noise levels. Because of the site's proximity to the bridge, TNM 2.5 makes certain adjustments to address higher noise levels produced by roadways on a structure. These adjustments may result in predicted noise levels that are higher than the ambient noise levels. The predicted noise levels are within 3 dBA of the ambient levels for all three monitoring sites. Based on the results, TNM 2.5 was considered capable of accurately predicting noise levels for this project.

In addition to the ambient noise level monitoring at select locations, 56 sensitive receiver locations were identified within the Study Area. Existing noise levels were modeled at each of these receiver locations. The modeled existing peak-hour noise levels along La Cholla Boulevard ranged from 58 dBA L_{Aeq1h} to 68 dBA L_{Aeq1h} at the residential locations and 62 dBA L_{Aeq1h} to 69 dBA L_{Aeq1h} at Rillito River Park (see Appendices C and D).

The model's results show that noise levels at 26 of the sensitive receiver locations exceed the PC NAP mitigation criterion for the 2007 existing conditions. Of these 26 locations, 23 were at residences adjacent to La Cholla Boulevard. The remaining three sensitive receiver locations were located in Rillito River Park.

4.0 Future Conditions

4.1 Future Noise Levels

Noise levels were evaluated for 56 sensitive receiver locations within the Study Area. Thirty-six of the receivers were directly adjacent to La Cholla Boulevard and located within 120 feet of the proposed La Cholla Boulevard centerline (the exception being at Rillito River Park). To represent the second row of homes parallel to but set farther back from La Cholla Boulevard, 20 additional receivers were evaluated. These receivers were located within 260 feet of the proposed La Cholla Boulevard centerline. The information provided by the additional row of receivers is useful in understanding roadway noise impacts at these locations for the proposed design with the future (2030) peak-hour traffic volumes. In addition, the design concept report includes alternatives that would eliminate one or both frontage roads and substitute residential property acquisitions. Thus, the evaluation of second row properties also identifies the likely impact and mitigation needs for design concept report alternatives that would involve these residential property acquisitions. Please see Appendix B for future roadway design information and receiver locations.

4.2 Noise Analysis Results

The 56 sensitive receivers were evaluated for traffic noise levels resulting from 2030 peak-hour traffic conditions. The results of the noise analyses are included in the *Noise Analysis Summary: Properties Adjacent to La Cholla Boulevard* (Appendix C) and the *Noise Analysis Summary: Second Row Properties* (Appendix D). The description of each column for both appendices follows:

- Column one lists an arbitrarily assigned number used to identify the receiver. Second row receivers (Appendix D) are identified by an "s" following the number. Identification numbers begin at the southern end of the project and progress numerically toward the northern end.
- Column two lists the distance and direction from the future roadway centerline to the sensitive receiver.
- Column three lists the address of the property the receiver represents.
- Column four provides the existing condition for the modeled noise level, in dBA L_{Aeq1h} (the equivalent average sound level within 1 hour).
- Column five provides unmitigated noise levels for the future build condition, using the proposed conditions and the 2030 peak-hour traffic volumes.
- Column six provides the future noise levels with the credit of 3 dBA for using RAC as the pavement surface.
- Column seven displays the mitigated future noise levels with RAC as the pavement surface, with the noise barriers constructed as presented in this study. The mitigated noise level is only provided for properties whose future noise levels with the credit of 3 dBA for RAC exceed the PC NAP mitigation criterion of 66 dBA or higher.
- Column eight provides a determination of whether mitigation measures should be considered at each location, based on the PC NAP criteria of noise levels reaching 66 dBA or higher.

The TNM 2.5 output files, from which the results came, are included in the *Traffic Noise Model (TNM 2.5) Output Files* (Appendix F). The files are entitled: *La Cholla, Existing Condition; La Cholla, Future-no RAC; La Cholla, Future-RAC;* and *La Cholla, Proposed-PC Criteria RAC*.

Predicted future peak-hour noise levels at the 36 existing sensitive receivers adjacent to La Cholla Boulevard would range from 59 dBA L_{Aeq} to 70 dBA L_{Aeq}, with the credit of 3 dBA applied for RAC. Of the 36 sensitive receiver locations, 32 receivers had a predicted future noise level exceeding the PC NAP mitigation criterion of 66 dBA or higher. Based on these noise levels, the 32 receivers are further evaluated for noise mitigation, as discussed in the next section.

The 20 second row sensitive receivers had noise levels ranging from 53 dBA L_{Aeq1h} to 66 dBA L_{Aeq1h} if the first row of homes were removed. Of the 20 sensitive receiver locations, 1 had a predicted future noise level exceeding the PC NAP mitigation criterion of 66 dBA or higher. This receiver is further evaluated for noise mitigation, as discussed in the next section.

5.0 Traffic Noise Considerations and Mitigation Alternatives

Several mitigation measures can be considered by Pima County to avoid, reduce, or otherwise mitigate environmental impacts associated with the proposed project. The discussion of these measures in this report does not obligate Pima County to implement them. Pima County may choose to modify, delete, or add measures to mitigate impacts.

Predicted future noise levels would exceed the PC NAP mitigation criterion for noise-sensitive properties at 32 sensitive receiver locations adjacent to La Cholla Boulevard and at 1 of the second row sensitive receiver locations. Noise mitigation measures were evaluated for these receivers. These measures are introduced in Section 2.5, *Potential Mitigation Strategies*. They have been individually analyzed for PC NAP defined feasibility and reasonability as they relate to this project.[1] The analysis is presented in Table 4.

[1]Feasibility deals with the engineering issues associated with the mitigation strategy. For each strategy, the following question was asked: Can engineering plans be developed to provide the abatement with consideration to the physical and acoustical limitations of this project area?

Reasonability considers, even if the abatement can be achieved with the mitigation, whether the cost will be reasonable, enough receivers will be benefited, and whether the structural efforts will be unreasonable (a barrier is too high, the design causes access issues, etc.).

Feasibility and reasonability are defined, according to the PC NAP, in Section 2.2: *Noise Abatement Criteria*.

Table 4. Analysis of potential mitigation strategies

Mitigation	Feasibility	Reasonability
Roadway alignment changes	Design plans can be developed to shift roadway away from the sensitive receivers on one side.	May be reasonable where changing the roadway alignment can move traffic far enough away from sensitive receivers to achieve adequate noise reduction. A substantial amount of space would be necessary to move the roadway far enough away from the receivers on one side of the road. Acquisition of properties to create the necessary space, realignment of connecting roadways, and the relocation of utilities would make the cost unreasonable.
Depressed roadway	A depressed roadway along La Cholla Boulevard is not feasible because of the need for driveway access and the location of the sanitary sewers.	May be reasonable where an adequate noise reduction can be achieved by constructing the roadway below grade. Widening La Cholla Boulevard will put traffic closer to sensitive receivers. Therefore, the grade necessary to produce an adequate noise reduction would be substantially lower than the existing grade. This would affect alignment with intersecting roads and driveways, and it would be necessary to relocate utilities. Retaining walls would be necessary, affecting driveway access. Resulting construction costs would be more than is reasonable for the expected noise reduction.
Rubberized asphalt concrete	Feasible in that it is relatively easy to include in the project construction. It can be used effectively in the local climate and terrain.	Is reasonable because it can easily be included in the construction plans. It entails a low level of required maintenance. The high durability equates to a reasonable cost for the life cycle of the pavement. Not reasonable for use on the bridge because of maintenance considerations.
Truck restrictions	May be feasible if surrounding arterial streets are designed to handle the additional truck traffic. However, it is not feasible because displacing the truck traffic may conflict with the planned function of the roadway. An arterial road, such as La Cholla Boulevard, generally carries truck traffic. Businesses located along La Cholla Boulevard require trucks.	May be reasonable if an adequate noise reduction can be achieved. However, it is unlikely that the level of truck traffic on La Cholla Boulevard is high enough for truck restrictions to be effective in reducing noise levels. Displacing truck traffic may shift noise impacts to another area.

Mitigation	Feasibility	Reasonability
Noise walls	Not feasible where the walls would limit sight distances for motorists and where crash barriers would limit the length of the walls.	May be reasonable where noise reduction is adequate and cost effective.
Earthen berms	Not feasible to construct berms within the space limitations of the right-of-way of La Cholla Boulevard.	May be reasonable where noise reduction is adequate and cost effective. Not reasonable because to construct berms, homes would need to be removed to provide the necessary space and the required costs would be unreasonable.

Based on this evaluation, noise walls and RAC are the most reasonable and feasible form of noise mitigation for La Cholla Boulevard, Ruthrauff Road to River Road. These two mitigation measures are thoroughly evaluated as they relate to the PC NAP criteria in Appendix E, *Evaluation of Rubberized Asphalt Concrete and Noise Barriers as Mitigation.* Each column is described below:

- Column one of the table lists the receivers potentially receiving sound reduction as a result of the barrier.
- Column two lists the number of residential units associated with the receivers.
- Column three provides the future noise levels for each receiver with the credit of 3 dBA for using RAC as the pavement surface.
- Column four displays the mitigated future noise levels with RAC as the pavement surface, assuming the potential noise barriers were to be constructed.
- Column five provides the number of units with noise levels reduced in full accordance with PC NAP requirements (5 dBA or more).
- Column six, *Potential barrier dimensions*, is divided into three sub-columns.
    - The first sub-column provides the potential barrier identification number—an arbitrarily assigned number increasing numerically as the barriers occur from south to north. This column also provides the approximate length of the barrier, in feet.
    - The second sub-column provides the barrier height, in feet, necessary to provide a noise reduction of 5 dBA or greater.
    - The third sub-column lists the total square footage of the barrier.
- Column seven, *Potential barrier costs*, provides the total cost for the barrier and the cost per benefited receiver.
    - The total barrier cost is calculated at $25 per square foot. This cost per square foot criteria is a baseline number established by PCDOT to provide a county-wide guideline for determining the cost reasonability of any noise wall. The actual cost of the wall may be higher or lower depending on aesthetic treatments, structural requirements, and fluctuating labor and material costs.

- The cost per benefited receiver is the total cost divided by the number of benefited units (from the fifth column).

The final column provides the final determination of whether or not the barrier meets all of the PC NAP criteria for reasonability. These criteria state that:

- The noise barrier will provide a minimum 5-dBA noise reduction without being more than 10 feet in height.
- The noise barrier will benefit more than one sensitive property.
- The cost of the noise abatement shall not exceed $35,000 per benefited receiver, at $25 per square foot of constructed barrier.

For the proposed improvements, five potential barriers were evaluated. Three of the barriers were evaluated for placement within the R/W, between the residences and La Cholla Boulevard. These are barriers 1, 3, and 5. Barrier 1 was evaluated for placement in front of the residential property south of Noreen Street on the east side of La Cholla Boulevard. Barrier 3 was evaluated for placement in front of the residential property south of Calle Narciso, on the west side of La Cholla Boulevard. Barrier 5 was evaluated for placement in front of the residential properties on the east side of La Cholla Boulevard, north of Jay Avenue. Barriers 2 and 4 were evaluated for placement within the medians separating the proposed frontage roads from La Cholla Boulevard. The sight distance necessary for motorists was considered while determining the lengths and placement of the barriers. They would range in height from 6 feet to 10 feet and would reduce noise levels at the benefited receivers to between 60 dBA and 64 dBA, for an average noise level reduction of 5 dBA.

No potential barriers were considered for construction along the Rillito River Park, although 2030 predicted noise levels exceeded PC NAP criteria for noise mitigation. The park runs parallel to Rillito River, with access to the public use trail from La Cholla Boulevard at four points. This park provides minimal seating or other areas for prolonged stays. Other than use for access to the public use trail, the park areas adjacent to La Cholla Boulevard do not provide for fixed recreational use—most park users would be passing through the area on the trail rather than staying in the area near La Cholla Boulevard for prolonged periods of time. Furthermore, the topography of the park and its elevation in relation to the roadway would require walls taller than are permitted. The access trails would create breaks in the walls, minimizing their effectiveness. Wall construction could also present safety hazards for the public.

The noise levels at 11 of the residences could not be reduced in full accordance with the PC NAP requirements because the effectiveness of the barrier was limited by the placement of the barriers to provide adequate sight distance for motorists. These receivers would experience noise reductions of 0 dBA to 4 dBA, less than the required noise reduction of 5 dBA. The placement of the evaluated barriers provided the 17 other receivers adjacent to La Cholla Boulevard and the 1 second row receiver with adequate noise reduction to meet PC NAP criteria.

Of the five barriers evaluated along La Cholla Boulevard, only three barriers met the PC NAP requirements for noise reduction, cost per benefited receiver (at $25 per square foot), and number of benefited receivers per wall. Barrier 2 is proposed for construction within the median separating the east frontage road from La Cholla Boulevard. This barrier would

benefit four sensitive receivers, at an approximate cost of $29,902 per receiver. Barrier 4 is proposed for construction within the median separating the west frontage road from La Cholla Boulevard. This barrier would benefit five sensitive receivers at an approximate cost of $22,840 per receiver. Barrier 5 is proposed for construction to provide noise mitigation for the residences north of Jay Avenue, on the east side of La Cholla Boulevard. This barrier would have openings to allow access to the adjacent properties. Seven sensitive receivers would be benefited by this barrier, including the 1 second row receiver. The cost per benefited receiver would be approximately $25,285.

The three barriers would amount to approximately 16,431 square feet of wall. Following the standard cost of $25 per square foot, as recommended by the PC NAP, the cost of noise mitigation along La Cholla Boulevard would be approximately $411,000.

Should the homes adjacent to the planned frontage roads be removed, none of the second row receivers then exposed to La Cholla Boulevard would experience noise levels exceeding the PC NAP criteria for noise abatement. Therefore, no noise mitigation for these properties would be warranted.

6.0 Construction Noise

Construction of any part of the proposed improvements may cause temporary noise impacts. The quantification of such impacts is difficult without data on this project's construction schedule and equipment use. Therefore, certain assumptions were made to predict the approximate noise level at the R/W line. These predictions are based on the loudest equipment expected to be used during each construction stage of a typical roadway project. Data on construction equipment noise are available from the USDOT's *Highway Construction Noise: Measurement, Prediction and Mitigation* (1977).

An analysis was conducted during a freeway construction project in Arizona that assessed the collective impact of construction noise. The noise levels were calculated at the R/W line. The distance between the R/W line and the construction activity was estimated based on the type of work being performed.

The results of the preliminary estimates, shown in Table 5, indicate that sensitive receivers adjacent to the R/W would be affected by construction noise. The highest noise levels would occur during the grading/earthwork phase.

Table 5. Construction equipment noise

Phase	Equipment	Equipment L_{max}[a]	Number of feet to right-of-way	L_{max}[a] at right-of-way
Site clearing	Dozer	84	50	88
	Backhoe	85	50	
Grading/earthwork	Scraper	92	75	93
	Grader	91	75	
Foundation	Backhoe	85	100	85
	Loader	84	100	
Base preparation	Compressor	85	100	85
	Dozer	84	100	

[a] maximum instantaneous sound level in decibels

The Pima County Noise Code (Chapter 9.30.070) limits construction activities to between 5 a.m. and 7 p.m. from April 15 to October 15 and between 6 a.m. and 7 p.m. from October 16 to April 14. Permits will be required if construction will need to occur outside of the allowed times.

7.0 Conclusion

Noise mitigation for the La Cholla Boulevard, Ruthrauff Road to River Road, project has been evaluated in this report. Future noise levels were predicted using TNM 2.5 with consideration of conditions with no mitigation, conditions with the application of RAC as the only mitigation, and conditions with the construction of noise walls and the application of RAC. Potential mitigation measures were evaluated for reasonability and feasibility with consideration of the existing conditions of La Cholla Boulevard and the proposed roadway design. The most reasonable and feasible mitigation measures for this project are the use of RAC for the roadway surface and the construction of noise walls where they meet Pima County's noise abatement criteria.

Three noise walls are recommended for construction along La Cholla Boulevard; barriers 2 and 4 would be placed in the proposed frontage road medians, and barrier 5 would be placed north of Jay Avenue on the east side of the road. These walls would benefit 16 individual residences at an approximate cost of $411,000. If one or both of the frontage roads were eliminated and adjacent residential properties at these locations were acquired (based on consideration of one of the design concept report alternatives), no noise walls would be warranted along this portion of La Cholla Boulevard. Barrier 5 would still be recommended.

Although the recommended noise walls meet PC NAP criteria for construction, desire for the noise walls must be expressed by a majority of the property owners at the benefited residences for each wall. Walls are not always desired because they block sunlight and views, are

sometimes considered a vandalism concern, or can be considered unattractive. The affected property owners for each recommended wall are contacted to assess its desirability. Fifty-one percent of the benefited property owners must consent in order for the noise wall to be constructed.

Noise abatement for construction-related activities will involve limiting construction activities to between the identified hours as described by the Pima County Noise Code (Chapter 9.30.070).

8.0 Bibliography and References

American Association of State Highway and Transportation Officials. 1993. *Guide on Evaluation and Abatement of Traffic Noise*.

JHK and Associates. 1996. *A Comparison of Traffic Noise from Asphalt, Rubber Asphalt, Concrete Friction Courses (ARACFC) and Portland Cement Concrete Pavements (PCCP)*, FHWA-AZ-96-433. Phoenix.

Pima Association of Governments. 2006. *2030 Regional Transportation Plan.* <http://www.pagnet.org/documents/RTP/RTP2030/RTP2030FullUpdate September2006.pdf> (accessed on April 17, 2008).

Pima County Department of Transportation (PCDOT). 2003. *Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects.* December 2003. Tucson.

———. 2008. *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road*. Prepared by Kimley-Horn and Associates. Tucson.

———. 2008. *Revision of Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects.* April 2008.

United States Department of Transportation, Federal Highway Administration (FHWA). 1976. *The Audible Landscape: A Manual for Highway Noise and Land Use*. Prepared by the Office of Research and Development. Washington, D.C.

———. 1977. *Highway Construction Noise: Measurement, Prediction and Mitigation*.

———. 1980. *Fundamentals and Abatement of Highway Traffic Noise: Textbook and Training Course*.

———. 1994. *A Guide to Visual Quality in Noise Barrier Design*, FHWA-HI-94-039.

———. 1995. *Highway Traffic Noise Analysis and Abatement, Policy and Guidance*.

9.0 Glossary

ambient noise level: The noise level existing in an area before the introduction of a proposed roadway improvement project. This quantity is measured in dBA and expressed as L_{eq} ambient noise levels.

at-grade roadway: A roadway that is level with the immediate surrounding terrain.

automobiles: All vehicles with two axles and four wheels, designed primarily for passenger transportation of cargo (light trucks). Generally, the gross vehicle weight is less than 10,000 pounds.

barrier: A solid wall or earthen berm that breaks the line-of-sight between the roadway and noise receiver location, reducing the noise level at the receiver.

decibel (dB): A logarithmic unit that indicates the amount of sound energy.

decibel, A-weighted (dBA): The A-weighted decibel scale approximates the sensitivity of the human ear. The approximate threshold of hearing is 0 dBA, while the approximate threshold of pain is 140 dBA. Most suburban areas have daytime noise levels ranging from 50 to 70 dBA.

depressed roadway: A roadway that is constructed below the immediate surrounding terrain.

design year: The future year used to determine the probable traffic volume for which a highway is designed.

elevated roadway: A roadway that is constructed above the immediate surrounding terrain, either on an embankment or a structure.

existing noise levels: The noise resulting from the natural and mechanical sources and human activity usually present in a particular area.

heavy trucks: All vehicles having three or more axles and eight or more wheels that are designed for cargo transportation. Generally, the gross vehicle weight is greater than 26,400 pounds.

L_{Aeq1h}: The L_{eq} for one hour.

L_{eq}: The equivalent steady-state, A-weighted sound level that, in a stated period of time, would contain the same acoustical energy as the time-varying sound levels during the same period.

level of service (LOS): The operating performance of a freeway, roadway, or intersection. Level of service is a qualitative description of operation based on the degree of delay and maneuverability.

light trucks: All vehicles with two axles and four wheels designed primarily for transportation of passengers and cargo. Generally, the gross vehicle weight is equal to or less than 10,000 pounds.

medium trucks: All vehicles having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 10,000 pounds but less than 26,400 pounds.

noise level reduction: The process of removing noise from an observer by the application of noise mitigation.

peak hour: The single morning or evening hour when the maximum traffic volume occurs.

receiver: The location at which noise levels are measured, modeled, and analyzed. Receivers of interest are typically residences, schools, parks, or other noise-sensitive properties.

right-of-way (R/W): Publicly owned land used or intended to be used for transportation and other purposes.

rubberized asphalt: This material consists of regular asphalt paving mixed with ground-up, used tires. Rubberized asphalt is generally smoother and quieter, helping to reduce tire noise.

sound level (noise level): Weighted sound level measured with a sound-level meter having metering characteristics and a frequency weighting of A, B, or C, as specified in the sound-level meter standard.

speed: The rate of movement of vehicular traffic, in miles per hour (mph).

traffic noise impacts: Impacts that occur when the predicted traffic noise equals or exceeds the noise abatement criteria levels.

Appendix A

Traffic Data

Traffic Data

Existing and projected traffic volumes were obtained from the *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road*, February 2008.

Existing two-way 24-hour traffic volumes were collected in August 2007 at three locations along La Cholla Boulevard within the Study Area:

1. La Cholla Boulevard, between Wetmore Road and Ruthrauff Road
2. La Cholla Boulevard, between Ruthrauff Road and Curtis Road
3. La Cholla Boulevard, between Curtis Road and River Road

Existing peak-hour traffic volumes are as follows:

Table A-1. 2007 existing peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Between Wetmore Road and Ruthrauff Road	290	290
Between Ruthrauff Road and Curtis Road	950	950
Between Curtis Road and River Road	1,140	1,140

Source: Kimley-Horn and Associates, Inc., *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road*, February 2008

The future conditions were calculated based on traffic projections from the Pima Association of Governments (PAG) regional model. The PAG model is based on the *Adopted 2030 Regional Transportation Plan*, which considers conditions resulting from all future roadway projects included in the plan.

Table A-2. 2030 forecast peak-hour traffic volumes

Location	Northbound vehicles	Southbound vehicles
Between Wetmore Road and Ruthrauff Road	440	440
Between Ruthrauff Road and Curtis Road	1,640	1,640
Between Curtis Road and River Road	1,760	1,760

Source: Kimley-Horn and Associates, Inc., *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road*, February 2008

The vehicle mix was measured in April 2007 during a 2-hour period from 9 a.m. to 11 a.m.

Table A-3. Vehicle mix

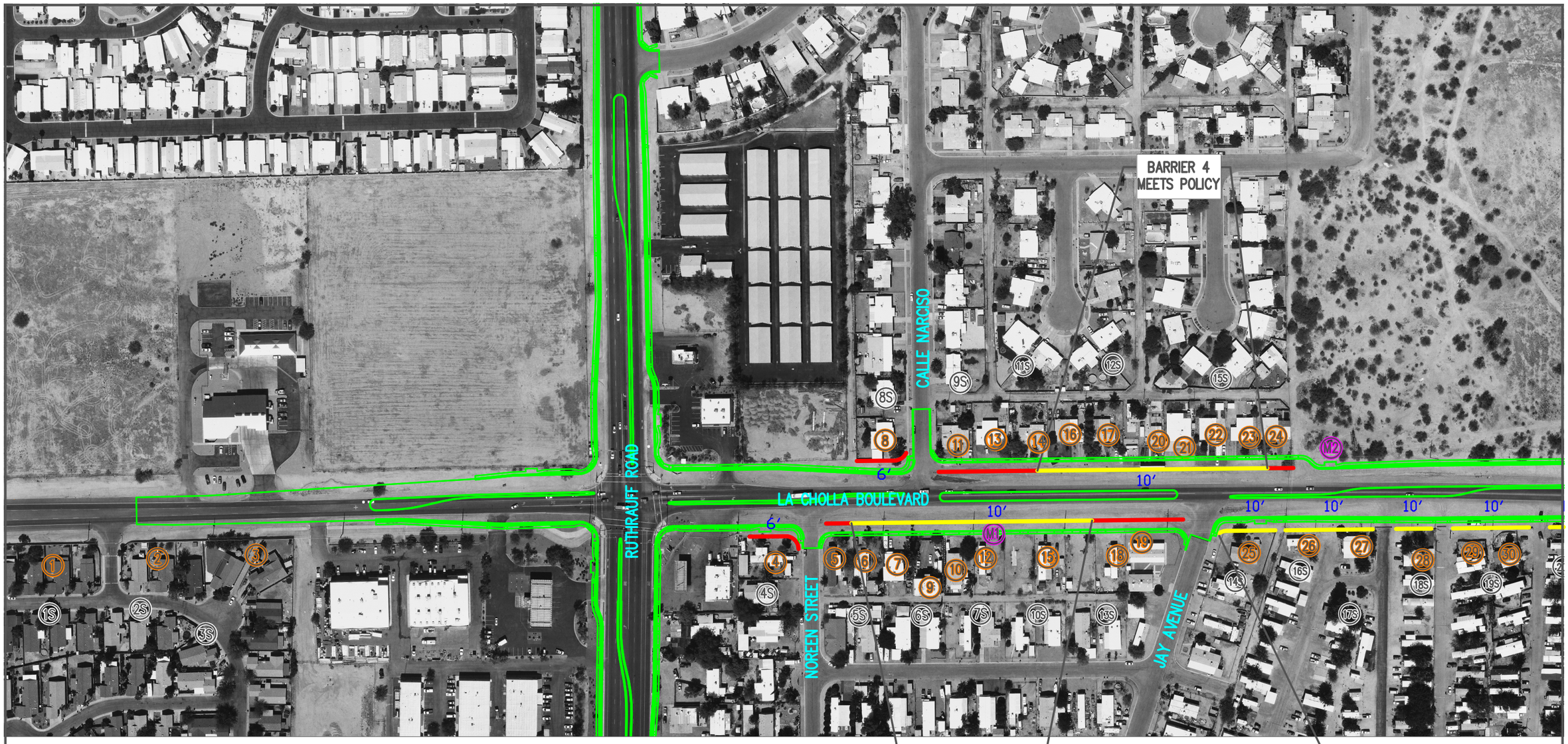
Location	Vehicle class type percentage		
	Automobiles	**Medium trucks**	**Heavy trucks**
Between Ruthrauff Road and Curtis Road	90	5	5
Between Curtis Road and River Road	90	5	5

Source: Kimley-Horn and Associates, Inc., *Final Traffic Engineering Study for La Cholla Boulevard, Ruthrauff Road to River Road*, February 2008

The existing and future operating speeds for La Cholla Boulevard, between Ruthrauff Road and River Road, are 45 mph.

Appendix B

Monitoring Sites, Receiver Locations, and Potential Barrier Locations



LEGEND

- Proposed Roadway Design
- (M1) Monitoring Site
- (1) Receiver Location
- (1S) Second Row Receiver Location
- Potential Barrier Meeting PCDOT Criteria
- Potential Barrier Not Meeting PCDOT Criteria
- 10′ Barrier Height Necessary to Achieve Sound Reduction

LA CHOLLA BOULEVARD *RUTHRAUFF ROAD TO RIVER ROAD*

WORK ORDER NUMBER 4LCITR

APPENDIX B - SHEET 1 OF 2
MONITORING SITES, RECEIVER LOCATIONS,
AND POTENTIAL BARRIER LOCATIONS

N

BARRIER 4
MEETS POLICY

CURTIS ROAD

RIVER ROAD

LA CHOLLA BOULEVARD

JAY AVENUE

BARRIER 5
MEETS POLICY

10′

LEGEND

- Proposed Roadway Design
- (M1) Monitoring Site
- (1) Receiver Location
- (1S) Second Row Receiver Location
- Potential Barrier Meeting PCDOT Criteria
- Potential Barrier Not Meeting PCDOT Criteria
- 10′ Barrier Height Necessary to Achieve Sound Reduction

LA CHOLLA BOULEVARD *RUTHRAUFF ROAD TO RIVER ROAD*

WORK ORDER NUMBER 4LCITR

APPENDIX B - SHEET 2 OF 2
MONITORING SITES, RECEIVER LOCATIONS,
AND POTENTIAL BARRIER LOCATIONS

N

Appendix C

Noise Analysis Summary

Properties Adjacent to La Cholla Boulevard

APPENDIX C – NOISE ANALYSIS SUMMARY
PROPERTIES ADJACENT TO LA CHOLLA BOULEVARD

Receiver ID	Distance and Direction from Future Centerline (feet)	Property Address	Existing Condition (2007) dBA L_{Aeq1h}	Unmitigated Future Condition (2030) dBA L_{Aeq1h}	Future Condition* with RAC, no barrier (2030) dBA L_{Aeq1h}	Future Condition* with RAC and barrier (2030) dBA L_{Aeq1h}	Mitigation Considerations (For future build condition)
1	92 East	4631 N. Brightside Drive	58	62	59	--	None—Below PC NAP
2	92 East	4661 N. Brightside Drive	59	63	60	--	None—Below PC NAP
3	90 East	2088 W. Brittain Drive	59	63	60	--	None—Below PC NAP
4	114 East	2091 W. Noreen Street	65	70	67	62	Potential Barrier 1 (See Appendix E)
5	96 East	4830 N. La Cholla Boulevard	65	70	67	65	Potential Barrier 2 (See Appendix E)
6	102 East	4838 N. La Cholla Boulevard	65	69	66	63	Potential Barrier 2 (See Appendix E)
7	110 East	4846 N. La Cholla Boulevard	65	70	67	62	Potential Barrier 2 (See Appendix E)
8	90 West	2101 W. Calle Narciso	68	72	69	64	Potential Barrier 3 (See Appendix E)
9	145 East	4854 N. La Cholla Boulevard	63	68	65	--	None—Below PC NAP
10	112 East	4900 N. La Cholla Boulevard	66	70	68	61	Potential Barrier 2 (See Appendix E)
11	82 West	4901 N. La Cholla Boulevard	68	72	69	69	Potential Barrier 4 (See Appendix E)
12	98 East	4908 N. La Cholla Boulevard	66	70	68	61	Potential Barrier 2 (See Appendix E)
13	92 West	4911 N. La Cholla Boulevard	67	71	68	68	Potential Barrier 4 (See Appendix E)
14	93 West	4921 N. La Cholla Boulevard	68	72	69	66	Potential Barrier 4 (See Appendix E)
15	99 East	4924 N. La Cholla Boulevard	66	71	68	62	Potential Barrier 2 (See Appendix E)
16	97 West	4931 N. La Cholla Boulevard	67	71	68	63	Potential Barrier 4 (See Appendix E)
17	98 East	4941 N. La Cholla Boulevard	67	71	68	62	Potential Barrier 4 (See Appendix E)

APPENDIX C – NOISE ANALYSIS SUMMARY
PROPERTIES ADJACENT TO LA CHOLLA BOULEVARD

Receiver ID	Distance and Direction from Future Centerline (feet)	Property Address	Existing Condition (2007) dBA L_{Aeq1h}	Unmitigated Future Condition (2030) dBA L_{Aeq1h}	Future Condition* with RAC, no barrier (2030) dBA L_{Aeq1h}	Future Condition* with RAC and barrier (2030) dBA L_{Aeq1h}	Mitigation Considerations (For future build condition)
18	98 East	4940 N. La Cholla Boulevard	66	71	68	67	Potential Barrier 2 (See Appendix E)
19	94 East	4950 N. La Cholla Boulevard	67	71	68	68	Potential Barrier 2 (See Appendix E)
20	83 West	4955 N. La Cholla Boulevard	68	72	69	62	Potential Barrier 4 (See Appendix E)
21	92 West	4961 N. La Cholla Boulevard	67	71	69	62	Potential Barrier 4 (See Appendix E)
22	98 West	4967 N. La Cholla Boulevard	67	71	68	62	Potential Barrier 4 (See Appendix E)
23	98 West	4973 N. La Cholla Boulevard	67	71	68	64	Potential Barrier 4 (See Appendix E)
24	99 West	4981 N. La Cholla Boulevard	67	71	68	66	Potential Barrier 4 (See Appendix E)
25	107 East	4968 N. Jay Avenue	66	70	67	62	Potential Barrier 5 (See Appendix E)
26	86 East	5000 N. La Cholla Boulevard	67	71	69	61	Potential Barrier 5 (See Appendix E)
27	88 East	5000 N. La Cholla Boulevard	67	71	68	63	Potential Barrier 5 (See Appendix E)
28	106 East	5000 N. La Cholla Boulevard	65	69	66	63	Potential Barrier 5 (See Appendix E)
29	119 East	5050 N. La Cholla Boulevard	66	70	67	62	Potential Barrier 5 (See Appendix E)
30	97 East	5050 N. La Cholla Boulevard	66	70	67	62	Potential Barrier 5 (See Appendix E)
31	88 East	5050 N. La Cholla Boulevard	68	71	68	63	Potential Barrier 5 (See Appendix E)
32	115 East	5100 N. La Cholla Boulevard	66	70	67	63	Potential Barrier 5 (See Appendix E)
33	108 West	Rillito River Park at La Cholla Boulevard southwest corner	66	70	-	-	Receiver location is not conducive to barriers
34	102 East	Rillito River Park at La Cholla Boulevard southeast corner	69	72	-	-	Receiver location is not conducive to barriers

APPENDIX C – NOISE ANALYSIS SUMMARY
PROPERTIES ADJACENT TO LA CHOLLA BOULEVARD

Receiver ID	Distance and Direction from Future Centerline (feet)	Property Address	Existing Condition (2007) dBA L_{Aeq1h}	Unmitigated Future Condition (2030) dBA L_{Aeq1h}	Future Condition* with RAC, no barrier (2030) dBA L_{Aeq1h}	Future Condition* with RAC and barrier (2030) dBA L_{Aeq1h}	Mitigation Considerations (For future build condition)
35	214 East	Rillito River Park at La Cholla Boulevard northeast corner	62	67	-	-	Receiver location is not conducive to barriers
36	17 West	Rillito River Park at La Cholla Boulevard northwest corner	68	71	-	-	Receiver location is not conducive to barriers

Note: Shading indicates the noise level exceeds the Pima County Noise Abatement Procedure criterion for noise abatement.
*Results reflect a 3-dBA credit for the application of rubberized asphalt concrete.

Appendix D

Noise Analysis Summary

Second Row Properties

APPENDIX D – NOISE ANALYSIS SUMMARY
SECOND ROW OF PROPERTIES

Receiver ID	Distance and Dirction from Future Centerline (feet)	Property Address	Existing Condition (2007) (dBA L_{Aeq1h})	Unmitigated Future Condition (2030) dBA L_{Aeq1h}	Future Condition* with RAC, no barrier (2030) dBA L_{Aeq1h}	Future Condition* with RAC and barrier (2030) dBA L_{Aeq1h}	Mitigation Considerations (For future build condition)
1S	202 East	4630 N. Brightside Drive	53	57	54	--	None—Below PC NAP
2S	202 East	4660 N. Brightside Drive	54	58	55	--	None—Below PC NAP
3S	250 East	2073 W. Brittain Drive	53	56	53	--	None—Below PC NAP
4S	175 East	2081 W. Noreen Street	61	66	63	--	None—Below PC NAP
5S	230 East	4837 N. Alicia Avenue	60	64	61	--	None—Below PC NAP
6S	235 East	4853 N. Alicia Avenue	60	64	61	--	None—Below PC NAP
7S	230 East	4909 N. Alicia Avenue	60	64	61	--	None—Below PC NAP
8S	170 West	2111 W. Calle Narciso	63	67	64	--	None—Below PC NAP
9S	220 West	2116 W. Calle Narciso	61	65	62	--	None—Below PC NAP
10S	235 East	4925 N. Alicia Avenue	60	64	61	--	None—Below PC NAP
11S	260 West	2115 W. Calle Cusco	59	63	60	--	None—Below PC NAP
12S	260 West	2116 W. Calle Cusco	59	63	60	--	None—Below PC NAP
13S	240 East	4941 N. Alicia Avenue	60	64	61	--	None—Below PC NAP
14S	175 East	4964 N. Jay Avenue	63	67	65	--	None—Below PC NAP
15S	230 West	2116 W. Calle Fortunado	60	64	61	--	None—Below PC NAP
16S	145 East	5000 N. La Cholla Boulevard	65	69	66	61	Potential Barrier 5 (see Appendix E)
17S	240 East	5000 N. La Cholla Boulevard	60	64	61	--	None—Below PC NAP

APPENDIX D – NOISE ANALYSIS SUMMARY
SECOND ROW OF PROPERTIES

Receiver ID	Distance and Direction from Future Centerline (feet)	Property Address	Existing Condition (2007) (dBA L_{Aeq1h})	Unmitigated Future Condition (2030) dBA L_{Aeq1h}	Future Condition* with RAC, no barrier (2030) dBA L_{Aeq1h}	Future Condition* with RAC and barrier (2030) dBA L_{Aeq1h}	Mitigation Considerations (For future build condition)
18S	180 East	5000 N. La Cholla Boulevard	63	67	64	--	None—Below PC NAP
19S	180 East	5050 N. La Cholla Boulevard	63	67	64	--	None—Below PC NAP
20S	140 East	5050 N. La Cholla Boulevard	65	68	65	--	None—Below PC NAP

Note: Shading indicates the noise level exceeds the Pima County Noise Abatement Procedure criterion for noise abatement.
*Results reflect a 3-dBA credit for the application of rubberized asphalt concrete.

Appendix E

Evaluation of Rubberized Asphalt Concrete and Noise Barriers as Mitigation

APPENDIX E
EVALUATION OF RUBBERIZED ASPHALT CONCRETE AND NOISE BARRIER AS MITIGATION

Receiver ID	Number of units	2030 noise level with RAC, no barrier (L_{Aeq1h})	2030 noise level with RAC, and barrier (L_{Aeq1h})	Number of benefited units	Potential barrier dimensions			Potential barrier costs	Comments
					Potential barrier ID and length	*Height**	*Potential barrier square footage (SF)*	*Total cost at $25/SF and cost per benefited receiver*	
4	1	67	62	1	Potential Barrier 1 Approximately 106 feet	6 feet	639	$15,.970 $15,970	Does not meet minimum number of benefited receivers
5 6 7 10 12 15 18 19	10	67 66 67 68 68 68 68 68	65** 63** 62 61 61 62 67** 68**	4	Potential Barrier 2 Approximately 478 feet	10 feet	4,784	$119,609 $29,902	Potential Barrier 2 Meets PCDOT policy
8	1	69	64	1	Potential Barrier 3 Approximately 100 feet	6 feet	602	$15,040 $15,040	Does not meet minimum number of benefited receivers
11 13 14 16 17 20 21 22 23 24	10	69 68 69 68 68 69 69 68 68 68	69** 68** 66** 63 62 62 62 62 64** 66**	5	Potential Barrier 4 Approximately 457 feet	10 feet	4,568	$114,202 $22,840	Potential Barrier 4 Meets PCDOT policy
25 26 27 28 29 30 31 32 16S	9	67 69 68 66 67 67 68 67 66	62 61 63 63** 62 62 63 63** 61	7	Potential Barrier 5 Approximately 707 feet	10 feet	7,079	$176,994 $25,285	Potential Barrier 5 Meets PCDOT policy

Note: Gray shading indicates the barrier meets Pima County Department of Transportation criteria.

* Potential barrier heights are measured from the ground surface and do not include sub-grades, footings, etc.

** Mitigation could not achieve 5-dBA reduction with maximum 10-foot-high barrier

Appendix F

Traffic Noise Model (TNM 2.5) Output Files

HDR, Inc.
C.B.

20 April 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Cholla
RUN: La Cholla, Existing Conditions
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier					With Barrier			
				LAeq1h		Increase over existing		Type Impact	Calculated LAeq1h	Noise Reduction		
				Calculated	Crit'n	Calculated	Crit'n Sub'l Inc			Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1	20	4	0.0	58.1	66	58.1	15	----	58.1	0.0	5	-5.0
Receiver 2	21	3	0.0	59.3	66	59.3	15	----	59.3	0.0	5	-5.0
Receiver 3	22	2	0.0	59.3	66	59.3	15	----	59.3	0.0	5	-5.0
Receiver 4	23	1	0.0	65.1	66	65.1	15	----	65.1	0.0	5	-5.0
Receiver 5	24	1	0.0	64.7	66	64.7	15	----	64.7	0.0	5	-5.0
Receiver 6	25	1	0.0	64.5	66	64.5	15	----	64.5	0.0	5	-5.0
Receiver 7	26	1	0.0	65.4	66	65.4	15	----	65.4	0.0	5	-5.0
Receiver 8	27	1	0.0	67.5	66	67.5	15	Snd Lvl	67.5	0.0	5	-5.0
Receiver 9	28	1	0.0	63.3	66	63.3	15	----	63.3	0.0	5	-5.0
Receiver 10	29	1	0.0	65.8	66	65.8	15	----	65.8	0.0	5	-5.0
Receiver 11	30	1	0.0	67.8	66	67.8	15	Snd Lvl	67.8	0.0	5	-5.0
Receiver 12	31	1	0.0	65.8	66	65.8	15	----	65.8	0.0	5	-5.0
Receiver 13	32	1	0.0	67.0	66	67.0	15	Snd Lvl	67.0	0.0	5	-5.0
Receiver 14	33	1	0.0	67.5	66	67.5	15	Snd Lvl	67.5	0.0	5	-5.0
Receiver 15	34	1	0.0	66.4	66	66.4	15	Snd Lvl	66.4	0.0	5	-5.0
Receiver 16	35	1	0.0	66.6	66	66.6	15	Snd Lvl	66.6	0.0	5	-5.0
Receiver 17	36	1	0.0	66.9	66	66.9	15	Snd Lvl	66.9	0.0	5	-5.0
Receiver 18	37	1	0.0	66.4	66	66.4	15	Snd Lvl	66.4	0.0	5	-5.0
Receiver 19	38	1	0.0	67.1	66	67.1	15	Snd Lvl	67.1	0.0	5	-5.0
Receiver 20	39	1	0.0	67.7	66	67.7	15	Snd Lvl	67.7	0.0	5	-5.0
Receiver 21	40	1	0.0	67.4	66	67.4	15	Snd Lvl	67.4	0.0	5	-5.0
Receiver 22	41	1	0.0	67.1	66	67.1	15	Snd Lvl	67.1	0.0	5	-5.0
Receiver 23	42	1	0.0	66.9	66	66.9	15	Snd Lvl	66.9	0.0	5	-5.0

Receiver 24	43	1	0.0	66.9	66	66.9	15	Snd Lvl	66.9	0.0	5	-5.0
Receiver 25	44	1	0.0	66.0	66	66.0	15	Snd Lvl	66.0	0.0	5	-5.0
Receiver 26	45	1	0.0	67.3	66	67.3	15	Snd Lvl	67.3	0.0	5	-5.0
Receiver 27	46	1	0.0	66.5	66	66.5	15	Snd Lvl	66.5	0.0	5	-5.0
Receiver 28	47	1	0.0	65.2	66	65.2	15	----	65.2	0.0	5	-5.0
Receiver 29	48	1	0.0	65.7	66	65.7	15	----	65.7	0.0	5	-5.0
Receiver 30	49	1	0.0	65.8	66	65.8	15	----	65.8	0.0	5	-5.0
Receiver 31	50	2	0.0	67.6	66	67.6	15	Snd Lvl	67.6	0.0	5	-5.0
Receiver 32	51	1	0.0	66.3	66	66.3	15	Snd Lvl	66.3	0.0	5	-5.0
Receiver 33	52	1	0.0	65.9	66	65.9	15	----	65.9	0.0	5	-5.0
Receiver 34	53	1	0.0	69.1	66	69.1	15	Snd Lvl	69.1	0.0	5	-5.0
Receiver 35	54	1	0.0	62.3	66	62.3	15	----	62.3	0.0	5	-5.0
Receiver 36	55	1	0.0	68.0	66	68.0	15	Snd Lvl	68.0	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	43	0.0	0.0	0.0
All Impacted	22	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR, Inc.
C.B.

19 April 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Cholla
RUN: La Cholla, Existing Conditions 2nd Row
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier					With Barrier			
				LAeq1h		Increase over existing		Type Impact	Calculated LAeq1h	Noise Reduction		
				Calculated	Crit'n	Calculated	Crit'n Sub'l Inc			Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1S	20	4	0.0	53.0	66	53.0	15	----	53.0	0.0	5	-5.0
Receiver 2S	21	3	0.0	53.9	66	53.9	15	----	53.9	0.0	5	-5.0
Receiver 3S	22	1	0.0	52.8	66	52.8	15	----	52.8	0.0	5	-5.0
Receiver 4S	23	1	0.0	61.1	66	61.1	15	----	61.1	0.0	5	-5.0
Receiver 5S	24	2	0.0	59.7	66	59.7	15	----	59.7	0.0	5	-5.0
Receiver 6S	25	2	0.0	59.7	66	59.7	15	----	59.7	0.0	5	-5.0
Receiver 7S	26	2	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 8S	27	1	0.0	62.7	66	62.7	15	----	62.7	0.0	5	-5.0
Receiver 9S	28	1	0.0	61.3	66	61.3	15	----	61.3	0.0	5	-5.0
Receiver 10S	29	2	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 11S	30	2	0.0	59.2	66	59.2	15	----	59.2	0.0	5	-5.0
Receiver 12S	31	2	0.0	59.2	66	59.2	15	----	59.2	0.0	5	-5.0
Receiver 13S	32	3	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 14S	33	1	0.0	62.9	66	62.9	15	----	62.9	0.0	5	-5.0
Receiver 15S	34	2	0.0	60.3	66	60.3	15	----	60.3	0.0	5	-5.0
Receiver 16S	35	1	0.0	64.6	66	64.6	15	----	64.6	0.0	5	-5.0
Receiver 17S	36	2	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 18S	37	1	0.0	62.5	66	62.5	15	----	62.5	0.0	5	-5.0
Receiver 19S	38	2	0.0	62.8	66	62.8	15	----	62.8	0.0	5	-5.0
Receiver 20S	39	2	0.0	64.6	66	64.6	15	----	64.6	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB

RESULTS: SOUND LEVELS

All Selected	37	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR, Inc.
C.B.

3 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Cholla
RUN: La Cholla, Future - NO RAC
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1	20	4	0.0	62.2	66	62.2	15	----	62.2	0.0	5	-5.0
Receiver 2	21	3	0.0	63.1	66	63.1	15	----	63.1	0.0	5	-5.0
Receiver 3	22	2	0.0	63.2	66	63.2	15	----	63.2	0.0	5	-5.0
Receiver 4	23	1	0.0	70.2	66	70.2	15	Snd Lvl	70.2	0.0	5	-5.0
Receiver 5	24	1	0.0	69.7	66	69.7	15	Snd Lvl	69.7	0.0	5	-5.0
Receiver 6	25	1	0.0	69.3	66	69.3	15	Snd Lvl	69.3	0.0	5	-5.0
Receiver 7	26	1	0.0	70.1	66	70.1	15	Snd Lvl	70.1	0.0	5	-5.0
Receiver 8	27	1	0.0	72.1	66	72.1	15	Snd Lvl	72.1	0.0	5	-5.0
Receiver 9	28	1	0.0	67.7	66	67.7	15	Snd Lvl	67.7	0.0	5	-5.0
Receiver 10	29	1	0.0	70.4	66	70.4	15	Snd Lvl	70.4	0.0	5	-5.0
Receiver 11	30	1	0.0	72.1	66	72.1	15	Snd Lvl	72.1	0.0	5	-5.0
Receiver 12	31	1	0.0	70.4	66	70.4	15	Snd Lvl	70.4	0.0	5	-5.0
Receiver 13	32	1	0.0	71.3	66	71.3	15	Snd Lvl	71.3	0.0	5	-5.0
Receiver 14	33	1	0.0	71.7	66	71.7	15	Snd Lvl	71.7	0.0	5	-5.0
Receiver 15	34	1	0.0	70.8	66	70.8	15	Snd Lvl	70.8	0.0	5	-5.0
Receiver 16	35	1	0.0	70.8	66	70.8	15	Snd Lvl	70.8	0.0	5	-5.0
Receiver 17	36	1	0.0	71.1	66	71.1	15	Snd Lvl	71.1	0.0	5	-5.0
Receiver 18	37	1	0.0	70.7	66	70.7	15	Snd Lvl	70.7	0.0	5	-5.0
Receiver 19	38	1	0.0	71.3	66	71.3	15	Snd Lvl	71.3	0.0	5	-5.0
Receiver 20	39	1	0.0	71.8	66	71.8	15	Snd Lvl	71.8	0.0	5	-5.0
Receiver 21	40	1	0.0	71.4	66	71.4	15	Snd Lvl	71.4	0.0	5	-5.0
Receiver 22	41	1	0.0	71.1	66	71.1	15	Snd Lvl	71.1	0.0	5	-5.0
Receiver 23	42	1	0.0	70.9	66	70.9	15	Snd Lvl	70.9	0.0	5	-5.0

Receiver 24	43	1	0.0	70.9	66	70.9	15	Snd Lvl	70.9	0.0	5	-5.0
Receiver 25	44	1	0.0	70.2	66	70.2	15	Snd Lvl	70.2	0.0	5	-5.0
Receiver 26	45	1	0.0	71.4	66	71.4	15	Snd Lvl	71.4	0.0	5	-5.0
Receiver 27	46	1	0.0	70.7	66	70.7	15	Snd Lvl	70.7	0.0	5	-5.0
Receiver 28	47	1	0.0	69.2	66	69.2	15	Snd Lvl	69.2	0.0	5	-5.0
Receiver 29	48	1	0.0	69.5	66	69.5	15	Snd Lvl	69.5	0.0	5	-5.0
Receiver 30	49	1	0.0	69.5	66	69.5	15	Snd Lvl	69.5	0.0	5	-5.0
Receiver 31	50	2	0.0	70.9	66	70.9	15	Snd Lvl	70.9	0.0	5	-5.0
Receiver 32	51	1	0.0	70.0	66	70.0	15	Snd Lvl	70.0	0.0	5	-5.0
Receiver 33	52	1	0.0	70.1	66	70.1	15	Snd Lvl	70.1	0.0	5	-5.0
Receiver 34	53	1	0.0	72.1	66	72.1	15	Snd Lvl	72.1	0.0	5	-5.0
Receiver 35	54	1	0.0	67.2	66	67.2	15	Snd Lvl	67.2	0.0	5	-5.0
Receiver 1S	55	4	0.0	56.8	66	56.8	15	----	56.8	0.0	5	-5.0
Receiver 2S	56	3	0.0	57.9	66	57.9	15	----	57.9	0.0	5	-5.0
Receiver 3S	57	1	0.0	56.0	66	56.0	15	----	56.0	0.0	5	-5.0
Receiver 4S	58	5	0.0	65.5	66	65.5	15	----	65.5	0.0	5	-5.0
Receiver 5S	59	2	0.0	63.6	66	63.6	15	----	63.6	0.0	5	-5.0
Receiver 6S	60	2	0.0	63.5	66	63.5	15	----	63.5	0.0	5	-5.0
Receiver 7S	61	2	0.0	63.8	66	63.8	15	----	63.8	0.0	5	-5.0
Receiver 8S	62	1	0.0	67.2	66	67.2	15	Snd Lvl	67.2	0.0	5	-5.0
Receiver 9S	63	1	0.0	65.3	66	65.3	15	----	65.3	0.0	5	-5.0
Receiver 10S	64	2	0.0	63.7	66	63.7	15	----	63.7	0.0	5	-5.0
Receiver 11S	65	2	0.0	62.9	66	62.9	15	----	62.9	0.0	5	-5.0
Receiver 12S	66	2	0.0	62.8	66	62.8	15	----	62.8	0.0	5	-5.0
Receiver 13S	67	3	0.0	63.8	66	63.8	15	----	63.8	0.0	5	-5.0
Receiver 14S	68	1	0.0	67.4	66	67.4	15	Snd Lvl	67.4	0.0	5	-5.0
Receiver 15S	69	2	0.0	64.1	66	64.1	15	----	64.1	0.0	5	-5.0
Receiver 16S	70	1	0.0	68.7	66	68.7	15	Snd Lvl	68.7	0.0	5	-5.0
Receiver 17S	71	2	0.0	63.7	66	63.7	15	----	63.7	0.0	5	-5.0
Receiver 18S	72	1	0.0	66.6	66	66.6	15	Snd Lvl	66.6	0.0	5	-5.0
Receiver 19S	73	2	0.0	66.7	66	66.7	15	Snd Lvl	66.7	0.0	5	-5.0
Receiver 20S	74	2	0.0	68.2	66	68.2	15	Snd Lvl	68.2	0.0	5	-5.0
Receiver 36	76	1	0.0	70.9	66	70.9	15	Snd Lvl	70.9	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	84	0.0	0.0	0.0
All Impacted	42	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR, Inc.
C.B.

3 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Cholla
RUN: La Cholla, Future - RAC
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1	20	4	0.0	59.2	66	59.2	15	----	59.2	0.0	5	-5.0
Receiver 2	21	3	0.0	60.1	66	60.1	15	----	60.1	0.0	5	-5.0
Receiver 3	22	2	0.0	60.2	66	60.2	15	----	60.2	0.0	5	-5.0
Receiver 4	23	1	0.0	67.2	66	67.2	15	Snd Lvl	67.2	0.0	5	-5.0
Receiver 5	24	1	0.0	66.7	66	66.7	15	Snd Lvl	66.7	0.0	5	-5.0
Receiver 6	25	1	0.0	66.3	66	66.3	15	Snd Lvl	66.3	0.0	5	-5.0
Receiver 7	26	1	0.0	67.1	66	67.1	15	Snd Lvl	67.1	0.0	5	-5.0
Receiver 8	27	1	0.0	69.1	66	69.1	15	Snd Lvl	69.1	0.0	5	-5.0
Receiver 9	28	1	0.0	64.7	66	64.7	15	----	64.7	0.0	5	-5.0
Receiver 10	29	1	0.0	67.4	66	67.4	15	Snd Lvl	67.4	0.0	5	-5.0
Receiver 11	30	1	0.0	69.2	66	69.2	15	Snd Lvl	69.2	0.0	5	-5.0
Receiver 12	31	1	0.0	67.4	66	67.4	15	Snd Lvl	67.4	0.0	5	-5.0
Receiver 13	32	1	0.0	68.3	66	68.3	15	Snd Lvl	68.3	0.0	5	-5.0
Receiver 14	33	1	0.0	68.7	66	68.7	15	Snd Lvl	68.7	0.0	5	-5.0
Receiver 15	34	1	0.0	67.8	66	67.8	15	Snd Lvl	67.8	0.0	5	-5.0
Receiver 16	35	1	0.0	67.9	66	67.9	15	Snd Lvl	67.9	0.0	5	-5.0
Receiver 17	36	1	0.0	68.2	66	68.2	15	Snd Lvl	68.2	0.0	5	-5.0
Receiver 18	37	1	0.0	67.8	66	67.8	15	Snd Lvl	67.8	0.0	5	-5.0
Receiver 19	38	1	0.0	68.4	66	68.4	15	Snd Lvl	68.4	0.0	5	-5.0
Receiver 20	39	1	0.0	68.8	66	68.8	15	Snd Lvl	68.8	0.0	5	-5.0
Receiver 21	40	1	0.0	68.5	66	68.5	15	Snd Lvl	68.5	0.0	5	-5.0
Receiver 22	41	1	0.0	68.1	66	68.1	15	Snd Lvl	68.1	0.0	5	-5.0
Receiver 23	42	1	0.0	67.9	66	67.9	15	Snd Lvl	67.9	0.0	5	-5.0

Receiver 24	43	1	0.0	67.9	66	67.9	15	Snd Lvl	67.9	0.0	5	-5.0
Receiver 25	44	1	0.0	67.2	66	67.2	15	Snd Lvl	67.2	0.0	5	-5.0
Receiver 26	45	1	0.0	68.4	66	68.4	15	Snd Lvl	68.4	0.0	5	-5.0
Receiver 27	46	1	0.0	67.7	66	67.7	15	Snd Lvl	67.7	0.0	5	-5.0
Receiver 28	47	1	0.0	66.2	66	66.2	15	Snd Lvl	66.2	0.0	5	-5.0
Receiver 29	48	1	0.0	66.5	66	66.5	15	Snd Lvl	66.5	0.0	5	-5.0
Receiver 30	49	1	0.0	66.5	66	66.5	15	Snd Lvl	66.5	0.0	5	-5.0
Receiver 31	50	2	0.0	68.0	66	68.0	15	Snd Lvl	68.0	0.0	5	-5.0
Receiver 32	51	1	0.0	67.1	66	67.1	15	Snd Lvl	67.1	0.0	5	-5.0
Receiver 33	52	1	0.0	68.5	66	68.5	15	Snd Lvl	68.5	0.0	5	-5.0
Receiver 34	53	1	0.0	70.2	66	70.2	15	Snd Lvl	70.2	0.0	5	-5.0
Receiver 35	54	1	0.0	66.7	66	66.7	15	Snd Lvl	66.7	0.0	5	-5.0
Receiver 1S	55	4	0.0	53.9	66	53.9	15	----	53.9	0.0	5	-5.0
Receiver 2S	56	3	0.0	55.0	66	55.0	15	----	55.0	0.0	5	-5.0
Receiver 3S	57	1	0.0	53.0	66	53.0	15	----	53.0	0.0	5	-5.0
Receiver 4S	58	5	0.0	62.6	66	62.6	15	----	62.6	0.0	5	-5.0
Receiver 5S	59	2	0.0	60.6	66	60.6	15	----	60.6	0.0	5	-5.0
Receiver 6S	60	2	0.0	60.5	66	60.5	15	----	60.5	0.0	5	-5.0
Receiver 7S	61	2	0.0	60.8	66	60.8	15	----	60.8	0.0	5	-5.0
Receiver 8S	62	1	0.0	64.3	66	64.3	15	----	64.3	0.0	5	-5.0
Receiver 9S	63	1	0.0	62.4	66	62.4	15	----	62.4	0.0	5	-5.0
Receiver 10S	64	2	0.0	60.8	66	60.8	15	----	60.8	0.0	5	-5.0
Receiver 11S	65	2	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 12S	66	2	0.0	59.9	66	59.9	15	----	59.9	0.0	5	-5.0
Receiver 13S	67	3	0.0	60.8	66	60.8	15	----	60.8	0.0	5	-5.0
Receiver 14S	68	1	0.0	64.4	66	64.4	15	----	64.4	0.0	5	-5.0
Receiver 15S	69	2	0.0	61.2	66	61.2	15	----	61.2	0.0	5	-5.0
Receiver 16S	70	1	0.0	65.7	66	65.7	15	----	65.7	0.0	5	-5.0
Receiver 17S	71	2	0.0	60.8	66	60.8	15	----	60.8	0.0	5	-5.0
Receiver 18S	72	1	0.0	63.7	66	63.7	15	----	63.7	0.0	5	-5.0
Receiver 19S	73	2	0.0	63.8	66	63.8	15	----	63.8	0.0	5	-5.0
Receiver 20S	74	2	0.0	65.3	66	65.3	15	----	65.3	0.0	5	-5.0
Receiver 36	76	1	0.0	68.7	66	68.7	15	Snd Lvl	68.7	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	84	0.0	0.0	0.0
All Impacted	33	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

HDR, Inc.
C.B.

3 June 2008
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: La Cholla
RUN: La Cholla, Proposed - PC Criteria RAC
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier					With Barrier			
				LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver 1	20	4	0.0	0.0	66	0.0	15	inactive	0.0	0.0	5	0.0
Receiver 2	21	3	0.0	0.0	66	0.0	15	inactive	0.0	0.0	5	0.0
Receiver 3	22	2	0.0	0.0	66	0.0	15	inactive	0.0	0.0	5	0.0
Receiver 4	23	1	0.0	67.4	66	67.4	15	Snd Lvl	62.2	5.2	5	0.2
Receiver 5	24	1	0.0	66.8	66	66.8	15	Snd Lvl	65.1	1.7	5	-3.3
Receiver 6	25	1	0.0	66.4	66	66.4	15	Snd Lvl	62.9	3.5	5	-1.5
Receiver 7	26	1	0.0	67.2	66	67.2	15	Snd Lvl	61.7	5.5	5	0.5
Receiver 8	27	1	0.0	69.3	66	69.3	15	Snd Lvl	64.4	4.9	5	-0.1
Receiver 9	28	1	0.0	64.9	66	64.9	15	----	59.6	5.3	5	0.3
Receiver 10	29	1	0.0	67.5	66	67.5	15	Snd Lvl	60.7	6.8	5	1.8
Receiver 11	30	1	0.0	69.2	66	69.2	15	Snd Lvl	69.1	0.1	5	-4.9
Receiver 12	31	1	0.0	67.5	66	67.5	15	Snd Lvl	60.7	6.8	5	1.8
Receiver 13	32	1	0.0	68.3	66	68.3	15	Snd Lvl	67.9	0.4	5	-4.6
Receiver 14	33	1	0.0	68.8	66	68.8	15	Snd Lvl	66.3	2.5	5	-2.5
Receiver 15	34	1	0.0	67.9	66	67.9	15	Snd Lvl	62.2	5.7	5	0.7
Receiver 16	35	1	0.0	68.0	66	68.0	15	Snd Lvl	63.0	5.0	5	0.0
Receiver 17	36	1	0.0	68.3	66	68.3	15	Snd Lvl	61.8	6.5	5	1.5
Receiver 18	37	1	0.0	67.8	66	67.8	15	Snd Lvl	66.8	1.0	5	-4.0
Receiver 19	38	1	0.0	68.4	66	68.4	15	Snd Lvl	68.0	0.4	5	-4.6
Receiver 20	39	1	0.0	68.9	66	68.9	15	Snd Lvl	61.9	7.0	5	2.0
Receiver 21	40	1	0.0	68.6	66	68.6	15	Snd Lvl	61.8	6.8	5	1.8
Receiver 22	41	1	0.0	68.2	66	68.2	15	Snd Lvl	62.2	6.0	5	1.0
Receiver 23	42	1	0.0	68.0	66	68.0	15	Snd Lvl	64.1	3.9	5	-1.1

Receiver 24	43	1	0.0	68.0	66	68.0	15	Snd Lvl	66.4	1.6	5	-3.4
Receiver 25	44	1	0.0	67.3	66	67.3	15	Snd Lvl	62.4	4.9	5	-0.1
Receiver 26	45	1	0.0	68.6	66	68.6	15	Snd Lvl	60.9	7.7	5	2.7
Receiver 27	46	1	0.0	67.8	66	67.8	15	Snd Lvl	62.7	5.1	5	0.1
Receiver 28	47	1	0.0	66.4	66	66.4	15	Snd Lvl	62.9	3.5	5	-1.5
Receiver 29	48	1	0.0	66.8	66	66.8	15	Snd Lvl	62.2	4.6	5	-0.4
Receiver 30	49	1	0.0	66.8	66	66.8	15	Snd Lvl	62.2	4.6	5	-0.4
Receiver 31	50	2	0.0	68.1	66	68.1	15	Snd Lvl	62.8	5.3	5	0.3
Receiver 32	51	1	0.0	67.2	66	67.2	15	Snd Lvl	62.6	4.6	5	-0.4
Receiver 33	52	1	0.0	68.5	66	68.5	15	Snd Lvl	68.5	0.0	5	-5.0
Receiver 34	53	1	0.0	70.2	66	70.2	15	Snd Lvl	70.2	0.0	5	-5.0
Receiver 35	54	1	0.0	66.7	66	66.7	15	Snd Lvl	66.7	0.0	5	-5.0
Receiver 1S	55	4	0.0	0.0	66	0.0	15	inactive	0.0	0.0	5	0.0
Receiver 2S	56	3	0.0	0.0	66	0.0	15	inactive	0.0	0.0	5	0.0
Receiver 3S	57	1	0.0	0.0	66	0.0	15	inactive	0.0	0.0	5	0.0
Receiver 4S	58	5	0.0	62.6	66	62.6	15	----	60.4	2.2	5	-2.8
Receiver 5S	59	2	0.0	60.7	66	60.7	15	----	58.3	2.4	5	-2.6
Receiver 6S	60	2	0.0	60.7	66	60.7	15	----	57.5	3.2	5	-1.8
Receiver 7S	61	2	0.0	61.0	66	61.0	15	----	57.5	3.5	5	-1.5
Receiver 8S	62	1	0.0	64.4	66	64.4	15	----	62.8	1.6	5	-3.4
Receiver 9S	63	1	0.0	62.4	66	62.4	15	----	61.5	0.9	5	-4.1
Receiver 10S	64	2	0.0	60.9	66	60.9	15	----	58.0	2.9	5	-2.1
Receiver 11S	65	2	0.0	60.0	66	60.0	15	----	58.5	1.5	5	-3.5
Receiver 12S	66	2	0.0	60.0	66	60.0	15	----	57.5	2.5	5	-2.5
Receiver 13S	67	3	0.0	60.9	66	60.9	15	----	59.0	1.9	5	-3.1
Receiver 14S	68	1	0.0	64.6	66	64.6	15	----	61.7	2.9	5	-2.1
Receiver 15S	69	2	0.0	61.3	66	61.3	15	----	58.8	2.5	5	-2.5
Receiver 16S	70	1	0.0	66.0	66	66.0	15	Snd Lvl	61.1	4.9	5	-0.1
Receiver 17S	71	2	0.0	61.0	66	61.0	15	----	58.2	2.8	5	-2.2
Receiver 18S	72	1	0.0	64.0	66	64.0	15	----	60.7	3.3	5	-1.7
Receiver 19S	73	2	0.0	64.1	66	64.1	15	----	60.5	3.6	5	-1.4
Receiver 20S	74	2	0.0	65.4	66	65.4	15	----	61.8	3.6	5	-1.4
Receiver 36	76	1	0.0	68.7	66	68.7	15	Snd Lvl	68.7	0.0	5	-5.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	84	0.0	3.1	7.7
All Impacted	34	0.0	3.8	7.7
All that meet NR Goal	15	5.0	6.0	7.7