Roadway Planning & Design Engineering Services for

La Cholla Boulevard:

Magee Road to Tangerine Road (4RTLTM) Phase 1

Noise Analysis Report

December 2009

Prepared for

PIMA COUNTY DOT

Prepared by

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1 Introduction

The purpose of this document is to evaluate the traffic noise effects associated with the widening of La Cholla Boulevard between Magee Road and Lambert Lane (Phase 1). The traffic noise analysis for the La Cholla Boulevard Phase 1 involved a series of steps. Each of these steps is discussed in detail in the following sections.

Background

The Pima County Department of Transportation (PCDOT) in cooperation with the Town of Oro Valley and the Regional Transportation Authority (RTA) proposes to widen approximately 5 miles of La Cholla Boulevard from a two-lane arterial roadway into a four-lane arterial roadway between Magee Road and Tangerine Road. The Inter-Governmental Agreement (IGA) with the RTA calls for this project to be completed in two phases. During Phase 1 of the proposed project, PCDOT will lead the preliminary roadway design for the entire corridor and will design and construct the roadway improvements from Magee Road to Lambert Lane. During Phase 1I, the Town of Oro Valley will complete the design and construct the roadway improvements from Lambert Lane to Tangerine Road.

Phase 1 includes the conceptual design resulting in a Design Concept Report (DCR) for the roadway improvements from Magee Road to Tangerine Road and an Environmental Assessment and Mitigation Report (EAMR) for the roadway improvements from Magee Road to Lambert Lane. Construction of Phase 1 from Magee Road to Lambert Lane is planned for the 2012 to 2016 implementation period of the 20 year RTA plan. Final design and construction of the roadway from Lambert Lane to Tangerine Road is planned for the 2022 to 2026 implementation period of the 20 year RTA plan.

This noise analysis addresses Phase 1 of the project. During Phase 2, noise analysis will be addressed in a separate study.

Project Location

La Cholla Boulevard between Magee Road and Lambert Lane is found in the jurisdictions of unincorporated Pima County, Arizona and the Town of Oro Valley (Figure 1). The cadastral location of this segment of road is Township 12 South, Range 13 East, near the eastern boundaries of sections 9, 16, 21, and 28, and near the western boundaries of sections 10, 15, 22, and 27 (Figure 2). The project will occur on a secured right-of-way acquired by the Pima County Department of Transportation, with adjacent ownership occurring on private land.

Existing Road Conditions and Land Use

La Cholla Boulevard is currently a two-lane, uncurbed, undivided road with traffic signals at the intersections of Overton Road and Lambert Lane. The existing roadway has two 12-foot wide travel lanes with approximately 4-foot wide paved shoulders, with a 12-foot wide unpaved and largely un-vegetated shoulder for most its length outside of paved areas. Similarly, Overton Road and Lambert Lane are two-lane, uncurbed undivided roads with two 12-foot wide travel lanes, 4-foot wide paved shoulders, and 12-foot unpaved and largely unvegetated shoulders outside of paved areas. Additional roadway features such as street parking, bicycle lanes, sidewalks, or transit stops are not present in the project area.

Current land use in the project area includes residential (single-family homes and townhome complexes), commercial (Omni Tucson National Resort), institutional (Alive Christian Fellowship and Grace Community

Church), recreation (CDO Wash proposed linear parkway, La Cholla/Honey Bee Loop Trail, and Birch Way), vacant land, and flood control/river. The density of development in the area is consistent with a suburban setting.

The terrain in the project area generally slopes southward and northward toward the CDO Wash. La Cholla Boulevard follows the existing terrain throughout the project area. Elevations within the project area vary from approximately 2,420 feet at Magee Road, 2,360 feet at the CDO Wash, and 2,760 feet at Lambert Lane.

Proposed Project Elements

The project involves the widening of La Cholla Boulevard between Magee Road and Lambert Lane. The design speed for this project is 50 miles per hour (mph) and will be posted for 45 mph, which is the same as the current posting. Project construction is scheduled to begin in 2012 and last 18 to 24 months. The project in Phase I includes the construction of the following specific improvements:

- Widen La Cholla Boulevard from a two-lane roadway to a four-lane roadway (two lanes northbound and two lanes southbound) between Magee Road and Lambert Lane.
- Construct raised medians and turning lanes throughout the length of the project.
- Construct bike lanes between Magee Road and Lambert Lane.
- Construct a multi-use path, sidewalks, crosswalks, and access ramps that will be Americans with Disabilities Act (ADA) compliant.
- Reconstruct the Overton Road and Lambert Lane intersections to provide two through lanes, one left-turn lane, and a right-turn lane for La Cholla Boulevard. Overton Road and Lambert Lane will supply one through lane, one left-turn lane, and a right-turn lane.
- Replace the existing at grade crossing of the CDO Wash with a new four-lane bridge.
- Drainage improvements consisting of improvements to existing drainage structures and construction of new drainage structures including culverts under La Cholla Boulevard.
- Install landscape improvements on project medians and along the shoulders to the right-of-way limit.

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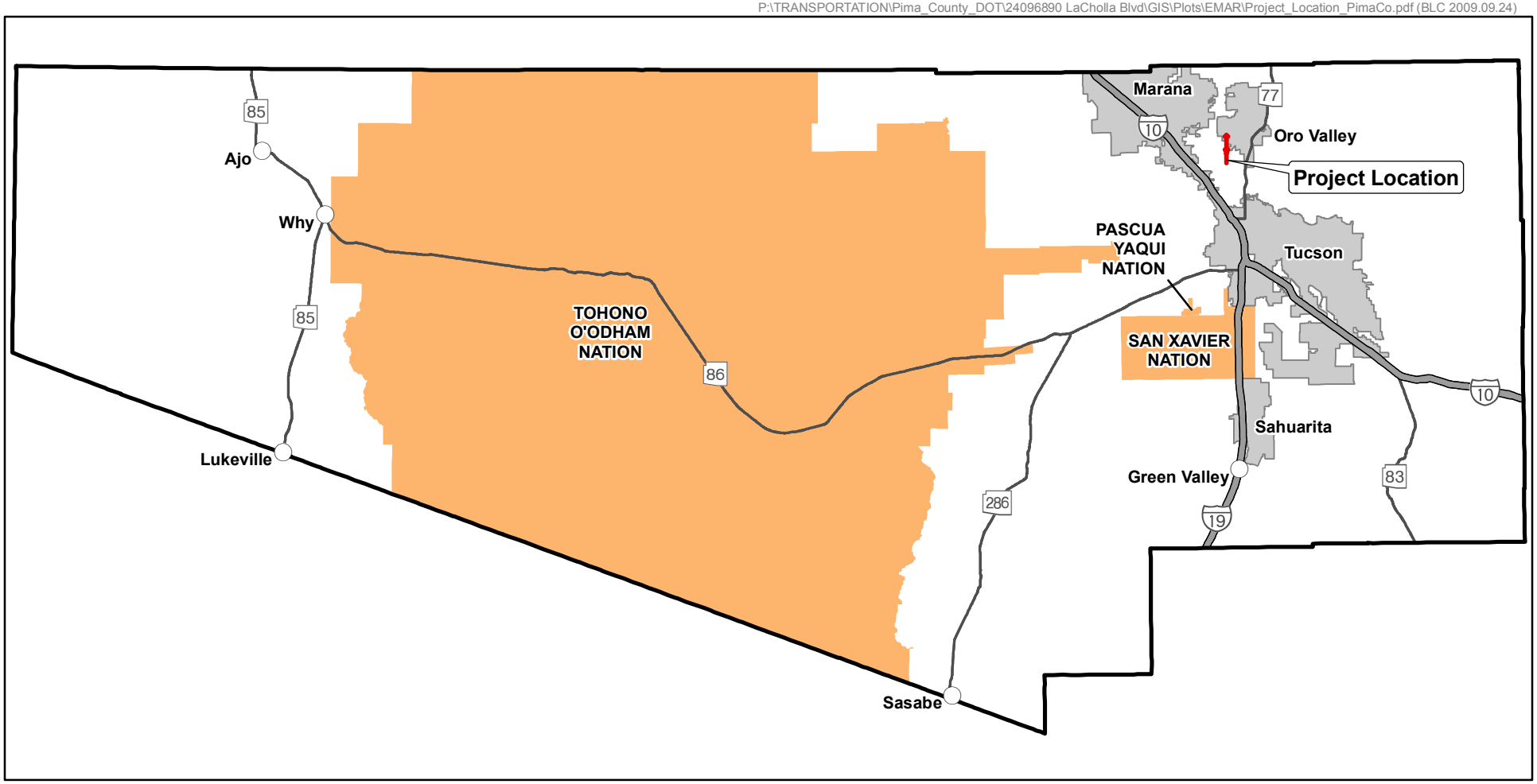

Legend

Project Location

General Features

Town

Interstate Highway

State Route

City

Indian Reservation

Pima County

N

0 10 20

Miles

Source:
Project Site: URS 2009
Base Map: ALRIS 2007, Pima County 2009
Roads: ADOT 2009

Figure 1

Project Location

La Cholla Boulevard, Magee Road to Lambert Lane Phase 1

Pima County Project Number: 4RTLTM

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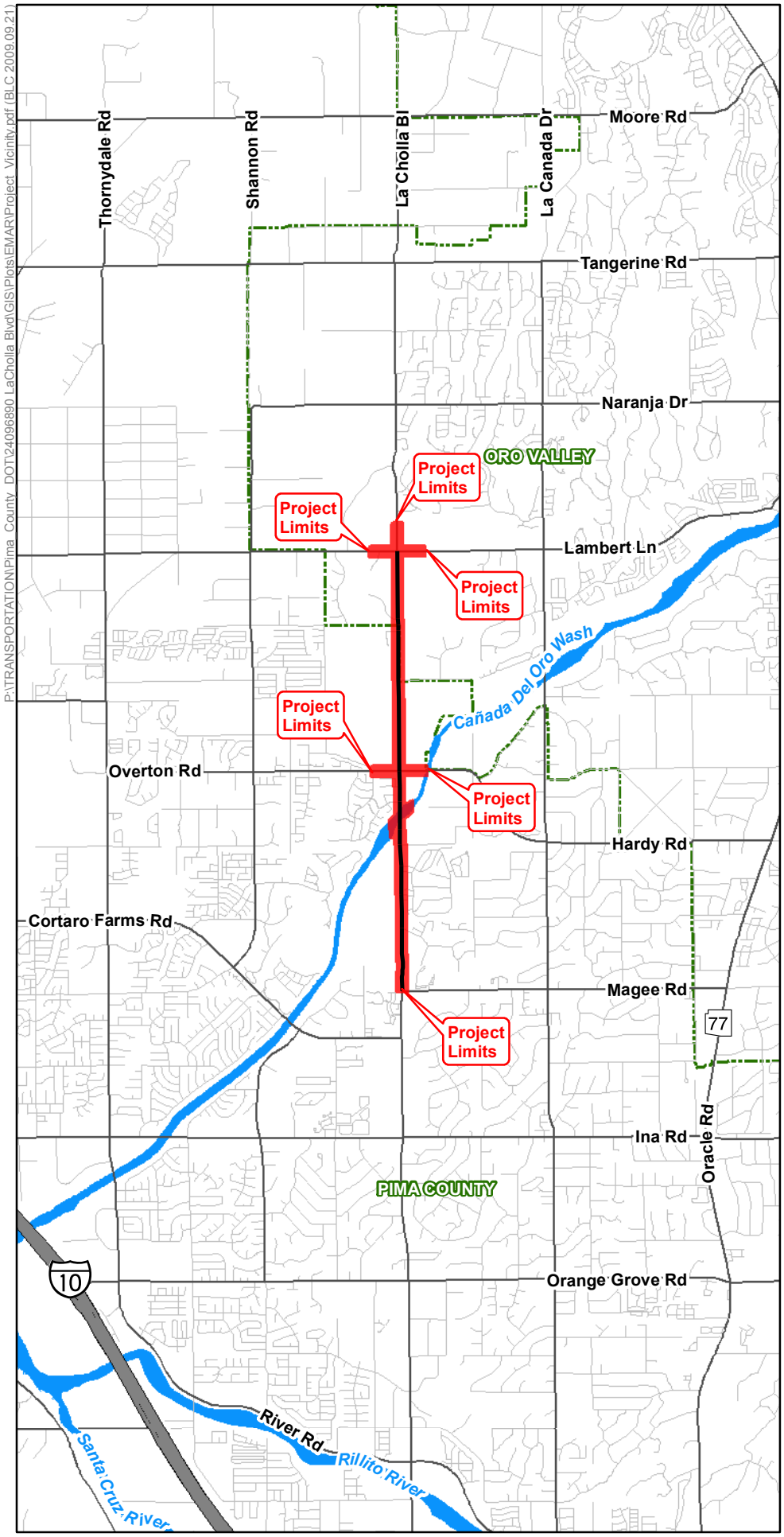

Figure 2
Project Vicinity

La Cholla Boulevard, Magee Road to Lambert Lane Phase 1

Pima County Project Number: 4RTLTM

Legend

- Project Area
- Project Centerline

General Features

- Interstate Highway
- Arterial Road
- Local Road
- Major Wash
- City Boundary

Source:
Project Area: URS 2009
Base Features: ADOT 2009, Pima County DOT 2009

N

0 0.5 1
Miles

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2 Methods

For this study, the methods for determining the future noise levels and identifying possible mitigation measures to address those increased noise levels involved a series of steps. In summary these steps included:

- An assessment of existing and planned land uses (residential, commercial, industrial, etc.) and determination of sensitive noise receivers within the project corridor.
- An assessment of existing conditions and noise levels (including: field measurements of noise using sound level meters; traffic volumes; vehicle types; vehicle speeds; roadway layout; area topography; existing walls, and; locations of residences relative to the roadway).
- Prediction of existing and the future build scenario for a reasonable worse case noise condition (peak noise hour) using the Federal Highway Administration (FHWA) Traffic Noise Model Version 2.5 (TNM 2.5).
- Comparison of model results with the noise abatement criteria established by the Pima County Department of Transportation and the Town of Oro Valley. Based on the results of the noise monitoring and modeling, potential noise mitigation was examined. This task included noise barrier modeling for noise mitigation as warranted by the results of the noise analysis. Reasonable and feasible mitigation, based on current PCDOT and Town of Oro Valley procedures, is then recommended.

Appendix A lists the references used in this report. For the benefit of the reader, a summary of acoustAppendix B presents acoustic terminology.

Overview

An assessment of existing and planned land uses (residential, commercial, industrial, etc.) and determination of sensitive noise receivers was undertaken within the project corridor. 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 4, *Noise Analysis Results*. Noise levels were measured at 16 sensitive receiver locations within the project area. The noise measurement locations are representative locations selected to determine the noise impacts along the project.

The TNM 2.5 model was used to predict the noise levels that would occur with the proposed improvements to La Cholla Boulevard receiver locations. 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. Modeled noise levels were calculated and compared with the noise levels measured at sensitive receiver locations. 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. Traffic volumes and speeds used in the modeling for this project represent "worst case" peak-hour traffic conditions.

Four conditions were modeled using TNM 2.5. Traffic Volumes used in the model were provided by PCDOT Traffic Division and Kittelson & Associates, Inc. traffic report (Kittelson & Associated 2009) which used Pima Association of Governments (PAG) traffic volumes. The model estimated the peak-hour traffic noise levels for:

- Existing traffic conditions – the model included the current street configuration and 2008 traffic volumes.
- Future no build condition – the model included current street configuration and future projected 2040 traffic volumes.
- Future build condition – the model included proposed road improvements and future projected 2040 traffic volumes. The Pima County portion of the project area used projected condition with a noise reduction credit of 3 dBA for the application of Rubberized Asphalt Concrete (RAC). The future bridge deck is modeled as concrete without RAC. The Town of Oro Valley portion did not include a noise reduction credit for use of RAC. Noise abatement criteria including the use of RAC are described in Section 3 *Noise Abatement Criteria*.
- Future build condition with noise barrier mitigation – the model included proposed road improvements, future projected 2040 traffic volumes, and projected condition with noise barriers (a credit of 3 dBA for the application of RAC for Pima County only).

Noise levels for the 2040 traffic and improved roadway conditions were 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.

TNM 2.5 Modeling

The TNM 2.5 model translated the roads 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 following data were used in the models:

- Vehicle Speeds – as follows
    - La Cholla Blvd from Magee Road to Lambert Lane – 45 mph
    - Overton Road – 45 mph
    - Lambert Lane – 45 mph
    - Side streets have a 25 mph posted speed limit
- Traffic Volumes were provided by PCDOT Traffic Division and Kittelson & Associates, Inc. traffic report (Kittelson & Associated 2009) which used Pima Association of Governments (PAG) traffic volumes, shown in Table 1.
- Vehicle Mix was provided by PCDOT Traffic Division and Kittelson & Associates, Inc. traffic report (Kittelson & Associated 2009) – 97% of the vehicles were automobiles, 2% ´medium vehicles´ (2-axle long, buses, 2-axle 6 tire) and 1% 'heavy vehicles' (3 to 6-axle vehicles).
- Elevations – topographic information was used for the roads and receivers. Topographic information was provided by URS Corporation.
- Ground – "Hard soil"
- Receiver heights – 5 feet above the ground

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 4, *Existing Noise Environment*—are presented in LAeq1h, the equivalent average sound level measured for 1 hour, approximating the sensitivity of the human ear.

Table 1. Peak AM and PM Hour Traffic Volumes

Road	Existing Volumes (2008)				Future Volumes (2040)			
	North or East Bound		South or West Bound		North or East Bound		South or West Bound	
	AM	PM	AM	PM	AM	PM	AM	PM
La Cholla Boulevard (between Magee Rd and Overton Rd)	372	854	1020	530	715	1606	1672	1073
La Cholla Boulevard (between Overton Rd and Lambert Ln)	360	586	628	447	844	1239	1270	1137
La Cholla Boulevard (between Lambert Ln and Naranja Dr)	464	546	644	394	765	1070	996	885
Overton Road (west of La Cholla Blvd)	924	347	212	663	762	460	257	933
Overton Road (east of La Cholla Blvd)	492	226	160	390	468	325	240	535
Lambert Lane (west of La Cholla Blvd)	452	281	168	341	721	517	426	526
Lambert Lane (east of La Cholla Blvd)	548	367	360	461	661	597	768	698
Source: Kittelson & Associates, Inc.								

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.

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 LAeq1h. 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 Leq during the measurement period (e.g., a police siren, a particularly noisy truck, or unusually high traffic volumes). Therefore, the use of LAeq1h 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 Noise Abatement Criteria

Potential negative impact from traffic noise is assessed on the basis of predicted noise levels approaching or exceeding Noise Abatement Criteria (NAC). Pima County and the Town of Oro Valley have different NAC. Each NAC is described below.

Pima County

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. The procedure, commonly called the Pima County Noise Abatement Procedure (PC NAP), contains methods for noise analysis, criteria for traffic noise abatement, and requirements for noise reports. Effective April 8, 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 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).

The PC NAP contains a provision allowing a noise reduction 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.

The PC NAP provides criteria for use of noise walls for noise abatement mitigation. Where a sound wall is considered all of the following criteria must be met in order to recommend the barrier:

- A reduction of at least 5 dBA must be achieved at noise sensitive receivers
- The barrier must benefit two or more adjacent receivers
- The cost of the barrier will not exceed $35,000 per benefitted receiver (using a cost of $25/ft^2)
- A majority of the property owners must approve the mitigation
- Mitigation is for only the first floor of multi-story residences
- Barriers must be less than 10 feet tall
- No mitigation will be provided for undeveloped properties unless building permit issued prior to the final EAMR document

Town of Oro Valley

The Town of Oro Valley uses the Arizona Department of Transportation (ADOT) noise abatement policy to address noise impacts from road projects.

According to ADOT noise abatement policy, potential negative impact from traffic noise is assessed on the basis of predicted noise levels approaching or exceeding the Federal Highway Administration's (FHWA) Noise Abatement Criteria (NAC). The NAC for residences and other sensitive exterior receivers is a 64 dBA for the peak traffic hour. The FHWA NAC specify noise levels considered to be the upper levels of acceptability for outdoor activities and to evaluate the need for noise mitigation measures due to road improvements. In addition to approaching or exceeding the NAC, a noise impact is indicated if the future noise levels are expected to "substantially increase" over existing levels.

ADOT *Noise Abatement Policy* (December 5, 2005) defines a traffic noise impact as:

- When the predicted level approaches or exceeds the FHWA's NAC. ADOT defines "approach" as being within 3 dBA of the appropriate NAC. Under this policy, residential impacts would occur when the future L_{eq}(h) value is 64 dBA or greater; or,
- When the predicted level substantially increases over existing noise levels. "Substantial" is defined as an increase of 15 dBA or higher.

FHWA and ADOT guidelines are similar to PC NAC in terms of requiring an exterior location and at the first floor of multi-floor residences. The Town of Oro Valleys does not allow a noise reduction credit of 3 dBA for the use of RAC.

The Town of Oro Valley provides criteria for use of noise walls for noise abatement mitigation. Where a sound wall is considered all of the following criteria must be met in order to recommend the barrier:

- A reduction of at least 5 dBA must be achieved at noise sensitive receivers with a resulting noise level below 64 dBA.
- Generally, it will not be reasonable to provide abatement for isolated developed properties
- The cost of the barrier will not exceed $46,000 per benefitted receiver
- Mitigation is for only the first floor of multi-story residences
- Barriers must be less than 20 feet tall

4 Noise Analysis Results

Existing Noise Environment

Sensitive Noise Receivers

Sensitive noise receivers in the study area consist of single family or multi-family housing units and places of worship. Single family housing occurs throughout the study area. Multi-family housing includes the Country Club Apartments. Places of worship include the Alive Christian Church and Grace Community Church. Twenty-five sensitive receivers were identified (see Table 2). Twenty sensitive receiver are located in Pima County and 5 sensitive receivers are located in the Town of Oro Valley (Location # 19, 20, 23, 24 and 25). Sensitive receiver locations are shown in Figure 3 and 4.

Table 2. Sensitive Receiver Locations

Location Number	Location Description
1	The Hills at Tucson National Subdivision – approximately 340 feet and 320 feet west of the existing and future construction centerlines, respectively. There is a 5-6 foot high wall on the east side of the subdivision.
2	N MaCarty Road - approximately 300 feet and 320 feet east of the existing and future centerlines, respectively. There is a 5 foot high wall between the home and La Cholla Blvd.
3	Dawn Drive – on the west edge of a future development. Approximately 110 feet and 140 feet east of the existing and future construction centerlines, respectively.
4	Fairfield Hills La Cholla – 8469 N Breezewood Place, approximately 80 feet and 140 feet east of the existing and future centerlines, respectively.
5	Fairfield Hills La Cholla – 8565 N Candlewood Loop, approximately 90 feet and 130 feet east of the existing and future centerlines, respectively.
6	Tucson National Golf Course – Approximately 165 feet and 135 feet west of the existing and future centerlines, respectively. Located on the southeast portion of a future development.
7	Fairfield Hills La Cholla – 8639 N Candlewood Loop, approximately 80 feet and 130 feet east of the existing and future centerlines, respectively.
8	Future Development - Approximately 170 feet and 140 feet west of the existing and future centerlines, respectively. Located on the east side of a future development.
9	Country Club Apartments – at the entrance to the apartments, approximately 100 feet and 130 feet east of the existing and future centerlines, respectively.
10	Country Club Apartments – southeast corner of La Cholla Blvd and W Hardy Road. There is a wall approximately 6½ feet high (on the apartment side). Location 10 is approximately 105 feet east of the existing and future centerlines.
11	The Bluffs Subdivision – Approximately 180 feet and 195 feet west of the existing and future centerlines, respectively. A 6 foot high wall is located at 9000 N Mexican Sage Place,
12	The Bluffs Subdivision – 9090 N Sweet Acacia Pl, there is a continuous 6 foot high wall on. Approximately 135 feet and 150 feet west of the existing and future centerlines, respectively. A frontage road is proposed for the west side on La Cholla Blvd in the vicinity of Location 13.
13	The Bluffs Subdivision – 2100 W Sunset Surprise Ct, there is a 5 foot high wall that is open at the entrance to the subdivision. Location 13 is approximately 125 feet west of the existing and future La Cholla Blvd centerlines.
14	9350 N La Cholla Blvd – vacant land, the prediction location is approximately 340 feet east of La Cholla Blvd. existing and future centerlines.

Location Number	Location Description
15	Northwest Bible Church - proposed future church located approximately 600 feet west of La Cholla Blvd.
16	9450 N La Cholla Blvd – residence located approximately 260 feet east of La Cholla Blvd.
17	Alive Christian Church - 9662 N La Cholla Blvd, on the southeast corner of La Cholla Blvd and W Lucero Rd. Location 17 is approximately 230 feet east of the existing and future centerlines.
18	Iron Wood Estates Subdivision (future) – located on the east side of the subdivision approximately 90 feet west of the La Cholla Blvd existing and future centerlines.
19	2040 W Lucero Road - northeast corner of La Cholla Blvd and W Lucero Rd, approximately 100 feet east of La Cholla Blvd.
20	9800 N La Cholla Blvd - approximately 130 feet east of La Cholla Blvd. existing and future centerlines.
21	9813 N La Cholla Blvd - approximately 180 feet west of La Cholla Blvd.
22	9906 N Rabwa Pl – approximately 120 feet west of the existing and future centerlines.
23	9950 N La Cholla Blvd, approximately 200 feet east of La Cholla Blvd.
24	Chaparral Heights Subdivision - 2136 W Owl Head Place, approximately 220 feet west of the existing and future centerlines.
25	Chaparral Heights Subdivision - 10325 N La Cholla Blvd, approximately 220 feet west of La Cholla Blvd.

Traffic Noise Monitoring

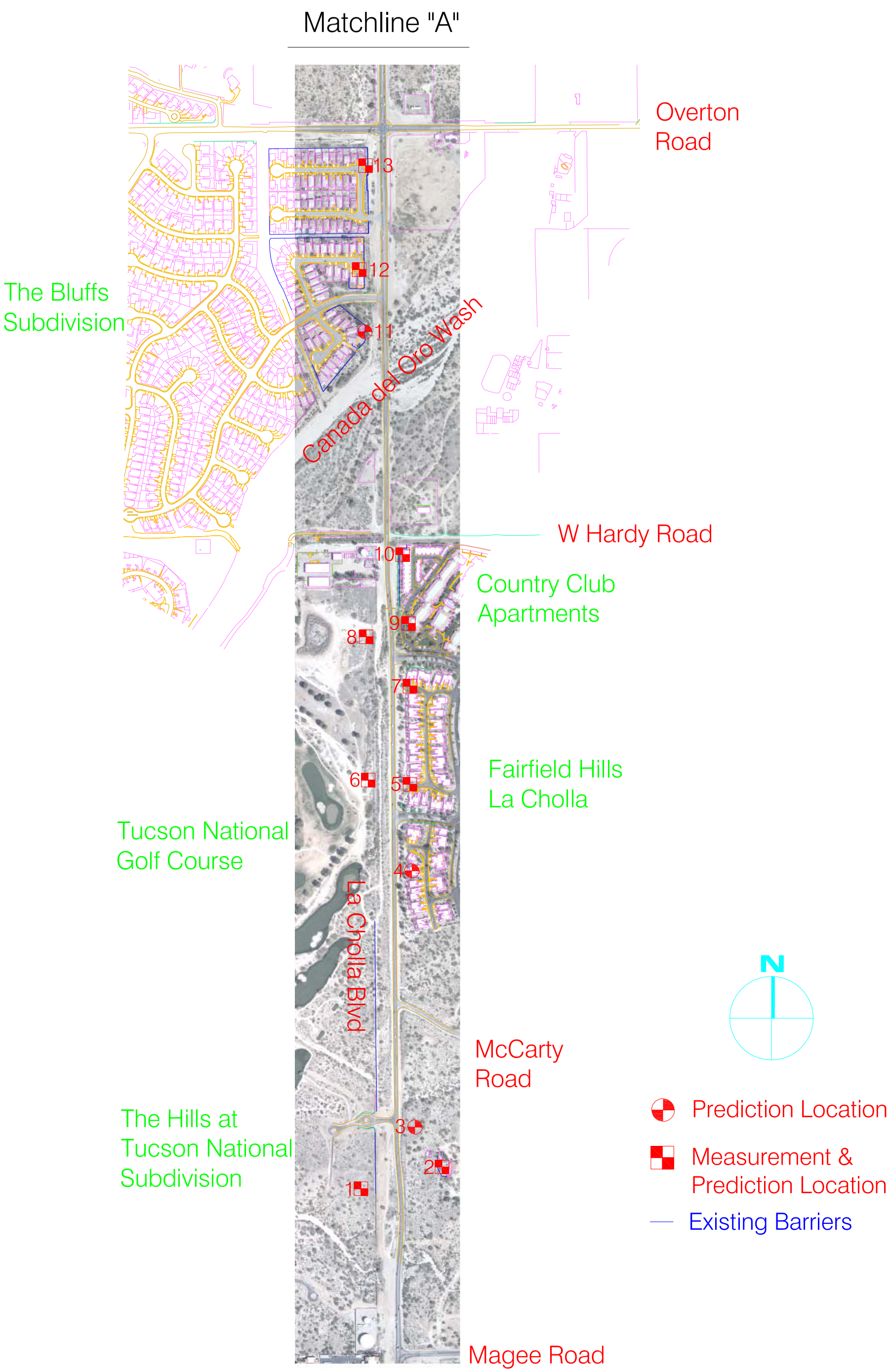
An assessment of existing traffic noise conditions was made. The monitoring program focused on residential and other sensitive land uses within the project area. A series of noise measurements were performed at 16 monitoring locations in the study area to document existing conditions. Monitoring was conducted according to PCDOT and ADOT procedures. Noise levels were measured using two Larson Davis 820 sound level meters, which meet the American National Standard Institute (ANSI) requirements for Type 1 sound level meters. The detectors of the meters were set for "slow" response (1 second samples). The microphones were located approximately five feet above the ground. The sound level meters were calibrated prior to and immediately after each noise measurement. Noise levels were measured for three 10 minutes periods at each of the sixteen measurement locations.

Noise was measured during peak AM traffic hours on Tuesday, October 13, 2009, Wednesday, October 14, 2009 and Thursday, October 15, 2009 from 7 to 9 AM and during peak PM traffic hours on Tuesday, November 17, 2009 and Wednesday, November 18, 2009 from 5 to 7 PM. These times were selected to represent peak traffic hours. Midday noise measurements were made on October 13 and 14, 2009 as an off peak time period verification. Actual traffic counts were used in the verification model.

The atmospheric conditions during the measurement periods were in compliance with PCDOT and ADOT noise measurement guidelines. Since atmospheric conditions affect sound propagation, the temperature and humidity are entered into the noise model.

- Tuesday, October 13, 2009 – During the morning measurement period the temperature was about 66°F, the relative humidity was about 64%, it was partly cloudy and there was a slight breeze from the northwest (1-3 mph). In the afternoon the temperature was about 82°F, the relative humidity was 23%, it was cloudy and there was no perceptible wind.

- Wednesday, October 14, 2009 – During the morning measurement period the temperature was about 65°F, the relative humidity was about 49%, it was clear and there was a slight wind from the south (2-4 mph). In the afternoon the temperature was about 84°F, the relative humidity was 25%, it was cloudy with a slight wind from the west (2-4 mph).



Pima County Department of Transportation | November 25, 2009 | Bill Holliday, PE

Figure No. 3

Sound Solutions Acoustical Consulting
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Tucson, AZ 85728
520-979-2213

INFO ONLY
Preliminary– Not for construction

LA CHOLLA – MAGEE TO LAMBERT
Tucson, Arizona

DESCRIPTION: Existing Road - Southern Half

SCALE: 1" = 600'

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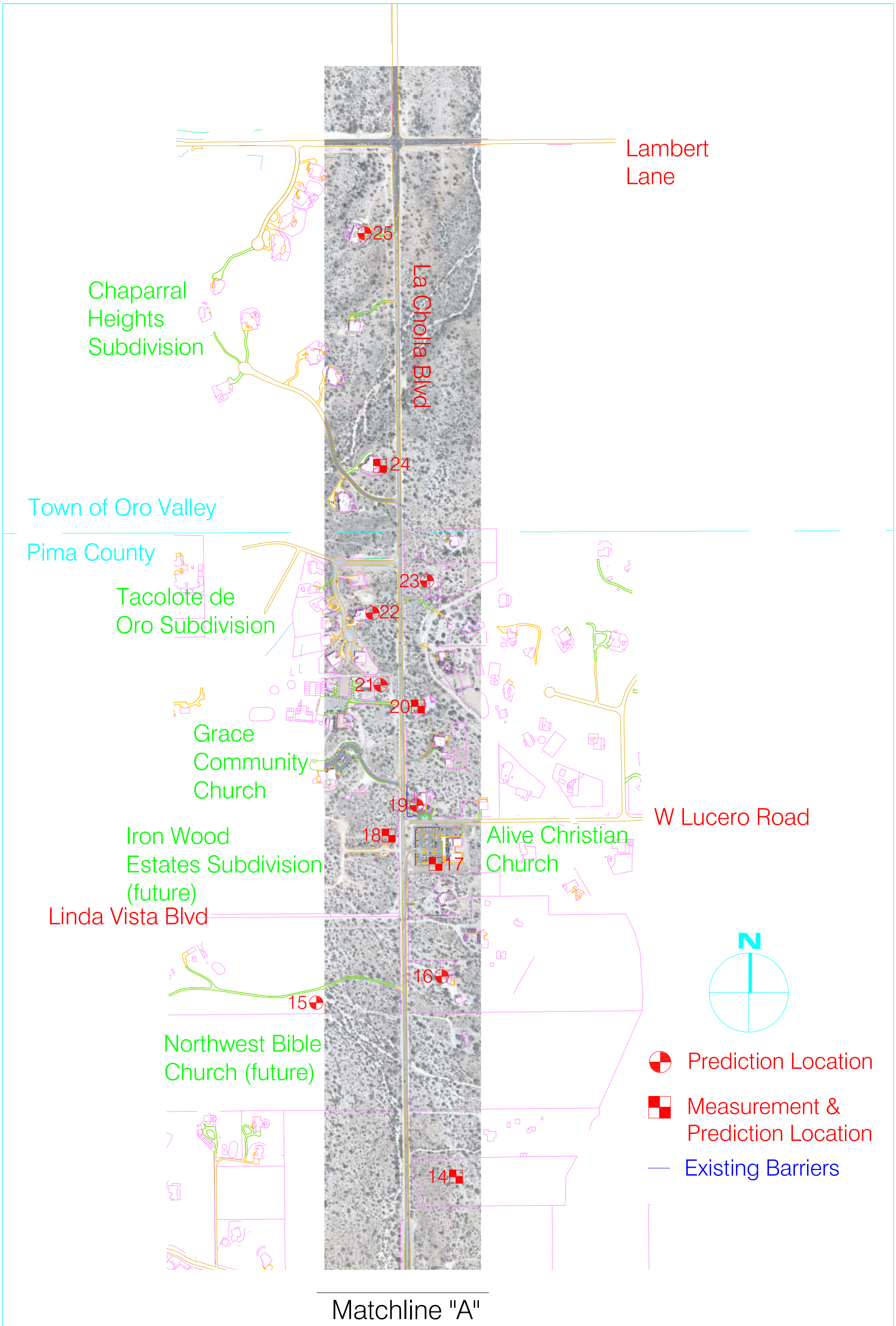

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Figure No. 4

Sound Solutions Acoustical Consulting
PO Box 65962
Tucson, AZ 85728
520-979-2213

INFO ONLY
Preliminary– Not for construction

LA CHOLLA – MAGEE TO LAMBERT
Tucson, Arizona

DESCRIPTION: Existing Road - Northern Half

SCALE: 1" = 600'

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- Thursday, October 15, 2009 AM – During the measurement period the temperature was about 42°F, the relative humidity was about 45%, it was clear and there was almost not wind.

- Tuesday, November 17, 2009 PM – During the measurement period the temperature was about 69°F, the relative humidity was about 12%, it was cloudy and there was a slight breeze from the east (2-4 mph).

- Wednesday, November 18, 2009 PM – During the measurement period the temperature was about 70°F, the relative humidity was about 19%, it was clear and there was a slight wind from the west (1-3 mph).

Noise Model Verification

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. Reported noise levels 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. The noise model verification results are summarized in Table 3.

Table 3. Field Verification Model Results

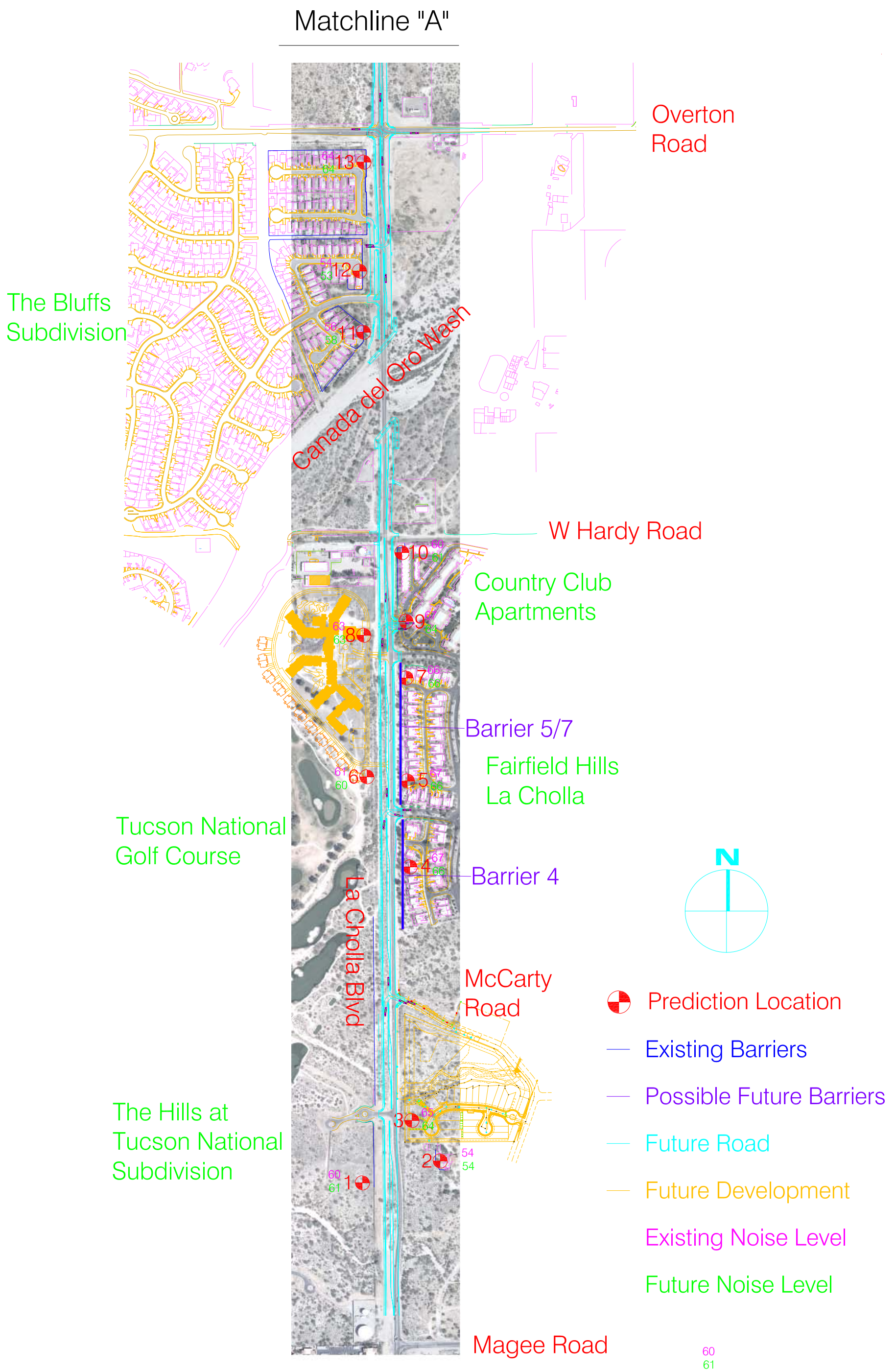
Measurement Location	Measurement Period	Average Measured Noise Level (dBA)	Modeled Noise Level (dBA)
1 - The Hills at Tucson National Subdivision	10/13/09 7:00-7:30 AM	59	60
2 – N MaCarty Road	11/17/09 5:00-5:30 PM	52	54
5 - Fairfield Hills La Cholla - Candlewood	10/13/09 7:40-8:10 AM	67	67
	10/13/09 12:00-12:30 PM	63	63
	10/13/09 2:00-2:30 PM	64	64
6 - Tucson National Golf Course	11/17/09 5:40-6:10 PM	60	61
7 - Fairfield Hills La Cholla - Candlewood	11/17/09 5:45-6:15 PM	66	66
8 – Future Development	11/17/09 6:30-7:00 PM	61	63
9 - Country Club, at entrance	10/13/09 8:15-8:45 AM	67	67
10 - Country Club	10/13/09 8:20-8:50 AM	58	60
12 - The Bluffs Subdivision - Sweet Acacia	10/14/09 7:00-7:30 AM	51	54
13 - The Bluffs Subdivision - Sunset Surprise	11/18/09 5:00-5:30 PM	63	64
14 - 9350 N La Cholla Blvd	11/18/09 5:00-5:30 PM	58	58
17 - Alive Christian Church	10/14/09 7:00-7:30 AM	57	59
	10/14/09 12:00-12:30 PM	54	54
	10/14/09 2:00-2:30 PM	55	56
18 - Iron Wood Estates Subdivision	11/18/09 5:45-6:15 PM	64	65
20 - 9800 N La Cholla Blvd	11/18/09 5:55-6:25 PM	63	63
22 - 9906 N Rabwa Pl	10/14/09 7:45-8:15 AM	59	60
24 – Chaparral Heights Sub - Owl Head	10/15/09 8:00-8:30 AM	61	62
Source: Calculations and measurements performed by Sound Solutions using TNM 2.5			

As shown in Table 3, the modeled noise levels are equal to or higher than the measured noise levels, showing that the predictions are conservative. These results reflect good agreement between measured and modeled values, hence, no parameter adjustment was needed. Variations between measured and modeled are due to many factors including: slight wind (not accounted for in the model), specific vehicles that may be louder or quieter then the modeled level, and other noise sources (birds and distant aircraft) not included in the noise model.

Future Noise Levels

Noise levels were modeled for 25 sensitive receiver locations: 20 sensitive receivers are located in Pima County and 5 sensitive receivers are located in the Town of Oro Valley. Modeled sensitive receiver locations are shown in Figure 5 and 6. Potential traffic noise impacts were evaluated relative to the PCDOT noise limit of 66 dBA and the ADOT noise limit, used by the Town of Oro Valley, of 64 dBA. The future no-build and build scenarios were computed using projected future traffic data provided by PAG and Kittelson & Associates, Inc. (Kittelson & Associates, Inc. 2009). The no-build scenario used existing road alignment, while the build scenario used future alignment provided by URS. Because Pima County and the Town of Oro Valley have different NAC, future noise levels are described separately.

TNM input and output files are presented in Appendices C to H. The barriers for the existing conditions are existing barriers.



Pima County Department of Transportation | November 25, 2009 | Bill Holliday, PE

Figure No. 5

Sound Solutions Acoustical Consulting
PO Box 65962
Tucson, AZ 85728
520-979-2213

INFO ONLY
Preliminary-Not for construction

LA CHOLLA – MAGEE TO LAMBERT
Tucson, Arizona

DESCRIPTION: Future Road - Southern Half

SCALE: 1" = 600'

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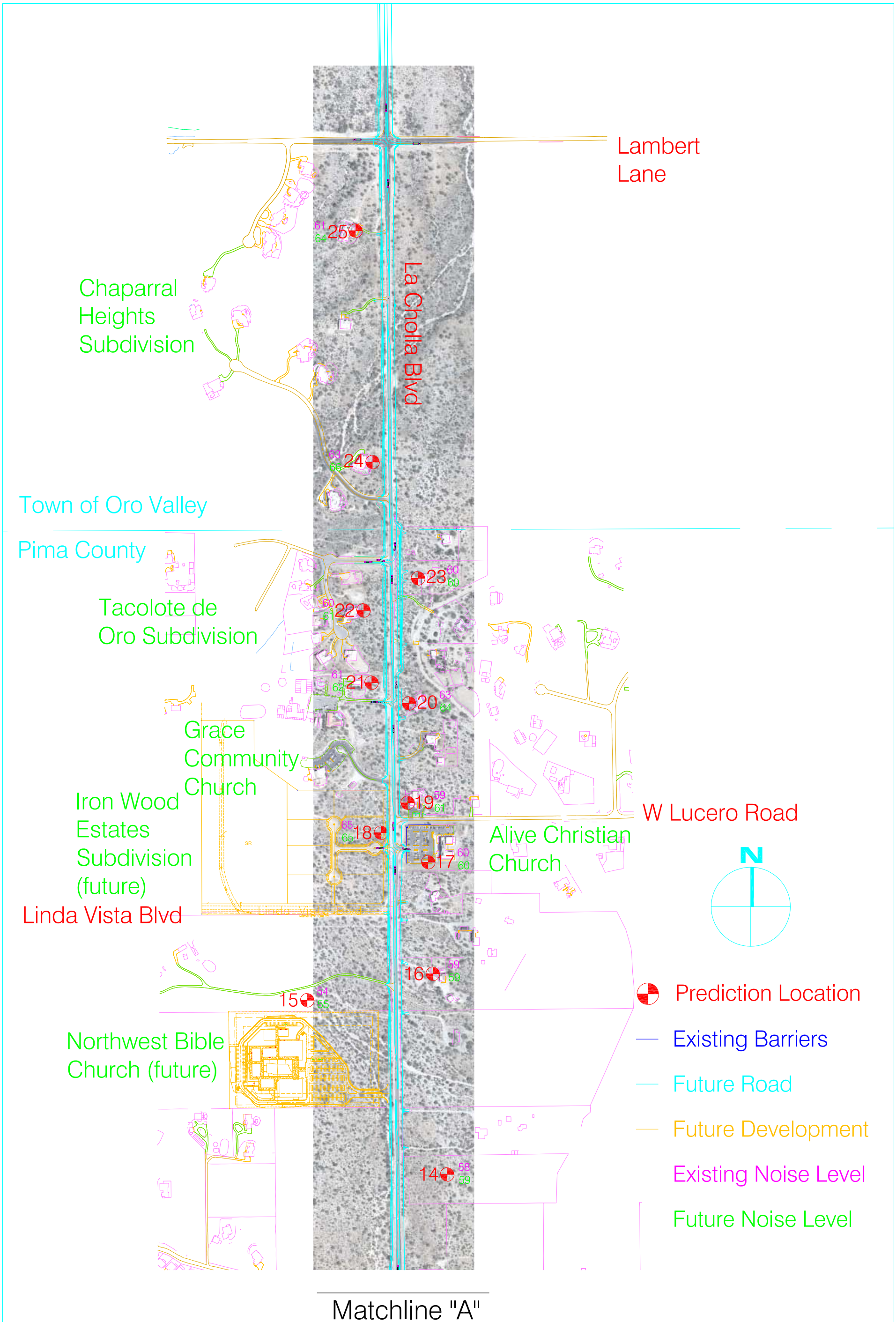

Pima County Department of Transportation | November 25, 2009 | Bill Holliday, PE

Figure No. 6

Sound Solutions Acoustical Consulting
PO Box 65962
Tucson, AZ 85728
520-979-2213

INFO ONLY
Preliminary– Not for construction

LA CHOLLA – MAGEE TO LAMBERT
Tucson, Arizona

DESCRIPTION: Future Road - Northern Half

SCALE: 1" = 600'

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Pima County

As shown in Table 4 and Figure 7, the predicted Future No-Build noise levels are between 1 dBA to 4 dBA higher than the existing noise levels. The predicted Future No-Build noise levels exceed the PCDOT noise limits at locations 3, 4, 5, 7, 9, 13, and 18.

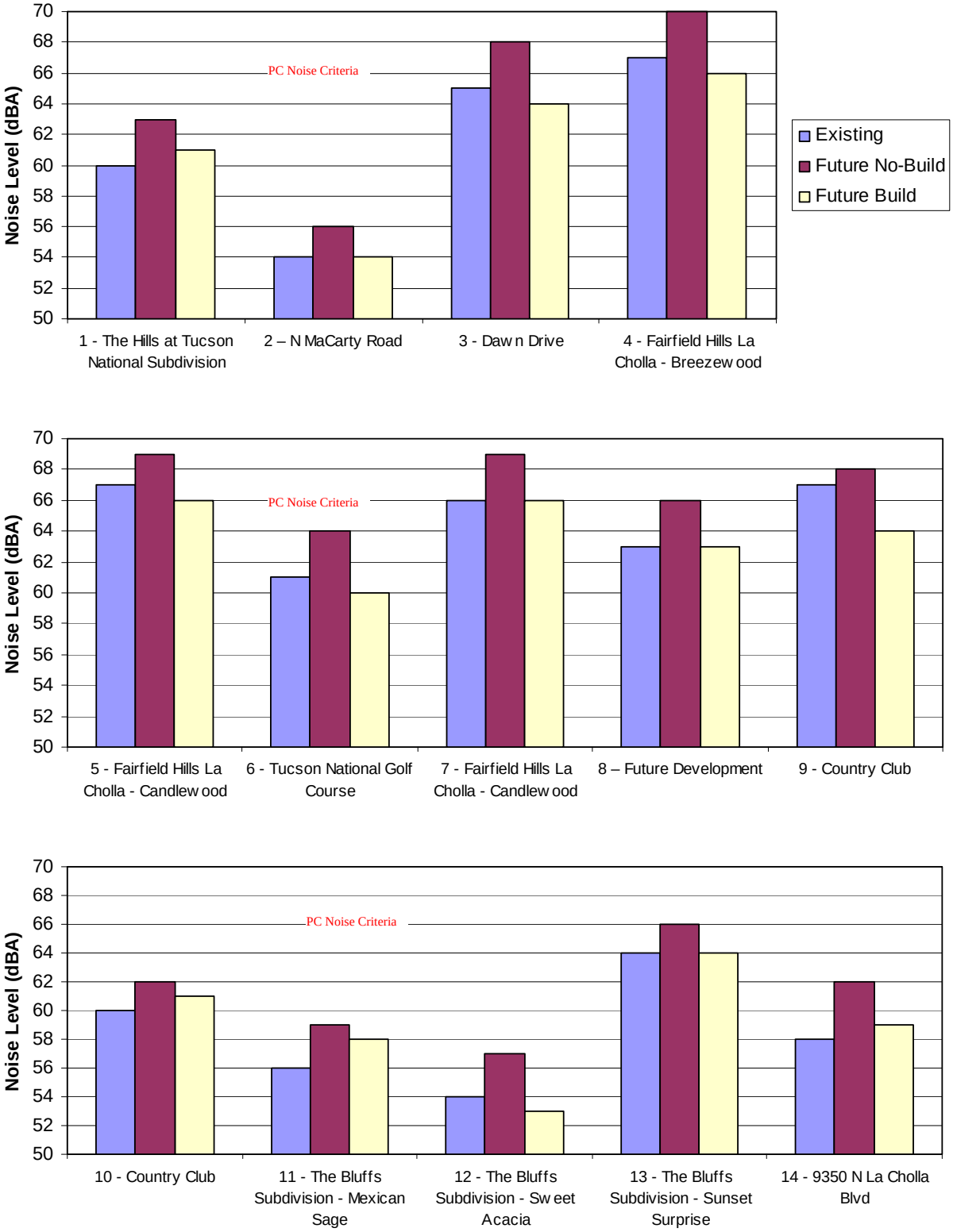
At ten locations the predicted Future Build noise levels are the same or lower than the existing noise levels. The predicted Future Build noise levels are 1 dBA to 2 dBA higher than at nine locations. The predicted Future Build noise levels exceed the PCDOT noise limits at locations 4, 5, and 7. The predicted Future Build noise levels are 1 dBA to 5 dBA lower than the Future No-Build noise levels. All predicted Future Build noise levels were modeled with a noise analysis credit of 3 dBA to account for the noise reduction properties of RAC.

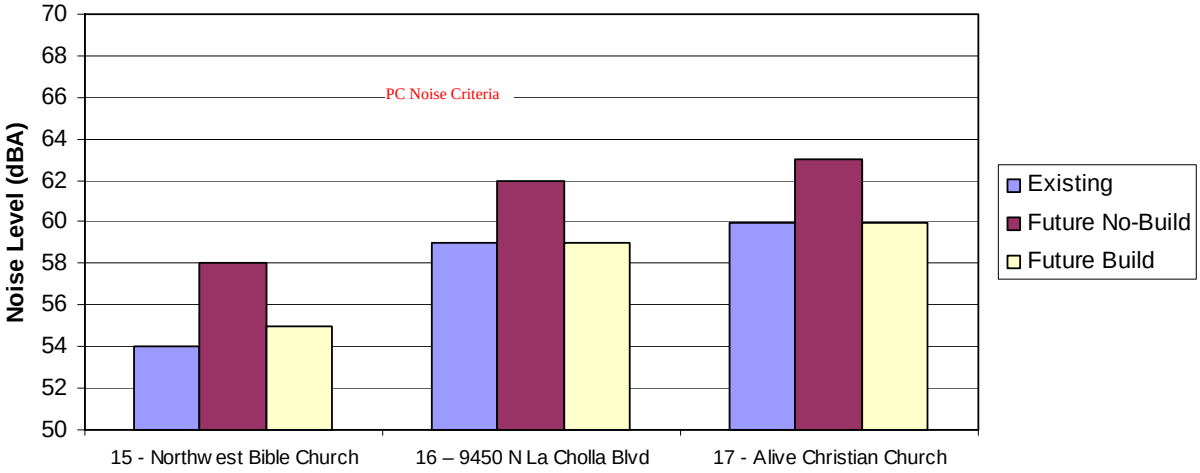
Table 4 Peak Hour Noise Prediction Results – Pima County

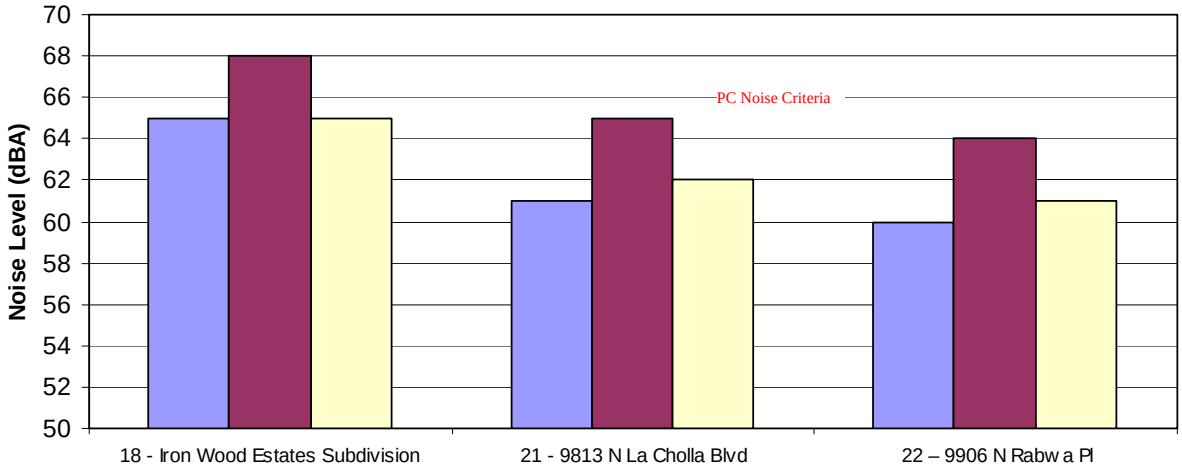
Sensitive Receiver Location	Existing Noise Level (dBA)	Future No-Build Noise Level (dBA)	Future Build Noise Level (dBA) [1]	Noise Criteria (dBA)
1 - The Hills at Tucson National Subdivision	60	63	61	66
2 – N MaCarty Road	54	56	54	66
3 - Dawn Drive	65	**68**	64	66
4 - Fairfield Hills La Cholla - Breezewood	**67**	**70**	**66**	66
5 - Fairfield Hills La Cholla - Candlewood	**67**	**69**	**66**	66
6 - Tucson National Golf Course	61	64	60	66
7 - Fairfield Hills La Cholla - Candlewood	**66**	**69**	**66**	66
8 – Future Development	63	**66**	63	66
9 - Country Club	**67**	**68**	64	66
10 - Country Club	60	62	61	66
11 - The Bluffs Subdivision - Mexican Sage	56	59	58	66
12 - The Bluffs Subdivision - Sweet Acacia	54	57	53	66
13 - The Bluffs Subdivision - Sunset Surprise	64	**66**	64	66
14 - 9350 N La Cholla Blvd	58	62	59	66
15 - Northwest Bible Church	54	58	55	66
16 – 9450 N La Cholla Blvd	59	62	59	66
17 - Alive Christian Church	60	63	60	66
18 - Iron Wood Estates Subdivision	65	**68**	65	66
21 - 9813 N La Cholla Blvd	61	65	62	66
22 – 9906 N Rabwa Pl	60	64	61	66
Minimum noise level	54	56	53	
Maximum noise level	67	70	66	
Average noise level	61	64	61	
Number of locations above the criteria	4	8	3	

Source: Calculations performed by Sound Solutions using TNM 2.5
Numbers in **bold** exceed noise limits
1 Includes 3 dBA noise reduction for RAC for locations in Pima County

Figure 7 Graph of Noise Prediction Results - Pima County







Oro Valley

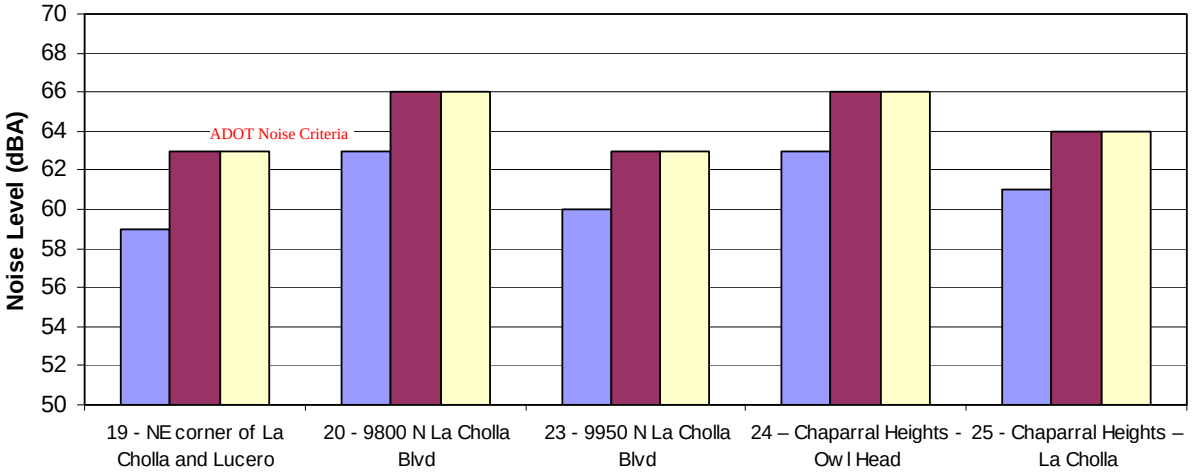
As shown in Table 5 and Figure 8, the predicted Future No-Build and Build noise levels exceed the ADOT noise limits at Locations 20, 23, 24 and 25. At Location 19, the existing barrier will be moved closer to the residence to accommodate new road alignment. The predicted noise level at this location is modeled using the Future Build wall position closer to the residence. At these locations in Oro Valley the noise reduction for RAC is not considered. Note that although there is an increase in noise level over existing, there would be the same increase if the project were not built.

Table 5. Noise Prediction Results – Oro Valley

Receiver Location	Existing Noise Level (dBA)	Future No-Build Noise Level (dBA)	Future Build Noise Level (dBA)	Noise Criteria (dBA)
19 - NE corner of La Cholla and Lucero	59	63	63[2]	64
20 - 9800 N La Cholla Blvd	63	**66**	**66**	64
23 - 9950 N La Cholla Blvd	60	63	63	64
24 – Chaparral Heights - Owl Head	63	**66**	**66**	64
25 - Chaparral Heights – La Cholla	61	**64**	**64**	64
Minimum noise level	59	63	63	
Maximum noise level	63	66	66	
Average noise level	61	65	65	
Number of locations above the criteria	0	4	4	

Source: Calculations performed by Sound Solutions using TNM 2.5
Numbers in **bold** exceed noise limits
2 With 5 foot high barrier constructed in future build

Figure 8. Graph of Noise Prediction Results – Oro Valley



5 Mitigation Measures

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 road design, road surface, and restrictions on the use of road, 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. 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.

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

Feasibility – Design plans can be developed to shift road away from the sensitive receivers on one side.

Reasonability – Road alignment changes may be reasonable where changing the road alignment can move traffic far enough away from sensitive receivers to achieve adequate noise reduction. However, a substantial amount of space would be necessary to move the road far enough away from the receivers to achieve the desired noise level reduction. Furthermore, changing road alignment for a sensitive receive could result in the undesired affect of increase noise levels for other sensitive receivers. Acquisition of properties to create the necessary space, realignment of connecting roads, and the relocation of utilities would make the cost unreasonable.

Rubberized Asphalt Pavement
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 road 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, Magee Road to Lambert Lane, project and the credit will be reflected in the noise analysis results for the Pima County portion of the project. The Town of Oro Valley does not allow a noise analysis credit for the use of RAC.

Feasibility – RAC is relatively easy to include in the project construction. It can be used effectively in the local climate and terrain.

Reasonability – Use of RAC is reasonable because it is included in the construction plans. It entails a low level of maintenance. The high durability equates to a reasonable cost for the life cycle of the pavement.

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).

Feasibility – Restriction on truck is not feasible because displacing the truck traffic may conflict with the planned function of the road. An arterial road, such as La Cholla Boulevard, generally carries truck traffic. Businesses located along La Cholla Boulevard require use of trucks for normal operation.

Reasonability – Implementing restrictions on truck use may be reasonable if an adequate noise reduction can

be achieved. However, the level of truck traffic on La Cholla Boulevard is not high enough for truck restrictions to be effective in reducing noise levels. Displacing truck traffic may shift noise impacts to another area.

Noise Barriers

Construction of noise barriers between the roads 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.

Feasibility – Construction of noise barriers are not feasible where the walls would limit sight distances for motorists and where safety barriers would limit the length of the walls.

Reasonability – Construction of noise barriers are reasonable where noise reduction is adequate and cost effective.

Pima County

The PCDOT regulation says that mitigation measures must be considered when either: 1) the projected noise levels at noise sensitive receivers are 66 dBA or more; or, 2) the projected noise levels are 15 dBA or more above the existing noise levels. Substantial increases in noise levels over existing levels were not found in this analysis.

The FHWA guideline states that when noise abatement measures are being considered, every reasonable effort shall be made to obtain substantial noise reduction. PCDOT sets a maximum cost of noise abatement per benefited developed property at $35,000 (using a construction cost of $\$25/ft^2$). Benefited receivers are those that receive a 5 dBA noise reduction from the proposed mitigation. PCDOT states that noise barrier construction shall not be constructed unless two or more adjacent receivers are benefited.

As stated earlier, Pima County allows a 3 dBA noise reduction for the use of RAC.

Oro Valley

The ADOT regulation says that mitigation measures must be considered when either: 1) the projected noise levels at noise sensitive receivers are 64 dBA or more; or, 2) the projected noise levels are 15 dBA or more above the existing noise levels. Substantial increases in noise levels over existing levels were not found in this analysis.

ADOT sets a recommended maximum cost of noise abatement per benefited developed property at $46,000. As with the PCDOT regulation, benefited properties are those that receive a 5 dBA noise reduction from proposed mitigation. ADOT does not specify a construction cost for the barriers. ADOT states that it will not be reasonable to provide abatement for isolated developed properties.

As stated earlier, ADOT does not allow a noise reduction for RAC.

Table 6 shows the required barrier size, benefited receivers (receiving a 5 dBA noise reduction or more) and the cost per benefited receiver for each area with impacted receivers.

Walls to be considered by affected property owners are shown in Figures 5 and 6. As shown in Table 7, barriers that meet the Pima County requirements are at Locations 4, 5 and 7. Walls are sometimes not

desirable because they block sunlight or views, may become a vandalism concern, or are considered unnatural and unattractive.

The southern barrier (Location 4), west of Breezewood, which could be located at the right of way (mid-way up the slope) is 745-feet long and the top of the barrier is 9-feet above the elevation of the ground at the right of way.

There are two options for the northern barrier (Locations 5 & 7), west of Candlewood, both would be about 915-feet long
1. The top of the barrier should be 10-feet above the elevation of the future road if it is located near the road or
2. The top of the barrier should be 9-feet above the elevation of the ground at the right of way (mid-way up the slope) with the barrier at the right of way.

The barriers meet the PDOT criteria for reasonable and feasible.

Table 6. Cost of Barriers per Benefited Receiver

Barrier ID and Location	Potential Wall Length	Potential Wall Height[1]	Benefited Receivers[2]	Cost per Benefited Receiver[3]	Walls to be Considered by Affected Property Owners
4 - Fairfield Hills La Cholla – Breezewood Located at ROW	745’	9’	10	$16,763	**Yes**
5 & 7 - Fairfield Hills La Cholla – Candlewood Located at ROW	915’	9’	12	$17,156	**Yes**
5 & 7 - Fairfield Hills La Cholla – Candlewood Located near road	915’	10’	12	$19,063	**Yes**
20 - 9800 N La Cholla Blvd	-	-	-	-	No[5,6]
24 - Chaparral Heights - Owl Head	-	-	-	-	No[6]
25 - Chaparral Heights – La Cholla	-	-	-	-	No[6]
Source: Calculations performed by Sound Solutions using TNM 2.5					

1 Barrier height relative to ground at wall elevation
2 Noise reduction of 5-7 dBA
3 Based on Pima County cost assumption of $25/ft^2
4 Needs to be higher than 10 feet
5 Breaks in the wall prevent a 5 dBA reduction
6 Only one impacted receiver benefits from a wall

With the two barriers constructed, the noise reduction at Locations 4, 5 and 7 will be 6 dBA, 5 dBA and 5 dBA, respectively.

6 Construction Noise

Properties in the vicinity of the project area would be exposed to noise from construction activities.

The Pima County Noise Code (Chapter 9.30.070) limits construction activities to between 5 AM and 7 PM, April 15 to October 15 and between 6 AM and 7 PM, October 16 to April 14. A noise variance will be required if nighttime construction is necessary.

Construction noise differs from traffic noise in several ways:

- Construction noise lasts only for the duration of the construction contract, with most construction activities in noise-sensitive areas being conducted during hours that are least disturbing to adjacent and nearby residents.
- Construction activities generally are of a short-term nature, and depend on the nature of construction operations.
- Construction noise also is intermittent and depends on the type of operation, location, and function of the equipment, and the equipment usage cycle. Traffic noise, on the other hand, is present in a more continuous fashion after construction activities are completed.

Adjacent properties in the project area would be exposed to noise from construction activity.

Table 7 shows the noise levels produced by various types of construction equipment. The types of construction equipment used for this project will typically generate noise levels of 80 to 90 dBA at a distance of 15 meters (50 feet) while the equipment is operating. Construction equipment operations can vary from intermittent to fairly continuous, with multiple pieces of equipment operating concurrently.

Table 7. Typical Construction Equipment Noise Levels

Type of Equipment	Noise Level in dBA at 50 Feet
Bulldozer	80
Front Loader	72 - 84
Jack Hammer or Rock Drill	81 - 98
Crane with Headache Ball	75 - 87
Backhoe	72 - 93
Scraper and Grader	80 - 93
Electrical Generator	71 - 82
Concrete Pump	81 - 83
Concrete Vibrator	76
Concrete and Dump Trucks	83 - 90
Air Compressor	74 - 87
Pile Drivers (Peaks)	95 - 106
Pneumatic Tools	81 - 98
Roller (Compactor)	73 - 75
Saws	73 - 82
Source: U.S. EPA Noise from Construction Equipment and Operations	

Locations within about 500 meters (1,650 feet) of a construction site are expected to experience occasional episodes of noise levels greater than 60 dBA. Areas within about 150 meters (500 feet) of a construction site will experience episodes with noise levels greater than 70 dBA. Such episodes of high noise levels will not be continuous throughout the day and will generally be restricted to daytime hours.

The following noise mitigation measures are recommended to reduce impacts from construction noise; however, not all measures may be feasible for the La Cholla project:

- Re-route truck traffic away from residential streets, if possible. Select streets with fewest homes, if no alternatives are available.
- Locate equipment on the construction lot as far away from noise sensitive receivers as possible.
- Combine noisy operations to occur in the same time period. The total noise will not increase significantly and the duration of the noise impact will be less.
- Avoid nighttime activities. Sensitivity to noise increases during the nighttime hours at residential receivers.
- Use specially quieted equipment when possible, such as quieted and enclosed air compressors, residential or critical grade mufflers on all engines.
- Stationary equipment will be located as far away from sensitive receptors as possible. Loud, disrupting construction activities in noise sensitive areas will be conducted during hours that are least disturbing to adjacent and nearby residents.

7 Conclusion

The widening of La Cholla Boulevard from Magee Road to Lambert Lane is a Regional Transportation Authority (RTA) funded roadway project. This is the Pima County part of the larger project from Magee to Tangerine.

The project is located approximately 10 miles north of downtown Tucson and is slightly less than 3 miles long, as shown in Figures 1 and 2.

Potential noise impacts from the majority of the proposed project were assessed following the Pima County Department of Transportation (PCDOT) and Federal Highway Administration (FHWA) procedures. The north end of the project is located in Oro Valley and was evaluated using Arizona Department of Transportation (ADOT) and FHWA procedures. The analysis assessed the impact of traffic noise from the expansion on nearby properties and compared them to the PCDOT and ADOT criteria to determine whether traffic noise mitigation is necessary.

The noise analysis results show that noise impacts could occur and that two barriers should be considered.

The project will use Rubberized Asphalt Concrete (RAC) which has been shown to reduce noise levels from traffic by over 3 decibels, A-weighted (dBA). Pima County allows a 3 dBA noise reduction for the use of RAC; however, ADOT and FHWA do not permit this noise reduction; hence, for the portion of the project in Pima County a noise reduction was taken and for the small portion in Oro Valley no reduction was taken.

The noise study shows that two barriers should be considered by the affected property owners near Fairfield Hills La Cholla. The southern barrier, west of Breezewood, could be located mid-way up the slope (at the right of way) is 745-feet long with the top of the barrier 9-feet above the elevation of the ground. There are two options for the northern barrier, west of Candlewood, both would be about 915-feet long with the top of the barrier 10-feet above the elevation of the future road if it is located near the road or with the top of the barrier 9-feet above the elevation of the ground at the right of way (mid-way up the slope) if it is located at the right of way. The barriers meet the PDOT criteria for reasonable and feasible.

Properties in the vicinity of the project area would be exposed to noise from construction activities. Steps should be taken to reduce impacts from construction noise.

APPENDIX A

References

PCDOT Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects 12/1/2003

PCDOT Revision of Traffic Noise Analysis and Mitigation Guidance for Major Road Projects, Amendment to Statement of Purpose, and Cost Effective Criteria 4/8/2008

ADOT Noise Abatement Policy 12/5/2005

ADOT Noise Abatement Policy Addendum 8/8/2007

Federal Highway Administration, DOT 23 CFR, Chapter 1, Subsection 772 4/1/1998

Traffic Engineering Study for La Cholla Boulevard, Magee Road to Tangerine Road – Pima County Department of Transportation, Traffic Division with Kittelson & Associates, Inc 2009

Traffic Noise Model Version 2.5 User's Guide (Addendum) 4/2004

Handbook of Acoustical Measurements and Noise Control, Third Edition, Cyril Harris 1998

Transit Noise and Vibration Impact Assessment, Federal Transit Administration 4/1995

Environmental Protections Authority – Noise Policy 1/2000

Federal Highway Administration, Measurement of Highway-Related Noise 1995

Federal Highway Administration, Highway Traffic Noise Analysis and Abatement Policy and Guideline 1995

APPENDIX B

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as "unwanted" sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 µPa, which is approximately the lowest sound pressure that can be detected by the human ear.

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, background noise, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[2] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the human auditory system does. Thus the A-weighted sound

1 D.W. Robinson and R.S. Dadson, "A Re-Determination of the Equal-Loudness Relations for Pure Tones," *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226).

level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown below.

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise.

Common Sound Levels in dBA

Common Outdoor Sounds	Sound Pressure Level (dBA)	Common Indoor Sounds	Subjective Evaluation
Auto horn at 10’ Jackhammer at 50’	**100**	Printing plant	Deafening
Gas lawn mower at 4’ Pneumatic drill at 50’	**90**	Auditorium during applause Food blender at 3’	Very Loud
Concrete mixer at 50’ Jet flyover at 5000’	**80**	Telephone ringing at 8’ Vacuum cleaner at 5’	
Large dog barking at 50’ Large transformer at 50’	**70**	Electric shaver at 1’	Loud
Automobile at 55 mph at 150’ Urban residential	**60**	Normal conversation at 3’	
Small town residence	**50**	Office noise Dishwasher in adjacent room	Moderate
	40	Soft stereo music in residence Library	
Rustling leaves	**30**	Average bedroom at night Soft whisper at 3’	Faint
Quiet rural nighttime	**20**	Broadcast and recording studio	
	10	Human breathing	Very Faint
	0	Threshold of hearing (audibility)	
Source: Sound Solution measurements and reference library			

APPENDIX C

Model Input/Output Files
FHWA Traffic Noise Model
Existing AM

Sound Solutions 24 November 2009
wmh TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: URS
RUN: La Cholla - Existing AM
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	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	65.2	66	65.2	10	----	60.1	5.1	8	-2.9
Receiver2	2	1	0.0	59.1	66	59.1	10	----	53.5	5.6	8	-2.4
Receiver3	3	1	0.0	65.2	66	65.2	10	----	65.2	0.0	8	-8.0
Receiver4	4	1	0.0	67.0	66	67.0	10	Snd Lvl	67.0	0.0	8	-8.0
Receiver5	5	1	0.0	66.6	66	66.6	10	Snd Lvl	66.6	0.0	8	-8.0
Receiver6	6	1	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
Receiver7	7	1	0.0	66.3	66	66.3	10	Snd Lvl	66.3	0.0	8	-8.0
Receiver8	8	1	0.0	62.9	66	62.9	10	----	62.9	0.0	8	-8.0
Receiver9	9	1	0.0	66.8	66	66.8	10	Snd Lvl	66.7	0.1	8	-7.9
Receiver10	10	1	0.0	65.3	66	65.3	10	----	59.5	5.8	8	-2.2
Receiver11	11	1	0.0	62.5	66	62.5	10	----	56.4	6.1	8	-1.9
Receiver12	12	1	0.0	63.8	66	63.8	10	----	54.4	9.4	8	1.4
Receiver13	13	1	0.0	65.8	66	65.8	10	----	63.8	2.0	8	-6.0
Receiver14	14	1	0.0	58.1	66	58.1	10	----	58.1	0.0	8	-8.0
Receiver15	15	1	0.0	54.2	66	54.2	10	----	54.2	0.0	8	-8.0
Receiver16	16	1	0.0	58.5	66	58.5	10	----	58.5	0.0	8	-8.0
Receiver17	17	1	0.0	59.6	66	59.6	10	----	59.4	0.2	8	-7.8
Receiver18	18	1	0.0	64.6	66	64.6	10	----	64.6	0.0	8	-8.0
Receiver19	19	1	0.0	65.5	66	65.5	10	----	59.0	6.5	8	-1.5
Receiver20	20	1	0.0	62.7	66	62.7	10	----	62.7	0.0	8	-8.0
Receiver21	21	1	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
Receiver22	22	1	0.0	60.1	66	60.1	10	----	60.1	0.0	8	-8.0
Receiver23	23	1	0.0	59.6	66	59.6	10	----	59.6	0.0	8	-8.0
Receiver24	24	1	0.0	62.4	66	62.4	10	----	62.4	0.0	8	-8.0

Receiver25	25	1	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
extra	26	1	0.0	63.1	66	63.1	10	----	63.1	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	26	0.0	1.6	9.4
All Impacted	4	0.0	0.0	0.1
All that meet NR Goal	1	9.4	9.4	9.4

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Existing AM**

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria: Existing LAeq1h	Impact Criteria LAeq1h	Impact Criteria Sub'l	NR Goal	Active in Calc.
			ft	ft	ft	ft	dBA	dBA	dB	dB	
Receiver1	1	1	79,055.5	94,038.6	2,420.00	4.92	0.00	66	10.0	8.0	Y
Receiver2	2	1	79,453.2	94,089.6	2,430.00	4.92	0.00	66	10.0	8.0	Y
Receiver3	3	1	79,249.7	94,377.4	2,423.00	4.92	0.00	66	10.0	8.0	Y
Receiver4	4	1	79,197.7	95,836.2	2,385.00	4.92	0.00	66	10.0	8.0	Y
Receiver5	5	1	79,198.9	96,552.4	2,372.00	4.92	0.00	66	10.0	8.0	Y
Receiver6	6	1	78,955.5	96,697.1	2,345.00	4.92	0.00	66	10.0	8.0	Y
Receiver7	7	1	79,199.3	97,220.2	2,365.00	4.92	0.00	66	10.0	8.0	Y
Receiver8	8	1	78,939.4	97,535.2	2,355.00	4.92	0.00	66	10.0	8.0	Y
Receiver9	9	1	79,175.9	97,607.8	2,360.00	4.92	0.00	66	10.0	8.0	Y
Receiver10	10	1	79,180.3	98,057.0	2,362.00	4.92	0.00	66	10.0	8.0	Y
Receiver11	11	1	78,885.9	99,526.7	2,369.00	4.92	0.00	66	10.0	8.0	Y
Receiver12	12	1	78,920.5	99,864.9	2,374.00	4.92	0.00	66	10.0	8.0	Y
Receiver13	13	1	78,926.5	100,650.6	2,382.00	4.92	0.00	66	10.0	8.0	Y
Receiver14	14	1	79,384.3	101,659.8	2,401.00	4.92	0.00	66	10.0	8.0	Y
Receiver15	15	1	78,431.2	102,832.5	2,443.00	4.92	0.00	66	10.0	8.0	Y
Receiver16	16	1	79,316.3	103,014.8	2,428.00	4.92	0.00	66	10.0	8.0	Y
Receiver17	17	1	79,253.9	103,803.7	2,442.00	4.92	0.00	66	10.0	8.0	Y
Receiver18	18	1	78,930.0	103,948.3	2,451.00	4.92	0.00	66	10.0	8.0	Y
Receiver19	19	1	79,092.7	104,234.1	2,458.00	4.92	0.00	66	10.0	8.0	Y
Receiver20	20	1	79,141.1	104,853.7	2,497.00	4.92	0.00	66	10.0	8.0	Y
Receiver21	21	1	78,821.9	105,023.7	2,534.00	4.92	0.00	66	10.0	8.0	Y
Receiver22	22	1	78,786.4	105,541.4	2,547.00	4.92	0.00	66	10.0	8.0	Y

Receiver23	23	1	79,187.4	105,737.1	2,507.00	4.92	0.00	66	10.0	8.0	Y
Receiver24	24	1	78,851.1	106,567.6	2,560.00	4.92	0.00	66	10.0	8.0	Y
Receiver25	25	1	78,757.3	108,114.2	2,596.00	4.92	0.00	66	10.0	8.0	Y
extra	26	1	79,112.3	108,424.0	2,595.00	4.92	0.00	66	10.0	8.0	Y

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: ROADWAYS
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Existing AM**

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

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	ft			ft	ft	ft		mph	%		
La Cholla	12.0	south	1	79,153.4	93,465.4	2,406.00				Average	
		point2	2	79,154.5	94,036.5	2,409.00				Average	
		point3	3	79,133.5	94,880.4	2,405.00				Average	
		point4	4	79,127.7	95,405.4	2,390.00				Average	
		point5	5	79,123.8	95,948.9	2,370.00				Average	
		point6	6	79,122.0	96,304.7	2,361.00				Average	
		point7	7	79,114.5	97,312.3	2,358.00				Average	
		point8	8	79,080.3	97,920.1	2,358.00				Average	
		point9	9	79,075.3	98,127.1	2,361.00				Average	
		point10	10	79,067.5	99,103.6	2,360.00				Average	
		point24	24	79,065.4	99,483.6	2,366.00				Average	
		point25	25	79,049.9	100,760.4	2,385.00				Average	
		point26	26	79,038.0	102,123.3	2,420.00				Average	
		point27	27	79,027.1	103,182.8	2,420.00				Average	
		point28	28	79,020.9	103,936.0	2,448.00				Average	
		point29	29	79,018.8	104,232.5	2,460.00				Average	
		point30	30	79,011.5	104,848.3	2,500.00				Average	
		point31	31	79,003.0	105,333.2	2,512.00				Average	
		point32	32	78,995.5	105,860.9	2,527.00				Average	
		point33	33	78,994.0	106,272.5	2,530.00				Average	
		point34	34	78,987.9	106,671.7	2,556.00				Average	
		point35	35	78,979.6	107,519.6	2,574.00				Average	
		point36	36	78,973.9	108,673.3	2,608.00				Average	
		north	11	78,956.2	110,492.5	2,635.00					
Overton West	12.0	point12	12	78,996.1	100,800.7	2,385.00				Average	

		point13	13	78,380.5	100,801.3	2,385.00				Average	
		point14	14	77,887.5	100,797.4	2,395.00					
Overton East	12.0	point15	15	79,111.8	100,806.9	2,385.00				Average	
		point16	16	79,974.8	100,815.0	2,380.00				Average	
		point17	17	80,672.8	100,818.2	2,387.00					
Lambert West	12.0	point18	18	78,888.6	108,725.2	2,607.00				Average	
		point19	19	77,791.1	108,719.5	2,590.00				Average	
		point20	20	77,512.8	108,716.4	2,585.00					
Lambert East	12.0	point21	21	79,025.9	108,728.8	2,607.00				Average	
		point22	22	79,595.6	108,730.1	2,600.00				Average	
		point23	23	80,384.5	108,738.5	2,604.00					

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Existing AM**

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
La Cholla	south	1	1350	45	28	45	14	45	0	0	0	0
	point2	2	1350	45	28	45	14	45	0	0	0	0
	point3	3	1350	45	28	45	14	45	0	0	0	0
	point4	4	1350	45	28	45	14	45	0	0	0	0
	point5	5	1350	45	28	45	14	45	0	0	0	0
	point6	6	1350	45	28	45	14	45	0	0	0	0
	point7	7	1350	45	28	45	14	45	0	0	0	0
	point8	8	1350	45	28	45	14	45	0	0	0	0
	point9	9	1350	45	28	45	14	45	0	0	0	0
	point10	10	1350	45	28	45	14	45	0	0	0	0
	point24	24	1350	45	28	45	14	45	0	0	0	0
	point25	25	958	45	20	45	10	45	0	0	0	0
	point26	26	958	45	20	45	10	45	0	0	0	0
	point27	27	958	45	20	45	10	45	0	0	0	0
	point28	28	958	45	20	45	10	45	0	0	0	0
	point29	29	958	45	20	45	10	45	0	0	0	0
	point30	30	958	45	20	45	10	45	0	0	0	0
	point31	31	958	45	20	45	10	45	0	0	0	0
	point32	32	958	45	20	45	10	45	0	0	0	0
	point33	33	958	45	20	45	10	45	0	0	0	0
	point34	34	958	45	20	45	10	45	0	0	0	0
	point35	35	958	45	20	45	10	45	0	0	0	0
	point36	36	1075	45	22	45	11	45	0	0	0	0

	north	11										
Overton West	point12	12	1102	45	23	45	11	45	0	0	0	0
	point13	13	1102	45	23	45	11	45	0	0	0	0
	point14	14										
Overton East	point15	15	632	45	13	45	7	45	0	0	0	0
	point16	16	632	45	13	45	7	45	0	0	0	0
	point17	17										
Lambert West	point18	18	601	45	12	45	6	45	0	0	0	0
	point19	19	601	45	12	45	6	45	0	0	0	0
	point20	20										
Lambert East	point21	21	881	45	18	45	9	45	0	0	0	0
	point22	22	881	45	18	45	9	45	0	0	0	0
	point23	23										

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: BARRIERS
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Existing AM**

Barrier									Points										
Name	Type	Height		If Wall	If Berm			Add'tnl	Name	No.	Coordinates (bottom)			Height	Segment				
		Min	Max	$ per	$ per	Top	Run:Rise	$ per			X	Y	Z	at	Seg Ht Perturbs			On	Important
				Unit	Unit	Width		Unit						Point	Incre-	#Up	#Dn	Struct?	Reflec-
				Area	Vol.			Length							ment				tions?
		ft	ft	$/sq ft	$/cu yd	ft	ft:ft	$/ft			ft	ft	ft	ft	ft				
Barrier2	W	5.00	99.99	0.00				0.00	point1	1	79,430.9	94,024.0	2,428.00	5.00	1.00	0	0		
									point2	2	79,405.7	94,153.4	2,433.00	5.00					
Barrier3	W	5.00	99.99	0.00				0.00	point3	3	79,072.0	94,374.5	2,407.00	5.00	1.00	0	0		
									point4	4	79,077.7	94,176.9	2,426.00	5.00	1.00	0	0		
									point5	5	79,073.6	93,925.8	2,413.00	5.00					
Barrier4	W	6.00	99.99	0.00				0.00	point6	6	79,168.1	97,651.4	2,360.00	6.00	1.00	0	0		
									point7	7	79,155.5	97,912.0	2,361.00	6.00	1.00	0	0		
									point8	8	79,154.4	98,084.7	2,361.00	6.00	1.00	0	0		
									point9	9	79,204.1	98,084.9	2,362.00	6.00					
Barrier5	W	6.00	99.99	0.00				0.00	point10	10	78,890.9	99,379.6	2,369.00	6.00	1.00	0	0		
									point11	11	78,935.9	99,433.9	2,369.00	6.00	1.00	0	0		
									point12	12	78,934.5	99,529.9	2,369.00	6.00	1.00	0	0		
									point13	13	78,933.3	99,662.8	2,370.00	6.00					
Barrier6	W	7.00	99.99	0.00				0.00	point14	14	78,846.8	99,768.0	2,373.00	7.00	1.00	0	0		
									point15	15	78,928.0	99,768.9	2,374.00	7.50	1.00	0	0		
									point16	16	78,927.1	100,100.6	2,375.00	7.00	1.00	0	0		
									point17	17	78,831.2	100,101.1	2,374.00	7.00					
Barrier7	W	5.00	99.99	0.00				0.00	point18	18	78,955.1	100,248.1	2,376.00	5.00	1.00	0	0		
									point19	19	78,952.3	100,681.1	2,382.00	5.00					
Barrier8	W	5.00	99.99	0.00				0.00	point20	20	78,952.3	100,696.8	2,382.00	5.00	1.00	0	0		
									point21	21	78,952.3	100,727.3	2,382.00	5.00	1.00	0	0		
									point22	22	78,810.7	100,727.8	2,382.00	5.00					
Barrier9	W	6.00	99.99	0.00				0.00	point23	23	79,108.4	104,132.1	2,453.00	6.00	1.00	0	0		
									point24	24	79,047.5	104,127.5	2,454.00	6.00	1.00	0	0		
									point25	25	79,039.8	104,496.5	2,475.00	6.00					

APPENDIX D

Model Input/Output Files
FHWA Traffic Noise Model
Existing PM

Sound Solutions 24 November 2009
wmh TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: URS
RUN: La Cholla - Existing PM
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	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	65.2	66	65.2	10	----	60.1	5.1	8	-2.9
Receiver2	2	1	0.0	59.1	66	59.1	10	----	53.5	5.6	8	-2.4
Receiver3	3	1	0.0	65.1	66	65.1	10	----	65.1	0.0	8	-8.0
Receiver4	4	1	0.0	67.0	66	67.0	10	Snd Lvl	67.0	0.0	8	-8.0
Receiver5	5	1	0.0	66.6	66	66.6	10	Snd Lvl	66.6	0.0	8	-8.0
Receiver6	6	1	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
Receiver7	7	1	0.0	66.3	66	66.3	10	Snd Lvl	66.3	0.0	8	-8.0
Receiver8	8	1	0.0	62.8	66	62.8	10	----	62.8	0.0	8	-8.0
Receiver9	9	1	0.0	66.7	66	66.7	10	Snd Lvl	66.7	0.0	8	-8.0
Receiver10	10	1	0.0	65.3	66	65.3	10	----	59.5	5.8	8	-2.2
Receiver11	11	1	0.0	62.4	66	62.4	10	----	56.4	6.0	8	-2.0
Receiver12	12	1	0.0	63.8	66	63.8	10	----	54.3	9.5	8	1.5
Receiver13	13	1	0.0	65.7	66	65.7	10	----	63.7	2.0	8	-6.0
Receiver14	14	1	0.0	58.1	66	58.1	10	----	58.1	0.0	8	-8.0
Receiver15	15	1	0.0	54.3	66	54.3	10	----	54.3	0.0	8	-8.0
Receiver16	16	1	0.0	58.6	66	58.6	10	----	58.6	0.0	8	-8.0
Receiver17	17	1	0.0	59.7	66	59.7	10	----	59.6	0.1	8	-7.9
Receiver18	18	1	0.0	64.8	66	64.8	10	----	64.8	0.0	8	-8.0
Receiver19	19	1	0.0	65.6	66	65.6	10	----	59.1	6.5	8	-1.5
Receiver20	20	1	0.0	62.9	66	62.9	10	----	62.8	0.1	8	-7.9
Receiver21	21	1	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
Receiver22	22	1	0.0	60.2	66	60.2	10	----	60.2	0.0	8	-8.0
Receiver23	23	1	0.0	59.7	66	59.7	10	----	59.7	0.0	8	-8.0
Receiver24	24	1	0.0	62.6	66	62.6	10	----	62.6	0.0	8	-8.0

Receiver25	25	1	0.0	60.5	66	60.5	10	----	60.5	0.0	8	-8.0
extra	26	1	0.0	63.1	66	63.1	10	----	63.1	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	26	0.0	1.6	9.5
All Impacted	4	0.0	0.0	0.0
All that meet NR Goal	1	9.5	9.5	9.5

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Existing PM**

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
La Cholla	south	1	1342	45	28	45	14	45	0	0	0	0
	point2	2	1342	45	28	45	14	45	0	0	0	0
	point3	3	1342	45	28	45	14	45	0	0	0	0
	point4	4	1342	45	28	45	14	45	0	0	0	0
	point5	5	1342	45	28	45	14	45	0	0	0	0
	point6	6	1342	45	28	45	14	45	0	0	0	0
	point7	7	1342	45	28	45	14	45	0	0	0	0
	point8	8	1342	45	28	45	14	45	0	0	0	0
	point9	9	1342	45	28	45	14	45	0	0	0	0
	point10	10	1342	45	28	45	14	45	0	0	0	0
	point24	24	1342	45	28	45	14	45	0	0	0	0
	point25	25	1002	45	21	45	10	45	0	0	0	0
	point26	26	1002	45	21	45	10	45	0	0	0	0
	point27	27	1002	45	21	45	10	45	0	0	0	0
	point28	28	1002	45	21	45	10	45	0	0	0	0
	point29	29	1002	45	21	45	10	45	0	0	0	0
	point30	30	1002	45	21	45	10	45	0	0	0	0
	point31	31	1002	45	21	45	10	45	0	0	0	0
	point32	32	1002	45	21	45	10	45	0	0	0	0
	point33	33	1002	45	21	45	10	45	0	0	0	0
	point34	34	1002	45	21	45	10	45	0	0	0	0
	point35	35	1002	45	21	45	10	45	0	0	0	0
	point36	36	912	45	19	45	9	45	0	0	0	0

	north	11										
Overton West	point12	12	980	45	20	45	10	45	0	0	0	0
	point13	13	980	45	20	45	10	45	0	0	0	0
	point14	14										
Overton East	point15	15	598	45	12	45	6	45	0	0	0	0
	point16	16	598	45	12	45	6	45	0	0	0	0
	point17	17										
Lambert West	point18	18	603	45	12	45	6	45	0	0	0	0
	point19	19	603	45	12	45	6	45	0	0	0	0
	point20	20										
Lambert East	point21	21	803	45	17	45	8	45	0	0	0	0
	point22	22	803	45	17	45	8	45	0	0	0	0
	point23	23										

APPENDIX E

Model Input/Output Files
FHWA Traffic Noise Model
Future No-Build AM

Sound Solutions
wmh

24 November 2009
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: URS
RUN: La Cholla - Future No-Build AM
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	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	67.6	66	67.6	10	Snd Lvl	62.4	5.2	8	-2.8
Receiver2	2	1	0.0	61.5	66	61.5	10	----	55.9	5.6	8	-2.4
Receiver3	3	1	0.0	67.5	66	67.5	10	Snd Lvl	67.5	0.0	8	-8.0
Receiver4	4	1	0.0	69.4	66	69.4	10	Snd Lvl	69.4	0.0	8	-8.0
Receiver5	5	1	0.0	68.4	66	68.4	10	Snd Lvl	68.4	0.0	8	-8.0
Receiver6	6	1	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
Receiver7	7	1	0.0	68.6	66	68.6	10	Snd Lvl	68.6	0.0	8	-8.0
Receiver8	8	1	0.0	65.2	66	65.2	10	----	65.2	0.0	8	-8.0
Receiver9	9	1	0.0	67.8	66	67.8	10	Snd Lvl	67.3	0.5	8	-7.5
Receiver10	10	1	0.0	67.7	66	67.7	10	Snd Lvl	61.8	5.9	8	-2.1
Receiver11	11	1	0.0	64.8	66	64.8	10	----	58.6	6.2	8	-1.8
Receiver12	12	1	0.0	66.1	66	66.1	10	Snd Lvl	56.9	9.2	8	1.2
Receiver13	13	1	0.0	67.8	66	67.8	10	Snd Lvl	65.8	2.0	8	-6.0
Receiver14	14	1	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
Receiver15	15	1	0.0	57.3	66	57.3	10	----	57.3	0.0	8	-8.0
Receiver16	16	1	0.0	61.7	66	61.7	10	----	61.7	0.0	8	-8.0
Receiver17	17	1	0.0	62.8	66	62.8	10	----	62.7	0.1	8	-7.9
Receiver18	18	1	0.0	67.9	66	67.9	10	Snd Lvl	67.9	0.0	8	-8.0
Receiver19	19	1	0.0	68.8	66	68.8	10	Snd Lvl	62.3	6.5	8	-1.5
Receiver20	20	1	0.0	66.0	66	66.0	10	Snd Lvl	65.9	0.1	8	-7.9
Receiver21	21	1	0.0	64.1	66	64.1	10	----	64.1	0.0	8	-8.0
Receiver22	22	1	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
Receiver23	23	1	0.0	62.8	66	62.8	10	----	62.8	0.0	8	-8.0
Receiver24	24	1	0.0	65.7	66	65.7	10	----	65.7	0.0	8	-8.0

Receiver25	25	1	0.0	63.6	66	63.6	10	----	63.6	0.0	8	-8.0
extra	26	1	0.0	66.1	66	66.1	10	Snd Lvl	66.1	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	26	0.0	1.6	9.2
All Impacted	13	0.0	2.3	9.2
All that meet NR Goal	1	9.2	9.2	9.2

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future No-Build AM**

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
La Cholla	south	1	2316	45	47	45	24	45	0	0	0	0
	point2	2	2316	45	47	45	24	45	0	0	0	0
	point3	3	2316	45	47	45	24	45	0	0	0	0
	point4	4	2316	45	47	45	24	45	0	0	0	0
	point5	5	2316	45	47	45	24	45	0	0	0	0
	point6	6	2316	45	47	45	24	45	0	0	0	0
	point7	7	2316	45	47	45	24	45	0	0	0	0
	point8	8	2316	45	47	45	24	45	0	0	0	0
	point9	9	2316	45	47	45	24	45	0	0	0	0
	point10	10	2316	45	47	45	24	45	0	0	0	0
	point24	24	2316	45	47	45	24	45	0	0	0	0
	point25	25	2051	45	42	45	21	45	0	0	0	0
	point26	26	2051	45	42	45	21	45	0	0	0	0
	point27	27	2051	45	42	45	21	45	0	0	0	0
	point28	28	2051	45	42	45	21	45	0	0	0	0
	point29	29	2051	45	42	45	21	45	0	0	0	0
	point30	30	2051	45	42	45	21	45	0	0	0	0
	point31	31	2051	45	42	45	21	45	0	0	0	0
	point32	32	2051	45	42	45	21	45	0	0	0	0
	point33	33	2051	45	42	45	21	45	0	0	0	0
	point34	34	2051	45	42	45	21	45	0	0	0	0
	point35	35	2051	45	42	45	21	45	0	0	0	0
	point36	36	1708	45	35	45	18	45	0	0	0	0

	north	11										
Overton West	point12	12	1235	45	25	45	13	45	0	0	0	0
	point13	13	1235	45	25	45	13	45	0	0	0	0
	point14	14										
Overton East	point15	15	687	45	14	45	7	45	0	0	0	0
	point16	16	687	45	14	45	7	45	0	0	0	0
	point17	17										
Lambert West	point18	18	1112	45	22	45	11	45	0	0	0	0
	point19	19	1112	45	22	45	11	45	0	0	0	0
	point20	20										
Lambert East	point21	21	1386	45	26	45	14	45	0	0	0	0
	point22	22	1386	45	26	45	14	45	0	0	0	0
	point23	23										

APPENDIX F

Model Input/Output Files
FHWA Traffic Noise Model
Future No-Build PM

Sound Solutions 24 November 2009
wmh TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: URS
RUN: La Cholla - Future No-Build PM
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	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	68.1	66	68.1	10	Snd Lvl	62.9	5.2	8	-2.8
Receiver2	2	1	0.0	62.0	66	62.0	10	----	56.4	5.6	8	-2.4
Receiver3	3	1	0.0	68.0	66	68.0	10	Snd Lvl	68.0	0.0	8	-8.0
Receiver4	4	1	0.0	69.9	66	69.9	10	Snd Lvl	69.9	0.0	8	-8.0
Receiver5	5	1	0.0	68.9	66	68.9	10	Snd Lvl	68.9	0.0	8	-8.0
Receiver6	6	1	0.0	63.7	66	63.7	10	----	63.7	0.0	8	-8.0
Receiver7	7	1	0.0	69.2	66	69.2	10	Snd Lvl	69.2	0.0	8	-8.0
Receiver8	8	1	0.0	65.7	66	65.7	10	----	65.7	0.0	8	-8.0
Receiver9	9	1	0.0	68.3	66	68.3	10	Snd Lvl	67.8	0.5	8	-7.5
Receiver10	10	1	0.0	68.2	66	68.2	10	Snd Lvl	62.4	5.8	8	-2.2
Receiver11	11	1	0.0	65.3	66	65.3	10	----	59.2	6.1	8	-1.9
Receiver12	12	1	0.0	66.6	66	66.6	10	Snd Lvl	57.4	9.2	8	1.2
Receiver13	13	1	0.0	68.3	66	68.3	10	Snd Lvl	66.3	2.0	8	-6.0
Receiver14	14	1	0.0	61.5	66	61.5	10	----	61.5	0.0	8	-8.0
Receiver15	15	1	0.0	57.8	66	57.8	10	----	57.8	0.0	8	-8.0
Receiver16	16	1	0.0	62.2	66	62.2	10	----	62.2	0.0	8	-8.0
Receiver17	17	1	0.0	63.3	66	63.3	10	----	63.2	0.1	8	-7.9
Receiver18	18	1	0.0	68.4	66	68.4	10	Snd Lvl	68.4	0.0	8	-8.0
Receiver19	19	1	0.0	69.2	66	69.2	10	Snd Lvl	62.7	6.5	8	-1.5
Receiver20	20	1	0.0	66.5	66	66.5	10	Snd Lvl	66.4	0.1	8	-7.9
Receiver21	21	1	0.0	64.6	66	64.6	10	----	64.6	0.0	8	-8.0
Receiver22	22	1	0.0	63.8	66	63.8	10	----	63.8	0.0	8	-8.0
Receiver23	23	1	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
Receiver24	24	1	0.0	66.2	66	66.2	10	Snd Lvl	66.2	0.0	8	-8.0

Receiver25	25	1	0.0	64.0	66	64.0	10	----	64.0	0.0	8	-8.0
extra	26	1	0.0	66.5	66	66.5	10	Snd Lvl	66.5	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	26	0.0	1.6	9.2
All Impacted	14	0.0	2.1	9.2
All that meet NR Goal	1	9.2	9.2	9.2

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future No-Build PM**

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
La Cholla	south	1	2599	45	54	45	27	45	0	0	0	0
	point2	2	2599	45	54	45	27	45	0	0	0	0
	point3	3	2599	45	54	45	27	45	0	0	0	0
	point4	4	2599	45	54	45	27	45	0	0	0	0
	point5	5	2599	45	54	45	27	45	0	0	0	0
	point6	6	2599	45	54	45	27	45	0	0	0	0
	point7	7	2599	45	54	45	27	45	0	0	0	0
	point8	8	2599	45	54	45	27	45	0	0	0	0
	point9	9	2599	45	54	45	27	45	0	0	0	0
	point10	10	2599	45	54	45	27	45	0	0	0	0
	point24	24	2599	45	54	45	27	45	0	0	0	0
	point25	25	2305	45	46	45	23	45	0	0	0	0
	point26	26	2305	45	46	45	23	45	0	0	0	0
	point27	27	2305	45	46	45	23	45	0	0	0	0
	point28	28	2305	45	46	45	23	45	0	0	0	0
	point29	29	2305	45	46	45	23	45	0	0	0	0
	point30	30	2305	45	46	45	23	45	0	0	0	0
	point31	31	2305	45	46	45	23	45	0	0	0	0
	point32	32	2305	45	46	45	23	45	0	0	0	0
	point33	33	2305	45	46	45	23	45	0	0	0	0
	point34	34	2305	45	46	45	23	45	0	0	0	0
	point35	35	2305	45	46	45	23	45	0	0	0	0
	point36	36	1896	45	39	45	20	45	0	0	0	0

	north	11										
Overton West	point12	12	1351	45	28	45	14	45	0	0	0	0
	point13	13	1351	45	28	45	14	45	0	0	0	0
	point14	14										
Overton East	point15	15	834	45	17	45	9	45	0	0	0	0
	point16	16	834	45	17	45	9	45	0	0	0	0
	point17	17										
Lambert West	point18	18	1012	45	21	45	10	45	0	0	0	0
	point19	19	1012	45	21	45	10	45	0	0	0	0
	point20	20										
Lambert East	point21	21	1247	45	26	45	13	45	0	0	0	0
	point22	22	1247	45	26	45	13	45	0	0	0	0
	point23	23										

APPENDIX G

Model Input/Output Files
FHWA Traffic Noise Model
Future Build AM

Sound Solutions 22 December 2009
wmh TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: URS
RUN: La Cholla - Future Build AM -3 for 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	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	66.6	66	66.6	10	Snd Lvl	60.2	6.4	8	-1.6
Receiver2	2	1	0.0	58.2	66	58.2	10	----	53.2	5.0	8	-3.0
Receiver3	3	1	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
Receiver4	4	1	0.0	65.2	66	65.2	10	----	59.1	6.1	8	-1.9
Receiver5	5	1	0.0	65.3	66	65.3	10	----	59.9	5.4	8	-2.6
Receiver6	6	1	0.0	60.1	66	60.1	10	----	60.1	0.0	8	-8.0
Receiver7	7	1	0.0	65.4	66	65.4	10	----	59.2	6.2	8	-1.8
Receiver8	8	1	0.0	63.0	66	63.0	10	----	63.0	0.0	8	-8.0
Receiver9	9	1	0.0	64.4	66	64.4	10	----	63.8	0.6	8	-7.4
Receiver10	10	1	0.0	65.3	66	65.3	10	----	60.2	5.1	8	-2.9
Receiver11	11	1	0.0	58.3	66	58.3	10	----	57.7	0.6	8	-7.4
Receiver12	12	1	0.0	59.5	66	59.5	10	----	52.7	6.8	8	-1.2
Receiver13	13	1	0.0	64.7	66	64.7	10	----	63.7	1.0	8	-7.0
Receiver14	14	1	0.0	58.2	66	58.2	10	----	58.2	0.0	8	-8.0
Receiver15	15	1	0.0	54.3	66	54.3	10	----	54.3	0.0	8	-8.0
Receiver16	16	1	0.0	58.7	66	58.7	10	----	58.7	0.0	8	-8.0
Receiver17	17	1	0.0	59.8	66	59.8	10	----	59.8	0.0	8	-8.0
Receiver18	18	1	0.0	64.7	66	64.7	10	----	64.3	0.4	8	-7.6
Receiver19	19	1	0.0	68.5	66	68.5	10	Snd Lvl	68.5	0.0	8	-8.0
Receiver20	20	1	0.0	66.0	66	66.0	10	Snd Lvl	66.0	0.0	8	-8.0
Receiver21	21	1	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
Receiver22	22	1	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
Receiver23	23	1	0.0	62.9	66	62.9	10	----	62.9	0.0	8	-8.0
Receiver24	24	1	0.0	65.7	66	65.7	10	----	65.7	0.0	8	-8.0

Receiver25	25	1	0.0	63.6	66	63.6	10	----	63.6	0.0	8	-8.0
Receiver 4a	26	1	0.0	66.0	66	66.0	10	Snd Lvl	60.4	5.6	8	-2.4
Receiver 5a	28	1	0.0	66.3	66	66.3	10	Snd Lvl	60.4	5.9	8	-2.1

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	27	0.0	2.0	6.8
All Impacted	5	0.0	3.6	6.4
All that meet NR Goal	0	0.0	0.0	0.0

Sound Solutions **6 December 2009**
wmh **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future Build AM -3 for RAC**

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria: Existing LAeq1h	Impact Criteria LAeq1h	Impact Criteria Sub'l	NR Goal	Active in Calc.
			ft	ft	ft	ft	dBA	dBA	dB	dB	
Receiver1	1	1	79,055.5	94,038.6	2,420.00	4.92	0.00	66	10.0	8.0	Y
Receiver2	2	1	79,453.2	94,089.6	2,430.00	4.92	0.00	66	10.0	8.0	Y
Receiver3	3	1	79,249.7	94,377.4	2,423.00	4.92	0.00	66	10.0	8.0	Y
Receiver4	4	1	79,216.2	95,828.6	2,385.00	4.92	0.00	66	10.0	8.0	Y
Receiver5	5	1	79,222.0	96,546.8	2,372.00	4.92	0.00	66	10.0	8.0	Y
Receiver6	6	1	78,955.5	96,697.1	2,345.00	4.92	0.00	66	10.0	8.0	Y
Receiver7	7	1	79,184.3	97,223.5	2,365.00	4.92	0.00	66	10.0	8.0	Y
Receiver8	8	1	78,939.4	97,535.2	2,355.00	4.92	0.00	66	10.0	8.0	Y
Receiver9	9	1	79,198.1	97,610.2	2,360.00	4.92	0.00	66	10.0	8.0	Y
Receiver10	10	1	79,180.3	98,057.0	2,362.00	4.92	0.00	66	10.0	8.0	Y
Receiver11	11	1	78,885.9	99,526.7	2,369.00	4.92	0.00	66	10.0	8.0	Y
Receiver12	12	1	78,920.2	99,877.4	2,374.00	4.92	0.00	66	10.0	8.0	Y
Receiver13	13	1	78,926.5	100,650.6	2,382.00	4.92	0.00	66	10.0	8.0	Y
Receiver14	14	1	79,384.3	101,659.8	2,401.00	4.92	0.00	66	10.0	8.0	Y
Receiver15	15	1	78,431.2	102,832.5	2,443.00	4.92	0.00	66	10.0	8.0	Y
Receiver16	16	1	79,316.3	103,014.8	2,428.00	4.92	0.00	66	10.0	8.0	Y
Receiver17	17	1	79,253.9	103,803.7	2,442.00	4.92	0.00	66	10.0	8.0	Y
Receiver18	18	1	78,930.0	103,948.3	2,451.00	4.92	0.00	66	10.0	8.0	Y
Receiver19	19	1	79,092.7	104,234.1	2,458.00	4.92	0.00	66	10.0	8.0	Y
Receiver20	20	1	79,141.1	104,853.7	2,497.00	4.92	0.00	66	10.0	8.0	Y
Receiver21	21	1	78,821.9	105,023.7	2,534.00	4.92	0.00	66	10.0	8.0	Y
Receiver22	22	1	78,786.4	105,541.4	2,547.00	4.92	0.00	66	10.0	8.0	Y

Receiver23	23	1	79,187.4	105,737.1	2,507.00	4.92	0.00	66	10.0	8.0	Y
Receiver24	24	1	78,851.1	106,567.6	2,560.00	4.92	0.00	66	10.0	8.0	Y
Receiver25	25	1	78,757.3	108,114.2	2,596.00	4.92	0.00	66	10.0	8.0	Y
Receiver 4a	26	1	79,217.7	96,005.8	2,380.00	4.92	0.00	66	10.0	8.0	Y
Receiver 5a	28	1	79,207.0	96,805.5	2,370.00	4.92	0.00	66	10.0	8.0	Y

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: ROADWAYS
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future Build AM -3 for RAC**

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

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	ft			ft	ft	ft		mph	%		
La Cholla	12.0	south	1	79,121.6	92,694.3	2,406.00				Average	
		point2	2	79,114.6	94,037.0	2,409.00				Average	
		point3	3	79,128.6	94,883.8	2,407.00				Average	
		point4	4	79,127.7	95,405.4	2,391.00				Average	
		point5	5	79,123.8	95,948.9	2,370.00				Average	
		point6	6	79,122.0	96,304.7	2,361.00				Average	
		point7	7	79,111.4	97,313.1	2,358.00				Average	
		point8	8	79,104.8	97,918.8	2,359.00				Average	
		point9	9	79,102.2	98,126.4	2,362.00				Average	
		top of brid	10	79,083.7	99,103.4	2,382.00				Average	Y
		n bridge	24	79,079.7	99,484.1	2,380.00				Average	Y
		overton	25	79,049.9	100,760.4	2,385.00				Average	
		point26	26	79,038.0	102,123.3	2,420.00				Average	
		point27	27	79,027.1	103,182.8	2,420.00				Average	
		point28	28	79,020.9	103,936.0	2,450.00				Average	
		point29	29	79,018.8	104,232.5	2,462.00				Average	
		point30	30	79,011.5	104,848.3	2,500.00				Average	
		point31	31	79,003.0	105,333.2	2,512.00				Average	
		point32	32	78,995.5	105,860.9	2,527.00				Average	
		point33	33	78,994.0	106,272.5	2,530.00				Average	
		point34	34	78,987.9	106,671.7	2,556.00				Average	
		point35	35	78,979.6	107,519.6	2,574.00				Average	
		point36	36	78,973.9	108,673.3	2,608.00				Average	
		north	11	78,956.2	110,492.5	2,635.00					
Overton West	12.0	point12	12	78,996.1	100,800.7	2,385.00				Average	

		point13	13	78,380.5	100,801.3	2,385.00				Average	
		point14	14	77,887.5	100,797.4	2,395.00					
Overton East	12.0	point15	15	79,111.8	100,806.9	2,385.00				Average	
		point16	16	79,974.8	100,815.0	2,380.00				Average	
		point17	17	80,672.8	100,818.2	2,387.00					
Lambert West	12.0	point18	18	78,888.6	108,725.2	2,607.00				Average	
		point19	19	77,791.1	108,719.5	2,590.00				Average	
		point20	20	77,512.8	108,716.4	2,585.00					
Lambert East	12.0	point21	21	79,025.9	108,728.8	2,607.00				Average	
		point22	22	79,595.6	108,730.1	2,600.00				Average	
		point23	23	80,384.5	108,738.5	2,604.00					
La Cholla west lane	12.0	south	37	79,078.0	94,882.5	2,407.00				Average	
		point38	38	79,075.2	95,405.6	2,391.00				Average	
		point39	39	79,067.7	95,950.8	2,370.00				Average	
		point40	40	79,068.7	96,308.6	2,361.00				Average	
		point41	41	79,061.3	97,313.4	2,358.00				Average	
		north	42	79,052.5	98,126.0	2,359.00					

Sound Solutions **7 December 2009**
wmh **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future Build AM -3 for RAC**

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
La Cholla	south	1	2316	45	47	45	24	45	0	0	0	0
	point2	2	2316	45	47	45	24	45	0	0	0	0
	point3	3	1158	45	24	45	12	45	0	0	0	0
	point4	4	1158	45	24	45	12	45	0	0	0	0
	point5	5	1158	45	24	45	12	45	0	0	0	0
	point6	6	1158	45	24	45	12	45	0	0	0	0
	point7	7	1158	45	24	45	12	45	0	0	0	0
	point8	8	1158	45	24	45	12	45	0	0	0	0
	point9	9	2316	45	47	45	24	45	0	0	0	0
	top of bridge	10	2316	45	47	45	24	45	0	0	0	0
	n bridge	24	2316	45	47	45	24	45	0	0	0	0
	overton	25	2051	45	42	45	21	45	0	0	0	0
	point26	26	2051	45	42	45	21	45	0	0	0	0
	point27	27	2051	45	42	45	21	45	0	0	0	0
	point28	28	2051	45	42	45	21	45	0	0	0	0
	point29	29	2051	45	42	45	21	45	0	0	0	0
	point30	30	2051	45	42	45	21	45	0	0	0	0
	point31	31	2051	45	42	45	21	45	0	0	0	0
	point32	32	2051	45	42	45	21	45	0	0	0	0
	point33	33	2051	45	42	45	21	45	0	0	0	0
	point34	34	2051	45	42	45	21	45	0	0	0	0
	point35	35	2051	45	42	45	21	45	0	0	0	0
	point36	36	1708	45	35	45	18	45	0	0	0	0

	north	11										
Overton West	point12	12	1235	45	25	45	13	45	0	0	0	0
	point13	13	1235	45	25	45	13	45	0	0	0	0
	point14	14										
Overton East	point15	15	687	45	14	45	7	45	0	0	0	0
	point16	16	687	45	14	45	7	45	0	0	0	0
	point17	17										
Lambert West	point18	18	1112	45	22	45	11	45	0	0	0	0
	point19	19	1112	45	22	45	11	45	0	0	0	0
	point20	20										
Lambert East	point21	21	1386	45	26	45	14	45	0	0	0	0
	point22	22	1386	45	26	45	14	45	0	0	0	0
	point23	23										
La Cholla west lane	south	37	1158	45	24	45	12	45	0	0	0	0
	point38	38	1158	45	24	45	12	45	0	0	0	0
	point39	39	1158	45	24	45	12	45	0	0	0	0
	point40	40	1158	45	24	45	12	45	0	0	0	0
	point41	41	1158	45	24	45	12	45	0	0	0	0
	north	42										

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: BARRIERS
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future Build AM -3 for RAC**

Barrier Name	Type	Height Min	Height Max	If Wall $ per Unit Area	If Berm $ per Unit Vol.	Top Width	Run:Rise	Add'tnl $ per Unit Length	Points Name	No.	Coordinates (bottom) X	Y	Z	Height at Point	Segment Seg Ht Incre-ment	Perturbs #Up	#Dn	On Struct?	Important Reflec-tions?
		ft	ft	$/sq ft	$/cu yd	ft	ft:ft	$/ft			ft	ft	ft	ft	ft				
Barrier2	W	5.00	99.99	0.00				0.00	point1	1	79,430.9	94,024.0	2,428.00	5.00	1.00	0	0		
									point2	2	79,405.7	94,153.4	2,433.00	5.00					
Barrier3	W	5.00	99.99	0.00				0.00	point3	3	79,072.0	94,374.5	2,407.00	5.00	1.00	0	0		
									point4	4	79,077.7	94,176.9	2,426.00	5.00	1.00	0	0		
									point5	5	79,073.6	93,925.8	2,413.00	5.00					
Barrier4	W	6.00	99.99	0.00				0.00	point6	6	79,168.1	97,651.4	2,360.00	6.00	1.00	0	0		
									point7	7	79,155.5	97,912.0	2,361.00	6.00	1.00	0	0		
									point8	8	79,154.4	98,084.7	2,361.00	6.00	1.00	0	0		
									point9	9	79,204.1	98,084.9	2,362.00	6.00					
Barrier5	W	6.00	99.99	0.00				0.00	point10	10	78,890.9	99,379.6	2,369.00	6.00	1.00	0	0		
									point11	11	78,935.9	99,433.9	2,369.00	6.00	1.00	0	0		
									point12	12	78,934.5	99,529.9	2,369.00	6.00	1.00	0	0		
									point13	13	78,933.3	99,662.8	2,370.00	6.00					
Barrier6	W	7.00	99.99	0.00				0.00	point14	14	78,846.8	99,768.0	2,373.00	7.00	1.00	0	0		
									point15	15	78,928.0	99,768.9	2,374.00	7.00	1.00	0	0		
									point16	16	78,927.1	100,100.6	2,375.00	7.00	1.00	0	0		
									point17	17	78,831.2	100,101.1	2,374.00	7.00					
Barrier7	W	5.00	99.99	0.00				0.00	point18	18	78,955.1	100,248.1	2,376.00	5.00	1.00	0	0		
									point19	19	78,952.3	100,681.1	2,382.00	5.00					
Barrier8	W	5.00	99.99	0.00				0.00	point20	20	78,952.3	100,696.8	2,382.00	5.00	1.00	0	0		
									point21	21	78,952.3	100,727.3	2,382.00	5.00	1.00	0	0		
									point22	22	78,810.7	100,727.8	2,382.00	5.00					
Barrier loc4	W	0.00	99.99	0.00				0.00	point26	26	79,166.3	95,625.1	2,398.00	5.00	1.00	1	1		
									point27	27	79,159.0	95,840.8	2,385.00	5.00	1.00	1	1		
									point28	28	79,161.9	96,297.0	2,375.00	5.00					
Barrier Loc5-7	W	0.00	99.99	0.00				0.00	point29	29	79,147.3	96,415.9	2,361.00	10.00	1.00	1	1		
									point30	30	79,146.9	96,831.0	2,360.00	10.00	1.00	1	1		
									point31	31	79,145.0	97,327.8	2,358.00	10.00					
Barrier loc18	W	0.00	99.99	0.00				0.00	point32	32	78,971.0	103,521.1	2,447.00	5.00	1.00	7	0		
									point33	33	78,971.0	103,886.1	2,448.00	5.00					

APPENDIX H

Model Input/Output Files
FHWA Traffic Noise Model
Future Build PM

Sound Solutions 22 December 2009
wmh TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: URS
RUN: La Cholla - Future Build PM -3 for 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	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	67.1	66	67.1	10	Snd Lvl	60.7	6.4	8	-1.6
Receiver2	2	1	0.0	58.7	66	58.7	10	----	53.7	5.0	8	-3.0
Receiver3	3	1	0.0	63.9	66	63.9	10	----	63.9	0.0	8	-8.0
Receiver4	4	1	0.0	66.2	66	66.2	10	Snd Lvl	60.0	6.2	8	-1.8
Receiver5	5	1	0.0	66.4	66	66.4	10	Snd Lvl	60.9	5.5	8	-2.5
Receiver6	6	1	0.0	60.2	66	60.2	10	----	60.2	0.0	8	-8.0
Receiver7	7	1	0.0	66.2	66	66.2	10	Snd Lvl	59.8	6.4	8	-1.6
Receiver8	8	1	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
Receiver9	9	1	0.0	65.1	66	65.1	10	----	64.5	0.6	8	-7.4
Receiver10	10	1	0.0	66.0	66	66.0	10	Snd Lvl	60.9	5.1	8	-2.9
Receiver11	11	1	0.0	58.8	66	58.8	10	----	58.2	0.6	8	-7.4
Receiver12	12	1	0.0	60.0	66	60.0	10	----	53.2	6.8	8	-1.2
Receiver13	13	1	0.0	65.2	66	65.2	10	----	64.1	1.1	8	-6.9
Receiver14	14	1	0.0	58.7	66	58.7	10	----	58.7	0.0	8	-8.0
Receiver15	15	1	0.0	54.8	66	54.8	10	----	54.7	0.1	8	-7.9
Receiver16	16	1	0.0	59.2	66	59.2	10	----	59.2	0.0	8	-8.0
Receiver17	17	1	0.0	60.2	66	60.2	10	----	60.2	0.0	8	-8.0
Receiver18	18	1	0.0	65.2	66	65.2	10	----	64.8	0.4	8	-7.6
Receiver19	19	1	0.0	69.0	66	69.0	10	Snd Lvl	69.0	0.0	8	-8.0
Receiver20	20	1	0.0	66.5	66	66.5	10	Snd Lvl	66.5	0.0	8	-8.0
Receiver21	21	1	0.0	61.6	66	61.6	10	----	61.6	0.0	8	-8.0
Receiver22	22	1	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
Receiver23	23	1	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
Receiver24	24	1	0.0	66.2	66	66.2	10	Snd Lvl	66.2	0.0	8	-8.0

Receiver25	25	1	0.0	64.0	66	64.0	10	----	64.0	0.0	8	-8.0
Receiver 4a	26	1	0.0	65.8	66	65.8	10	----	59.9	5.9	8	-2.1
Receiver 5a	28	1	0.0	66.0	66	66.0	10	Snd Lvl	60.0	6.0	8	-2.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	27	0.0	2.1	6.8
All Impacted	9	0.0	4.0	6.4
All that meet NR Goal	0	0.0	0.0	0.0

Sound Solutions **24 November 2009**
wmh **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **URS**
RUN: **La Cholla - Future Build PM -3 for RAC**

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
La Cholla	south	1	2599	45	54	45	27	45	0	0	0	0
	point2	2	2599	45	54	45	27	45	0	0	0	0
	point3	3	1558	45	32	45	16	45	0	0	0	0
	point4	4	1558	45	32	45	16	45	0	0	0	0
	point5	5	1558	45	32	45	16	45	0	0	0	0
	point6	6	1558	45	32	45	16	45	0	0	0	0
	point7	7	1558	45	32	45	16	45	0	0	0	0
	point8	8	1558	45	32	45	16	45	0	0	0	0
	point9	9	2599	45	54	45	27	45	0	0	0	0
	top of bridge	10	2599	45	54	45	27	45	0	0	0	0
	n bridge	24	2599	45	54	45	27	45	0	0	0	0
	overton	25	2305	45	46	45	23	45	0	0	0	0
	point26	26	2305	45	46	45	23	45	0	0	0	0
	point27	27	2305	45	46	45	23	45	0	0	0	0
	point28	28	2305	45	46	45	23	45	0	0	0	0
	point29	29	2305	45	46	45	23	45	0	0	0	0
	point30	30	2305	45	46	45	23	45	0	0	0	0
	point31	31	2305	45	46	45	23	45	0	0	0	0
	point32	32	2305	45	46	45	23	45	0	0	0	0
	point33	33	2305	45	46	45	23	45	0	0	0	0
	point34	34	2305	45	46	45	23	45	0	0	0	0
	point35	35	2305	45	46	45	23	45	0	0	0	0
	point36	36	1896	45	39	45	20	45	0	0	0	0

	north	11										
Overton West	point12	12	1351	45	28	45	14	45	0	0	0	0
	point13	13	1351	45	28	45	14	45	0	0	0	0
	point14	14										
Overton East	point15	15	834	45	17	45	9	45	0	0	0	0
	point16	16	834	45	17	45	9	45	0	0	0	0
	point17	17										
Lambert West	point18	18	1012	45	21	45	10	45	0	0	0	0
	point19	19	1012	45	21	45	10	45	0	0	0	0
	point20	20										
Lambert East	point21	21	1247	45	26	45	13	45	0	0	0	0
	point22	22	1247	45	26	45	13	45	0	0	0	0
	point23	23										
La Cholla west lane	south	37	1041	45	21	45	11	45	0	0	0	0
	point38	38	1041	45	21	45	11	45	0	0	0	0
	point39	39	1041	45	21	45	11	45	0	0	0	0
	point40	40	1041	45	21	45	11	45	0	0	0	0
	point41	41	1041	45	21	45	11	45	0	0	0	0
	north	42										