Traffic Noise Analysis

Washoe Regional Transportation Commission &
Nevada Department of Transportation

Lemmon Drive Traffic Improvements and Resiliency Project

August 2025

Acronyms and Abbreviations

23 CFR 772	Title 23, Part 772 of the Code of Federal Regulations
dBA	A-weighted decibel
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
L_{eq}	Equivalent noise levels
LOS	Level of service
NAC	Noise Abatement Criteria
NDOT	Nevada Department of Transportation
NEPA	National Environmental Policy Act
RTC Washoe	Regional Transportation Commission of Washoe County
TNM	Traffic Noise Model

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1.0 Introduction

1.1 Project Overview

The Regional Transportation Commission of Washoe County (RTC Washoe), in cooperation with the Nevada Department of Transportation (NDOT) and the Federal Highway Administration (FHWA) are proposing improvements to Lemmon Drive in the City of Reno, Washoe County, Nevada. The Lemmon Drive Traffic Improvements and Resiliency Project involves realigning Lemmon Drive to reconstruct a safer and more resilient roadway between Fleetwood Drive and Ramsey Way. The project proposes to realign Lemmon Drive to the west on an existing berm, elevating the roadway to mitigate flooding impacts. The project also includes the reconstruction of a multi-use path within the project limits and the construction of a new path connecting Lemmon Drive to Lemmon Valley Elementary School. Additionally, the project would eliminate residential driveway connections to a regional road, implement required earthwork balancing to avoid altering the base flood elevation, and stormwater improvements, including the construction of retention and equalization basins. These comprehensive measures collectively enhance safety, connectivity, and transportation resiliency in Lemmon Valley.

The purpose of this report is to evaluate potential traffic noise impacts and possible abatement measures under the requirements of Title 23, Part 772 of the Code of Federal Regulations (23 CFR 772) "Procedures for Abatement of Highway Traffic Noise." 23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement for highway projects. According to 23 CFR 772.3, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with FHWA noise standards. Compliance with 23 CFR 772 provides compliance with the noise impact assessment requirements of the National Environmental Policy Act (NEPA).

This report describes the results of a traffic noise study conducted for the Lemmon Drive Traffic Improvements and Resiliency Project. The traffic noise analysis was conducted according to the NDOT's Traffic and Construction Noise Abatement Policy. The purpose of the analysis was to assess potential traffic noise impacts at noise sensitive locations, or receivers, by evaluating worst case hourly traffic noise levels and evaluating possible traffic noise abatement at locations predicted to experience future traffic noise impacts using both the 2050 No-Build and Build alternatives. The study also evaluates potential noise impacts during construction and provides needed mitigation strategies. **Figure 1** shows the project location.

1.2 Purpose and Need of the Project

Why is the Project Needed?

In 2017, Lemmon Drive was overtopped by floodwaters and faced emergency closures and an extensive mitigation response which disrupted the community's access highlighting the need for a more resilient roadway. Washoe County has limited financial and human resources to continuously provide flood mitigation for Lemmon Drive and private property. The total cost for maintenance, HESCO barrier placement, and continuous pumping for the 2017-2019 flood event was $11.6 million (Washoe County, 2022).

In addition, multimodal enhancements were identified as a community need in the RTC's North Valleys Regional Transportation Study.

What is the Purpose of the Project?

The purpose of the project is to provide a safe and reliable regional road with at least one dry lane in each direction of travel during a 100-year flood event and provide safe access for all multimodal users.

1.3 Proposed Action and Alternatives

Build Alternative

The Build Alternative would reconstruct and raise the profile of the existing roadway from Fleetwood Drive to Palace Drive along the existing alignment. The section of roadway would provide two through lanes in each direction with a raised median. Dedicated left- and right-turn lanes would be provided at the intersections of Fleetwood Drive, Patrician Drive, and Palace Drive.

As the roadway extends to the north it would transition to provide one lane in each direction with a raised center median. In the northbound direction, dedicated right turn pockets would be provided at Arkansas Street, Chickadee Drive, Arizona Street, and Oregon Drive. Just north of Deodar Way the roadway alignment would shift west of the existing roadway. This realigned segment of roadway would run along the east side of an existing berm allowing the roadway to be constructed above the existing Federal Emergency Management Agency (FEMA) 100-year flood elevation. Arkansas Street, Chickadee Drive, and Arizona Street would be extended to tie into the new, realigned roadway. Near Oregon Drive the roadway alignment would tie into the existing roadway alignment with full reconstruction extending to Ramsey Way. See **Figure 2**.

The Build Alternative would also involve modifications to cross-street direct access realigned Lemmon Drive at Nectar Street, Tupelo Street, Waterash Street, Idaho Street, Pompe Way, and Dillon Way. Pompe Way and Dillon Way would be connected via a new frontage road which provides access to Lemmon Drive at Ramsey Way. Idaho Street and Waterash Street would utilize rehabilitated existing Lemmon Drive as local frontage road access to Arizona Street or Chickadee Drive which would then provide access to the realigned Lemmon Drive. A new connection from the Matterhorn Drive and Tupelo Street intersection to Chickadee Drive would provide access to the realigned Lemmon Drive also.

In addition to roadway improvements, substantial drainage improvements would also be constructed under the Build Alternative. Key drainage features would include rehabilitation of the existing drainage channel from Fleetwood Drive to Palace Drive. Equalization culverts would be constructed to replicate existing drainage between the east and west side of the existing berm during higher Swan Lake water elevations. These equalization culverts would be located at existing breaks in the berm north of Deodar Way and near Idaho Street. Volumetric mitigation basins would also be constructed between the new, realigned Lemmon Drive and existing Lemmon Drive within the FEMA floodplain. This mitigation would provide 1.3 cubic yards of basin excavation for everyone 1 cubic yard of embankment placed within the FEMA 100-year floodplain.

Additional items to be constructed with the Build Alternative include a 10-foot shared use path along the reconstructed and realigned Lemmon Drive roadway, intersection lighting, signing, striping, and reconstruction of the Patrician Drive rectangular rapid flashing beacon (RRFB). Additional pedestrian enhancements would be constructed from Lemmon Drive to the Lemmon Valley Elementary School along Patrician Drive.

No Build Alternative

The No Build Alternative would not construct any improvements to Lemmon Drive and only routine maintenance would continue. Lemmon Drive would remain below the 100-year floodplain. The No Build Alternative would eliminate the costs associated with construction of the project but would not meet the project's purpose and need.

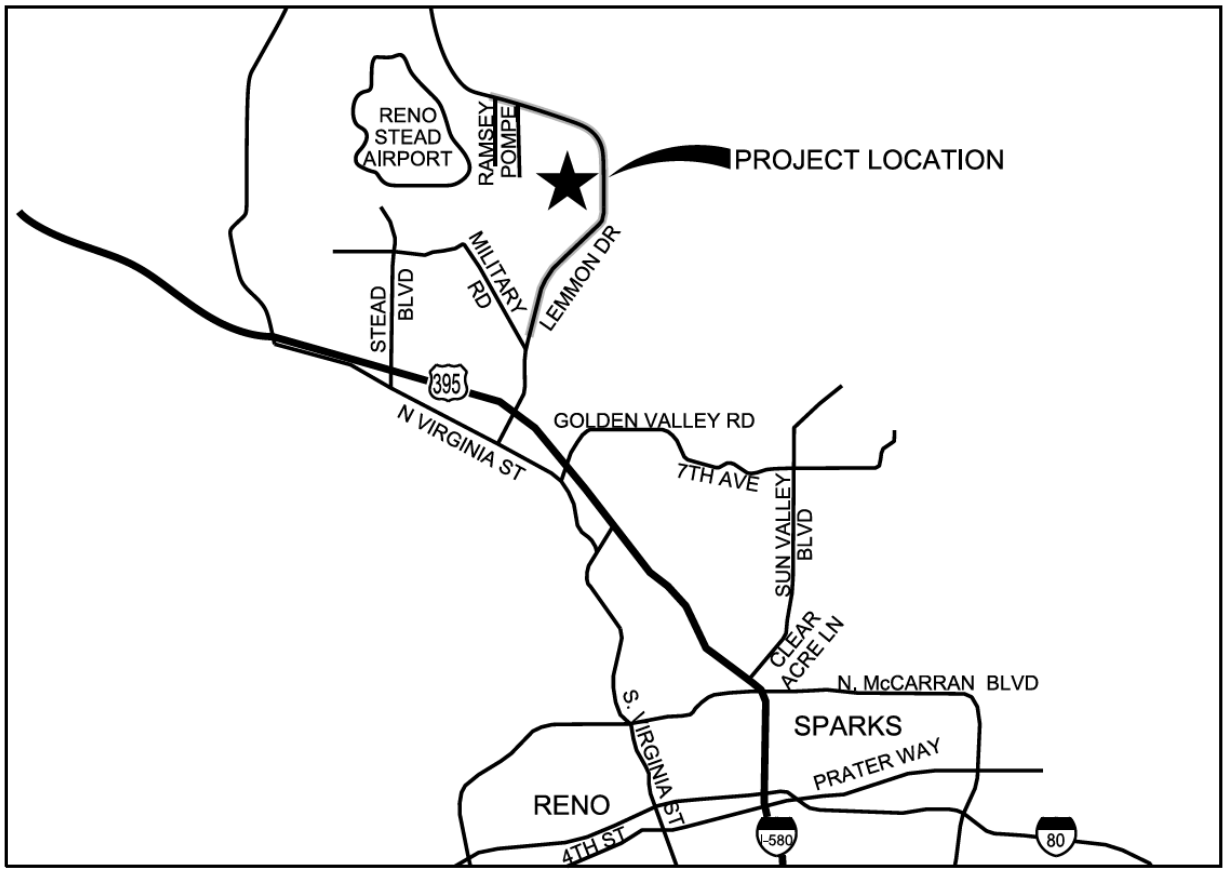


Figure 1. Project Vicinity Map

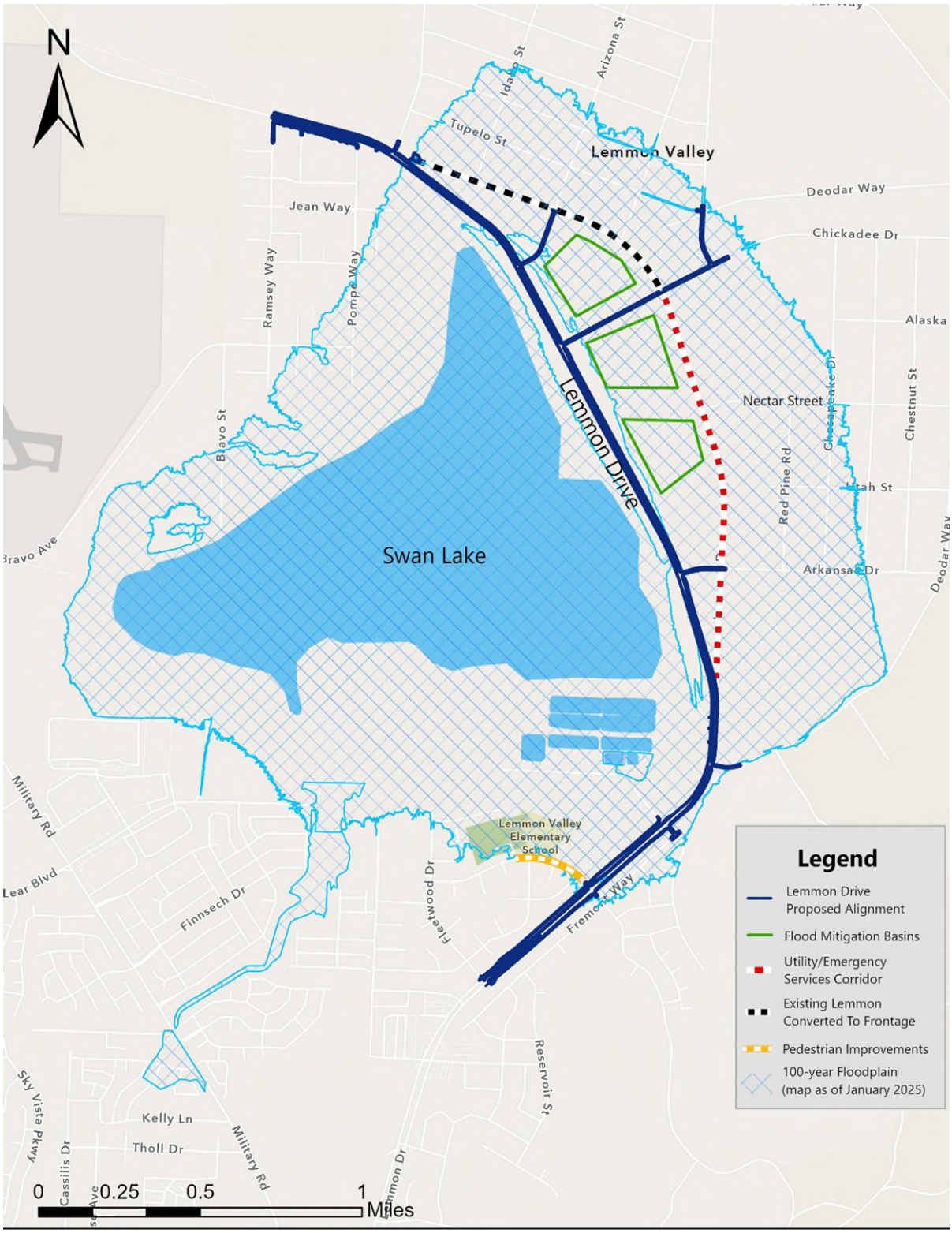


Figure 2. Lemmon Drive Build Alternative

2.0 Regulatory Criteria

Lemmon Valley-Golden Valley is within Unincorporated Washoe County. Noise-related ordinances in Washoe County include rules for barking and quiet hours; nothing specific to traffic noise. As this is a Federally funded project, FHWA and NDOT's requirements have been utilized for determining possible traffic noise impacts.

The criteria for evaluating noise impacts used in this report are contained in Title 23 of the Code of Federal Regulations (CFR), Part 772 - Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772) and NDOT's Traffic and Construction Noise Abatement Policy. The traffic noise analysis was conducted to evaluate the change in noise conditions that could result from the Lemmon Drive Traffic Improvements and Resiliency Project. NDOT's noise guidelines are consistent with those of FHWA (23 CFR 772). FHWA has approved them for use on federal-aid projects in Nevada.

FHWA guidelines state that traffic noise abatement must be considered when a traffic noise impact occurs at a particular land use or activity category. The FHWA traffic noise abatement criterion (NAC) under Activity Categories B and C of 67 A-weighted sound level decibels (dBA) applies to residences, churches, schools, recreation areas, and similar land use activities. **Table 1** on the following page provides noise levels for different land use categories. NDOT determines a traffic noise impact to occur when predicted future traffic noise levels approach or exceed the established FHWA NAC for a given Activity Category. NDOT defines approach as within 1 dB of the NAC (a rounded 66 dBA for Activity Categories B and C and a rounded 71 dBA for Category E).

In addition to the criterion sound levels described in Table 1, FHWA and NDOT consider a traffic noise impact to occur if sound levels in the design year substantially exceed existing noise levels. FHWA gives state highway agencies the flexibility to establish their own definition of a substantial increase. The NDOT policy states that a design year traffic noise level of a rounded 12 dB or more over existing noise levels constitutes a substantial increase in noise level for a new highway project.

3.0 Methodology

Traffic noise levels were evaluated using FHWA's Traffic Noise Model (TNM) version 2.5. TNM 2.5 is the analytical method developed for highway traffic noise prediction. The model is described in detail in the TNM User's Guide and Technical Manual. In short, TNM is based upon Reference Energy Emission Levels (REMEL) for automobiles, medium trucks (two axles), and heavy trucks (three or more axles), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, terrain features, atmospheric conditions, and the acoustical characteristics of the site.

Table 1: Noise Level Criteria (NAC) [Hourly A-Weighted Sound Level decibels (dBA)[1]]

Activity category	Activity Criteria[2]		Evaluation Location	Activity Description
	$L_{eq(h)}$	$L_{10(h)}$		
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	70	Exterior	Residential.
C[3]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	--	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	--	--	Undeveloped lands that are not permitted.

Source: FHWA 23 CFR 772

[1] Either $L_{eq(h)}$ or $L_{10(h)}$ (but not both) may be used on a project.

[2] The $L_{eq(h)}$ and $L_{10(h)}$ Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

[3] Includes undeveloped lands permitted for this activity category.

TNM 2.5 was developed to predict hourly L_{eq} values for free-flowing and interrupted-flow traffic conditions and is considered to be accurate within ±3 dB. The model enables the user to account for the effects over/through rows of buildings and dense vegetation. TNM enables the user to input terrain elevation lines to account for shielding effects of natural terrain. Noise levels are determined under worst-case traffic noise conditions. Primary consideration is given to

exterior areas of frequent human use. Unless otherwise stated, all sound levels reported are energy equivalent levels (L_{eq}), A-weighted, and measured in decibels (dBA).

Traffic noise levels calculated by TNM were validated using onsite traffic noise level measurement data and traffic counts for the duration of the measurements. Validation measurements were taken at 11 representative locations for two consecutive 15-minute intervals to obtain L_{eq} values. To model the roadways, receptor locations and intervening topography within the project area, terrain information, and roadway geometry data were obtained from the available design plans and publicly available aerial photos. Appendix A contains the measurement data for the validation points.

Existing traffic volumes are based on the actual counts conducted as part of the traffic study and the future No Build and Build traffic volumes were forecasted using traffic counts at Fleetwood Drive, Patrician Drive, Palace Drive, Deodar Way, and Oregon Boulevard. As forecast is based on the traffic counts at these intersections; therefore, there are some differences for the same segments of the roads where there are no side streets or driveways. The higher of two volumes are used for the noise analysis.

Forecasted traffic volumes for the No Build and Build alternatives are the same as the proposed project will not increase the capacity. However, there would be differences between predicted No Build and Build cases even when alignment has not moved. The main reason for differences in the noise level was the profile change of the new road. Other features of the project, such as new bike lane, sidewalk, and drainage channels, were also cause of differences in the noise levels.

Review of the forecasted data indicated that volumes during the afternoon peak hour (4:00pm – 6:00pm) would be much higher than during the morning peak hour (7:00am – 9:00am). Therefore, afternoon (PM) peak hour traffic volumes are used for the traffic noise analysis.

There was no traffic forecast for area north of Arkansas Street; however, field observations indicated that traffic volume drop north of Arkansas Street. The reason for this drop of the volume is that residences at a neighborhood located east of Lemmon Drive use this street to get to their community. Therefore, forecasted traffic volumes for north of Arkansas Street were reduced by 25%.

Appendix B lists the traffic data used as inputs to the TNM. As this segment of Lemmon Drive serves residential neighborhoods, the project traffic study assumed that there would not be any heavy trucks but there would be 5% medium trucks during the morning peak hour and 4% during the afternoon peak hour.

There would likely be a small number of buses and motorcycles, but they are not included in the traffic noise model and their overall noise contributions would not be significant. There are typically few school buses during morning peak hours but none during the afternoon peak hour as schools close before afternoon traffic peak hour. As afternoon peak hour traffic volumes are

utilized for predicting the traffic noise impact; therefore, no school buses are considered for the traffic noise impact analysis.

The following are speeds used for the different roadway segments for the Existing and No Build cases:

- A vehicle speed of 35 miles per hour was used for the Lemmon Drive from south end of the project to Deodar Way.
- A vehicle speed of 45 miles per hour was used for the Lemmon Drive from Deodar Way to Chickadee Drive.
- A vehicle speed of 25 miles per hour was used for the Lemmon Drive from Chickadee Drive to Ramsey Way and the dirt road passed Ramsey Way.
- A vehicle speed of 25 miles per hour was used for the side streets.

The following are speeds used for the different roadway segments for the Build case:

- A vehicle speed of 35 miles per hour was used for the Lemmon Drive from south end of the project to Deodar Way.
- A vehicle speed of 45 miles per hour was used for the Lemmon Drive from Deodar Way to Oregon Boulevard.
- A vehicle speed of 35 miles per hour was used for the Lemmon Drive from Oregon Boulevard to Ramsey Way.
- A vehicle speed of 25 miles per hour was used for the side streets and the dirt road passed Ramsey Way.

4.0 Noise Setting

Vehicular traffic on Lemmon Drive is the main source of noise in the study area with traffic on side streets having a minor contribution to the background noise levels. General aviation planes flying from Reno Stead Airport, located at the northern part of the project limit and west of Lemmon Drive, have some contribution to the background noise levels at the project vicinity. However, noise levels from small airplanes using this airport do not produce enough high noise levels at the ground level at the study area.

The project study area primarily consists of single-family residences (Activity Category B) and undeveloped lands that are not permitted (Activity Category G). Houses are mainly located at two clusters, one at the south end of the study area and one at the north end. There are sidewalks and bike lane along Lemmon Drive (Activity Category F), which will be reconstructed as part of the proposed project. There is also one church with a preschool along the existing Lemmon Drive (Category C).

Traffic volumes were not available for some of the small side streets connecting to Lemmon Drive; therefore, they were not considered in the model as a traffic noise source. However, they were included in the model for the purpose of defining the terrain and accounting for asphalt surfaces.

Six areas are used to define the noise study area. **Figures 3** to **7** show these areas. Traffic noise monitoring was conducted at 11 locations within these areas for model validation purposes.

4.1 Area 1

Southeast of Lemmon Drive just before Fleetwood Drive to just past Palace Drive. Area 1 consists of single-family houses, which back to Lemmon Drive, are addressed on Fremont Way, and have no access from Lemmon Drive. Residences use Patrician Drive to access their neighborhood. Most of these houses have wooden fences for their backyards or side yards from which light goes through; therefore, they are not considered in the noise model. There is only one house with a new solid wood fence that would reduce the noise but it is not included in model per NDOT direction. There is a sidewalk along the fence line of houses, which is not considered an outdoor use area. There is an apartment complex just outside the project limit located west of Lemmon Drive, which is also included in the study.

4.2 Area 2

Northwest of Lemmon Drive from just south of Fleetwood Drive to just past W Patrician Drive. Area 2 also consists of single-family houses, which have access from Magnolia Way and Aristocrat Way and not from Lemmon Drive. These houses can access Lemmon Drive from either Fleetwood Drive (southern end) or Patrician Drive (northern end) of Area 2. Most of these houses have wooden fences for their backyards or side yards from which light goes through; therefore, they are not considered in the noise model. There is a sidewalk in the area between houses and Lemmon Drive, which is not considered an outdoor use area.

4.3 Area 3

West of Lemmon Drive just north of Deodar Way. Area 3 consists of two farm houses with a large fenced area which includes a barn and four cabins.

4.4 Area 4

This area is located east of Lemmon Drive and north of Nectar Street, represents a church which has a preschool with a playground.

4.4 Area 5

North of Lemmon Drive between Tupelo Street and Oregon Boulevard Frontage Road. Area 5 consists of single-story single-family houses. Most of these houses have chain linked fences for their front yards or side yards; therefore, they are not considered in the noise model. It appears that the outdoor frequent use areas of some of the houses are located on the side or behind the house; however, noise levels are predicted at the area between houses and roadway per NDOT's request to present the highest possible traffic noise levels at these properties. Most of these houses have access from Lemmon Drive. As a result of the project, this part of existing Lemmon Drive would end at a cul-de-sac at the west end and it will provide access to the houses.

4.5 Area 6

South of Lemmon Drive between Oregon Boulevard and approximately 400 feet west of Ramsey Way. Area 6 consists of single-story single-family houses. Most of these houses have chain linked fences for their front yards or side yards; therefore, they are not considered in the noise model. It appears that the outdoor frequent use areas of some of the houses are located on the side or behind the house; however, noise levels are predicted at the area between houses and roadway per NDOT's request to predict the highest possible traffic noise levels at these properties. Access of these houses are from Lemmon Drive or side streets. Lemmon Drive is a dirt road west of Ramsey Way with almost no traffic. After completion of the proposed project, these houses would have access from a Lemmon Drive Frontage Road.

5.0 Measured Traffic Noise Levels

Short term noise level measurements were conducted at 11 locations. These locations represent a sidewalk along Lemmon Drive or other areas accessible to the public. Measurements were conducted on November 28 and 29, 2023.

The sound level meter was set to measure the noise continuously but to save the results every 15 minutes. Two consecutive 15-minute intervals were measured at each site per directions from NDOT. Noise levels for each 15-minute interval were reviewed to identify any levels that might be out of norm due to a loud event. A very loud motorcycle drove next to the sound level meter at 10:59 am causing a spike at the measured noise levels at site ST2 and raised the overall noise to 66.7 dBA. This elevated reading was an anomaly and subsequently removed from the dataset.

Forms describing details of each site as well as pictures of each site are presented in Appendix A. The noise monitoring locations are shown on the figure contained in Appendix C.

Two Larson Davis Soundtrack LxT1 sound level meters were used for the noise measurements. One sound level meter was operated by CA Group staff and the second one with NDOT noise specialist. These instruments comply with the requirements of the American National Standards Institute and International Electrotechnical Commission for Type I (precision) sound-level equipment. This equipment satisfies FHWA requirements (ANSI S1.4-1983, TYPE II or better). The sound level meter factory calibrated documents are included in Appendix E.

CA Group staff conducted measurements at locations identified previously and approved by NDOT. NDOT noise specialist also conducted noise measurements at the nearby locations and sometimes across the street. However, CA Group and NDOT measurements at Site ST11 where next to each other. After reviewing the measured data by CA Group, it was determined that collected data for Site 11 was in three segments instead of two 15-minute segments; therefore, NDOT measured noise levels were utilized for this site.

While noise monitoring was in progress at each site, traffic volumes on Lemmon Drive were recorded using a video camera. Traffic volumes were also recorded during noise measurements when there was traffic on a cross street near the measurement site.

Traffic speeds were recorded using a radar gun. It has to be mentioned that some vehicles were reducing their speed when they were noticing someone with radar gun. Unfortunately, there was not an appropriate location to be hidden from the approaching traffic while also able to record the speed. Counted traffic volumes and speeds, along with corresponding 15-minute-long noise measurements, were used for the model verification.

6.0 Traffic Noise Model Validation

TNM input files for the existing conditions were created using the existing roadway geometry and buildings. Measured 15-miniute long traffic noise levels along with the corresponding existing traffic volumes were used to evaluate the accuracy of the TNM in estimating traffic noise exposure within the project area. **Table 2** summarizes noise levels obtained during the traffic noise measurements and compares them to levels predicted by TNM. Appendix A contains the noise measurement data sheets and Appendix B includes traffic counts as well as recorded traffic speeds.

From the data in **Table 2**, it is apparent that noise levels predicted by TNM are comparable to measured levels and there are within ± 3 dB. Based on the results of the predictions, it was determined that no adjustments to the model were needed to estimate existing and future peak-hour traffic noise levels.

Table 2: Validation - Comparison of Measured and Predicted Traffic Noise Levels

Area	Site #	Description	Location and coordinate	Measured L_{eq} (dBA)	Predicted L_{eq} (dBA)	Δ (dB)
1	ST1	Dirt area behind the house	Behind 9485 Fremont Way 39° 38′ 44″ N 119° 49′ 55″ W	63.2	62.2	-1.0
				63.1	64.1	+1.0
1	ST2	On sidewalk along Patrician Dr	Corner of Lemmon Dr and Patrician Dr 39° 38′ 36″ N 119° 50′ 06″ W	62.1	60.5	-1.6
				63.8*	62.3	-1.5
1	ST3	On a sidewalk	Behind 9095 Fremont Way 39° 38′ 21″ N 119° 50′ 27″ W	58.8	57.8	-1.0
				59.5	58.6	-0.9
2	ST4	Dirt area behind the house	Behind 320 Magnolia Way 39° 38′ 32″ N 119° 50′ 15″ W	59.0	56.2	-2.8
				58.0	56.9	-1.1
2	ST5	On a sidewalk	Behind 450 Camio Ct 39° 38′ 26″ N 119° 50′ 50″ W	59.5	59.7	+0.2
				61.1	62.9	+1.8

Table 2 cont: Validation - Comparison of Measured and Predicted Traffic Noise Levels

Area	Site #	Description	Location and coordinate	Measured L_{eq} (dBA)	Predicted L_{eq} (dBA)	Δ (dB)
3	ST6	Open public area	In front of 10000 Lemmon Dr 39° 39′ 4″ N 119° 49′ 44″ W	59.7	58.5	-1.2
				58.8	59.8	+1.0
4	ST7	East of the sidewalk	North of New Life Assembly of God church 39° 39′ 55″ N 119° 49′ 47″ W	55.8	54.1	-1.7
				57.0	55.6	-0.4
5	ST8	Open public area	In front of 11505 Waterash St 39° 40′ 19″ N 119° 50′ 04″ W	60.9	59.4	-1.5
				61.0	59.5	-1.5
5	ST9	Public area next to the street	In front of 11745 Idaho St 39° 40′ 28″ N 119° 50′ 34″ W	55.0	53.4	-1.6
				55.6	55.3	-0.3
5	ST10	Dirt field between the sidewalk and road	Corner of Lemmon Dr and Oregon Blvd 39° 40′ 31″ N 119° 50′ 50″ W	56.5	54.9	-1.6
				54.8	54.0	-0.8
6	ST11**	Open public area	Corner of Lemmon Dr and Ramsey Way 39° 40′ 35″ N 119° 51′ 14″ W	55.8	56.7	+1.1
				54.7	55.0	+0.3

Note: * A very loud motorcycle drove next to the sound level meter at 10:59 am causing a spike at the measured noise levels and raised the overall noise to 66.7 dBA. This high noise level was deleted and overall L_{eq} was recalculated.
** Used noise levels recorded by NDOT.

7.0 Calculated Peak-Hour Noise Exposure

A total of 117 receptors were used to predict existing and future traffic noise levels which provide full coverage of the study area. A large portion of these receptors represented the outdoor areas of the first-row houses that are closest to the roadway. There are 79 receptors that represent residential areas and a church/preschool, which include R1a, R1b, R16a, as well as R1 to R76.

There are 30 receptors from R80 to R110 that represent undeveloped lots along the alignment. These points are located approximately 15 ft from the R/W line.

There are also seven receptors that represent the sidewalks along Lemmon Drive. These receptors are numbered from R120 to R126.

Figures in Appendix C clearly show the noise modeling locations and their address as well as parcel numbers for the empty lots are provided in **Table 3**.

Afternoon traffic volumes for existing conditions assume 2024 PM peak traffic volumes as they are in general higher than AM peak volumes. These volumes are below level of service (LOS) C volumes. The estimated traffic noise levels for the existing peak-hour equivalent noise levels (L_{eq}) at the residential areas along the existing and future Lemmon Drive are between 35 and 59 dBA.

The low noise level of 35 dBA is at a house which is located at the far west of the project and outside of project limits where Lemmon Drive is a dirt road. This receptor is on a small hill and about 250 feet from connection of Lemmon Drive and Ramsey Way. For all practical purposes, it is not exposed to any traffic noise but four or five cars an hour going slowly on the dirt road.

Noise levels on the sidewalks along Lemmon Drive are 50 to 62 dBA. The predicted existing noise levels at the empty lots along the existing and future Lemmon Drive are between 31 and 58 dBA.

The future noise levels for the No Build case would be higher on average by 1.1 dBA than the Existing case in average due to the higher traffic volumes.

Under Existing and No Build conditions, none of the receivers were predicted to meet or exceed the NDOT noise level criteria. The highest noise levels are predicted on the sidewalks along Lemmon Drive.

Even though traffic volumes for the No Build and Build alternatives are the same, there would be some differences in the noise levels due to the profile and alignment changes of the Lemmon Drive and few side streets. In addition, the new sidewalks, bike lanes, and drainage ditches would affect the future Build traffic noise levels.

Future predicted traffic noise levels at the residential areas for the Build alternative would be between 32 and 61 dBA. Future traffic noise levels on the sidewalks along Lemmon Drive would be between 33 and 64 dBA for the Build alternative.

Predicted future noise level at receptor R125 would be as low as 33 dBA as this point will be far back from the proposed Lemmon Drive. The predicted future noise levels at the empty lots along the existing and future Lemmon Drive would be between 32 and 60 dBA.

Receptors that were along the existing Lemmon Drive but now are far from the proposed Lemmon Drive are still included in the traffic noise analysis. The predicted future noise levels at these receptors are from low 30s to high 40s dBA as they would not be exposed to any major traffic noise after construction of the new Lemmon Drive. Most of the existing Lemmon Drive starting approximately 1,000 feet north of Deodar Way will be repurposed as an utility and emergency access road and only a small portion at the north end would be kept to provide local residential access.

Two of the receptors that represent the sidewalks had to be moved for the Build case as the sidewalk alignment was changed due to the proposed project, and one receptor had to be moved up because of the changes to the sidewalk profile. Elevation of one point was changed to match the elevation of the future sidewalk elevation.

Table 3 summarizes existing and future peak-hour traffic noise levels for the 117 receptor locations. The predicted traffic noise levels under the Build conditions would not meet or exceed the NDOT noise level criteria at the residential properties and the predicted noise increases do not constitute substantial increases in noise level (12 dB).

Table 3: Existing and Future Peak-Hour Noise Levels

TNM Representative Receiver Number	TNM Existing Easting	TNM Existing Northing	TNM Existing Elevation	Dwelling Units	Activity Category	Physical Address or APN for the empty lots	Row	Existing PM, dBA (2024)	2050 No Build PM, dBA	2050 Build PM, No Soundwall, dBA	Existing Land Use Code GC - General commercial MDS - Medium density suburban GR - General rural LDS - Low density Suburban	Notes
R01a	2270654.2	14908743.0	4946.06	7	B	9401 Lemmon Dr	1	56	57	57	GC - Ten or more units	Outside the project limits - Apartment buildings
R01b	2270827.0	14908949.0	4942.93	1	B	9255 Fleetwood Dr	1	54	55	55	MDS - Mobile home	Outside the project limits
R01	2270986.8	14909058.0	4942.07	2	B	9250 Fleetwood Dr	1	56	57	58	MDS - Mobile home	
R02	2271131.2	14909221.0	4940.08	2	B	452 Cameo Ct	1	52	53	55	MDS - Mobile home	
R03	2271470.8	14909482.0	4937.79	3	B	400 Magnolia Way	1	53	55	57	MDS - Mobile home	
R04	2271694.8	14909693.0	4935.01	3	B	360 Magnolia Way	1	54	55	57	MDS - Mobile home	
R05	2271935.8	14909917.0	4931.97	2	B	320 Magnolia Way	1	54	55	57	MDS - Mobile home	
R06	2272183.8	14910142.0	4930.19	2	B	240 Aristocrat Way	1	54	55	57	MDS - Mobile home	
R07	2272227.8	14910217.0	4929.69	3	B	230 Aristocrat Way	1	55	56	57	MDS - Mobile home	
R08	2272463.0	14910386.0	4927.36	4	B	210 Aristocrat Way	1	54	55	57	MDS - Mobile home	
R09	2270957.2	14909235.0	4940.08	2	B	480 Magnolia Way	3	46	47	49	MDS - Mobile home	Third row
R10	2271384.0	14909710.0	4937.07	3	B	375 Magnolia Way	3	47	48	50	MDS - Mobile home	Third row
R11	2271749.2	14909797.0	4933.87	1	B	340 Magnolia Way	2	52	53	55	MDS - Mobile home	Second row
R12	2271834.8	14910078.0	4932.42	1	B	300 Magnolia Way	2	48	49	51	MDS - Mobile home	Second row
R13	2272380.2	14910569.0	4927.25	6	B	205 Aristocrat Way	2	49	51	53	MDS - Mobile home	Second row
R14	2272612.2	14910534.0	4927.17	1	B	105 W Patrician Dr	1	56	58	58	MDS - Mobile home	Next to a side road and not effected by the profile change at Build case
R15	2272413.8	14910693.0	4926.39	1	B	125 W Patrician Dr	2	55	57	57	MDS - Mobile home	
R16a	2270889.0	14908607.0	4944.94	3	B	9075 Fremont Way	1	58	59	59	MDS - Single Family	Outside the project limits
R16	2271219.2	14908904.0	4941.40	4	B	9125 Fremont Way	1	56	57	58	MDS - Single Family	
R17	2271416.2	14909090.0	4938.57	3	B	9155 Fremont Way	1	57	58	58	MDS - Single Family	
R18	2271635.8	14909288.0	4937.00	3	B	9185 Fremont Way	1	57	58	59	MDS - Single Family	
R19	2271821.0	14909461.0	4935.28	3	B	9215 Fremont Way	1	57	58	59	MDS - Single Family	
R20	2272003.5	14909650.0	4933.40	3	B	9245 Fremont Way	1	59	61	61	MDS - Single Family	
R21	2272199.5	14909825.0	4931.42	3	B	9275 Fremont Way	1	59	60	61	MDS - Single Family	
R22	2272390.0	14910008.0	4929.27	3	B	9305 Fremont Way	1	59	61	61	MDS - Single Family	
R23	2272641.5	14910234.0	4927.55	3	B	100 E Patrician Dr	1	58	60	61	MDS - Single Family	
R24	2271371.0	14908766.0	4940.82	3	B	9120 Fremont Way	2	46	48	49	MDS - Single Family	Second row
R25	2271446.5	14908826.0	4939.93	2	B	9140 Fremont Way	2	46	47	49	MDS - Single Family	Second row
R26	2271605.0	14908990.0	4937.91	5	B	9160 Fremont Way	2	46	48	49	MDS - Single Family	Second row
R27	2272154.2	14909469.0	4932.99	5	B	9230 Fremont Way	2	46	47	49	MDS - Single Family	Second row
R28	2272781.5	14910361.0	4927.37	2	B	9355 Fremont Way	1	58	60	61	MDS - Single Family	

Table 3: Existing and Future Peak-Hour Noise Levels

TNM Representative Receiver Number	TNM Existing Easting	TNM Existing Northing	TNM Existing Elevation	Dwelling Units	Activity Category	Physical Address or APN for the empty lots	Row	Existing PM, dBA (2024)	2050 No Build PM, dBA	2050 Build PM, No Soundwall, dBA	Existing Land Use Code GC - General commercial MDS - Medium density suburban GR - General rural LDS - Low density Suburban	Notes
R29	2272980.0	14910525.0	4926.32	3	B	9385 Fremont Way	1	57	58	59	MDS - Single Family	
R30	2273163.0	14910684.0	4925.54	4	B	9415 Fremont Way	1	56	57	59	MDS - Single Family	
R31	2273379.0	14910880.0	4924.98	3	B	9455 Fremont Way	1	56	57	59	MDS - Single Family	
R32	2273608.2	14911107.0	4924.27	4	B	9495 Fremont Way	1	57	58	59	MDS - Single Family	
R33	2273818.0	14911297.0	4923.08	3	B	9535 Fremont Way	1	57	58	59	MDS - Single Family	
R34	2273429.8	14910687.0	4925.04	2	B	140 Judy Way	2	47	48	52	MDS - Single Family	Second row
R35	2273981.8	14911146.0	4923.99	1	B	9510 Fremont Way	2	46	47	51	MDS - Single Family	Second row
R36	2273953.0	14911432.0	4921.87	1	B	9545 Fremont Way	1	57	58	57	MDS - Single Family	
R37	2274137.2	14911302.0	4924.13	1	B	9520 Fremont Way	2	46	47	50	MDS - Single Family	Second row
R38	2274420.5	14912751.0	4924.76	1	B	9950 Lemmon Dr	1	56	57	60	GR - Single Family	In the Build case, the roadway has become much closer
R39	2274420.0	14913006.0	4925.10	5	B	10000 Lemmon Dr	1	55	57	59	GR - Single Family	
R40	2274256.2	14918296.0	4920.75	1	C	11000 Lemmon Dr	1	56	57	35	MDS - General Commercial	
R41	2273215.5	14920651.0	4922.61	1	B	26 Waterash St	1	47	49	32	LDS - Single Family	
R42	2273053.8	14920717.0	4923.20	1	B	26 Waterash St	1	49	50	32	LDS - Single Family	
R43	2272835.2	14920772.0	4923.00	1	B	11505 Lemmon Dr	1	51	52	32	LDS - Single Family	
R44	2272730.5	14920826.0	4922.81	1	B	11515 Lemmon Dr	1	50	51	32	LDS - Single Family	
R45	2272630.2	14920876.0	4924.97	1	B	11525 Lemmon Dr	1	49	50	33	LDS - Single Family	
R46	2272469.2	14920951.0	4922.67	1	B	11535 Lemmon Dr	1	48	49	33	LDS - Single Family	
R47	2272332.0	14921008.0	4922.90	1	B	11545 Lemmon Dr	1	47	48	33	LDS - Single Family	
R48	2272190.8	14921059.0	4922.68	1	B	11555 Lemmon Dr	1	47	48	33	LDS - Single Family	
R49	2272022.5	14921120.0	4922.92	1	B	24 Arizona St	1	47	48	34	LDS - Single Family	
R50	2271821.2	14921178.0	4923.38	1	B	11575 Lemmon Dr	1	47	48	34	LDS - Single Family	
R51	2271700.5	14921218.0	4922.88	1	B	11585 Lemmon Dr	1	46	47	35	LDS - Single Family	
R52	2271507.8	14921284.0	4923.16	1	B	11595 Lemmon Dr	1	46	47	36	LDS - Single Family	
R53	2271365.0	14921327.0	4922.67	1	B	11605 Lemmon Dr	1	45	47	36	LDS - Single Family	
R54	2271232.2	14921375.0	4923.58	1	B	11615 Lemmon Dr	1	46	47	37	LDS - Single Family	
R55	2271085.8	14921431.0	4923.34	1	B	11635 Lemmon Dr	1	45	46	39	LDS - Single Family	
R56	2270963.2	14921470.0	4922.78	1	B	11625 Lemmon Dr	1	45	46	38	LDS - Single Family	
R57	2270754.5	14921542.0	4921.54	1	B	11725 Lemmon Dr	1	45	46	39	LDS - Vacant Single Family	
R58	2270559.2	14921593.0	4920.68	1	B	11745 Lemmon Dr	1	46	47	40	LDS - Mobile Home	
R59	2270389.8	14921655.0	4921.02	1	B	11765 Lemmon Dr	1	45	46	40	LDS - Mobile Home	

Table 3: Existing and Future Peak-Hour Noise Levels

TNM Representative Receiver Number	TNM Existing Easting	TNM Existing Northing	TNM Existing Elevation	Dwelling Units	Activity Category	Physical Address or APN for the empty lots	Row	Existing PM, dBA (2024)	2050 No Build PM, dBA	2050 Build PM, No Soundwall, dBA	Existing Land Use Code GC - General commercial MDS - Medium density suburban GR - General rural LDS - Low density Suburban	Notes
R60	2270249.2	14921712.0	4921.08	1	B	11795 Lemmon Dr	1	45	46	41	LDS - Single Family	
R61	2270079.0	14921768.0	4922.12	1	B	11825 Lemmon Dr	1	44	45	42	LDS - Single Family	
R62	2270003.8	14921791.0	4922.79	1	B	11835 Lemmon Dr	1	45	46	42	LDS - Single Family	
R63	2269820.8	14921855.0	4924.94	1	B	11845 Lemmon Dr	1	44	45	44	LDS - Single Family	
R64	2269690.2	14921897.0	4928.12	1	B	11855 Lemmon Dr	1	45	46	47	LDS - Single Family	
R65	2269495.8	14921961.0	4931.00	1	B	30 Oregon Blvd	1	47	48	50	LDS - Single Family	
R66	2269313.0	14921992.0	4934.45	1	B	11905 Lemmon Dr	1	48	49	53	LDS - Single Family	
R67	2269120.4	14921860.0	4937.43	1	B	11900 Lemmon Dr	1	44	45	51	LDS - Mobile Home	
R68	2268686.2	14921997.1	4955.10	1	B	15 Pompe Way	1	43	44	49	LDS - Mobile Home	
R69	2268460.4	14922066.4	4963.29	1	B	11980 Lemmon Dr	1	44	45	49	LDS - Mobile Home	
R70	2268261.1	14922115.3	4974.25	1	B	12060 Lemmon Dr	1	44	45	50	LDS - Mobile Home	
R71	2268028.9	14922180.6	4987.82	1	B	12140 Lemmon Dr	1	44	46	51	LDS - Mobile Home	
R72	2267800.6	14922239.6	4999.64	1	B	12180 Lemmon Dr	1	45	46	49	LDS - Mobile Home	
R73	2267568.9	14922291.2	5012.46	1	B	12200 Lemmon Dr	1	47	48	49	LDS - Mobile Home	
R74	2267359.9	14922337.1	5026.77	1	B	15 Ramsey Way	1	44	46	47	LDS - Mobile Home	Outside the project limits
R75	2267139.7	14922389.3	5043.53	1	B	12300 Lemmon Dr	1	35	36	38	LDS - Mobile Home	Outside the project limits
R76	2269250.08	14922071.3	4936.63	--	B	11905 Lemmon Dr	1	43	44	49	LDS - Single Family	At same property as R66
R80	2273205.5	14911094.7	4921.62	--	G	080-461-30	1	53	54	54	Vacant - Single Family	
R81	2274253.6	14912029.8	4921.51	--	G	080-461-33	1	52	53	54	Vacant - Single Family	
R82	2274389.8	14912335.0	4922.32	--	G	080-461-34	1	54	55	60	Vacant - Single Family	
R83	2274385.4	14911838.7	4925.86	--	G	080-730-35	1	56	58	57	Vacant - Single Family	
R84	2274661.6	14913169.2	4920.91	--	G	080-730-16	1	56	58	57	Vacant - Single Family	
R85	2274684.4	14913948.8	4920.22	--	G	080-730-14	1	56	58	55	Vacant - Single Family	
R86	2274298.7	14913908.8	4929.93	--	G	080-671-57	1	48	49	60	Vacant - Other	
R87	2274712.8	14914921.0	4920.94	--	G	080-730-11	1	56	57	58	Vacant - Single Family	
R88	2274484.2	14914978.9	4919.46	--	G	080-671-57	1	56	57	57	Vacant - Other	
R89	2274201.5	14915022.0	4922.59	--	G	080-671-57	1	44	45	53	Vacant - Other	
R90	2273869.0	14915222.0	4936.63	--	G	080-671-43	1	39	40	60	Vacant - Single Family	Majority within Swan Lake typical water level
R91	2273731.6	14915570.2	4930.95	--	G	080-671-57	1	38	39	56	Vacant - Other	
R92	2273174.6	14916602.6	4936.28	--	G	080-671-39	1	35	36	58	Vacant - Other	Majority within Swan Lake typical water level

Table 3: Existing and Future Peak-Hour Noise Levels

TNM Representative Receiver Number	TNM Existing Easting	TNM Existing Northing	TNM Existing Elevation	Dwelling Units	Activity Category	Physical Address or APN for the empty lots	Row	Existing PM, dBA (2024)	2050 No Build PM, dBA	2050 Build PM, No Soundwall, dBA	Existing Land Use Code GC - General commercial MDS - Medium density suburban GR - General rural LDS - Low density Suburban	Notes
R93	2272647.2	14917544.0	4934.88	--	G	080-671-55	1	33	35	55	Vacant - Other	
R94	2273586.5	14916358.3	4928.44	--	G	080-671-56	1	37	38	54	Vacant - Other	
R95	2273018.2	14917352.2	4932.70	--	G	080-671-55	1	35	36	53	Vacant - Other	
R96	2274507.1	14915673.1	4919.17	--	G	080-671-57	1	55	56	56	Vacant - Other	
R97	2274742.7	14916814.0	4919.32	--	G	080-281-01	1	54	55	40	Vacant - Other-Unbuildable	
R98	2274473.4	14916984.0	4919.24	--	G	080-671-56	1	56	57	38	Vacant - Other	
R99	2273925.8	14919280.2	4922.07	--	G	540-051-01	1	56	58	33	Vacant - Single Family	
R100	2273707.7	14919205.6	4921.35	--	G	080-722-03	1	57	59	34	Vacant - Other-Unbuildable	
R101	2273435.9	14920245.1	4921.67	--	G	080-721-04	1	55	56	32	Vacant - Single Family	
R102	2272056.1	14920868.1	4921.89	--	G	080-722-03	1	42	43	35	Vacant - Other-Unbuildable	
R103	2271439.0	14921075.2	4922.22	--	G	080-722-03	1	44	45	37	Vacant - Other-Unbuildable	
R104	2272443.4	14918378.2	4937.38	--	G	080-722-03	1	33	35	59	Vacant - Other-Unbuildable	
R105	2271781.1	14919561.2	4933.37	--	G	080-722-02	1	32	33	55	Vacant - Other-Unbuildable	
R106	2271358.9	14919843.5	4932.07	--	G	080-722-02	1	31	32	54	Vacant - Other-Unbuildable	
R107	2270746.5	14920976.5	4921.34	--	G	080-722-03	1	34	35	49	Vacant - Other-Unbuildable	
R108	2269613.6	14921518.7	4925.53	--	G	080-722-03	1	38	39	53	Vacant - Other-Unbuildable	
R109	2268292.7	14922335.3	4976.28	--	G	086-290-54	1	43	44	51	Vacant - Mixed Use	
R110	2274132.6	14917985.2	4920.30	--	G	080-671-56	1	58	59	36	Vacant - Other	
R120	2271025.0	14908807.0	4940.80	--	F	Sidewalk	1	62	63	64	Public Right-of-Way	
R121	2271392.5	14909328.0	4933.46	--	F	Sidewalk	1	59	60	58	Public Right-of-Way	Receivers representing a sidewalk which has been moved back in the Build case as a result of the proposed project
R122	2272014.2	14909887.0	4932.94	--	F	Sidewalk	1	59	60	59	Public Right-of-Way	
R123	2273533.8	14911114.0	4920.96	--	F	Sidewalk	1	62	63	64	Public Right-of-Way	
R124	2272485.2	14910130.0	4927.75	--	F	Sidewalk	1	62	63	64	Public Right-of-Way	
R125	2272884.8	14920806.0	4922.98	--	F	Sidewalk	1	53	54	33	Public Right-of-Way	

Table 3: Existing and Future Peak-Hour Noise Levels												
TNM Representative Receiver Number	TNM Existing Easting	TNM Existing Northing	TNM Existing Elevation	Dwelling Units	Activity Category	Physical Address or APN for the empty lots	Row	Existing PM, dBA (2024)	2050 No Build PM, dBA	2050 Build PM, No Soundwall, dBA	Existing Land Use Code GC - General commercial MDS - Medium density suburban GR - General rural LDS - Low density Suburban	Notes
R126	2269448.5	14921937.0	4931.50	--	F	Sidewalk	1	50	51	52	Public Right-of-Way	

Note: PM peak hour traffic volumes were used for the traffic noise impact analysis as they are in general higher than AM peak volumes.

8.0 Impacts/Abatement

8.1 Impacts

Receptors evaluated for this project constitute NAC Categories B, C, F, and G activities. Categories B and C include residential areas, parks, picnic areas, playgrounds, schools, trails, and trail crossings with an hourly noise limit that approaches or exceeds 67 dBA (L_{eq}). There are no noise limits for undeveloped lands which are considered as Categories F and G.

The existing, No Build, and Build predicted traffic noise levels for the project area would not approach or exceed the NAC, therefore, there would be no traffic noise impacts as a result of the proposed project.

If there are changes to the present design, there may be traffic noise impacts associated with the proposed project.

8.2 Abatement/Mitigation

No abatement measures are proposed as part of this study because there would be no traffic noise impacts associated with the proposed project.

9.0 Construction Noise

The main construction activities will be related to the reconstruction and new alignment of Lemmon Drive. The construction activities anticipated to generate significant levels of noise include:

- Demolition of the existing roads, sidewalk, and curbs;
- Preparing and compacting the base for the new roadway;
- Laying down asphalt on the new roadway.

Table 4 lists typical noise levels from various construction equipment that may be used.

The main noise source will be from demolishing the asphalt and concrete of the existing roadway. There are residences adjacent to Lemmon Drive at the south and north ends of the project. Houses at the south end are further away from the roadway and their backyards are next to the right of way line. These houses have their access from roads parallel to Lemmon Drive.

Table 4: Maximum Noise Levels of Construction Equipment

Equipment Description	L_{max}, 50 feet (dBA, slow)
Compactor (ground)	80
Compressor (air)	80
Concrete mixer truck	85
Dump truck	84
Front end loader	80
Grader	85
Pavement scraper	85
Backup alarm	85
Jackhammer	90

Source: FHWA-HEP-06-015, 2006

Houses located south of Patrician Drive are at least 150 ft from the existing Lemmon Drive, with the exception of a house at the corner of Patrician Drive and Fremont Way, which is approximately 75 ft from the existing Lemmon Drive. This house is the closest house to Lemmon Drive at the south end of the project. Some of houses located north of Patrician Drive and east of Lemmon Drive are approximately 100 ft from the edge of Lemmon Drive.

Majority of the houses at the north end are approximately 125 to 150 ft from edge of Lemmon Drive and most have their access from Lemmon Drive. There are few houses close to Ramsey Way that are within 100 ft of Lemmon Drive.

There are no noise sensitive sites at the area where the new alignment of Lemmon Drive will be located.

Sidewalks adjacent to Lemmon Drive would be closest noise sensitive sites to the roadway; however, these sidewalks most probably would not be accessible during the construction due to the safety considerations.

The loudest noise would be related to use of jackhammer. According to the data provided in FHWA Construction Noise Handbook, the maximum noise from a jackhammer at 50 feet is 89 to 90 dBA. Using this data, the calculated jackhammer noise at the outside of the closet house at the south end of the project would be approximately 86 to 87 dBA; however, majority of houses would be exposed to noise level of approximately 81 to 84 dBA. Noise levels at the backyards of these houses could be as high as 88 dBA during the existing roadway demolition.

The predicted loudest noise from the construction activities at the houses at the north end of the project would be 84 dBA. Majority of the houses would be exposed to noise levels of 81 to

82 dBA. Again, noise levels could be higher at the front yards of these houses, but typically the front yard is not considered as a frequent outdoor use area.

As this work would be conducted during daytime, it should not cause any disturbance, especially inside the building where noise levels will be reduced further.

People may be allowed to use certain parts of sidewalks and bike lanes that are not closed to the construction activities. People on the sidewalks and bike lanes would be exposed to noise levels of up to 88 dBA, but users of the sidewalks and bike lanes would not be spending long time at a given point; therefore, their exposure to the high noise level will be for short time periods.

Construction noise would be temporary, intermittent, and the intensity would vary for different areas of the project and the construction activity. People at the houses adjacent to Lemmon Drive could be impacted during certain construction activity periods. As these days some people work from home, construction noise may disturb them for short time periods.

Construction operations will adhere to NDOT standards as there are no local construction noise requirements. Mitigation measures for stationary and mobile equipment shall be addressed in the contract documents; as needed, and could address placement, hours of operation, noise level limits, or proper maintenance of equipment.

Dirt compacting using vibratory roller would generate the highest vibration levels. No structural damage is anticipated beyond 100 feet from dirt compacting. No impact piling is expected. Some houses would be within the 100 ft distance from the dirt compacting activities. These houses should be identified when construction activities are finalized and special attention must be given to the vibration generating activities at these houses. It is advisable that a pre-construction survey to be conducted at houses within 100 feet of the dirt compacting activities to document existing cracks at the buildings and driveways.

The following is a list of the possible mitigation measures in the construction phase:

- Restrict construction hours to daylight hours and conduct no construction activities on Sundays.
- Install temporary noise barriers made of plywood or acoustical blankets around noisy operation where necessary.
- Train staff in construction best practices.
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts, and replacing worn out components.
- Use newer equipment with improved noise muffling and ensure that all equipment has the manufacturers' recommended noise abatement measures, such as mufflers, engine covers, and engine vibration isolators intact and operational. Newer equipment will generally be quieter in operation than older equipment. All construction equipment should be inspected at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding, etc.).

- Shut down or throttle down between work periods for machines and construction plant items (e.g., trucks) that may be in intermittent use.
- Reduce the amount of equipment operating simultaneously as far as practicable.
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors as far as practicable.
- Avoid transportation of materials on- and off-site through existing community areas during nighttime hours.
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.
- Record and respond to complaints according to the established grievance redress mechanism.
- Keep nearby residences informed in advance about noisy activities during various construction phases.
- When there is a possibility of human annoyance from construction activities, conduct such activity only during weekday daytime hours when the ambient background noise and vibration is higher and many residents are away from their homes at work.
- Reduce the force of vibratory rollers close to noise sensitive receptors along the road to avoid vibration impacts.

10.0 REFERENCES

Code of Federal Regulations [CFR], 2010. Title 23 CFR Part 772—Procedures for Abatement of Highway Traffic Noise and Construction Noise. http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/

U.S. Department of Transportation, 1977. *Highway Construction Noise: Measurement, Prediction, and Mitigation.*

U.S. Department of Transportation, Federal Highway Administration. 2004. *FHWA Traffic Noise Model User's Guide* (Version 2.5 Addendum). *Report No. FHWA-PD-96-009*. Washington DC. April.

Federal Highway Administration, 1998. *Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010*. Washington DC. February.

Federal Highway Administration's Traffic Noise Model (FHWA TNM®), Technical Manual update sheets address the changes implemented in FHWA TNM®, Version 2.5.

Federal Highway Administration, 2011. Highway Traffic Noise: Analysis and Abatement Guidance, Document Number FHWA-HEP-10-025. December.

Federal Highway Administration, 2006. Construction Noise Handbook, FHWA-HEP-06-015, Final Report, Prepared by Volpe National Transportation Systems Center. August.

Nevada Department of Transportation, 2022. NDOT Traffic and Construction Noise Analysis and Abatement Policy, October.

Figure 3. Vicinity Map Noise Study Areas 1 and 2

Figure 4. Vicinity Map Noise Study Area 3

Figure 5. Vicinity Map Noise Study Area 4

Figure 6. Vicinity Map Noise Study Area 5

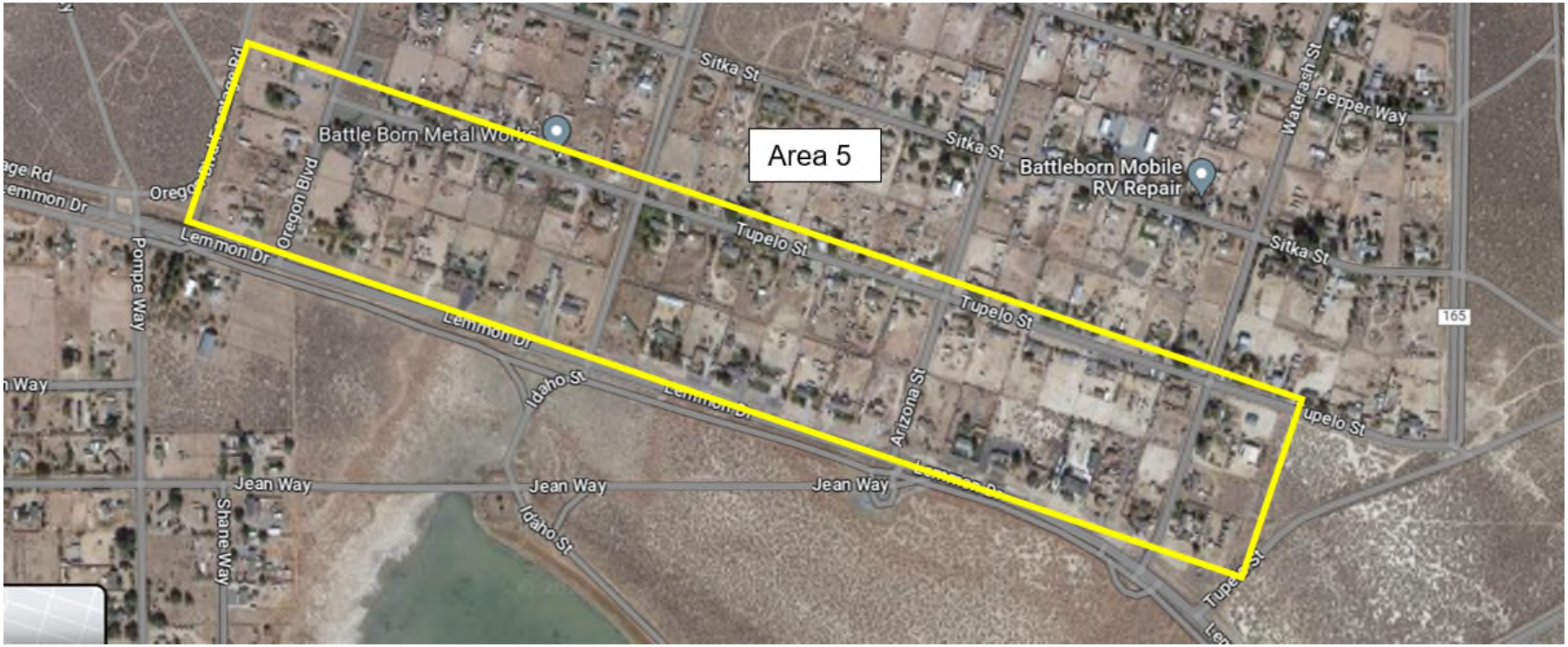


Figure 7. Vicinity Map Noise Study Area 6

APPENDIX A: NOISE MEASUREMENT DATA

Site 1 – Short term noise measurement
11:15 – 11:30 am and 11:45 – 12:00 pm. Coordinates – 39° 38’ 44” N, 119° 49’ 55” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/29/23

MEASUREMENT ADDRESS: Site1 Behind 9485 Fremont Way

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 1

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:

SYSTEM PWR: ☒ BAT ☐ AC

(observations at start of measurement)

TEMP: 35 °F

SKIES: ~~Clear/~~Sunny Cloudy

CAMERA _____

PHOTO NOs. _____

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609
Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / 0.1 / 11:10
After _____ / _____ / _____ / _____

METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:

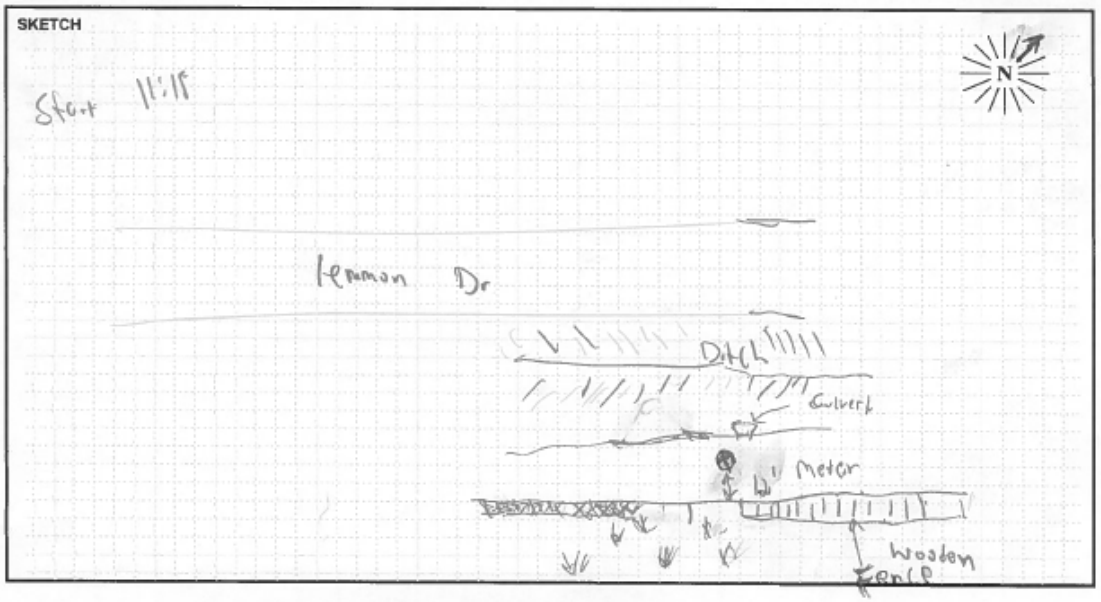
Dist. to Center of Nearest Lane _____ ☐ Video ☐ Radar

Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 2 – Short term noise measurement
10:30 – 11:00 am. Coordinates – 39° 38’ 36” N, 119° 50’ 06” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/29/23

MEASUREMENT ADDRESS: Site 2 Lemmon Dr and Patrician Dr.

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 2

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 35 °F
SKIES: Clear/ Sunny
CAMERA _____
PHOTO NOs. _____

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609
Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / 0.02 / 10:24
After _____ / _____ / _____ / _____

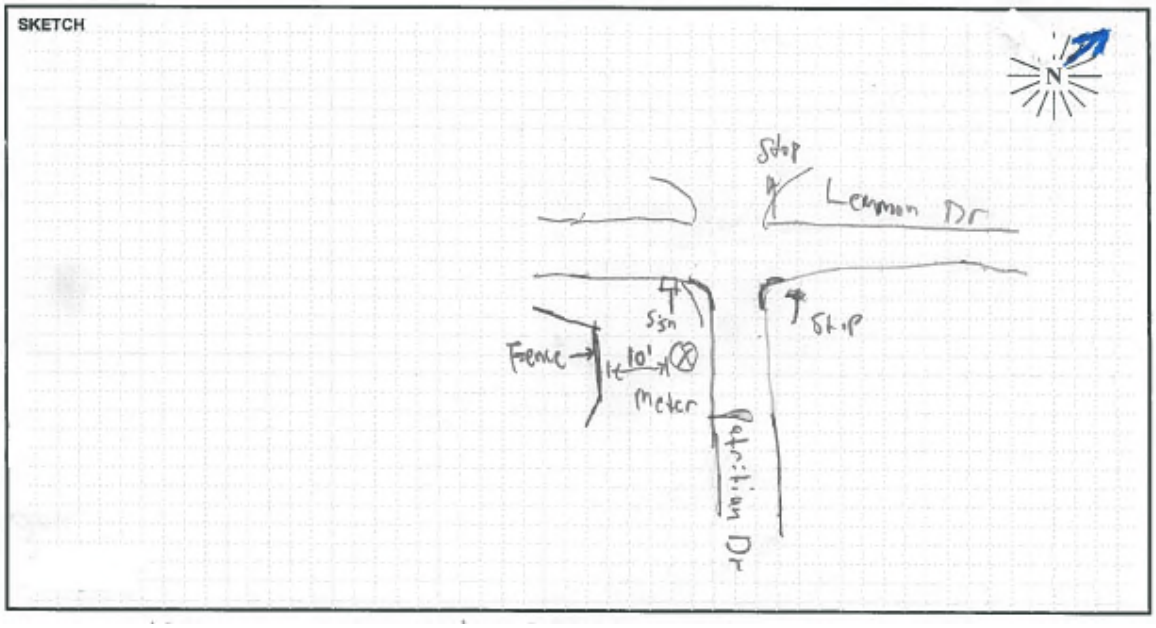
METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar
Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 3 – Short term noise measurement
9:30 – 10:00 am. Coordinates – 39° 38’ 21” N, 119° 50’ 27” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/29/23

MEASUREMENT ADDRESS: Site 3 Behind 9095 Fremont Way

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 3

SOUND LEVEL METER: ☐ LD-870 ☐ LD-820 ☐ LD-824 ☐ LD-812 ☒ LD- LxT1 ☐ _____

SERIAL #: 006172

MICROPHONE: ☐ WIND SCREEN ☐ NON-POLAR ☐ POLARIZED ☒ 1/2-INCH ☐ FREEFIELD ☐ 1-INCH ☐ RANDOM

SERIAL #: 340341

PRE AMP: ☐ LD-900 ☐ LD-828 ☒ PRMLxT1

SERIAL #: 55884

NOTES:

SYSTEM PWR: ☒ BAT ☐ AC

(observations at start of measurement)

TEMP: 31 °F

SKIES: Clear/ Sunny

CAMERA _____

PHOTO NOs. _____

CALIBRATOR: ☒ LD CA200 ☐ B&K 4231 S/N 21609

Freq, Hz. ☐ 250 ☒ 1000 ☐ _____

CALIBRATION RECORD: Input, dB / Reading, dB / Offset, dB / Time

Before: 94 / 70.01 / 9:25

After: _____ / _____ / _____ / _____

METER SETTINGS: ☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE ☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:

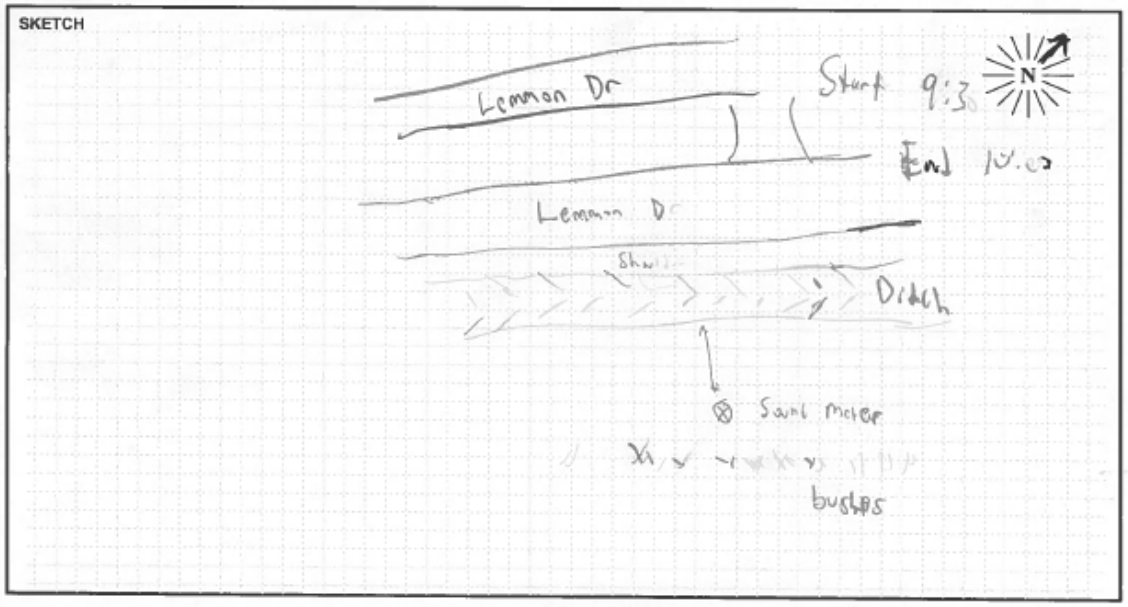
Dist. to Center of Nearest Lane _____ ☐ Video ☐ Radar

Counts AT MT HT

MEAS. TYPE: Long Term x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 4 – Short term noise measurement
2:45 – 3:15 pm. Coordinates – 39° 38’ 32” N, 119° 50’ 15” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/28/23

MEASUREMENT ADDRESS: Site 4 Behind 320 Magnolia Way

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 4

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 000670

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:

SYSTEM PWR: ☒ BAT ☐ AC

(observations at start of measurement)

TEMP: 48 °F

SKIES: Clear/ Sunny

CAMERA _____

PHOTO NOs. _____

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609

Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / -0.01 / 2:40
After _____ / _____ / _____ / _____

METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:

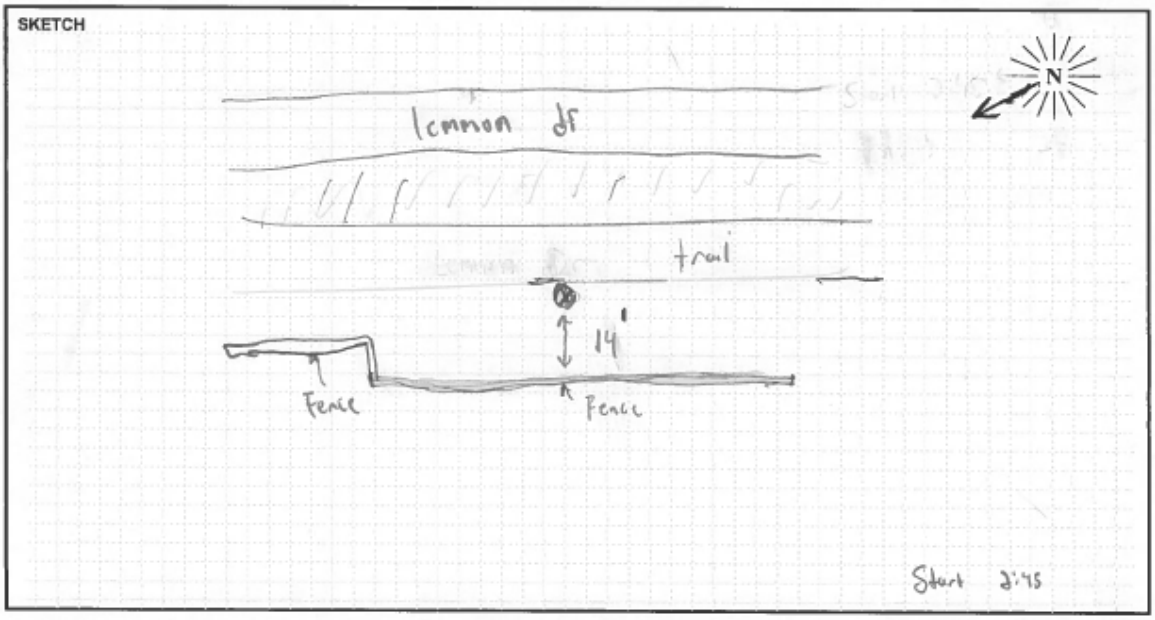
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar

Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 5 – Short term noise measurement
11:00 – 11:30 am. Coordinates – 39° 38’ 26” N, 119° 50’ 50” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada
OPERATOR: Saul Perez
DATE: 11/28/23
MEASUREMENT ADDRESS: Behind / East of 459 Camino Ct.
CITY: Lemmon Valley
☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel
SITE NO.: 5

SOUND LEVEL METER: ☐ LD-870 ☐ LD-820 ☐ LD-824 ☐ LD-812 ☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN ☐ NON-POLAR ☐ POLARIZED ☒ 1/2-INCH ☐ FREEFIELD ☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP: ☐ LD-900 ☐ LD-828 ☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 45 °F
SKIES: Clear/ Sunny
CAMERA _____
PHOTO NOs. _____

CALIBRATOR: ☒ LD CA200 ☐ B&K 4231 S/N 21 6009
Freq, Hz. ☐ 250 ☒ 1000 ☐ _____

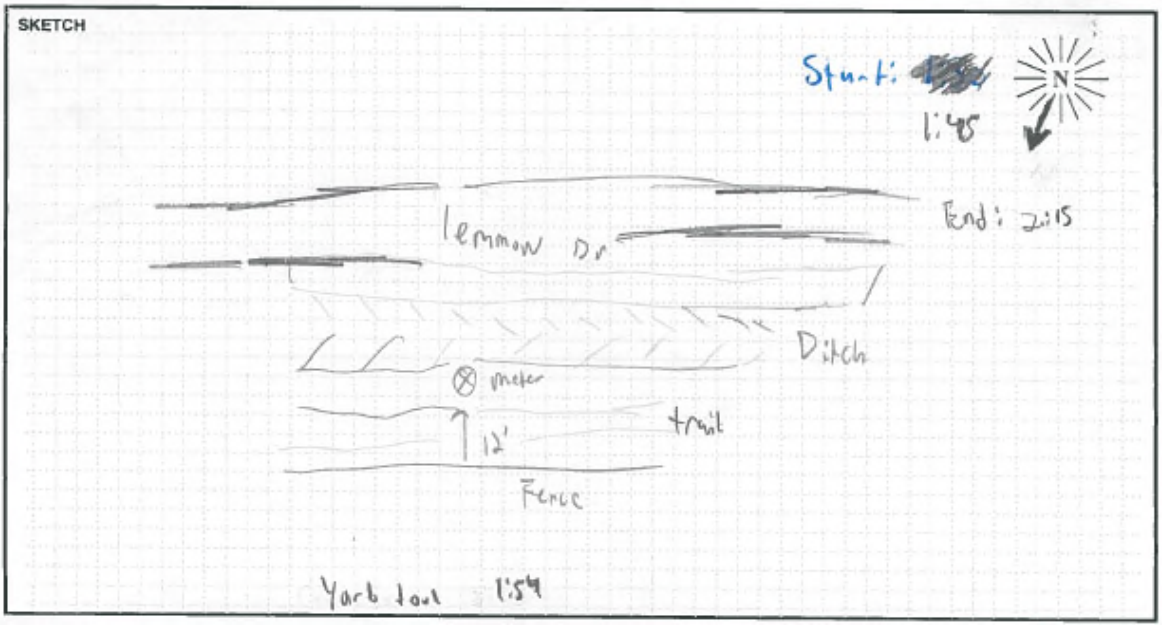
CALIBRATION RECORD: Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / 0.07 / 1:11
After _____ / _____ / _____ / _____

METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES: Dist. to Center of Nearest Lane _____ ☐ Video ☐ Radar Counts AT MT HT
MEAS. TYPE: Long Term x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 6 – Short term noise measurement
12:45 – 1:15 pm. Coordinates – 39° 39’ 4” N, 119° 49’ 44” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada
OPERATOR: Saul Perez
DATE: 10/28/23
MEASUREMENT ADDRESS: Site 6 South of Idaho St.
CITY: Lemmon Valley
☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Hotel ☐ Comm
SITE NO.: 6

SOUND LEVEL METER: ☐ LD-870 ☐ LD-820 ☐ LD-824 ☐ LD-812 ☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN ☐ NON-POLAR ☐ POLARIZED ☒ 1/2-INCH ☐ FREEFIELD ☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP: ☐ LD-900 ☐ LD-828 ☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 40 °F
SKIES: Clear/ Sunny
CAMERA _____
PHOTO NOs. _____

CALIBRATOR: ☒ LD CA200 ☐ B&K 4231 S/N 21609
Freq, Hz. ☐ 250 ☒ 1000 ☐ _____

CALIBRATION RECORD: Input, dB / Reading, dB / Offset, dB / Time
Before: 94 / _____ / -0.07 / 12:39
After: _____ / _____ / _____ / _____

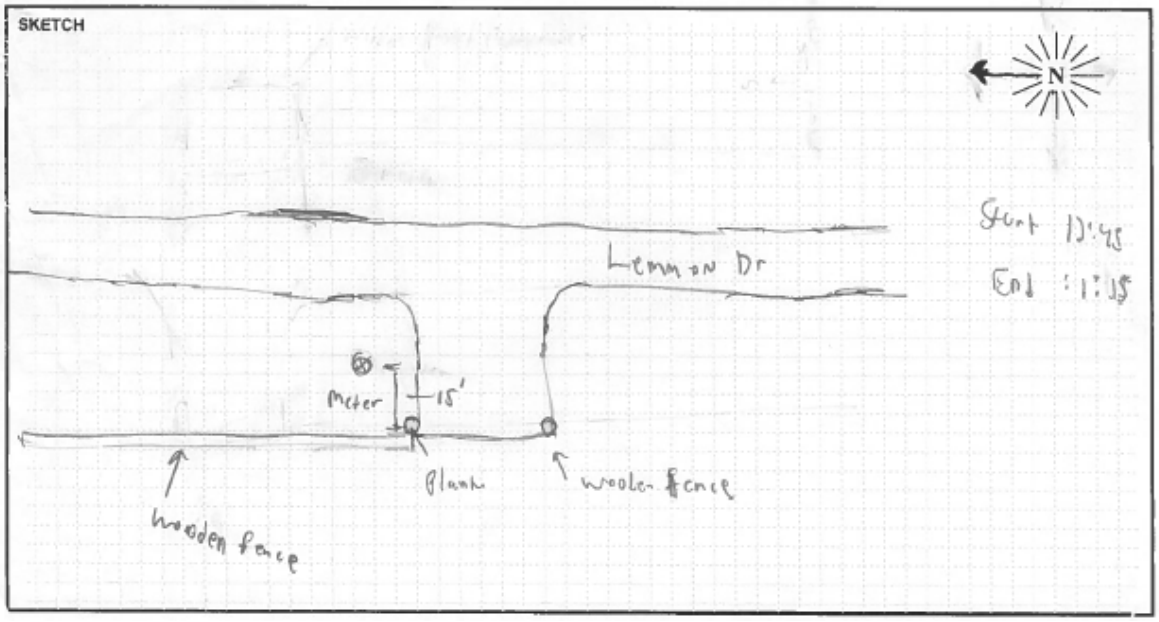
METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar
Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 7 – Short term noise measurement
11:00 – 11:30 am. Coordinates – 39° 39’ 55” N, 119° 49’ 47” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/28/23

MEASUREMENT ADDRESS: Site 7 N 11000 Lemmon Dr.

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 7

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 37 °F
SKIES: Clear/ Sunny
CAMERA _____
PHOTO NOs. _____

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609

Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / -0.05 / 10:45
After _____ / _____ / _____ / _____

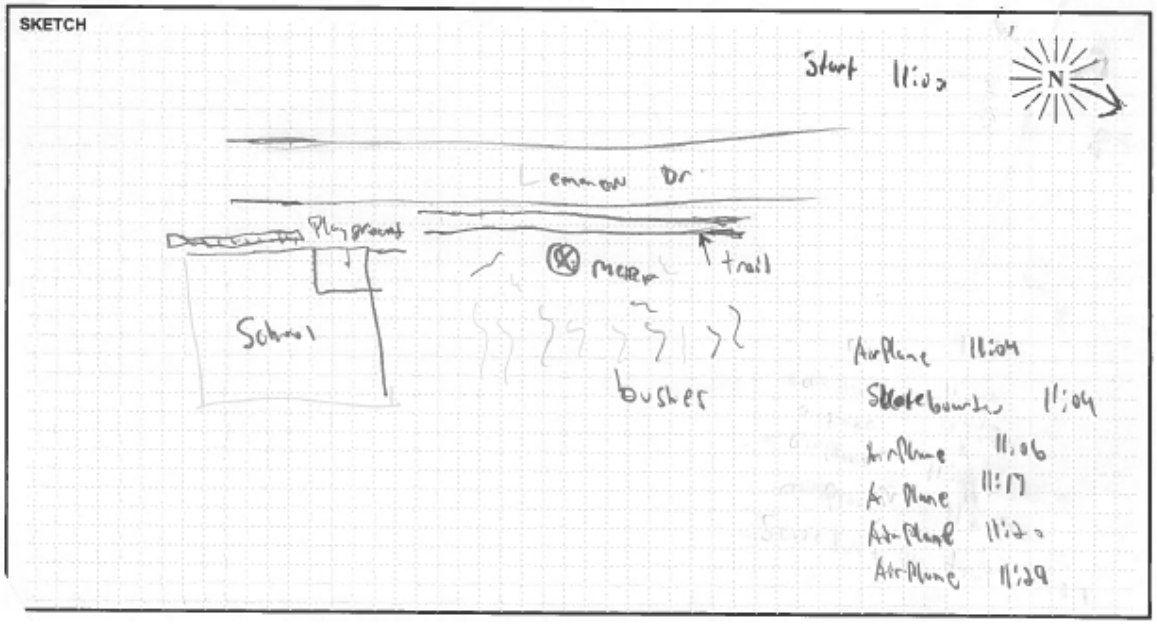
METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar
Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 8 – Short term noise measurement
2:30 – 3:00 pm. Coordinates – 39° 40’ 19” N, 119° 50’ 04” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/29/23

MEASUREMENT ADDRESS: Site 8 Lemmon Dr and Watershed St.

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 8

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340391

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 42 °F
SKIES: ~~Clear/ Sunny~~ Cloudy
CAMERA _____
PHOTO NOs. _____

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609
Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / 0.1 / 2:27
After _____ / _____ / _____ / _____

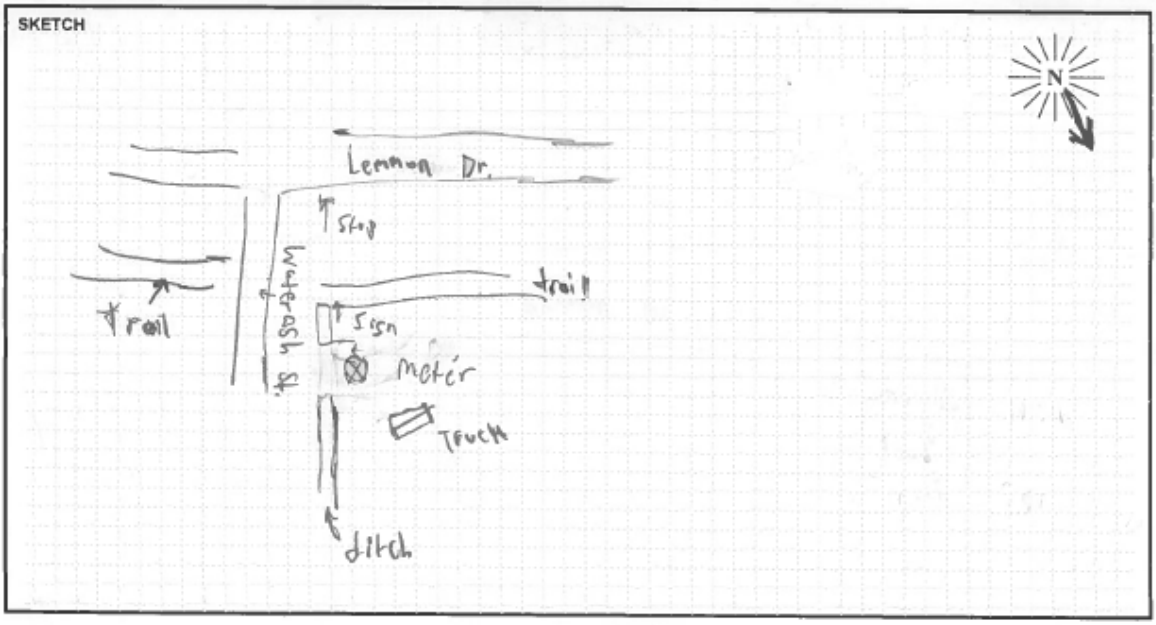
METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar
Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 9 – Short term noise measurement
1:45 – 2:15 pm. Coordinates – 39° 40’ 28” N, 119° 50’ 34” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/29/23

MEASUREMENT ADDRESS: Site 9 Lemmon Dr and Idaho St.

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 9

SOUND LEVEL METER: ☐ LD-870 ☐ LD-820 ☐ LD-824 ☐ LD-812 ☒ LD- LxT1 ☐ _____

SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN ☐ NON-POLAR ☐ POLARIZED ☒ 1/2-INCH ☐ FREEFIELD ☐ 1-INCH ☐ RANDOM

SERIAL #: 340371

PRE AMP: ☐ LD-900 ☐ LD-828 ☒ PRMLxT1

SERIAL #: 55884

NOTES:

SYSTEM PWR: ☒ BAT ☐ AC

(observations at start of measurement)

TEMP: 40 °F

CALIBRATOR: ☒ LD CA200 ☐ B&K 4231 S/N 21609

Freq, Hz. ☐ 250 ☒ 1000 ☐ _____

CALIBRATION RECORD: Input, dB / Reading, dB / Offset, dB / Time

Before 94 / _____ / 0.04 / 1:37

After _____ / _____ / _____ / _____

SKIES ~~Clear Sunny~~ Cloudy

METER SETTINGS: ☒ A-WTD ☐ C-WTD ☐ LINEAR ☐ IMPULSE ☒ SLOW ☐ FAST ☐ 1/1 OCT ☐ 1/3 OCT ☒ INTERVALS 15 - MINUTE ☒ L_N PERCENTILE VALUES

CAMERA _____

PHOTO NOs. _____

NOTES:

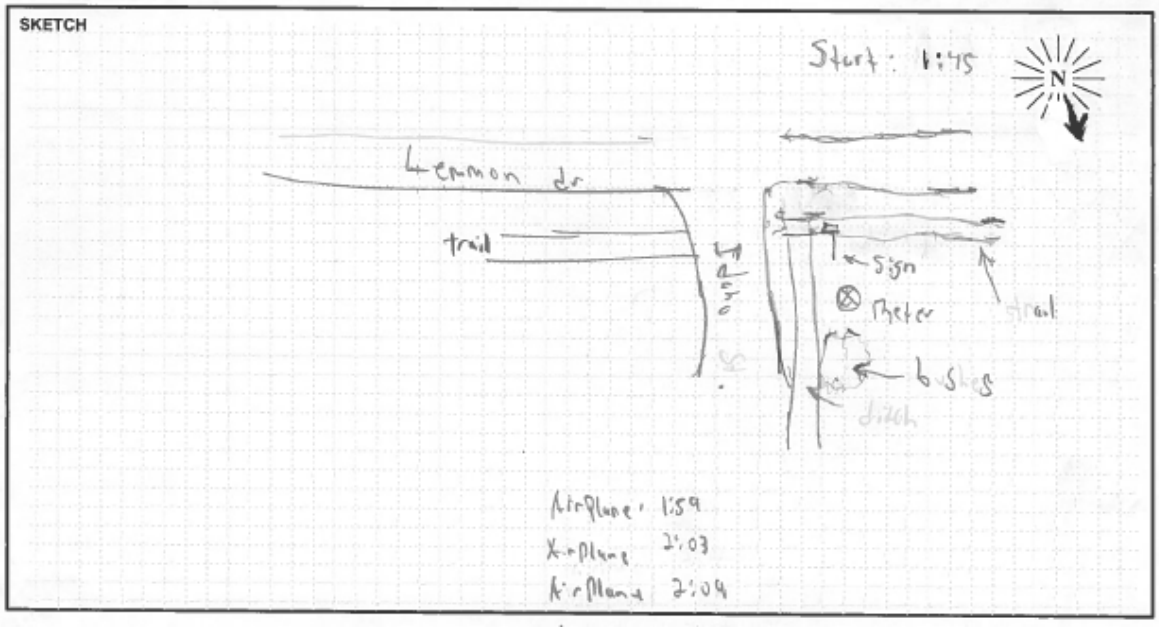
Dist. to Center of Nearest Lane _____ ☐ Video ☐ Radar

Counts AT MT HT

MEAS. TYPE: Long Term x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 10 – Short term noise measurement
1:00 – 1:30 pm. Coordinates – 39° 40’ 31” N, 119° 50’ 50” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 4/29/23

MEASUREMENT ADDRESS: Lemmon Dr and Oregon Blvd Site 10

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 10

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 40 °F
SKIES: ~~Clear~~ Sunny Cloudy

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609
Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / _____ / -00.2 / 12:51
After _____ / _____ / _____ / _____

METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

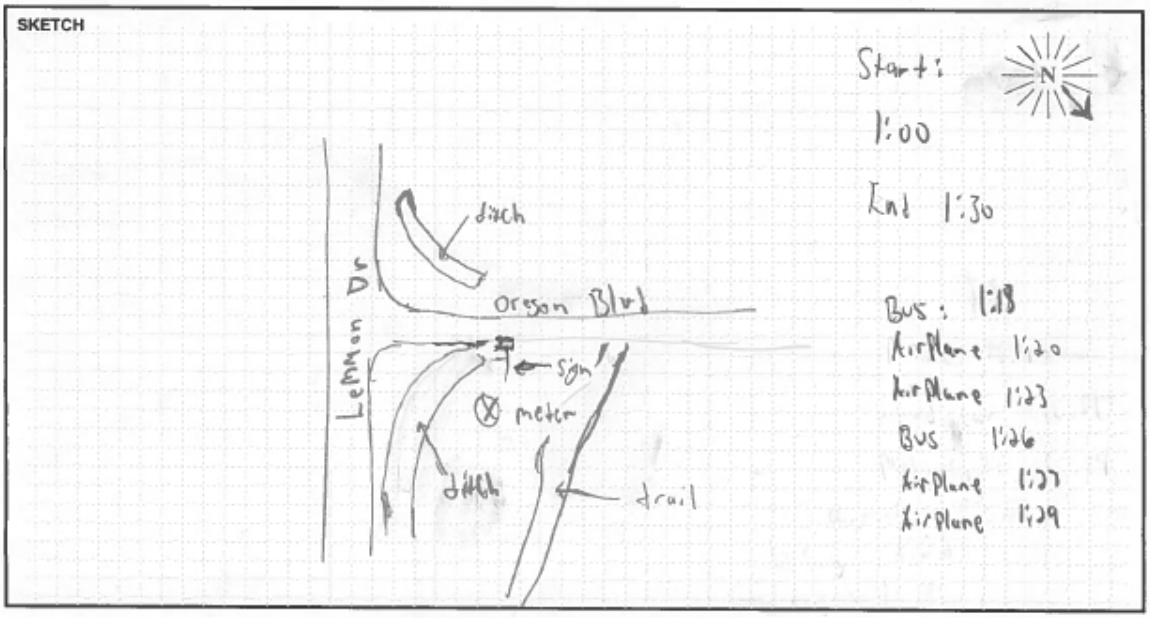
CAMERA _____
PHOTO NOs. _____

NOTES:
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar
Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



Site 11 – Short term noise measurement (this set was not used)
7:30 – 8:00 am. Coordinates – 39° 40’ 35” N, 119° 51’ 14” W

FIELD SURVEY FORM

PROJECT: Lemmon Drive Project, Segment 2, Reno, Nevada

OPERATOR: Saul Perez

DATE: 11/28/23

MEASUREMENT ADDRESS: SEC Lemmon Dr and Ramsey Way

CITY: Lemmon Valley

☒ Single-Family ☐ Multi-Family ☐ Recr. ☐ Comm ☐ Hotel

SITE NO.: 11

SOUND LEVEL METER:
☐ LD-870 ☐ LD-820
☐ LD-824 ☐ LD-812
☒ LD- LxT1 ☐ _____
SERIAL #: 0006170

MICROPHONE: ☐ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM
SERIAL #: 340341

PRE AMP:
☐ LD-900
☐ LD-828
☒ PRMLxT1
SERIAL #: 55884

NOTES:
SYSTEM PWR: ☒ BAT ☐ AC
(observations at start of measurement)
TEMP: 29 °F
SKIES: Clear/ Sunny
CAMERA _____
PHOTO NOs. _____

CALIBRATOR:
☒ LD CA200
☐ B&K 4231
S/N 21609
Freq, Hz.
☐ 250
☒ 1000
☐ _____

CALIBRATION RECORD:
Input, dB / Reading, dB / Offset, dB / Time
Before 94 / / 0.31 / 7:23
After / / / /

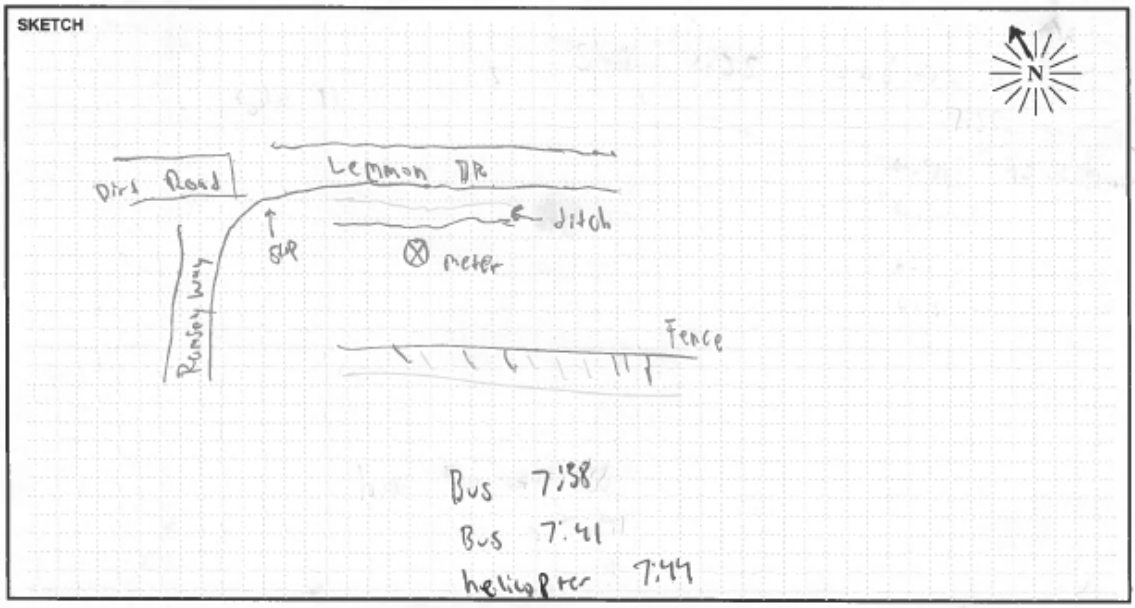
METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS 15 - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

NOTES:
Dist. to Center of Nearest Lane _____
☐ Video ☐ Radar
Counts AT MT HT

MEAS. TYPE:
Long Term
x Short Term

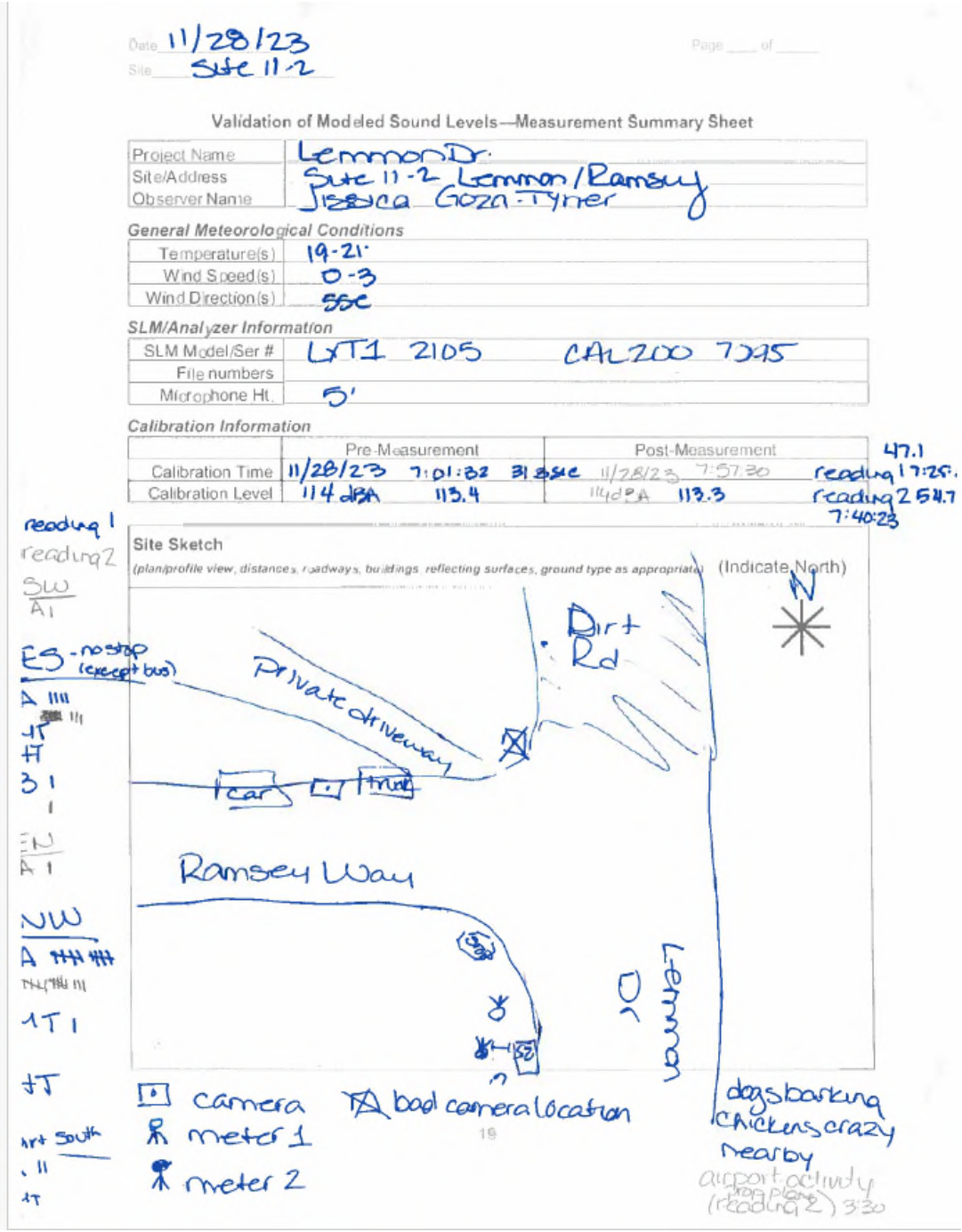
DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:

SKETCH



NDOT noise measurement at Site 11

Results of this measurement was used for the validation



Date 11/28/23
Site Site 11-2

Page ___ of ___

Validation of Modeled Sound Levels—Measurement Summary Sheet

Project Name	Lemmon Dr.
Site/Address	Site 11-2 Lemmon/Ramsey
Observer Name	Jessica Goza-Tyner

General Meteorological Conditions

Temperature(s)	19-21°
Wind Speed(s)	0-3
Wind Direction(s)	SSE

SLM/Analyzer Information

SLM Model/Ser #	LxT1 2105 CAL200 7245
File numbers	
Microphone Ht.	5'

Calibration Information

	Pre-Measurement		Post-Measurement	
Calibration Time	11/28/23 7:01:32	31.8SE	11/28/23 7:57:30	
Calibration Level	114 dBA	113.4	114 dBA	113.3

47.1
reading 1 7:25:
reading 2 54.7
7:40:23

reading 1
reading 2
SW
A1
ES - no stop (except bus)
A
4T
H
3 1
1
EN
A 1
NW
A
1T 1
4T
4T South
11
4T

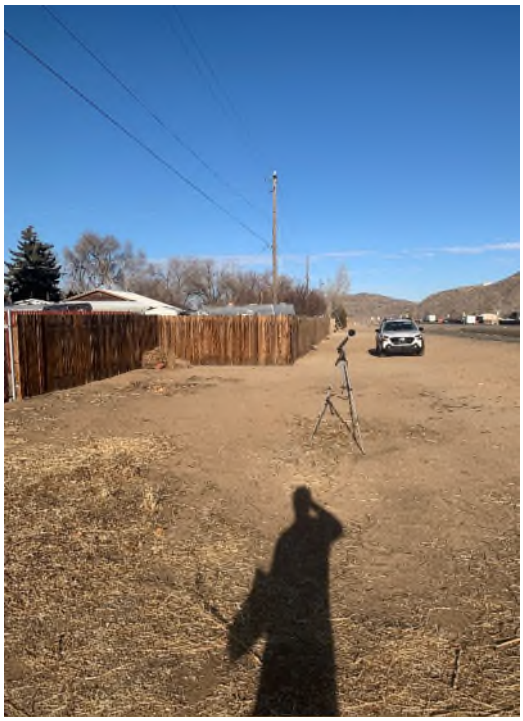
Site Sketch
(plan/profile view, distances, roadways, buildings, reflecting surfaces, ground type as appropriate) (Indicate North)

Dirt Rd
Private driveway
Car
Truck
Ramsey Way
Lemmon Dr
camera
meter 1
meter 2
bad camera location
dogs barking
chickens crazy
nearby
airport activity
(reading 2) 3:30

Site 1

Site 2

Site 3



Site 4

Site 5

Site 6

Site 7

Site 8

Site 9

Site 10

Site 11

APPENDIX B: TRAFFIC DATA

Validation traffic counts

Site	Road name and	Start	Speed	15 min Volume					1 hr Volume				
No.	direction	Time	mph	car	MT	HT	Bus	motorcycle	car	MT	HT	Bus	motorcycle
1	Lemmon Dr - NE	11:15 AM	42	34					136	0	0	0	0
	Lemmon Dr - SW		39	38	1	1			152	4	4	0	0
	Lemmon Dr - NE	11:45 AM	42	42	3	1			168	12	4	0	0
	Lemmon Dr - SW		41	32	2				128	8	0	0	0
2	Lemmon Dr - NE	10:30 AM	33	33	2				132	8	0	0	0
	Lemmon Dr - SW		33	48	3				192	12	0	0	0
	E Patrician Dr - N&S		--	23					92	0	0	0	0
	Lemmon Dr - NE	10:45 AM	39	31	2			2	124	8	0	0	8
	Lemmon Dr - SW		40	32	2			1	128	8	0	0	4
	E Patrician Dr - N&S		--	17	2				68	8	0	0	0
3	Lemmon Dr - NE	9:30 AM	33	24	6				96	24	0	0	0
	Lemmon Dr - SW		30	73	3			1	292	12	0	0	4
	Lemmon Dr - NE	9:45 AM	34	38	5				152	20	0	0	0
	Lemmon Dr - SW		31	52	4	2			208	16	8	0	0
4	Lemmon Dr - NE	2:45 PM	27	106	3				424	12	0	0	0
	Lemmon Dr - SW		32	41	2				164	8	0	0	0
	Lemmon Dr - NE	3:00 PM	27	90	1		4		360	4	0	16	0
	Lemmon Dr - SW		30	38	4			1	152	16	0	0	4
5	Lemmon Dr - NE	1:45 PM	47	50	3				200	12	0	0	0
	Lemmon Dr - SW		47	32					128	0	0	0	0
	Lemmon Dr - NE	2:00 PM	47	68	7		1		272	28	0	4	0
	Lemmon Dr - SW		45	50	2	2			200	8	8	0	0
6	Lemmon Dr - N	12:45 PM	38	39	2				156	8	0	0	0
	Lemmon Dr - S		40	27					108	0	0	0	0
	Lemmon Dr - N	1:00 PM	37	44	4				176	16	0	0	0
	Lemmon Dr - S		39	30	2				120	8	0	0	0
7	Lemmon Dr - N	11:00 AM	46	17	1				68	4	0	0	0
	Lemmon Dr - S		45	24					96	0	0	0	0
	Lemmon Dr - N	11:15 AM	44	21	2				84	8	0	0	0
	Lemmon Dr - S		44	28	2				112	8	0	0	0
8	Lemmon Dr - W	2:30 PM	32	43	2				172	8	0	0	0
	Lemmon Dr - E		35	27	3		1		108	12	0	4	0
	Waterash St - N		--	18	1				72	4	0	0	0
	Waterash St - S		--	6	1				24	4	0	0	0
	Lemmon Dr - W	2:45 PM	28	23	2		1		92	8	0	4	0
	Lemmon Dr - E		31	20					80	0	0	0	0
	Waterash St - N		--	24	1				96	4	0	0	0
	Waterash St - S		--	6					24	0	0	0	0
9	Lemmon Dr - W	1:45 PM	33	18					72	0	0	0	0
	Lemmon Dr - E		35	11	1			1	44	4	0	0	4
	Idaho St - S		26	5					20	0	0	0	0
	Lemmon Dr - W	2:00 PM	30	19					76	0	0	0	0
	Lemmon Dr - E		40	19	1				76	4	0	0	0
	Idaho St - S		18	12					48	0	0	0	0

Site No.	Road name and direction	Start Time	Speed mph	15 min Volume					1 hr Volume				
				car	MT	HT	Bus	motorcycle	car	MT	HT	Bus	motorcycle
10	Lemmon Dr - W	1:00 PM	36	12	1				48	4	0	0	0
	Lemmon Dr - E		35	8					32	0	0	0	0
	Oregon Blvd - N		--						0	0	0	0	0
	Oregon Blvd - S		24	6					24	0	0	0	0
	Lemmon Dr - W	1:15 PM	32	8					32	0	0	0	0
	Lemmon Dr - E		28	3			3		12	0	0	12	0
	Oregon Blvd - N		--	3					12	0	0	0	0
	Oregon Blvd - S		--	1					4	0	0	0	0
11	Lemmon Dr - W	7:25 AM	25	10	2				40	8	0	0	0
	Lemmon Dr - E		--	6			1		24	0	0	4	0
	Lemmon Dr - W *		--	2					8	0	0	0	0
	Lemmon Dr - E *		--	0					0	0	0	0	0
	Ramsey Way - N		22	4			1		16	0	0	4	0
	Ramsey Way - S		--	10	2				40	8	0	0	0
	Lemmon Dr - W	7:40 AM	26	12					48	0	0	0	0
	Lemmon Dr - E		--	5			1		20	0	0	4	0
	Lemmon Dr - W *		--	1					4	0	0	0	0
	Lemmon Dr - E *		--	0					0	0	0	0	0
	Ramsey Way - N		22	4			1		16	0	0	4	0
	Ramsey Way - S		17	12					48	0	0	0	0
Note:	* Lemmon Dr west of Ramsey is a dirt road.												

Peak Hour Traffic Volumes

Location	Road name and direction	Speed	Existing				No Build and Build (2050)			
		mph	car	MT	HT	Total	car	MT	HT	Total
South of Fleetwood Dr	Lemmon Dr - NE	35	544	23	--	567	699	29	--	728
	Lemmon Dr - SW	35	246	10	--	256	275	11	--	286
	Fleetwood Dr - W	25	87	--	--	87	116	--	--	116
	Fleetwood Dr - E	25	51	--	--	51	75	--	--	75
North of Fleetwood Dr	Lemmon Dr - NE	35	454	19	--	473	602	25	--	627
	Lemmon Dr - SW	35	200	8	--	208	217	9	--	226
South of Patrician Dr	Lemmon Dr - NE	35	460	19	--	479	601	25	--	626
	Lemmon Dr - SW	35	206	9	--	215	270	11	--	281
	Patrician Dr - E, west of Lemmon Dr	25	58	--	--	58	86	--	--	86
	Patrician Dr - W, west of Lemmon Dr	25	94	--	--	94	132	--	--	132
North of Patrician Dr	Lemmon Dr - NE	35	350	15	--	365	468	20	--	488
	Lemmon Dr - SW	35	142	6	--	148	197	8	--	205
	Patrician Dr - E, east of Lemmon Dr	25	56	--	--	56	86	--	--	86
	Patrician Dr - W, east of Lemmon Dr	25	45	--	--	45	70	--	--	70
South of Palace Dr	Lemmon Dr - N	35	355	15	--	370	468	19	--	487
	Lemmon Dr - S	35	145	6	--	151	194	8	--	202
	Palace Dr - W	25	10	--	--	10	25	--	--	25
	Palace Dr - E	25	11	--	--	11	25	--	--	25
North of Palace Dr	Lemmon Dr - N	35	348	15	--	363	463	19	--	482
	Lemmon Dr - S	35	139	6	--	145	189	8	--	197
North of Deodar Way to Arkansas St	Lemmon Dr - N	45	336	14	--	350	437	18	--	455
	Lemmon Dr - S	45	159	7	--	166	207	9	--	216
North of Arkansas St to Chickadee Dr	Lemmon Dr - N	45	261	11	--	272	347	14	--	362
	Lemmon Dr - S	45	104	4	--	109	142	6	--	148
North of Chickadee Dr to Oregon Blvd	Lemmon Dr - W	25*	66	3	--	69	86	4	--	90
	Lemmon Dr - E	25*	43	2	--	45	56	2	--	59
	Orange Blvd - N	25	47	--	--	47	61	--	--	61
	Orange Blvd - S	25	10	--	--	10	13	--	--	13
West of Oregon Blvd	Lemmon Dr - W	25**	41	2	--	43	54	2	--	56
	Lemmon Dr - E	25**	54	2	--	56	70	3	--	73
Ramsey Way	SB	25	41	2	--	43	54	2	--	56
	NB	25	54	2	--	56	70	3	--	73

Forecast is based on the traffic counts at intersections; therefore, there are some differences for the same segments of the roads where there are no side streets or driveways. The higher of two volumes are used for the noise analysis.

* 45 mph for the Build case

** 35 mph for the Build case

APPENDIX C: NOISE STUDY AREA DETAIL MAP

Exhibit 1

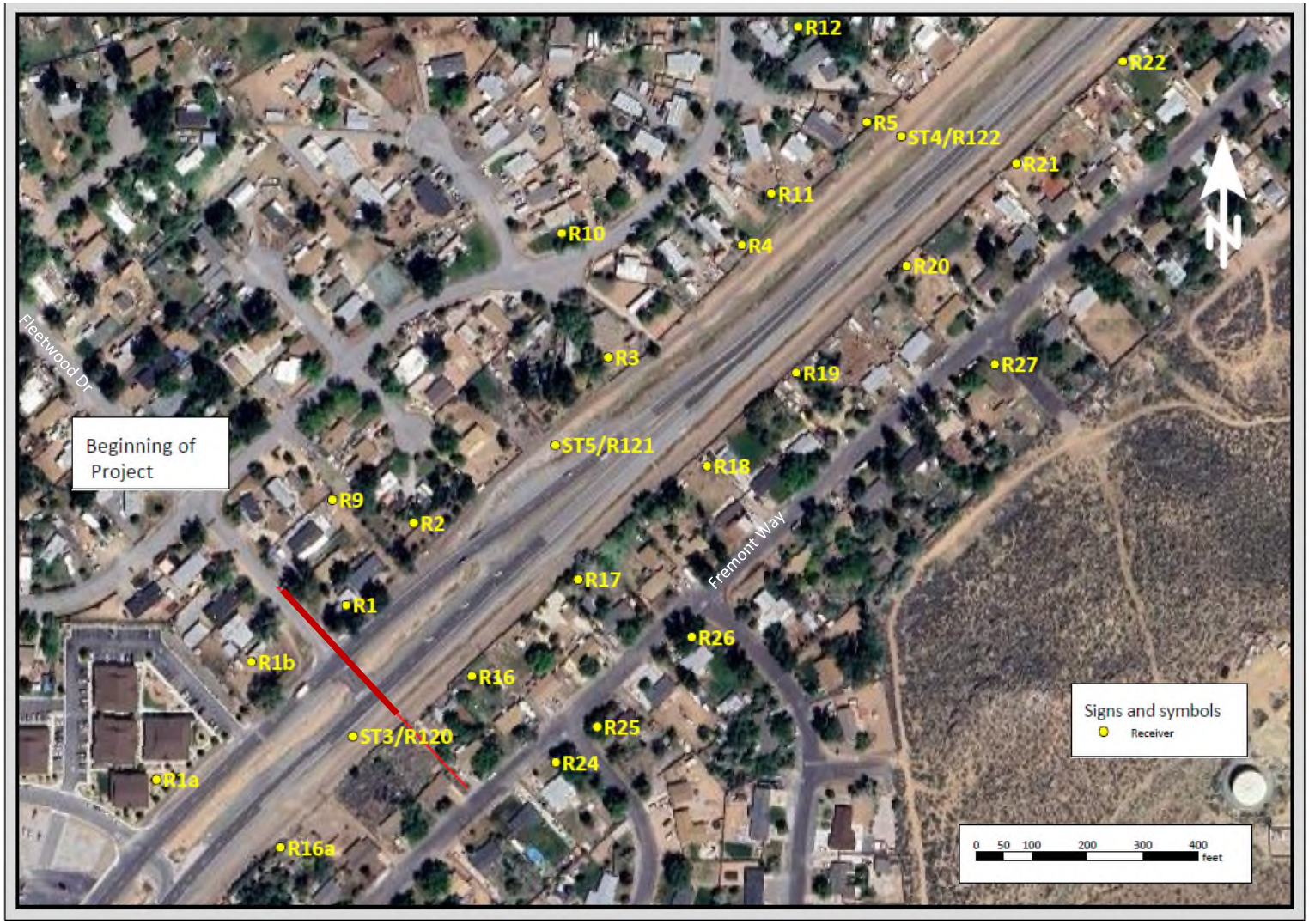


Exhibit 2


Lemmon Valley Elementary School
Lemmon Drive Frontage Rd
Consultant One
Place Dr
W Patrician Dr
E Patrician
Aristocrat Way
Judy Way
Gremlin Way
165
R36
R33
R37
R35
R32
ST1/R123
R30
R31
R34
R15
R13
R14
R29
R8
R28
ST2
R23
R7
R6
R124
R22
Signs and symbols
Receiver
0 50 100 200 300 400
feet

Exhibit 3

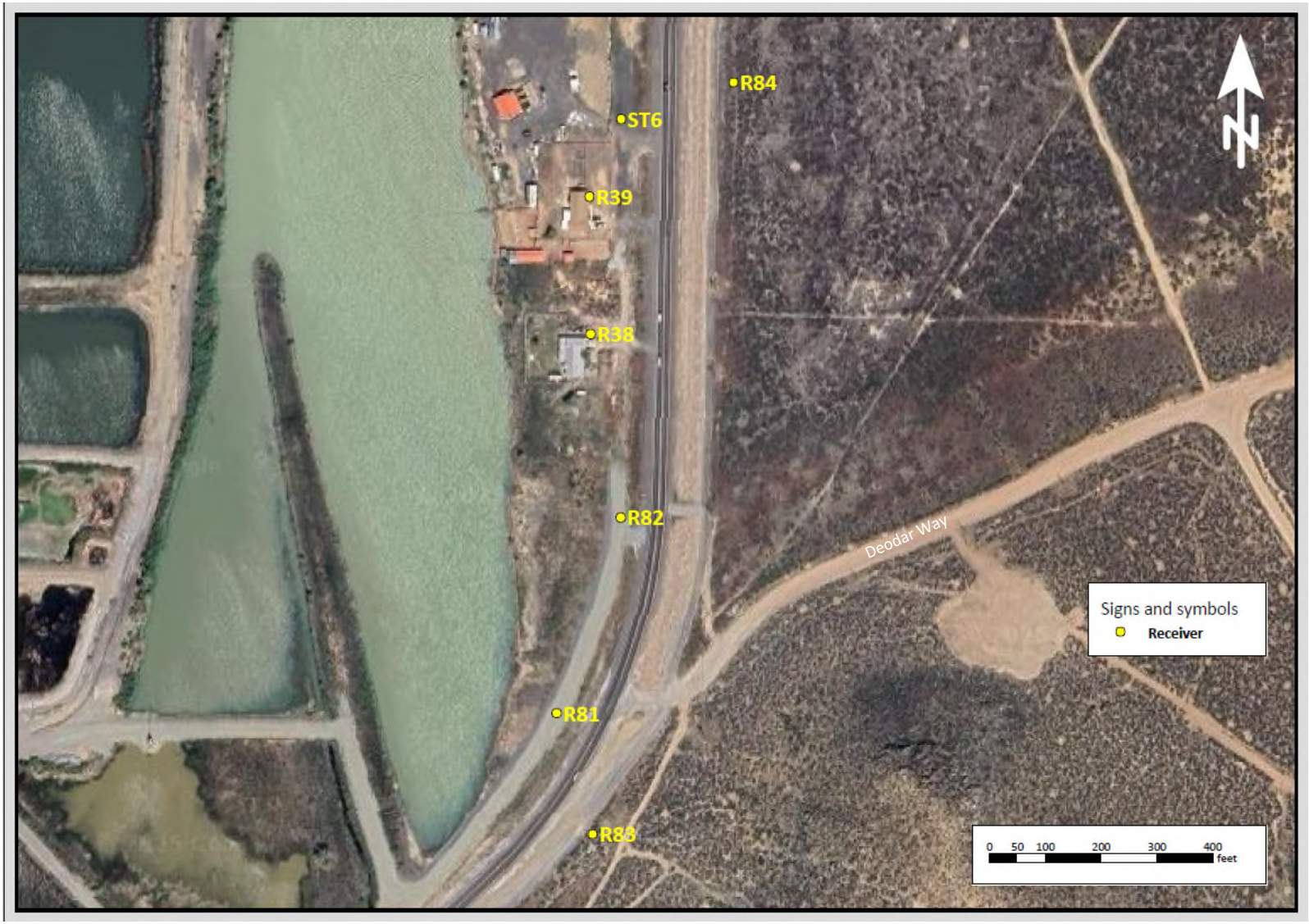

R84
ST6
R39
R38
R82
Deodar Way
R81
R83
N
Signs and symbols
Receiver
0 50 100 200 300 400
feet

Exhibit 4

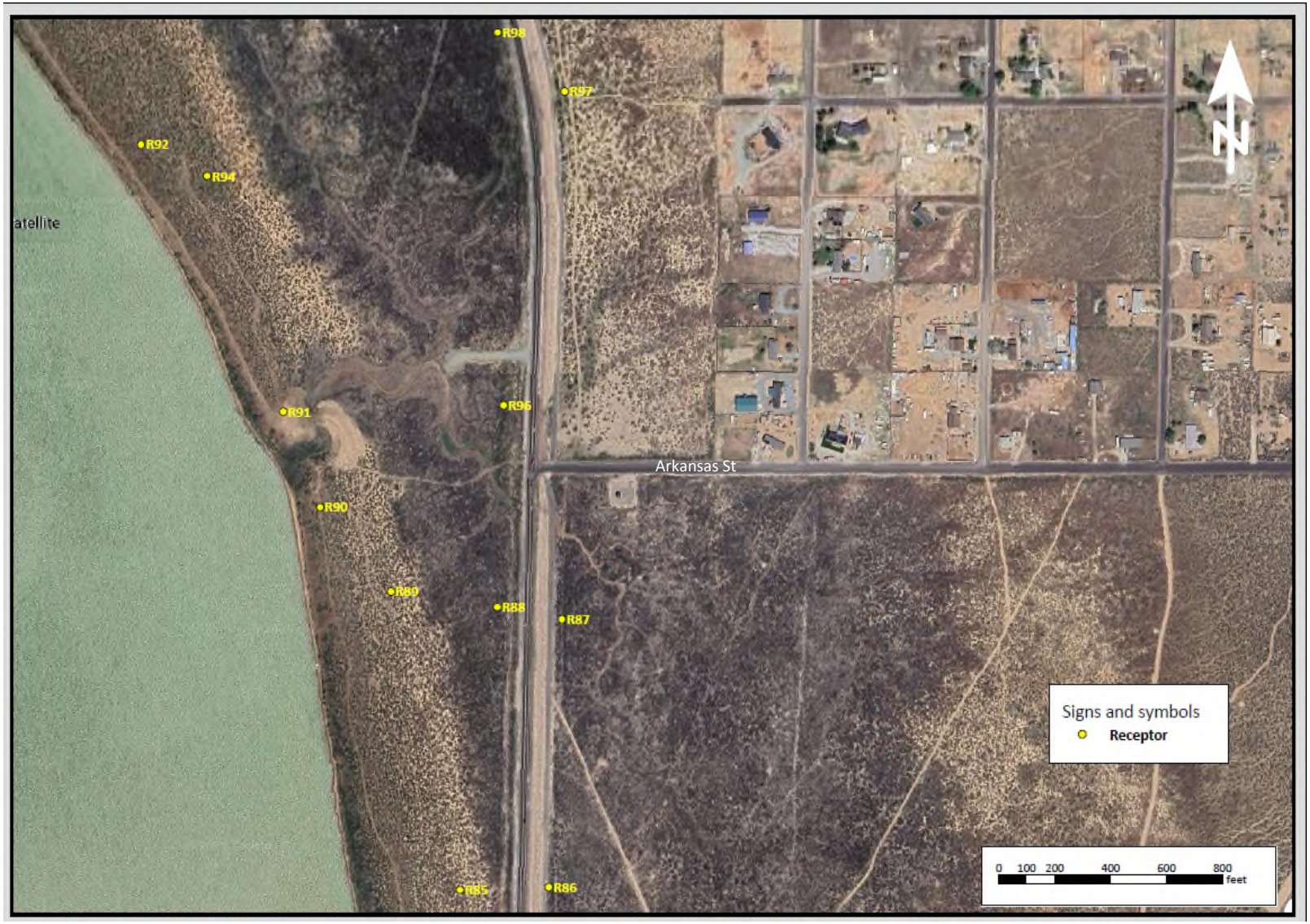

R98
R97
R92
R94
atellite
R91
R96
Arkansas St
R90
R89
R88
R87
R85
R86
N
Signs and symbols
Receptor
0 100 200 400 600 800
feet

Exhibit 5

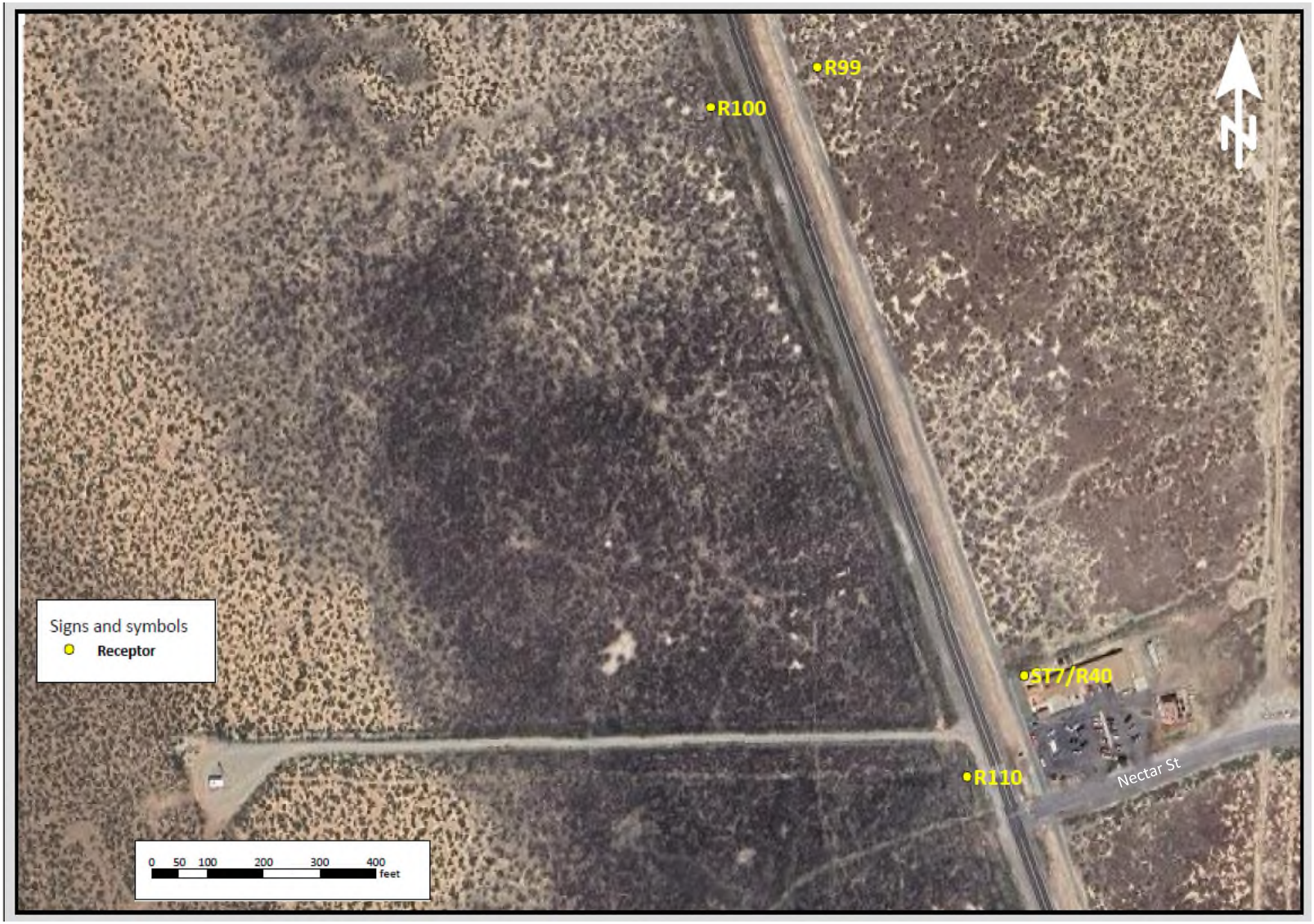

R99
R100
N
Signs and symbols
Receptor
ST7/R40
R110
Nectar St
0 50 100 200 300 400
feet

Exhibit 6

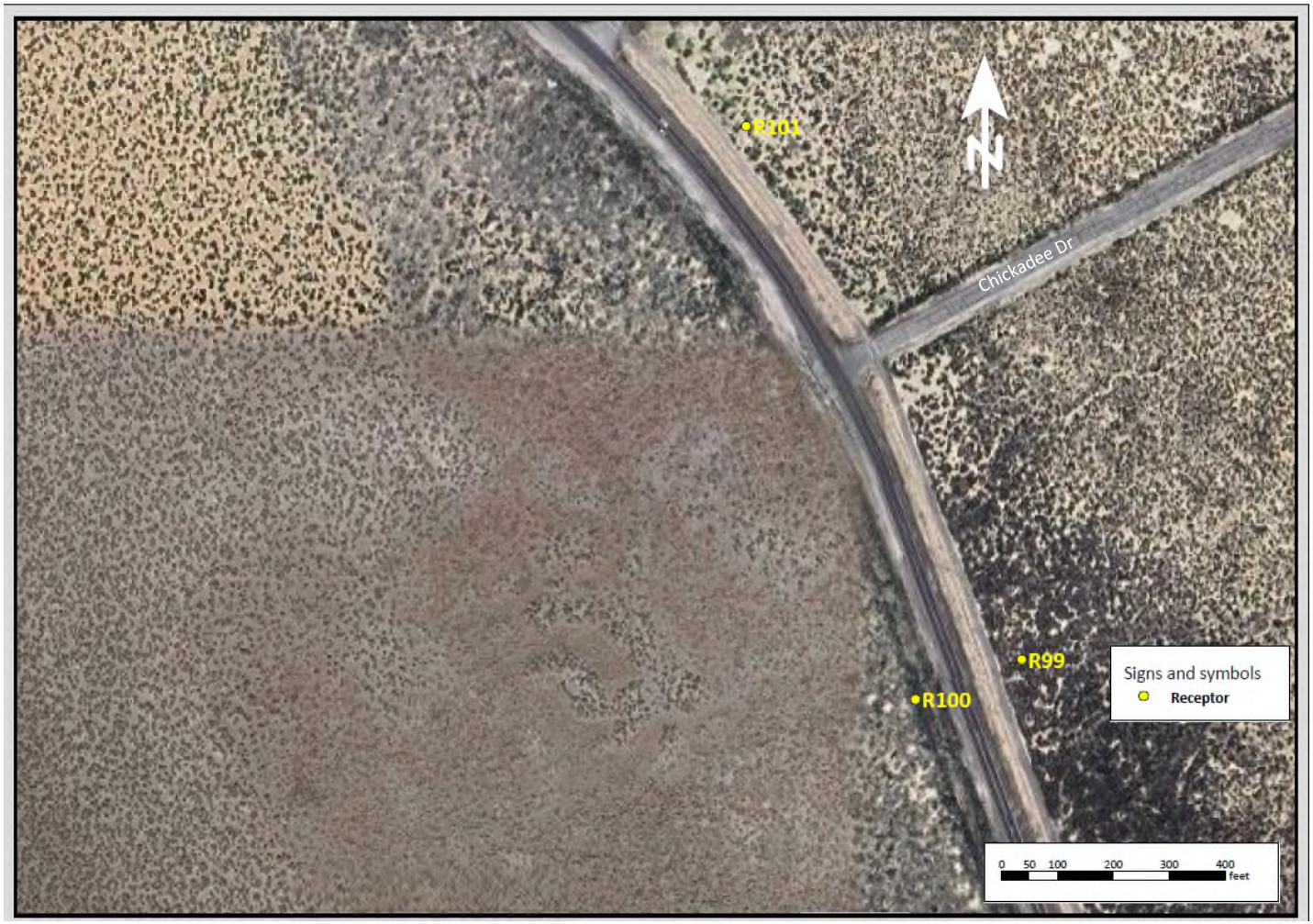

R101
Chickadee Dr
R99
R100
Signs and symbols
Receptor
0 50 100 200 300 400
feet

Exhibit 7


Tupelo St
Arizona St
Waterash St
emmon Dr
Jean Way
R59
R54
R53
R52
R51
R50
R49
R48
R47
R46
R45
R44
R43
R125
R42
ST8
R41
R103
R102
Signs and symbols
Receiver
0 50 100 200 300 400
feet

Exhibit 8


R76
R66
R65
ST10/R126
R64
R63
R62
R61
R60
R59
R58
ST9
R57
R56
R55
R67
R108
R107
Oregon Blvd
Lemmon Dr
Idaho St
N
Signs and symbols
Receptor
0 50 100 200 300 400
feet

Exhibit 9

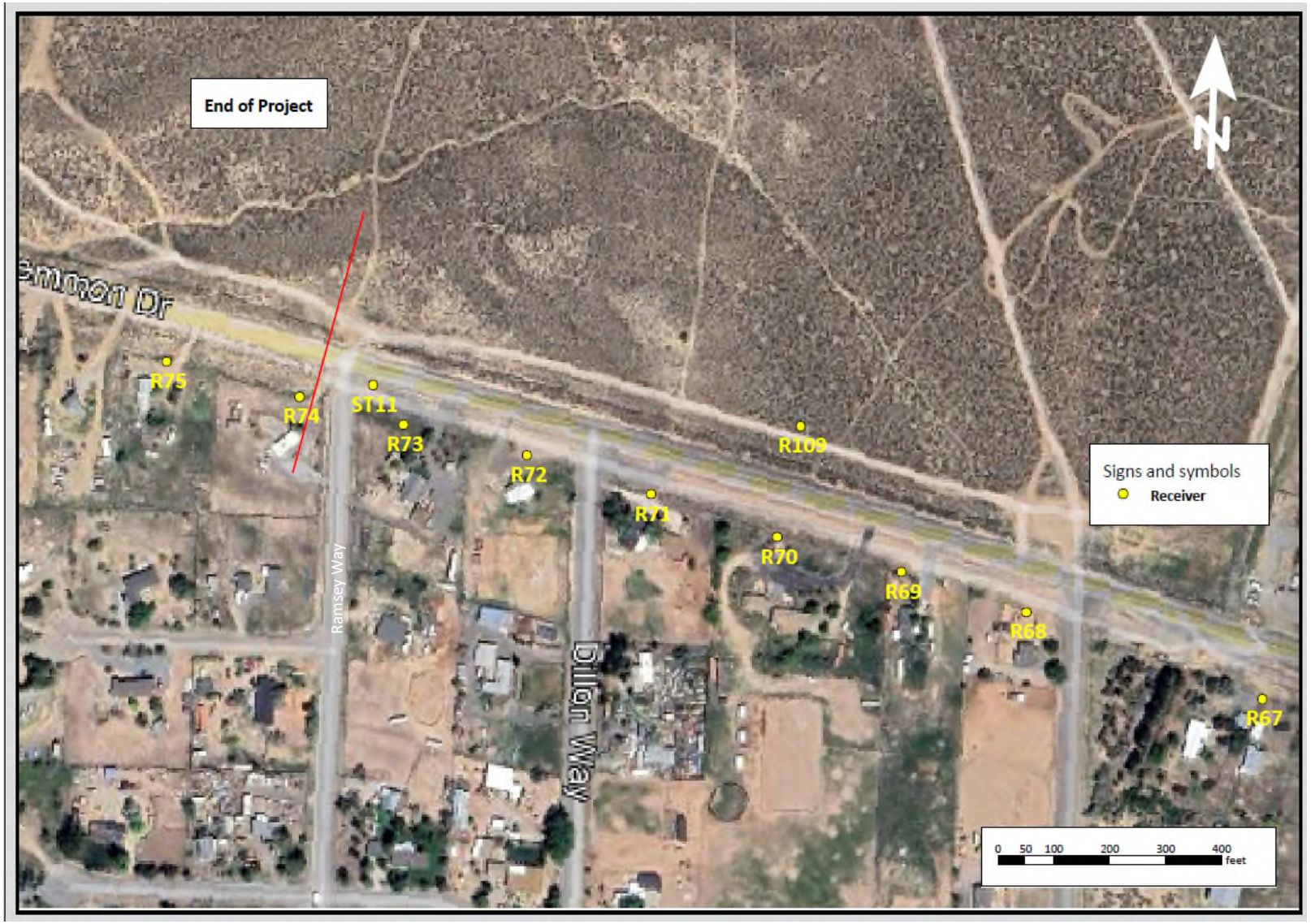

End of Project
N
R75
R74
ST11
R73
R72
R71
R109
R70
R69
R68
R67
Ramsey Way
Dillon Way
Signs and symbols
Receiver
0 50 100 200 300 400
feet

Exhibit 10

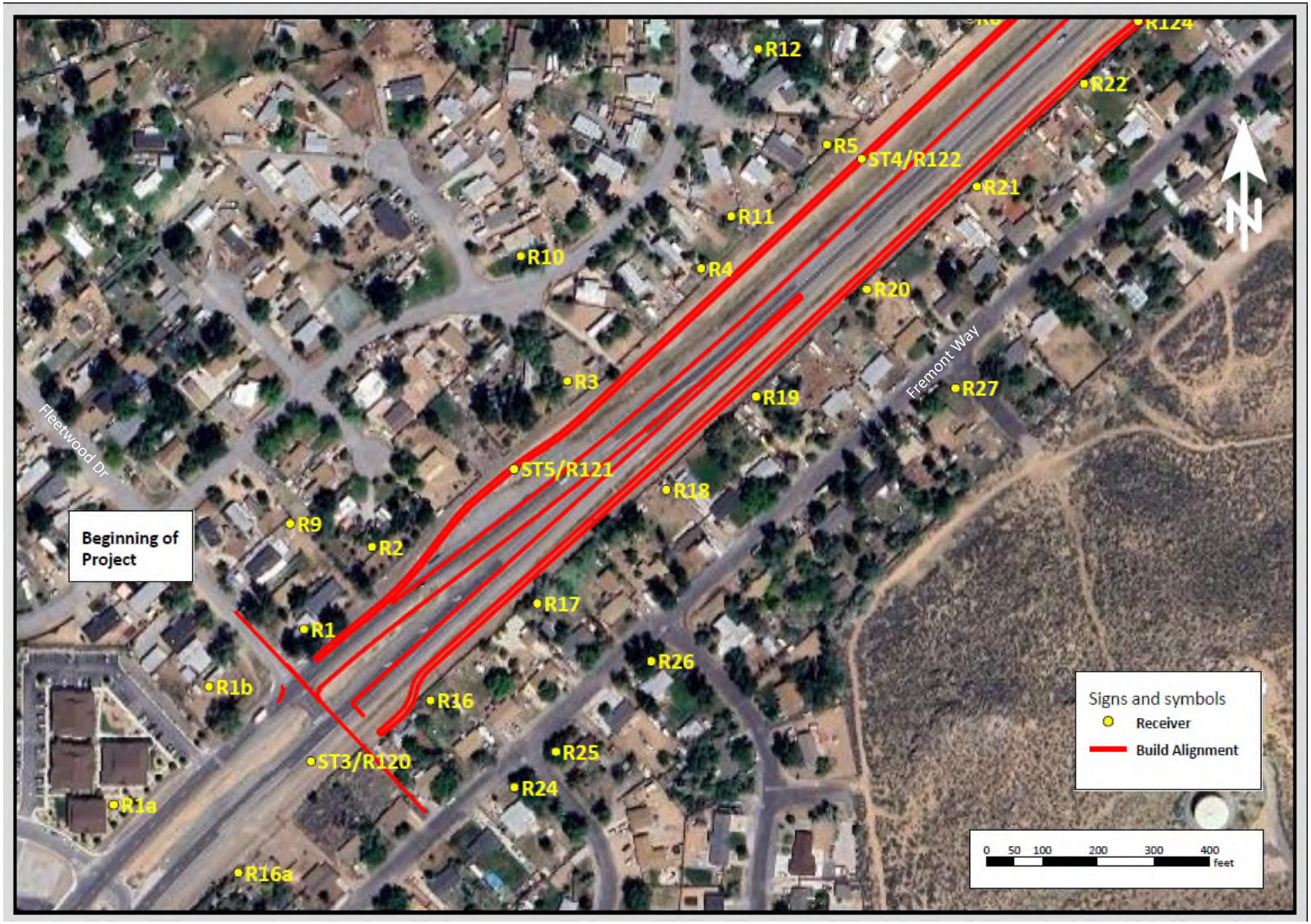

R12
R22
R5
ST4/R122
R21
R11
R10
R4
R20
R3
R19
R27
Fremont Way
Fleetwood Dr
ST5/R121
R18
Beginning of Project
R9
R2
R17
R1
R26
R1b
R16
R25
ST3/R120
R24
R1a
R16a
Signs and symbols
Receiver
Build Alignment
0 50 100 200 300 400
feet

Exhibit 11


Arsten St
Lemmon Valley Elementary School
W Patrician Dr
Aristocrat Way
Judy Way
Gremlin Way
E Patrician
Consultant One
Palace Dr
165
R36
R33
R37
R35
R32
ST1/R123
R31
R34
R30
R29
R28
R15
R13
R14
R8
R23
R7
R6
R124
R22
N
Signs and symbols
Receiver
Build Alignment
0 50 100 200 300 400
feet

Exhibit 12


R84
R39
R38
R82
R81
R83
Deodar Way
N
Signs and symbols
Receiver
Build Alignment
0 50 100 200 300 400
feet

Exhibit 13

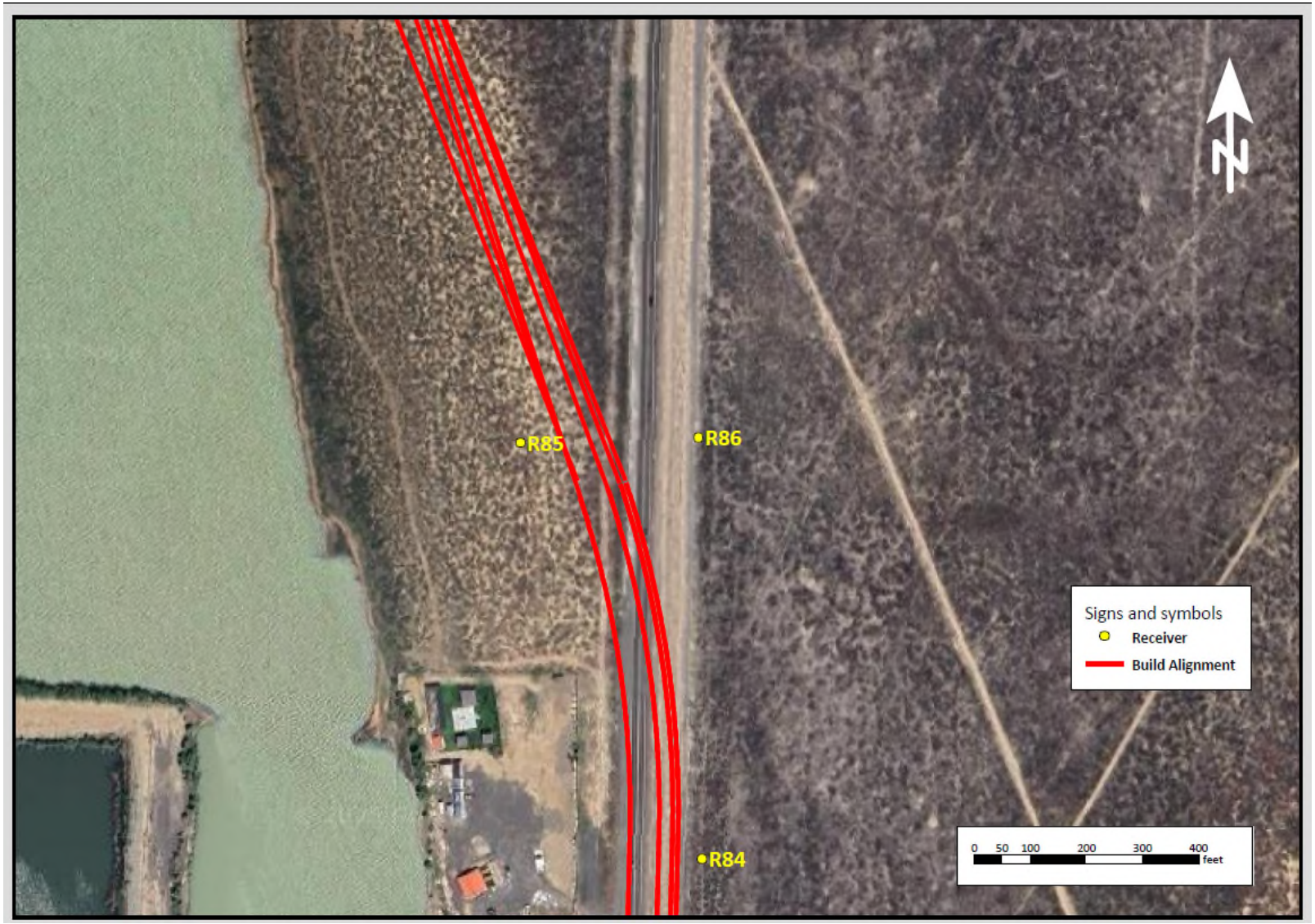

R85
R86
R84
N
Signs and symbols
Receiver
Build Alignment
0 50 100 200 300 400
feet

Exhibit 14


R93
R95
R98
R97
R92
R94
R96
R91
Arkansas St
R90
R89
R88
R87
Signs and symbols
Receptor
Build Alignment
0 100 200 400 600 800
N

Exhibit 15


R106
R105
R104
Chickadee Dr
N
Signs and symbols
Receptor
Build Alignment
0 50 100 200 300 400
feet

Exhibit 16

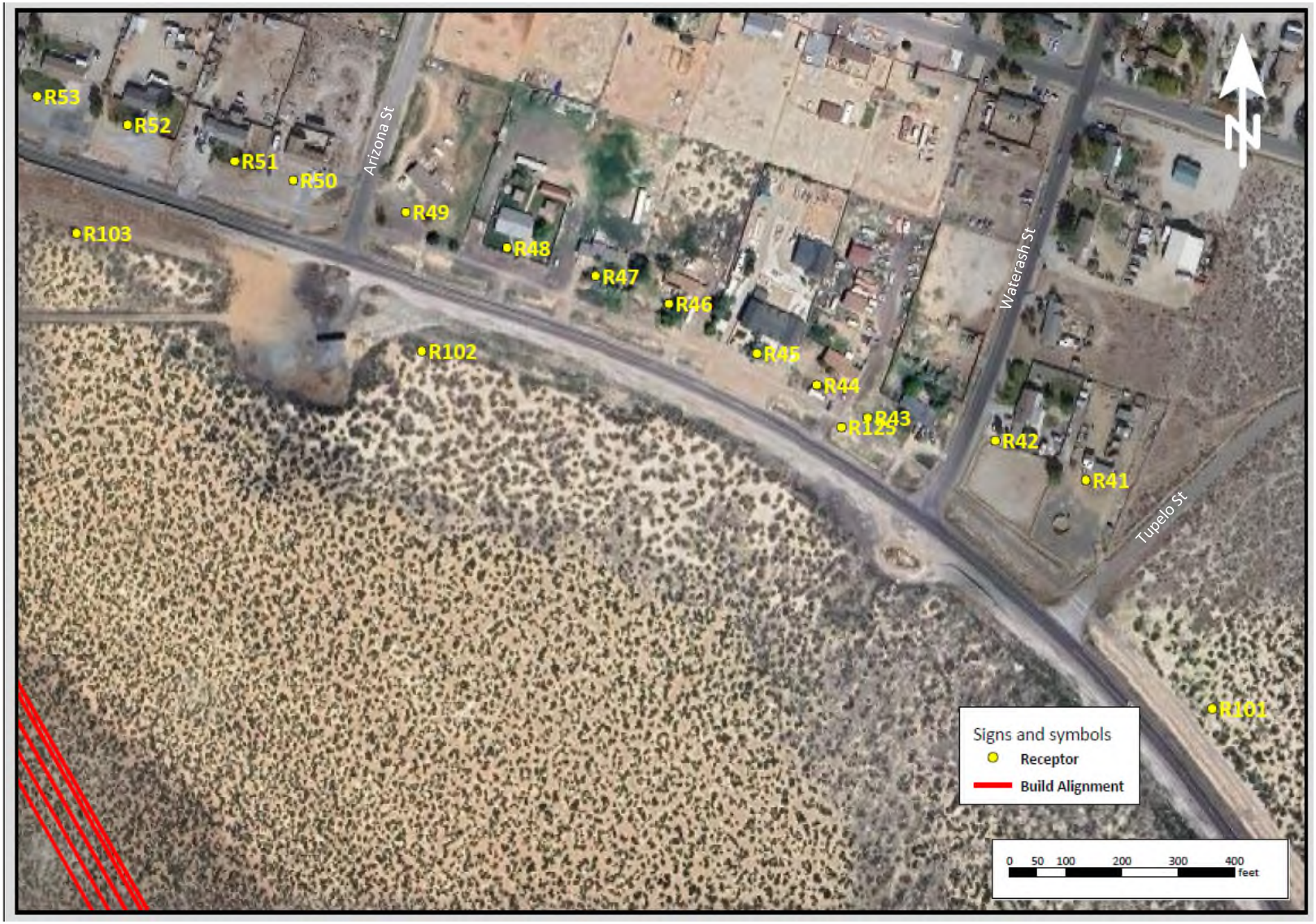

R53
R52
R51
R50
R49
R48
R47
R46
R45
R44
R43
R125
R42
R41
R103
R102
R101
Arizona St
Waterash St
Tupelo St
N
Signs and symbols
Receptor
Build Alignment
0 50 100 200 300 400
feet

Exhibit 17

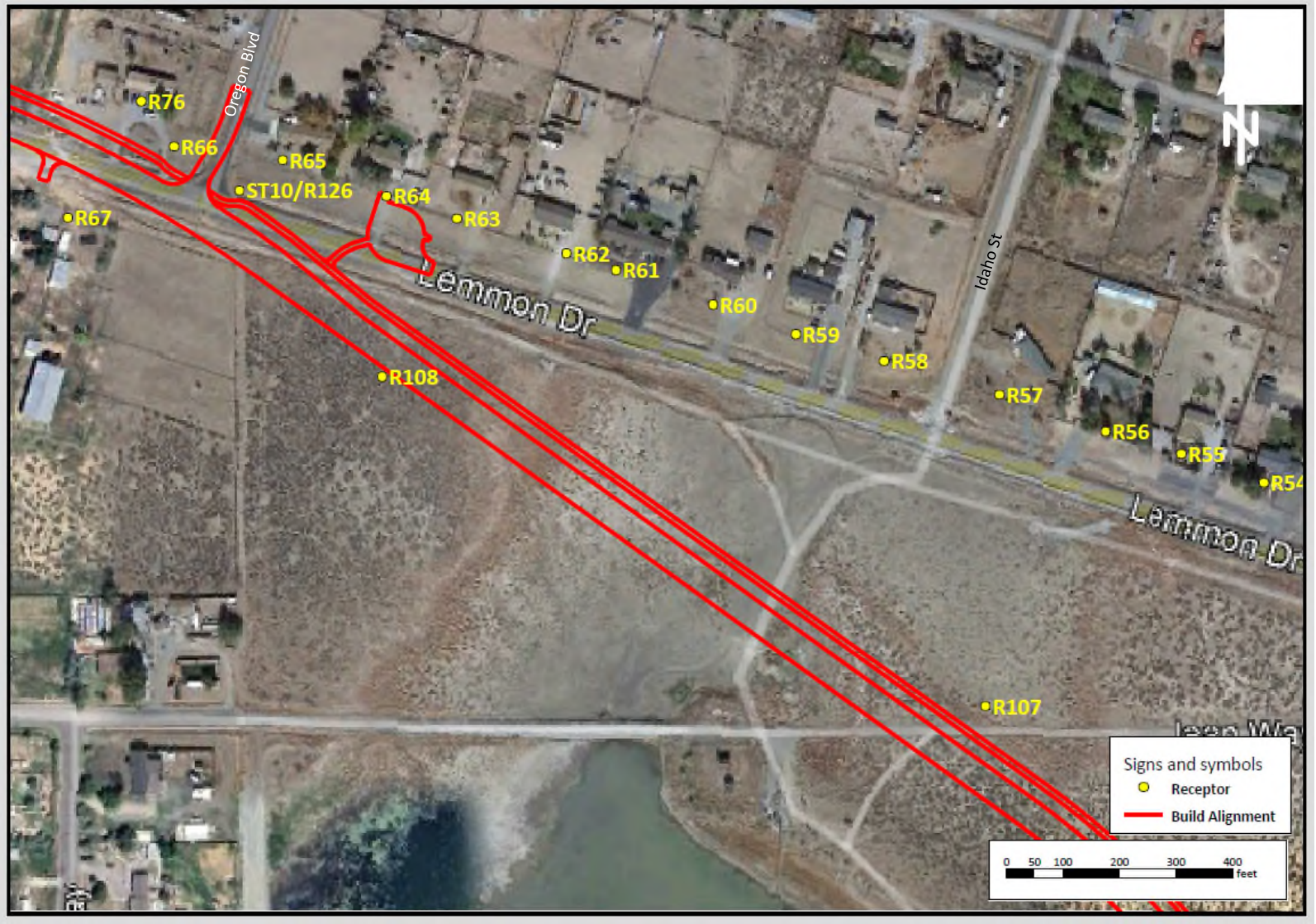
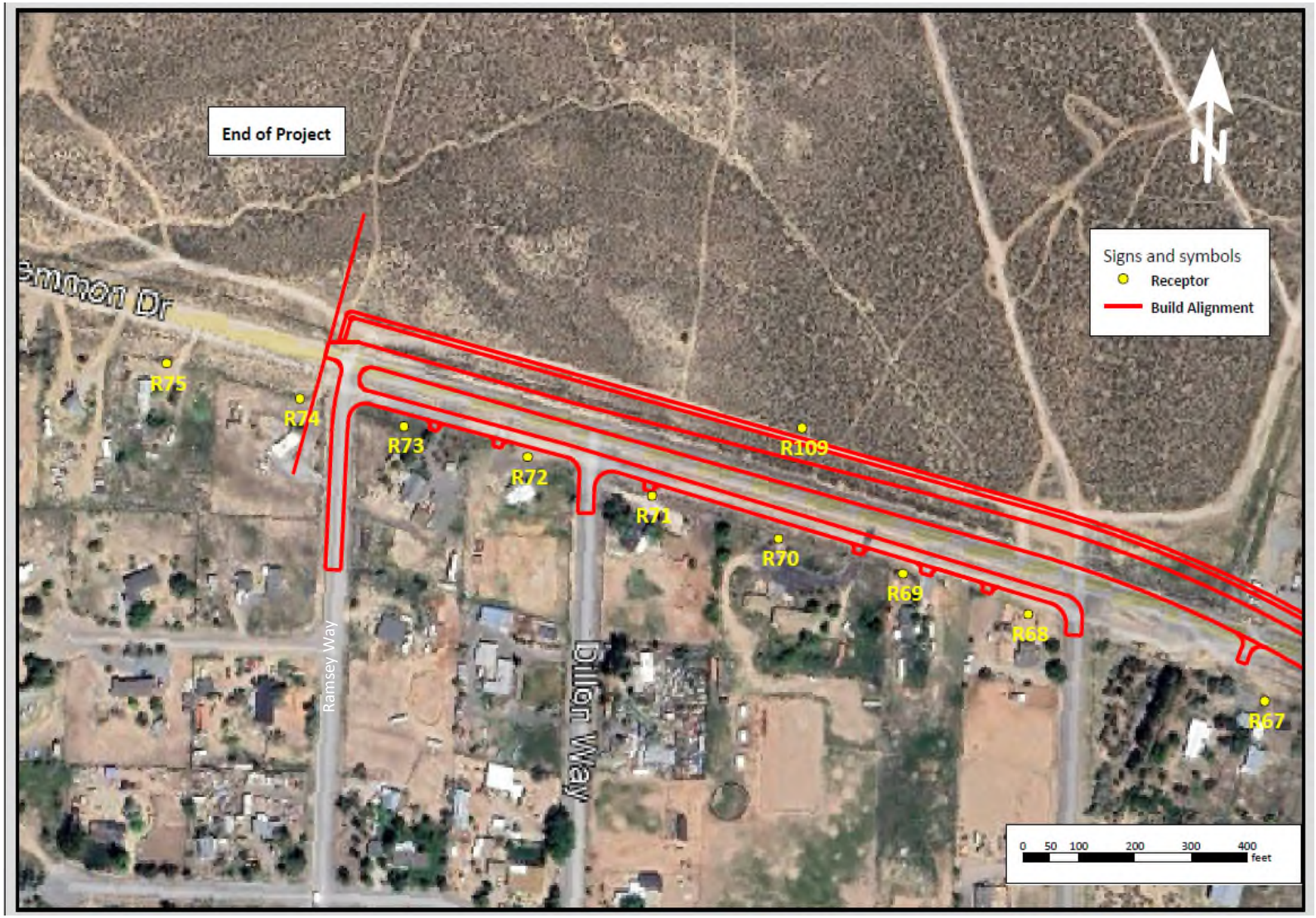

R76
R66
R65
ST10/R126
R64
R63
R67
R62
R61
R60
R59
R58
R57
R56
R55
R54
R108
R107
Oregon Blvd
Lemmon Dr
Idaho St
Signs and symbols
Receptor
Build Alignment
0 50 100 200 300 400
feet

Exhibit 17


End of Project
Emmon Dr
R75
R74
R73
R72
R71
R70
R69
R68
R67
R109
Ramsey Way
Dillon Way
Signs and symbols
Receptor
Build Alignment
N
0 50 100 200 300 400
feet

APPENDIX D: PERSONNEL WHO PREFORMED NOISE STUDY

Areg Gharabegian – Lead Noise Engineer

Areg has MS and BS in Mechanical Engineering and over 40 years of experience in project management and technical noise and vibration studies with various state departments of transportation, private sector, and other clients. He has predicted highway noise levels using the Traffic Noise Model (TNM) computer program for existing roadways and future planned transportation corridors. Areg's experience includes designing noise barriers and building acoustical improvements to reduce adverse traffic noise effects, conducting traffic noise and vibration measurements, and developing computerized noise contours for highways. Areg was part of the original technical team that developed requirements for the TNM and he has provided formal training in use of TNM to Caltrans staff and others.

He has conducted commercial airport and air force base noise impact analyses and generated noise contours for civilian and military aircraft operations using Integrated Noise Model (INM) and NOISEMAP computer programs. Conducted noise and vibration measurements and predicted impacts from the commuter and freight trains, metros, street cars, Maglev, and light rail transit operations in several cities and recommended mitigation measures using FRA and FTA procedures. Areg has developed unique methods for mitigating train vibration impacts using shredded tires and simplified floating slabs.

Areg has made numerous presentations at conferences and has many publications in different journals.

Saul Perez

Saul has his bachelor's degree in Civil Engineering. He is an engineering intern (EI) at the CA Group Las Vegas office, he collaborates with senior engineers on projects and participates in the development of roadway design plans, cost estimates, associated calculations, design drawings, and drafting and publishing of civil plans. He has been an engineering intern for two years. His prior work experience included assisting with the NDOT Tropicana avenue widening project sound measurements.

He assisted by conducting the traffic noise measurements for 11 sites.

His NHI training "How to measure Highway Traffic Noise" certification is attached.

Alexa Cavaretta

Alexa is an environmental planner with 3 years of experience in environmental work. She has a background in both transportation and geotechnical engineering. Her primary responsibility at CA Group is to assist with preparation of environmental clearance documents required by the National Environmental Policy Act (NEPA) including Environmental Assessments and Environmental Impact Statements. Alexa is also involved in the development of corridor studies and feasibility studies, as well as supporting administrative and technical tasks.

She has done traffic noise measurements in Carsons City and was involved in conducting traffic noise measurements at 11 sites along Lemmon Drive, as well as recording traffic volumes, tabulating results, organizing collected data in the field.

Her NHI training "How to measure Highway Traffic Noise" certification is attached.

Jessica Goza-Tyner

Jessica is an Associate Engineer with NDOT responsible for air quality and traffic noise analysis.

Her NHI training "How to measure Highway Traffic Noise" certification is attached.

U.S. Department of Transportation
Federal Highway Administration

Office of Technical Services

national highway institute

CERTIFICATE OF TRAINING

Saul Perez

has participated in

NHI Course No. FHWA-NHI-142088

How to Measure Highway Traffic Noise

Hosted by: **National Highway Institute**

Location: *Web-Based Course* ***Hours of Instruction:*** *2 hours*

Date: *3/22/2021*

Thomas P. Harman
Acting Director | National Highway Instit

U.S. Department of Transportation
Federal Highway Administration

national highway institute

CERTIFICATE OF TRAINING

Alexa Cavaretta

has participated in

NHI Course No. FHWA-NHI-142088

How to Measure Highway Traffic Noise

Hosted by: **National Highway Institute**

Location: *Web-Based Course* ***Hours of Instruction:*** *2 hours*

Date: *2/16/2023*

Thomas Harman
Thomas Harman, Director
National Highway Institute

RTC NEVADA DOT SAFE AND CONNECTED

U.S. Department of Transportation
Federal Highway Administration

national highway institute

CERTIFICATE OF TRAINING

Jessica Goza Tyner

has participated in

NHI Course No. FHWA-NHI-142088

How to Measure Highway Traffic Noise

Hosted by: **National Highway Institute**

Location: *Web-Based Course*

Date: *12/29/2022*

Hours of Instruction: *2 hours*

Thomas Harman

Thomas Harman, Director
National Highway Institute

APPENDIX E: CALIBRATION CERTIFICATE

Calibration Certificate

Certificate Number 2023011262

Customer:
The Modal Shop
10310 AeroHub Boulevard
Cincinnati, OH 45215, United States

Model Number	CAL200	***Procedure Number***	D0001.8386		
Serial Number	21609	***Technician***	Scott Montgomery		
Test Results	**Pass**	***Calibration Date***	28 Aug 2023		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	24	°C	± 0.3 °C
Description	Larson Davis CAL200 Acoustic Calibrator	***Humidity***	37	%RH	± 3 %RH
		Static Pressure	101.0	kPa	± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	06/21/2023	06/21/2024	001021
Larson Davis Model 2900 Real Time Analyzer	03/31/2023	03/31/2024	001051
Microphone Calibration System	02/22/2023	02/22/2024	005446
1/2" Preamplifier	08/16/2023	08/16/2024	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/04/2023	08/04/2024	006507
1/2 inch Microphone - R1 - 200V	10/05/2022	10/05/2023	006510
Pressure Sensor	11/02/2022	11/02/2023	007827

Output Level

Nominal Level [dB]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
94	101.0	94.01	93.80	94.20	0.15	Pass
114	101.2	114.00	113.80	114.20	0.14	Pass

-- End of measurement results--

Frequency

Nominal Level [dB]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
94	101.0	1,000.04	993.00	1,007.00	0.20	Pass
114	101.2	1,000.03	993.00	1,007.00	0.20	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N)

Nominal Level [dB]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
94	101.0	0.45	0.00	2.00	0.25 ‡	Pass
114	101.2	0.37	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Level Change Over Pressure

Tested at: 114 dB, 25 °C, 31 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
108.0	107.9	-0.03	-0.25	0.25	0.04 ‡	Pass
101.3	101.4	0.00	-0.25	0.25	0.04 ‡	Pass
92.0	92.1	0.02	-0.25	0.25	0.04 ‡	Pass
83.0	83.3	0.01	-0.25	0.25	0.04 ‡	Pass
74.0	74.3	-0.03	-0.25	0.25	0.04 ‡	Pass
65.0	65.1	-0.12	-0.25	0.25	0.04 ‡	Pass

-- End of measurement results--

Frequency Change Over Pressure

Tested at: 114 dB, 25 °C, 31 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
108.0	107.9	0.00	-7.00	7.00	0.20 ‡	Pass
101.3	101.4	0.00	-7.00	7.00	0.20 ‡	Pass
92.0	92.1	0.00	-7.00	7.00	0.20 ‡	Pass
83.0	83.3	-0.01	-7.00	7.00	0.20 ‡	Pass
74.0	74.3	-0.01	-7.00	7.00	0.20 ‡	Pass
65.0	65.1	-0.02	-7.00	7.00	0.20 ‡	Pass

-- End of measurement results--

Certificate Number 2023011262

Total Harmonic Distortion + Noise (THD+N) Over Pressure

Tested at: 114 dB, 25 °C, 31 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
108.0	107.9	0.37	0.00	2.00	0.25 ‡	Pass
101.3	101.4	0.36	0.00	2.00	0.25 ‡	Pass
92.0	92.1	0.35	0.00	2.00	0.25 ‡	Pass
83.0	83.3	0.34	0.00	2.00	0.25 ‡	Pass
74.0	74.3	0.34	0.00	2.00	0.25 ‡	Pass
65.0	65.1	0.34	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Signatory: Scott Montgomery

LARSON DAVIS – A PCB DIVISION
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

8/28/2023 3:44:10PM

LARSON DAVIS
A PCB DIVISION

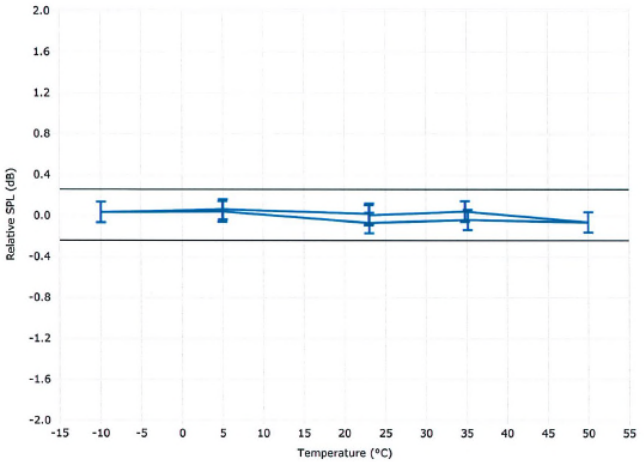
D0001.8410 Rev F

Model CAL200 Relative SPL vs. Temperature

Larson Davis Model CAL200 Serial Number: 21609

Model CAL200 Relative SPL vs. Temperature at 50% RH.
A 2559 Mic (SN: 2915) with a PRM901 Preamp (SN: 0186), station 8 was used to check the levels.

Test Date: 17 Jul 2023 2:30:52 PM



0.1dB expanded uncertainty at ~95% confidence level (k=2)

Sequence File: CAL200.SEQ

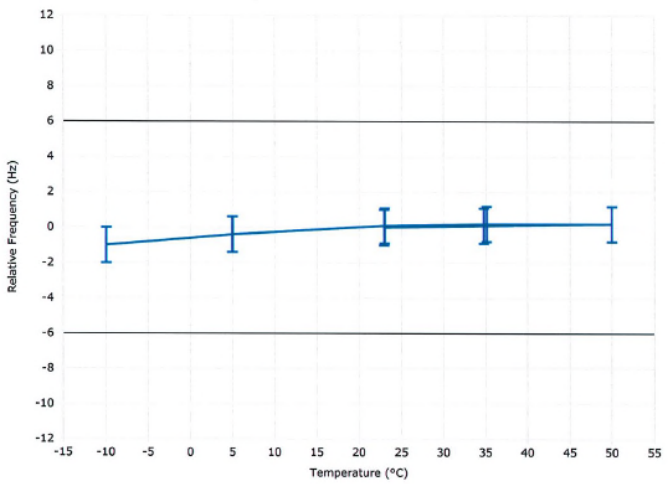
Test Location: Larson Davis – A PCB Division
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

Model CAL200 Relative Frequency vs. Temperature

Larson Davis Model CAL200 Serial Number: 21609

Model CAL200 Relative Frequency vs. Temperature at 50% RH.
A 2559 Mic (SN: 2915) with a PRM901 Preamp (SN: 0186), station 8 was used to check the levels.

Test Date: 17 Jul 2023 2:30:52 PM



1.0 Hz expanded uncertainty at ~95% confidence level (k=2)

Sequence File: CAL200.SEQ

Test Location: Larson Davis – A PCB Division
1681 West 820 North, Provo, Utah 84601
Tel: 716 684-0001 www.LarsonDavis.com

Page 2 of 2

THE MODAL SHOP

AN AMPHENOL COMPANY

~Certificate of Calibration~

10310 Aerohub Boulevard
Cincinnati, OH 45215
Ph: 513.351.9919
Fax: 513.458.2172
www.modalshop.com

Manufacturer:	PCB	**Customer:**	TMS Rental
Model Number:	377B02	**Address:**	
Serial Number:	340341		
Asset ID:		**Cal Date / Cal ID:**	Sep 14, 2023 11:21:10
Description:	Free-Field Microphone	**Due Date:**	

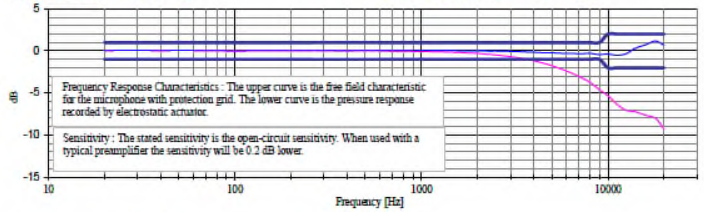
Sensitivity:

251.3 Hz	1000 Hz	
-25.56	-25.63	dB re. 1V/Pa
52.72	52.32	mV/Pa

Temperature:	71 (22)	°F (°C)
Humidity:	52	%
Ambient Pressure:	999.9	mbar

Reference Sens: In Tolerance
Freq. Response: In Tolerance

Polarization Voltage: 0 VDC



Traceability: The calibration is traceable through NIST Project A2349.
Notes:
Calibration results relate only to the items calibrated.
This certificate may not be reproduced, except in full, without written permission.
This calibration is performed in compliance with ISO 9001, ISO 17025 and ANSI Z540.
Measurement uncertainty (250 Hz sensitivity calibration) at 95% confidence level: 0.30 dB
Calibrated per procedure PRD-P204.

User Note: As Found / As Left: In Tolerance.

Frequency Response with reference to level at 251.3 Hz

Frequency (Hz)	Upper (dB)	Frequency (Hz)	Upper (dB)	Frequency (Hz)	Upper (dB)	Frequency (Hz)	Upper (dB)
20	0.04	630	0.03	4500	-0.20		
25	0.07	800	0.06	5000	-0.21		
31.5	0.08	1000	0.05	5600	-0.28		
40	0.04	1120	0.05	6300	-0.28		
50	0.07	1250	0.05	7100	-0.33		
63	0.06	1400	0.04	8000	-0.29		
80	0.05	1600	0.02	9000	-0.43		
100	-0.02	1800	0.01	10000	-0.37		
125	0.05	2000	0.01	11200	-0.51		
160	0.05	2240	-0.02	12500	-0.34		
200	0.03	2500	-0.02	14000	0.30		
250	0.02	2800	-0.04	16000	0.76		
315	0.03	3150	-0.07	18000	1.17		
400	0.02	3550	-0.11	20000	0.68		
500	0.04	4000	-0.16				

Technician: Ed Devlin

Approval:

Reference Equipment Used:

Manuf.	*Model*	*Serial*	*Cal. Date*	*Due Date*
GRAS	40AG	58093	5/31/2023	5/31/2024

ACCREDITED
Calibration Lab
CALIBRATION CERT 2849.01

Page 1 of 1

Calibration Certificate

Certificate Number 2023001706
Customer:
The Modal Shop
10310 AeroHub Boulevard
Cincinnati, OH 45215, United States

Model Number	LxT1		***Procedure Number***	D0001.8378	
Serial Number	0006170		***Technician***	Jacob Cannon	
Test Results	**Pass**		***Calibration Date***	9 Feb 2023	
Initial Condition	AS RECEIVED same as shipped		***Calibration Due***		
Description	SoundTrack LxT Class 1		***Temperature***	23.64 °C	± 0.25 °C
	Class 1 Sound Level Meter		***Humidity***	49.2 %RH	± 2.0 %RH
	Firmware Revision: 2.404		***Static Pressure***	87.51 kPa	± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 014992 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

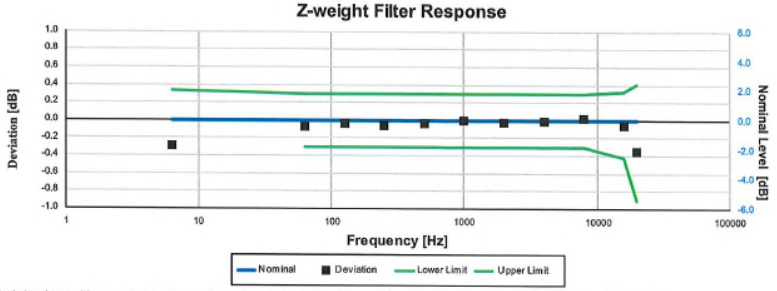
Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-02-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-12-29	2023-12-29	007118

Certificate Number 2023001706

Z-weight Filter Response



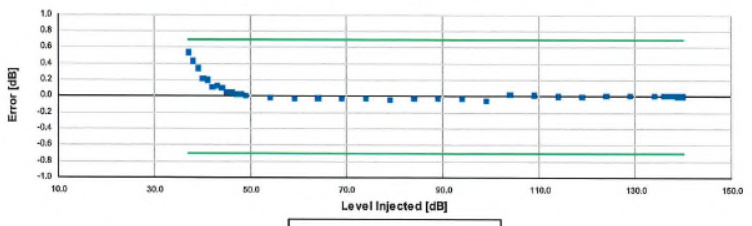
Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.29	-0.29	-1.11	0.33	0.15	Pass
63.10	-0.07	-0.07	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.06	-0.06	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-0.03	-0.30	0.30	0.15	Pass
3,981.07	-0.01	-0.01	-0.30	0.30	0.15	Pass
7,943.28	0.03	0.03	-0.30	0.30	0.15	Pass
15,848.93	-0.06	-0.06	-0.42	0.32	0.15	Pass
19,952.62	-0.35	-0.35	-0.91	0.41	0.15	Pass

-- End of measurement results--

Certificate Number 2023001706

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
37.00	0.54	-0.70	0.70	0.16	Pass
38.00	0.44	-0.70	0.70	0.16	Pass
39.00	0.35	-0.70	0.70	0.16	Pass
40.00	0.22	-0.70	0.70	0.16	Pass
41.00	0.20	-0.70	0.70	0.16	Pass
42.00	0.12	-0.70	0.70	0.16	Pass
43.00	0.13	-0.70	0.70	0.17	Pass
44.00	0.10	-0.70	0.70	0.17	Pass
45.00	0.05	-0.70	0.70	0.16	Pass
46.00	0.04	-0.70	0.70	0.16	Pass
47.00	0.03	-0.70	0.70	0.16	Pass
48.00	0.02	-0.70	0.70	0.16	Pass
49.00	0.01	-0.70	0.70	0.16	Pass
54.00	-0.02	-0.70	0.70	0.16	Pass
59.00	-0.03	-0.70	0.70	0.16	Pass
64.00	-0.02	-0.70	0.70	0.16	Pass
69.00	-0.03	-0.70	0.70	0.16	Pass
74.00	-0.03	-0.70	0.70	0.16	Pass
79.00	-0.04	-0.70	0.70	0.16	Pass
84.00	-0.03	-0.70	0.70	0.16	Pass
89.00	-0.03	-0.70	0.70	0.16	Pass
94.00	-0.03	-0.70	0.70	0.16	Pass
99.00	-0.05	-0.70	0.70	0.15	Pass
104.00	0.02	-0.70	0.70	0.15	Pass
109.00	0.02	-0.70	0.70	0.15	Pass
114.00	0.01	-0.70	0.70	0.15	Pass
119.00	0.00	-0.70	0.70	0.15	Pass
124.00	0.01	-0.70	0.70	0.15	Pass
129.00	0.01	-0.70	0.70	0.15	Pass
134.00	0.01	-0.70	0.70	0.15	Pass
136.00	0.01	-0.70	0.70	0.15	Pass
137.00	0.01	-0.70	0.70	0.15	Pass
138.00	0.01	-0.70	0.70	0.15	Pass
139.00	0.01	-0.70	0.70	0.15	Pass
140.00	0.01	-0.70	0.70	0.15	Pass

-- End of measurement results--

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	134.63	133.14	135.14	0.15	Pass
		Positive Pulse	134.62	133.13	135.13	0.15	Pass
	30	Negative Pulse	133.69	133.14	135.14	0.15	Pass
		Positive Pulse	133.68	133.13	135.13	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.16 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.26	± 1.50	0.15 ‡	Pass
106.85	3	-0.15	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	0.00	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 µs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.14	± 1.00	0.15 ‡	Pass
	10	-0.23	± 1.50	0.15 ‡	Pass
106.85	3	-0.14	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	0.01	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.94	93.89	94.09	0.15	Pass
0 dB Gain, Linearity	41.12	40.29	41.69	0.16	Pass
OBA Low Range	93.99	93.89	94.09	0.15	Pass
OBA Normal Range	93.99	93.20	94.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	26.90	36.00	Pass
C-weight Noise Floor	26.60	35.00	Pass
Z-weight Noise Floor	32.61	39.00	Pass

-- End of measurement results--

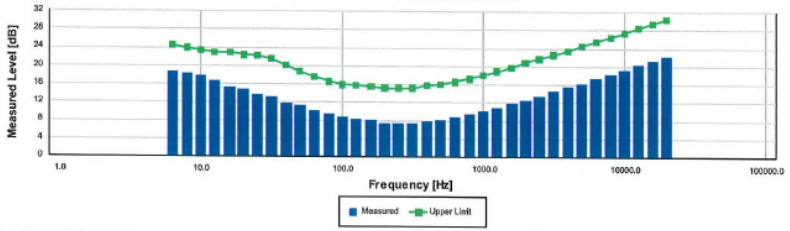
Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.18	135.05	136.65	0.15	Pass
THD	-66.67		-58.00	0.01 ‡	Pass
THD+N	-62.69		-58.00	0.01 ‡	Pass

-- End of measurement results--

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	18.78	24.60	Pass
8.00	18.43	24.00	Pass
10.00	17.78	23.50	Pass
12.50	16.69	23.00	Pass
16.00	15.42	22.90	Pass
20.00	14.91	22.40	Pass
25.00	13.59	22.30	Pass
31.50	13.20	21.50	Pass
40.00	11.93	20.20	Pass
50.00	11.27	18.80	Pass
63.00	10.12	17.60	Pass
80.00	9.53	16.60	Pass
100.00	8.84	15.90	Pass
125.00	8.27	15.70	Pass
160.00	8.10	15.50	Pass
200.00	7.46	15.20	Pass
250.00	7.33	15.20	Pass
315.00	7.50	15.20	Pass
400.00	7.80	15.70	Pass
500.00	8.19	16.00	Pass
630.00	8.74	16.60	Pass
800.00	9.48	17.30	Pass
1,000.00	10.14	18.10	Pass
1,250.00	10.86	18.90	Pass
1,600.00	11.81	19.80	Pass
2,000.00	12.65	20.80	Pass
2,500.00	13.57	21.70	Pass
3,150.00	14.57	22.60	Pass
4,000.00	15.44	23.50	Pass
5,000.00	16.36	24.50	Pass
6,300.00	17.34	25.50	Pass
8,000.00	18.41	26.50	Pass
10,000.00	19.34	27.40	Pass
12,500.00	20.37	28.50	Pass
16,000.00	21.36	29.50	Pass
20,000.00	22.36	30.40	Pass

-- End of measurement results--

-- End of Report--

Signatory: *Jacob Cannon*

NDOT Instrument Calibration Certificates

Calibration Certificate

Certificate Number 2023012397
Customer:
Nevada Department of Transportation

Model Number	LxT1	***Procedure Number***	D0001.8384
Serial Number	0002105	***Technician***	Jacob Cannon
Test Results	**Pass**	***Calibration Date***	15 Sep 2023
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	15 Sep 2024
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	***Temperature***	23.76 °C ± 0.25 °C
		Humidity	51.1 %RH ± 2.0 %RH
		Static Pressure	86.44 kPa ± 0.13 kPa

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 µPa.***

Larson Davis CAL200. S/N 9079
Larson Davis CAL291. S/N 0108
PCB 377B02. S/N 175009
Larson Davis PRMLxT1L. S/N 016160

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.11 (R2009) Class 1
IEC 61260:2001 Class 1	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to

1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-4034218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013 / ANSI/ASA S1.4-2014/Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1; the sound level meter submitted for testing conforms to the class 1specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2023-09-12	2024-09-12	001250
Hart Scientific 2626-S Humidity/Temperature Sensor	2023-02-20	2024-08-20	006946
Larson Davis CAL200 Acoustic Calibrator	2023-07-17	2024-07-17	007027
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2023-03-30	2024-03-30	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Adjusted Level: 114.01
As Received Level: 114.07

-- End of measurement results--

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-27.81	-29.61	-26.24	0.14	Pass

-- End of measurement results--

Certificate Number 2023012397

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.21	-0.20	-1.20	0.80	0.23	Pass
1000	0.18	0.00	-0.70	0.70	0.23	Pass
8000	-2.54	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	40.25

-- End of measurement results--

-- End of Report--

Signatory: Jacob Cannon

Calibration Certificate

Certificate Number 2023012405

Customer:
Nevada Department of Transportation

Model Number	CAL200	***Procedure Number***	D0001.8386
Serial Number	7095	***Technician***	Scott Montgomery
Test Results	**Pass**	***Calibration Date***	18 Sep 2023
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	18 Sep 2024
Description	Larson Davis CAL200 Acoustic Calibrator	***Temperature***	23 °C ± 0.3 °C
		Humidity	32 %RH ± 3 %RH
		Static Pressure	101.3 kPa ± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	06/21/2023	06/21/2024	001021
Larson Davis Model 2900 Real Time Analyzer	03/31/2023	03/31/2024	001051
Microphone Calibration System	02/22/2023	02/22/2024	005446
1/2" Preamplifier	08/16/2023	08/16/2024	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/04/2023	08/04/2024	006507
1/2 inch Microphone - RI - 200V	10/05/2022	10/05/2023	006510
Pressure Sensor	11/02/2022	11/02/2023	007827

Certificate Number 2023012405

Output Level

Nominal Level [dB]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
94	101.3	93.98	93.80	94.20	0.15	Pass
114	101.2	113.97	113.80	114.20	0.14	Pass

-- End of measurement results--

Frequency

Nominal Level [dB]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
94	101.3	1,000.20	993.00	1,007.00	0.20	Pass
114	101.2	1,000.17	993.00	1,007.00	0.20	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N)

Nominal Level [dB]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
94	101.3	0.40	0.00	2.00	0.25 ‡	Pass
114	101.2	0.37	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Level Change Over Pressure

Tested at: 114 dB, 23 °C, 32 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
108.0	107.7	-0.03	-0.25	0.25	0.04 ‡	Pass
101.3	101.3	0.00	-0.25	0.25	0.04 ‡	Pass
92.0	92.0	0.02	-0.25	0.25	0.04 ‡	Pass
83.0	82.9	0.01	-0.25	0.25	0.04 ‡	Pass
74.0	74.4	-0.03	-0.25	0.25	0.04 ‡	Pass
65.0	65.4	-0.12	-0.25	0.25	0.04 ‡	Pass

-- End of measurement results--

Frequency Change Over Pressure

Tested at: 114 dB, 23 °C, 32 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
108.0	107.7	0.00	-7.00	7.00	0.20 ‡	Pass
101.3	101.3	0.00	-7.00	7.00	0.20 ‡	Pass
92.0	92.0	0.00	-7.00	7.00	0.20 ‡	Pass
83.0	82.9	-0.01	-7.00	7.00	0.20 ‡	Pass
74.0	74.4	-0.01	-7.00	7.00	0.20 ‡	Pass
65.0	65.4	-0.01	-7.00	7.00	0.20 ‡	Pass

-- End of measurement results--

Certificate Number 2023012405

Total Harmonic Distortion + Noise (THD+N) Over Pressure

Tested at: 114 dB, 23 °C, 32 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
108.0	107.7	0.38	0.00	2.00	0.25 ‡	Pass
101.3	101.3	0.37	0.00	2.00	0.25 ‡	Pass
92.0	92.0	0.36	0.00	2.00	0.25 ‡	Pass
83.0	82.9	0.34	0.00	2.00	0.25 ‡	Pass
74.0	74.4	0.33	0.00	2.00	0.25 ‡	Pass
65.0	65.4	0.32	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Signatory: *Scott Montgomery*