US 50 West: Wills Boulevard to McCulloch Boulevard (Milepost 313 to Milepost 307)

Project Number: STA 0503-088
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Traffic Noise Impact Assessment

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List of Acronyms and Abbreviations

Ave	Avenue
Blvd	Boulevard
CDOT	Colorado Department of Transportation
EA	Environmental Assessment
dB	decibels
FHU	Felsburg Holt & Ullevig
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
L_{eq}	one-hour equivalent sound level
LOS	level of service
mph	miles per hour
NAC	Noise Abatement Criterion
PEL	Planning and Environmental Linkages
Rd	Road
ROW	right-of-way
TNM	FHWA's Traffic Noise Model

1. Introduction

This environmental assessment (EA) is for safety and capacity improvements to US Highway 50 (US 50) between Wills Boulevard (Blvd) and McCulloch Blvd that the Colorado Department of Transportation (CDOT) is proposing, in consultation with Federal Highway Administration (FHWA), within the City of Pueblo, Pueblo County, and Pueblo West Metropolitan District (PWMD). This project is the third in a sequence of improvements that CDOT is making to US 50, all under the framework of the *US 50 West Planning and Environmental Linkages (PEL) Study* (CDOT, 2012a). The US 50 West PEL established the purpose and need, evaluated a full range of alternatives, and developed the *US 50 West PEL Implementation Plan* (CDOT, 2012b) for the PEL recommended Preferred Alternative within a 12-mile corridor from Swallows Road to Baltimore Avenue. Safety and capacity improvements included in the PEL recommended Preferred Alternative generally consist of widening US 50 from four lanes to six lanes from McCulloch Blvd to Wills Blvd and establishing grade-separated interchanges at McCulloch Blvd, Purcell Blvd, and Pueblo Blvd. US 50 would remain a four-lane highway west of McCulloch Blvd.

At the completion of the PEL Study, funds were not available to construct the recommended improvements for the entire PEL Corridor, leading CDOT to implement a sequence of improvement projects in coordination with FHWA. The following summarizes the sequence of completed National Environmental Policy Act (NEPA) studies and recent improvements for US 50 that have led to this *US 50 West Wills Blvd to McCulloch Blvd EA,* as shown in **Figure 1**:

- The *US 50 West Purcell Blvd to Wills Blvd EA* (CDOT, 2014) provides widening 3.4 miles of eastbound US 50 from two lanes to three lanes from Purcell Blvd to Wills Blvd to establish five lanes (three eastbound and two westbound). Safety improvements include adding northbound right turns onto US 50 at McCulloch Blvd and Purcell Blvd and establishing two water quality ponds on the east and west sides of Wild Horse Dry Creek. In addition, widening the eastbound bridge at Wild Horse Dry Creek accommodates a future pedestrian/bicycle path. Construction of these improvements is scheduled for completion in 2016.
- The *US 50 West Wills Blvd to BNSF Acceleration Lane Categorical Exclusion* (CDOT, 2015), recently approved by CDOT, establishes a westbound acceleration lane on US 50 from Wills Blvd to the BNSF right-of-way (ROW), east of the BNSF bridge, shown on **Figure 1**. Construction of the acceleration lane is scheduled for 2016.
- CDOT and FHWA are currently undertaking the *US 50 West Wills Blvd to McCulloch Blvd EA* to provide additional safety and capacity improvements to US 50. Improvements include widening 3.4 miles of westbound US 50 between Wills Blvd and Purcell Blvd, from two lanes to three lanes; and widening 2.4 miles of westbound and eastbound US 50 between Purcell Blvd and McCulloch Blvd, from two lanes to three lanes in each direction. Grade-separated interchanges would be established within the US 50 ROW at Purcell Blvd and Pueblo Blvd. A future pedestrian/bicycle path would also be accommodated between Wills Blvd and Pueblo Blvd. A regional water quality pond is proposed to treat US 50 runoff and PWMD municipal runoff.

The Proposed Action, in combination with the improvements under construction from Purcell Blvd to Wills Blvd, would establish six-lane capacity (three lanes in each direction) in the most congested portion of the PEL Corridor, between Wills Blvd and McCulloch Blvd.

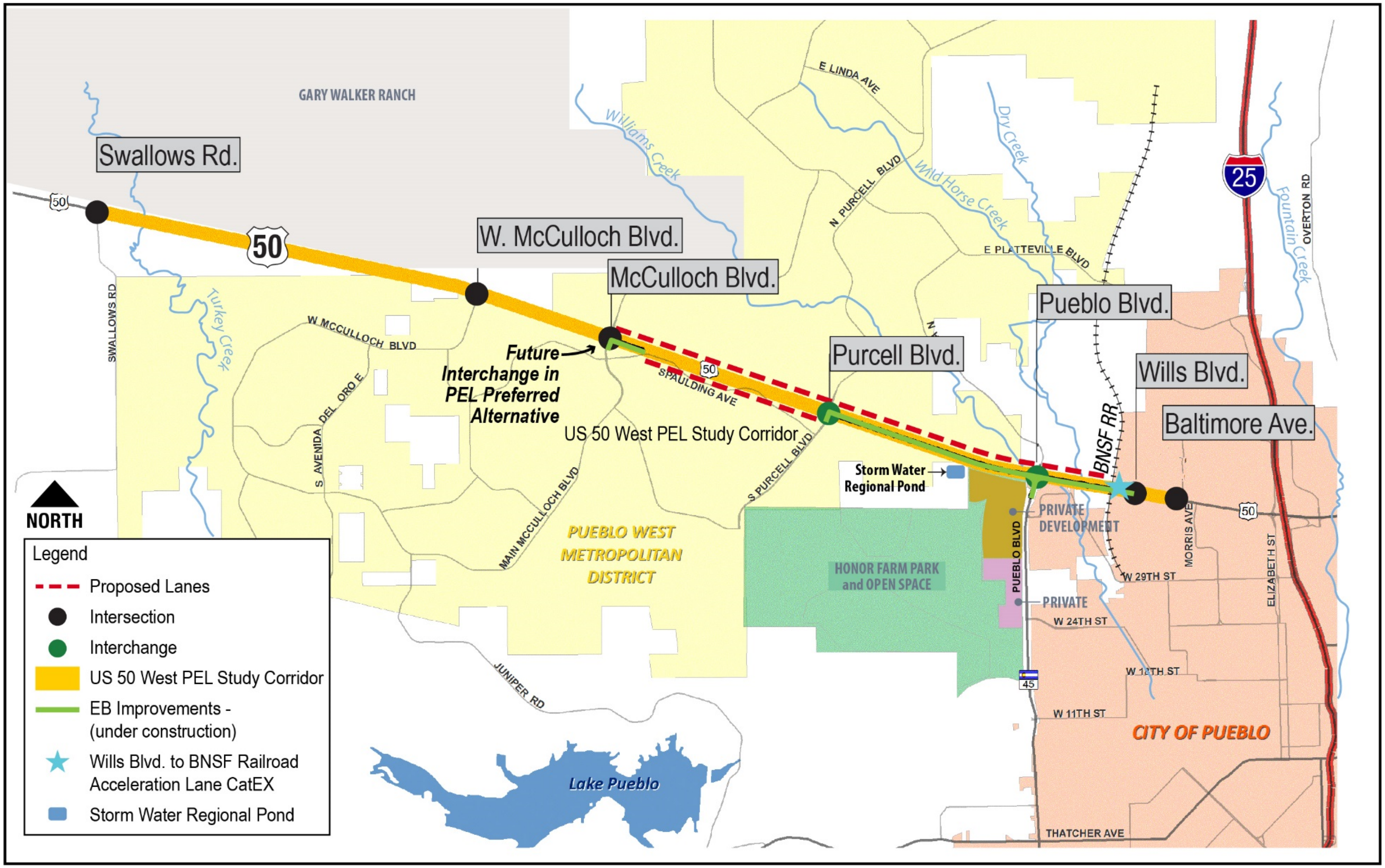
For this EA, the existing features of US 50, including the improvements approved through the *US 50 West Purcell Blvd to Wills Blvd EA* (CDOT, 2014) and the *US 50 West Wills Blvd to BNSF Acceleration Lane Categorical Exclusion,* represent the No Action Alternative. The No Action Alternative assumes that no other major capacity improvements would be made to US 50. The No Action Alternative also includes routine maintenance to keep the existing transportation network in good operating condition.

CDOT and FHWA prepared this EA to evaluate the Proposed Action benefits and environmental impacts, relevant to the No Action Alternative. This EA will also ensure that the Proposed Action would have logical termini and independent utility and would not restrict other reasonably foreseeable transportation improvements identified in the PEL recommended Preferred Alternative.

Future elements of the PEL recommended Preferred Alternative will undergo NEPA analysis as funding for design, ROW, and construction becomes available.

The overall purpose of the noise analysis was to determine whether traffic noise levels at any sensitive receptors within approximately 500 feet of Proposed Action improvements may exceed applicable impact thresholds. If so, the feasibility and reasonableness of noise abatement actions for the impacted receptors were considered for inclusion in the project. For the analysis, roads that would be changed or newly built by the project, or would have substantially different traffic volumes because of the Proposed Action, were included.

Figure 1. Proposed Action and PEL Study Corridor



2. Project Description

2.1 Proposed Action

The Proposed Action for this *US 50 West Wills Blvd to McCulloch Blvd* EA involves widening 3.4 miles of westbound US 50 from two lanes to three lanes, to include a third westbound lane from Wills Blvd (Milepost 313.15) to Purcell Blvd (Milepost 309.78), and widening 2.4 miles of both westbound and eastbound US 50 from Purcell Blvd (Milepost 309.78) to McCulloch Blvd (Milepost 307.34). Grade-separated interchanges would be established at Pueblo Blvd and at Purcell Blvd. The Proposed Action from Wills Blvd to McCulloch Blvd, in combination with the eastbound improvements under construction from Purcell Blvd to Wills Blvd, would establish six lanes, with three eastbound and three westbound lanes, for 5.8 miles of US 50, consistent with the *US 50 West PEL Implementation Plan* (CDOT, 2012b).

CDOT is proposing the following transportation improvements between Wills Blvd and McCulloch Blvd:

- **Wills Blvd Intersection to BNSF Railroad Bridge (Milepost 313.15 to 312.87) –** A third westbound lane would be established by restriping the Wills Blvd to BNSF acceleration lane (*US 50* West *Wills Blvd to BNSF Acceleration Lane Categorical Exclusion;* CDOT, 2015a) and by extending the westbound lane through the BNSF railroad bridge underpass to Pueblo Blvd.
- **BNSF Railroad Bridge through Pueblo Blvd Intersection (Milepost 312.87 to Milepost 312.65) –** The westbound lanes of US 50 in the vicinity of Pueblo Blvd would be realigned to be parallel to the eastbound lanes from Milepost 311.45 to Milepost 312.65, and the existing westbound bridge over Wild Horse Dry Creek would be replaced. A grade-separated interchange would be established, with Pueblo Blvd crossing over US 50. The Williams Creek concrete box culvert (CBC) under the eastbound US 50 lanes would be extended 160 ft. to accommodate the realigned westbound lanes, including the westbound third-lane widening. Pueblo Blvd would be widened to accommodate two additional left turn lanes onto westbound US 50 via a right-side exit ramp. The existing westbound US 50 lanes would be retained and modified to provide access from US 50 onto southbound Pueblo Blvd. The *US 50 West PEL Implementation Plan* (CDOT, 2012b) identifies the Proposed Action at US 50 at Pueblo Blvd to be implemented as phased improvements over time. The Proposed Action would implement a diamond-type interchange at Pueblo Blvd. The PEL recommends a Diverging Diamond Interchange configuration, which would be implemented at some time in the future when the Pueblo Blvd Extension is developed as an expressway between US 50 and I-25 (CDOT, 2012a).
- **Pueblo Blvd to Purcell Blvd Intersection (Milepost 312.65 to Milepost 309.78) –** The westbound third lane would extend from Pueblo Blvd to Purcell Blvd, and a full six-lane grade-separated interchange would be developed, with US 50 crossing over Purcell Blvd. A CBC under Purcell Blvd would be extended to accommodate a future pedestrian/bicycle trail and future widening of Purcell Blvd.

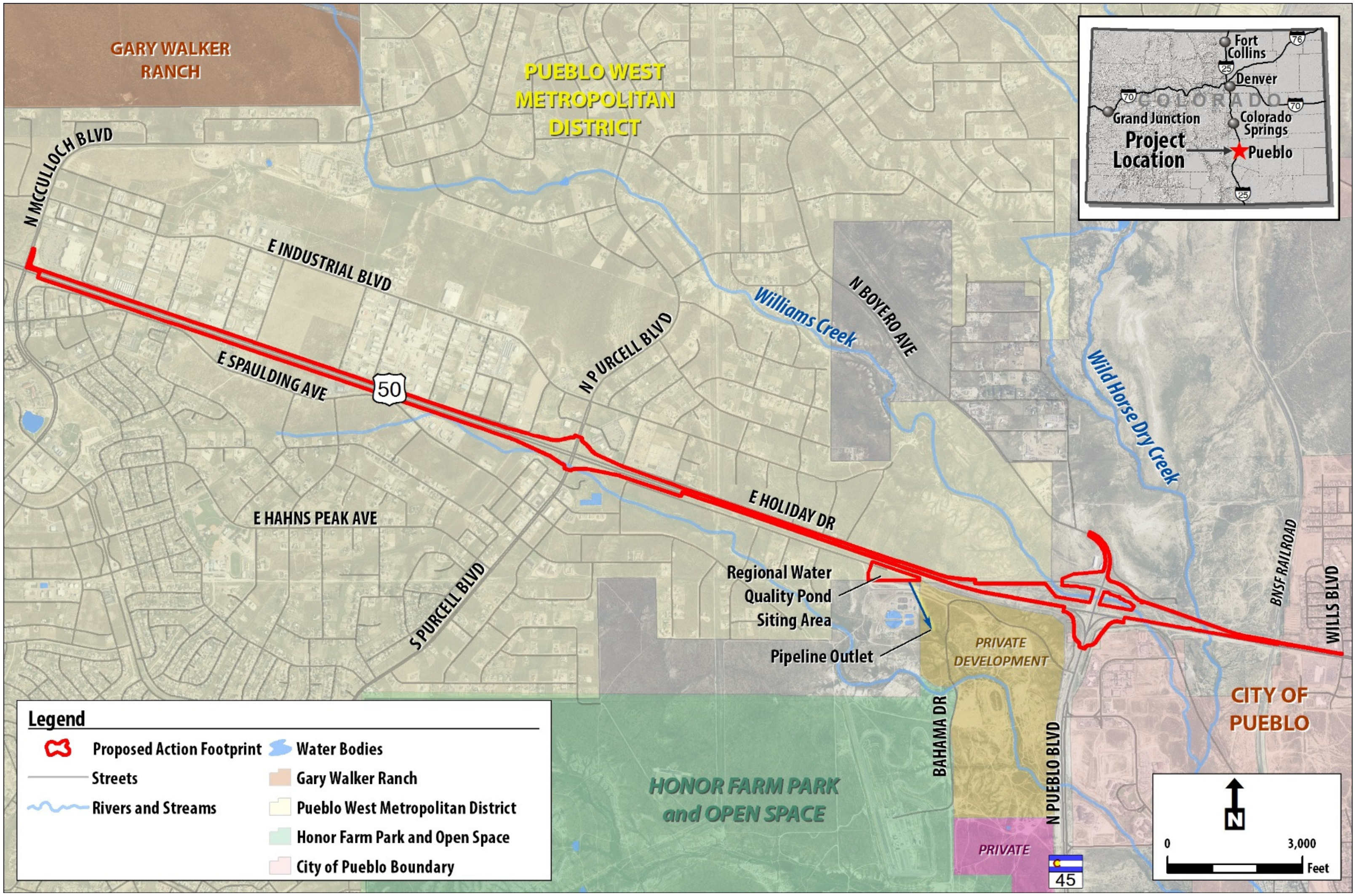
- **Purcell Blvd to McCulloch Blvd (Milepost 309.78 to Milepost 307.34) –** The Proposed Action would include a third westbound lane extending from Purcell Blvd and terminating at a right turn onto northbound McCulloch Blvd; and a third eastbound lane extending from the newly established northbound right turn from McCulloch Blvd and terminating at Purcell Blvd. The ultimate configuration for US 50 and McCulloch Blvd, although not part of this EA, is a grade-separated interchange as identified in the *US 50 West PEL Implementation Plan* (CDOT, 2012b).
- **Pedestrian/Bicycle Path –** The Proposed Action would accommodate a future pedestrian/bicycle path within CDOT ROW along the south side of US 50 from Wills Blvd to Pueblo Blvd, which is an element of the PEL recommended Preferred Alternative (CDOT, 2012a). The slope paving adjacent to the eastbound lanes at the BNSF railroad underpass would be modified to accommodate the pedestrian/bicycle path.
- **Municipal Separate Storm Sewer System (MS4) Improvements/Regional Pond –** The Proposed Action would include water quality improvements and a regional pond. Stormwater runoff for the westbound lane widening and interchange improvements between Wills Blvd and Pueblo Blvd (Milepost 313.15 to Milepost 311.5) would be directed to the two extended detention basins under construction on the east and west sides of Wild Horse Dry Creek. Stormwater runoff for the westbound and eastbound lanes between Pueblo Blvd and McCulloch Blvd (Milepost 311.5 to Milepost 307.34) would be directed to a proposed regional pond site within a private parcel west of Pueblo Blvd and south of US 50.

Figure 2 provides a general map of the Proposed Action.

2.2 No Action Alternative

The existing features of US 50, including the improvements approved through the *US 50 West Purcell Blvd to Wills Blvd EA* (CDOT, 2014) and the *US 50 West Wills Blvd to BNSF Acceleration Lane Categorical Exclusion*, represent the No Action Alternative. The No Action Alternative assumes that no other major capacity improvements would be made to US 50. The No Action Alternative also includes routine maintenance to keep the existing transportation network in good operating condition.

Figure 2. Proposed Action



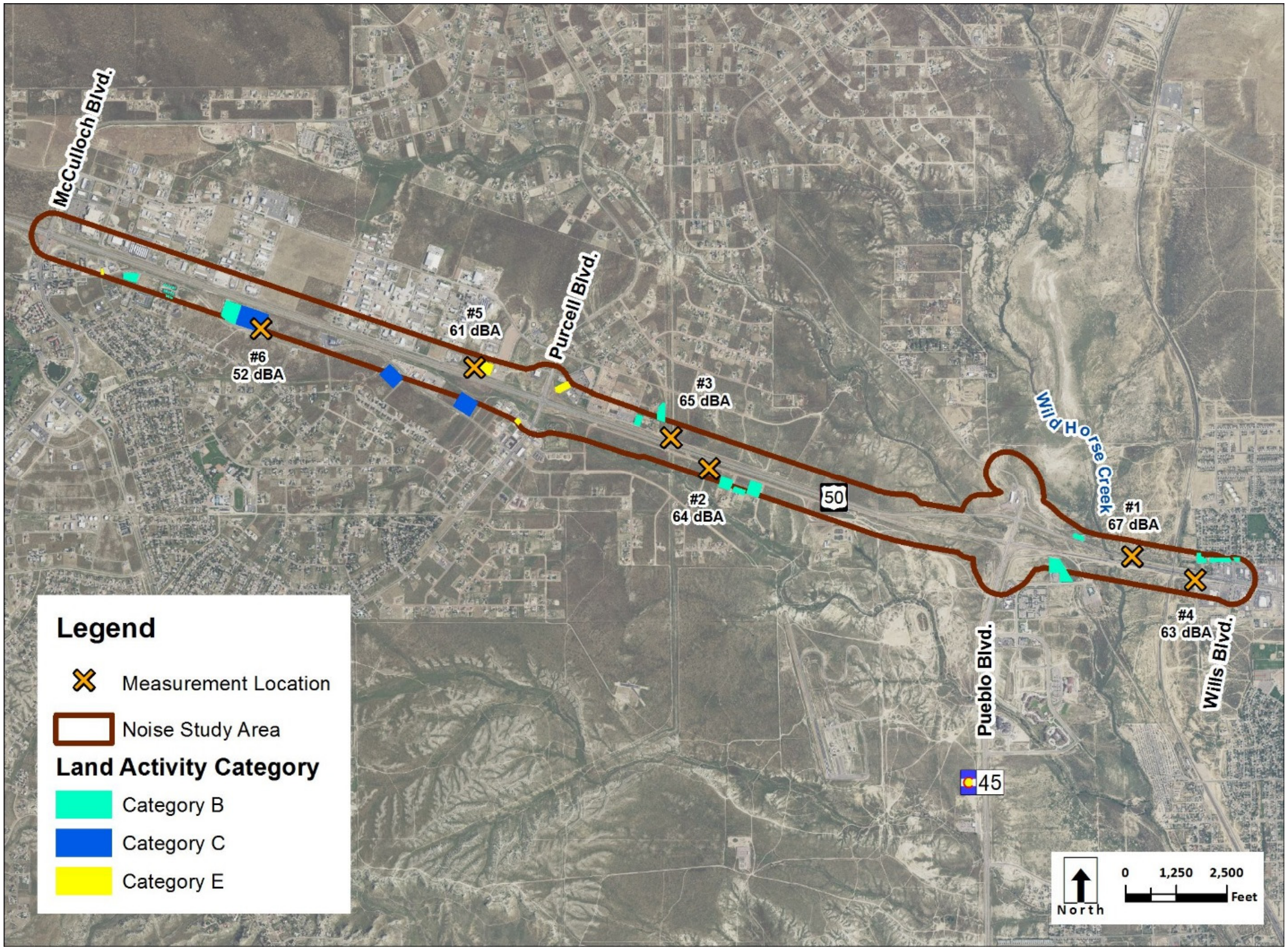
2.3 Summary of Project Traffic Noise Setting

The Proposed Action will add a travel lane to westbound US 50 from Wills Blvd to McCulloch Blvd and to eastbound US 50 from McCulloch Blvd to Purcell Blvd. In addition, two interchanges on US 50 will be constructed at Purcell Blvd and Pueblo Blvd. Therefore, the Proposed Action is a Type I project in terms of noise, which triggered the noise analysis.

The Noise Study Area includes several noise-sensitive land uses, such as residences and churches along US 50 (**Figure 3**). Numerous businesses that are not noise sensitive are along US 50. Much of the Noise Study Area is currently undeveloped. Building permit records from the City of Pueblo and Pueblo County for the undeveloped areas were reviewed and no active/imminent construction projects for these properties were identified. Therefore, the undeveloped lands in the Noise Study Area were not "permitted" and were considered to be not noise sensitive for this analysis.

The major roads in the Noise Study Area are US 50 and Pueblo Blvd. Other substantive roads are Wills Blvd, McCulloch Blvd, Purcell Blvd, and frontage roads paralleling US 50. The terrain is essentially level, in noise terms, though there is a gentle slope up to the north and down to the south. There are no major topographic features expected to affect noise propagation, with the possible exception of the BNSF Railroad bridge. Buildings in the Noise Study Area tend to be relatively scattered, though their density tends to be greater near Wills Blvd and McCulloch Blvd. Ground vegetation is sparse throughout the Noise Study Area.

Figure 3. Noise Study Area, Land Categories, and Measurement Results



3. Basics of Sound

Sound is created when an object vibrates and radiates part of that energy as acoustic pressure or waves through a medium, such as air, water, or a solid. Noise is commonly defined as unwanted sound. Sound and noise have many characteristics that are important to consider for impacts, including loudness (energy intensity), frequency, and variation over time.

Sound pressure levels are measured in units of decibels (dB). The dB scale is logarithmic. To illustrate this, consider that two identical noise sources, each producing 60 dB, would produce 63 dB when added together. The human ear can sense a wide range of sound pressure levels, with the maximum levels having more than one million times the sound energy of the minimum levels.

The human ear is not equally receptive to all frequencies of sound-producing vibrations. Mathematical adjustments to overall sound levels through sound frequencies using the "A" weighting network are often used to approximate how people perceive sound levels. In simple terms, the weighting consists of reducing the levels of the low and extremely high frequency sounds by specified amounts. Sound levels that have been weighted this way are reported in dBA.

Research has shown that most people do not notice a difference in loudness between sound levels of less than 3 dBA, which corresponds to a two-fold change in the sound energy. Similarly, most people relate a 10-dBA increase in sound levels to a doubling of sound loudness, though it represents a 10-fold increase in sound energy.

Noise often is not constant and fluctuates over time because of the characteristics of the source. For example, traffic noise will fluctuate from changes in traffic volumes, vehicle types, or vehicle speeds. The fluctuations make it difficult to describe fully the many aspects of noise through a single value, but CDOT uses the one-hour equivalent sound level (L_{eq}) as the metric for assessing traffic noise impacts (CDOT, 2015b). In simple terms, the L_{eq} is the "average" of the fluctuating noise levels over a time period; more precisely, it is the constant sound level that would produce the same amount of overall sound energy as the naturally fluctuating noise levels.

Sound levels decrease with distance from the source because of spreading, atmospheric absorption, interference from objects, and ground effects. "Hard" ground (such as asphalt) and "soft" ground (such as grass) affect sound transmission differently. "Hard" ground is more reflective and leads to louder sound levels farther from the source. Using traffic noise passing over "hard" ground as an example, either doubling the traffic volume or cutting the distance from the listener to the roadway in half could cause a 3-dBA increase in noise levels, which would be barely noticeable to most people.

On busy roads and highways, the loudest traffic noise generally occurs when the largest traffic volume can travel at the highest speed. This may not occur during rush hour if the traffic volume becomes so high that roads become congested and vehicles slow. The noisiest traffic condition generally corresponds to Level of Service (LOS) C or D for a highway (CDOT, 2015b).

4. Analysis Methods

State and federal transportation departments have defined noise evaluation criteria for environmental impact analyses. United States Code of Federal Regulations Title 23 Part 772 established federal standards for the abatement of highway traffic noise (FHWA, 2012). CDOT developed traffic noise analysis guidance based on the federal standards (CDOT, 2015b). Because US 50 is the primary road of interest for the Proposed Action, the appropriate noise evaluation criteria are these federal and state highway guidelines. CDOT has the more restrictive levels for noise impacts, which are shown in **Table 1**.

Table 1. CDOT Noise Abatement Criteria

Activity Category	Impact Level (L_{eq})	Description of Activity Category
A	56 dBA (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	66 dBA (Exterior)	Residential
C	66 dBA (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, schools, Section 4(f) sites, trails, trail crossings, and television studios
D	51 dBA (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, schools and television studios
E	71 dBA (Exterior)	Hotels, motels, offices, restaurants, bars and other developed lands, properties or activities not included in A–D or F
F	NA	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, ship yards, utilities (water resources, water treatment, electrical), and warehousing
G	NA	Undeveloped lands that are not permitted for development

Source: CDOT, 2015b

The overall noise analysis was based on measurements of current conditions (2015) and on modeling of existing (2011) traffic conditions and two future design year (2035) conditions. Measurements of current noise levels were performed on May 13 and October 7, 2015 (**Section 5.1**). Computer modeling was used to examine sensitive receptors in the Noise Study Area (**Section 2.3**. The noise results were compared to applicable criteria to assess for and identify impacted areas (**Section 6**). The efficacy of noise abatement measures for the impacted areas was evaluated and abatement was recommended if appropriate according to CDOT feasibility and reasonableness guidelines (**Section 7**).

The noise sensitive areas that are the focus of the CDOT Noise Abatement Criteria (NAC) generally are exterior areas of frequent human use on properties (**Table 1**). These areas include uses such as decks for Category B, playgrounds at parks for Category C, or exterior dining areas at restaurants for Category E. Typically the most crucial NAC on highway projects is for homes (Category B), which has an hourly L_{eq} of 66 dBA.

Noise impacts occur when receptors near the project roads will have noise levels at or above the relevant CDOT NAC (**Table 1**) or future noise levels will increase by 10 dBA or more over existing conditions. These noise levels for peak noise hours are evaluated through computer modeling. Receptors that are found to be impacted by noise (**Section 6**) are considered for abatement actions (**Section 7**). Abatement actions found to be both feasible and reasonable according to the guidelines are included in construction of the proposed improvements.

For the noise impact discussion, the "peak hour" refers to the highest traffic noise hour, which may or may not correspond to the hour of greatest traffic volume. Note that traffic noise can decrease during rush hour due to lower vehicle speeds from overloaded and congested roads.

4.1 Traffic Noise Measurements

The traffic noise measurements were taken with an NTI XL2 Type 1 sound level meter calibrated at the site with a Larson-Davis CAL200 calibrator. This equipment conforms to American National Standards Institute Standard S1.4 for Type 1 sound level meters. Calibrations traceable to the US National Institute of Standards and Technology were performed in the field before and after each set of measurements using the acoustical calibrator. The measurement microphone was protected by a windscreen and located on a tripod approximately 5 feet above the ground. The microphone was positioned at each site to characterize the exposure to the dominant noise sources in the area.

The traffic noise measurements were spread over the Noise Study Area (**Figure 3**). Noise measurements were made during weather conditions, including wind speed, that were acceptable according to FHWA guidance (FHWA, 1996). Weather conditions were monitored during the measurements. Short-term (15-minute) traffic noise measurements were performed at each location (**Section 5.1**) to document existing ambient conditions in the area. Traffic counts, including the number of large trucks, were collected during the noise measurement periods. The measurement results were used to document ambient conditions and to evaluate the performance of the computer models.

4.2 Traffic Noise Modeling Methods

Modeling is used because day-to-day variations in traffic or weather conditions that affect noise levels cannot be captured or quantified by brief noise measurements alone and because future noise levels cannot be measured now. Modeling can also evaluate many more locations than can reasonably be field measured. The modeling results represent predicted typical average conditions during peak traffic noise periods.

Computer modeling was performed for existing conditions and two project alternatives for Year 2035. The traffic noise modeling software was FHWA's Traffic Noise Model (TNM) Version 2.5.

The existing traffic conditions model included the 2011 traffic volumes and road configurations, except with the recent US 50 eastbound lane project in place. The two future alternatives were modeled for their respective 2035 conditions (**Section 6**). The traffic study completed for the PEL was the source of the traffic volumes (CDOT, 2012a).

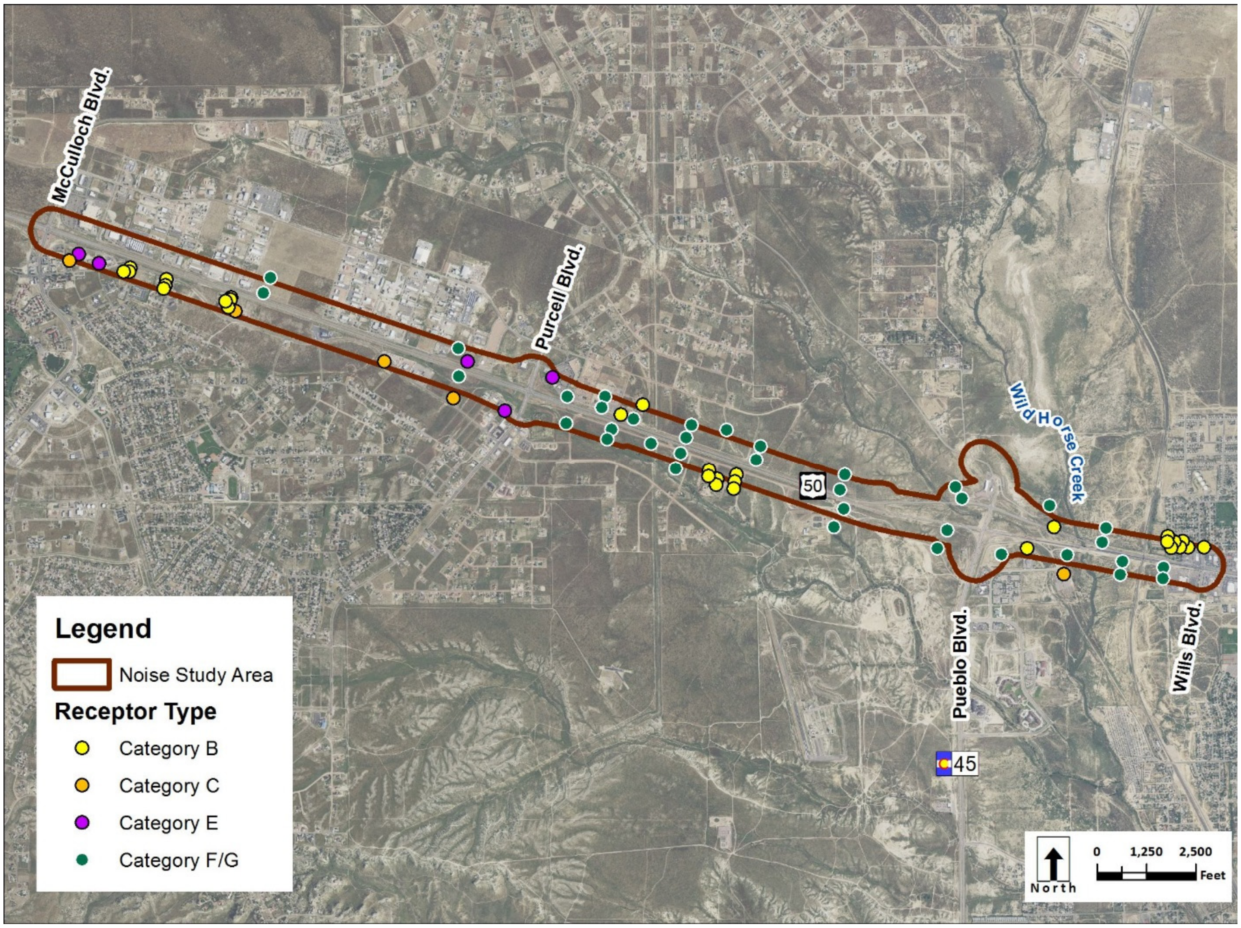
TNM was used to calculate noise levels at approximately 75 points within 500 feet of a modeled roadway, as illustrated in **Figure 4**. This distance followed CDOT guidance (CDOT, 2015b) and was chosen as the Noise Study Area to identify the receptors that the alternatives may impact. In some cases, a single model point represented several nearby receptors/properties where traffic and geography were similar (for example, one point for multiple apartment units). Therefore, the number of model "points" is not always the same as the number of individual "receptors" in the discussion below. The same model points were used in each model for consistency. The modeled roadways were those that would be built or changed by the Proposed Action or are important local noise sources. US 50 was the most substantial noise source in the Noise Study Area.

The current positions of roads and streets were mapped and used in both the existing conditions and No Action Alternative models, though the individual road parameters differed between the two models. Note that both existing conditions and No Action included a third eastbound travel lane on US 50 from Purcell Blvd to Wills Blvd. The additional improvements planned through the Proposed Action (**Section 2.1**) were modeled to assess the possible noise impacts.

In general, the TNM models used the following data:

- Units – feet and miles per hour (mph)
- Current roadway alignments – XY coordinates from CAD files and aerial photographs
- Future roadway alignments – XY coordinates from CAD files
- Vehicle speeds – posted US 50 speed limits: 65 mph McCulloch Blvd to Pueblo Blvd; 55 mph Pueblo Blvd to Wills Blvd and Pueblo Blvd (25 to 45 mph for other minor streets)
- Traffic volumes – from the PEL; morning peak hour used
- Vehicle mix – from published CDOT traffic count data
- Elevations – from ground surface contours of the Noise Study Area and preliminary road designs; field measurement locations and modeled points were 5 feet above ground
- Structural and terrain barriers as needed to emulate the existing area; addition of abatement barriers to models where appropriate for the abatement evaluations

1 Figure 4. Points Modeled in TNM



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5. Affected Environment

Residential, religious, and business areas near US 50 were examined for the project. The current traffic noise conditions in the Noise Study Area were assessed through a combination of measurements and modeling. The existing conditions for traffic noise for these areas are presented below.

5.1 Traffic Noise Measurements

Short-term traffic noise measurements were performed to document existing ambient conditions in May and October 2015. The measurements were intended to be representative of traffic noise conditions across the Noise Study Area. The locations, as illustrated in **Figure 3**, were representative of other nearby properties that may have the same or different land uses. **Table 2** presents the measurement results. One of the measurement results reached the CDOT NAC for Categories B and C.

Table 2. Field Measurement and Verification Noise Model Results

Location Number	Location	Measurement L_{eq} (dBA)	Verification Model (dBA)	Difference (dBA)
1	Milepost 312.6	67.3	69.3	2.0
2	Milepost 310.5	63.5	61.3	-2.2
3	Milepost 310.3	65.2	69.2	4.0
4	Milepost 312.9	62.5	64.6	2.1
5	Milepost 309.3	60.6	62.3	1.7
6	Milepost 308.3	52.3	55.1	2.8

Source: Felsburg, Holt & Ullevig (FHU) data, 2015.

5.2 Traffic Noise Verification Model

As a check on noise model parameters, the traffic conditions observed during the noise measurements were used to construct a verification model in TNM (Appendix D). The intent was to check the accuracy of the noise levels calculated through a model that reflected the road alignment and traffic volumes during the field measurements. A close match between model results and field measurements ensured that the other models provided accurate results (CDOT, 2015b).

The verification model covered the areas where noise level measurements were made (**Figure 3**). The model was constructed in TNM using the same approach as the alternatives models (**Section 4.2**).

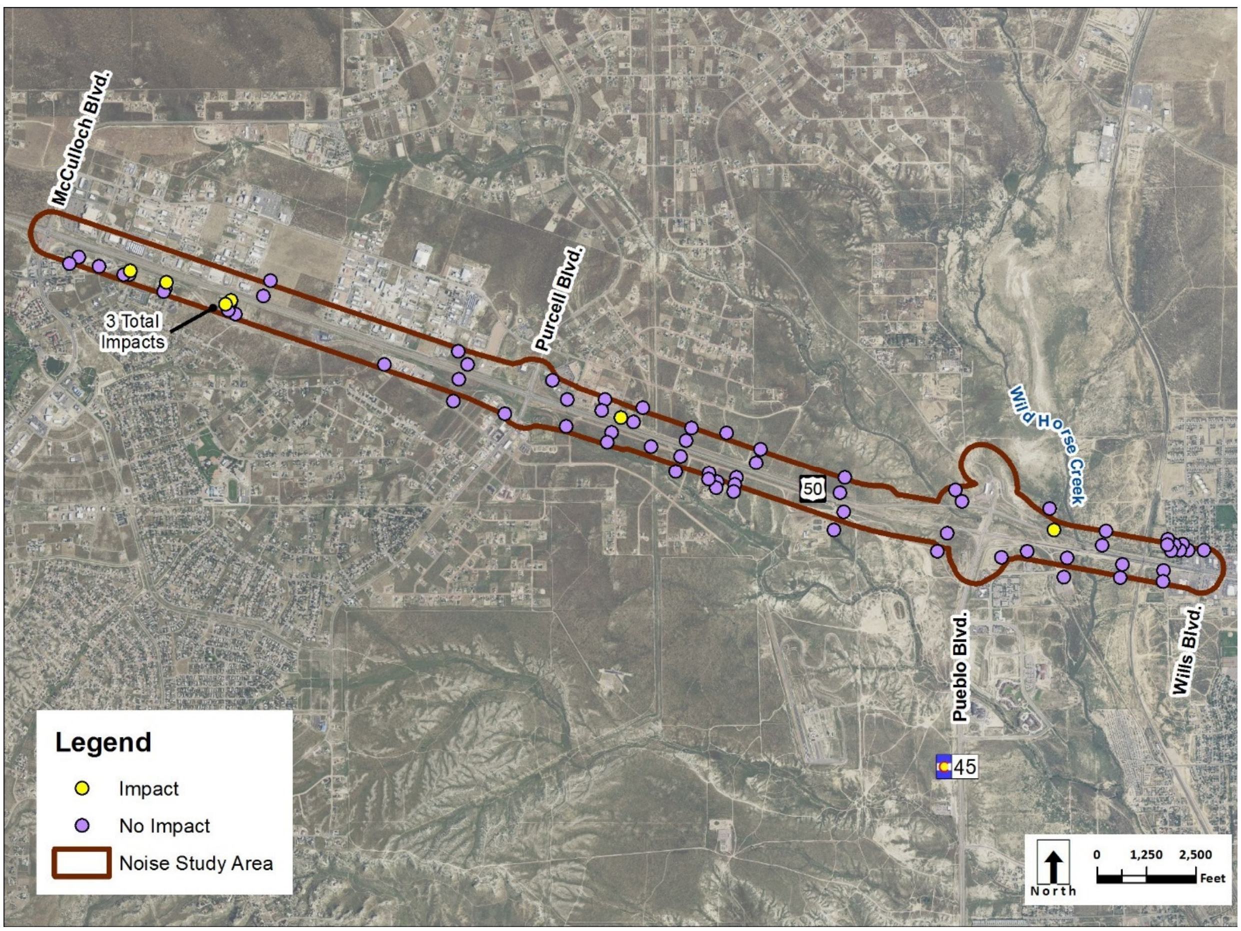
It was concluded that "field grass" ground type should be used in place of the default "lawn" type in all the TNM models. With this, the verification results were in close agreement, as shown in **Table 2**. (Note: The 4.0 dBA difference for Location 3 was ascribed to the 9 mph wind present during the measurement.) Overall, the results were acceptable according to the CDOT guidelines (CDOT, 2015b), which require the difference in results to be no more than 3 dBA.

5.3 Existing Conditions Traffic Noise Model Results

A noise model was developed (**Section 4**) to evaluate existing conditions. The existing conditions model included the major existing roads that may be affected by the US 50 West Project, with existing (2011) traffic volumes and road layouts.

Approximately 75 points were modeled for traffic noise impacts, as shown in **Figure 4** and **Appendix A**. Overall, the calculated noise level range for the model points was 54 to 73 dBA. **Figure 5** shows the seven modeled points calculated to be impacted from existing traffic noise levels being at or above the respective NAC during the peak hour. These points represent 26 residential (Category B) receptors.

Figure 5. Impacted Model Points from Existing Conditions Model



6. Environmental Consequences

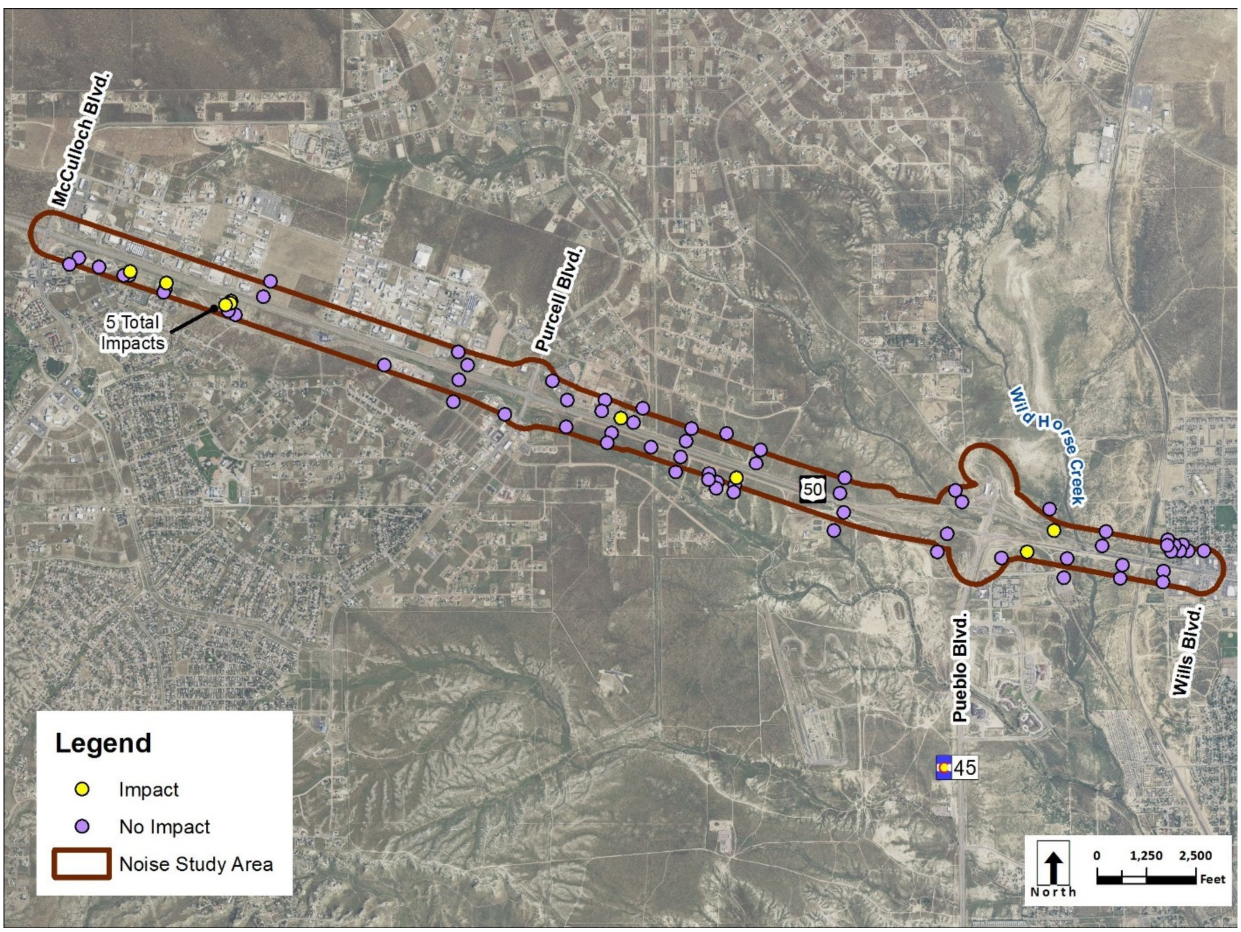
Section 2 described the alternatives being considered for the US 50 West Project. The traffic noise modeling effort was conducted as described in **Section 4** to assess whether future noise levels in the Noise Study Area would exceed relevant CDOT thresholds. If so, abatement measures to alleviate the predicted impacts would be considered and evaluated for the Proposed Action following CDOT guidelines (**Section 7**).

6.1 No Action Alternative 2035 Results

Seventy-five points were modeled for traffic noise impacts, as shown in **Figure 4** and **Appendix A**. Overall, the calculated noise level range for the model points was 56 to 74 dBA.

Figure 6 shows the 11 modeled points calculated to be impacted from 2035 No Action Alternative traffic noise levels being above the respective NAC during the peak hour. No points are expected to experience a 10-dBA increase; the largest increase was calculated to be 3 dBA. These points represent 41 residential (Category B) receptors.

Figure 6. Impacted Model Points for No Action Alternative—Year 2035

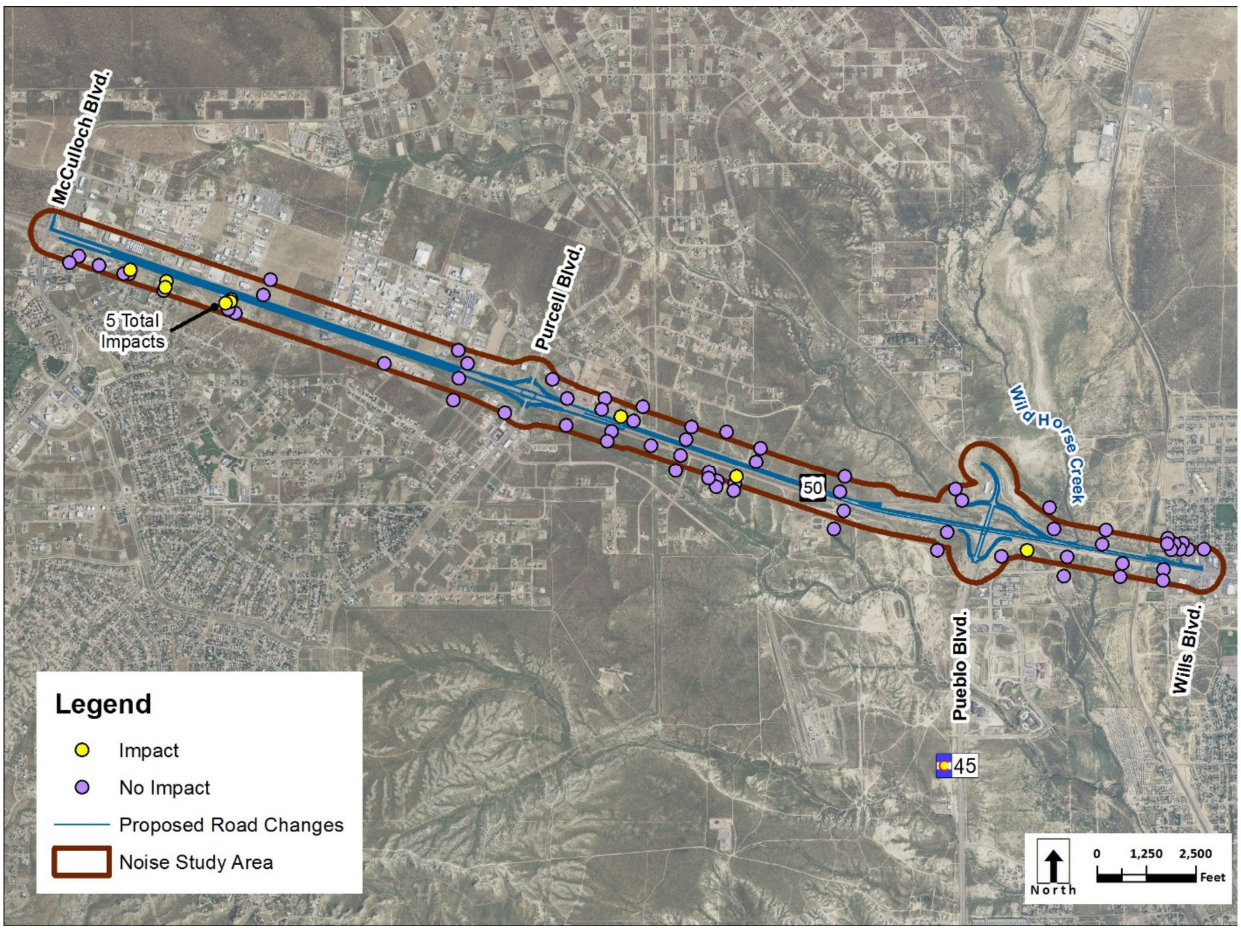


6.2 Proposed Action 2035 Results

Seventy-five points were modeled for traffic noise impacts, as shown in **Figure 4** and **Appendix A**. Overall, the calculated noise level range for the model points was 55 to 75 dBA.

Figure 7 shows the 11 modeled points calculated to be impacted from 2035 Proposed Action traffic noise levels being above the respective NAC during the peak hour. Note that one home near Pueblo Blvd would no longer be impacted by noise. No points are expected to experience a 10-dBA increase; the largest increase was calculated to be 5 dBA. These points represent 44 residential (Category B) receptors, which is three more impacts than with the No Action Alternative.

Figure 7. Impacted Model Points for Proposed Action—Year 2035



6.3 Summary of Future Noise Impacts

Traffic noise impacts were predicted for both alternatives in 2035. The two alternatives differed by a small number of noise impacts (three receptors) given the current land development.

To support local land use planning decisions and future development, the distances to the CDOT Category B and E NACs in 2035 were evaluated. **Figure 8** illustrates the estimated noise contour lines for the Proposed Action. The distances vary somewhat over the corridor due to topography and changing road alignments, but in general, land within approximately 350 feet from the proposed new edge of pavement for US 50 may be above the residential NAC of 66 dBA during peak traffic noise hours. Under CDOT and FHWA guidelines, these undeveloped properties may not be compatible with residential uses without mitigation for traffic noise.

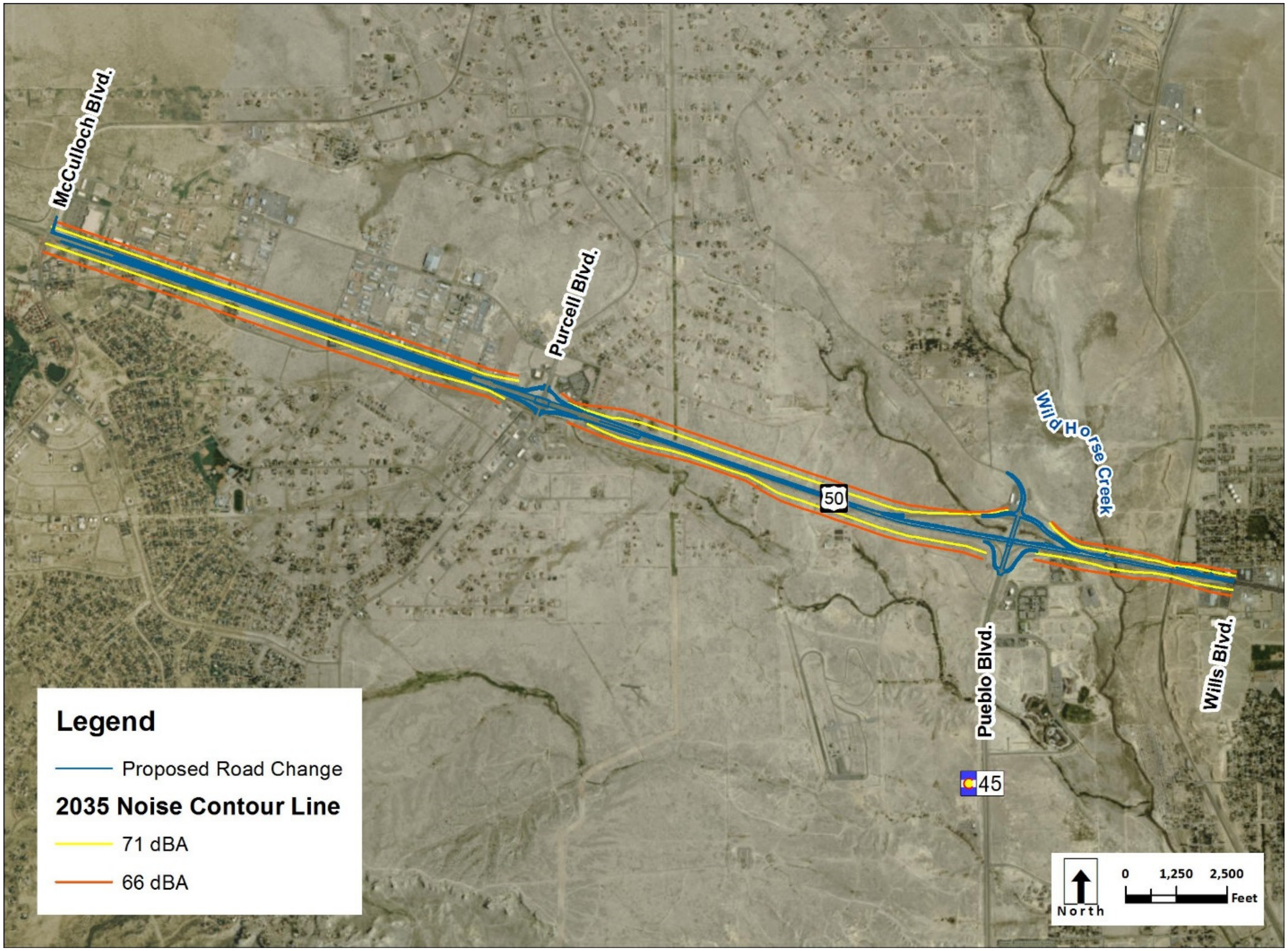
6.4 Construction Noise

The Proposed Action could expose adjoining properties in the area to noise from construction activities. Construction noise differs from traffic noise in several ways:

- Construction noise lasts only for the duration of the construction event, with most construction activities in noise-sensitive areas being conducted during hours that are least
- Construction activities generally are short term and, depending on the nature of the construction operations, could last from seconds (for example, a truck passing a receptor) to months (for example, constructing a bridge).
- Construction noise is intermittent and depends on the type of operation, location, and function of the equipment, and the equipment usage cycle.

Construction noise is not assessed like operational traffic noise; there are no CDOT NACs for construction noise. Construction noise would be subject to relevant local regulations and ordinances, and any construction activities would be expected to comply with them. The City of Pueblo had noise regulations that may affect construction; Pueblo County and Pueblo West did not when this document was prepared.

Figure 8. Noise Level Contour Lines—Proposed Action Year 2035



The Noise Study Area contains residential areas. To minimize the temporary elevated noise levels that may be experienced during construction, standard best practices should be incorporated into construction contracts, where it is feasible to do so. These may include:

- Notify neighbors in advance when construction noise may occur and its expected duration so that they may plan appropriately.
- Manage construction activities to keep noisy activities as far from sensitive receptors as possible.
- Keep exhaust systems on equipment in good working order. Maintain equipment on a regular basis and subject it to inspection by the construction project manager to ensure maintenance.
- Use properly designed engine enclosures and intake silencers where appropriate.
- Use temporary noise barriers where appropriate and possible.
- Locate stationary equipment as far from sensitive receptors as possible.
- Perform construction activities in noise sensitive areas during hours that are least disturbing to adjacent and nearby residents.

7. Noise Abatement Evaluation

The results from the traffic noise analysis indicate that receptors would be impacted by noise from the Proposed Action; therefore, potential abatement actions for the impacted receptors were investigated for the Proposed Action (CDOT, 2015b; FHWA, 2011). Impacted areas are not guaranteed abatement measures under the guidelines, but abatement measures for the areas must be evaluated for feasibility and reasonableness. Reasonableness includes assessment of abatement benefits and costs.

Section 6.2 described the calculated noise impacts for the Proposed Action. Several types of noise abatement for the impacts were considered. Barriers, a common abatement action, as well as other kinds of abatement were considered. The overall feasibility and reasonableness of noise abatement actions that provided a substantive benefit for the impacted receptors were evaluated. Those actions found to be feasible and reasonable were then recommended for inclusion in the US 50 West Project.

For reasons described below, barriers appeared to be the only viable abatement action and were the only abatement evaluated through modeling. CDOT uses several criteria to evaluate noise barriers (CDOT, 2015b). CDOT's required minimum noise reduction is 5 dBA for a barrier to be feasible, with a 7 dBA noise reduction goal.

7.1 Evaluation of Abatement Other than Barriers

CDOT guidelines include several non-barrier abatement options. For various reasons described below, none of these options appeared to be viable for the Proposed Action.

Traffic management measures, such as lane closures or reduced speeds, could reduce noise but application of these measures is not reasonable for the roads of primary interest to the project or compatible with the purpose of the Proposed Action. Some reasons for the proposed improvements are to enhance access and traffic flow by adding travel lanes to US 50 for peak period traffic volumes; closing these lanes to reduce noise would not be reasonable. One impacted receptor would need to have a noise reduction of 7 dBA to have an abatement measure. To meet this, traffic speeds would need to be reduced by approximately 25 mph, which would not be compatible with the intended function of US 50 in the PEL corridor.

Changes in horizontal alignments of the roads near the impacted receptors could reduce noise but have limited possibilities as an abatement action. The Proposed Action is intended to preserve as much of the US 50 infrastructure in the PEL Corridor as possible. Because the PEL Corridor has development on both sides, shifting the roads away from where noise impacts occur would be prohibitively expensive and disruptive.

Changes in vertical alignments (cuts or fills) could reduce noise. However, wholesale changes in road elevations would require a much larger and expensive project and could have secondary impacts to connecting or adjoining roads that would not be reasonable or desirable. Other undesirable impacts, such as to drainage or utilities, could be created. In summary, vertical elevation changes were evaluated, but vertical realignments simply to reduce traffic noise are not practical.

Noise buffer zones could reduce noise levels, but there are limited opportunities for impacted receptors in the Noise Study Area due to prior development of parcels. Often, the development has been purposely built near the roads for access, which leaves little or no space for a buffer. In the places where there are noise impacts, sufficient space for buffers is generally not available. Buffer zones may be effective for new development in the corridor, however.

Pavement types and surfaces can affect traffic noise. Research efforts to learn more about the long-term noise benefits of different pavement types and surface treatments are ongoing. Quieter pavement types can be preferred for the project when minimum requirements for safety, durability, and other material parameters are also met. However, this cannot be counted as an abatement action under the noise reduction evaluation because it is not a "permanent" solution.

7.2 Traffic Noise Barrier Evaluations

To permit the evaluation of noise barriers, computer models with barriers protecting the impacted areas were developed in TNM. Multiple barrier locations needed to be evaluated (CDOT, 2015), but the conditions in the Noise Study Area generally limited the placement options available. A preferred barrier location often is near the road ROW, so that future road improvements are less likely to disturb the barriers. A relatively effective barrier location often is near the edge of the road, so that smaller barriers might be possible. These locations were evaluated for the noise barriers, though for this project, the locations were near each other and provided similar results.

Each potential barrier was assessed for effectiveness and feasibility. If the minimum parameters for an effective barrier were met and the barrier was found to be feasible, the barrier was checked for reasonableness according to CDOT guidance (CDOT, 2015b). The feasibility and reasonableness of each barrier determined whether the barrier was recommended for the Proposed Action (**Appendix B**). **Appendix C** summarizes the feasibility and reasonableness findings for each barrier.

Briefly, for an abatement action to be feasible, it must:

- Provide at least 5 dBA of noise reduction to one impacted receptor.
- Not have any "fatal flaw" issues (safety, maintenance, access, drainage, etc.).
- Be constructible within normal engineering standards.
- Not exceed 20 feet in height.

For an abatement action to be reasonable, it must:

- Meet the design goal of at least 7 dBA of noise reduction at one receptor.
- Meet the cost/benefit index of not more than $6,800/receptor/dBA of benefit.
- Have support from more than 50 percent of the potentially benefitting receptors.

Figure 9 shows the locations evaluated for noise barriers. It is important to note that the noise barriers can be earth berms or constructed walls and that many materials can be effective barriers. Berms can be effective but need considerably more space than comparable walls. The impacted receptors tend to be close to project roads and there are also project drainage considerations. This made earth berms impractical choices for this project.

Each barrier was assessed for feasibility and reasonableness (CDOT, 2015b). Barrier recommendations were made based on these findings. The two selected locations for each barrier were generally 10 feet in toward US 50 from CDOT's ROW line (to provide access for maintenance) or generally 10 feet away from the future US 50 pavement. Barrier cost-effectiveness was based on a CDOT generic 5-year average unit cost of $45/square foot of barrier and compared to the CDOT upper threshold of $6,800/receptor/decibel of benefit.

Table 3 and the following sections summarize the barrier results for each impacted area. **Table 4** and **Appendix B** present the performance results for the primary barriers discussed in the following sections.

Figure 9. Locations of Traffic Noise Abatement Barriers Evaluated

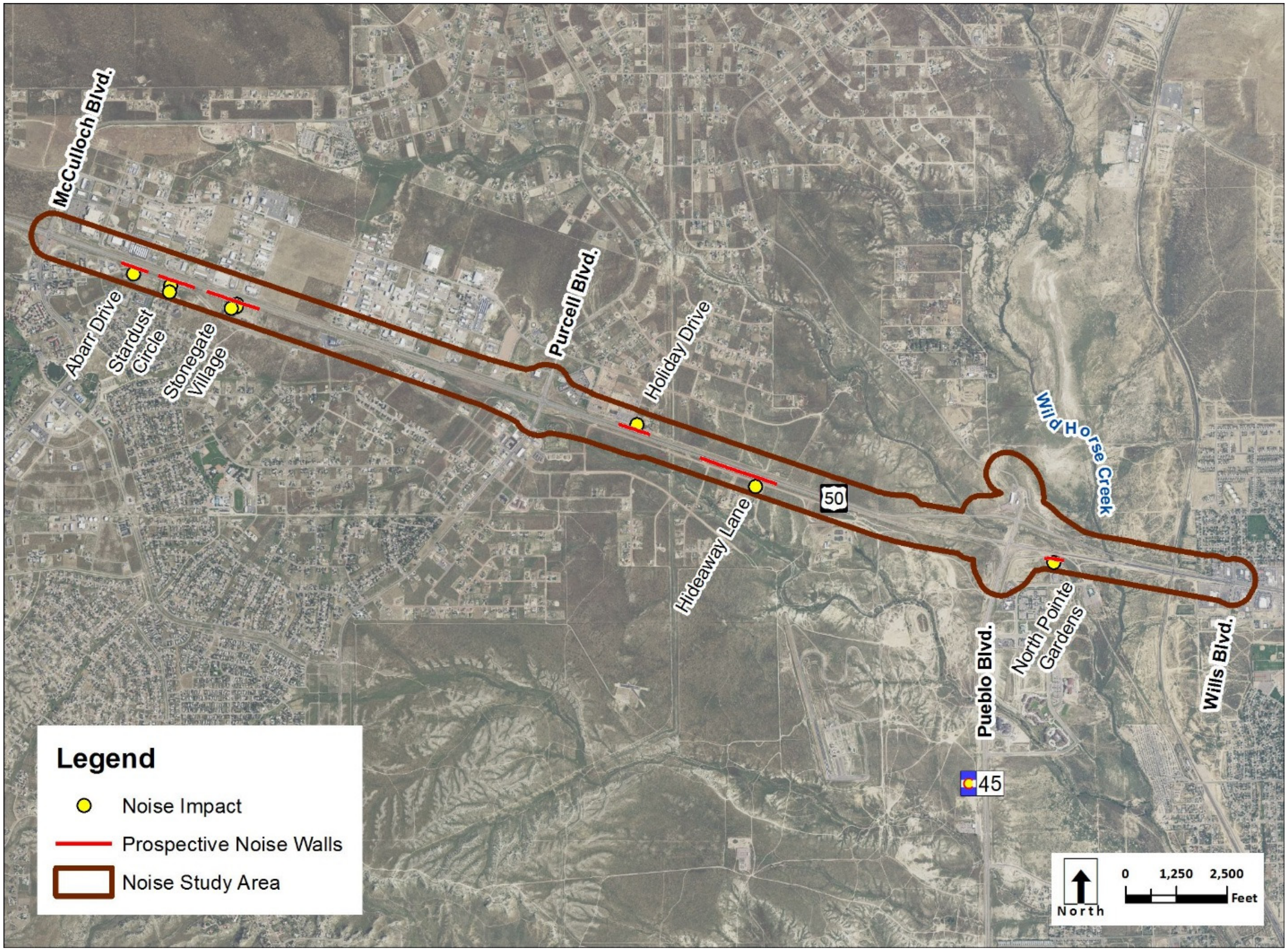


Table 3. Summary of Noise Abatement Barriers Evaluated

Noise Impacted Area	Barrier Segment Dimensions from TNM (feet)	Total Barrier Size (square feet)	Approximate Barrier Cost
North Pointe Gardens	8 x 137 9 x 122 10 x 616	8,354	$375,900
5 S. Hideaway Lane	12 x 250 17 x 250 18 x 1000 19 x 500	34,750	$1,564,000
1107 E. Holiday Drive	8 x 208 10 x 100 11 x 100 12 x 100 14 x 300	9,164	$412,400
Stonegate Village	6 x 115 11 x 612 12 x 451 13 x 201	15,450	$695,100
Stardust Circle	14 x 953	13,340	$600,400
Abarr Drive	6 x 125 12 x 111 13 x 467	8,153	$366,900

Source: FHU modeling results, 2016.

Table 4. Summary of Barrier Performance and Abatement Conclusions

Noise Impacted Area	Number of Benefitting Receptors	Total Decibels of Benefit Provided	Benefit/Cost Analysis ($/receptor/dBA)	Is Barrier Feasible?	Is Barrier Reasonable?	Is Barrier Recommended?	Conclusion
North Pointe Gardens	2	12.2	30,810	Yes	No	No	Not recommended.
5 S. Hideaway Lane	4	23.8	65,710	Yes	No	No	Not recommended.
1107 E. Holiday Drive	1	7.0	58,910	Yes	No	No	Not recommended.
Stonegate Village	38	276.2	2,520	Yes	Yes	Yes	Recommended for Proposed Action.
Stardust Circle	11	65.0	9,240	Yes	No	No	Not recommended.
Abarr Drive	8	46.0	7,980	Yes	No	No	Not recommended.

Source: FHU modeling results, 2016.

7.2.1 North Pointe Gardens

Traffic noise under the Proposed Action would have an impact on an assisted living center at 3777 Parker Blvd. The building is approximately even with US 50 in elevation. An abatement barrier extending along the US 50 ROW (**Figure 9**) was evaluated to mitigate the predicted noise impacts.

Table 3 presents the wall dimensions that were evaluated. This barrier was calculated to provide a 7-dBA noise reduction benefit to the site. Based on these results, this barrier was found to be feasible and met CDOT's design goal. **Table 4** summarizes the cost/benefit criterion result for this barrier, which exceeded CDOT's limit for reasonableness. Therefore, the abatement barrier is feasible but not reasonable and is not recommended for the Proposed Action (**Table 4**). The same conclusion was reached for a barrier along the US 50 pavement.

7.2.2 5 S. Hideaway Lane

Traffic noise under the Proposed Action would have an impact on one home at 5 S. Hideaway Lane. The home is approximately even with US 50 in elevation. An abatement barrier for this home and several neighboring homes, which were not impacted, was evaluated to mitigate the predicted noise impact (**Figure 9**).

A barrier along the US 50 ROW was evaluated, but it was found that this location could not meet the CDOT design goal, even with a 20-foot-tall wall. Therefore, a barrier near the proposed eastbound US 50 pavement was examined. **Table 3** presents the wall dimensions that were evaluated. This barrier was calculated to provide a 7-dBA noise reduction benefit to one home and 5-dBA benefits to three other homes. Based on these results, this barrier was found to be feasible and met CDOT's design goal. **Table 4** summarizes the cost/benefit criterion result for this barrier, which exceeded CDOT's limit for reasonableness. Therefore, the abatement barrier is feasible but not reasonable and is not recommended for the Proposed Action (**Table 4**).

7.2.3 1107 E. Holiday Drive

Traffic noise under the Proposed Action would have an impact on an isolated home at 1107 E. Holiday Drive. The home is approximately even with US 50 in elevation. An abatement barrier extending along the US 50 pavement (**Figure 9**) was evaluated to mitigate the predicted noise impact.

Table 3 presents the wall dimensions that were evaluated. This barrier was calculated to provide a 7-dBA noise reduction benefit to the home. Based on these results, this barrier was found to be feasible and met CDOT's design goal. **Table 4** summarizes the cost/benefit criterion result for this barrier, which exceeded CDOT's limit for reasonableness. Therefore, the abatement barrier is feasible but not reasonable and is not recommended for the Proposed Action (**Table 4**). The same conclusion was reached for a barrier along the US 50 ROW.

7.2.4 Stonegate Village

Traffic noise under the Proposed Action would impact 20 residences in the Stonegate Village complex. The apartments are approximately even with US 50 in elevation and are two-story buildings with upper level balconies. An abatement barrier extending along the US 50 ROW (**Figure 9**) was evaluated to mitigate the predicted noise impacts.

Table 3 presents the wall dimensions that were evaluated. This barrier was calculated to provide a 7-dBA noise reduction benefit to several units. Based on these results, this barrier was found to be feasible and met CDOT's design goal. **Table 4** summarizes the cost/benefit criterion result for this barrier, which met CDOT's limit for reasonableness. Therefore, this abatement barrier is feasible and reasonable and is recommended for the Proposed Action (**Table 4**). Because of this result, a barrier along the edge of pavement was not evaluated.

7.2.5 Stardust Circle

Traffic noise under the Proposed Action would have an impact on 11 homes along the 100-block of Stardust Circle. The homes are approximately even with US 50 in elevation. An abatement barrier extending along the US 50 ROW (**Figure 9**) was evaluated to mitigate the predicted noise impacts.

Table 3 presents the wall dimensions that were evaluated. This barrier was calculated to provide a 7-dBA noise reduction benefit to several homes. Based on these results, this barrier was found to be feasible and met CDOT's design goal. **Table 4** summarizes the cost/benefit criterion result for this barrier, which exceeded CDOT's limit for reasonableness. Therefore, the abatement barrier is feasible but not reasonable and is not recommended for the Proposed Action (**Table 4**). The same conclusion was reached for a barrier along the US 50 pavement.

7.2.6 Abarr Drive

Traffic noise under the Proposed Action would have an impact on four homes along the 100-block of Abarr Drive. The homes are approximately even with US 50 in elevation. An abatement barrier extending along the US 50 ROW (**Figure 9**) was evaluated to mitigate the predicted noise impacts.

Table 3 presents the wall dimensions that were evaluated. This barrier was calculated to provide a 7-dBA noise reduction benefit to several homes. Based on these results, this barrier was found to be feasible and met CDOT's design goal. **Table 4** summarizes the cost/benefit criterion result for this barrier, which exceeded CDOT's limit for reasonableness. Therefore, the abatement barrier is feasible but not reasonable and is not recommended for the Proposed Action (**Table 4)**. The same conclusion was reached for a barrier along the US 50 pavement.

7.3 Impacted Receptors After Recommended Abatement

For a noise abatement action to be recommended, it must be both feasible and reasonable according to the evaluation guidelines (CDOT, 2015b). Several areas were identified with traffic noise impacts (**Section 5**) and a noise barrier was determined to be feasible and reasonable for one location (**Section 7.2**). Therefore, the number of traffic noise impacts will be reduced under the Proposed Action through the recommended noise mitigation actions.

7.3.1 No Action Alternative

Because the No Action Alternative does not include any improvements or noise abatement actions, there would be no change in the traffic noise impacts (**Section 6.1**). Traffic noise would still impact the same 41 Category B receptors, as shown in **Figure 6**.

7.3.2 Proposed Action

A noise abatement wall for Stonegate Village has been recommended for the Proposed Action (**Table 4**). With the barrier parameters listed in **Table 3**, the traffic noise levels would be reduced for 18 impacted properties such that the number of noise impacts would change from 44 to 26.

7.4 Statement of Likelihood

The analysis described above concluded that one noise abatement action would be both feasible and reasonable. The barriers along North Pointe Gardens, Hideaway Lane, Holiday Drive, Stardust Circle and Abarr Lane (**Table 4; Appendix B**) were found not to be reasonable and were not recommended. The barrier along Stonegate Village (**Table 4; Appendix B**) was found to be feasible and reasonable and was recommended for inclusion with the Proposed Action. The final noise abatement decisions will be made during the final design and public involvement phases of the project. Coordination on noise abatement decisions may occur at that time, as necessary.

8. References

Colorado Department of Transportation (CDOT). 2012a. *US 50 West Planning and Environmental Linkages (PEL) Study*. June.

—. 2012b. *US 50 West PEL Implementation Plan*. June.

—. 2014. *US 50 West Purcell Blvd to Wills Blvd Environmental Assessment*. June.

—. 2015a. *US 50 West Wills Blvd to BNSF Acceleration Lane Categorical Exclusion*. October.

—. 2015b. *Noise Analysis and Abatement Guidelines*, January 15.

Federal Highway Administration. 1996. *Measurement of Highway-Related Noise*, May.

Federal Highway Administration. 2011. *Highway Traffic Noise: Analysis and Abatement Guidance*, December.

Federal Highway Administration. 2012. *Procedures for Abatement of Highway Traffic Noise and Construction Noise*. Code of Federal Regulations, Title 23, Part 772.

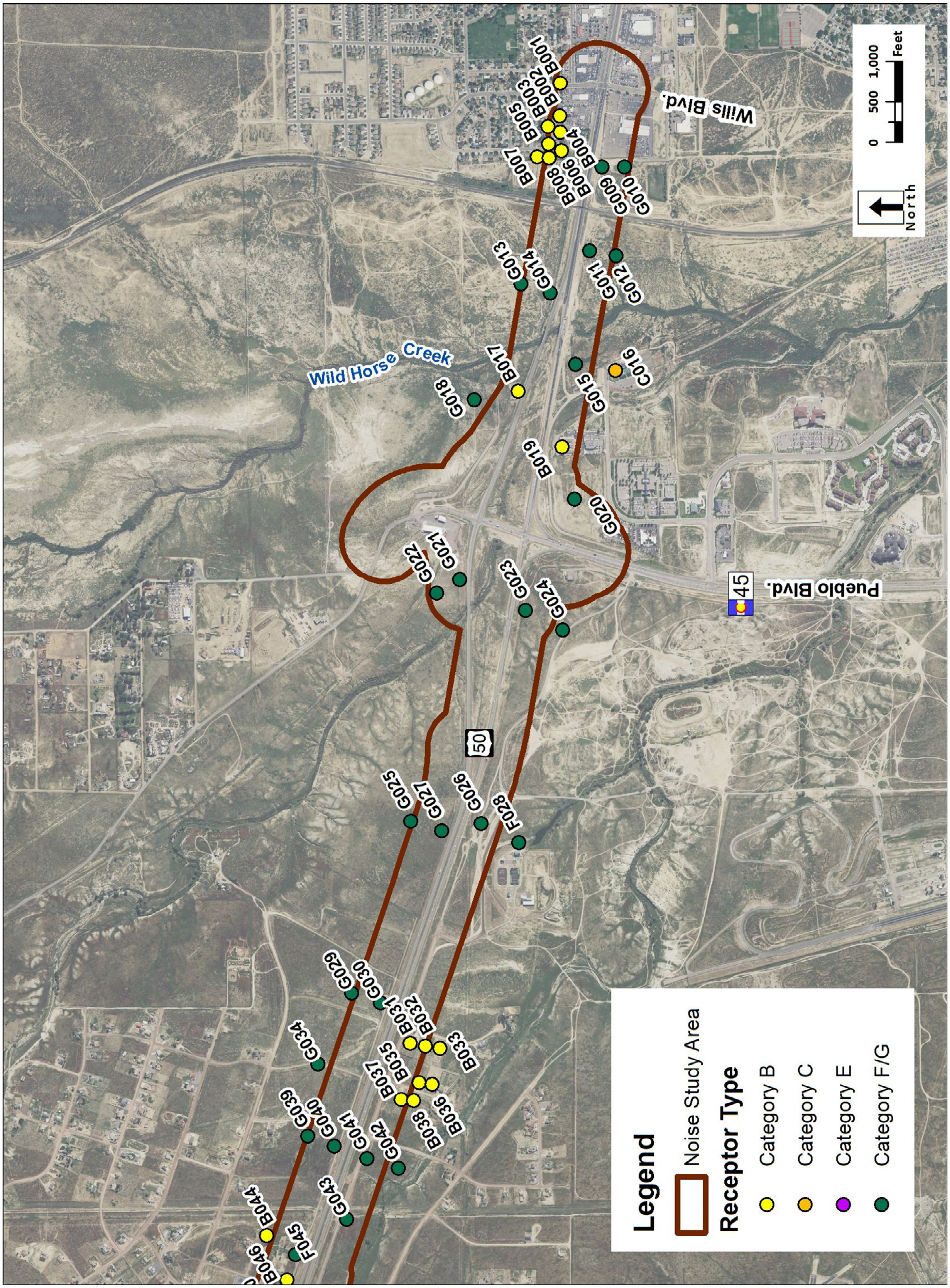
Appendix A
Traffic Volumes, Model Points and Noise Results

TNM Traffic Volumes and Speeds

TNM Road	Cars per hour	M. Trucks per hour	H. Trucks per hour	Speed mph)
Existing Conditions				
EB US50 0	998	39	28	65
EB US50 1 ACC	1940	77	54	65
EB US50 1 CRU	1940	77	54	65
EB US50 2 ACC	3036	120	84	65
EB US50 2 CRU	3036	120	84	65
EB US50 3 ACC	2414	58	58	55
EB US50 3 CRU	2414	58	58	55
EB US50 4	1865	45	45	45
frontage 1	97	2	1	45
frontage 2	97	2	1	45
frontage 3	97	2	1	35
frontage 4	97	2	1	35
NB MCCULLOCH 1	1465	30	15	35
NB MCCULLOCH 2	572	12	6	35
NB PUEBLO 1	975	30	15	55
NB PUEBLO 2	507	15	8	25
NB PUEBLO 3	33	1	1	35
NB PURCELL 1	1484	31	15	30
NB PURCELL 2	941	19	10	30
SB MCCULLOCH 1	364	8	4	35
SB MCCULLOCH 2	529	11	5	35
SB PUEBLO 1	168	5	3	35
SB PUEBLO 2	583	18	9	25
SB PUEBLO 3	1577	48	25	55
SB PURCELL 1	577	12	6	30
SB PURCELL 2	524	11	5	30
WB US50 1	758	18	18	45
WB US50 2 ACC	1102	27	27	55
WB US50 2 CRU	1102	27	27	55
WB US50 3 ACC	1096	43	30	65
WB US50 3 CRU	1096	43	30	65
WB US50 4 ACC	576	23	16	65
WB US50 4 CRU	576	23	16	65
WB US50 5	459	18	13	65
WILLS N	189	4	2	30
WILLS S	107	2	1	35
2035 No Action Alternative				
EB US50 0	1729	68	48	65
EB US50 1 ACC	2834	112	79	65
EB US50 1 CRU	2834	112	79	65
EB US50 2 ACC	4288	103	103	65
EB US50 2 CRU	4288	103	103	65
EB US50 3 ACC	3625	87	87	55
EB US50 3 CRU	3625	87	87	55
EB US50 4	3578	86	86	45
frontage 1	786	16	8	45

TNM Road	Cars per hour	M. Trucks per hour	H. Trucks per hour	Speed mph)
frontage 2	378	8	4	45
frontage 3	97	2	1	35
frontage 4	97	2	1	35
NB MCCULLOCH 1	2503	52	26	35
NB MCCULLOCH 2	1717	35	18	35
NB PUEBLO 1	1979	41	20	55
NB PUEBLO 2	1445	30	15	25
NB PUEBLO 3	698	14	7	35
NB PURCELL 1	1959	40	20	30
NB PURCELL 2	2357	49	24	30
SB MCCULLOCH 1	1116	23	12	35
SB MCCULLOCH 2	1217	25	13	35
SB PUEBLO 1	538	11	6	35
SB PUEBLO 2	1106	23	11	25
SB PUEBLO 3	2309	48	24	55
SB PURCELL 1	1203	25	12	30
SB PURCELL 2	781	16	8	30
WB US50 1	1507	36	36	45
WB US50 2 ACC	2061	50	50	55
WB US50 2 CRU	2061	50	50	55
WB US50 3 ACC	2237	54	54	65
WB US50 3 CRU	2174	86	60	65
WB US50 4 ACC	900	36	25	65
WB US50 4 CRU	900	36	25	65
WB US50 5	768	30	21	65
WILLS N	398	8	4	30
WILLS S	165	3	2	35
2035 Proposed Action				
EB PUEBLO OFF	1373	54	38	40
EB PUEBLO ON	735	18	18	55
EB PURCELL OFF	576	23	16	40
EB PURCELL ON	1949	77	54	55
EB US50 0	1729	68	48	65
EB US50 1 ACC	2834	112	79	65
EB US50 1 CRU	2834	112	79	65
EB US50 2	2258	89	63	65
EB US50 3	4288	103	103	65
EB US50 4	2839	112	79	55
EB US50 5	3625	87	87	55
EB US50 6	3578	86	86	45
frontage 1	786	16	8	45
frontage 2	378	8	4	45
frontage 3	97	2	1	35
frontage 4	97	2	1	35
NB MCCULLOCH 1	2503	52	26	35
NB MCCULLOCH 2	1717	35	18	35
NB PUEBLO 1	1979	41	20	55
NB PUEBLO 2	1445	30	15	35
NB PUEBLO 3	698	14	7	35

TNM Road	Cars per hour	M. Trucks per hour	H. Trucks per hour	Speed mph)
NB PURCELL 1	1958	40	20	30
NB PURCELL 2	1261	26	13	30
NB PURCELL 3	2357	49	24	30
SB MCCULLOCH 1	1116	23	12	35
SB MCCULLOCH 2	1217	25	13	35
SB PUEBLO 1	538	11	6	35
SB PUEBLO 2	1106	23	11	35
SB PUEBLO 3	2309	48	24	55
SB PURCELL 1	1203	25	12	30
SB PURCELL 2	1504	31	16	30
SB PURCELL 3	781	16	8	30
WB PUEBLO OFF	782	19	19	40
WB PUEBLO ON ACC	900	36	25	40
WB PUEBLO ON CRU	900	36	25	55
WB PURCELL OFF	1499	59	42	40
WB PURCELL ON	150	6	4	40
WB US50 1	1507	36	36	45
WB US50 2 ACC	2060	50	50	55
WB US50 2 CRU	2060	50	50	55
WB US50 3	1278	31	31	65
WB US50 4	2174	86	60	65
WB US50 5	675	27	19	65
WB US50 6	900	36	25	65
WB US50 7	768	30	21	65
WILLS N	398	8	4	30
WILLS S	165	3	2	35


Legend
Noise Study Area
Receptor Type
Category B
Category C
Category E
Category F/G
0 500 1,000 Feet
North
Wills Blvd.
Pueblo Blvd.
Wild Horse Creek
45
50
B001
B002
B003
B004
B005
B006
B007
B008
G009
G010
G011
G012
G013
G014
G015
C016
B017
G018
B019
G020
G021
G22
G023
G024
G025
G026
G027
F028
G029
G030
B031
B032
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B035
B036
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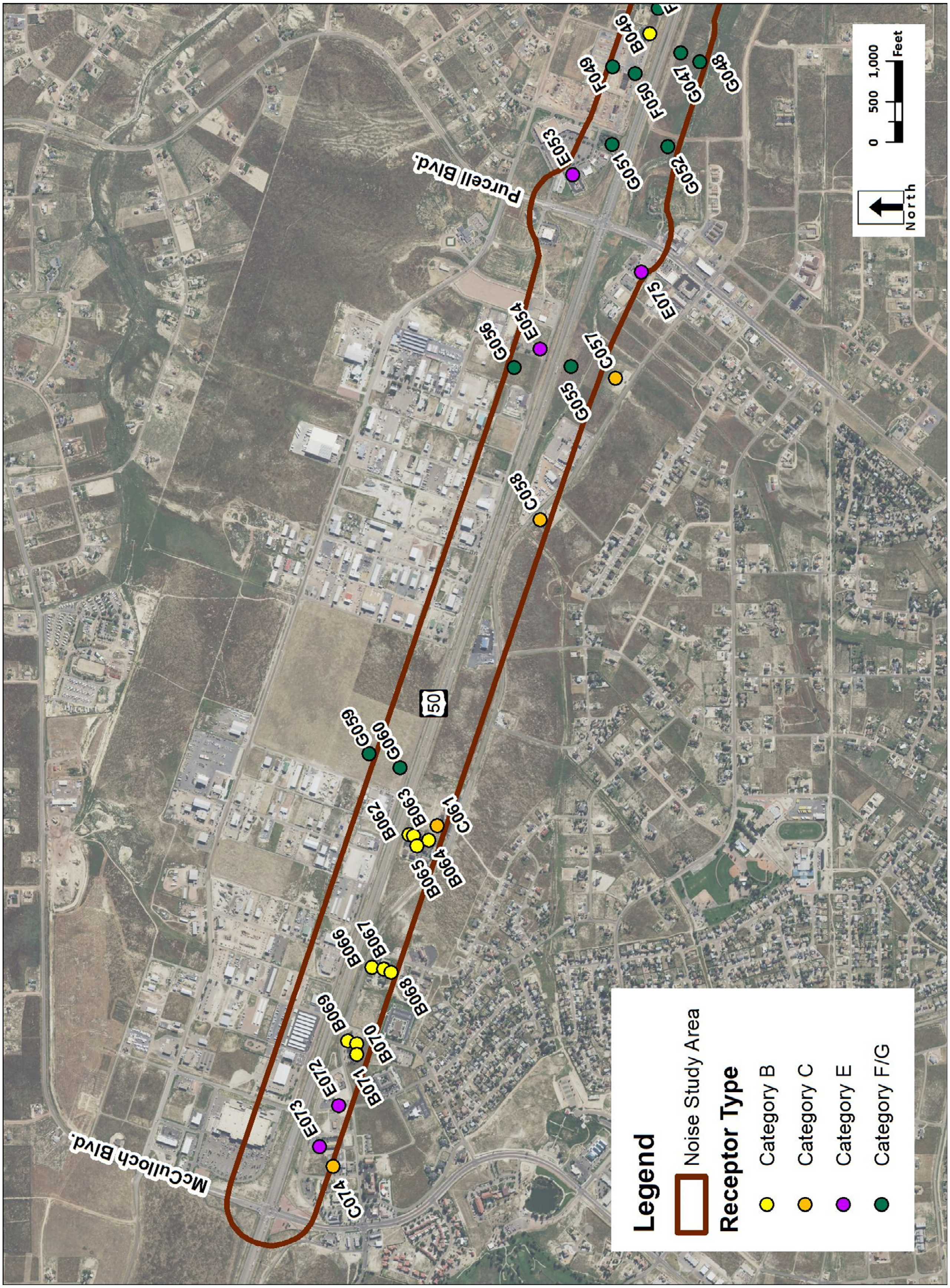
B044
F045
B046



Purcell Blvd.
McCulloch Blvd.
50
E053
F049
B046
F050
G051
G047
G048
G052
E075
E054
G056
G055
C057
C058
G059
G060
B062
B063
C061
B065
B064
B066
B067
B068
B069
B070
B071
E072
E073
C074
Legend
Noise Study Area
Receptor Type
Category B
Category C
Category E
Category F/G
0
500
1,000
Feet
North

Model Point	Activity Category / CDOT NAC (dBA)	Receptors	Existing (2011) L_{eq} (dBA)	Existing L_{eq} Result	No Action Alternative (2035) L_{eq} (dBA)	No Action L_{eq} Result	No Action Increase Over Existing (dBA)	Proposed Action (2035) L_{eq} (dBA)	Proposed Action L_{eq} Result	Proposed Action Increase Over Existing (dBA)
B001	B / 66	1	58.5	----	61.2	----	2.7	61.5	----	3.0
B002	B / 66	5	57.4	----	59.4	----	2.0	60.5	----	3.1
B003	B / 66	6	54.3	----	56.4	----	2.1	57.2	----	2.9
B004	B / 66	3	58.9	----	61.0	----	2.1	61.5	----	2.6
B005	B / 66	3	55.6	----	57.7	----	2.1	58.3	----	2.7
B006	B / 66	3	61.2	----	63.2	----	2.0	63.6	----	2.4
B007	B / 66	1	53.9	----	56.0	----	2.1	56.2	----	2.3
B008	B / 66	2	56.6	----	58.6	----	2.0	59	----	2.4
G009	G / NA	0	70.2	----	72.2	----	2.0	72.1	----	1.9
G010	G / NA	0	57.0	----	59.0	----	2.0	59.1	----	2.1
G011	G / NA	0	66.4	----	68.5	----	2.1	69.2	----	2.8
G012	G / NA	0	56.3	----	58.3	----	2.0	58.6	----	2.3
G013	G / NA	0	58.0	----	60.1	----	2.1	59.8	----	1.8
G014	G / NA	0	69.5	----	71.8	----	2.3	71	----	1.5
G015	G / NA	0	66.7	----	68.5	----	1.8	69.4	----	2.7
C016	C / 66	1	54.8	----	56.7	----	1.9	57.4	----	2.6
B017	B / 66	2	68.7	Impact	71.2	Impact	2.5	64.5	----	-4.2
G018	G / NA	0	55.1	----	57.4	----	2.3	55.4	----	0.3
B019	B / 66	3	65.1	----	66.9	Impact	1.8	67.8	Impact	2.7
G020	G / NA	0	57.9	----	59.7	----	1.8	60.3	----	2.4
G021	G / NA	0	69.1	----	71.8	----	2.7	65.5	----	-3.6
G022	G / NA	0	62.6	----	64.6	----	2.0	62.7	----	0.1
G023	G / NA	0	72.1	----	73.4	----	1.3	73.8	----	1.7
G024	G / NA	0	57.8	----	59.4	----	1.6	59.6	----	1.8
G025	G / NA	0	59.3	----	61.0	----	1.7	64.6	----	5.3
G026	G / NA	0	70.0	----	71.3	----	1.3	71.4	----	1.4
G027	G / NA	0	71.9	----	73.8	----	1.9	73.8	----	1.9
F028	F / NA	0	55.0	----	56.4	----	1.4	56.4	----	1.4
G029	G / NA	0	58.1	----	59.8	----	1.7	60.6	----	2.5
G030	G / NA	0	71.3	----	73.2	----	1.9	73.3	----	2.0
B031	B / 66	1	64.5	----	65.9	Impact	1.4	66	Impact	1.5
B032	B / 66	1	59.4	----	60.8	----	1.4	60.9	----	1.5
B033	B / 66	1	56.3	----	57.7	----	1.4	57.8	----	1.5
G034	G / NA	0	56.8	----	58.4	----	1.6	59.1	----	2.3
B035	B / 66	1	58.0	----	59.4	----	1.4	59.5	----	1.5

Model Point	Activity Category / CDOT NAC (dBA)	Receptors	Existing (2011) L_{eq} (dBA)	Existing L_{eq} Result	No Action Alternative (2035) L_{eq} (dBA)	No Action L_{eq} Result	No Action Increase Over Existing (dBA)	Proposed Action (2035) L_{eq} (dBA)	Proposed Action L_{eq} Result	Proposed Action Increase Over Existing (dBA)
B036	B / 66	1	55.0	----	56.5	----	1.5	56.5	----	1.5
B037	B / 66	1	61.7	----	63.1	----	1.4	63.1	----	1.4
B038	B / 66	1	57.5	----	59.0	----	1.5	59.1	----	1.6
G039	G / NA	0	61.1	----	62.7	----	1.6	63.5	----	2.4
G040	G / NA	0	72.2	----	74.2	----	2.0	74.2	----	2.0
G041	G / NA	0	64.6	----	66.0	----	1.4	66.1	----	1.5
G042	G / NA	0	54.8	----	56.3	----	1.5	56.4	----	1.6
G043	G / NA	0	66.7	----	68.0	----	1.3	68.2	----	1.5
B044	B / 66	1	59.1	----	60.7	----	1.6	62.1	----	3.0
F045	F / NA	0	71.3	----	73.3	----	2.0	73.2	----	1.9
B046	B / 66	1	71.5	Impact	73.5	Impact	2.0	72.6	Impact	1.1
G047	G / NA	0	69.4	----	70.8	----	1.4	71.8	----	2.4
G048	G / NA	0	58.1	----	59.5	----	1.4	61	----	2.9
F049	F / NA	0	61.4	----	63.0	----	1.6	63.8	----	2.4
F050	F / NA	0	71.1	----	73.0	----	1.9	70.5	----	-0.6
G051	G / NA	0	69.5	----	71.7	----	2.2	66.3	----	-3.2
G052	G / NA	0	61.3	----	62.7	----	1.4	63.5	----	2.2
E053	E / 71	1	55.7	----	57.6	----	1.9	56.9	----	1.2
E054	E / 71	1	68.2	----	69.9	----	1.7	69.6	----	1.4
G055	G / NA	0	69.9	----	71.6	----	1.7	69.7	----	-0.2
G056	G / NA	0	58.6	----	60.4	----	1.8	62.6	----	4.0
C057	C / 66	1	54.0	----	55.7	----	1.7	57.2	----	3.2
C058	C / 66	1	56.9	----	58.8	----	1.9	60.2	----	3.3
G059	G / NA	0	55.4	----	57.2	----	1.8	58.1	----	2.7
G060	G / NA	0	68.1	----	69.8	----	1.7	69.6	----	1.5
C061	C / 66	1	58.9	----	60.6	----	1.7	62.5	----	3.6
B062	B / 66	2	72.1	Impact	73.8	Impact	1.7	74.1	Impact	2.0
B062 2nd	B / 66	2	72.5	Impact	74.2	Impact	1.7	74.5	Impact	2.0
B063	B / 66	4	62.0	----	63.7	----	1.7	63.5	----	1.5
B063 2nd	B / 66	4	64.1	----	65.8	Impact	1.7	66.1	Impact	2.0
B064	B / 66	9	55.5	----	57.2	----	1.7	59	----	3.5
B064 2nd	B / 66	9	60.3	----	62.0	----	1.7	62.1	----	1.8
B065	B / 66	8	64.3	----	66.0	Impact	1.7	67.8	Impact	3.5
B065 2nd	B / 66	8	67.3	Impact	69.0	Impact	1.7	69.0	Impact	1.7
B066	B / 66	6	68.8	Impact	71.4	Impact	2.6	71.6	Impact	2.8

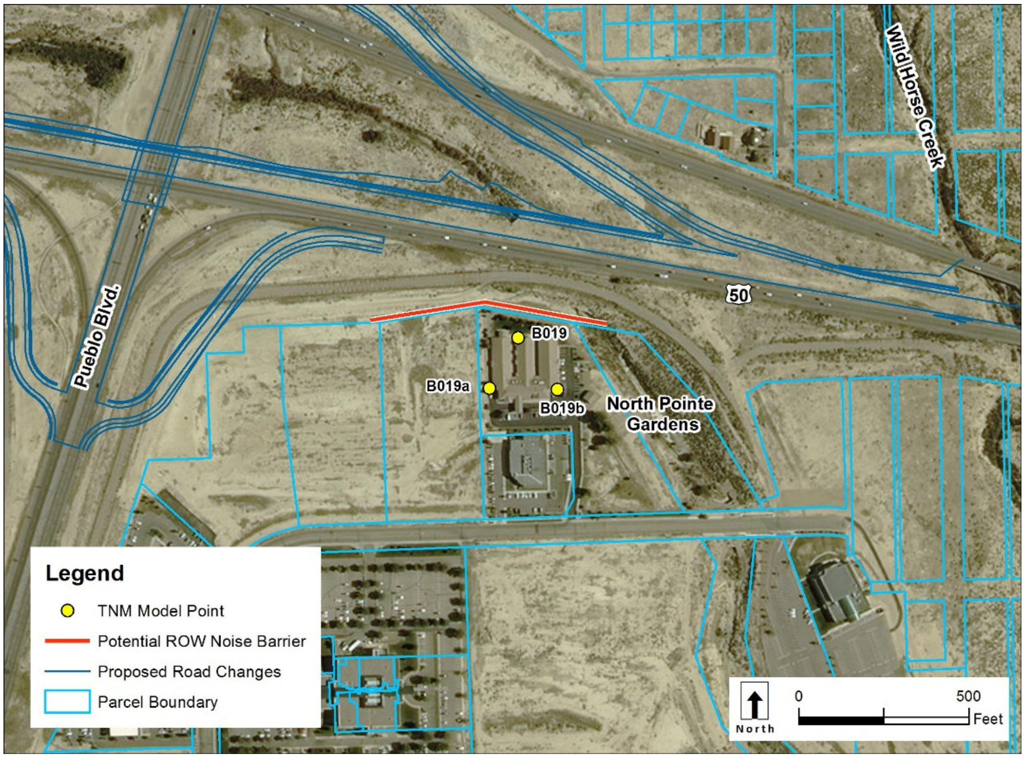
Model Point	Activity Category / CDOT NAC (dBA)	Receptors	Existing (2011) L_{eq} (dBA)	Existing L_{eq} Result	No Action Alternative (2035) L_{eq} (dBA)	No Action L_{eq} Result	No Action Increase Over Existing (dBA)	Proposed Action (2035) L_{eq} (dBA)	Proposed Action L_{eq} Result	Proposed Action Increase Over Existing (dBA)
B067	B / 66	5	63.3	----	65.2	----	1.9	67.0	Impact	3.7
B068	B / 66	4	56.8	----	58.7	----	1.9	60.0	----	3.2
B069	B / 66	4	66.5	Impact	69.3	Impact	2.8	70.2	Impact	3.7
B070	B / 66	8	58.4	----	60.7	----	2.3	62.3	----	3.9
B071	B / 66	8	56.2	----	58.8	----	2.6	60.3	----	4.1
E072	E / 71	1	61.4	----	63.9	----	2.5	65.6	----	4.2
E073	E / 71	1	63.5	----	65.2	----	1.7	67.3	----	3.8
C074	C / 66	1	56.7	----	58.7	----	2.0	60.1	----	3.4
E075	E / 71	1	58.8	----	60.5	----	1.7	61.2	----	2.4

---- = not above CDOT NAC

NA = not applicable

Appendix B
Noise Abatement Barrier Modeling Results

North Pointe Gardens



Approximate dimensions of the traffic noise abatement wall (that protects entire property).

Barrier	Barrier Height & Width (feet)	Overall Barrier Size (sq. ft.)	Overall Cost
North Pointe Gardens (B019)	9 x 252 10 x 364 15 x 259 16 x 193	12,880	$579,650

Noise abatement results from TNM for the above wall.

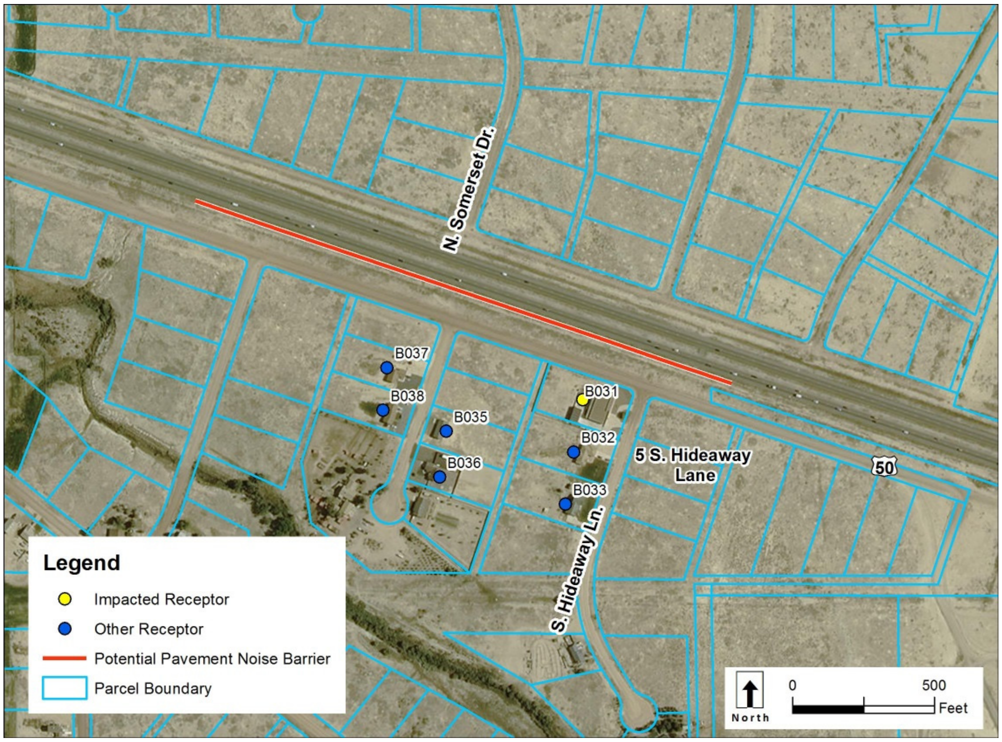
TNM Model Receptor	Units	NAC (dBA)	2035 Level w/o Abatement (dBA)	Result from Modeling	Noise reduction w/ Abatement (dBA)	Noise Level w/ Abatement (dBA)	Does Receptor Benefit?*
B019	1	66	67.8	Impact	8.7	59.1	Yes
B019a	1	66	59.4	No Impact	5.0	54.4	Yes
B019b	1	66	65.3	No Impact	5.0	60.3	Yes

* Only benefitting receptors are included in the benefit/cost calculations.

Total Barrier Benefit = 18.7 dBA

Cost Benefit Index = $579,650 / 18.7 = $31,000/receptor▪decibel

5 S. Hideaway Lane



Approximate dimensions of the optimized traffic noise abatement wall.

Barrier	Barrier Height & Width (feet)	Overall Barrier Size (sq. ft.)	Overall Cost
5 S. Hideaway Lane (B031)	12 x 250 17 x 250 18 x 1000 19 x 500	34,750	$1,564,000

Noise abatement results from TNM for the above wall.

TNM Model Receptor	Units	NAC (dBA)	2035 Level w/o Abatement (dBA)	Result from Modeling	Noise reduction w/ Abatement (dBA)	Noise Level w/ Abatement (dBA)	Does Receptor Benefit?*
B031	1	66	66.0	Impact	6.6	59.4	Yes
B032	1	66	60.9	No Impact	3.2	57.7	No
B033	1	66	57.8	No Impact	2.5	55.4	No
B035	1	66	59.5	No Impact	5.2	54.3	Yes
B036	1	66	56.5	No Impact	3.5	53.0	No
B037	1	66	63.1	No Impact	7.0	56.1	Yes
B038	1	66	59.1	No Impact	5.0	54.0	Yes

* Only benefitting receptors are included in the benefit/cost calculations.

Total Barrier Benefit = 23.9 dBA

Cost Benefit Index = $1,564,000 / 23.8 = $65,710/receptor▪decibel

1107 E. Holiday Drive

Approximate dimensions of the optimized traffic noise abatement wall.

Barrier	Barrier Height & Width (feet)	Overall Barrier Size (sq. ft.)	Overall Cost
1107 E. Holiday Drive (B046)	8 x 208 10 x 100 11 x 100 12 x 100 14 x 300	9,164	$412,400

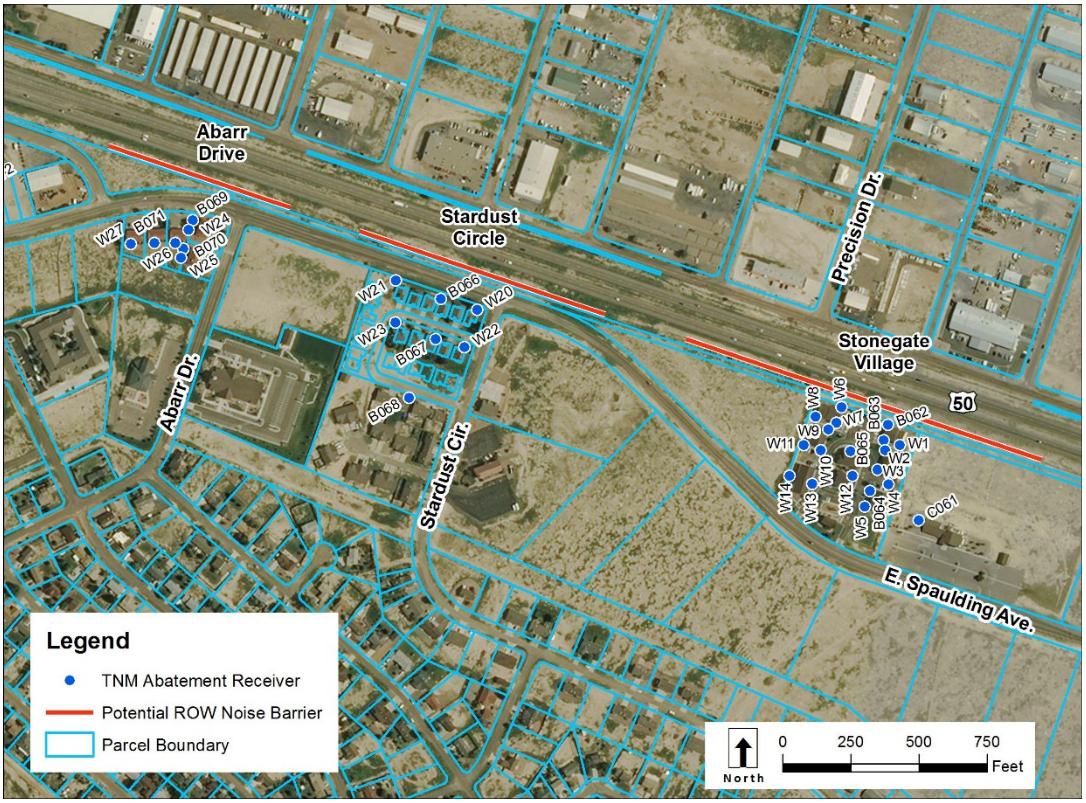
Noise abatement results from TNM for the above wall.

TNM Model Receptor	Units	NAC (dBA)	2035 Level w/o Abatement (dBA)	Result from Modeling	Noise reduction w/ Abatement (dBA)	Noise Level w/ Abatement (dBA)	Does Receptor Benefit?*
B046	1	66	72.6	Impact	7.0	65.6	Yes

* Only benefitting receptors are included in the benefit/cost calculations.

Total Barrier Benefit = 7.0 dBA
Cost Benefit Index = $412,400 / 7.0 = $58,910/receptor▪decibel

Stonegate Village, Stardust Circle, and Abarr Drive



Approximate dimensions of the optimized traffic noise abatement walls.

Barrier	Barrier Height & Width (feet)	Overall Barrier Size (sq. ft.)	Overall Cost
Stonegate Village	6 x 115 11 x 612 12 x 451 13 x 201	15,450	$695,100
Stardust Circle	14 x 953	13,340	$600,400
Abarr Drive	6 x 125 12 x 111 13 x 467	8,153	$366,900

Noise abatement results from TNM for Stonegate Village wall.

TNM Model Receptor	Units	NAC (dBA)	2035 Level w/o Abatement (dBA)	Result from Modeling	Noise reduction w/ Abatement (dBA)	Noise Level w/ Abatement (dBA)	Does Receptor Benefit?*
C061	1	66	62.5	No Impact	3.9	58.6	No
B062	1	66	74.1	Impact	11.1	63.0	Yes
B062 2	1	66	74.6	Impact	6.8	67.8	Yes
B063	1	66	63.3	No Impact	7.4	55.9	Yes
B063 2	1	66	65.1	No Impact	6.5	58.6	Yes
B064	1	66	59.0	No Impact	7.2	51.8	Yes
B064 2	1	66	62.0	No Impact	7.7	54.3	Yes
B065	2	66	67.1	Impact	10.2	56.9	Yes
B065 2	2	66	67.8	Impact	8.2	59.6	Yes
W1 1	1	66	68.9	Impact	8.1	60.8	Yes
W1 2	1	66	69.3	Impact	6.2	63.1	Yes
W2 1	1	66	66.9	Impact	6.7	60.2	Yes
W2 2	1	66	67.7	Impact	5.6	62.1	Yes
W3 1	1	66	63.2	No Impact	8.8	54.4	Yes
W3 2	1	66	64.7	No Impact	8.0	56.7	Yes
W4 1	2	66	64.5	No Impact	5.2	59.3	Yes
W4 2	2	66	66.2	Impact	5.0	61.2	Yes
W5 1	1	66	55.9	No Impact	5.7	50.2	Yes
W5 2	1	66	59.8	No Impact	7.0	52.8	Yes
W6 1	1	66	74.3	Impact	11.6	62.7	Yes
W6 2	1	66	74.9	Impact	6.9	68.0	Yes
W7 1	1	66	66.3	Impact	10.3	56.0	Yes
W7 2	1	66	67.0	Impact	7.6	59.4	Yes
W8 1	1	66	67.6	Impact	9.3	58.3	Yes
W8 2	1	66	69.0	Impact	7.3	61.7	Yes
W9 1	1	66	65.4	No Impact	7.0	58.4	Yes
W9 2	1	66	67.1	Impact	6.0	61.1	Yes
W10 1	1	66	58.1	No Impact	8.4	49.7	Yes
W10 2	1	66	59.7	No Impact	6.6	53.1	Yes
W11 1	1	66	64.0	No Impact	6.4	57.6	Yes
W11 2	1	66	66.5	Impact	6.2	60.3	Yes
W12 1	2	66	60.1	No Impact	3.6	56.5	No
W12 2	2	66	62.4	No Impact	3.5	58.9	No
W13 1	2	66	55.9	No Impact	4.9	51.0	No
W13 2	2	66	59.5	No Impact	6.3	53.2	Yes
W14 1	2	66	59.8	No Impact	3.9	55.9	No
W14 2	2	66	64.7	No Impact	5.0	59.7	Yes

* Only benefitting receptors are included in the benefit/cost calculations.

<u>Stonegate Village</u>
Total Barrier Benefit = 276.2 dBA
Cost Benefit Index = $695,100 / 276.2 = $2,520/receptor▪decibel

Noise abatement results from TNM for Stardust Circle wall.

TNM Model Receptor	Units	NAC (dBA)	2035 Level w/o Abatement (dBA)	Result from Modeling	Noise reduction w/ Abatement (dBA)	Noise Level w/ Abatement (dBA)	Does Receptor Benefit?*
B066	2	66	71.6	Impact	5.2	66.4	Yes
B067	3	66	67.0	Impact	7.1	59.9	Yes
B068	4	66	59.7	No Impact	3.5	56.2	No
W20	2	66	72.1	Impact	5.3	66.8	Yes
W21	2	66	71.9	Impact	5.0	66.9	Yes
W22	1	66	66.4	Impact	6.0	60.4	Yes
W23	1	66	67.2	Impact	6.7	60.5	Yes

* Only benefitting receptors are included in the benefit/cost calculations.

<u>Stardust Circle</u>
Total Barrier Benefit = 65.0 dBA
Cost Benefit Index = $600,400 / 65.0 = $9,240/receptor▪decibel

Noise abatement results from TNM for Abarr Drive wall.

TNM Model Receptor	Units	NAC (dBA)	2035 Level w/o Abatement (dBA)	Result from Modeling	Noise reduction w/ Abatement (dBA)	Noise Level w/ Abatement (dBA)	Does Receptor Benefit?*
B069	2	66	70.3	Impact	5.1	65.2	Yes
B070	2	66	60.6	No Impact	7.0	53.6	Yes
B071	4	66	55.5	No Impact	0.1	55.4	No
W24	2	66	68.0	Impact	5.2	62.8	Yes
W25	2	66	57.1	No Impact	5.7	51.4	Yes
W26	4	66	58.4	No Impact	0.1	58.3	No
W27	4	66	54.4	No Impact	0.1	54.3	No

* Only benefitting receptors are included in the benefit/cost calculations.

<u>Abarr Drive</u>
Total Barrier Benefit = 46.0 dBA
Cost Benefit Index = $366,900 / 46.0 = $7,980/receptor▪decibel

Appendix C
Noise Abatement Barrier Evaluation Worksheets

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # ________________ Date of Analysis: 1-25-16

Project Name & Location: US 50 WB North Pointe Gardens

A. FEASIBILITY:
1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
☑ YES ☐ NO

B. REASONABLENESS:
1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
☐ YES ☑ NO
3. Are more than 50% of responding benefited resident/owners in favor of the recommended noise abatement measure?
☐ YES ☐ NO

C. INSULATION CONSIDERATION:
1. Are normal noise abatement measures physically infeasible or economically unreasonable?
☑ YES ☐ NO
If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
☐ YES ☑ NO
b. If yes, is it reasonable and feasible to provide insulation for these buildings?
☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:
1. Are noise mitigation measures feasible?
☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
☐ YES ☑ NO
4. Shall noise abatement measures be provided?
☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:
The cost benefit index is too high at $30,800. Barrier is not recommended.

Completed by: Dale Tischmak Date: 2-24-16

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # ________________ Date of Analysis: 1-25-16

Project Name & Location: US 50 WB   Hideaway Lane

A. FEASIBILITY:
1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:
1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of responding benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO

C. INSULATION CONSIDERATION:
1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☑ YES ☐ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☑ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:
Examined wall for entire neighborhood, not just the impacted home.

E. STATEMENT OF LIKELIHOOD:
1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:
The cost benefit index is too high at $65,700. Barrier is not recommended.

Completed by: Dale Tischmak   Date: 2-24-16

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # STA 0503-088 Date of Analysis: 1-25-16

Project Name & Location: US 50 Holiday Drive

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of responding benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☑ YES ☐ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☑ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Isolated home

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

the cost benefit index is too high at $58,900. Barrier is not recommended.

Completed by: Dale Tischmak Date: 1-26-16

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # STA 0503-088 Date of Analysis: 1-26-16

Project Name & Location: US 50 Stonegate

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☒ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☒ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☒ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☒ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☒ YES ☐ NO
3. Are more than 50% of responding benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO TBD

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☒ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

B3 to be determined at final design.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☒ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☒ YES ☐ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☒ NO
4. Shall noise abatement measures be provided?
   ☒ YES ☐ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

A barrier is recommended.

Completed by: Dale Tischmak Date: 1-26-16

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # ________________ Date of Analysis: 1-25-16

Project Name & Location: US 50 WB Stardust Circle

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of responding benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☑ YES ☐ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☑ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Frontage road traffic reduces effectiveness.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

The cost benefit index is too high at $9240. Barrier is not recommended.

Completed by: Dale Tischmak Date: 2-24-16

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # STA 0503-088 Date of Analysis: 1-25-16

Project Name & Location: US 50 Aharr Drive

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ❒ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ❒ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ❒ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ❒ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ❒ YES ☑ NO
3. Are more than 50% of responding benefited resident/owners in favor of the recommended noise abatement measure?
   ❒ YES ❒ NO

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☑ YES ❒ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ❒ YES ☑ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ❒ YES ❒ NO

D. ADDITIONAL CONSIDERATIONS:

Frontage road traffic reduces effectiveness.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ❒ NO
2. Are noise mitigation measures reasonable?
   ❒ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ❒ YES ☑ NO
4. Shall noise abatement measures be provided?
   ❒ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

The cost benefit index is too high at $8,000. Barrier is not recommended.

Completed by: Dale Tischmak Date: 1-25-16

Appendix D
Traffic Data from Noise Measurements

Presented below are the traffic data gathered during the on-site traffic noise measurements collected on May 13 and October 7, 2015. These were the data used for the TNM verification model. Note that some road construction was occurring on US 50 during the measurement periods, so traffic did not seem to be travelling at the full posted speed limit in all cases.

Road	Equivalent Hourly Traffic Volume			Estimated Speed (MPH)
	Cars	Md. Trucks	Hvy. Trucks	
Measurement 1 (May 13)				
US 50 WB	1348	20	44	55
US 50 EB	1500	16	20	55
Measurement 2 (May 13)				
US 50 WB	1348	24	32	55
US 50 EB	1184	24	48	55
Grouse Dr.	24	0	4	25
Measurement 3 (May 13)				
US 50 WB	1756	24	24	55
US 50 EB	1264	32	24	55
Measurement 4 (May 13)				
US 50 WB	1776	36	20	55
US 50 EB	1460	44	16	45
Measurement 5 (October 7)				
US 50 WB	700	12	24	55
US 50 EB	868	12	8	55
Enterprise Dr.	112	0	0	35
Measurement 6 (October 7)				
US 50 WB	900	24	16	55
US 50 EB	708	24	24	55
Spaulding Dr.	144	0	0	45