



TRAFFIC-NOISE IMPACT ASSESSMENT TECHNICAL MEMORANDUM

FOR THE

Federal Boulevard Improvements between West 7th Avenue and West Howard Place Environmental Assessment

Prepared for

CITY AND COUNTY OF DENVER

COLORADO DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

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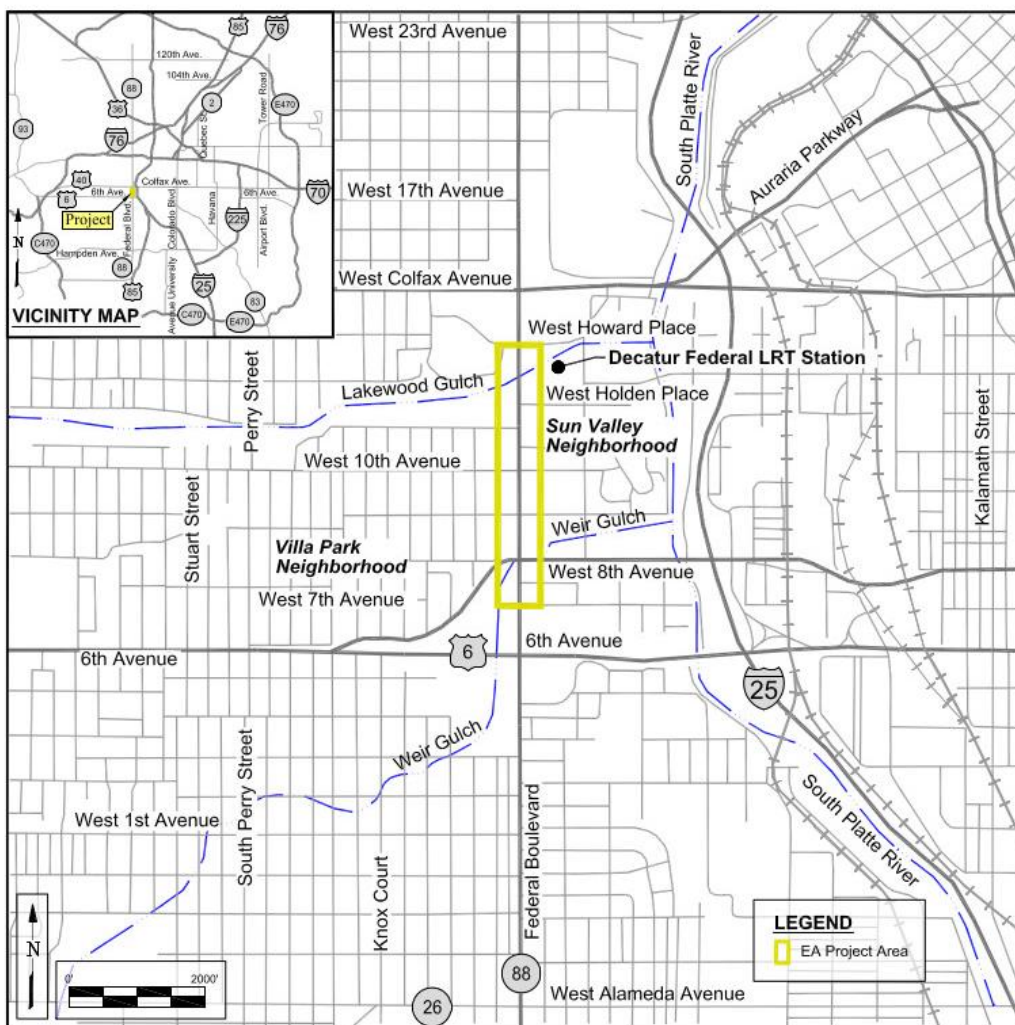
ACRONYMS

| | |
|--------|--|
| AADT | Annual Average Daily Traffic |
| AASHTO | American Association of State Highway and Transportation Officials |
| ADA | Americans with Disability Act |
| ANSI | American National Standards Institute |
| CAD | Computer-aided Design |
| CCD | City and County of Denver |
| CDOT | Colorado Department of Transportation |
| CFR | Code of Federal Regulations |
| dBA | A-weighted decibels |
| EA | Environmental Assessment |
| EPA | Environmental Protection Agency |
| FHU | Felsburg, Holt, & Ullevg |
| PEL | Planning and Environmental Linkages Study |
| FHWA | Federal Highway Administration |
| Leq | A-weighted Hourly Equivalent Noise Level |
| LRT | Light Rail Transit |
| MPH | Miles Per Hour |
| MS4 | Municipal Separate Storm Sewer System |
| NAC | Noise Abatement Criteria |
| NIST | National Institute of Standards and Technology |
| PEL | Planning and Environmental Linkages |
| RTD | Regional Transportation District |
| TNM | Traffic Noise Model |

INTRODUCTION

This Technical Memorandum has been prepared in support of the *Federal Boulevard Improvements Environmental Assessment (EA)* ("Project Area," Figure 1). The general Project Area extends from West 7th Avenue to West Howard Place along Federal Boulevard. This Memorandum evaluates the effects of the Federal Boulevard Improvement Project (Proposed Action) and the No-Action Alternative with respect to traffic noise. The study area used in this assessment encompasses the portion of Federal Boulevard between West 7th and West Howard Place with a 500-foot buffer from the edge of the roadway ("Study Area").

Figure 1. EA Project Area



Federal and Local Regulations/Policies

- 23 Code of Federal Regulations (CFR) 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, identifies the required process for the

evaluation of noise during National Environmental Policy Act studies as well as the requirement for the disclosure of traffic-noise information to local planning agencies for use in their land-use-planning activities (FHWA, 2004).

- Federal Highway Administration’s (FHWA’s) *Measurement of Highway-Related Noise* provides direction on how to conduct noise assessments (FHWA, 1996).
- Colorado Department of Transportation’s (CDOT’s) *Noise Analysis and Abatement Guidelines* directs how the FHWA noise regulations will be implemented for CDOT projects (CDOT, 2013). These guidelines include direction on conducting traffic-noise studies, analyzing abatement options, investigating construction noise levels, and coordinating noise-level information with local land-use-planning officials.

PEL STUDY SUMMARY

A Planning and Environmental Linkages Study (PEL) Study was prepared for the project in October 2009 by Felsburg Holt & Ullevig (FHU, 2009a). In addition, a *Traffic Noise Impact Analysis* was prepared as a supporting document to the PEL Study (FHU, 2009b). The PEL Study was performed for the portion Federal Boulevard between West 5th Avenue to West Howard Place, which extends an additional 0.25 mile south of the EA Project Area. The study area evaluated as part of the PEL Study includes residential, commercial, industrial, and public land uses.

Noise impacts occur when properties analyzed have noise levels at or above the relevant CDOT Noise Abatement Criteria (NAC) in the year 2035 or the noise levels in the year 2035 will have increased by 10 A-weighted decibels (dBA) or more over existing conditions modeled from the year 2008. Properties that were found to be impacted by noise were then considered for mitigation measures.

- No-Action Alternative: Under the No-Action Alternative identified in the PEL Study, 49 receivers (41 commercial properties and 8 residential or public-park properties) would be impacted by traffic noise in 2035.
- Proposed Action: Under the proposed action identified in the PEL Study, 41 (32 commercial properties and 9 residential or public park properties) receivers would be impacted by traffic noise in 2035, which was 8 fewer than the no-action alternative. The number of impacted receivers for the proposed action identified in the PEL Study was less than that of the no-action alternative because eight receivers (receptors) would be removed through right-of-way (ROW) property acquisitions. Property acquisition required for the PEL Study’s proposed action would also remove a building that is currently acting as a noise barrier for one of the motel receivers, thereby raising the motel’s noise level above CDOT’s impact threshold (66 dBA).
- Mitigation measures for impacted areas were evaluated according to the process in CDOT’s guidelines; however, no mitigation measures were recommended

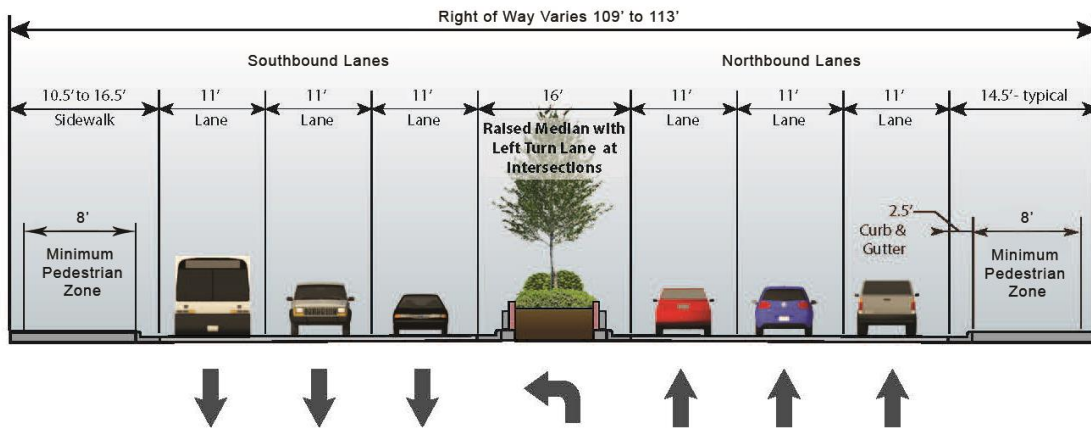
because proposed noise barriers were not considered feasible or reasonable under CDOT's NAC.

PROPOSED ACTION

The Proposed Action is to add a third northbound lane between West 7th Avenue and West 10th Avenue and a raised median throughout the Project Area to improve mobility and safety (Figure 2). North of West 10th Avenue, the width of the existing three northbound lanes would be brought up to standard (11 feet). The existing southbound lanes would also be brought up to standard width in areas where they are currently substandard.

Note that this Project Area differs from that of the PEL Study as the portion of Federal Boulevard to the south of West 7th Avenue, including the interchange with United States Highway 6 (US 6), is being addressed by the US 6 Bridges Design-Build project. However, the proposed improvements are consistent with the Proposed Action in the PEL Study.

Figure 2. Proposed Action



The widening of Federal Boulevard during the Proposed Action will meet American Association of State Highway and Transportation Officials (AASHTO) and CDOT standards. Access will be limited by controlling left-turns at non-signalized points. In the Proposed Action, the existing signalized crosswalks at the intersections of Federal Boulevard with West 8th Avenue and West 10th Avenue will be upgraded with new traffic and pedestrian signal indications and enhanced concrete crosswalks. Sidewalks on the west and east sides of the street will be brought up to Americans with Disabilities Act (ADA) standards; this will match the existing sections of Federal Boulevard to the north and south.

Access to bus service, which connects to local and regional destinations as well as the greater transit system, including the nearby West Line of RTD's LRT system, will be improved by upgrading the sidewalk to be consistent and compliant with ADA standards. Additionally, connectivity to the Weir Gulch Trail would be enhanced with better signage for the trail, reducing the curvature of the "T" intersection where the trail and sidewalk

connect along West 8th Avenue, signage for the Trail, and a wider sidewalk along West 8th Avenue, all of which support the City and County of Denver's (CCD's) Bicycle Master Plan (CCD, 2001) and Denver Moves (CCD, 2011). These improvements are anticipated to improve mobility, safety, and enhance multi-modal options within the Project Area.

In summary, the Proposed Action consists of the following elements:

- Federal Boulevard roadway alignment and improvements
 - Widening Federal Boulevard from the ROW boundary on the west side of Federal Boulevard toward the east between West 7th Avenue and approximately West 10th Avenue with an additional 11-foot northbound lane
 - Restriping and widening the three northbound lanes on Federal Boulevard between approximately West 10th Avenue to approximately West Howard Place to be 11 feet wide
 - Restriping and widening the three southbound lanes on Federal Boulevard between approximately West 7th Avenue and West 10th Avenue to be 11 feet wide
- Bicycle and pedestrian improvements
 - Improving the sidewalks on the east side of Federal Boulevard between West 7th Avenue and West 10th Avenue to meet ADA standards and better accommodate pedestrians
 - Standardizing inconsistent sidewalk widths on both the east and west sides of Federal Boulevard with an 8-foot pedestrian zone consisting of either a detached 5-foot sidewalk with a 3-foot buffer or an attached 8-foot sidewalk with ADA-compliant curb ramps and driveway cuts
 - Enhancing access to the Decatur-Federal LRT station through improved multi-modal connectivity by improving the sidewalks throughout the Project Area
 - Upgrading existing pedestrian signals and constructing enhanced concrete crosswalks at the signalized intersections of Federal Boulevard with West 8th Avenue and West 10th Avenue
 - Enhancing bicycle and pedestrian connectivity to the Weir Gulch Trail with better signage, wider sidewalks, and access ramps
 - Enhancing bicycle connectivity to Routes D-10 and D-12 by adding signage in the Project Area that meets CCD and CDOT standards

NO-ACTION ALTERNATIVE

The No-Action Alternative would leave Federal Boulevard as it currently is configured and would not provide any improvements beyond typical maintenance activities. The roadway would remain the same, with 3 southbound and 2 northbound lanes (each 9.5 to 11 feet in width) and a continuous two-way, center, left-turn median between West

7th Avenue and West 10th Avenue (Figure 3). The segment of Federal Boulevard from West 10th Avenue to West Howard Place has three southbound and three northbound lanes, and a continuous two-way left-turn median over Lakewood Gulch (Figure 4). The existing sidewalks along the both sides of Federal Boulevard in the Project Area are either narrow or not well-defined, and the curb ramps at intersections do not meet current ADA or CDOT standards. As part of State Highway 88, normal maintenance of Federal Boulevard would continue to be performed by CDOT. This includes the current direct discharge of stormwater to the nearby gulches.

Figure 3. No-Action Alternative between West 7th Avenue and West 10th Avenue

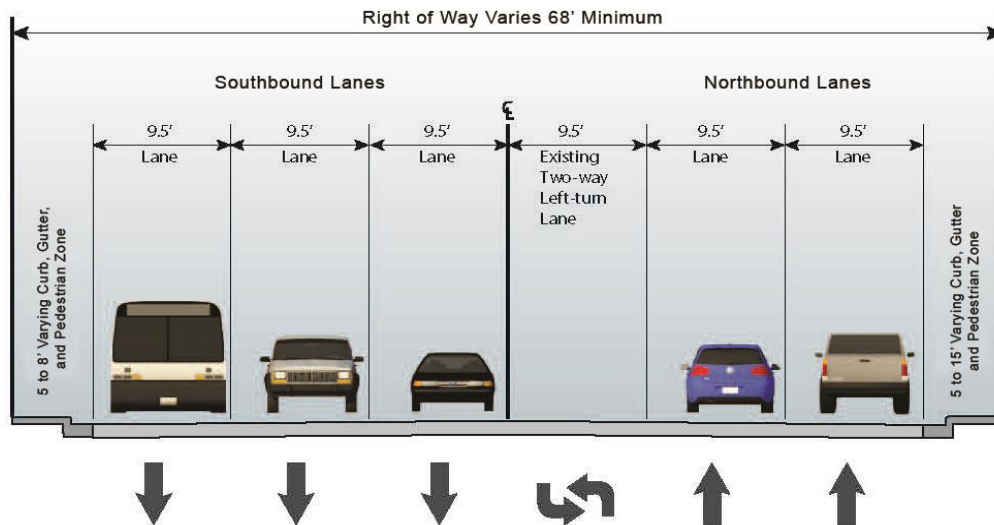
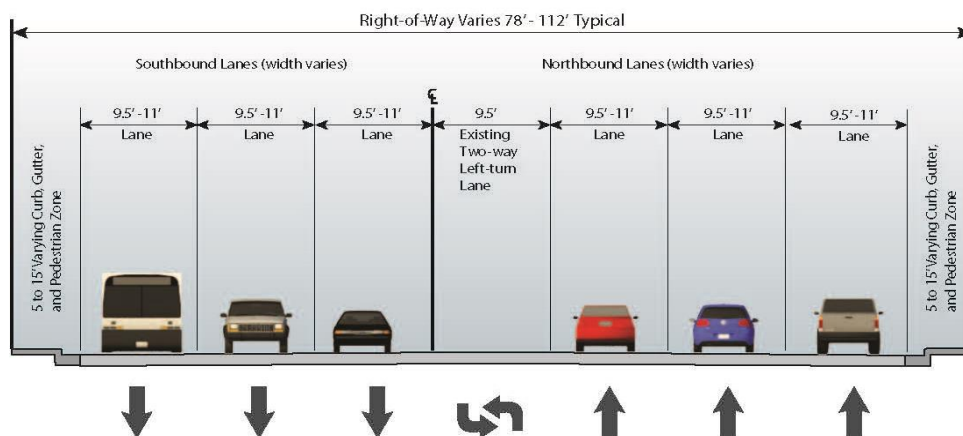


Figure 4. No-Action Alternative between West 10th Avenue and West Howard Place



METHODOLOGY

The noise assessment discussed in this Technical Memorandum was conducted in accordance with CDOT’s *Noise Analysis and Abatement Guidelines* (CDOT, 2013). CDOT noise guidelines are consistent with those of FHWA’s 23 CFR 772 and have been approved by FHWA for use on Federal-aid projects in Colorado. CDOT’s guidelines establish appropriate NAC and design requirements for noise mitigation. The guidelines state that noise mitigation should be considered for any receptor or group of receptors where predicted traffic noise, after consideration of design-year traffic volumes and roadway conditions, equal or exceed CDOT’s NAC, which are listed in Table 1. The guidelines also state that noise mitigation should be considered for any receptors where projected noise levels for design-year conditions create a “Substantial Increase Over Existing Levels,” which is defined by CDOT as 10 dBA or more.

For this noise assessment, noise levels were projected at residences and other noise-sensitive receptors located adjacent to Federal Boulevard between West 7th Avenue and West Howard Place as well as a 500-foot buffer per CDOT policy. Receptors and the land use at their location were identified during a field survey. Existing noise levels were measured at those locations and then used to validate the model. Receptors are considered to be impacted by noise when loudest-hour design-year noise levels are projected to equal or exceed CDOT’s NAC, or where design-year noise levels are predicted to exceed existing noise levels by 10 dBA or more. All noise-level projections were accomplished through the use of FHWA’s Traffic Noise Model (TNM) Version 2.5.

Table 1. CDOT Noise Abatement Criteria

| Activity Category ¹ | Activity in Leq(h)* | Location | Activity Description |
|--------------------------------|---------------------|----------|--|
| A | 56 | 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 |
| B1 | 66 | Exterior | Residential |
| C ² | 66 | Exterior | Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day-care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of religious worship, playgrounds, public-meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings |
| D | 51 | Interior | Auditoriums, day-care centers, hospitals, libraries, medical facilities, places of religious worship, public-meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios |

| Activity Category ¹ | Activity in Leq(h)* | Location | Activity Description |
|--------------------------------|---------------------|----------|---|
| E ² | 71 | Exterior | Hotels, motels, offices, restaurants, and bars as well as other developed lands, properties, or activities not included in A–D or F |
| F | N/A | N/A | Agriculture; airports; bus yards; emergency services; industrial, logging, and maintenance facilities; manufacturing, mining, rail yards, and retail facilities; ship yards; water-resources, water-treatment, and electrical utilities; and warehouses |

Table 2. CDOT Noise Abatement Criteria (*Continued*)

| Activity Category ¹ | Activity in Leq(h)* | Location | Activity Description |
|--------------------------------|---------------------|----------|---|
| G | N/A | N/A | Undeveloped lands that are not permitted for development. |

Notes:

Source: CDOT, 2013

¹ In February 2013, CDOT issued a new *Noise Analysis and Abatement Guideline* document, which supersedes the 2002 guidelines. The 2002 CDOT guidance was used during the PEL Study; therefore, some activity categories and activities Leg(h) have changed.

² Includes undeveloped lands permitted for this activity category.

* Hourly A-weighted sound level in dBA, reflecting a 1-dBA approach value below 23 CFR 772 values

Leq: The equivalent, steady-state sound level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same time period.

Leq(h): The hourly value of Leq.

To be included in a project, a potential noise-mitigation measure must first be found to be feasible. Criteria for the determination of a “feasible mitigation measure” include:

- The mitigation measure must be projected to achieve at least 5 dBA of noise reduction at the location of at least one impacted receptor.
- The mitigation measure must not create any “fatal flaw” safety or maintenance issues, such as reduced sight distances, shadowing of ice-prone areas, and interference with snow/debris removal.
- If a barrier is the mitigation measure under evaluation, it must be possible to construct it in a continuous manner, as gaps in noise barriers (e.g., for driveways) significantly degrade barriers’ performance.
- The maximum-allowable wall height is 20 feet. Walls requiring extraordinary cost will not be considered feasible. The slopes on either side of earthen berms should not exceed 2.5:1.
- Per CDOT’s guidance, if a noise barrier that has been evaluated for a particular location is deemed not to be feasible, an assessment of the reasonableness criteria is not required, and the noise-abatement evaluation is considered complete.

If a mitigation measure is found to be feasible, it is then analyzed for its “reasonableness.” A summary of the reasonableness criteria is as follows:

- The barrier needs to achieve a 7-dB reduction in noise for at least one benefited receptor.
- The cost-benefit index of the mitigation measure should not exceed \$6,800 per dB of reduction per benefited receptor, where a benefited receptor receives at least a 5-dB reduction from the barrier.
- An “Initial Benefitted Persons Preference Survey” shall be conducted. A barrier must receive more than 50 percent of the vote to be considered further.

Noise Level Prediction Methodology and Input Data

The FHWA’s TNM Version 2.5 was used to predict existing and design-year traffic-noise levels within the Noise Study Area. The TNM calculates the following:

- Hourly A-weighted equivalent noise level (Leq(h)) at a receptor’s location given the noise level of automobiles, medium trucks, and heavy trucks
- Volume and speed of each of these vehicle types on each roadway of interest
- Relative location of all roadways, receptors, and terrain features (i.e., natural and man-made barriers)
- Type of ground surface that exists between each receptor and each roadway

All measured and projected noise levels are expressed in dBA with A-weighting. The hourly equivalent noise levels are defined as the equivalent steady-state sound level that, in a given hourly period, contains the same acoustic energy as the time-varying sound for the same hourly period. Noise from traffic emanates from four primary sources: 1) tire/road interface, 2) engines, 3) aerodynamics, and 4) exhaust stacks. The dBA-weighted values are used to determine the noise impact upon potential receptors. The data used to model noise levels of this Project are discussed in the sections below.

Traffic-Noise Measurements

The traffic-noise measurements were taken on April 4, 2014, by a SoundPro DL-1 sound-level meter. The SoundPro DL-1 meets American National Standards Institute (ANSI) Type 2 specifications: the units employed were calibrated within the past 24 months by the manufacturer and were field-calibrated, prior to the measurements, with a Quest QC-10 calibrator. Noise measurements were made during weather conditions that were “acceptable” according to the FHWA guidance, including wind speed, and these weather conditions were monitored during the measurements (FHWA, 1996).

The noise-measurement equipment described above conforms to ANSI Standard S1.4 for Type 2 sound level meters. Acoustical calibrations, traceable to the U.S. National Institute of Standards and Technology (NIST), were carried out in the field before and after each set of measurements were taken. The measurement microphone was protected by a 3.5-

inch-diameter outdoor windscreen and located on a tripod approximately 5 feet above the ground. The microphone was positioned at each location to characterize the exposure to the dominant noise sources in the area. The measurement meters were configured to record the equivalent sound levels (Leq, dBA).

The traffic-noise measurements were taken from two locations in the Study Area (Figure 5). Short-term (10-minute) traffic-noise measurements were performed in duplicate, back-to-back intervals in the afternoon to document existing ambient conditions in the Study Area. Traffic volumes and truck percentages were counted, and traffic speeds were measured by driving a test vehicle through the Study Area during each noise measurement in order to validate the TNM model of the location (Appendix A). At the time the measurements were taken, winds were calculated to be between 5 and 7 miles per hour (MPH) with an average speed of approximately 6 MPH generally coming from the south to southeast. The temperature was approximately 47° Fahrenheit, and the relative humidity was approximately 29 percent.

Traffic-Noise Modeling Methods

Computer modeling was performed for existing conditions as well as for conditions forecasted for the year 2035 under the Proposed Action and No-Action Alternative. 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. In addition, modeling can evaluate a much more expansive scope of locations than can reasonably be measured in the field. Modeling results represent the typical average traffic conditions during peak noise periods. The ultimate purpose of these models is to show whether traffic-noise levels would be high enough to impact neighboring properties and, subsequently, whether noise mitigation should be evaluated or provided for such impacts within the Study Area.

The existing traffic conditions model was based upon the 2012 road configuration (which has not changed) and traffic volumes. The Proposed Action of this EA was modeled using the proposed roadway configuration and 2035 traffic volumes as forecasted by the traffic model developed during the PEL Study. The No-Action Alternative was modeled using the existing roadway configuration with the projected 2035 traffic volumes. The 2035 predicted afternoon peak traffic volumes were used because they are projected to be higher than the morning peak hour.

The TNM was used to calculate noise levels up to 500 feet from Federal Boulevard and at more than 100 points (Figure 5). This distance was sufficient to identify the receivers that could be impacted by the Proposed Action or the No-Action Alternative and follows CDOT's guidance (CDOT, 2013). In some cases, a single model point might represent several nearby receivers and properties where traffic and geography were similar (e.g., one point for residential homes in tight proximity to each other), so the number of model "points" is not always the same as the number of individual "receivers." The modeled roadways are roads that would be changed by the Proposed Action or are important local noise sources. The same model points are used in both the Proposed Action and the No-

Action Alternative for consistency, except where the Proposed Action would remove a specific receiver.

TNM requires a considerable amount of input data, including the geometry of the roadways as well as the traffic volumes, vehicle-fleet mix, and vehicle speeds. For consistency within this Memorandum, the CDOT's Online Transportation Information System 2012 and 2035 Annual Average Daily Traffic (AADT) was used (CDOT, 2014). In addition, a breakdown of the vehicle-fleet mix was also provided by CDOT and was used in this modeling effort (CDOT, 2014). The current locations of roads and streets were mapped and used in both the existing conditions and No-Action Alternative models, though because of changes to traffic volumes between the two scenarios, road parameters differed between the two modeled results. The Proposed Action was modeled to assess the possible noise impacts from roadway changes if the Proposed Action were to be implemented. In general, the following data were used in this modeling:

- Units: The units used in the modeling were feet and MPH.
- Current Roadway Alignments: The X-axis and Y-axis coordinates from computer-aided design (CAD) files and aerial photographs were used.
- Future Roadway Alignments: X-axis and Y-axis coordinates from CAD files also were used.
- Vehicle Speeds: The vehicle speeds ranged from 25–35 MPH..
- Traffic Volumes: These volumes were obtained from CDOT's Online Transportation Information System (afternoon peak hour).
- Vehicle Mix: The vehicle mix was taken from noise-measurement vehicle-count data and CDOT's Online Transportation Information System traffic data (included as Appendix B) (CDOT, 2014).

Figure 5. Study Area and Modeled Elements



- Elevations: Due to the relatively horizontal roadway surface and surrounding land use, TNM Z-elevation data was modeled as flat and receiver elevations were adjusted on a case-by-case basis.
- Structural barriers (i.e., buildings): Structural and other barriers were included, as appropriate, to emulate the existing area; mitigation barriers were added to the models, where appropriate, for the mitigation-measure evaluations.

EXISTING CONDITIONS

There are residential and commercial areas within the Study Area that are of interest to the Project as well as industrial and public property, including parks. The traffic-noise conditions for the year 2014 in the Study Area were assessed for model validation through a combination of measurements and modeling.

Traffic-Noise Measurements and Validation Model

Per consultation with CDOT, both of the two sets of validation measurements were taken at two locations, east and west of the Study Area (Rudel, February 13, 2014). Each location was judged to be representative of other nearby properties that have the same or different land use (Figure 4). A brief description of each measurement location is provided below:

- NM-01 is located at 1100 Federal Boulevard, approximately 90 feet west from the edge of Federal Boulevard and approximately 100 feet northeast of a residential home. The measurement location is level in elevation with Federal Boulevard, and there is a clear view of traffic on Federal Boulevard from the property. Little to no non-traffic-noise sources were audible during validation measurements.
- NM-02 is located at 815 Federal Boulevard, approximately 70 feet east from the edge of Federal Boulevard and about 100 feet northwest of the Westside Community Health Center. The measurement location is level in elevation with Federal Boulevard, and there is a clear view of traffic on Federal Boulevard from the property. Little to no non-traffic-noise sources were audible during validation measurements.

Traffic volumes observed during the validation measurements are listed in Table 2. The traffic data were input into the “Existing Conditions” TNM model. Resulting noise levels projected by the TNM were compared to the noise levels actually measured at the Project locations described above in order to validate the accuracy of the model. The measured and predicted noise levels and the validation results are shown in Table 2. The model over-predicted noise levels by 0.3 to 0.8 dB, which is within the ± 3 -dBA tolerance considered acceptable for highway noise analyses (CDOT, 2013).

Table 3. Verification Noise Model Results

| Location | Location (Shown in Figure 5) | Measured Noise Level (dBA) | Verification Model Result (dBA) | Predicted Minus Measured (dBA) |
|----------|---------------------------------|----------------------------------|---------------------------------------|---|
| NM-01 | 1100 Federal Boulevard | 63.6 | 63.3 | 0.3 |
| NM-02 | 815 Federal Boulevard | 66.5 | 65.7 | 0.8 |

Note:

*Noise levels were measured as Leq(h).

Existing Traffic-Noise Model Results

The Existing Conditions model used traffic volumes from the year 2012 and included the major existing roads that could be affected if the Proposed Action were to be implemented. More than 100 receptors were modeled for traffic noise (Figure 5).

Overall, the calculated noise-level range for the model receptors was 52 to 71 dBA (Appendix C). Modeled receptors that represent seven receivers, all Category E, were calculated to have existing traffic noise above the respective NAC during the afternoon peak hour. The Existing Conditions model results were consistent with the measurement results in that some Study Area locations currently meet or exceed the applicable CDOT NAC.

IMPACT ASSESSMENT

The traffic-noise modeling effort was conducted to assess whether future noise levels near the Project’s Federal Boulevard corridor would exceed relevant CDOT or FHWA thresholds under either the Proposed Action or the No-Action Alternative. If so, mitigation measures to moderate the projected impacts were considered and evaluated for the Proposed Action in accordance with CDOT guidelines.

No-Action Alternative Year 2035 Results

The areas impacted under the existing conditions in the year 2012 also would be impacted under the No-Action Alternative in the year 2035 (Figure 6). The traffic-noise patterns of the No-Action Alternative are similar to those of the existing conditions, although noise levels extended slightly farther away from Federal Boulevard, due to increased traffic volumes in 2035. This noise-level propagation makes the impacted area larger overall, resulting in a higher number of impacted receivers.

For the No-Action Alternative in the year 2035, 16 receivers in the Study Area would be at or above the respective NAC and would be impacted by traffic noise (Table 3 and Figure 6). All impacted receptors are Category E properties. The calculated noise levels at the modeled receptors ranged from 52 to 72 dBA (Appendix C). The largest projected noise increase over existing conditions was 1.0 dBA. None of the NAC Category B and C receivers were calculated to be at or above 66 dBA in the year 2035 under the No-Action Alternative.

Figure 6. Forecasted 2035 No-Action Noise Impacted Receivers



Proposed Action 2035 Results

For the Proposed Action, 15 receivers in the Study Area were calculated to be at or above the NAC and impacted by traffic noise (Figure 7), which is one receiver less than the No-Action Alternative (Table 3). Of those receivers impacted, all are Category E. Overall, the calculated noise level at the modeled receptors ranged from 52 to 72 dBA (Appendix C). The largest projected noise increase over existing conditions was 1.8 dBA.

The number of impacted receivers for the Proposed Action is one less than would be impacted under the No-Action Alternative, due to acquisition of one property.

Table 4. Summary of Traffic-Noise Impacts

| Property Type | Activity in Leq(h)* | Number of Properties Impacted: Existing Conditions (2012) | Number of Properties Impacted: No-Action Alternative (2035) | Number of Properties Impacted: Proposed Action (2035) |
|------------------------|---------------------|---|---|---|
| NAC Categories B and C | 66 | 0 | 0 | 0 |
| NAC Category E | 71 | 7 | 16 | 15 |

Note:

*Hourly A-weighted sound level in dBA, reflecting a 1-dBA approach value below 23 CFR 772 values

Summary of Traffic-Noise Impacts

Traffic-noise impacts were projected for both the Proposed Action and the No-Action Alternative for 2035. The projected impacts (without mitigation) are summarized in Table 3. In general, receptors within approximately 50 feet of Federal Boulevard were found to be impacted by traffic noise. The impacted receptors were “front row” relative to Federal Boulevard. The primary difference between the Proposed Action and the No-Action Alternative is that the Proposed Action would impact fewer receivers than the No-Action Alternative because several properties where current receptors are located would need to be acquired for ROWs.

Table 5. Traffic-Noise Impacts

| Resource | Proposed Action Alternative | No-Action Alternative |
|---|---|--|
| Federal Boulevard between West 7 th Avenue and West Howard Place is an urbanized corridor with 116 receptors within 500 feet of Federal Boulevard between West 7 th Avenue and West Howard Place. Adjacent land uses include commercial, industrial, and public properties. | Permanent Impacts: Fifteen commercial receptors would be impacted by noise in 2035 under the Proposed Action, which is one less than the No-Action Alternative. The number of impacted receptors for the Proposed Action is reduced because one receptor impacted under the No-Action Alternative would be removed through ROW acquisition. | Permanent Impacts: Sixteen commercial receptors out of 116 overall would be impacted by traffic noise in 2035 if the No-Action Alternative were to be implemented. Temporary Impacts: No temporary noise impacts would occur if the No-Action Alternative were to be implemented. |

Traffic-Noise Impact Assessment for the Federal Boulevard Improvements EA

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|--|---|--|
| | <p>Temporary Impacts: Noise levels may increase temporarily during construction.</p> | |
|--|---|--|

Figure 7. Forecasted 2035 Proposed Action Impacted Receivers



MITIGATION MEASURES

The results of this traffic-noise assessment indicate that 15 receptors would be impacted by noise if the Proposed Action were to be implemented (Table 3). Therefore, potential mitigation measures for the impacted receptors under the Proposed Action were investigated in accordance with relevant guidelines (CDOT, 2013; FHWA, 1995). Although impacted areas are not guaranteed mitigation measures under these guidelines, mitigation measures for the areas must be evaluated for feasibility and reasonableness. Reasonableness includes an assessment of mitigation benefits and costs.

Although several types of noise mitigation were considered, barriers are the only viable mitigation measure and are the only mitigation that was assessed by computer modeling. CDOT has several criteria to evaluate noise barriers. CDOT's minimum noise reduction is 5 dBA for a barrier to be feasible, with a 10-dBA reduction goal (CDOT, 2013).

Evaluation of Mitigation Other than Barriers

CDOT guidelines require the evaluation of several non-barrier mitigation options. For a variety of reasons that are described below, none of these options are viable in regard to the Proposed Action.

Traffic-management measures, such as lane closures or reduced speeds, could reduce noise, but they are not reasonable for this Project as they do not meet the purpose and needs of this Project. One need of the Project is to improve mobility; hence, closing lanes would not be compatible with the overall purpose of the Project. The speed limit on Federal Boulevard is currently 35 MPH and reducing that limit would not be practical for such an arterial street. Therefore, the traffic-management actions are not viable for noise mitigation.

Changes in the horizontal alignment of Federal Boulevard near the impacted receptors could reduce noise at those locations, but this change in alignment has limited possibilities for implementation during the Proposed Action. The Federal Boulevard corridor has horizontal-alignment constraints because the area is fully developed with a high number of access points, and many buildings are only a few feet from the Boulevard itself. Seven commercial-property acquisitions for ROWs are associated with the Proposed Action, and changes to the horizontal alignment of roadway would only increase this number. There does not appear to be any reasonable horizontal-alignment choices for the Proposed Action.

Noise buffer zones could reduce noise levels, but there are no opportunities for such buffer zones in the Project Area due to existing land uses. Creation of buffer zones would require substantial property acquisition and displacement of impacted receptors, which is neither desirable nor practicable.

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 Proposed Action when

minimum requirements for safety, durability, and so on are also met. However, this cannot be identified as a mitigation measure under this noise assessment, because such treatments are not a “permanent” solution.

Traffic-Noise Barrier Evaluations

Noise barriers were evaluated for all impacted receptors as a mitigation measure. Most of the impacted properties are commercial businesses, and commercial businesses typically do not have noise-sensitive exterior uses. Noise barriers would make a given business less visible from the street and could interfere with established property-access points. Barriers would need to be essentially continuous along Federal Boulevard to provide any kind of effective noise benefit, but this formation would obstruct the numerous curb cuts required by the Proposed Action as well as impede direct access to most businesses. A continuous barrier would also pose problems for pedestrians, who intend to access businesses from the sidewalk, and it would also introduce safety issues related to police- and fire-department access.

No Category B or C properties were identified as impacted by the Proposed Action. Barriers protecting the impacted Category E areas (i.e., commercial properties) were evaluated through the TNM models. Each potential barrier was assessed for effectiveness and feasibility. If the minimum parameters for an effective barrier were met and the barrier was feasible, the barrier was evaluated for reasonability according to CDOT’s guidance (CDOT, 2013). The Category E locations evaluated for noise barriers are shown in Figure 7 and modeled noise-barrier locations are shown in Figure 8. The feasibility and reasonableness of each barrier determined whether the barrier was recommended for this Project (Table 4 and Appendix D).

Development of potential barrier locations was complicated by the need to maintain access to the affected (and neighboring) properties. Often the need to maintain access meant that gaps in the barriers were necessary, which in turn reduces barrier effectiveness. To minimize long-term ownership and maintenance considerations for these barriers, it was assumed that the barriers would be on Federal Boulevard’s ROW. It is important to note that noise barriers can be either earthen berms or constructed walls and that a variety of materials can be used as effective constructed barriers. Berms can be very effective, but they occupy considerably more space than comparable walls. Throughout the Study Area, the impacted receptors are very close to the roadway. This made earthen berms impractical or impossible choices for the noise barriers in this particular Study Area.

Barrier cost-effectiveness was based upon an assumed cost of \$45/square foot of barrier and compared to the CDOT’s maximum reasonable cost index of \$6,800/receptor/decibel. The barrier evaluation results are summarized in Table 6.

Figure 8. Modeled Noise Walls

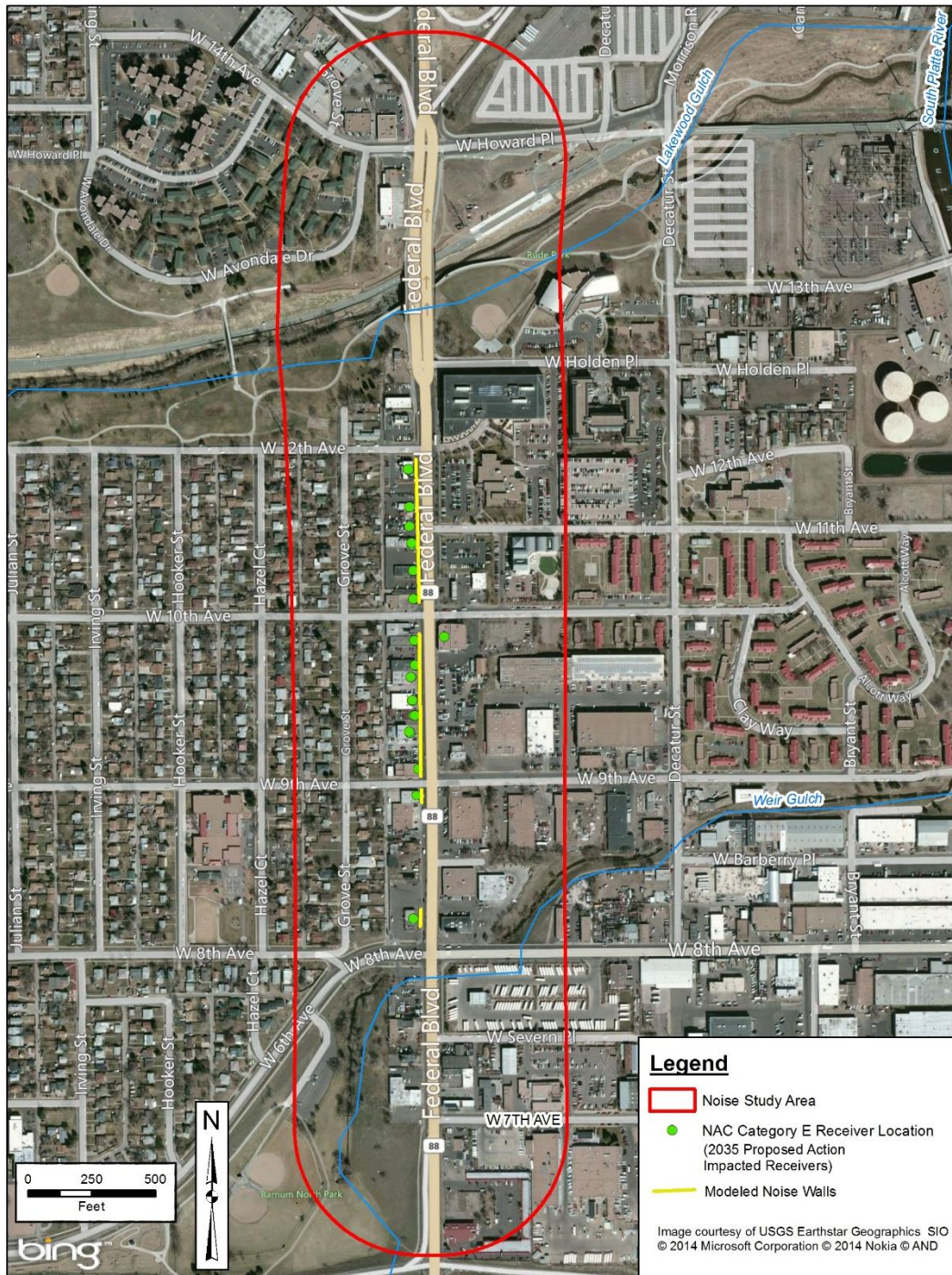


Table 6. Traffic-Noise Mitigation Barrier Summary

| Noise-Impacted Category E Area (Figure 8) | Average Barrier Height (feet) | Barrier Length (feet) | Reduction in dBA? | Feasible? | Reasonable? | Barrier Recommended? | Comment |
|---|-------------------------------|-----------------------|-------------------|-----------|-------------|----------------------|--|
| North of 10 th Avenue | 7 | 555 | 38 | No | No | No | Blocks sidewalk and emergency-response access. Would result in inadequate sight distances. |
| South of 10 th Avenue | 10 | 396 | 38 | No | No | No | Blocks sidewalk and emergency-response access. Would result in inadequate sight distances. |
| South of 9 th Avenue | 8 | 154 | 11 | No | No | No | Blocks sidewalk and emergency-response access. Would result in inadequate sight distances. |
| North of 8 th Avenue | 10 | 67 | 5 | No | No | No | Blocks sidewalk and emergency-response access. Would result in inadequate sight distances. |

Construction Noise for the Proposed Action

Adjoining properties throughout the Study Area could be exposed to noise from construction activities if the Proposed Action were to be implemented. As described in the PEL Study, construction noise differs from traffic noise in several ways, including:

- Construction noise lasts only for the duration of the construction activities, with most construction in noise-sensitive areas being conducted during hours that are the least disturbing to adjacent and nearby residents.
- Construction activities are generally short-term and, depending upon the nature of the construction, could last from seconds (e.g., a truck passing a receptor) to months (e.g., roadway widening).
- 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 traffic noise; there are no CDOT NACs for construction noise. Construction noise would be subject to pertinent local regulations and ordinances, and all construction activities would be expected to comply with them.

Very little of the Project Area corridor directly abuts residential areas, although homes are located a one-half block from Federal Boulevard. To address the temporarily elevated noise levels that could be experienced during construction, standard mitigation measures

will be incorporated into the construction contracts let for the Proposed Action where it is feasible to do so. These measures will include:

- Exhaust systems on equipment will be in good working order. Equipment will be maintained on a regular basis, and will be subject to inspection by the project manager to ensure maintenance.
- Properly designed engine enclosures and intake silencers will be used where appropriate.
- New equipment will be subject to new-product noise-emission standards.
- Stationary equipment will be located as far from sensitive receptors as possible.
- Most construction activities in noise-sensitive areas will be conducted during hours that are least disturbing to the general public. If night work is anticipated, a temporary noise-variance permit with the CCD will be required.
- Compliance with CCD noise regulations (Municipal Code, Chapter 36).

In cases where CCD noise regulations might be violated by construction activities, a variance will be requested from the Department of Environmental Health Summary of Recommended Mitigation Measures

Fifteen NAC Category E areas were identified in the Study Area as being impacted by traffic noise if the Proposed Action were to be implemented. Consistent with the PEL Study, mitigation measures for these areas were evaluated for this EA (Appendix C), and no mitigation measures are recommended for the reasons described above (Table 4). These findings have been based upon the specific Project design as of April 2014; should design refinement substantially change the vertical or horizontal alignments, the assessment would require revision.

REQUIRED PERMITS

Construction will be scheduled during evening hours to lessen the concomitant impacts to neighborhood traffic and safety. If night work were to occur as part of the construction phase of the Federal Boulevard Improvements Project, a temporary noise-variance permit from the CCD will be required.

STAKEHOLDER COORDINATION

The CCD has continued to provide opportunities for public involvement between the PEL Study in 2009 and initiation of this EA. A public meeting was held in August 14, 2014 prior to the completion of this EA to solicit further comment on and discussion of the Project. A Spanish-speaking translator was present at the open house, and materials were presented in both English and Spanish; Korean translation was available upon request. Stakeholder coordination will continue to take place throughout the Project's development and construction.

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- FHU, 2009b. "Federal Boulevard (5th Avenue to Howard Place) Traffic Noise Impact Analysis," Felsburg Holt and Ullevig, June 2009.
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APPENDIX A – DATA VALIDATION MEASUREMENT DATA

| Field Noise Measurements | | | | |
|---------------------------------|------------------------|-------------------|------------------|------------------|
| Project: | Federal Reconstruction | | | |
| Date: | 4/4/2014 | | | |
| Personnel: | T.Sparks S. Fanello | | | |
| Equipment: | SoundPro DL | | | |
| Version: | DL-2-1/3 | | | |
| Serial #: | BIJ090027 | | | |
| Weather: | Sunny | | | |
| Wind Speed: | 7 mph | | | |
| Wind Direction: | South | | | |
| Temperature: | 47 Degrees | | | |
| Relative Humidity: | 29% | | | |
| Noise Measurement #01 | | | | |
| Location: | NM-01 | | | |
| Start Time: | 1355 | | | |
| End Time: | 1405 | | | |
| Leq: | 63.6 dBA | | | |
| | Northbound | Southbound | Eastbound | Westbound |
| Speed: | 35 | 35 | NA | NA |
| Automobiles | 201 (1206) | 188 (1128) | NA | NA |
| Medium Trucks | 1 (6) | 1 (6) | | |
| Heavy Trucks | 1 (6) | 3 (18) | | |
| Buses | 2 (12) | 2 (12) | | |
| Motorcycles | 0 (0) | 2 (12) | | |

| Field Noise Measurements | | | | |
|---------------------------------|------------------------|-------------------|------------------|------------------|
| Project: | Federal Reconstruction | | | |
| Date: | 4/4/2014 | | | |
| Personnel: | T.Sparks S. Fanello | | | |
| Equipment: | SoundPro DL | | | |
| Version: | DL-2-1/3 | | | |
| Serial #: | BIJ090027 | | | |
| Weather: | Sunny | | | |
| Wind Speed: | 7 mph | | | |
| Wind Direction: | South | | | |
| Temperature: | 47 Degrees | | | |
| Relative Humidity: | 29% | | | |
| Noise Measurement #02 | | | | |
| Location: | NM-02 | | | |
| Start Time: | 1415 | | | |
| End Time: | 1425 | | | |
| Leq: | 66.5 dBA | | | |
| | Northbound | Southbound | Eastbound | Westbound |
| Speed: | 35 | 35 | NA | NA |
| Automobiles | 158 (948) | 200 (1200) | NA | NA |
| Medium Trucks | 3 (18) | 4 (24) | | |
| Heavy Trucks | 2 (12) | 3 (18) | | |
| Buses | 5 (30) | 2 (12) | | |
| Motorcycles | 0 (0) | 0 (0) | | |

APPENDIX B - CDOT ONLINE TRANSPORTATION INFORMATION
SYSTEM TRAFFIC DATA

Colorado Department of Transportation - Online Transportation Information System (OTIS)

| Analysis Year | Station ID | Route | Beg Ref | End Ref | AADT | Year | AADT Single | AADT Combined | Percent Trucks | Description | Projected AADT | Projected Single Trucks | Projected Combined Trucks |
|---------------|------------|-------|---------|---------|--------|------|-------------|---------------|----------------|--|----------------|-------------------------|---------------------------|
| 2012 | 103836 | 088A | 0 | 0.14 | 35,000 | 2012 | 1,300 | 460 | 5.1 | ON SH 88 FEDERAL BLVD S/O SH 40 COLFAX AVE | NA | NA | NA |
| 2035 | 103836 | 088A | 0 | 0.14 | 35,000 | 2012 | 1,300 | 460 | 5.1 | ON SH 88 FEDERAL BLVD S/O SH 40 COLFAX AVE | 39,025 | 1,450 | 513 |

Source: CDOT, 2014

CDOT Online Traffic Data 2012 and 2035 AADT, % vehicle type, 16:00 Hour

| Data Validation | Northbound | Southbound Total | Southbound Lane 1 | Southbound Lane 2 | Speed | | | | | | | | |
|----------------------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|----------------------|----------------------|-----------|
| Autos | 1206 | 1128 | 564 | 564 | 35 | | | | | | | | |
| Medium Trucks | 6 | 6 | 3 | 3 | 35 | | | | | | | | |
| Heavy Trucks | 6 | 18 | 9 | 9 | 35 | | | | | | | | |
| Buses | 12 | 12 | 6 | 6 | 35 | | | | | | | | |
| Motorcycles | 0 | 12 | 6 | 6 | 35 | | | | | | | | |
| 2012 Existing | Northbound | Southbound Total | Southbound Lane 1 | Southbound Lane 2 | Speed | Eastbound 10th Avenue | Westbound 10th Avenue | Speed | Eastbound 8th Avenue | Westbound 8th Avenue | Speed | | |
| Total | 1719 | 1938 | NA | NA | NA | 31 | 81 | NA | 70 | 436 | NA | | |
| Autos | 1633 | 1841 | 921 | 921 | 35 | 29 | 77 | 30 | 67 | 414 | 35 | | |
| Medium Trucks | 64 | 72 | 36 | 36 | 35 | 1 | 3 | 30 | 3 | 16 | 35 | | |
| Heavy Trucks | 22 | 25 | 13 | 13 | 35 | 0 | 1 | 30 | 1 | 6 | 35 | | |
| 2035 No Build | Northbound | Southbound Total | Southbound Lane 1 | Southbound Lane 2 | Speed | Eastbound 10th Avenue | Westbound 10th Avenue | Speed | Eastbound 8th Avenue | Westbound 8th Avenue | Speed | | |
| Total | 2018 | 2275 | NA | NA | NA | 35 | 95 | NA | 90 | 575 | NA | | |
| Autos | 1917 | 2161 | 1081 | 1081 | 35 | 33 | 90 | 30 | 86 | 546 | 35 | | |
| Medium Trucks | 75 | 84 | 42 | 42 | 35 | 1 | 4 | 30 | 3 | 21 | 35 | | |
| Heavy Trucks | 26 | 30 | 15 | 15 | 35 | 0 | 1 | 30 | 1 | 7 | 35 | | |
| 2035 Proposed Action | Northbound Total | Northbound Lane 1 | Northbound Lane 2 | Southbound Total | Southbound Lane 1 | Southbound Lane 2 | Speed | Eastbound 10th Avenue | Westbound 10th Avenue | Speed | Eastbound 8th Avenue | Westbound 8th Avenue | Speed |
| Total | 2018 | NA | NA | 2275 | NA | NA | NA | 35.00 | 95.00 | NA | 90 | 575 | NA |
| Autos | 1917 | 959 | 959 | 2161 | 1081 | 1081 | 35 | 33 | 90 | 30 | 86 | 546 | 35 |
| Medium Trucks | 75 | 37 | 37 | 84 | 42 | 42 | 35 | 1 | 4 | 30 | 3 | 21 | 35 |
| Heavy Trucks | 26 | 13 | 13 | 30 | 15 | 15 | 35 | 0 | 1 | 30 | 1 | 7 | 35 |

Notes:
 AADT Annual Average Daily Traffic
 NA Not Applicable

APPENDIX C – TNM SOUND LEVEL RESULTS

RESULTS: SOUND LEVELS

1/11-670-02

| | | | | | | | | | | | |
|------------------------------|--|---|--|--|--|--------------------------------|--|---|--|--|--|
| Pinyon Environmental | | | | | | 13 May 2014 | | | | | |
| T.Sparks | | | | | | TNM 2.5 | | | | | |
| | | | | | | Calculated with TNM 2.5 | | | | | |
| RESULTS: SOUND LEVELS | | | | | | | | | | | |
| PROJECT/CONTRACT: | | 1/11-670-02 | | | | | | | | | |
| RUN: | | Federal Reconstruction Existing 2012 | | | | | | | | | |
| BARRIER DESIGN: | | INPUT HEIGHTS | | | | | | Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA. | | | |
| ATMOSPHERICS: | | 68 deg F, 50% RH | | | | | | | | | |

| Receiver | | | | | | | | | | | | |
|-----------------|------------|-------------|-----------------|-------------------|---------------|-------------------------------|---------------------|-------------------|------------------------|-------------------|------------------------------|-----------|
| Name | No. | #DUs | Existing | No Barrier | | | With Barrier | | | | Calculated minus Goal | |
| | | | LAeq1h | LAeq1h | Crit'n | Increase over existing | Type | Calculated | Noise Reduction | | | |
| | | | | Calculated | Crit'n | Calculated | Crit'n | Impact | LAeq1h | Calculated | Goal | |
| | | | dBA | dBA | dBA | dB | dB | | dBA | dB | dB | dB |
| R-1 | 5 | 1 | 0.0 | 55.3 | 66 | 55.3 | 10 | ---- | 55.3 | 0.0 | 10 | -10.0 |
| R-2 | 6 | 1 | 0.0 | 57.7 | 66 | 57.7 | 10 | ---- | 57.7 | 0.0 | 10 | -10.0 |
| R-3 | 7 | 1 | 0.0 | 57.6 | 66 | 57.6 | 10 | ---- | 57.6 | 0.0 | 10 | -10.0 |
| R-4 | 8 | 1 | 0.0 | 57.2 | 66 | 57.2 | 10 | ---- | 57.2 | 0.0 | 10 | -10.0 |
| R-5 | 9 | 1 | 0.0 | 57.5 | 66 | 57.5 | 10 | ---- | 57.5 | 0.0 | 10 | -10.0 |
| R-6 | 10 | 1 | 0.0 | 57.3 | 66 | 57.3 | 10 | ---- | 57.3 | 0.0 | 10 | -10.0 |
| R-7 | 11 | 1 | 0.0 | 57.3 | 66 | 57.3 | 10 | ---- | 57.3 | 0.0 | 10 | -10.0 |
| R-8 | 12 | 1 | 0.0 | 57.7 | 66 | 57.7 | 10 | ---- | 57.7 | 0.0 | 10 | -10.0 |
| R-9 | 13 | 1 | 0.0 | 57.3 | 66 | 57.3 | 10 | ---- | 57.3 | 0.0 | 10 | -10.0 |
| R-10 | 14 | 1 | 0.0 | 57.2 | 66 | 57.2 | 10 | ---- | 57.2 | 0.0 | 10 | -10.0 |
| R-11 | 15 | 1 | 0.0 | 57.6 | 66 | 57.6 | 10 | ---- | 57.6 | 0.0 | 10 | -10.0 |
| R-12 | 16 | 1 | 0.0 | 57.8 | 66 | 57.8 | 10 | ---- | 57.8 | 0.0 | 10 | -10.0 |
| R-13 | 17 | 1 | 0.0 | 57.4 | 66 | 57.4 | 10 | ---- | 57.4 | 0.0 | 10 | -10.0 |
| R-14 | 18 | 1 | 0.0 | 58.0 | 66 | 58.0 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 |
| R-15 | 19 | 1 | 0.0 | 59.7 | 66 | 59.7 | 10 | ---- | 59.7 | 0.0 | 10 | -10.0 |
| R-16 | 20 | 1 | 0.0 | 58.7 | 66 | 58.7 | 10 | ---- | 58.7 | 0.0 | 10 | -10.0 |
| R-17 | 21 | 1 | 0.0 | 57.7 | 66 | 57.7 | 10 | ---- | 57.7 | 0.0 | 10 | -10.0 |
| R-18 | 22 | 1 | 0.0 | 57.9 | 66 | 57.9 | 10 | ---- | 57.9 | 0.0 | 10 | -10.0 |
| R-19 | 23 | 1 | 0.0 | 57.5 | 66 | 57.5 | 10 | ---- | 57.5 | 0.0 | 10 | -10.0 |
| R-20 | 24 | 1 | 0.0 | 57.9 | 66 | 57.9 | 10 | ---- | 57.9 | 0.0 | 10 | -10.0 |
| R-21 | 25 | 1 | 0.0 | 57.7 | 66 | 57.7 | 10 | ---- | 57.7 | 0.0 | 10 | -10.0 |
| R-22 | 26 | 1 | 0.0 | 57.5 | 66 | 57.5 | 10 | ---- | 57.5 | 0.0 | 10 | -10.0 |
| R-23 | 27 | 1 | 0.0 | 57.3 | 66 | 57.3 | 10 | ---- | 57.3 | 0.0 | 10 | -10.0 |
| R-24 | 28 | 1 | 0.0 | 57.2 | 66 | 57.2 | 10 | ---- | 57.2 | 0.0 | 10 | -10.0 |

RESULTS: SOUND LEVELS

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| | | | | | | | | | | | | |
|------|----|---|-----|------|----|------|----|---------|------|-----|----|-------|
| R-25 | 29 | 1 | 0.0 | 57.2 | 66 | 57.2 | 10 | ---- | 57.2 | 0.0 | 10 | -10.0 |
| R-26 | 30 | 1 | 0.0 | 57.4 | 66 | 57.4 | 10 | ---- | 57.4 | 0.0 | 10 | -10.0 |
| R-27 | 31 | 1 | 0.0 | 57.3 | 66 | 57.3 | 10 | ---- | 57.3 | 0.0 | 10 | -10.0 |
| R-28 | 34 | 1 | 0.0 | 57.1 | 66 | 57.1 | 10 | ---- | 57.1 | 0.0 | 10 | -10.0 |
| R-29 | 35 | 1 | 0.0 | 58.1 | 66 | 58.1 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 |
| R-30 | 36 | 1 | 0.0 | 58.0 | 66 | 58.0 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 |
| R-31 | 37 | 1 | 0.0 | 58.2 | 66 | 58.2 | 10 | ---- | 58.2 | 0.0 | 10 | -10.0 |
| R-32 | 38 | 1 | 0.0 | 58.9 | 66 | 58.9 | 10 | ---- | 58.9 | 0.0 | 10 | -10.0 |
| R-33 | 39 | 1 | 0.0 | 58.4 | 66 | 58.4 | 10 | ---- | 58.4 | 0.0 | 10 | -10.0 |
| R-34 | 40 | 1 | 0.0 | 58.8 | 66 | 58.8 | 10 | ---- | 58.8 | 0.0 | 10 | -10.0 |
| R-35 | 41 | 1 | 0.0 | 59.1 | 66 | 59.1 | 10 | ---- | 59.1 | 0.0 | 10 | -10.0 |
| R-36 | 42 | 1 | 0.0 | 59.3 | 66 | 59.3 | 10 | ---- | 59.3 | 0.0 | 10 | -10.0 |
| R-37 | 43 | 1 | 0.0 | 60.9 | 66 | 60.9 | 10 | ---- | 60.9 | 0.0 | 10 | -10.0 |
| R-38 | 44 | 1 | 0.0 | 55.1 | 66 | 55.1 | 10 | ---- | 55.1 | 0.0 | 10 | -10.0 |
| R-39 | 45 | 1 | 0.0 | 52.2 | 66 | 52.2 | 10 | ---- | 52.2 | 0.0 | 10 | -10.0 |
| R-40 | 47 | 1 | 0.0 | 52.8 | 66 | 52.8 | 10 | ---- | 52.8 | 0.0 | 10 | -10.0 |
| R-41 | 48 | 2 | 0.0 | 53.4 | 66 | 53.4 | 10 | ---- | 53.4 | 0.0 | 10 | -10.0 |
| R-42 | 49 | 2 | 0.0 | 53.5 | 66 | 53.5 | 10 | ---- | 53.5 | 0.0 | 10 | -10.0 |
| R-43 | 50 | 2 | 0.0 | 53.6 | 66 | 53.6 | 10 | ---- | 53.6 | 0.0 | 10 | -10.0 |
| R-44 | 51 | 2 | 0.0 | 54.5 | 66 | 54.5 | 10 | ---- | 54.5 | 0.0 | 10 | -10.0 |
| R-45 | 52 | 2 | 0.0 | 54.7 | 66 | 54.7 | 10 | ---- | 54.7 | 0.0 | 10 | -10.0 |
| R-46 | 53 | 2 | 0.0 | 54.0 | 66 | 54.0 | 10 | ---- | 54.0 | 0.0 | 10 | -10.0 |
| R-47 | 54 | 2 | 0.0 | 53.9 | 66 | 53.9 | 10 | ---- | 53.9 | 0.0 | 10 | -10.0 |
| R-48 | 55 | 2 | 0.0 | 54.1 | 66 | 54.1 | 10 | ---- | 54.1 | 0.0 | 10 | -10.0 |
| R-49 | 56 | 2 | 0.0 | 53.9 | 66 | 53.9 | 10 | ---- | 53.9 | 0.0 | 10 | -10.0 |
| R-50 | 57 | 2 | 0.0 | 53.9 | 66 | 53.9 | 10 | ---- | 53.9 | 0.0 | 10 | -10.0 |
| R-51 | 58 | 2 | 0.0 | 54.8 | 66 | 54.8 | 10 | ---- | 54.8 | 0.0 | 10 | -10.0 |
| R-52 | 59 | 2 | 0.0 | 63.1 | 66 | 63.1 | 10 | ---- | 63.1 | 0.0 | 10 | -10.0 |
| R-53 | 60 | 1 | 0.0 | 56.4 | 66 | 56.4 | 10 | ---- | 56.4 | 0.0 | 10 | -10.0 |
| R-54 | 61 | 1 | 0.0 | 55.4 | 71 | 55.4 | 10 | ---- | 55.4 | 0.0 | 10 | -10.0 |
| R-55 | 62 | 1 | 0.0 | 58.4 | 71 | 58.4 | 10 | ---- | 58.4 | 0.0 | 10 | -10.0 |
| R-56 | 63 | 1 | 0.0 | 56.8 | 71 | 56.8 | 10 | ---- | 56.8 | 0.0 | 10 | -10.0 |
| R-57 | 64 | 1 | 0.0 | 57.3 | 71 | 57.3 | 10 | ---- | 57.3 | 0.0 | 10 | -10.0 |
| C-1 | 65 | 1 | 0.0 | 69.9 | 71 | 69.9 | 10 | ---- | 69.9 | 0.0 | 10 | -10.0 |
| C-2 | 66 | 1 | 0.0 | 69.1 | 71 | 69.1 | 10 | ---- | 69.1 | 0.0 | 10 | -10.0 |
| C-3 | 67 | 1 | 0.0 | 69.2 | 71 | 69.2 | 10 | ---- | 69.2 | 0.0 | 10 | -10.0 |
| C-4 | 68 | 1 | 0.0 | 71.0 | 71 | 71.0 | 10 | Snd Lvl | 71.0 | 0.0 | 10 | -10.0 |
| C-5 | 69 | 1 | 0.0 | 70.6 | 71 | 70.6 | 10 | ---- | 70.6 | 0.0 | 10 | -10.0 |
| C-6 | 70 | 1 | 0.0 | 70.8 | 71 | 70.8 | 10 | ---- | 70.8 | 0.0 | 10 | -10.0 |
| C-7 | 71 | 1 | 0.0 | 71.0 | 71 | 71.0 | 10 | Snd Lvl | 71.0 | 0.0 | 10 | -10.0 |
| C-8 | 72 | 1 | 0.0 | 70.7 | 71 | 70.7 | 10 | ---- | 70.7 | 0.0 | 10 | -10.0 |

RESULTS: SOUND LEVELS

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| | | | | | | | | | | | | |
|------|-----|---|-----|------|----|------|----|---------|------|-----|----|-------|
| C-9 | 73 | 1 | 0.0 | 71.2 | 71 | 71.2 | 10 | Snd Lvl | 71.2 | 0.0 | 10 | -10.0 |
| C-10 | 74 | 1 | 0.0 | 69.1 | 71 | 69.1 | 10 | ---- | 69.1 | 0.0 | 10 | -10.0 |
| C-11 | 75 | 1 | 0.0 | 70.8 | 71 | 70.8 | 10 | ---- | 70.8 | 0.0 | 10 | -10.0 |
| C-12 | 76 | 1 | 0.0 | 70.9 | 71 | 70.9 | 10 | ---- | 70.9 | 0.0 | 10 | -10.0 |
| C-13 | 77 | 1 | 0.0 | 71.0 | 71 | 71.0 | 10 | Snd Lvl | 71.0 | 0.0 | 10 | -10.0 |
| C-14 | 78 | 1 | 0.0 | 71.3 | 71 | 71.3 | 10 | Snd Lvl | 71.3 | 0.0 | 10 | -10.0 |
| C-15 | 79 | 1 | 0.0 | 71.0 | 71 | 71.0 | 10 | Snd Lvl | 71.0 | 0.0 | 10 | -10.0 |
| C-16 | 80 | 1 | 0.0 | 71.5 | 71 | 71.5 | 10 | Snd Lvl | 71.5 | 0.0 | 10 | -10.0 |
| C-17 | 81 | 1 | 0.0 | 70.4 | 71 | 70.4 | 10 | ---- | 70.4 | 0.0 | 10 | -10.0 |
| C-18 | 82 | 1 | 0.0 | 70.4 | 71 | 70.4 | 10 | ---- | 70.4 | 0.0 | 10 | -10.0 |
| C-19 | 83 | 1 | 0.0 | 69.3 | 71 | 69.3 | 10 | ---- | 69.3 | 0.0 | 10 | -10.0 |
| C-20 | 84 | 1 | 0.0 | 69.5 | 71 | 69.5 | 10 | ---- | 69.5 | 0.0 | 10 | -10.0 |
| C-21 | 85 | 1 | 0.0 | 69.6 | 71 | 69.6 | 10 | ---- | 69.6 | 0.0 | 10 | -10.0 |
| C-22 | 86 | 1 | 0.0 | 67.1 | 71 | 67.1 | 10 | ---- | 67.1 | 0.0 | 10 | -10.0 |
| C-23 | 87 | 1 | 0.0 | 70.5 | 71 | 70.5 | 10 | ---- | 70.5 | 0.0 | 10 | -10.0 |
| C-24 | 88 | 1 | 0.0 | 69.4 | 71 | 69.4 | 10 | ---- | 69.4 | 0.0 | 10 | -10.0 |
| C-25 | 90 | 1 | 0.0 | 63.3 | 71 | 63.3 | 10 | ---- | 63.3 | 0.0 | 10 | -10.0 |
| C-26 | 91 | 1 | 0.0 | 68.7 | 71 | 68.7 | 10 | ---- | 68.7 | 0.0 | 10 | -10.0 |
| C-27 | 92 | 1 | 0.0 | 66.4 | 71 | 66.4 | 10 | ---- | 66.4 | 0.0 | 10 | -10.0 |
| C-28 | 93 | 1 | 0.0 | 68.1 | 71 | 68.1 | 10 | ---- | 68.1 | 0.0 | 10 | -10.0 |
| C-29 | 94 | 1 | 0.0 | 63.8 | 71 | 63.8 | 10 | ---- | 63.8 | 0.0 | 10 | -10.0 |
| C-30 | 95 | 1 | 0.0 | 60.2 | 66 | 60.2 | 10 | ---- | 60.2 | 0.0 | 10 | -10.0 |
| C-31 | 96 | 1 | 0.0 | 63.0 | 71 | 63.0 | 10 | ---- | 63.0 | 0.0 | 10 | -10.0 |
| C-32 | 96 | 1 | 0.0 | 61.4 | 71 | 61.4 | 10 | ---- | 61.4 | 0.0 | 10 | -10.0 |
| C-33 | 97 | 1 | 0.0 | 64.6 | 71 | 64.6 | 10 | ---- | 64.6 | 0.0 | 10 | -10.0 |
| C-34 | 98 | 1 | 0.0 | 66.4 | 71 | 66.4 | 10 | ---- | 66.4 | 0.0 | 10 | -10.0 |
| C-35 | 99 | 1 | 0.0 | 67.2 | 71 | 67.2 | 10 | ---- | 67.2 | 0.0 | 10 | -10.0 |
| C-36 | 100 | 1 | 0.0 | 61.3 | 71 | 61.3 | 10 | ---- | 61.3 | 0.0 | 10 | -10.0 |
| C-37 | 101 | 1 | 0.0 | 58.1 | 71 | 58.1 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 |
| C-38 | 102 | 1 | 0.0 | 54.6 | 71 | 54.6 | 10 | ---- | 54.6 | 0.0 | 10 | -10.0 |
| C-39 | 103 | 1 | 0.0 | 52.2 | 71 | 52.2 | 10 | ---- | 52.2 | 0.0 | 10 | -10.0 |
| C-40 | 104 | 1 | 0.0 | 55.5 | 71 | 55.5 | 10 | ---- | 55.5 | 0.0 | 10 | -10.0 |
| C-41 | 108 | 1 | 0.0 | 59.2 | 71 | 59.2 | 10 | ---- | 59.2 | 0.0 | 10 | -10.0 |
| C-43 | 111 | 1 | 0.0 | 56.6 | 71 | 56.6 | 10 | ---- | 56.6 | 0.0 | 10 | -10.0 |
| C-44 | 112 | 1 | 0.0 | 55.7 | 71 | 55.7 | 10 | ---- | 55.7 | 0.0 | 10 | -10.0 |
| C-45 | 113 | 1 | 0.0 | 55.2 | 71 | 55.2 | 10 | ---- | 55.2 | 0.0 | 10 | -10.0 |
| C-42 | 114 | 1 | 0.0 | 55.1 | 71 | 55.1 | 10 | ---- | 55.1 | 0.0 | 10 | -10.0 |
| C-46 | 115 | 1 | 0.0 | 68.7 | 71 | 68.7 | 10 | ---- | 68.7 | 0.0 | 10 | -10.0 |
| C-47 | 116 | 1 | 0.0 | 69.0 | 71 | 69.0 | 10 | ---- | 69.0 | 0.0 | 10 | -10.0 |
| C-48 | 117 | 1 | 0.0 | 68.1 | 71 | 68.1 | 10 | ---- | 68.1 | 0.0 | 10 | -10.0 |
| C-49 | 118 | 1 | 0.0 | 66.9 | 71 | 66.9 | 10 | ---- | 66.9 | 0.0 | 10 | -10.0 |

RESULTS: SOUND LEVELS

1/11-670-02

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|-----------------------|-----|--------------|------------------------|------------|------------|------|----|------|------|-----|----|-------|
| C-50 | 129 | 1 | 0.0 | 59.2 | 71 | 59.2 | 10 | ---- | 59.2 | 0.0 | 10 | -10.0 |
| C-51 | 130 | 1 | 0.0 | 60.5 | 71 | 60.5 | 10 | ---- | 60.5 | 0.0 | 10 | -10.0 |
| A-1 | 131 | 1 | 0.0 | 67.7 | 71 | 67.7 | 10 | ---- | 67.7 | 0.0 | 10 | -10.0 |
| A-2 | 132 | 1 | 0.0 | 69.6 | 71 | 69.6 | 10 | ---- | 69.6 | 0.0 | 10 | -10.0 |
| A-3 | 133 | 1 | 0.0 | 63.0 | 71 | 63.0 | 10 | ---- | 63.0 | 0.0 | 10 | -10.0 |
| A-4 | 134 | 1 | 0.0 | 69.6 | 71 | 69.6 | 10 | ---- | 69.6 | 0.0 | 10 | -10.0 |
| A-5 | 135 | 1 | 0.0 | 67.3 | 71 | 67.3 | 10 | ---- | 67.3 | 0.0 | 10 | -10.0 |
| A-6 | 136 | 1 | 0.0 | 68.9 | 71 | 68.9 | 10 | ---- | 68.9 | 0.0 | 10 | -10.0 |
| A-7 | 137 | 1 | 0.0 | 69.2 | 71 | 69.2 | 10 | ---- | 69.2 | 0.0 | 10 | -10.0 |
| A-8 | 138 | 1 | 0.0 | 70.9 | 71 | 70.9 | 10 | ---- | 70.9 | 0.0 | 10 | -10.0 |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | |
| | | | dB | dB | dB | | | | | | | |
| All Selected | | 128 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All Impacted | | 7 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | | | | | | | |

RESULTS: SOUND LEVELS

1/11-670-02

| | |
|----------------------------------|---|
| Pinyon Environmental T.Sparks | 13 May 2014 TNM 2.5 Calculated with TNM 2.5 |
|----------------------------------|---|

RESULTS: SOUND LEVELS

| | |
|-------------------|---------------------------------------|
| PROJECT/CONTRACT: | 1/11-670-02 |
| RUN: | Federal Reconstruction No Action 2035 |
| BARRIER DESIGN: | INPUT HEIGHTS |
| ATMOSPHERICS: | 68 deg F, 50% RH |

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

| Receiver Name | No. | #DUs | Existing | | No Barrier | | Increase over existing | | With Barrier | | | | |
|------------------|-----|------|---------------------|---------------------|---------------------|--------|------------------------|--------|--------------|--------------------------------|----------------------------|------|-----------------------|
| | | | L _{Aeq} 1h | L _{Aeq} 1h | L _{Aeq} 1h | Crit'n | Calculated | Crit'n | Type Impact | Calculated L _{Aeq} 1h | Noise Reduction Calculated | Goal | Calculated minus Goal |
| | | | dBA | dBA | dBA | | dB | dB | | dBA | dB | dB | dB |
| R-1 | 5 | 1 | 55.3 | 56.0 | 66 | | 0.7 | 10 | ---- | 56.0 | 0.0 | 5 | -5.0 |
| R-2 | 6 | 1 | 57.7 | 58.3 | 66 | | 0.6 | 10 | ---- | 58.3 | 0.0 | 5 | -5.0 |
| R-3 | 7 | 1 | 57.6 | 58.2 | 66 | | 0.6 | 10 | ---- | 58.2 | 0.0 | 5 | -5.0 |
| R-4 | 8 | 1 | 57.2 | 57.9 | 66 | | 0.7 | 10 | ---- | 57.9 | 0.0 | 5 | -5.0 |
| R-5 | 9 | 1 | 57.5 | 58.2 | 66 | | 0.7 | 10 | ---- | 58.2 | 0.0 | 5 | -5.0 |
| R-6 | 10 | 1 | 57.3 | 58.0 | 66 | | 0.7 | 10 | ---- | 58.0 | 0.0 | 5 | -5.0 |
| R-7 | 11 | 1 | 57.3 | 58.0 | 66 | | 0.7 | 10 | ---- | 58.0 | 0.0 | 5 | -5.0 |
| R-8 | 12 | 1 | 57.7 | 58.3 | 66 | | 0.6 | 10 | ---- | 58.3 | 0.0 | 5 | -5.0 |
| R-9 | 13 | 1 | 57.3 | 58.0 | 66 | | 0.7 | 10 | ---- | 58.0 | 0.0 | 5 | -5.0 |
| R-10 | 14 | 1 | 57.2 | 57.9 | 66 | | 0.7 | 10 | ---- | 57.9 | 0.0 | 5 | -5.0 |
| R-11 | 15 | 1 | 57.6 | 58.3 | 66 | | 0.7 | 10 | ---- | 58.3 | 0.0 | 5 | -5.0 |
| R-12 | 16 | 1 | 57.8 | 58.5 | 66 | | 0.7 | 10 | ---- | 58.5 | 0.0 | 5 | -5.0 |
| R-13 | 17 | 1 | 57.4 | 58.1 | 66 | | 0.7 | 10 | ---- | 58.1 | 0.0 | 5 | -5.0 |
| R-14 | 18 | 1 | 58.0 | 58.6 | 66 | | 0.6 | 10 | ---- | 58.6 | 0.0 | 5 | -5.0 |
| R-15 | 19 | 1 | 59.7 | 60.4 | 66 | | 0.7 | 10 | ---- | 60.4 | 0.0 | 5 | -5.0 |
| R-16 | 20 | 1 | 58.7 | 59.4 | 66 | | 0.7 | 10 | ---- | 59.4 | 0.0 | 5 | -5.0 |
| R-17 | 21 | 1 | 57.7 | 58.4 | 66 | | 0.7 | 10 | ---- | 58.4 | 0.0 | 5 | -5.0 |
| R-18 | 22 | 1 | 57.9 | 58.6 | 66 | | 0.7 | 10 | ---- | 58.6 | 0.0 | 5 | -5.0 |
| R-19 | 23 | 1 | 57.5 | 58.2 | 66 | | 0.7 | 10 | ---- | 58.2 | 0.0 | 5 | -5.0 |
| R-20 | 24 | 1 | 57.9 | 58.6 | 66 | | 0.7 | 10 | ---- | 58.6 | 0.0 | 5 | -5.0 |
| R-21 | 25 | 1 | 57.7 | 58.4 | 66 | | 0.7 | 10 | ---- | 58.4 | 0.0 | 5 | -5.0 |
| R-22 | 26 | 1 | 57.5 | 58.1 | 66 | | 0.6 | 10 | ---- | 58.1 | 0.0 | 5 | -5.0 |
| R-23 | 27 | 1 | 57.3 | 58.0 | 66 | | 0.7 | 10 | ---- | 58.0 | 0.0 | 5 | -5.0 |
| R-24 | 28 | 1 | 57.2 | 57.9 | 66 | | 0.7 | 10 | ---- | 57.9 | 0.0 | 5 | -5.0 |

RESULTS: SOUND LEVELS

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| | | | | | | | | | | | | |
|------|----|---|------|------|----|-----|----|---------|------|-----|---|------|
| R-25 | 29 | 1 | 57.2 | 57.9 | 66 | 0.7 | 10 | ---- | 57.9 | 0.0 | 5 | -5.0 |
| R-26 | 30 | 1 | 57.4 | 58.1 | 66 | 0.7 | 10 | ---- | 58.1 | 0.0 | 5 | -5.0 |
| R-27 | 31 | 1 | 57.3 | 58.0 | 66 | 0.7 | 10 | ---- | 58.0 | 0.0 | 5 | -5.0 |
| R-28 | 34 | 1 | 57.1 | 57.8 | 66 | 0.7 | 10 | ---- | 57.8 | 0.0 | 5 | -5.0 |
| R-29 | 35 | 1 | 58.1 | 58.8 | 66 | 0.7 | 10 | ---- | 58.8 | 0.0 | 5 | -5.0 |
| R-30 | 36 | 1 | 58.0 | 58.7 | 66 | 0.7 | 10 | ---- | 58.7 | 0.0 | 5 | -5.0 |
| R-31 | 37 | 1 | 58.2 | 58.9 | 66 | 0.7 | 10 | ---- | 58.9 | 0.0 | 5 | -5.0 |
| R-32 | 38 | 1 | 58.9 | 59.6 | 66 | 0.7 | 10 | ---- | 59.6 | 0.0 | 5 | -5.0 |
| R-33 | 39 | 1 | 58.4 | 59.1 | 66 | 0.7 | 10 | ---- | 59.1 | 0.0 | 5 | -5.0 |
| R-34 | 40 | 1 | 58.8 | 59.5 | 66 | 0.7 | 10 | ---- | 59.5 | 0.0 | 5 | -5.0 |
| R-35 | 41 | 1 | 59.1 | 59.8 | 66 | 0.7 | 10 | ---- | 59.8 | 0.0 | 5 | -5.0 |
| R-36 | 42 | 1 | 59.3 | 60.1 | 66 | 0.8 | 10 | ---- | 60.1 | 0.0 | 5 | -5.0 |
| R-37 | 43 | 1 | 60.9 | 61.7 | 66 | 0.8 | 10 | ---- | 61.7 | 0.0 | 5 | -5.0 |
| R-38 | 44 | 1 | 55.1 | 55.8 | 66 | 0.7 | 10 | ---- | 55.8 | 0.0 | 5 | -5.0 |
| R-39 | 45 | 1 | 52.2 | 52.9 | 66 | 0.7 | 10 | ---- | 52.9 | 0.0 | 5 | -5.0 |
| R-40 | 47 | 1 | 52.8 | 53.4 | 66 | 0.6 | 10 | ---- | 53.4 | 0.0 | 5 | -5.0 |
| R-41 | 48 | 2 | 53.4 | 54.1 | 66 | 0.7 | 10 | ---- | 54.1 | 0.0 | 5 | -5.0 |
| R-42 | 49 | 2 | 53.5 | 54.2 | 66 | 0.7 | 10 | ---- | 54.2 | 0.0 | 5 | -5.0 |
| R-43 | 50 | 2 | 53.6 | 54.3 | 66 | 0.7 | 10 | ---- | 54.3 | 0.0 | 5 | -5.0 |
| R-44 | 51 | 2 | 54.5 | 55.2 | 66 | 0.7 | 10 | ---- | 55.2 | 0.0 | 5 | -5.0 |
| R-45 | 52 | 2 | 54.7 | 55.3 | 66 | 0.6 | 10 | ---- | 55.3 | 0.0 | 5 | -5.0 |
| R-46 | 53 | 2 | 54.0 | 54.7 | 66 | 0.7 | 10 | ---- | 54.7 | 0.0 | 5 | -5.0 |
| R-47 | 54 | 2 | 53.9 | 54.6 | 66 | 0.7 | 10 | ---- | 54.6 | 0.0 | 5 | -5.0 |
| R-48 | 55 | 2 | 54.1 | 54.8 | 66 | 0.7 | 10 | ---- | 54.8 | 0.0 | 5 | -5.0 |
| R-49 | 56 | 2 | 53.9 | 54.6 | 66 | 0.7 | 10 | ---- | 54.6 | 0.0 | 5 | -5.0 |
| R-50 | 57 | 2 | 53.9 | 54.6 | 66 | 0.7 | 10 | ---- | 54.6 | 0.0 | 5 | -5.0 |
| R-51 | 58 | 2 | 54.8 | 55.5 | 66 | 0.7 | 10 | ---- | 55.5 | 0.0 | 5 | -5.0 |
| R-52 | 59 | 2 | 63.1 | 64.1 | 66 | 1.0 | 10 | ---- | 64.1 | 0.0 | 5 | -5.0 |
| R-53 | 60 | 1 | 56.4 | 57.1 | 66 | 0.7 | 10 | ---- | 57.1 | 0.0 | 5 | -5.0 |
| R-54 | 61 | 1 | 55.4 | 56.1 | 71 | 0.7 | 10 | ---- | 56.1 | 0.0 | 5 | -5.0 |
| R-55 | 62 | 1 | 58.4 | 59.1 | 71 | 0.7 | 10 | ---- | 59.1 | 0.0 | 5 | -5.0 |
| R-56 | 63 | 1 | 56.8 | 57.5 | 71 | 0.7 | 10 | ---- | 57.5 | 0.0 | 5 | -5.0 |
| R-57 | 64 | 1 | 57.3 | 58.0 | 71 | 0.7 | 10 | ---- | 58.0 | 0.0 | 5 | -5.0 |
| C-1 | 65 | 1 | 69.9 | 70.6 | 71 | 0.7 | 10 | ---- | 70.6 | 0.0 | 5 | -5.0 |
| C-2 | 66 | 1 | 69.1 | 69.8 | 71 | 0.7 | 10 | ---- | 69.8 | 0.0 | 5 | -5.0 |
| C-3 | 67 | 1 | 69.2 | 69.9 | 71 | 0.7 | 10 | ---- | 69.9 | 0.0 | 5 | -5.0 |
| C-4 | 68 | 1 | 71.0 | 71.7 | 71 | 0.7 | 10 | Snd Lvl | 71.7 | 0.0 | 5 | -5.0 |
| C-5 | 69 | 1 | 70.6 | 71.3 | 71 | 0.7 | 10 | Snd Lvl | 71.3 | 0.0 | 5 | -5.0 |
| C-6 | 70 | 1 | 70.8 | 71.5 | 71 | 0.7 | 10 | Snd Lvl | 71.5 | 0.0 | 5 | -5.0 |
| C-7 | 71 | 1 | 71.0 | 71.6 | 71 | 0.6 | 10 | Snd Lvl | 71.6 | 0.0 | 5 | -5.0 |
| C-8 | 72 | 1 | 70.7 | 71.4 | 71 | 0.7 | 10 | Snd Lvl | 71.4 | 0.0 | 5 | -5.0 |

RESULTS: SOUND LEVELS

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|------|-----|---|------|------|----|-----|----|---------|------|-----|---|------|
| C-9 | 73 | 1 | 71.2 | 71.8 | 71 | 0.6 | 10 | Snd Lvl | 71.8 | 0.0 | 5 | -5.0 |
| C-10 | 74 | 1 | 69.1 | 69.8 | 71 | 0.7 | 10 | ---- | 69.8 | 0.0 | 5 | -5.0 |
| C-11 | 75 | 1 | 70.8 | 71.4 | 71 | 0.6 | 10 | Snd Lvl | 71.4 | 0.0 | 5 | -5.0 |
| C-12 | 76 | 1 | 70.9 | 71.6 | 71 | 0.7 | 10 | Snd Lvl | 71.6 | 0.0 | 5 | -5.0 |
| C-13 | 77 | 1 | 71.0 | 71.7 | 71 | 0.7 | 10 | Snd Lvl | 71.7 | 0.0 | 5 | -5.0 |
| C-14 | 78 | 1 | 71.3 | 71.9 | 71 | 0.6 | 10 | Snd Lvl | 71.9 | 0.0 | 5 | -5.0 |
| C-15 | 79 | 1 | 71.0 | 71.6 | 71 | 0.6 | 10 | Snd Lvl | 71.6 | 0.0 | 5 | -5.0 |
| C-16 | 80 | 1 | 71.5 | 72.2 | 71 | 0.7 | 10 | Snd Lvl | 72.2 | 0.0 | 5 | -5.0 |
| C-17 | 81 | 1 | 70.4 | 71.0 | 71 | 0.6 | 10 | Snd Lvl | 71.0 | 0.0 | 5 | -5.0 |
| C-18 | 82 | 1 | 70.4 | 71.1 | 71 | 0.7 | 10 | Snd Lvl | 71.1 | 0.0 | 5 | -5.0 |
| C-19 | 83 | 1 | 69.3 | 69.9 | 71 | 0.6 | 10 | ---- | 69.9 | 0.0 | 5 | -5.0 |
| C-20 | 84 | 1 | 69.5 | 70.2 | 71 | 0.7 | 10 | ---- | 70.2 | 0.0 | 5 | -5.0 |
| C-21 | 85 | 1 | 69.6 | 70.3 | 71 | 0.7 | 10 | ---- | 70.3 | 0.0 | 5 | -5.0 |
| C-22 | 86 | 1 | 67.1 | 67.8 | 71 | 0.7 | 10 | ---- | 67.8 | 0.0 | 5 | -5.0 |
| C-23 | 87 | 1 | 70.5 | 71.2 | 71 | 0.7 | 10 | Snd Lvl | 71.2 | 0.0 | 5 | -5.0 |
| C-24 | 88 | 1 | 69.4 | 70.1 | 71 | 0.7 | 10 | ---- | 70.1 | 0.0 | 5 | -5.0 |
| C-25 | 90 | 1 | 63.3 | 64.0 | 71 | 0.7 | 10 | ---- | 64.0 | 0.0 | 5 | -5.0 |
| C-26 | 91 | 1 | 68.7 | 69.4 | 71 | 0.7 | 10 | ---- | 69.4 | 0.0 | 5 | -5.0 |
| C-27 | 92 | 1 | 66.4 | 67.1 | 71 | 0.7 | 10 | ---- | 67.1 | 0.0 | 5 | -5.0 |
| C-28 | 93 | 1 | 68.1 | 68.8 | 71 | 0.7 | 10 | ---- | 68.8 | 0.0 | 5 | -5.0 |
| C-29 | 94 | 1 | 63.8 | 64.5 | 71 | 0.7 | 10 | ---- | 64.5 | 0.0 | 5 | -5.0 |
| C-30 | 95 | 1 | 60.2 | 60.9 | 66 | 0.7 | 10 | ---- | 60.9 | 0.0 | 5 | -5.0 |
| C-31 | 96 | 1 | 63.0 | 63.7 | 71 | 0.7 | 10 | ---- | 63.7 | 0.0 | 5 | -5.0 |
| C-32 | 96 | 1 | 61.4 | 62.1 | 71 | 0.7 | 10 | ---- | 62.1 | 0.0 | 5 | -5.0 |
| C-33 | 97 | 1 | 64.6 | 65.2 | 71 | 0.6 | 10 | ---- | 65.2 | 0.0 | 5 | -5.0 |
| C-34 | 98 | 1 | 66.4 | 67.1 | 71 | 0.7 | 10 | ---- | 67.1 | 0.0 | 5 | -5.0 |
| C-35 | 99 | 1 | 67.2 | 67.9 | 71 | 0.7 | 10 | ---- | 67.9 | 0.0 | 5 | -5.0 |
| C-36 | 100 | 1 | 61.3 | 62.0 | 71 | 0.7 | 10 | ---- | 62.0 | 0.0 | 5 | -5.0 |
| C-37 | 101 | 1 | 58.1 | 58.8 | 71 | 0.7 | 10 | ---- | 58.8 | 0.0 | 5 | -5.0 |
| C-38 | 102 | 1 | 54.6 | 55.3 | 71 | 0.7 | 10 | ---- | 55.3 | 0.0 | 5 | -5.0 |
| C-39 | 103 | 1 | 52.2 | 52.9 | 71 | 0.7 | 10 | ---- | 52.9 | 0.0 | 5 | -5.0 |
| C-40 | 104 | 1 | 55.5 | 56.2 | 71 | 0.7 | 10 | ---- | 56.2 | 0.0 | 5 | -5.0 |
| C-41 | 108 | 1 | 59.2 | 59.9 | 71 | 0.7 | 10 | ---- | 59.9 | 0.0 | 5 | -5.0 |
| C-43 | 111 | 1 | 56.6 | 57.3 | 71 | 0.7 | 10 | ---- | 57.3 | 0.0 | 5 | -5.0 |
| C-44 | 112 | 1 | 55.7 | 56.4 | 71 | 0.7 | 10 | ---- | 56.4 | 0.0 | 5 | -5.0 |
| C-45 | 113 | 1 | 55.2 | 55.8 | 71 | 0.6 | 10 | ---- | 55.8 | 0.0 | 5 | -5.0 |
| C-42 | 114 | 1 | 55.1 | 55.8 | 71 | 0.7 | 10 | ---- | 55.8 | 0.0 | 5 | -5.0 |
| C-46 | 115 | 1 | 68.7 | 69.4 | 71 | 0.7 | 10 | ---- | 69.4 | 0.0 | 5 | -5.0 |
| C-47 | 116 | 1 | 69.0 | 69.7 | 71 | 0.7 | 10 | ---- | 69.7 | 0.0 | 5 | -5.0 |
| C-48 | 117 | 1 | 68.1 | 68.8 | 71 | 0.7 | 10 | ---- | 68.8 | 0.0 | 5 | -5.0 |
| C-49 | 118 | 1 | 66.9 | 67.6 | 71 | 0.7 | 10 | ---- | 67.6 | 0.0 | 5 | -5.0 |

RESULTS: SOUND LEVELS

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| | | | | | | | | | | | | |
|-----------------------|-----|--------------|------------------------|------------|------------|-----|----|---------|------|-----|---|------|
| C-50 | 129 | 1 | 59.2 | 59.9 | 71 | 0.7 | 10 | ---- | 59.9 | 0.0 | 5 | -5.0 |
| C-51 | 130 | 1 | 60.5 | 61.2 | 71 | 0.7 | 10 | ---- | 61.2 | 0.0 | 5 | -5.0 |
| A-1 | 131 | 1 | 67.7 | 68.4 | 71 | 0.7 | 10 | ---- | 68.4 | 0.0 | 5 | -5.0 |
| A-2 | 132 | 1 | 69.6 | 70.3 | 71 | 0.7 | 10 | ---- | 70.3 | 0.0 | 5 | -5.0 |
| A-3 | 133 | 1 | 63.0 | 63.7 | 71 | 0.7 | 10 | ---- | 63.7 | 0.0 | 5 | -5.0 |
| A-4 | 134 | 1 | 69.6 | 70.3 | 71 | 0.7 | 10 | ---- | 70.3 | 0.0 | 5 | -5.0 |
| A-5 | 135 | 1 | 67.3 | 68.0 | 71 | 0.7 | 10 | ---- | 68.0 | 0.0 | 5 | -5.0 |
| A-6 | 136 | 1 | 68.9 | 69.6 | 71 | 0.7 | 10 | ---- | 69.6 | 0.0 | 5 | -5.0 |
| A-7 | 137 | 1 | 69.2 | 69.9 | 71 | 0.7 | 10 | ---- | 69.9 | 0.0 | 5 | -5.0 |
| A-8 | 138 | 1 | 70.9 | 71.6 | 71 | 0.7 | 10 | Snd Lvl | 71.6 | 0.0 | 5 | -5.0 |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | |
| | | | dB | dB | dB | | | | | | | |
| All Selected | | 128 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All Impacted | | 16 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | | | | | | | |

RESULTS: SOUND LEVELS

1/11-670-02

Pinyon Environmental
T.Sparks
13 May 2014
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: 1/11-670-02
 RUN: Federal Reconstruction Proposed Action
 BARRIER DESIGN: INPUT HEIGHTS
 Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.
 ATMOSPHERICS: 68 deg F, 50% RH

| Receiver | | With Barrier | | | | | | | | | | | |
|----------|-----|--------------|-----------------|------------------------------|--------|-----------------------------------|------------------|-------------|-------------------|----------------------------|------|-----------------------|--|
| Name | No. | #DUs | Existing LAeq1h | No Barrier LAeq1h Calculated | Crit'n | Increase over existing Calculated | Crit'n Sub'l Inc | Type Impact | Calculated LAeq1h | Noise Reduction Calculated | Goal | Calculated minus Goal | |
| | | | dBA | dBA | dBA | dB | dB | | dBA | dB | dB | dB | |
| R-1 | 5 | 1 | 55.3 | 55.9 | 66 | 0.6 | 10 | ---- | 55.9 | 0.0 | 10 | -10.0 | |
| R-2 | 6 | 1 | 57.7 | 58.5 | 66 | 0.8 | 10 | ---- | 58.5 | 0.0 | 10 | -10.0 | |
| R-3 | 7 | 1 | 57.6 | 58.4 | 66 | 0.8 | 10 | ---- | 58.4 | 0.0 | 10 | -10.0 | |
| R-4 | 8 | 1 | 57.2 | 58.1 | 66 | 0.9 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 | |
| R-5 | 9 | 1 | 57.5 | 58.4 | 66 | 0.9 | 10 | ---- | 58.4 | 0.0 | 10 | -10.0 | |
| R-6 | 10 | 1 | 57.3 | 58.1 | 66 | 0.8 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 | |
| R-7 | 11 | 1 | 57.3 | 58.1 | 66 | 0.8 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 | |
| R-8 | 12 | 1 | 57.7 | 58.5 | 66 | 0.8 | 10 | ---- | 58.5 | 0.0 | 10 | -10.0 | |
| R-9 | 13 | 1 | 57.3 | 58.2 | 66 | 0.9 | 10 | ---- | 58.2 | 0.0 | 10 | -10.0 | |
| R-10 | 14 | 1 | 57.2 | 58.0 | 66 | 0.8 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 | |
| R-11 | 15 | 1 | 57.6 | 58.5 | 66 | 0.9 | 10 | ---- | 58.5 | 0.0 | 10 | -10.0 | |
| R-12 | 16 | 1 | 57.8 | 58.7 | 66 | 0.9 | 10 | ---- | 58.7 | 0.0 | 10 | -10.0 | |
| R-13 | 17 | 1 | 57.4 | 58.2 | 66 | 0.8 | 10 | ---- | 58.2 | 0.0 | 10 | -10.0 | |
| R-14 | 18 | 1 | 58.0 | 58.8 | 66 | 0.8 | 10 | ---- | 58.8 | 0.0 | 10 | -10.0 | |
| R-15 | 19 | 1 | 59.7 | 60.5 | 66 | 0.8 | 10 | ---- | 60.5 | 0.0 | 10 | -10.0 | |
| R-16 | 20 | 1 | 58.7 | 59.5 | 66 | 0.8 | 10 | ---- | 59.5 | 0.0 | 10 | -10.0 | |
| R-17 | 21 | 1 | 57.7 | 58.6 | 66 | 0.9 | 10 | ---- | 58.6 | 0.0 | 10 | -10.0 | |
| R-18 | 22 | 1 | 57.9 | 58.8 | 66 | 0.9 | 10 | ---- | 58.8 | 0.0 | 10 | -10.0 | |
| R-19 | 23 | 1 | 57.5 | 58.2 | 66 | 0.7 | 10 | ---- | 58.2 | 0.0 | 10 | -10.0 | |
| R-20 | 24 | 1 | 57.9 | 58.8 | 66 | 0.9 | 10 | ---- | 58.8 | 0.0 | 10 | -10.0 | |
| R-21 | 25 | 1 | 57.7 | 58.6 | 66 | 0.9 | 10 | ---- | 58.6 | 0.0 | 10 | -10.0 | |
| R-22 | 26 | 1 | 57.5 | 58.3 | 66 | 0.8 | 10 | ---- | 58.3 | 0.0 | 10 | -10.0 | |
| R-23 | 27 | 1 | 57.3 | 58.0 | 66 | 0.7 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 | |
| R-24 | 28 | 1 | 57.2 | 58.1 | 66 | 0.9 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 | |

RESULTS: SOUND LEVELS

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| | | | | | | | | | | | | |
|------|----|---|------|------|----|-----|----|---------|------|-----|----|-------|
| R-25 | 29 | 1 | 57.2 | 58.0 | 66 | 0.8 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 |
| R-26 | 30 | 1 | 57.4 | 58.3 | 66 | 0.9 | 10 | ---- | 58.3 | 0.0 | 10 | -10.0 |
| R-27 | 31 | 1 | 57.3 | 58.1 | 66 | 0.8 | 10 | ---- | 58.1 | 0.0 | 10 | -10.0 |
| R-28 | 34 | 1 | 57.1 | 58.0 | 66 | 0.9 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 |
| R-29 | 35 | 1 | 58.1 | 59.0 | 66 | 0.9 | 10 | ---- | 59.0 | 0.0 | 10 | -10.0 |
| R-30 | 36 | 1 | 58.0 | 58.8 | 66 | 0.8 | 10 | ---- | 58.8 | 0.0 | 10 | -10.0 |
| R-31 | 37 | 1 | 58.2 | 59.0 | 66 | 0.8 | 10 | ---- | 59.0 | 0.0 | 10 | -10.0 |
| R-32 | 38 | 1 | 58.9 | 59.7 | 66 | 0.8 | 10 | ---- | 59.7 | 0.0 | 10 | -10.0 |
| R-33 | 39 | 1 | 58.4 | 59.3 | 66 | 0.9 | 10 | ---- | 59.3 | 0.0 | 10 | -10.0 |
| R-34 | 40 | 1 | 58.8 | 59.6 | 66 | 0.8 | 10 | ---- | 59.6 | 0.0 | 10 | -10.0 |
| R-35 | 41 | 1 | 59.1 | 59.9 | 66 | 0.8 | 10 | ---- | 59.9 | 0.0 | 10 | -10.0 |
| R-36 | 42 | 1 | 59.3 | 60.2 | 66 | 0.9 | 10 | ---- | 60.2 | 0.0 | 10 | -10.0 |
| R-37 | 43 | 1 | 60.9 | 61.8 | 66 | 0.9 | 10 | ---- | 61.8 | 0.0 | 10 | -10.0 |
| R-38 | 44 | 1 | 55.1 | 55.7 | 66 | 0.6 | 10 | ---- | 55.7 | 0.0 | 10 | -10.0 |
| R-39 | 45 | 1 | 52.2 | 52.9 | 66 | 0.7 | 10 | ---- | 52.9 | 0.0 | 10 | -10.0 |
| R-40 | 47 | 1 | 52.8 | 53.5 | 66 | 0.7 | 10 | ---- | 53.5 | 0.0 | 10 | -10.0 |
| R-41 | 48 | 2 | 53.4 | 54.1 | 66 | 0.7 | 10 | ---- | 54.1 | 0.0 | 10 | -10.0 |
| R-42 | 49 | 2 | 53.5 | 54.1 | 66 | 0.6 | 10 | ---- | 54.1 | 0.0 | 10 | -10.0 |
| R-43 | 50 | 2 | 53.6 | 54.3 | 66 | 0.7 | 10 | ---- | 54.3 | 0.0 | 10 | -10.0 |
| R-44 | 51 | 2 | 54.5 | 55.2 | 66 | 0.7 | 10 | ---- | 55.2 | 0.0 | 10 | -10.0 |
| R-45 | 52 | 2 | 54.7 | 55.3 | 66 | 0.6 | 10 | ---- | 55.3 | 0.0 | 10 | -10.0 |
| R-46 | 53 | 2 | 54.0 | 54.6 | 66 | 0.6 | 10 | ---- | 54.6 | 0.0 | 10 | -10.0 |
| R-47 | 54 | 2 | 53.9 | 54.5 | 66 | 0.6 | 10 | ---- | 54.5 | 0.0 | 10 | -10.0 |
| R-48 | 55 | 2 | 54.1 | 54.6 | 66 | 0.5 | 10 | ---- | 54.6 | 0.0 | 10 | -10.0 |
| R-49 | 56 | 2 | 53.9 | 54.5 | 66 | 0.6 | 10 | ---- | 54.5 | 0.0 | 10 | -10.0 |
| R-50 | 57 | 2 | 53.9 | 54.6 | 66 | 0.7 | 10 | ---- | 54.6 | 0.0 | 10 | -10.0 |
| R-51 | 58 | 2 | 54.8 | 55.5 | 66 | 0.7 | 10 | ---- | 55.5 | 0.0 | 10 | -10.0 |
| R-52 | 59 | 2 | 63.1 | 64.1 | 66 | 1.0 | 10 | ---- | 64.1 | 0.0 | 10 | -10.0 |
| R-53 | 60 | 1 | 56.4 | 56.9 | 66 | 0.5 | 10 | ---- | 56.9 | 0.0 | 10 | -10.0 |
| R-54 | 61 | 1 | 55.4 | 56.3 | 71 | 0.9 | 10 | ---- | 56.3 | 0.0 | 10 | -10.0 |
| R-55 | 62 | 1 | 58.4 | 59.2 | 71 | 0.8 | 10 | ---- | 59.2 | 0.0 | 10 | -10.0 |
| R-56 | 63 | 1 | 56.8 | 57.5 | 71 | 0.7 | 10 | ---- | 57.5 | 0.0 | 10 | -10.0 |
| R-57 | 64 | 1 | 57.3 | 58.0 | 71 | 0.7 | 10 | ---- | 58.0 | 0.0 | 10 | -10.0 |
| C-1 | 65 | 1 | 69.9 | 70.6 | 71 | 0.7 | 10 | ---- | 70.6 | 0.0 | 10 | -10.0 |
| C-2 | 66 | 1 | 69.1 | 69.8 | 71 | 0.7 | 10 | ---- | 69.8 | 0.0 | 10 | -10.0 |
| C-3 | 67 | 1 | 69.2 | 69.9 | 71 | 0.7 | 10 | ---- | 69.9 | 0.0 | 10 | -10.0 |
| C-4 | 68 | 1 | 71.0 | 71.7 | 71 | 0.7 | 10 | Snd Lvl | 71.7 | 0.0 | 10 | -10.0 |
| C-5 | 69 | 1 | 70.6 | 71.4 | 71 | 0.8 | 10 | Snd Lvl | 71.4 | 0.0 | 10 | -10.0 |
| C-6 | 70 | 1 | 70.8 | 71.5 | 71 | 0.7 | 10 | Snd Lvl | 71.5 | 0.0 | 10 | -10.0 |
| C-7 | 71 | 1 | 71.0 | 71.6 | 71 | 0.6 | 10 | Snd Lvl | 71.6 | 0.0 | 10 | -10.0 |
| C-8 | 72 | 1 | 70.7 | 71.4 | 71 | 0.7 | 10 | Snd Lvl | 71.4 | 0.0 | 10 | -10.0 |

RESULTS: SOUND LEVELS

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| | | | | | | | | | | | | |
|------|-----|---|------|------|----|-----|----|---------|------|-----|----|-------|
| C-9 | 73 | 1 | 71.2 | 71.8 | 71 | 0.6 | 10 | Snd Lvl | 71.8 | 0.0 | 10 | -10.0 |
| C-10 | 74 | 1 | 69.1 | 69.8 | 71 | 0.7 | 10 | ---- | 69.8 | 0.0 | 10 | -10.0 |
| C-11 | 75 | 1 | 70.8 | 71.5 | 71 | 0.7 | 10 | Snd Lvl | 71.5 | 0.0 | 10 | -10.0 |
| C-12 | 76 | 1 | 70.9 | 71.6 | 71 | 0.7 | 10 | Snd Lvl | 71.6 | 0.0 | 10 | -10.0 |
| C-13 | 77 | 1 | 71.0 | 71.7 | 71 | 0.7 | 10 | Snd Lvl | 71.7 | 0.0 | 10 | -10.0 |
| C-14 | 78 | 1 | 71.3 | 71.9 | 71 | 0.6 | 10 | Snd Lvl | 71.9 | 0.0 | 10 | -10.0 |
| C-15 | 79 | 1 | 71.0 | 71.6 | 71 | 0.6 | 10 | Snd Lvl | 71.6 | 0.0 | 10 | -10.0 |
| C-16 | 80 | 1 | 71.5 | 72.2 | 71 | 0.7 | 10 | Snd Lvl | 72.2 | 0.0 | 10 | -10.0 |
| C-17 | 81 | 1 | 70.4 | 71.0 | 71 | 0.6 | 10 | Snd Lvl | 71.0 | 0.0 | 10 | -10.0 |
| C-18 | 82 | 1 | 70.4 | 71.2 | 71 | 0.8 | 10 | Snd Lvl | 71.2 | 0.0 | 10 | -10.0 |
| C-19 | 83 | 1 | 69.3 | 69.9 | 71 | 0.6 | 10 | ---- | 69.9 | 0.0 | 10 | -10.0 |
| C-20 | 84 | 1 | 69.5 | 70.2 | 71 | 0.7 | 10 | ---- | 70.2 | 0.0 | 10 | -10.0 |
| C-21 | 85 | 1 | 69.6 | 70.3 | 71 | 0.7 | 10 | ---- | 70.3 | 0.0 | 10 | -10.0 |
| C-22 | 86 | 1 | 67.1 | 67.9 | 71 | 0.8 | 10 | ---- | 67.9 | 0.0 | 10 | -10.0 |
| C-23 | 87 | 1 | 70.5 | 71.2 | 71 | 0.7 | 10 | Snd Lvl | 71.2 | 0.0 | 10 | -10.0 |
| C-24 | 88 | 1 | 69.4 | 70.2 | 71 | 0.8 | 10 | ---- | 70.2 | 0.0 | 10 | -10.0 |
| C-25 | 90 | 1 | 63.3 | 64.2 | 71 | 0.9 | 10 | ---- | 64.2 | 0.0 | 10 | -10.0 |
| C-26 | 91 | 1 | 68.7 | 69.4 | 71 | 0.7 | 10 | ---- | 69.4 | 0.0 | 10 | -10.0 |
| C-27 | 92 | 1 | 66.4 | 67.2 | 71 | 0.8 | 10 | ---- | 67.2 | 0.0 | 10 | -10.0 |
| C-28 | 93 | 1 | 68.1 | 68.9 | 71 | 0.8 | 10 | ---- | 68.9 | 0.0 | 10 | -10.0 |
| C-29 | 94 | 1 | 63.8 | 65.3 | 71 | 1.5 | 10 | ---- | 65.3 | 0.0 | 10 | -10.0 |
| C-30 | 95 | 1 | 60.2 | 62.0 | 66 | 1.8 | 10 | ---- | 62.0 | 0.0 | 10 | -10.0 |
| C-31 | 96 | 1 | 63.0 | 64.7 | 71 | 1.7 | 10 | ---- | 64.7 | 0.0 | 10 | -10.0 |
| C-32 | 96 | 1 | 61.4 | 63.1 | 71 | 1.7 | 10 | ---- | 63.1 | 0.0 | 10 | -10.0 |
| C-33 | 97 | 1 | 64.6 | 66.0 | 71 | 1.4 | 10 | ---- | 66.0 | 0.0 | 10 | -10.0 |
| C-34 | 98 | 1 | 66.4 | 68.0 | 71 | 1.6 | 10 | ---- | 68.0 | 0.0 | 10 | -10.0 |
| C-35 | 99 | 1 | 67.2 | 68.8 | 71 | 1.6 | 10 | ---- | 68.8 | 0.0 | 10 | -10.0 |
| C-36 | 100 | 1 | 61.3 | 62.7 | 71 | 1.4 | 10 | ---- | 62.7 | 0.0 | 10 | -10.0 |
| C-37 | 101 | 1 | 58.1 | 59.5 | 71 | 1.4 | 10 | ---- | 59.5 | 0.0 | 10 | -10.0 |
| C-38 | 102 | 1 | 54.6 | 56.0 | 71 | 1.4 | 10 | ---- | 56.0 | 0.0 | 10 | -10.0 |
| C-39 | 103 | 1 | 52.2 | 53.2 | 71 | 1.0 | 10 | ---- | 53.2 | 0.0 | 10 | -10.0 |
| C-40 | 104 | 1 | 55.5 | 56.5 | 71 | 1.0 | 10 | ---- | 56.5 | 0.0 | 10 | -10.0 |
| C-41 | 108 | 1 | 59.2 | 60.6 | 71 | 1.4 | 10 | ---- | 60.6 | 0.0 | 10 | -10.0 |
| C-43 | 111 | 1 | 56.6 | 57.9 | 71 | 1.3 | 10 | ---- | 57.9 | 0.0 | 10 | -10.0 |
| C-44 | 112 | 1 | 55.7 | 56.8 | 71 | 1.1 | 10 | ---- | 56.8 | 0.0 | 10 | -10.0 |
| C-45 | 113 | 1 | 55.2 | 56.1 | 71 | 0.9 | 10 | ---- | 56.1 | 0.0 | 10 | -10.0 |
| C-42 | 114 | 1 | 55.1 | 56.2 | 71 | 1.1 | 10 | ---- | 56.2 | 0.0 | 10 | -10.0 |
| C-46 | 115 | 1 | 68.7 | 69.3 | 71 | 0.6 | 10 | ---- | 69.3 | 0.0 | 10 | -10.0 |
| C-47 | 116 | 1 | 69.0 | 69.7 | 71 | 0.7 | 10 | ---- | 69.7 | 0.0 | 10 | -10.0 |
| C-48 | 117 | 1 | 68.1 | 68.8 | 71 | 0.7 | 10 | ---- | 68.8 | 0.0 | 10 | -10.0 |
| C-49 | 118 | 1 | 66.9 | 67.5 | 71 | 0.6 | 10 | ---- | 67.5 | 0.0 | 10 | -10.0 |

RESULTS: SOUND LEVELS

1/11-670-02

| | | | | | | | | | | | | | |
|-----------------------|-----|--------------|------------------------|------------|------------|-----|----|------|------|-----|----|-------|--|
| C-50 | 129 | 1 | 59.2 | 59.8 | 71 | 0.6 | 10 | ---- | 59.8 | 0.0 | 10 | -10.0 | |
| C-51 | 130 | 1 | 60.5 | 61.3 | 71 | 0.8 | 10 | ---- | 61.3 | 0.0 | 10 | -10.0 | |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | |
| All Selected | | 120 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| All Impacted | | 15 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | | | | | | | | |

RESULTS: SOUND LEVELS

1/11-670-02

| | | | | | | | | | | | | | |
|--|------------|--|---------------------------------------|--|---------------|-------------------------------|------------------|--|---|------------------------|-------------|--------------------------------------|--|
| Pinyon Environmental T.Sparks | | | | | | | | 18 August 2014 TNM 2.5 Calculated with TNM 2.5 | | | | | |
| RESULTS: SOUND LEVELS | | | | | | | | | | | | | |
| PROJECT/CONTRACT: | | 1/11-670-02 | | | | | | | | | | | |
| RUN: | | Federal Reconstruction Proposed Action | | | | | | | | | | | |
| BARRIER DESIGN: | | 2035 PA -5 dB Goal | | | | | | | | | | | |
| Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA. | | | | | | | | | | | | | |
| ATMOSPHERICS: | | 68 deg F, 50% RH | | | | | | | | | | | |
| Receiver | | | | | | | | | | | | | |
| Name | No. | #DUs | Existing L_{Aeq}1h | No Barrier L_{Aeq}1h Calculated | Crit'n | Increase over existing | | With Barrier | | | | | |
| | | | | | | Calculated | Crit'n | Type Impact | Calculated L_{Aeq}1h | Noise Reduction | | | |
| | | | | | | | Sub'l Inc | | | Calculated | Goal | Calculated minus Goal | |
| | | | dB | dB | dB | dB | dB | | dB | dB | dB | dB | |
| C-4 | 68 | 1 | 71.0 | 71.8 | 71 | 0.8 | 10 | Snd Lvl | 66.5 | 5.3 | 5 | 0.3 | |
| C-5 | 69 | 1 | 70.6 | 71.5 | 71 | 0.9 | 10 | Snd Lvl | 64.6 | 6.9 | 5 | 1.9 | |
| C-6 | 70 | 1 | 70.8 | 71.6 | 71 | 0.8 | 10 | Snd Lvl | 64.7 | 6.9 | 5 | 1.9 | |
| C-7 | 71 | 1 | 71.0 | 71.7 | 71 | 0.7 | 10 | Snd Lvl | 64.9 | 6.8 | 5 | 1.8 | |
| C-8 | 72 | 1 | 70.7 | 71.5 | 71 | 0.8 | 10 | Snd Lvl | 64.5 | 7.0 | 5 | 2.0 | |
| C-9 | 73 | 1 | 71.2 | 72.0 | 71 | 0.8 | 10 | Snd Lvl | 66.9 | 5.1 | 5 | 0.1 | |
| C-10 | 74 | 1 | 69.1 | 69.9 | 71 | 0.8 | 10 | ---- | 68.8 | 1.1 | 5 | -3.9 | |
| C-11 | 75 | 1 | 70.8 | 71.6 | 71 | 0.8 | 10 | Snd Lvl | 66.2 | 5.4 | 5 | 0.4 | |
| C-12 | 76 | 1 | 70.9 | 71.7 | 71 | 0.8 | 10 | Snd Lvl | 64.6 | 7.1 | 5 | 2.1 | |
| C-13 | 77 | 1 | 71.0 | 71.9 | 71 | 0.9 | 10 | Snd Lvl | 64.9 | 7.0 | 5 | 2.0 | |
| C-14 | 78 | 1 | 71.3 | 72.1 | 71 | 0.8 | 10 | Snd Lvl | 65.3 | 6.8 | 5 | 1.8 | |
| C-15 | 79 | 1 | 71.0 | 71.7 | 71 | 0.7 | 10 | Snd Lvl | 65.2 | 6.5 | 5 | 1.5 | |
| C-16 | 80 | 1 | 71.5 | 72.3 | 71 | 0.8 | 10 | Snd Lvl | 67.1 | 5.2 | 5 | 0.2 | |
| C-17 | 81 | 1 | 70.4 | 71.1 | 71 | 0.7 | 10 | Snd Lvl | 65.8 | 5.3 | 5 | 0.3 | |
| C-18 | 82 | 1 | 70.4 | 71.3 | 71 | 0.9 | 10 | Snd Lvl | 65.0 | 6.3 | 5 | 1.3 | |
| C-19 | 83 | 1 | 69.3 | 70.0 | 71 | 0.7 | 10 | ---- | 69.4 | 0.6 | 5 | -4.4 | |
| C-20 | 84 | 1 | 69.5 | 70.2 | 71 | 0.7 | 10 | ---- | 70.1 | 0.1 | 5 | -4.9 | |
| C-21 | 85 | 1 | 69.6 | 70.3 | 71 | 0.7 | 10 | ---- | 70.2 | 0.1 | 5 | -4.9 | |
| C-23 | 87 | 1 | 70.5 | 71.4 | 71 | 0.9 | 10 | Snd Lvl | 66.1 | 5.3 | 5 | 0.3 | |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | |
| All Selected | | 19 | 0.1 | 5.0 | 7.1 | | | | | | | | |

C:\TNM25\Federal\Existing Run\2035 No Build\2035 Proposed Act\2035 PA W Barriers

RESULTS: SOUND LEVELS**1/11-670-02**

| | | | | | | | | | | | | |
|-----------------------|--|----|-----|-----|-----|--|--|--|--|--|--|--|
| All Impacted | | 15 | 5.1 | 6.2 | 7.1 | | | | | | | |
| All that meet NR Goal | | 15 | 5.1 | 6.2 | 7.1 | | | | | | | |

APPENDIX D – CDOT NOISE ABATEMENT DETERMINATION
WORKSHEET



Noise Analysis and Abatement Guidelines

COLORADO DEPARTMENT OF TRANSPORTATION NOISE ABATEMENT DETERMINATION WORKSHEET

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

STIP # _____ Date of Analysis: April 9, 2014

Project Name & Location: Federal Boulevard Improvements between 7th Avenue and Howard Place.

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 benefited resident/owners in favor of the recommended noise abatement measure?
 YES NO

C. INSULATION CONSIDERATION: NA

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:

Several commercial properties were impacted. Due to the proximity of the commercial properties to Federal Boulevard, barriers would need to include gaps for commercial access. This would impact the effectiveness of the noise barrier.

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:

Noise barriers identified did not meet CDOT's feasibility and reasonableness criteria. Barriers would block access to commercial properties and access to pedestrian sidewalks, and restrict emergency response access. Noise barriers are not recommended for this project.

Completed by: Tyler Sparks, Pinyon Environmental, Inc Date: April 10, 2014