120TH AVENUE CORRIDOR IMPROVEMENTS
TRAFFIC NOISE TECHNICAL REPORT

NEPA Categorical Exclusion
Project Number AQC M945-004 and Subaccount Number 23371

February 2021

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LIST OF ABBREVIATIONS AND ACRONYMS

CDOT	Colorado Department of Transportation
CFR	Code of Federal Regulations
dBA	A-weighted decibels
EB	eastbound
FHU	Felsburg Holt & Ullevig
FHWA	Federal Highway Administration
ft^2	square feet
Guidance	FHWA's Highway Traffic Noise: Analysis and Abatement Guidance
ID	identification
L_{eq}	one-hour equivalent sound level
mph	miles per hour
NAC	Noise Abatement Criterion
NAAG	Noise Analysis and Abatement Guidelines
NB	northbound
NEPA	National Environmental Policy Act
SB	southbound
SH	State highway
TNM	FHWA's Traffic Noise Model
US	U.S. highway
WB	westbound

1 EXECUTIVE SUMMARY

This traffic noise technical report has been prepared in support of the 120th Avenue Corridor Improvements project that will widen 120th Avenue between Sylvia Drive and the RTD North Metro Commuter Rail Line in Northglenn, Colorado. An executive summary of this project's traffic noise analysis and abatement evaluation is included in Table 1.

Table 1 Project Overview

Project Location and Type I Status Explanation	This project is in Northglenn, Adams County, Colorado (Figure 1). The project is Type I for noise because lanes will be added to 120th Avenue.
Noise Level and Impact Overview	• Existing (2019) noise levels were modeled for the reevaluation and ranged from 51.6 to 69.4 A-weighted decibels (dBA) at 79 receivers[1], which represent 235 receptors. • Future (2040) modeled noise levels for the Proposed Action ranged from 53.1 to 71.6 dBA at 79 receivers, which represent 235 receptors. The Proposed Action is expected to impact the following receivers and receptors: o 13 Activity Category B receivers / 34 receptors o 2 Activity Category E receivers / 2 receptors
Noise Abatement Considerations and Commitments Overview	Four noise abatement barriers were analyzed, as shown in Figure 5. Two were found to be feasible and reasonable.
Information for Local Officials	The Noise Study Zone includes land that is unpermitted and undeveloped (i.e., Activity Category G). Therefore, Part 772.17 of Title 23 of the Code of Federal Regulations (23 CFR 772.17) is applicable and information for local officials is provided in Section 9.

2 PROJECT INTRODUCTION

The Colorado Department of Transportation (CDOT) and the City of Northglenn (City), in cooperation with the Federal Highway Administration (FHWA), are preparing a Categorical Exclusion document for this project. The project will widen 120th Avenue from Sylvia Drive to the RTD North Metro Commuter Rail Line, a distance of almost one mile (Figure 1). Currently, 120th Avenue in the corridor generally has two travel lanes in each direction. 120th Avenue will be widened to three travel lanes in each direction, to become consistent with the 120th Avenue sections immediately east and west of the project area.

The improvements are described in Table 2 and are hereafter called the Proposed Action. The Proposed Action constitutes a Type I project because it includes addition of through-travel lanes in both directions of 120th Avenue. Because the project is Type I and because there is at least one Activity Category A, B, C, D, and/or E receptor within the Noise Study Zone, a noise analysis is needed to determine if traffic noise levels will be impacted as a result of building the project.

[1] A receiver is a modeled point that can represent one or more receptors. Receptor types are listed in Table 3, in the column titled "Description of Land Use Category." A receiver that represents more than one receptor must represent receptors of the same Activity Category.

Felsburg Holt & Ullevig (FHU), acting on behalf of CDOT, the City and FHWA, conducted the noise analysis and prepared this report. Table 2 includes information about this project and provides context for this traffic noise analysis.

Table 2 Project Background

Project Location	This project is in Northglenn, Adams County, Colorado (Figure 1).
Affected Roadways	120th Avenue; Claude Court
Project Purpose	Widen 120th Avenue to three through-lanes in each direction in the corridor. This will make the cross-section of 120th Avenue a consistent three lanes at a regional level.
Project Need	To improve transportation safety, maintain infrastructure, improve traffic mobility, and accommodate growing travel demand
Proposed Action Description	The project will include: • Reconstruct existing sidewalks where impacted by the widening. Where feasible, detached multi-use trails will be considered. • Modify central raised medians and exterior curb and gutter to account for addition or extension of turn lanes where identified. Raised median islands will be landscaped. • Modify traffic signals at Irma Drive to account for the additional lane. The depth of disturbance will be approximately 21 feet below ground surface for traffic signal caissons. • Install a new traffic signal at Race Street. • Install new street lighting throughout the project limits. • Construct drainage and water quality improvements. • Relocate impacted utilities.
Prior National Environmental Policy Act (NEPA) Approvals	None

3 ANALYSIS BACKGROUND

This noise analysis was conducted as required by 23 CFR 772 in accordance with CDOT's *Noise Analysis and Abatement Guidelines* (NAAG) (CDOT, 2015) and FHWA's *Highway Traffic Noise: Analysis and Abatement Guidance* (Guidance) (FHWA, 2011). The analysis determined whether 2040 traffic noise levels from the Proposed Action will exceed applicable impact thresholds at properties (i.e., receptors) within the Proposed Action Noise Study Zone (Section 4.1). Traffic noise abatement measures must be evaluated for any such impacted receptors.

This noise analysis included the following tasks:

- Conducting field measurements of existing sound levels (Section 4.1)
- Validating a noise model using field measurement data (Section 4.2)
- Modeling existing noise conditions for existing roadways (Sections 4.3 and Section 5)
- Modeling Proposed Action for design roadways (Sections 4.3 and Section 5)
- Completing a noise abatement evaluation (Section 6)
- Determining future noise contour lines for unpermitted, undeveloped land (Section 9)

3.1 Characteristics of Noise

Fundamental information about noise, such as terminology, how sound travels, and sound intensity, is included in CDOT's NAAG. It is incorporated by reference to supplement this report.

3.2 Applicable Regulations, Guidelines, and Tools

The following regulation, guidelines, and tools were used to complete this noise analysis:

- ***23 CFR 772 (Procedures for Abatement of Highway Traffic Noise and Construction Noise)*** (FHWA, 2010): Federal highway noise standard that must be followed in analyzing and abating highway traffic noise. This regulation required states to adopt state-specific guidelines, which included adopting specific parameters such as the noise reduction design goal.
- **CDOT NAAG** (CDOT, 2015): Fulfilled Federal requirement to adopt state-specific guidelines. Provides Colorado's procedural and technical requirements for analyzing highway project traffic noise and evaluating noise abatement.
- **FHWA Guidance** (FHWA, 2011)**:** Provides FHWA guidance for applying 23 CFR 772 in the analysis and abatement of highway traffic noise.
- **FHWA Traffic Noise Model (TNM) Version 2.5,** (FHWA, February 2004): Software used to determine existing and design year noise levels.
- ***Noise Measurement Handbook*** (FHWA, 2018): Includes procedures for measuring highway noise.

3.3 CDOT Noise Abatement Criteria and Land Use Activity Categories

A traffic noise impact occurs to a receptor if either of the following conditions are met:

- Predicted design year traffic noise level equals or exceeds CDOT's Noise Abatement Criteria (NAC)
- Predicted design year traffic noise level substantially exceeds the existing highway traffic noise level. "Substantial" is defined as a noise increase of 10 dBA or more between the existing and design years.

CDOT's NAC are shown in Table 3. CDOT's NAAG requires that the one-hour equivalent sound level (L_{eq}) metric be used in the analysis.

The NAC for Activity Category D applies to interior areas of frequent human use. The other NACs apply to exterior areas of frequent human use. Example exterior areas include yards for Activity Category B, park activity areas for Activity Category C, and outdoor restaurant dining areas for Activity Category E.

Undeveloped lands for which development has been permitted before the Date of Public Knowledge for the Proposed Action must be treated as though the proposed development has already been constructed. CDOT considers a proposed development to be permitted when a formal building permit has been issued to the developer for construction.

Table 3 CDOT Noise Abatement Criteria

Activity Category	Activity L_{eq} (dBA)[1]	Evaluation Location	Description of Land Use Category
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.
B[2]	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 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 worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[2]	71	Exterior	Hotels, motels, time-share resorts, vacation rental properties, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	Not Applicable	Not Applicable	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	Not Applicable	Not Applicable	Undeveloped lands that are not permitted for development.

[1] Hourly A-weighted sound level in dBA, reflecting a 1-dBA approach value below 23 CFR 772 values
[2] Includes undeveloped lands permitted for this activity category.

4 NOISE ANALYSIS METHODS

The noise analysis includes identifying the Noise Study Zone, identifying the land uses within the Noise Study Zone, taking noise measurements within the Noise Study Zone, validating the TNM noise model, and developing various noise models. These steps are described below.

4.1 Noise Study Zone Identification

The Noise Study Zone for this project extends 500 feet in all directions from the proposed edge of travel lanes throughout the project extent, as shown in Figure 2.

4.2 Land Use Identification

Table 4 identifies the land use categories and noise receivers and receptors included. Figure 2 identifies the land uses in the Noise Study Zone.

Table 4 Land Use Considerations

Receiver Activity Category Summary (Appendix C-1)	Receivers with the following Activity Categories were modeled in the existing condition and 2040 scenarios: • Activity Category B: 66 receivers representing 222 receptors • Activity Category C: 4 receivers representing 4 receptors • Activity Category E: 9 receivers representing 9 receptors
Other Considerations	• The Noise Study Zone does not contain any permitted receptors that have not been built. • The Noise Study Zone contains Activity Category F activities and Activity Category G land. Activity Category F activities and Activity Category G land are not considered noise sensitive, so receivers are not required for these locations. However, contour lines must be provided for Activity Category G lands, which are shown in Figure 6. • The Noise Study Zone does not have any Section 4(f) sites with frequent human use. • The Northglenn Subdivision is understood to be an eligible Section 106 resource (Figure 2). These homes have been included as Activity Category B receptors, rather than Activity Category C.

4.3 Noise Measurements

Tables 5 and 6 summarize noise measurement information for this analysis. Two traffic noise measurements were performed to acquire data for TNM model validation (Figure 2). Traffic counts and speeds, listed in Table A-1 of Appendix A, were collected during the noise measurement periods. Noise measurement field data sheets are in Appendix A.

Table 5 Noise Measurement Summary

Measurement Location ID	Location (Figure 2)	Date	Time		Length (minutes)
			Start	Stop	
1	120th and Race	7/7/20	11:50 a.m.	12:05 p.m.	15
2	120th and Irma	7/7/20	12:15 p.m.	12:30 p.m.	15

Table 6 Noise Measurement Details

Number of Noise Measurement Locations	2
Noise Measurement Locations	Traffic noise measurement locations represented setback distances of Activity Category B (residential) receptors along 120th Avenue (Figure 2).
Basis for Measurement Length	120th Avenue has relatively consistent and frequent traffic, so a relatively short measurement period was sufficient to collect representative data.
Method to Estimate Traffic Volume During Noise Measurement	Vehicles on 120th Avenue were counted live on site.
Method to Estimate Traffic Speed	Radar
Weather Conditions Summary (See Appendix A)	Noise measurements were made during weather conditions acceptable according to FHWA guidance (FHWA, 2018). Weather conditions, including wind speed, were monitored during the measurements.
Sound Level Meter Used	NTI XL2, Type I
Sound Level Meter Laboratory Calibration Date	August 2019

Field Calibrator Used	CAL200. Calibrations traceable to the United States National Institute of Standards and Technology were performed in the field before each set of measurements and checked in the field after each set of measurements.
Height of Noise Measurement Above Grade	5 feet

4.4 Model Validation

Existing noise levels that were measured in the field were compared to calculated levels from TNM using the traffic data observed during the noise measurements to verify the accuracy of the TNM model. This process is called model validation. If the measured and calculated levels are within ±3 dBA of each other, the model is within the accepted level of accuracy and is considered to have been validated. Measured noise levels, corresponding modeled noise levels, and the differences between the two are presented in Table 7.

Table 7 Noise Measurement Results and Model Validation Summary

Measurement Location ID	Location (Figure 2)	Measured L_{eq} (dBA)	Modeled L_{eq} (dBA)	Difference (dBA)
1	120th and Race	62.0	62.6	0.6
2	120th and Irma	68.8	69.8	1.0

Differences between measured and modeled levels are all within the allowable ±3 dBA tolerance. Therefore, the TNM model is validated for this project.

4.5 TNM Model Inputs

The noise model software used on this project was TNM Version 2.5, as required by FHWA. It was used to analyze noise levels for existing (2019) and future design year (2040) conditions. As part of the analysis, noise levels were calculated by the model at receivers in the Noise Study Zone. Each receiver represented one or more receptors. The TNM modeling used the traffic conditions during the estimated worst traffic-noise hour. Table 8 describes model inputs and methods.

Table 8 TNM Model Inputs

Noise Sensitive Receptors	Noise sensitive receptors are defined according to Table 3. Receivers (modeled points) have been selected to represent the receptors in the Noise Study Zone.
Receivers	Individual receivers are listed in Appendix C-1 and shown in Figures 3 and 4.
Modeled Roadways	The following roadways were included in TNM: • 120th Avenue • Washington Street • Washington Center Parkway • Irma Drive • Race Street • Claude Court For the Proposed Action, the analysis included roads that would be changed or newly built by the project, would have substantially different traffic volumes, or would be important local traffic noise sources.

Differences in How Roadways Were Modeled Between Alternatives	Only the Proposed Action alternative was modeled for the design year. The new 120th Avenue would have a consistent three through lanes each direction and lane alignments would be modified to fit right-of-way constraints.
TNM Objects and Elevations	TNM objects included in the models were terrain lines, buildings modeled as barriers, buildings modeled as building rows and noise barriers (Figure 3). Elevations were obtained from survey data from the project and publicly available topography data.
Existing Noise Barriers	The Noise Study Zone has three existing noise barriers for Northglenn Subdivision residences south of 120th Avenue from Sylvia Drive to Claude Court (Figure 3). These are double-sided, wooden fences approximately 8.5-feet tall (see Photo 1). The barriers appeared to be in good repair. The City has stated that they own and maintain these barriers and that the City is committed to maintaining them for the next 20 years (Appendix E). These barriers will not be disturbed by the Proposed Action. For these reasons after consultation with CDOT staff, the wooden fences were modeled as noise barriers in TNM.
Modeled Pavement Type	Average (FHWA requirement)
Default Ground Type	Lawn
Traffic Data (See Appendix B)	• Roadway coordinates are in State Plane Central from GIS data • Traffic volumes were taken from a site traffic study for 2019 (FHU, 2019) and supplemental project traffic analysis for 2040 (FHU, 2020) • Modeled vehicle mix was 5.7 percent medium trucks and 1.6 percent heavy trucks from online CDOT OTIS data • Worst traffic-noise hour was concluded to be the afternoon peak hour due to highest traffic volumes

5 TNM RESULTS

In the analysis, 79 receivers representing 235 receptors were modeled (Appendix C-1). The modeled noise levels were used to identify which, if any, receptors would be impacted as a result of the Proposed Action.

5.1 Existing Conditions Summary

Under existing conditions (2019), modeled noise levels at 79 receivers ranged from 51.6 to 69.4 dBA. Figure 3 shows the locations of modeled receivers. Appendix C-1 has the modeled noise level at each receiver. Existing conditions are not described as having noise impacts. If the project were not built, the project would not be responsible to abate noise regardless if existing noise levels exceeded NACs.

5.2 No Action Alternative Summary

This project is classified by NEPA as a Categorical Exclusion project and does not have a No Action Alternative.

Photo 1: Existing Noise Barrier

5.3 Proposed Action Summary

Under the Proposed Action (2040), modeled noise levels at 79 receivers range from 53.1 to 71.6 dBA. Fifteen receivers, representing 36 receptors, would exceed the NAC. No receivers

would experience a substantial noise increase of at least 10 dBA. Therefore, a total of 15 receivers, representing 36 receptors, would be impacted during the design year worst-hour noise period (Figure 4). Appendix C-1 has the modeled noise level at each receiver.

5.4 Considered Alternative Summary

This project does not have a Considered Alternative.

6 NOISE ABATEMENT EVALUATION

As described in Section 5.3, 36 receptors in the Noise Study Zone were calculated to be impacted by noise in 2040 under the Proposed Action. Therefore, abatement for the impacted receptors was evaluated in accordance with guidelines from CDOT's NAAG and FHWA's Guidelines. Although abatement was required to be evaluated, abatement is only recommended for inclusion in the project when determined to be both feasible and reasonable.

Abatement is feasible if it:

- Provides at least 5 dBA of noise reduction for at least one impacted receptor
- Does not have any "fatal flaw" issues (e.g., safety, maintenance, access, drainage)
- Does not exceed 20 feet in height to meet the required noise reductions

If an abatement action is not feasible, further evaluation is not needed. Otherwise, abatement reasonableness is evaluated. Abatement is reasonable if it:

- Meets the minimum noise reduction design goal of at least 7 dBA for at least one benefitted receptor
- The Cost Benefit ($/dBA/receptor) equals or is less than the CDOT Cost Benefit Index ($6,800/dBA/receptor)
- Has support from more than 50 percent of the potentially benefited receptors (determined through Benefited Receptor Preference Survey, which may be conducted after the NEPA process and may be documented in a separate report)

6.1 Noise Abatement Options Considered

Noise barriers (walls and, to a lesser extent, berms) are commonly used as noise abatement and must be evaluated for all impacted receptors, per 23 CFR 772.13(c)(1). Other mitigation measures may also be considered, including traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, or exclusive lane designations); alteration of horizontal and vertical alignments; or acquisition of real property or interests therein to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. However, these other mitigation measures are generally not feasible and/or reasonable. For this project, noise walls were the only abatement evaluated.

6.2 Noise Abatement by Noise Insulation

The Noise Study Zone does not have any Activity Category D receptors. Therefore, noise insulation was not considered as abatement for this project.

6.3 Noise Barrier Evaluation

The Proposed Action has impacts grouped into four areas (Figure 4). Barrier placement for each impacted area was considered in multiple locations. The location concluded to provide the best

performance for each set of impacted receivers was optimized, and those results are described in Tables C-2 and C-3. Figure 5 shows the best performing evaluated barrier locations. Appendix D has four CDOT Noise Abatement Determination Worksheets (CDOT Form 1209); one was completed for each optimized barrier. Of the four evaluated noise barriers, two were found to be feasible and reasonable, as described in Appendix C-2 and Appendix D.

7 STATEMENT OF LIKELIHOOD

The noise abatement evaluation for the Proposed Action is described in Chapter 6. Sixteen receivers, representing 36 receptors, were determined to be impacted by traffic noise in 2040 from the Proposed Action (Figure 4).

Noise abatement was determined to be feasible and reasonable in two locations, on the north side of 120th Avenue for the Red Hawk Ranch and Keystone communities (Appendix C-2). Therefore, those two noise walls are recommended to be constructed.

Noise abatement at two other locations was determined not to be feasible and/or reasonable (Appendix C-2).

Note that feasibility and reasonableness determinations for this project may change if there are changes in final design after approval of the NEPA documentation. In addition, abatement will not be built if the Benefited Receptor Preference Survey results in 50 percent or less support for the abatement.

8 CONSTRUCTION NOISE

This section describes construction noise implications, construction noise mitigation strategies, and identifies whether the project is in an area with local noise ordinances.

8.1 Construction Noise Implications

Properties adjoining project construction may be exposed to noise from construction activities for the Proposed Action. Examples of noise from construction equipment are shown in Table 9. Construction noise differs from traffic noise in several ways:

- Construction noise lasts only for the duration of construction, with most construction activities in noise-sensitive areas being conducted during hours that are least disturbing to most nearby residents, when feasible.
- Construction activities generally are short term and, depending on the nature of the construction operations, last from seconds (e.g., a truck passing a receptor) to months (e.g., bridge construction).
- Construction equipment noise is intermittent and depends on the type of operation, location, and function of the equipment, as well as the equipment usage cycle.
- As opposed to operational traffic noise, construction noise is not analyzed. There are no FHWA or CDOT construction NACs. However, construction noise is subject to relevant local regulations and ordinances (Section 8.3).

Table 9 Typical Construction Equipment Noise

Equipment	Maximum Noise Level (dBA at 50 feet)[1]
Scraper	89
Dozer (Bulldozer)	85
Truck (Heavy Truck)	88[2]
Pickup Truck	55

Equipment	Maximum Noise Level (dBA at 50 feet)[1]
Concrete Pump Truck	82
Backhoe	80
Pneumatic Tools	85

Notes:

[1] Noise levels are from Table 9.1 of FHWA's 2006 Construction Noise Handbook (FHWA, 2006), unless otherwise noted.
[2] This noise level is from Table 9.9 of FHWA's 2006 Construction Noise Handbook (FHWA, 2006), which is taken from Chapter 12 of the FTA Transit Noise and Vibration Guidance Handbook.

8.2 Construction Noise Mitigation Strategies

To minimize construction noise levels, typical best management practices will be incorporated into construction contracts where it is appropriate to do so. These may include:

- Notify neighbors in advance when construction noise may occur.
- 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/or subject it to inspection by the construction project manager to ensure maintenance is being conducted.
- Use properly designed engine enclosures and intake silencers if appropriate.
- Use new equipment, which is subject to new product noise emission standards.
- Perform construction activities in noise sensitive areas during hours that are least disturbing to nearby residents, as feasible.

8.3 Local Noise Ordinances

Construction activities associated with the Proposed Action may be subject to Chapter 9 Article 13 of the City's municipal code. Section 9-13-4 places limits on noise from construction projects between 7:00 p.m. and 7:00 a.m. Additionally, the City of Thornton municipal code Section 38-441 addresses construction noise—generally it prohibits construction from 9 p.m. to 6 a.m. and requires daytime construction to meet noise limits for industrial districts. These ordinances should be consulted for more details on specific requirements.

9 INFORMATION FOR LOCAL OFFICIALS

This project's Noise Study Zone includes land that is unpermitted and undeveloped (i.e., Activity Category G) (Figure 2). Therefore, 23 CFR 772.17 is applicable and noise related information needs to be provided to local officials to support local land use planning decisions and future development.

Noise contour lines, representing distances from the edge of the outside travel lane of the highway improvement to the 2040 noise levels from 120th Avenue for the Activity Category B/C NAC (66 dBA) and Activity Category E NAC (71 dBA) thresholds, were developed for the Noise Study Zone (Figure 6).

The distances may vary through the corridor due to topography, differing road configurations, or differing traffic conditions. In general, land within approximately 130 feet from the edge of the outside travel lane of 120th Avenue is predicted to exceed 66 dBA during 2040 worst-hour traffic noise hours and the corresponding distance to 71 dBA is predicted to be approximately 60 feet.

Properties developed within the described contour lines would not be compatible with Activity Category B or C (66 dBA) or Activity Category E (71 dBA) uses, respectively.

Each state highway agency is required to identify when the public is officially notified of a proposed highway project location. CDOT's NAAG defines the Date of Public Knowledge as the date on which the final environmental project document is approved (i.e., signed CatEx Form 128, Finding of No Significant Impact or Record of Decision). After this date, CDOT and FHWA will be responsible for analyzing and documenting existing and future noise levels for these lands as part of Type I noise analyses, but will not be required to provide noise abatement for development on these lands if it was permitted after the Date of Public Knowledge. In addition, these areas would not be eligible for Federal-aid participation for Type II projects, if funding to the Type II program were to be reinstated in Colorado. Decisions concerning such noise abatement are left to local government agencies and private developers.

10 SOURCES AND REFERENCES

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Federal Highway Administration (FHWA). 2004. FHWA Traffic Noise Model® User's Guide (Version 2.5 Addendum), April.

FHWA. 2006. Construction Noise Handbook, August.

FHWA. 2010. Procedures for Abatement of Highway Traffic Noise and Construction Noise, 23 C.F.R. § 772

FHWA. 2011. Highway Traffic Noise: Analysis and Abatement Guidance, December.

FHWA. 2018. *Noise Measurement Handbook*, FHWA-HEP-18-065, June.

Figure 1 120th Avenue Widening Project Location and Noise Study Zone

Figure 2 Noise Study Zone Activity Categories and Noise Measurement Locations

Figure 3 TNM Roads, Receivers and Other Modeled Objects—2040 Proposed Action

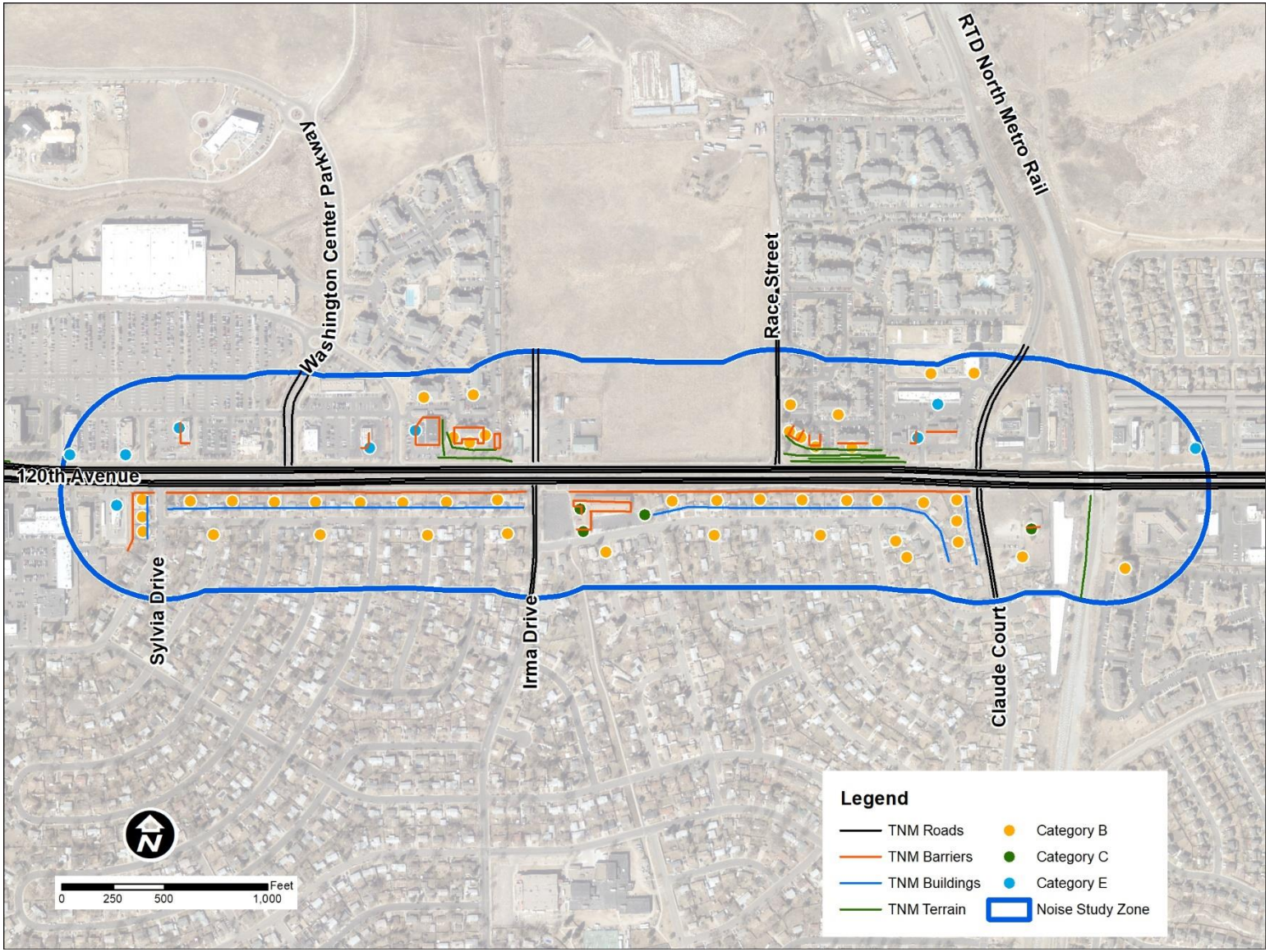

Figure 4 Noise Impacts for 2040 Proposed Action

Figure 5 Potential Noise Abatement Barrier Locations and Findings

Figure 6 2040 Proposed Action Noise Level Contours for Activity Category G

APPENDIX A NOISE MEASUREMENT DATA

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Table A-1 Noise Measurement Traffic Volumes and Speeds Used in Model Validation

Roadway	Location	Date and Time of Traffic Volume and Speed Measurement	Equivalent Hourly Traffic Volume			Estimated Vehicular Speed (mph)[1]	Posted Speed Limit (mph)[2]
			Cars	Medium Trucks	Heavy Trucks		
120th WB	1	7/7/20 11:50 a.m.	1208	16	24	45	45
120th EB	1	7/7/20 11:50 a.m.	1400	16	16	45	45
120th WB	2	7/7/20 12:15 p.m.	1280	16	16	45	45
120th EB	2	7/7/20 12:15 p.m.	1408	24	16	45	45

[1] estimated from radar

[2] provided for informational purposes; estimated speed is used in validation modeling

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Date: 7-7-20
Project #: 119600

Noise Measurement Worksheet

Meter: ☐ NTI XL2 (S/N A2A-04345-D1; gray)
(check box) ☒ NTI XL2 (S/N A2A-06663-EO; white)

Project Name: 120th
Measurement by: T. Schmank

Pre-Check: 114.0 dBA
Post-Check: 114.0 dBA

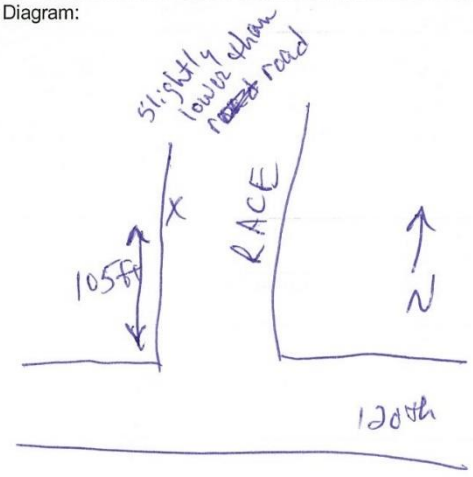
Start Time	Duration	Leq	Maximum	Minimum
1150	15 min	67.0 / dBA	68.6 / dBA	46.0 / dBA

Avg/Max Wind	Wind Direction	Temperature
5 / 20 mph	W, N, E swirl	93

UTM Coordinates:		R. Humidity
503090	4418260	16 %

Data Files:
-001

Site Diagram:



Radar ~45 MPH

Interrupted by pedestrian.

Traffic Counts

	Cars	Med. Truck	Hvy. Truck
WB 7.5 min	25, 19, 25, 25, 25, 25, 7 (151)	11 (2)	11 (3)
EB 7.5 min	25, 25, 25, 25, 25, 25, 25 (175)	11 (2)	11 (2)

	Bus	MC
WB		1
EB		1

15 min. Front
10

Page 6 rev. 2_2018

FELSBURG HOLT & ULLEVIG
connecting & enhancing communities
6300 S. Syracuse, Suite 600
Centennial, CO 80111
Ph. 303.721.1440

Date: 7-7-20
Project #: 119600

Noise Measurement Worksheet

Meter: ☐ NTI XL2 (S/N A2A-04345-D1; gray)
(check box) ☒ NTI XL2 (S/N A2A-06663-EO; white)

Project Name: 120th
Measurement by: Tischmak

Pre-Check: 114.0 dBA
Post-Check: 114.0 dBA

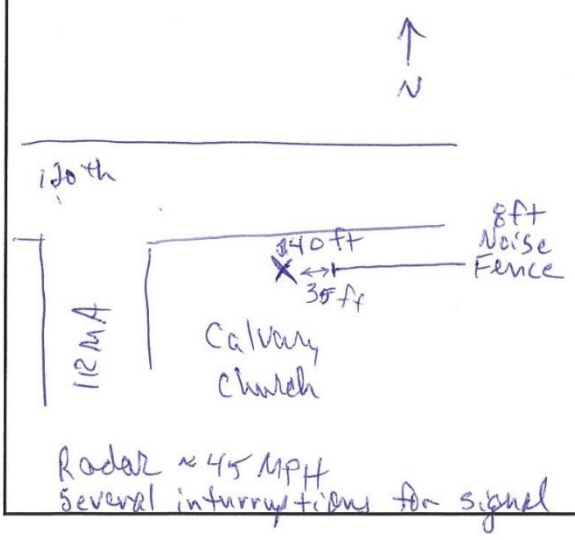
Start Time	Duration	Leq	Maximum	Minimum
~~1215~~ 1215	15 min	68.8 dBA	83.5 dBA	50.4 dBA

Avg/Max Wind	Wind Direction	Temperature
3 / 7 mph	N	92

UTM Coordinates: 502776 4418186
R. Humidity: 14 %

Data Files: -002

Site Diagram:



Radar ≈ 45 MPH
several interruptions for signal

Traffic Counts

	Cars	Med. Truck	Hvy. Truck
EB 7.5 min	25 25 24 24 25 24 24 (176)	III (3)	II (2)
		Bus	MC
WB 7.5 min	25 25 24 25 24 25 10 (160)	II (2)	II (2)
		Bus (1)	MC

~15 min Signals
IIIIII
IIIII (12)

APPENDIX B TNM NOISE MODELING INPUT DATA

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Figure B-1: Noise Study Area TNM Receivers 1

Figure B-2: Noise Study Area TNM Receivers 2

Table B-1: TNM Traffic Input Data

Roadway Link	Number of Lanes	Vehicles / Lane / Hour[1]			Speed (mph)
		Cars	Med Truck	Hvy Truck	
Existing Conditions Model Traffic Data (2019)					
CLAUDE NB N 1lane	1	357	22	6	35
CLAUDE NB S 1lane	1	174	0	0	25
CLAUDE SB N 1lane	1	353	22	6	35
CLAUDE SB S 1lane	1	123	0	0	25
EB 120 A 3lanes	3	1812	111	30	45
EB 120 B1 1lane	1	603	37	10	45
EB 120 B2 1lane	1	603	37	10	45
EB 120 B3 1lane	1	603	37	10	45
EB 120 C1 1lane	1	905	55	15	45
EB 120 C2 1lane	1	905	55	15	45
EB 120 D1 1lane	1	1038	64	17	45
EB 120 D2 1lane	1	1038	64	17	45
EB 120 E1 1lane	1	946	58	16	45
EB 120 E2 1lane	1	946	58	16	45
EB 120 F 3lanes	3	1874	115	31	45
EB 120 F1 1lane	1	937	58	16	45
EB 120 F2 1lane	1	937	58	16	45
EB 120 H 3lanes	3	1874	115	31	45
IRMA NB 1lane	1	273	0	0	25
IRMA SB 1lane	1	225	0	0	25
WASH NB N 3lanes	3	809	50	14	45
WASH NB S 2lanes	2	1054	65	18	25
WASH SB N 2lanes	2	891	55	15	25
WASH SB S 2lanes	2	1080	66	18	40
WASHP NB 2lanes	2	353	22	6	30
WASHP SB 2lanes	2	430	26	7	30
WB 120 A 2lanes	2	1261	77	21	45
WB 120 B 2lanes	2	1261	77	21	45
WB 120 C1 1lane	1	632	39	11	45
WB 120 C2 1lane	1	632	39	11	45
WB 120 D1 1lane	1	687	42	12	45
WB 120 D2 1lane	1	687	42	12	45
WB 120 E1 1lane	1	452	28	8	45
WB 120 E2 1lane	1	452	28	8	45
WB 120 E3 1lane	1	452	28	8	45
WB 120 F1 1lane	1	435	27	7	45
WB 120 F2 1lane	1	435	27	7	45
WB 120 F3 1lane	1	435	27	7	45
WB 120 G 3lanes	3	1537	94	26	45
2040 Design Year Proposed Action Model Traffic Data					
CLAUDE NB N 1lane	1	1085	67	18	35
CLAUDE NB S 1lane	1	195	0	0	25

Roadway Link	Number of Lanes	Vehicles / Lane / Hour[1]			Speed (mph)
		Cars	Med Truck	Hvy Truck	
CLAUDE SB N 1lane	1	775	47	13	35
CLAUDE SB S 1lane	1	150	0	0	25
EB 120 A 3lanes	3	2644	162	44	45
EB 120 B1	1	893	55	15	45
EB 120 B2	1	893	55	15	45
EB 120 B3	1	893	55	15	45
EB 120 C1	1	948	58	16	45
EB 120 C2	1	948	58	16	45
EB 120 C3	1	948	58	16	45
EB 120 D1	1	898	55	15	45
EB 120 D2	1	898	55	15	45
EB 120 D3	1	898	55	15	45
EB 120 E1	1	869	53	15	45
EB 120 E2	1	869	53	15	45
EB 120 E3	1	869	53	15	45
EB 120 F1	1	846	52	14	45
EB 120 F2	1	846	52	14	45
EB 120 F3	1	846	52	14	45
IRMA N NB 1lane	1	370	0	0	30
IRMA N SB 1lane	1	295	0	0	30
IRMA NB 1lane	1	285	0	0	25
IRMA SB 1lane	1	240	0	0	25
Race NB	1	410	0	0	30
Race SB	1	425	0	0	30
WASH NB N 3lanes	3	1122	69	19	45
WASH NB S 2lanes	2	1461	90	24	25
WASH SB N 2lanes	2	1234	76	21	25
WASH SB S 2lanes	2	1526	94	26	40
WASHP NB 2lanes	2	510	31	9	30
WASHP SB 2lanes	2	631	39	11	30
WB 120 A1	1	710	43	12	45
WB 120 A2	1	710	43	12	45
WB 120 A3	1	710	43	12	45
WB 120 B1	1	744	46	12	45
WB 120 B2	1	744	46	12	45
WB 120 B3	1	744	46	12	45
WB 120 C1	1	784	48	13	45
WB 120 C2	1	784	48	13	45
WB 120 C3	1	784	48	13	45
WB 120 D1	1	770	47	13	45
WB 120 D2	1	770	47	13	45
WB 120 D3	1	770	47	13	45
WB 120 E 3lanes	3	2319	142	39	45

[1] Traffic data from project-related analyses (FHU, 2019; FHU, 2020)

APPENDIX C TNM NOISE MODELING RESULTS

TNM files, which contain model inputs and outputs, were submitted electronically to CDOT

Table C-1 Modeled Receiver Noise Levels without Abatement

Receiver Name[1]	Activity Category / CDOT NAC (dBA)	Number of Receptors Per Receiver	Existing (2019) L_{eq} (dBA)	2040 Proposed Action L_{eq} (dBA)	2040 Change from Existing (dBA)	Impact from Project? (Yes or No)
07_BN	B / 66	4	54.4	57.2	2.8	No
07_BN_2	B / 66	4	57.5	60.4	2.9	No
07_BN_3	B / 66	4	60.3	62.6	2.3	No
08_BN	B / 66	2	58.4	60.7	2.3	No
08_BN_2	B / 66	2	64.1	66.1	2.0	Yes
09_BN	B / 66	2	59.0	60.9	1.9	No
09_BN_2	B / 66	2	65.7	67.7	2.0	Yes
09_BN_3	B / 66	2	66.1	68.1	2.0	Yes
10_BN	B / 66	2	54.5	57.3	2.8	No
10_BN_2	B / 66	2	57.1	59.9	2.8	No
10_BN_3	B / 66	2	59.5	62.0	2.5	No
11_BN	B / 66	2	56.4	58.6	2.2	No
11_BN_2	B / 66	2	63.8	66.1	2.3	Yes
11_BN_3	B / 66	2	64.9	67.1	2.2	Yes
16_BN	B / 66	2	57.0	63.1	6.1	No
16_BN_2	B / 66	2	62.0	65.7	3.7	Yes
17_BN	B / 66	2	54.9	61.1	6.2	No
17_BN_2	B / 66	2	59.3	63.8	4.5	No
18_BN	B / 66	2	60.3	63.7	3.4	No
18_BN_2	B / 66	2	64.2	66.5	2.3	Yes
19_BN	B / 66	2	64.5	68.1	3.6	Yes
19_BN_2	B / 66	2	68.8	71.1	2.3	Yes
20_BN	B / 66	6	56.0	59.3	3.3	No
20_BN_2	B / 66	6	60.2	62.4	2.2	No
20_BN_3	B / 66	6	61.3	63.6	2.3	No
21_BN	B / 66	4	65.2	68.1	2.9	Yes
21_BN_2	B / 66	4	68.8	70.9	2.1	Yes
21_BN_3	B / 66	4	68.9	71.0	2.1	Yes
23_BN	B / 66	7	53.8	56.5	2.7	No
25_BN	B / 66	8	58.6	62.3	3.7	No
25_BN_2	B / 66	8	60.6	64.3	3.7	No
25_BN_3	B / 66	8	61.6	65.1	3.5	No
02_EN	E / 71	1	69.4	71.6	2.2	Yes
03_EN	E / 71	1	69.0	71.5	2.5	Yes
04_EN	E / 71	1	58.7	61.3	2.6	No
05_EN	E / 71	1	66.5	69.3	2.8	No
06_EN	E / 71	1	58.6	61.2	2.6	No

Receiver Name[1]	Activity Category / CDOT NAC (dBA)	Number of Receptors Per Receiver	Existing (2019) L_{eq} (dBA)	2040 Proposed Action L_{eq} (dBA)	2040 Change from Existing (dBA)	Impact from Project? (Yes or No)
22_EN	E / 71	1	62.0	64.0	2.0	No
24_EN	E / 71	1	56.3	59.3	3.0	No
26_EN	E / 71	1	64.2	66.1	1.9	No
04_BS	B / 66	1	62.2	64.4	2.2	No
05_BS	B / 66	1	58.5	60.8	2.3	No
06_BS	B / 66	1	56.3	58.7	2.4	No
07_BS	B / 66	3	62.7	65.1	2.4	No
08_BS	B / 66	4	55.4	58.0	2.6	No
09_BS	B / 66	3	62.5	65.2	2.7	No
10_BS	B / 66	3	62.6	65.4	2.8	No
11_BS	B / 66	3	62.9	65.3	2.4	No
12_BS	B / 66	4	55.4	58.0	2.6	No
13_BS	B / 66	3	62.9	65.2	2.3	No
14_BS	B / 66	3	62.8	65.1	2.3	No
15_BS	B / 66	4	55.7	58.0	2.3	No
16_BS	B / 66	3	63.2	65.3	2.1	No
17_BS	B / 66	4	63.5	65.9	2.4	Yes
18_BS	B / 66	2	57.8	60.3	2.5	No
21_BS	B / 66	4	52.5	54.9	2.4	No
23_BS	B / 66	3	62.6	64.7	2.1	No
24_BS	B / 66	4	54.1	56.4	2.3	No
25_BS	B / 66	3	62.4	64.6	2.2	No
26_BS	B / 66	3	62.0	64.5	2.5	No
27_BS	B / 66	3	60.7	63.0	2.3	No
28_BS	B / 66	4	53.7	55.9	2.2	No
29_BS	B / 66	3	61.7	63.7	2.0	No
30_BS	B / 66	3	62.1	63.9	1.8	No
31_BS	B / 66	2	53.6	55.7	2.1	No
32_BS	B / 66	3	51.9	53.9	2.0	No
33_BS	B / 66	3	62.1	64.0	1.9	No
34_BS	B / 66	1	62.3	64.5	2.2	No
35_BS	B / 66	2	58.3	60.5	2.2	No
36_BS	B / 66	3	56.7	59.1	2.4	No
37_BS	B / 66	1	56.0	58.6	2.6	No
39_BS	B / 66	8	54.8	55.2	0.4	No
39_BS_2	B / 66	8	59.6	60.0	0.4	No
39_BS_3	B / 66	8	60.6	61.8	1.2	No
19_CS	C / 66	1	56.1	58.1	2.0	No
20_CS	C / 66	1	51.7	54.1	2.4	No

Receiver Name[1]	Activity Category / CDOT NAC (dBA)	Number of Receptors Per Receiver	Existing (2019) L_{eq} (dBA)	2040 Proposed Action L_{eq} (dBA)	2040 Change from Existing (dBA)	Impact from Project? (Yes or No)
22_CS	C / 66	1	57.9	60.0	2.1	No
38_CS	C / 66	1	51.6	53.1	1.5	No
03_ES	E / 71	1	66.6	68.5	1.9	No

[1] Receiver names that end with "_2" are second floor receptors; those that end with "_3" are third floor receptors. All others are ground-level receptors.

Figure C-1 Wall 4 Site (Keystone) Evaluation Information

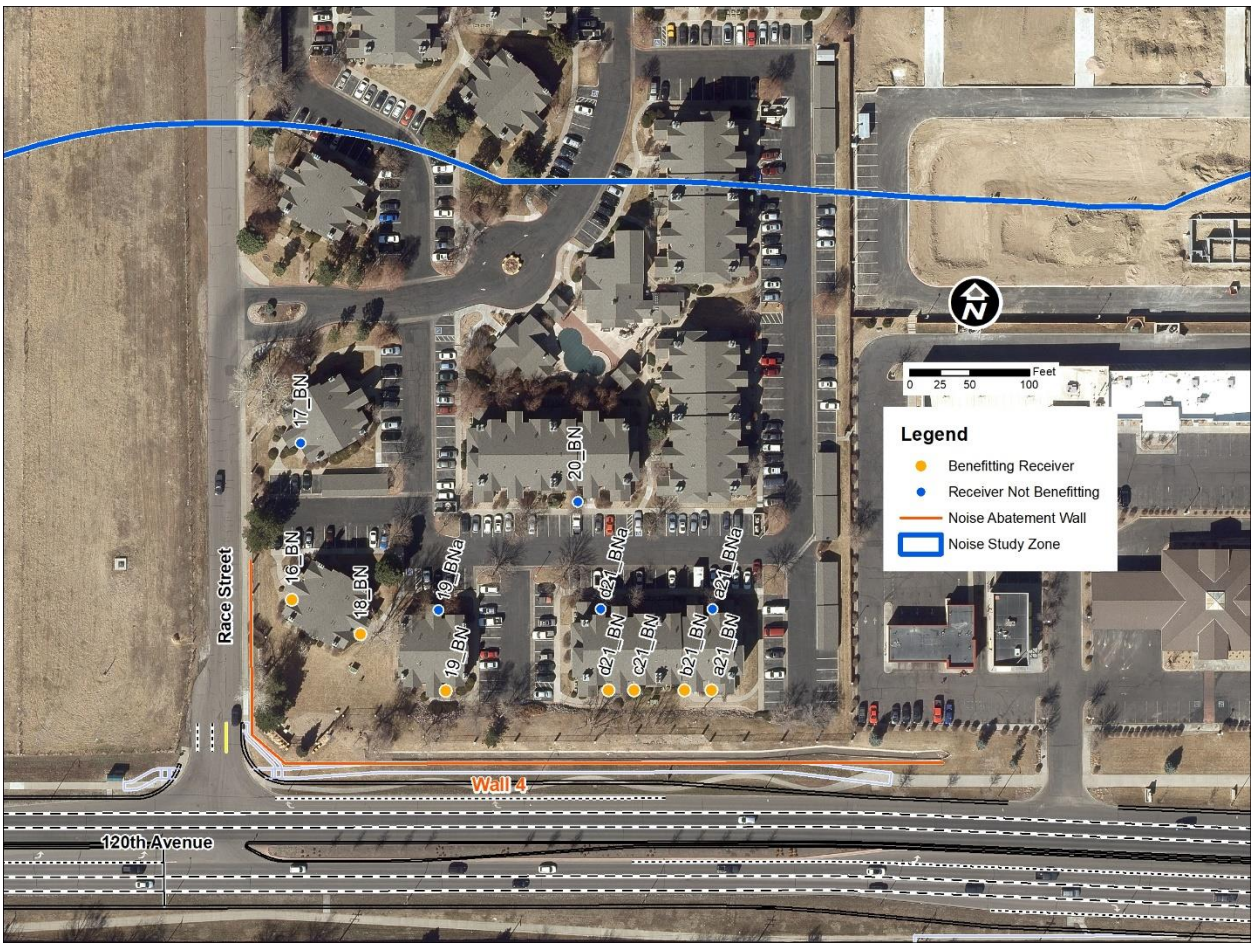

Table C-2 Noise Abatement Barrier Evaluation Data

Barrier ID	Wall 1	Wall 2	Wall 3	Wall 4
Barrier Location (general)	Northglenn, Sylvia to Irma	Chipotle/Panda Express Patios	Red Hawk Ranch	Keystone
Barrier Location: Distance from Proposed Edge of Roadway (feet)	25	30	18	17
Benefited Receiver IDs	See Table C-3	See Table C-3	See Table C-3	See Table C-3
Figure	B-1	B-1	B-1	C-1
Optimized Barrier Height & Length (feet)	15 x 38 (west) 16 x 682 17 x 184 18 x 184 16 x 153 15 x 554(east)	8 x 385	9 x 292 (west) 11 x 103 12 x 121 (east)	10 x 30 (west) 13 x 30 14 x 212 15 x 98 16 x 296 15 x 24 14 x 41 (east)
Barrier Area (square feet)	28,647	3,080	5,216	10,791
Unit Cost	$45/ft^2	$45/ft^2	$45/ft^2	$45/ft^2
Total Cost	$1,289,115	$138,600	$234,720	$485,595
No. Benefited Receptors	25	2	12	24
Total Decibels of Benefit Provided	152.2	13.7	72.6	207.1
Average Benefit (dBA/receptor)	6.1	6.9	6.0	8.6
Cost Benefit ($/dBA/receptor)	8,470	10,117	3,233	2,345
Design year L_{eq} Range Without Abatement (dBA)	58.0 to 66.0	71.6 to 71.7	56.7 to 68.1	45.1 to 71.2
Design year L_{eq} Range With Abatement (dBA)	54.0 to 64.0	64.4 to 65.2	52.6 to 64.2	45.1 to 66.0
Feasible?	Yes	Yes	Yes	Yes
Reasonable?	No	No	Yes	Yes
Recommended?	No	No	Yes	Yes

Table C-3 Modeled Noise Levels Without and With Abatement Barriers

Benefited Receiver Description	Number of Receptors per Receiver	2040 Proposed Action Levels (dBA)[1]		
		L_{eq} Without Abatement	L_{eq} With Abatement	Insertion Loss
Wall 1—Northglenn Subdivision; Sylvia to Irma (Figure B-1)				
04_BS	1	64.4	64.0	0.4
05_BS	1	60.8	60.1	0.7
06_BS	1	59.2	57.9	1.3
07_BS	3	65.1	60.0	5.1
08_BS	4	58.0	54.9	3.1
09_BS	3	65.2	58.8	6.4
10_BS	3	65.5	58.9	6.6
11_BS	3	65.3	58.5	6.8
12_BS	4	58.0	54.0	4.0
13_BS	3	65.3	58.3	7.0
14_BS	3	65.1	59.1	6.0
15_BS	4	58.0	54.3	3.7
16_BS	3	65.3	59.5	5.8
17_BS	4	66.0	60.8	5.2
18_BS	2	60.3	58.7	1.6
Wall 2—Chipotle/Panda Express (Figure B-1)				
02_EN	1	71.7	65.2	6.5
03_EN	1	71.6	64.4	7.2
Wall 3—Red Hawk Ranch (Figure B-1)				
08_BN	1	58.9	55.8	3.1
08_BN_2	1	65.6	60.6	5.0
09_BN	2	60.8	55.6	5.2
09_BN_2	2	67.7	59.1	8.6
09_BN_3	2	68.1	62.7	5.4
11_BN	1	60.3	54.0	6.3
11_BN_2	1	66.9	60.7	6.2
11_BN_3	1	67.3	64.2	3.1
a08_BN	1	56.7	53.2	3.5
a08_BN_2	1	63.0	56.9	6.1
a09_BN	2	41.7	41.7	0.0
a09_BN_2	2	46.1	46.1	0.0
a09_BN_3	2	48.7	48.8	-0.1
a11_BN	1	58.0	52.6	5.4
a11_BN_2	1	65.4	60.2	5.2
a11_BN_3	1	66.4	63.5	2.9
Wall 4—Keystone (Figure C-1)				
16_BN	2	63.1	56.1	7.0
16_BN_2	2	65.7	60.5	5.2
17_BN	2	60.9	60.1	0.8
17_BN_2	2	63.5	62.5	1.0

Benefited Receiver Description	Number of Receptors per Receiver	2040 Proposed Action Levels (dBA)[1]		
		L_{eq} Without Abatement	L_{eq} With Abatement	Insertion Loss
18_BN	2	63.8	53.6	10.2
18_BN_2	2	66.5	56.6	9.9
19_BN	2	68.1	57.7	10.4
19_BN_2	2	71.2	60.4	10.8
20_BN	6	58.3	54.1	4.2
20_BN_2	6	61.3	57.6	3.7
20_BN_3	6	62.5	59.5	3.0
a21_BN	1	67.9	58.0	9.9
a21_BN_2	1	70.9	61.4	9.5
a21_BN_3	1	70.9	65.9	5.0
b21_BN	1	67.8	57.9	9.9
b21_BN_2	1	70.9	61.1	9.8
b21_BN_3	1	71.0	65.9	5.1
c21_BN	1	67.7	57.6	10.1
c21_BN_2	1	70.9	60.6	10.3
c21_BN_3	1	71.0	65.9	5.1
d21_BN	1	67.7	57.6	10.1
d21_BN_2	1	70.9	60.6	10.3
d21_BN_3	1	71.0	66.0	5.0
19_BNa	2	47.0	46.8	0.2
19_BN_2a	2	51.4	51.3	0.1
d21_BNa	1	45.1	45.1	0.0
d21_BN_2a	1	49.3	49.3	0.0
d21_BN_3a	1	51.8	51.8	0.0
a21_BNa	1	46.8	46.8	0.0
a21_BN_2a	1	50.9	50.9	0.0
a21_BN_3a	1	53.1	53.1	0.0

[1] Values reported in this table are for evaluating noise barrier performance; they are not intended to identify noise impacts.

APPENDIX D NOISE ABATEMENT DETERMINATION WORKSHEETS (CDOT FORM 1209)

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DEPARTMENT OF TRANSPORTATION

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 # SA23371 Date of Analysis: 8-13-20

Project Name & Location: 120th Ave Wall 1 Northglenn

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 NA

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 NA

D. ADDITIONAL CONSIDERATIONS:
there is an existing 8-ft wooden noise barrier for the neighborhood. Therefore the project wall must be quite tall to achieve 7 dBA reduction.

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 NA
4. Shall noise abatement measures be provided?
☐ YES ☒ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:
An 18-ft wall was needed to acheive a 7dBA reduction so the cost benefit came out high at $8,470. The barrier is not recommended.

Completed by: Dale Tischmak Date: 8-13-20

CDOT Form #1209 Revised 02/15

DEPARTMENT OF TRANSPORTATION

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 # SA 23371 Date of Analysis: 8-13-20

Project Name & Location: 120th Ave Wall 2 Chipotle

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 NA

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 NA

D. ADDITIONAL CONSIDERATIONS:
this wall is for two dining patios - Category E.

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 NA
4. Shall noise abatement measures be provided?
   ☐ YES ☒ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:
The cost benefit for this wall was $10,117. The wall is not recommended.

Completed by: Dale Tischmak Date: 8-13-20

CDOT Form #1209 Revised 02/15

DEPARTMENT OF TRANSPORTATION

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 # SA 23371 Date of Analysis: 1-21-21

Project Name & Location: 120th Ave Wall 3 Red Hawk

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 To be determined

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 NA
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO NA

D. ADDITIONAL CONSIDERATIONS:
This affects a 3-story apartment building. The wall evaluated would benefit 3rd floor receptors.

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 NA
4. Shall noise abatement measures be provided?
   ☒ YES ☐ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:
The cost benefit worked out to be about $3,200. Therefore, the wall is recommended.

Completed by: Dale Tschmak Date: 1-21-21

CDOT Form #1209 Revised 02/11

DEPARTMENT OF TRANSPORTATION

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 # SA 23371 Date of Analysis: 1-21-21

Project Name & Location: 120th Ave Wall 4 Keystone

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 To be determined

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 NA
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO NA

D. ADDITIONAL CONSIDERATIONS:
This property has 2 and 3 story apartment buildings. The wall evaluated would benefit 3rd floor receptors.

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 NA
4. Shall noise abatement measures be provided?
   ☒ YES ☐ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:
The cost benefit worked out to be about $2,300. therefore, the wall is recommended.

Completed by: Dale Tischmak Date: 1-21-21

CDOT Form #1209 Revised 02/11

APPENDIX E NOISE WALL MAINTENANCE LETTER, CITY OF NORTHGLENN

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Public Works Department/Engineering Division
11701 Community Center Drive
Northglenn, CO 80233
P- 303.450-8984
F- 303.450-4020
www.northglenn.org

February 24, 2021

To whom it may concern,

The City of Northglenn will continue to maintain the wooden fence noise wall on the south side of 120th Avenue starting approximately 110 feet west of Sylvia Drive to the west side of Claude Court. The fence is currently maintained by the City of Northglenn's Parks and Recreation Department.

Sincerely,

Nate Haasis, P.E.
City of Northglenn
Senior Engineer

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