Traffic Noise Analysis Report

I-25/I-80 Interchange

Traffic Noise Analysis Report

I-25/I-80 Interchange Project

Wyoming Department of Transportation

January 2020

Traffic Noise Analysis Report

For the

I-25/I-80 Interchange Project
Laramie County

WYDOT Project Number I806212
FHWA—WYDOT—EA-20-01

Prepared for:

Wyoming Department of Transportation
and
U.S. Department of Transportation
Federal Highway Administration

Prepared by:
Jacobs Engineering Group, Inc.

January 2020

Contents

Appendices*

Appendix A: Technical and Supporting Documentation
Appendix B: Public and Agency Coordination
Appendix C: Build Alternative Preliminary Design Figures
Appendix D: Cumulative Impacts
*All appendices are included on the CD attached to the back cover of hard copies of this document because of their large file size.

Figures

Tables

Acronyms and Abbreviations

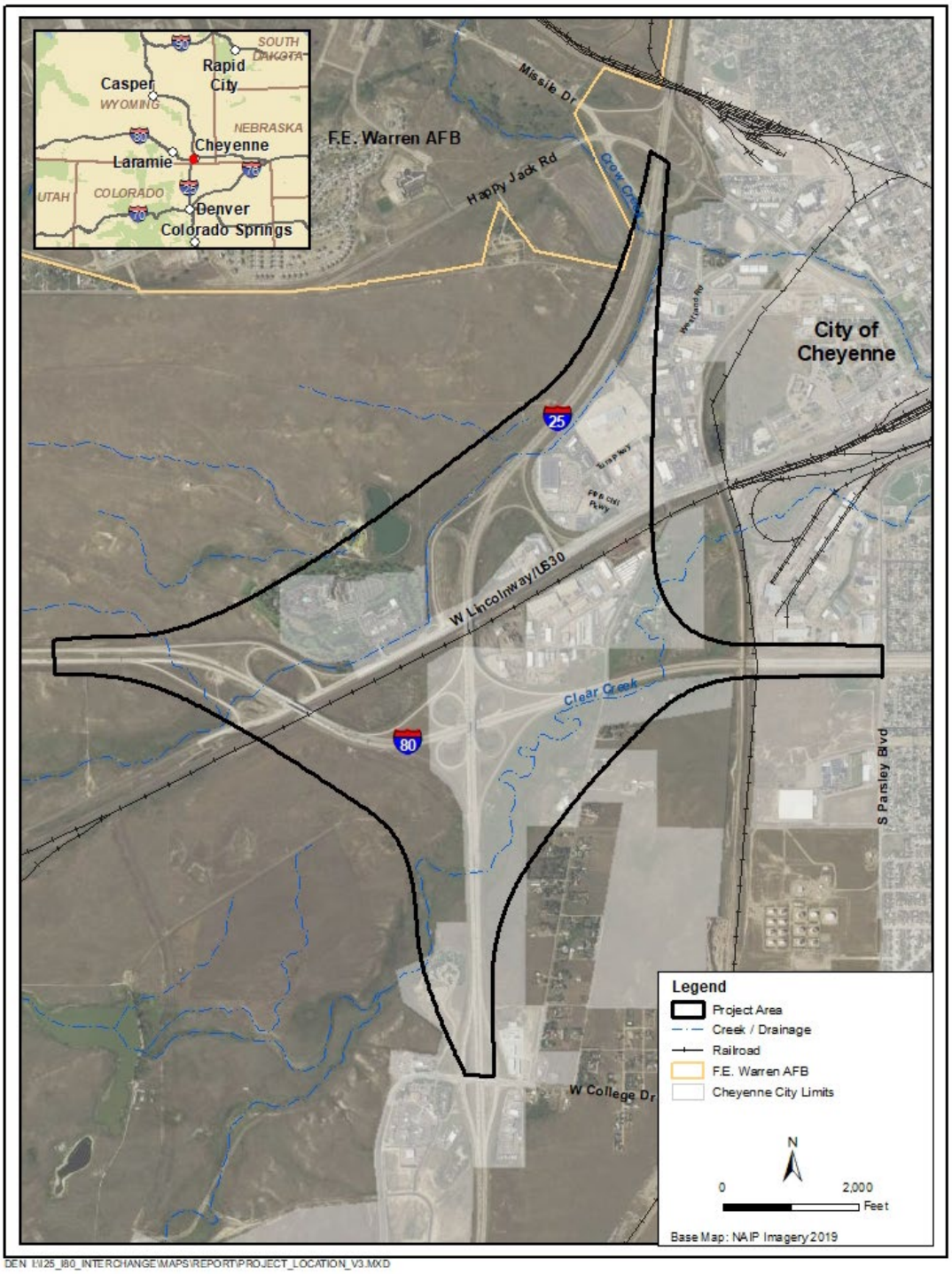
Acronym or Abbreviation	Definition
dBA	A-weighted decibel(s)
EA	Environmental Assessment
FHWA	Federal Highway Administration
I-#	Interstate #
Leq(h)	hourly equivalent sound level
Lincolnway	U.S. Highway 30
LOS	level of service
mph	mile(s) per hour
MPO	Metropolitan Planning Organization
NAC	Noise Abatement Criteria
SFR	single family residence
TNM	traffic noise model
WYDOT	Wyoming Department of Transportation

Chapter 1 **Introduction**

The purpose of this report is to summarize the traffic noise analysis conducted for the I-25/I-80 Interchange Project (project) in support of the Environmental Assessment (EA). The EA is being prepared in compliance with the National Envionmental Policy Act.

The Wyoming Department of Transportation (WYDOT) and the Federal Highway Administration (FHWA) are proposing to replace the existing Interstate (I) 25/I-80 and I-25/US 30 (Lincolnway) interchanges at the southwestern corporate limits of the City of Cheyenne in Laramie County, Wyoming (Figure 1). The I-25/I-80 interchange is one of two system-level interchanges in Wyoming and is the most heavily trafficked interchange in the state, serving as a critical transportation hub facilitating the local, regional, and national movement of people and goods. Also included in the project and located approximately 0.5 mile north of the I-25/I-80 interchange, the I-25/Lincolnway interchange would be replaced. Lincolnway is the main arterial roadway directly connecting Cheyenne to the interstate system. The need for the project is driven by crashes, increasing travel demands, and the support of Cheyenne's future development goals.

Figure 1: Project Location



Chapter 2 **Project Alternatives**

WYDOT is evaluating two alternatives in detail for the EA, described in the following sections.

2.1: Alternative 1: No Build Alternative

The No Build Alternative maintains the existing configurations. Future improvements would include maintenance, safety improvements (dynamic message signs, guardrail, etc.) which would likely increase as the structures and pavement ages. The No Build Alternative also includes projects that are reasonably foreseeable to be implemented by the Design Year 2045, but none of the nearby improvements would affect or influence future traffic through the interchanges.

2.2: Alternative 2: Build Alternative

The Build Alternative includes full replacement of both the I-25/I-80 and I-25/Lincolnway interchanges.

To accommodate future traffic volumes and support local development, the Build Alternative includes bridge structures capable of expanding to three travel lanes in each direction of travel along I-25 and I-80. To support local access and mobility, full movements are maintained between the interchanges and with Lincolnway.

Improvements specific to each interchange are discussed in subsequent subsections. Improvements shared across both interchanges include the following:

- Replacing 5 existing major roadway structures and constructing 13 new major roadway structures
- Widening existing I-25 and I-80 to the inside to accommodate a proposed third lane in each direction of travel along I-25 and I-80, making use of the existing 32-foot grassy median. Accommodating this third lane and full-width shoulder also will require some widening to the outside of existing pavement
- Installing new culverts for the full length of the proposed roadway width and median drain inlets for roadway drainage.

Full access to and from both interchanges and Lincolnway would continue to be provided. The existing right-of-way widths at the I-80/I-25 interchange vary considerably because of the ramp alignments.

The following sections describe general improvements proposed at each of the two interchanges. Construction is anticipated to be delivered in phases, as discussed in Chapter 4 of the EA.

Figure 2a: Existing I-25 and I-80 Interstate Typical Sections

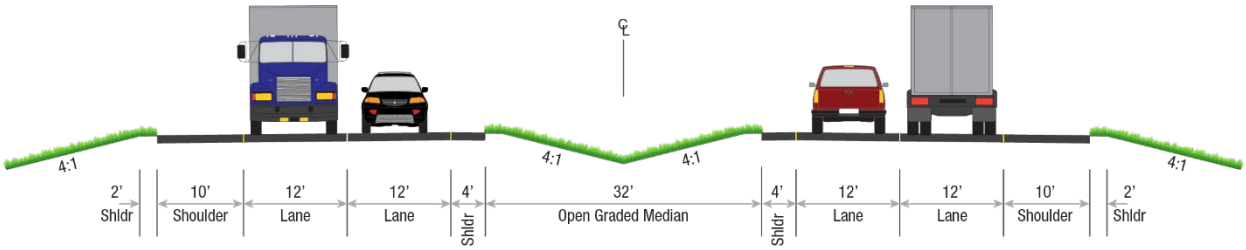
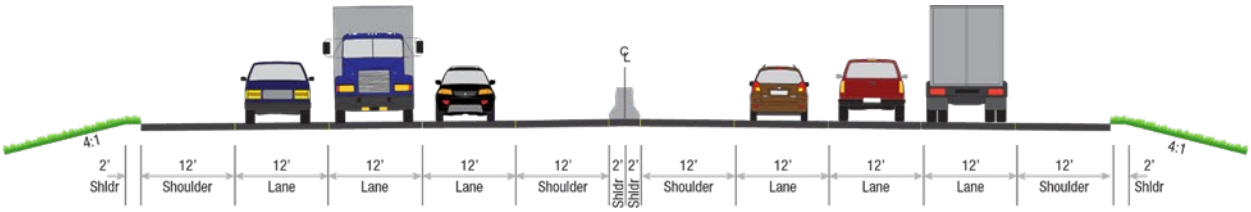


Figure 2b: Proposed I-25 and I-80 Interstate Typical Sections



I-25/I-80 Interchange:

For the I-25/I-80 system-level interchange, the main elements of the Build Alternative would include the following:

- Replacing both the westbound-to-southbound and eastbound-to-northbound cloverleaf ramps with directional flyover ramps and increasing the radii of the two remaining loop ramps to meet modern design speeds and capacity requirements
- Reconstructing the directional ramps in each of the four interchange quadrants to fit the new flyover ramp alignments
- Constructing two new structures over the UPRR
- Adding auxiliary lanes between ramps throughout the interchange
- Shifting the I-25 alignment 35 feet west and the I-80 alignment 35 feet south to reduce construction costs and duration, limit traffic disturbance during construction, and improve a known accident hotspot on eastbound I-80 when approaching the interchange.

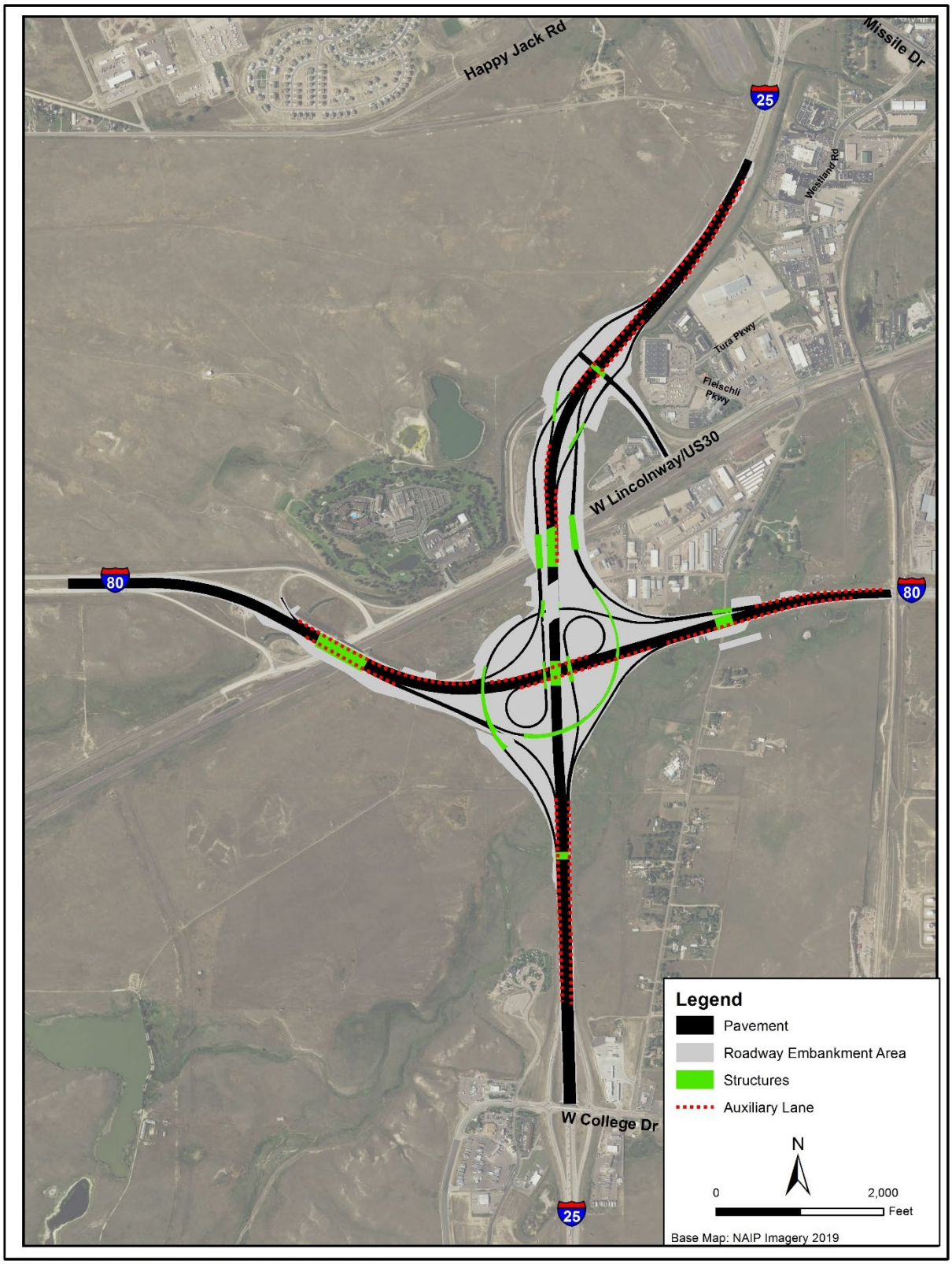
I-25/Lincolnway Interchange:

For the service-level interchange at I-25 and Lincolnway, the major elements of the Build Alternative would include the following:

- Removing the northbound I-25 off-ramp and southbound I-25 on-ramp
- Adding braided ramps to separate I-25/I-80 traffic from traffic accessing Lincolnway
- Creating new grade-separated ramp connections to a crossroad on a new structure over I-25; the crossroad will provide access between the interchange and Lincolnway

The resulting roadway design would consolidate the access between I-25 and Lincolnway to the eastern side of I-25. Direct Lincolnway access would be maintained both to and from I-25.

Figure 3: Build Alternative



Chapter 3 **Characteristics of Sound and Noise**

Noise is generally referred to as unwanted sound. The terms noise and sound are used synonymously. Sound from highway traffic is generated primarily from a vehicle's tires, engine, and exhaust. It is commonly measured in decibels (dB).

Sound occurs over a wide range of frequencies, but not all frequencies are detectable by the human ear. For this reason, an adjustment is made to the high and low frequencies to approximate the way an average person hears traffic sounds. This adjustment is called A-weighting (dBA).

Traffic sound levels also vary based on the changing number, type, and speed of vehicles. To account for this variation, a single value (Leq) is used to represent the average or equivalent sound level over a given time period.

In typical noisy environments, changes in noise of 1 to 2 dBA are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dBA in typically noisy environments.

Chapter 4 **Noise Abatement Criteria**

FHWA established Noise Abatement Criteria (NAC) for different types of land uses and human activities, as shown in Table 1. Table 1 depicts noise in dBA, which are sound levels that best approximate the human ear, over a specific period of time, indicated as the hourly equivalent sound level (Leq[h]). Per WYDOT noise policy (2011), highway traffic noise impacts occur when the predicted highway traffic noise levels approach (less than 1 dBA of the NAC) or exceed the NAC, or when the predicted highway traffic noise levels substantially exceed the existing highway traffic noise levels. WYDOT defines s*ubstantially exceed* as an increase of at least 15 dBA.

Table 1: FHWA Noise Abatement Criteria, Hourly A-Weighted Sound Level Decibels

Activity Category	Activity Leq(h)	Evaluation Location	Activity Description
A	57	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[1]	67	Exterior	Residential
C[1]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	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[1]	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A through D or F.
F	N/A	N/A	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	N/A	N/A	Undeveloped lands that are not permitted for development.

Source: WYDOT 2011

[1] – Includes undeveloped lands permitted for this activity category.

N/A = not available

Chapter 5 **Methodology**

WYDOT has developed guidelines for the analysis and abatement of highway traffic noise in accordance with regulations developed by FHWA (Code of Federal Regulations Title 23 Part 772). These guidelines are set forth in the *Noise Analysis and Abatement Policy* (WYDOT 2011). The methods employed for this analysis are consistent with both FHWA and WYDOT guidelines for analyzing traffic noise, and include the following:

- Coordinate with local agencies to determine if there are any permitted develoments within the study area that would need to be included in the model and analysis.
- Identify noise-sensitive receptors (discrete or representative locations of a noise sensitive area) within the study area that are likely to be impacted by traffic noise.
- Validate the FHWA Traffic Noise Model (TNM) 2.5 by collecting field measurement data consistent with FHWA's *Measurement of Highway Related Noise* guidance (1996).
- Estimate existing and future traffic noise levels using the FHWA approved TNM 2.5 and based on characteristics that would yield the worst traffic noise impact for the design year (in this case, 2045).
- Identify future noise impacts at noise-sensitive receptors.
- Consider and evaluate traffic noise abatement measures based on feasibility and reasonableness (defined below), if applicable.

Traffic data used for the analysis were based on Year 2040 model volumes. Annual traffic growth rates were used to adjust these volumes to estimated Year 2045 volumes. The annual growth rates were calculated using the 2018 existing p.m. peak hour volumes and the 2040 vision model forecast p.m. peak hour volumes. Individual growth rates were calculated and applied to each ramp and mainline interstate segment. The Cheyenne Metropolitan Planning Organization (MPO) will be providing new traffic model data for Year 2045. Once this data is obtained, a traffic sensitivity analysis will be conducted and the traffic noise analysis will be updated accordingly.

5.1: Traffic Noise Model

FHWA's approved TNM 2.5 was used for this analysis. The basic inputs to noise modeling include roadway network layout, site characteristics, traffic volume projections, fleet mix, and vehicular operating speeds. All TNM input/output files are included in Appendix A.

Traffic volumes estimated for the proposed project, as discussed above, are representative of level of service (LOS) C/D or better conditions and would be highest during the p.m. peak hour. Traffic data (peak hour volumes, speeds, and truck percentages) used for this analysis are included in Appendix B.

Chapter 6 Existing Noise Conditions

6.1: Noise Sensitive Receptors

Noise-sensitive receptors are those areas where frequent outdoor human use would occur that may be impacted by future conditions. These receptors were identified within the study area, which includes areas in and near the study area where noise impacts may occur.

There are 14 noise-sensitive receptors in the study area that were included in the noise model (Figure 4). No category A land uses were identified. Most of the noise-sensitive receptors include residential development (category B), recreational uses (category C), and commercial development (category E). Category D activities (indoor noise levels) were not considered because exterior outdoor uses exist on these properties (category C) that would be considered more noise sensitive. Agricultural land (category F) was also identified within the study area, but a noise analysis is not required for this category. Undeveloped land (category G) that is not permitted for development was identified within the study area, and noise contours were provided to assist in local planning decision making. There are other category E receptors (hotels, WYDOT License Service Facility, etc.) within the study area. However, these land uses were not considered noise sensitive receptors since there is no frequent outdoor use.

6.2: Field Noise Measurements

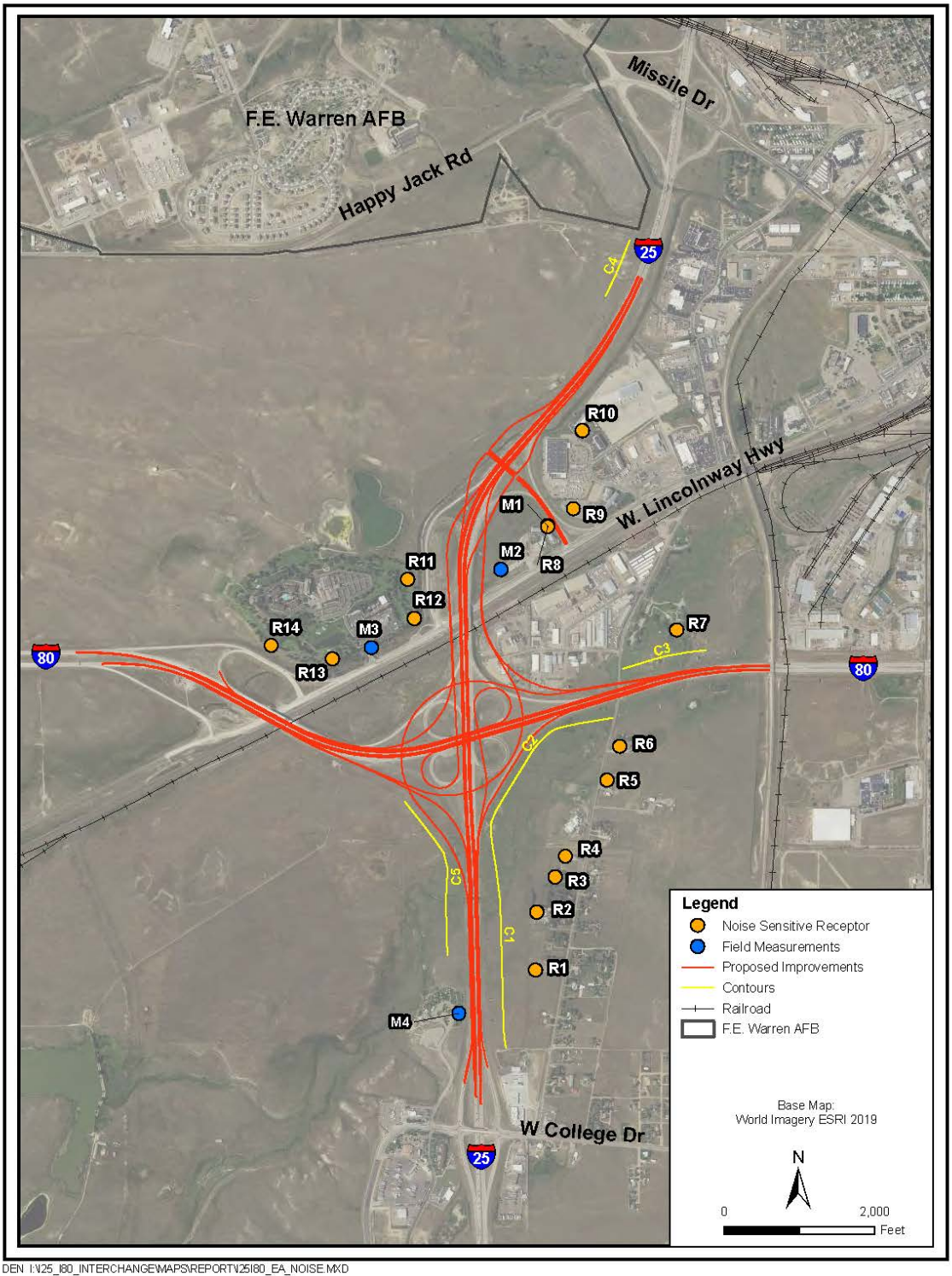
In July 2019, four noise measurements were taken within the study area to determine ambient noise levels. These measurements were used to validate the traffic noise model and ensure noise level predictions are as accurate as possible. Weather conditions were partly sunny with 5- to 10 mile-per hour (mph) winds. Highway pavement conditions were dry. Temperatures averaged 83 degrees Fahrenheit throughout the day. Noise monitoring was conducted using a Quest 2900 Type I sound level meter that meets American National Standards Institute (ANSI) standards. Meters were calibrated and placed at 5 feet above ground surface, as this is the average height of the human ear. Each noise measurement was collected for approximately 15 minutes at each location, as called for by FHWA guidance (1996). Traffic counts were collected by vehicle type simultaneously with the noise measurements. Operating speeds, existing geometry, and traffic counts were input into the FHWA-approved TNM 2.5 software for validation analysis. Field datasheets are included in Appendix C.

Table 2 summarizes the field-recorded and TNM-predicted noise levels. Figure 4 depicts the locations of the field noise measurements. The differences between the field recordings and the noise levels predicted by the model were within 3 dBA at each receptor, which is considered validated per WYDOT noise policy (2011). Therefore, the model was considered an accurate representation of the existing conditions.

Table 2: Field-recorded and TNM-predicted Noise Levels

Location	Field-recorded Noise Levels (dBA)	TNM-predicted Noise Levels (dBA)	Difference (+/-)
Meter Location 1 (La Quinta)	57.3	57.4	+0.1
Meter Location 2 (Americas Best Value)	60.0	60.3	+0.3
Meter Location 3 (Little America Golf Course)	59.4	57.5	-1.9
Meter Location 4 (WYDOT Driver's Services)	67.6	67.4	-0.2

Figure 4: Traffic Noise Analysis Map



DEN I:\I25_I80_INTERCHANGE\MAPS\REPORT\25I80_EA_NOISE.MXD

Chapter 7 Existing and Future Noise Levels

Existing and future noise models were developed for all noise-sensitive receptors within the study area. All modeled noise-sensitive receptors are depicted on Figure 4. The modeled noise levels for existing conditions and for the No Build and Build Alternatives conditions are summarized in Table 3. Modeled noise levels that exceed the NAC are shown in bold font.

7.1: Existing Noise Levels

Under existing conditions, none of the noise-sensitive receptors within the study area have noise levels that approach or exceed the NAC.

7.2: No Build Alternative

By the year 2045, one receptor (R12) would have noise levels that approach or exceed the NAC under the No Build Alternative. Noise abatement measures were not considered for the No Build Alternative.

7.3: Build Alternative

In the design year 2045, under the Build Alternative scenario, noise levels would not approach or exceed the NAC. Therefore, noise abatement was not considered. No receptors would experience a substantial noise increase of 15 dBA over existing conditions.

Table 3: Existing and Future Noise Levels

Receptor Number	Receptor Type	Number of Receptors by Activity	NAC Category/Leq	2018 Existing Noise Levels[1]	2045 No Build Alternative Noise Levels[1]	2045 Build Alternative Noise Levels[1]	Difference between Build and Existing	Build Alternative Impact?
R1	SFR	1	B/66	59.6	63.2	64.2	+4.6	No
R2	SFR	1	B/66	59.6	63.3	64.1	+4.5	No
R3	SFR	1	B/66	57.8	61.2	61.4	+3.6	No
R4	SFR	1	B/66	57.2	60.5	60.6	+3.4	No
R5	SFR	1	B/66	58.4	61.1	61.1	+2.7	No
R6	SFR	1	B/66	61.8	64.2	64.5	+2.7	No
R7	Park	1	C/66	62.0	64.3	64.3	+2.3	No
R8	Hotel	1	E/71	62.0	64.8	69.2	+7.2	No
R9	Restaurant	1	E/71	59.2	62.2	62.2	+3	No
R10	Hotel	1	E/71	62.9	66.2	65.7	+2.8	No
R11	Golf Course	1	C/66	60.5	64.0	62.5	+2	No
R12	Golf Course	1	C/66	62.2	**65.7**	64.3	+2.1	No
R13	Golf Course	1	C/66	60.0	62.6	63.1	+3.1	No
R14	Golf Course	1	C/66	55.9	58.3	58.1	+2.2	No

Note – **bold** font indicates an exceedance of the NAC

[1] – units are in dBA

SFR = Single Family Residence

Chapter 8 **Noise Abatement Analysis**

When traffic noise impacts are identified, noise abatement must be considered and evaluated for both feasibility and reasonableness for each receptor location. Feasibility is the combination of acoustical and engineering factors. Reasonableness is the combination of social, economic, and environmental factors.

A feasible noise barrier must achieve at least a 5-dBA noise reduction by at least one impacted receptor in predicted future noise levels. Constructability, engineering, maintenance, and other design issues must also be considered. For example, a noise barrier cannot create a safety or unacceptable maintenance problem or engineering fatal flaw, such as reduction of line-of-sight, accessibility deficiencies, icing, or other notable roadway maintenance concerns.

Noise abatement is considered reasonable if it meets the noise reduction design goal, meets an acceptable cost per benefited receptor, and considers the benefited receptor's desires as described below:

- The noise reduction design goal of 7 dBA must be met by at least one benefited receptor, and a 5-dBA noise reduction for additional receptors (impacted or not) based on WYDOT noise policy.
- The cost per benefited receptor is $23,000.
- Fifty-one percent of the benefited receptors must agree to the noise abatement measures.

Future noise impacts are not anticipated at any of the noise sensitive receptor sites. Therefore, noise abatement was not considered.

Chapter 9 **Noise Impact Contour Analysis**

Coordination was conducted with Laramie County and the City of Cheyenne to determine if there were any permitted lands within the study area. Noise impact contours have been estimated for the undeveloped lands (category G) within the study area because there are no active permits for development. Upon completion of this noise analysis, information should be provided to the county and city with jurisdiction over the undeveloped lands adjacent to the proposed project. The State of Wyoming has no mandates that prohibit noise-sensitive development adjacent to highways. However, the local planning agencies can use this information to minimize traffic noise impacts to future development of properties adjacent to the proposed project and for noise compatible land use planning. Noise impact contours are presented in Table 4 and depicted on Figure 4.

Table 4: Traffic Noise Impact Contours

Contour Label	Contour Area	Impact Contour	Distance from Center of Nearest Travel Lane
C1	North of College and east of I-25	71 dBA	300 feet
C2	South of I-80 and east of I-25 (ramps)	71 dBA	120 feet
C3	North of I-80 and east of I-25	71 dBA	240 feet
C4	North of Lincoln interchange and west of I-25	71 dBA	280 feet
C5	North of College and west of I-25	71 dBA	300 feet

Chapter 10 **Construction Noise**

Construction activities associated with the proposed project would temporarily elevate noise levels in the proposed study area. Noise resulting from construction activities would depend on the different types of equipment used, the distance between construction noise sources and sensitive noise receptors, and the timing and duration of noise-generating activities. Construction activities would be temporary and would mostly occur during normal daytime hours.

Noise associated with the construction of the proposed project is difficult to predict. Heavy machinery, the major source of noise during construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. None of the receptors are expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. If noise is a concern during construction, further assessment will be required to determine use of appropriate control measures in an effort to reduce temporary noise levels.

Chapter 11 **Conclusions and Recommendations**

At this time, none of the noise sensitive receptors would be impacted as a result of the proposed project. Therefore, noise abatement was not considered. If substantial changes are made to this project's design elements, the noise analysis will need to be re-assessed to evaluate the impact of those changes.

Chapter 12 **References**

Federal Highway Administration (FHWA). 1996. *Measurement of Highway Related Noise*. Final. May. https://www.fhwa.dot.gov/environment/noise/measurement/measure.pdf

Wyoming Department of Transportation (WYDOT). 2011. *Noise Analysis and Abatement Policy. July*. http://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Environmental_Services/Documents/2011%20Noise%20Analysis%20and%20Abatement%20Policy.pdf. July 13, 2011.

Appendix A: TNM Input/Output Data

(electronic files submitted to WYDOT)

Appendix B: Traffic Data

Appendix C: Field Measurement Datasheets