3.10 Noise

3.10.1 What concerns related to noise are important to this project?

Traffic noise is an important issue to residents living near the I-70 highway. The I-70 Mountain Corridor carries large volumes of high-speed traffic, but traffic congestion (and, therefore, speed) is erratic and does not produce consistent noise levels. Many trucks use the Corridor, some of which use engine compression brakes that produce intermittent and very loud noises. Topography and other constraints mean that many residences sit close to or above the noise sources, where mitigation is difficult to achieve.

Noise is defined as unwanted sound and is most commonly measured on the decibel (dB) scale, ranging from 0 dB (threshold of human hearing) to 140 dB (where sound causes pain). An "A-weighted decibel," or dBA, is used for impact assessment because it mimics the varying sensitivity of humans to sounds at different frequencies. Noise levels of 40 to 50 dBA are typical of a quiet neighborhood, while 70 to 80 dBA might be heard adjacent to a busy urban street or highway. An increase or decrease in noise by 5 dBA is readily noticeable by most people. The human ear perceives an increase or decrease in noise by 10 dBA as twice or half as loud, respectively.

New highway and rail facilities must consider their noise effects on sensitive receptors, such as residences, schools, parks, and businesses. In addition to the National Environmental Policy Act (NEPA), state and federal regulations specific to transportation noise also apply to the Corridor. Federal Highway Administration (FHWA) regulations governing highway noise appear in 23 Code of Federal Regulations Part 772. The Colorado Department of Transportation (CDOT) established procedures that implement the federal regulations in the *CDOT Noise Analysis and Abatement Guidelines* (December 2002). Federal Transit Administration (FTA) and Federal Railroad Administration (FRA) regulations apply to transit noise, regulating vibration and horn noise assessment for transit facilities.

3.10.2 What study area and process was used to analyze noise?

The lead agencies analyzed existing and future noise levels at select locations within seven representative communities along the Corridor (see **Figure 3.10-1**). The lead agencies measured noise levels continuously for several days in each of the representative communities between 2001 and 2004 to determine existing noise levels. Although these noise measurements are 6 to 9 years old, they are still representative of noise conditions in the Corridor. The noise level analysis considers noise conditions during the loudest hour of the day (the hour of peak traffic volumes, when traffic is traveling at free-flow speeds). The majority of the Corridor areas studied already reached the loudest hour on a regular basis at the time of the measurements, meaning, the highway was filling to capacity during the measurements and thus got as loud as it is going to get under current capacity while maintaining free-flowing travel speeds. In areas where the highway still has capacity, and therefore the loudest hour noise levels have the potential to increase, increases would be small (1 decibel [dB] or less) and regardless would not affect the results of the study, which are based on loudest hour noise levels and future traffic conditions.

The lead agencies then predicted the increase in noise levels occurring as a result of the Action Alternatives. They used FHWA procedures to predict highway noise and FTA procedures to predict Rail and Advanced Guideway System noise. Predicted changes in noise levels were based on the following:

- The Federal Highway Administration Traffic Noise Model (TNM) was used to estimate the increase in noise levels expected due to projected (2035) traffic volume increases.
- The noise increase from outward lane shifts to accommodate transit was estimated to be 1 dB.

- Federal Transit Administration procedures were used to estimate the noise from transit systems.
- General acoustic principles were used to estimate the effects on noise levels of reflections from cliffs, elevation of highway lanes and transit systems, and changes in line of sight from receivers to highway/transit noise sources.

These changes in noise levels were added together to predict noise levels in each of the representative communities for each alternative. For Combination alternatives, estimates of future noise levels included the total of both highway improvements and transit systems.

Once future noise levels were predicted, the lead agencies compared those noise levels to impact criteria to determine whether a noise impact occurs. Because vehicles on the I-70 highway will likely be the dominant source of noise in the Corridor even if Rail or Advanced Guideway System is implemented, CDOT's highway noise impact assessment methodology was employed in this study to judge impacts of the Action Alternatives. Specifically, predicted noise levels were compared to CDOT's Noise Abatement Criteria (NAC); FTA and FRA impact criteria were not employed.

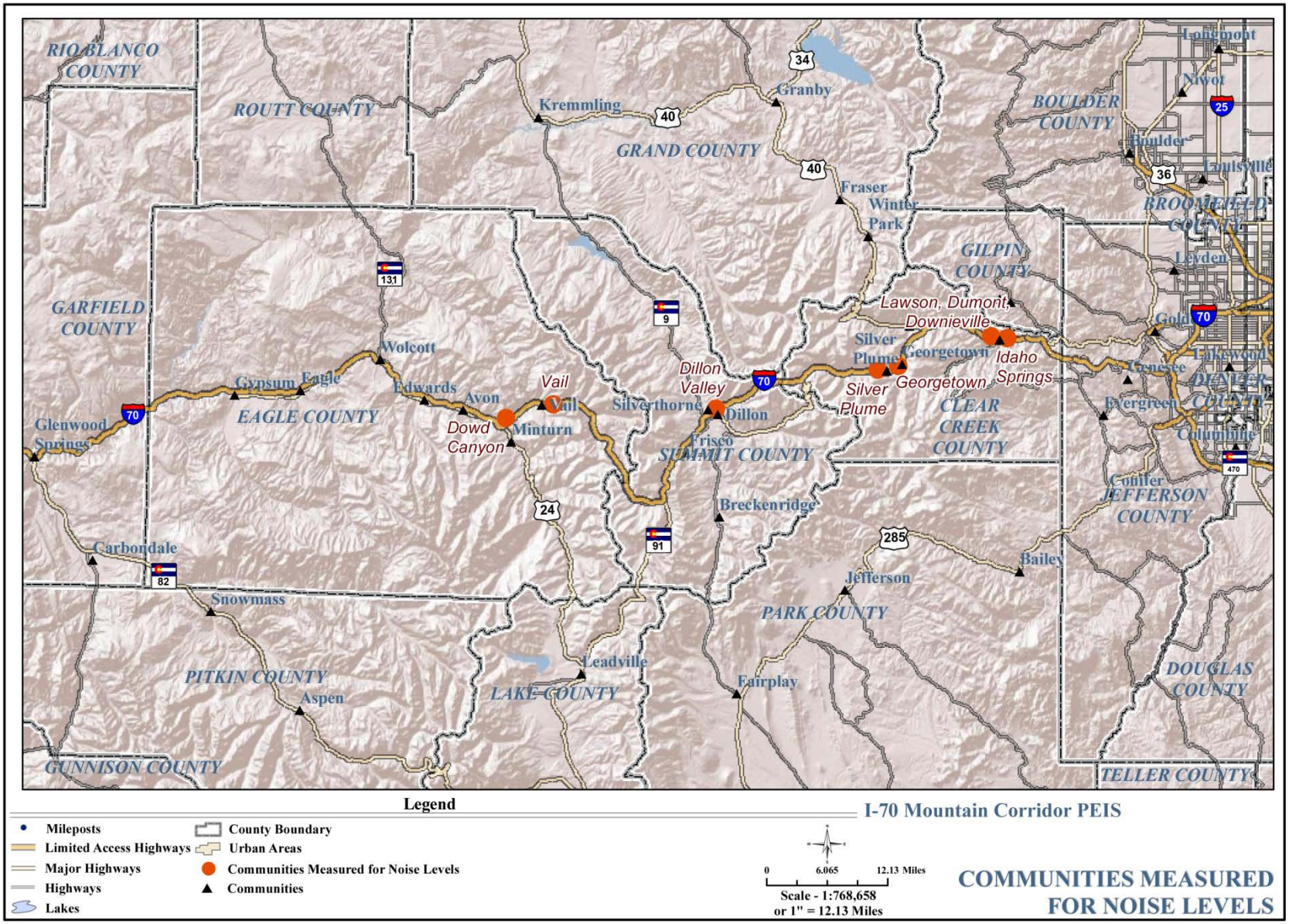
Colorado Department of Transportation NAC consider noise-sensitive receptors such as residences, parks, or schools impacted if noise levels during the loudest hour of the day equal or exceed 66 decibels (expressed as A-weighted decibels or dBA), or if future noise levels exceed existing levels by 10 dBA or more. These regulations apply to all noise analyses conducted in Colorado. Some stakeholders suggest that travel patterns and noise conditions in the Corridor are more variable than typical highways and, therefore, are not represented accurately by CDOT and FHWA noise policies. Lead agencies must follow statewide and national noise guidance but acknowledge that noise is an important issue to be evaluated further in Tier 2 processes.

Colorado Department of Transportation guidelines require noise mitigation to be considered for any impacted noise-sensitive receptor. The Colorado Department of Transportation must meet the feasibility and reasonableness test of proposed mitigation measures based on considerations such as the amount of noise reduction that can be achieved and the cost per benefited receiver per dBA of noise reduction. The *I-70 Mountain Corridor PEIS Noise Technical Report* (CDOT, March 2011) includes additional information about the noise evaluation, methodology, and results.

3.10.3 What agencies have CDOT and FHWA coordinated with and what are their relevant issues?

Noise specialists with the lead agencies helped develop the methodology and approach to noise analysis for the Corridor. No outside agencies regulate noise studies or impact analyses; however, stakeholders participated in the discussion of noise issues.

Figure 3.10-1. Communities Measured for Noise Levels



3.10.4 What are the areas of noise interest identified in the Corridor?

Noise along the existing Corridor exceeds CDOT NAC in many locations, with existing peak-hour noise levels ranging from 52 dBA to 72 dBA (**Table 3.10-1**). With the exception of Dowd Canyon, noise levels are currently at or above the impact threshold of 66 dBA for at least one location in every community sampled. **Figure 3.10-1** illustrates the communities and locations where noise levels were measured.

Table 3.10-1. Measured Noise Levels 2001–2004

Town	Location**	Loudest Hour (dBA)**
Dowd Canyon	Creekside Condos	62
	Kayak Crossing Condos	60
Vail	Golf course	63
	West side of town, south of the I-70 highway	67
	West side of town, north of the I-70 highway	65
Dillon Valley (before construction of noise wall)	East side of residential area	66
	West side of residential area	61
	Church	69
Silver Plume	Behind existing noise wall	57
	Near interchange	59
	East end of town	68
	Railroad depot	63
Georgetown	Below the I-70 highway bench	52
	East of interchange	68
Lawson, Downieville, and Dumont	Lawson: South side of the I-70 highway, along Silver Lakes Drive	65
	Dumont: South side of the I-70 highway, along Stanley Road	68
Idaho Springs	Residences on east end of town	65
	Downtown	65
	Residences on west end of town	64
	Charlie Tayler Waterwheel	72

***Shaded cells represent impacted areas.*

3.10.5 How do the alternatives potentially affect noise?

The Action Alternatives directly impact noise-sensitive receptors due to changes in noise levels on the I-70 highway and indirect impacts related to increased traffic and induced growth in other areas. Except in the Vail area, which is affected by existing noise, the No Action Alternative does not result in noise impacts; the Minimal Action, Bus in Guideway, and Advanced Guideway System Alternatives result in minor increases in noise levels; and the Rail with Intermountain Connection, Highway, and Combination alternatives cause the greatest increase in noise levels. Impacts of the Preferred Alternative range from minor to noticeable (increases of 0 to 5 dBA).

In the seven communities measured for this Tier 1 study, impacts from most or all alternatives primarily occur in Vail, Lawson, Downieville, Dumont, and Idaho Springs because those areas already experience elevated noise levels. See the *I-70 Mountain Corridor PEIS Noise Technical Report* (CDOT, March 2011) for additional information.

How do the alternatives directly affect noise in the Corridor?

Table 3.10-2 summarizes the predicted 2035 loudest hour noise levels, which range from 53 dBA to 70 dBA. The table also shows in parentheses the predicted increase over existing conditions presented in **Table 3.10-1**. The analysis and table group the alternatives because noise levels are similar among modes. Loudest hour noise for Transit alternatives is the hour of day when the most trips occur. For the Highway alternatives, loudest hour levels occur when the highway is at capacity but still flowing freely. As congestion builds, traffic speeds (and noise levels) decrease. The predicted noise levels in **Table 3.10-2** are estimates of future noise levels at representative locations in the Corridor; Tier 2 processes will include a more exhaustive analysis of potential noise levels at all potentially affected receptors.

Table 3.10-2. 2035 Predicted Noise Levels

	Area (West to East)						
Alternative	**Dowd Canyon**	**Vail**	**Dillon Valley**	**Silver Plume**	**Georgetown**	**Lawson, Downieville, and Dumont**	**Idaho Springs**
No Action	62 (+2)	67 (+2)	59 (0)	57 (0)	53 (0)	65 (0)	65 (0)
Minimal Action	62 (+2)	67 (+2)	59 (0)	57 (0)	57 (+4)	67 (+2)	65 (0)
Rail with IMC	64 (+4)	68 (+3)	60 (+1)	58 (+1)	57 (+4)	66 (+1)	66 (+1)
AGS	62 (+2)	67 (+2)	60 (+1)	58 (+1)	56 (+3)	65 (0)	65 (0)
Bus in Guideway	63 (+3)	68 (+3)	61 (+1)	58 (+1)	54 (+1)	66 (+1)	69 (+4)
Six-Lane Highway (55 or 65 mph)	64 (+4)	- - -	- - -	59 (+2)	55 (+2)	67 (+2)	70 (+5)
Reversible/HOV/HOT Lanes	64 (+4)	- - -	- - -	59 (+2)	55 (+2)	67 (+2)	70 (+5)
Combination Six-Lane Highway with Rail and IMC	65 (+5)	68 (+3)	60 (+1)	61 (+4)	57 (+4)	68 (+3)	70 (+5)
Combination Six-Lane Highway with AGS	64 (+4)	67 (+2)	60 (+1)	61 (+4)	57 (+4)	68 (+3)	70 (+5)
Combination Six-Lane Highway Bus in Guideway	64 (+4)	67 (+2)	60 (+1)	61 (+4)	57 (+4)	68 (+3)	70 (+5)
Preferred Alternative[1]	64 (+4)	67 (+2)	60 (+1)	58 to 61 (+1 to +4)	56 to 57 (+3 to +4)	65 to 68 (0 to +3)	65 to70 (0 to +5)

[1]The Preferred Alternative is presented as a range because the adaptive management component allows it to be implemented based on future needs and associated triggers for further action. Section 2.7.2 of this document describes the triggers for implementing components of the Preferred Alternative.

Key to Abbreviations/Acronyms

---- = not applicable; the alternative does not include improvements in this location

AGS = Advanced Guideway System
HOT = High Occupancy Toll
HOV = High Occupancy Vehicle
IMC = Intermountain Connection
mph = miles per hour

Increases in noise levels of less than 3 dBA are generally imperceptible to humans. Increases of 3 dBA to 5 dBA are noticeable, and increases of 10 dBA are perceived as a doubling of loudness. These relationships hold true, however, only when there is no change to the character of the noise. This is the case with the No Action, Bus in Guideway, and Highway alternatives. However, Transit alternatives and Combination alternatives that include transit introduce noise sources with different frequency and time characteristics, which are likely noticeable even when they are less loud than the highway.

In general, the Minimal Action Alternative generates noise levels similar to those of the No Action Alternative for all communities except Georgetown, which experiences a 4 dBA increase under the Minimal Action Alternative, and Lawson, Downieville, Dumont, which experiences a 2 dBA increase under the Minimal Action Alternative. The remaining Action Alternatives increase noise levels between 1 dBA (imperceptible) and 5 dBA (noticeable) in the seven representative communities. The Preferred Alternative results in noise levels similar to those of the other Action Alternatives, in most cases. Under all alternatives, trucks use engine compression brakes that produce intermittent and very loud noises.

- Dowd Canyon, Dillon Valley, Silver Plume, and Georgetown do not experience noise impacts above the NAC under any alternative. However, Dowd Canyon and Georgetown experience perceptible noise increases under most alternatives, and Silver Plume experiences perceptible noise increases under the Combination alternatives. Although existing noise level measurements showed noise levels above 66 dBA in two locations in Georgetown and Silver Plume, neither location would experience future noise impacts under the Action Alternatives; one location does not have any receptors, and the other would be protected by reconstruction of an existing noise wall.
- Vail experiences noise impacts above the NAC under all alternatives, primarily because the existing noise level already exceeds the NAC.
- Similarly, because existing noise levels in Lawson, Downieville, Dumont, and Idaho Springs are only 1 dBA lower than the NAC, those communities experience noise impacts above the NAC under most alternatives except the No Action and Advanced Guideway System alternatives.
- Idaho Springs experiences the highest increase in noise of the Corridor communities under all Action Alternatives except the Minimal Action and Advanced Guideway System alternatives, which do not affect noise levels in Idaho Springs.

Most maintenance activities, such as snow plowing and deicing, generate noise levels within the levels analyzed under regular operations of the alternatives. Some longer-term maintenance activities could involve construction. Noise from such activities is similar to construction noise and is discussed below.

How do the alternatives indirectly affect noise?

Indirect noise impacts include increased traffic on roads providing access to the transit stations. Noise levels increase 3 dBA for every doubling of traffic volumes, provided there is no congestion. In addition, induced growth in the area results in additional background noise, such as traffic on local streets, building construction, and other daily activities.

How does construction of the alternatives affect noise?

Construction generates noise from construction equipment that potentially impacts nearby residences and businesses. Nighttime construction noise also occurs off and on. Construction noise at receptor locations usually depends on the loudest one or two pieces of equipment operating nearby. Noise levels from diesel-powered equipment range from 80 dBA to 95 dBA at a distance of 50 feet. Impact equipment such as rock drills and pile drivers could generate louder noise levels.

Construction noise is subject to local ordinances. Most of the towns in the Corridor have only "nuisance" codes in place and do not specifically address construction noise. One exception is Vail, where construction noise is limited to 90 dBA between 7:00 AM and 7:00 PM.

Construction activities could produce considerable vibration levels. Although the FTA regulations were not used to analyze construction noise impacts for this analysis, the FTA impact assessment procedures provide limits for both damage and annoyance from vibration that must be followed during construction.

What are the project effects on noise in 2050?

Loudest-hour noise levels from highway and transit facilities in 2050 are likely nearly the same as those in 2035. The I-70 highway is the loudest noise source in the Corridor and reaches capacity in most areas under all alternatives by 2035. Any additional traffic demand increases congestion, which decreases rather than increases noise levels. In areas with additional peak-hour capacity in 2035, the extra capacity and the corresponding traffic increases are so small, associated loudest-hour noise level increases are imperceptible. Maximum noise levels from intermittent noise such as engine compression brakes do not increase between 2035 and 2050. Changes in auto technology could result in quieter-operating vehicles between 2035 and 2050, which may reduce noise levels (however, such changes are likely small).

Regarding transit service, if bus or train service operates more frequently, noise levels increase. On a long-term average basis, service frequency needs to double before noise level increases become perceptible, and such high service increases are unlikely. Also, the maximum noise level created by passing trains will not get any louder. However, the number of noise "events" caused by passing trains increase correspondingly with service increases.

3.10.6 What will be addressed in Tier 2 processes?

Tier 2 processes will include a more robust analysis of potential noise impacts and mitigation based on the configuration of proposed highway improvements, associated traffic projections, and refined field noise measurements taken at potentially affected receptor locations. Noise studies will be conducted in accordance with appropriate regulatory standards; that is, following CDOT noise impact assessment methodology for highway improvements, and FTA noise impact assessment methods for rail improvements. Information about noise studies, methodologies, and modeling results will be included in any public involvement efforts associated with Tier 2 processes.

The Colorado Department of Transportation's noise policies suggest that a quantitative analysis of construction noise be considered for large, complex projects. This is the case here, and CDOT should conduct such an analysis as part of any future Tier 2 environmental processes. The Colorado Department of Transportation should also analyze construction vibration as part of Tier 2 processes.

The Colorado Department of Transportation will conduct the following activities during Tier 2 processes:

- Develop specific and more detailed mitigation strategies and measures
- Develop best management practices specific to each project
- Adhere to any new laws and regulations that may be in place when Tier 2 processes are underway, including new regulations regarding noise abatement criteria expected to go into effect in July 2011

3.10.7 What are the approaches to programmatic mitigation planning for noise?

The lead agencies do not propose any specific mitigation strategies at this time but will consider a full range of mitigation options in Tier 2 processes to reduce highway noise for impacted communities. See the *I-70 Mountain Corridor PEIS Noise Technical Report* (CDOT, March 2011) for details. The following mitigation options are to be considered:

- Noise walls
- Noise berms
- Concrete barriers
- Creation of noise buffer areas
- Enforcing engine compression brake muffler use
- Noise insulation of buildings
- Pavement type
- Active noise control
- Cut and cover tunnels
- Adjusting vertical and horizontal alignments

The Federal Highway Administration does not consider pavement type as noise mitigation at this time, because the long-term effectiveness of pavement types in noise mitigation has not yet been proven. Active noise control and cut and cover tunnels are also not considered as noise mitigation by FHWA, although CDOT may consider them in addition to other federally approved noise mitigation measures.

The lead agencies will follow the I-70 Mountain Corridor Context Sensitive Solutions Aesthetic Guidelines and consider landscaping and vegetated berms for noise mitigation during design. The Colorado Department of Transportation will work with local planning agencies to minimize noise effects on planned development in the Corridor.

Generally, the most practical noise mitigation strategy to avoid or reduce direct effects in the Corridor includes the construction of noise barriers. In some areas, topography may reduce the effectiveness of noise barriers—for example, when receptors sit higher than the road—and Tier 2 processes will conduct project-specific noise analyses to determine where noise barriers can offer effective mitigation. Other strategies to mitigate noise impacts, such as land acquisition for buffer zones and altering the horizontal and vertical alignment, are effective but may be less practical in the Corridor because of topographic and development constraints.

Construction noise impacts could be mitigated by limiting work to certain hours of the day when possible, requiring the use of well-maintained equipment, and other strategies.