

3.6 Noise and Vibration

This section describes the noise and vibration impacts that could result from construction and operation of the proposed rail line. The subsections that follow describe the noise and vibration study areas; the methods used to analyze the impacts; the affected environment, including ambient noise measurement results; and potential noise and vibration impacts of the Action Alternatives and No-Action Alternative, including modeled noise contours and the estimated number of receptors (i.e., noise-sensitive locations) potentially affected.

3.6.1 Analysis Methods

This subsection identifies the study areas, data sources, and analysis methods OEA used to analyze noise and vibration associated with rail construction and operations.

3.6.1.1 Study Areas

OEA delineated two study areas for the analysis of potential noise and vibration impacts. The project study area refers to the area in the vicinity of the Action Alternatives, while the downline study area refers to areas near existing rail lines in Utah and Colorado where rail traffic could increase if the proposed rail line were constructed.

- **Project study area.** For the project study area, OEA considered areas within approximately 1 mile from the track centerline for each Action Alternative. OEA selected this distance prior to conducting the analysis because in OEA's experience, this distance is sufficient to identify potential noise and vibration impacts from the proposed rail construction and operations. Because the Action Alternatives would primarily traverse sparsely populated areas, there are many locations within 1 mile of the centerline that do not warrant a noise and vibration analysis. Therefore, OEA's analysis focused on areas with particularly sensitive wildlife habitat, areas known to contain important cultural resources, and areas with buildings where people live or congregate, such as residences, churches, and schools.
- **Downline study area.** For the downline analysis of noise and vibration, OEA defined a study area that includes existing rail lines extending from the proposed rail connection near Kyune, Utah, to the eastern and southern boundaries of the Denver Metro/North Front Range air quality nonattainment area, as described in Section 3.1, *Vehicle Safety and Delay*.

3.6.1.2 Data Sources

OEA reviewed the following data sources to determine the potential impacts due to noise and vibration that could result from construction and operation of the Action Alternatives and compared those impacts to the No-Action Alternative.

- Locations of proposed bridges and other structures provided by the Coalition, as well as the Coalition's construction plans and schedules, including plans for pile-driving and blasting.
- Anticipated train traffic volumes, train composition, and train speed obtained from the Coalition.

- Train traffic characteristics on existing rail lines in the downline study area obtained from multiple sources, as described in Appendix C, *Downline Analysis Study Area and Train Characteristics*.
- Locations of at-grade road crossings that would be constructed as part of the proposed rail line provided by the Coalition and locations of existing at-grade road crossings in the downline study area obtained from the Federal Railroad Administration (FRA) crossings database. Road crossing locations are important for the noise analysis because of greater noise exposure due to locomotive warning horn sounding at crossings.
- Geographic information system (GIS) data, including aerial photographs and design details of the proposed rail line obtained from the Coalition.
- OEA noise criteria and FRA vibration criteria.
- Digital Terrain Model (DTM) employing Google Earth imagery to account for acoustic shielding where appropriate. This type of acoustical modeling can result in narrower noise contours than by assuming flat ground. Conversely, wider noise contours can result due to other acoustic features, such as curved sections of track.
- Greater sage-grouse lek locations identified through agency consultation.
- Locations of noise-sensitive receptors (e.g., houses, nursing homes, schools, places of worship, campgrounds) identified using aerial photographs or agency information, and cultural resources identified through OEA's consultation with tribes, agencies, other stakeholders, and the public.
- Federal Transit Administration (FTA) methods for construction noise and vibration and operational vibration analyses.
- The *Conrail Acquisition Environmental Impact Statement* (Board 1998a) and the *Draft Environmental Assessment for the Canadian National/Illinois Central Railway Acquisition* (Board 1998b) for wayside noise¹ estimates.
- The *Draft Environmental Impact Statement, Proposed Rule for the Use of Locomotive Horns at Highway-Rail Grade Crossings* (FRA 1999) for horn noise estimates.
- Information on other relevant projects or actions for analyzing cumulative impacts.

3.6.1.3 Analysis Methods

OEA used the following methods to analyze noise and vibration impacts. For the noise analysis, OEA evaluated whether construction and operation of the proposed rail line would result in a 3 A-weighted decibel (dBA)² or greater increase in noise levels and whether railroad noise levels (due to wayside noise and locomotive warning horn noise) would equal or exceed a 65 day-night average

¹ Wayside noise is train noise adjacent to a rail line that comes from sources other than the locomotive horn, such as engine noise, exhaust noise, and noise from steel train wheels rolling on steel rails. Wayside noise is primarily a function of train speed, train length, and number of locomotives.

² A-weighted decibel (dBA) is a measure of noise level used to compare noise from various sources. A-weighting approximates the frequency response of human hearing.

noise level (DNL),³ consistent with the Board's environmental regulations at 49 C.F.R. § 1105.7e(6). OEA also assessed whether vibration would cause impacts. Appendix L, *Noise and Vibration Analysis Methods*, provides the equations and further describes the methods OEA used to perform the noise and vibration analysis.

- **OEA identified noise sources from rail construction and operation.** OEA based wayside noise estimates on noise level measurements and associated train composition, speeds, and related information compiled for previous OEA analyses (Board 1998a, 1998b) and used data on horn noise compiled by FRA (1999). OEA used information on train composition, frequency, length, and speed provided by the Coalition for project-related rail traffic and information from multiple sources, as described in Appendix C, *Downline Analysis Study Area and Train Characteristics*, for rail traffic on the existing rail lines in the downline study area.
- **OEA evaluated noise impacts from construction.** OEA used the FTA general assessment method (FTA 2006) to evaluate noise impacts from rail construction. This method is used when details of construction methods and schedule are not yet known. OEA estimated the combined noise level for general construction equipment at the receptor nearest each Action Alternative and compared the noise level with established assessment criteria.
- **OEA modelled noise contours for rail operation.** OEA used an environmental noise computer software application (CadnaA -Computer Aided Noise Abatement) and wayside noise and horn reference levels from previous studies to generate noise level contours. The noise model inputs include horn noise; wayside noise; and train frequency, length, and speed.
- **OEA collected baseline noise data.** To establish a baseline for determining if there would be a 3 dBA or greater increase in noise, OEA measured ambient noise⁴ in the project study area. For the downline study area, OEA based existing noise level estimates on current rail traffic levels because train noise is the dominant source of noise in those areas.
- **OEA estimated noise exposure from rail construction and operations.** OEA estimated noise exposure that would result from rail construction in terms of equivalent sound level (L_{eq}).⁵ OEA quantified potential noise impacts on wildlife from rail construction and operations in terms of Sound Exposure Level (SEL).⁶ OEA estimated human noise exposure from rail operations in terms of DNL based on information provided by the Coalition about potential operations on the proposed rail line and the results of OEA's rail noise model.
- **OEA estimated the number of noise-sensitive receptors potentially affected by each Action Alternative.** OEA estimated the number of noise-sensitive receptors within the 65 DNL noise contour for each Action Alternative and noise-sensitive receptors that would experience an increase in DNL of at least 3 dBA. OEA used digital aerial photographs and GIS software to

³ Day-night average noise level (DNL or L_{dn}) is the energy average of dBA sound level over a 24-hour period; it includes a 10-decibel adjustment factor for noise between 10:00 p.m. and 7:00 a.m. to account for the greater sensitivity of most people to noise during the night. The effect of nighttime adjustment is that one nighttime event, such as a train passing by between 10:00 p.m. and 7:00 a.m., is equivalent to 10 similar events during the daytime.

⁴ Ambient noise is the sum of all noise (from human and naturally occurring sources) at a specific location over a specific time. It is usually used to characterize the noise environment without the new proposed noise source.

⁵ Equivalent sound level (L_{eq}) is the energy-averaged sound pressure level averaged over a specified unit of time, frequently 1 hour.

⁶ Sound exposure level (SEL) describes cumulative noise exposure from a single noise event. It is represented by the total A-weighted sound energy during the event, normalized to a 1-second interval.

identify noise-sensitive receptors within the 65 DNL noise contour. The result of this analysis was an estimate of the total number of noise-sensitive receptors likely to be exposed to project-related noise levels of 65 DNL or greater and the number of receptors where the DNL would increase by at least 3 dBA. This method was used for both the project study area and the downline study area.

- **OEA assessed vibration impacts from rail construction and operations.** OEA based the analysis of potential vibration impacts on published train and construction equipment vibration data and FTA methods. Specifically, OEA evaluated vibration impacts using peak particle velocity (PPV) for building damage and root-mean square velocity (VdB) for human annoyance.

3.6.2 Affected Environment

This subsection identifies the existing environmental conditions related to noise and vibration in the study areas. Existing noise conditions vary considerably in the study areas. For example, existing ambient sound levels generally are higher in populated areas than in unpopulated areas. In areas with low ambient sound levels, such as remote areas, rail noise could be more noticeable than in areas with higher ambient sound levels.

3.6.2.1 Project Study Area

OEA measured ambient noise levels in the project study area from September 23 through 25, 2019 (Monday through Wednesday). OEA's noise field monitoring team placed five calibrated noise monitors⁷ at representative noise-sensitive receptor locations. The criteria for selecting locations included the proximity to noise-sensitive receptors (e.g., residence), proximity to proposed alignments, and coverage of the entire study area. Figure 3.6-1 shows the noise monitoring locations and noise-sensitive receptors in the project study area. Table 3.6-1 shows the results of the ambient noise monitoring. OEA identified 222 noise-sensitive receptors in the 1-mile-wide study area by visually inspecting aerial photography. All of the 222 receptors are residences. OEA excluded from the noise analysis receptors that are entirely or partially within the rail line footprint that would likely be permanently displaced by construction of the Action Alternatives⁸. These receptors include one residence (R-09) for the Indian Canyon Alternative, five residences (R-03, R-04, R-05, R-06, and R-07) for the Wells Draw Alternative, and two residences (R-01 and R-09) for the Whitmore Park Alternative. Appendix L, *Noise and Vibration Analysis Methods*, identifies the locations of these receptors.

⁷ Noise monitor refers to an environmentally protected sound level meter that can automatically collect sound data over a period of several days.

⁸ The rail line footprint includes the area of the railbed, as well as the full width of the area cleared and cut or filled. The rail line footprint would also include other physical structures installed as part of the proposed rail line, such as fence lines, communications towers, siding tracks, relocated roads, and power distribution lines. The rail line footprint is the area where rail line operations and maintenance would occur. The area would be permanently disturbed. The temporary footprint is the area that could be temporarily disturbed during construction, including areas for temporary material laydown, staging, and logistics. Disturbed areas in the temporary footprint would be reclaimed and revegetated following construction. The project footprint is the combined area of the rail line footprint and temporary footprint, both of which would be disturbed during construction, comprising where construction and operations of the proposed rail line would occur.

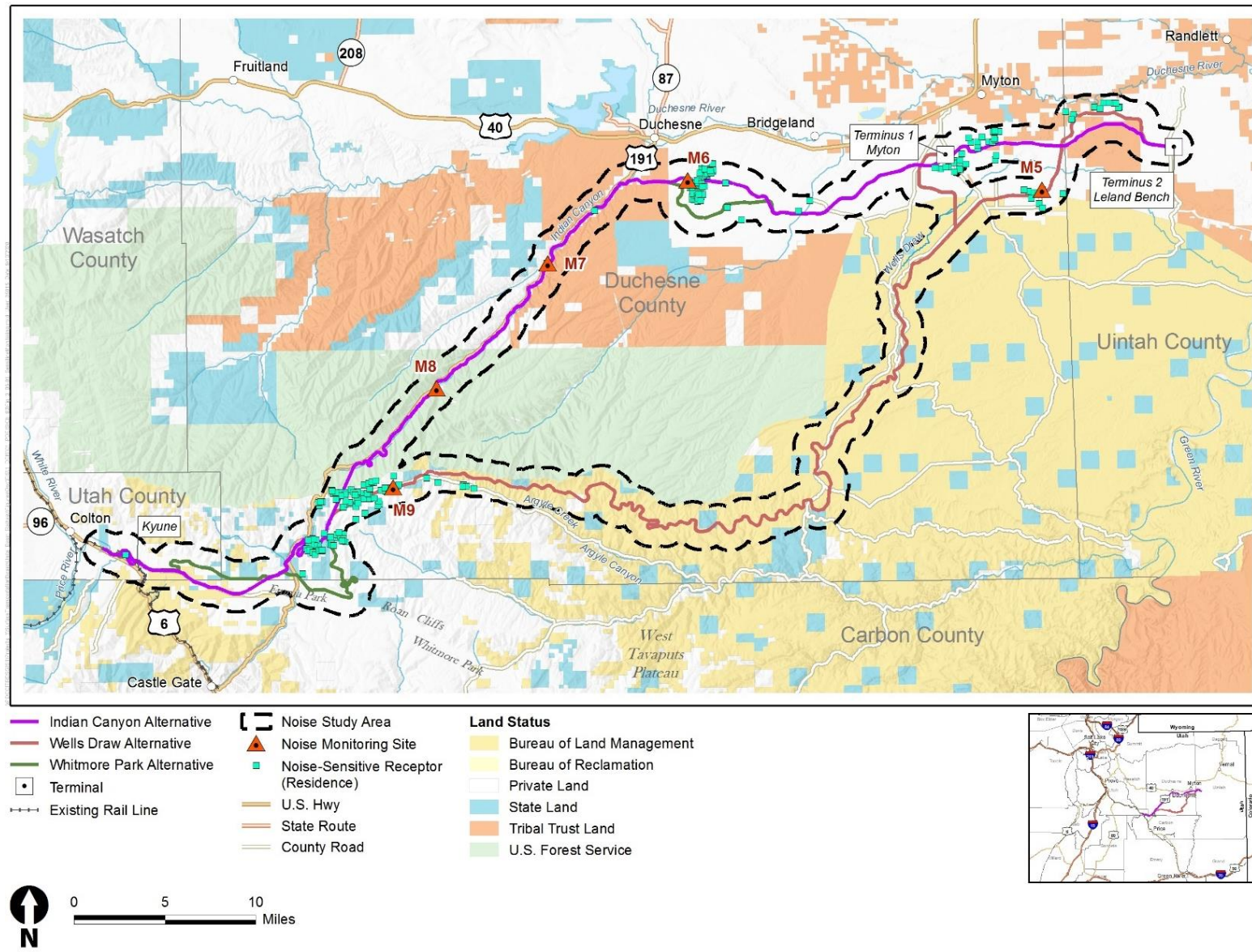
Figure 3.6-1. Noise Monitoring Locations and Noise-Sensitive Receptors in the Project Study Area

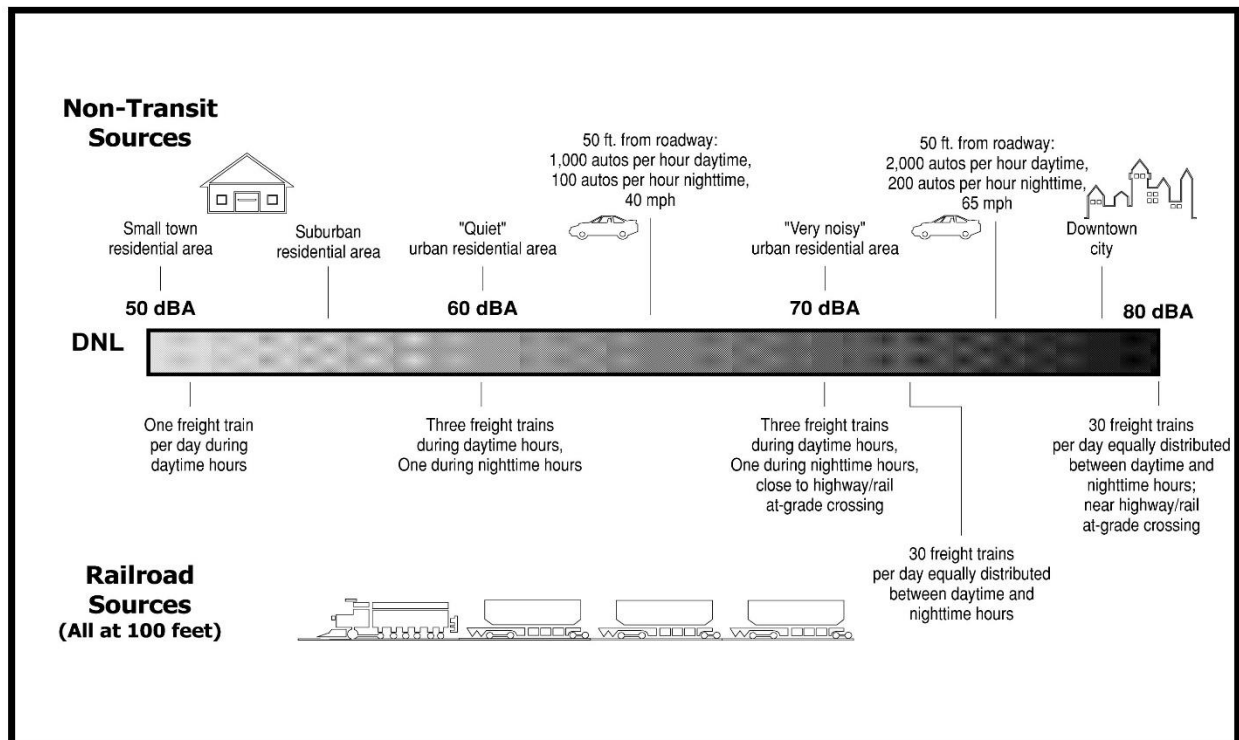
Table 3.6-1. Ambient Noise Monitoring Results

Location	DNL dBA
M5	56
M6	47
M7	52
M8	52
M9	33

Notes:

DNL = day-night average sound level; dBA = A-weighted decibel

Ambient sound levels ranged from DNL dBA 33 to 56. These sound levels range from quieter than the USEPA “small town residential” to “suburban residential” categories (Figure 3.6-2). This result is typical for an area like the project study area that contains both remote locations and more populated areas.

Figure 3.6-2. Typical Day-Night Average Noise Levels

Source: USEPA 1974

3.6.2.2 Downline Study Area

Estimated noise levels for the downline study area are detailed in Appendix L, *Noise and Vibration Analysis Methods*, along with the estimated changes in noise levels.

3.6.3 Environmental Consequences

Construction and operation of the proposed rail line could result in impacts related to noise and vibration. This subsection first presents the potential impacts that would be the same for all three Action Alternatives and then compares the potential impacts that would be different across the Action Alternatives. For comparison purposes, this subsection also discusses noise and vibration under the No-Action Alternative. OEA's analysis of noise impacts on wildlife is presented in Section 3.4, *Biological Resources*.

3.6.3.1 Impacts Common to All Action Alternatives

This subsection discusses potential noise and vibration impacts that would be the same across the three Action Alternatives.

Project Study Area

Construction

Construction of any of the Action Alternatives could result in noise and vibration impacts. Operation of heavy equipment to construct tunnels, bridges, rail embankments, and installation of other rail facilities would result in noise and vibration that could affect noise-sensitive receptors (i.e., residences) in the study area.

Noise Levels

FTA publishes standardized reference construction noise levels for construction equipment, referenced to a standard noise measurement distance of 50 feet. These "source" levels can be used to compute construction noise levels at various distances. During construction of any of the Action Alternatives, the two noisiest pieces of general construction equipment would be heavy trucks and bulldozers, both of which would likely operate simultaneously. Table 3.6.2 lists FTA reference noise levels for these pieces of equipment and the combined heavy truck and bulldozer noise level at 50 feet from the noise source. The table also shows the noise level for an impact pile-driver, the noisiest piece of specialized construction equipment, which OEA analyzed separately because it would be used only in certain applications, such as bridge construction.

Table 3.6-2. Reference Noise Levels for Construction Equipment

Equipment	Noise Level at 50 Feet (dBA)
Heavy truck	88
Bulldozer	85
Heavy truck and bulldozer combined	90
Pile-driver (impact type)	101

Notes:

Source: FTA 2006

dBA = A-weighted decibels

For comparison, Table 3.6.3 shows the FTA construction noise criteria for residential, commercial, and industrial areas. OEA used these FTA thresholds to assess the severity of construction noise at noise-sensitive receptors in the study area. The FTA thresholds that OEA used to assess rail

construction noise are higher than the thresholds that OEA used for rail operations because construction noise would be temporary, whereas operations-related noise would be permanent.

Table 3.6-3. Federal Transit Administration Construction Noise Criteria

Land Use	Daytime 1-hour L_{eq} (dBA)	Nighttime 1-hour L_{eq} (dBA)
Residential	90	80
Commercial	100	100
Industrial	100	100

Notes:

Source: FTA 2006

L_{eq} = equivalent sound level; dBA = A-weighted decibels

Subsection 3.6.3.2, *Impact Comparison between Action Alternatives*, presents the estimated noise levels during rail construction at sensitive receptors in the study area for each Action Alternative. For any of the Action Alternatives, the closest residence would be located more than 300 feet from the rail line and the estimated combined noise level from general construction equipment at the closest receptor would be approximately 73 dBA. Because this estimate is lower than the FTA construction noise thresholds for residential areas, OEA concludes that none of the Action Alternatives would result in adverse noise impacts from general construction equipment. OEA is recommending mitigation requiring the Coalition develop and implement a construction noise and vibration control plan (NV-MM-1) that addresses noise from general construction equipment.

OEA estimated that noise from pile-driving would range from 78 dBA to 84 dBA at the closest sensitive receptor, depending on the Action Alternative. Because the estimated noise from pile-driving would be less than the FTA construction noise thresholds for residential areas during the daytime, OEA concludes that none of the Action Alternatives would result in adverse noise impacts from pile-driving provided that pile-driving does not take place at night. To ensure that noise impacts from pile-driving are minimized, OEA is recommending mitigation requiring the Coalition avoid nighttime construction and pile-driving near residential areas, to the extent practicable, and employ quieter vibratory pile-driving or noise curtains for project-related construction where FTA construction noise criteria could be exceeded (NV-MM-2). If OEA's recommended mitigation is implemented, OEA concludes that noise impacts from construction would not be significant.

Vibration

To assess vibration impacts from general construction equipment, OEA estimated vibration levels at sensitive receptors from bulldozer operation, based on FTA data. OEA used bulldozers as representative construction equipment for the vibration analysis because they are commonly used in rail construction and produce relatively high vibration levels. As discussed in Subsection 3.6.3.2, *Impact Comparison between Action Alternatives*, vibration levels from bulldozer operations at the closest receptors would range from 0.001193 to 0.001864 inch per second, depending on the Action Alternative. Vibration from pile-driving at the closest sensitive receptors would range from 0.0108 to 0.0273 inch per second, depending on the Action Alternative. Construction-related vibration could be perceptible at certain locations, but vibration would be infrequent, temporary, and well below the FTA fragile building damage criterion of 0.20 inch per second. To ensure that construction-related vibration impacts are minimized, OEA is recommending mitigation requiring the Coalition prepare a construction noise and vibration control plan (NV-MM-1). If OEA's

recommended mitigation is implemented, OEA concludes that construction-related vibration impacts would not be significant.

Operations

Operation of any of the Action Alternatives would result in noise and vibration impacts. The severity of these impacts would depend on the alternative, the volume of rail traffic, and the locations of sensitive receptors relative to the proposed rail line. Operations-related noise would include noise from diesel locomotive engines and the sound of locomotive and railcar wheels on the rail line (collectively referred to as wayside noise). The amount of wayside noise from each train depends on train speed, train length, and the number of locomotives. In addition to wayside noise, operations-related noise also includes noise from locomotive warning horns that would sound at at-grade road crossings.

Noise Levels

OEA considered operations-related noise for both the high rail traffic scenario and the low rail traffic scenario. Under the high rail traffic scenario, an average of 10.52 trains would pass by receptors along the proposed rail line per day. OEA assumed that each of these trains would include approximately eight locomotives and 113 rail cars. Under the low rail traffic scenario, an average of 3.68 trains would pass by receptors along the proposed rail line. OEA assumed that each of these trains would include eight locomotives and 116.5 cars. For both scenarios, OEA assumed that each of the eight locomotives would be 76 feet long, rail cars would be 60 feet long, and the overall train length would be approximately 7,403 feet. The typical operating speed of the trains would be 15 miles per hour.

Based on the Board's thresholds and past precedent, OEA concluded that rail operations would result in an adverse noise impact if wayside or horn noise would cause noise levels at the receptor to increase by at least 3 dBA and cause noise levels at the receptor to meet or exceed 65 DNL. To identify receptors where both of those thresholds could be met, OEA modeled the 3 dBA noise increase contour and the 65 DNL noise level contour along each of the three Action Alternatives.

Table 3.6-4 shows the distances to the 65 DNL contour lines (wayside noise and horn noise) for both rail traffic scenarios. These distances are based on train horn, locomotive, and rail car sound power levels, number of cars and locomotives, speed, number and time of day of train passbys; they do not account for topography, track curvature, and other site-specific factors.

Table 3.6-4. 65 DNL Noise Contour Distances by Rail Traffic Scenario

Noise Type	Feet
High Rail Traffic Scenario	
Horn noise	654
Wayside noise	516
Low Rail Traffic Scenario	
Horn noise	325
Wayside noise	256

Using noise modeling software, OEA modified these 65 DNL contour distances based on site-specific factors. The computer-generated noise contour distances can vary substantially from the values in Table 3.6-4 because of the shielding effects of topography and other factors, such as curved sections of track. Depending on the exact track geometry, curved sections can focus sound on a particular area, thus, increasing the noise contour distances. The wayside noise contour distance for the proposed rail line would be substantial because of the relatively large number of locomotives that would generate diesel engine noise coupled with slow train speed. The slow train speed increases the amount of time locomotive noise persists in a particular geographic area, which in turn, increases the cumulative noise exposure.

Beyond the computer-generated noise contour distances, noise levels would be less than 65 DNL during rail operations. Under the low rail traffic scenario, all sensitive receptors would be located outside of the 65 DNL contour. Therefore, OEA concluded that the low rail traffic scenario would not result in adverse noise impacts and did not analyze this scenario further.

Under the high rail traffic scenario, operation of the proposed rail line would result in adverse noise impacts on between one and six residences, depending on the Action Alternative. Subsection 3.6.3.2, *Impact Comparison between Action Alternatives*, presents the number of receptors that could be affected under each Action Alternative. Appendix L, *Noise and Vibration Analysis Methods*, includes the equations and data used for calculating wayside and locomotive horn noise levels. Appendix L, Figure L-4 through Figure L-6, show the 65 DNL and 3 dBA increase contours for the rail segments that have noise-sensitive receptors in the project study area. OEA calculated the 3 dBA increase contour using the ambient sound measurements (Table 3.6.1) to characterize the existing noise conditions. The area within the 3 dBA increase contour can be large if the ambient sound level is sufficiently low.

Vibration

There are two types of impacts that result from rail-related ground vibration: damage to buildings and annoyance to humans. Building damage thresholds are much higher than human annoyance thresholds. Because ground-borne vibration levels generated by trains are typically relatively low, even cosmetic building damage from vibration is rare (Appendix L, *Noise and Vibration Analysis Methods*). Based on the average train speed of 15 miles per hour and assuming a crest factor (the ratio between average and peak vibration levels) of 4.0,⁹ the building damage contour for the FTA fragile building damage criterion of 0.20 inch per second would be 10 feet wide (5 feet on each side of the track centerline). No buildings would be within 5 feet of any of the Action Alternatives; therefore, OEA does not expect any damage to buildings due to vibration from rail operations.

Using the FTA infrequent event (less than 30 trains per day) criterion of 80 VdB¹⁰ (FTA 2006), the vibration annoyance contour along the proposed rail line would extend 25 feet from the track centerline. Because no receptors would be within 25 feet of any of the Action Alternatives, vibration levels resulting from rail operations would be lower than FTA's infrequent event criterion of 80 VdB.

⁹ FTA recommends a crest factor of 4 to 5 for ground-borne vibration analysis of trains. Appendix L, *Noise and Vibration Analysis Methods*, includes a graph that shows the crest factor in terms of the relationship between peak and average (RMS) vibration levels.

¹⁰ FTA defines infrequent events as 30 or less vibration events per day, occasional events as between 30 and 70 events per day, and frequent events as more than 70 events per day. FTA's human annoyance criterion for residences is 80 root-mean square velocity (VdB) for infrequent events, 75 VdB for occasional events, and 72 VdB for frequent events.

Therefore, OEA concludes that operation of the proposed rail line would not result in any adverse vibration impacts.

Downline Study Area

OEA performed a noise analysis to estimate the potential project-related increase in noise levels along the rail segments in the downline study area (Appendix C, *Downline Analysis Study Area and Train Characteristics*) potentially affecting adjacent noise-sensitive receptors. Potential impacts in the downline study area would be the same for all Action Alternatives. OEA's analysis of downline noise impacts considered the volume, composition, routes, and speed of trains that would originate in the Basin, as well as the existing volumes, composition, and speed of passenger and freight trains on existing rail lines in the downline study area.

OEA found that downline train noise could increase by as little as 0.4 dB to as much as 6 dB, depending on the previously mentioned factors. Table 3.6-5 displays the range in noise level increases along the five downline rail segments that OEA analyzed (Appendix C, *Downline Analysis Study Area and Train Characteristics*, Figure C-1). Noise levels would increase by 3 dB or more along four of the five downline rail segments.

Table 3.6-5. Estimated Train Noise Level Increases by Downline Segment

Downline Segment	Length (miles)	Noise Level Increase (dB)	
		Minimum	Maximum
Kyune to Denver	457.4	3.4	6.0
Denver Eastbound	59.0	1.0	3.6
Denver Southbound	16.6	0.4	0.6
Denver Northbound	69.2	2.6	4.5
Denver East/North	3.2	3.2	3.2

Appendix L, *Noise and Vibration Analysis Methods*, shows the calculated noise level increase for each downline rail segment for the high rail traffic scenario. Ground-borne vibration from trains increases as a function of train speed. Downline project trains would be at the same speed as existing train traffic. Consequently, there would be no train speed-related changes in vibration levels.

3.6.3.2 Impact Comparison between Action Alternatives

This subsection compares the potential noise and vibration impacts between the three Action Alternatives.

Construction

The most important factor for comparing construction noise and vibration impacts between the Action Alternatives is the number of sensitive receptors that would experience construction-related noise and vibration levels above the FTA criteria. Table 3.6-6 presents the estimated general construction (combined) noise levels and bulldozer vibration levels at the sensitive receptors that would be closest to each Action Alternative. As the table shows, none of the Action Alternatives would result in construction-related noise levels at sensitive receptors that would exceed the FTA criteria of 90 dBA for daytime noise or 80 dBA for nighttime noise in residential areas (Table 3.6-3).

Construction-related vibration could be perceptible at some locations, but the frequency of vibration events would be low (and temporary) and would be well below the FTA fragile building damage criterion of 0.20 inch per second.

Table 3.6-6. Estimated Construction-Related Noise and Vibration Levels at Sensitive Receptors

Action Alternative	Receptor	Distance to Rail Line (feet)	Bulldozer Vibration (PPV in inches per second)	General Construction (combined) Noise Level (dBA)
Indian Canyon	R-12	329	0.001864	73
	R-02	335	0.001814	73
	R-11	338	0.001790	73
	R-13	343	0.001751	73
	R-08	362	0.001615	73
	R-10	443	0.001193	71
Wells Draw	R-02	337	0.001798	73
Whitmore Park	R-08	362	0.001615	73
	R-10	443	0.001193	71

Notes:

PPV = peak particle velocity; dBA = A-weighted decibel

OEA assumed that pile-driving would occur during construction of bridges over water bodies or at rail–roadway crossings. The precise location and method of bridge construction would be determined during the final engineering and design stage, which would occur after the Board issues its final decision and only if the Board decides to authorize construction and operation. Table 3.6-7 reports the estimated potential pile-driving noise and vibration levels at the closest receptor to any proposed bridge location for each Action Alternative. If the Coalition were to use other techniques for bridge construction, such as vibratory or sonic pile-driving, noise and vibration levels would be lower than those shown in the table.

Table 3.6-7. Estimated Pile-Driving Noise and Vibration Levels at Proposed Bridge Locations

Action Alternative	Distance to Nearest Receptor (feet)	Pile-Driving Vibration PPV (inches per second)	Pile-Driving Noise Level (dBA)
Indian Canyon	364	0.0273	84
Wells Draw	485	0.0178	81
Whitmore Park	676	0.0108	78

Notes:

PPV = peak particle velocity; dBA = A-weighted decibel

Estimated vibration levels from pile-driving activity for any of the Action Alternatives would be below the FTA fragile building damage criterion of 0.20 inch per second; therefore, OEA does not anticipate any building damage due to vibration from pile-driving. Estimated noise levels from pile-driving would be below the FTA criteria for daytime noise (Table 3.6-3) for any of the Action Alternatives. For the Wells Draw Alternative and the Indian Canyon Alternative, noise from pile-driving would exceed the FTA thresholds if pile-driving were to occur at night. OEA is, therefore, recommending mitigation requiring the Coalition avoid nighttime construction and pile-driving near residential areas, to the extent practicable, and employ quieter vibratory pile-driving or noise

curtains for project-related construction where FTA construction noise criteria could be exceeded (NV-MM-2).

Tunnel construction may require drill and blast mining techniques in certain locations. Pile-driving may also be needed for certain tunnel structures. In addition, other noise sources could include truck traffic for hauling excavation materials. These activities could cause noise and vibration impacts at nearby sensitive locations. Vibration due to blasting can be calculated based on the distance to receptors and pounds of explosive charge. A U.S. Bureau of Mines (1989) study estimated that blasting shots at a square root distance of 70 feet/lb^{1/2} would typically result in ground PPV values of 0.08 to 0.15 inch per second, which is lower than the FTA fragile building damage criterion of 0.20 inch per second. OEA assumes that once tunnel construction details are known, the Coalition would adjust blasting shots and other vibration/noise sources to minimize impacts. OEA is recommending mitigation requiring the Coalition develop and implement a construction noise and vibration monitoring plan that addresses blasting noise and vibration issues related to tunnel construction, in addition to noise and vibration from general construction and pile-driving (NV-MM-1). The Coalition should provide the construction noise and vibration plan to OEA for review and approval prior to undertaking construction activities.

Operations

For operations-related noise impacts, OEA compared the three Action Alternatives in terms of the number of sensitive receptors that would fall within the 3 dBA increase contour and the 65 DNL contour for each Action Alternative. Consistent with the Board's thresholds for noise analysis and OEA's established methods for assessing noise impacts, OEA concluded that receptors that would fall within both contours would experience an adverse noise impact as a result of rail operations.

Because ambient sound levels in the project study area are low at many locations, the contour for the 3 dBA increase is large, ranging from 455 to 15,140 feet in width (Appendix L, *Noise and Vibration Analysis Methods*). Table 3.6-8 shows the total number of residential receptors within the +3 dBA contours for each Action Alternative. The Indian Canyon Alternative would have the most receptors (68) within the 3 dBA increase contour, followed by the Wells Draw Alternative (51), and then the Whitmore Park Alternative (28). Appendix L displays the locations of the receptors within the 3 dBA contours.

Table 3.6-8. Receptors within 3 dBA Increase Contour by Action Alternative

Action Alternative	Receptors within +3 dBA Contour
Indian Canyon	68
Wells Draw	51
Whitmore Park	28

For any of the Action Alternatives, the 65 DNL contour would fall entirely within the 3 dBA increase contour. Table 3.6.9 identifies the receptors that would fall within both contours and that, therefore, would experience adverse noise impacts during rail operations. The table also identifies the DNL values at those receptors. As the table shows, operation of the Indian Canyon Alternative would result in adverse noise impacts on the largest number of receptors (6), followed by the Whitmore Park Alternative (2) and then the Wells Draw Alternative (1).

Table 3.6-9. Receptors within the 65 DNL Contour by Action Alternative

Receptor ID	Indian Canyon Alternative	Wells Draw Alternative	Whitmore Park Alternative
DNL Value at Receptor Locations			
R-02	65	65	--
R-08	67	--	67
R-10	65	--	65
R-11	66	--	--
R-12	66	--	--
R-13	66	--	--
Number of Receptors in 65 DNL Contour			
Total	6	1	2

All of the receptors identified in Table 3.6-9 are residences and all would fall within the wayside noise contour, meaning that the increase in noise levels would be a result of wayside noise, not necessarily horn noise. Figure 3.6-3 shows close-up views of the receptors within the 65 DNL contours for the three Action Alternatives. Appendix L, *Noise and Vibration Analysis Methods*, includes the noise contours for additional portions of the project study area.

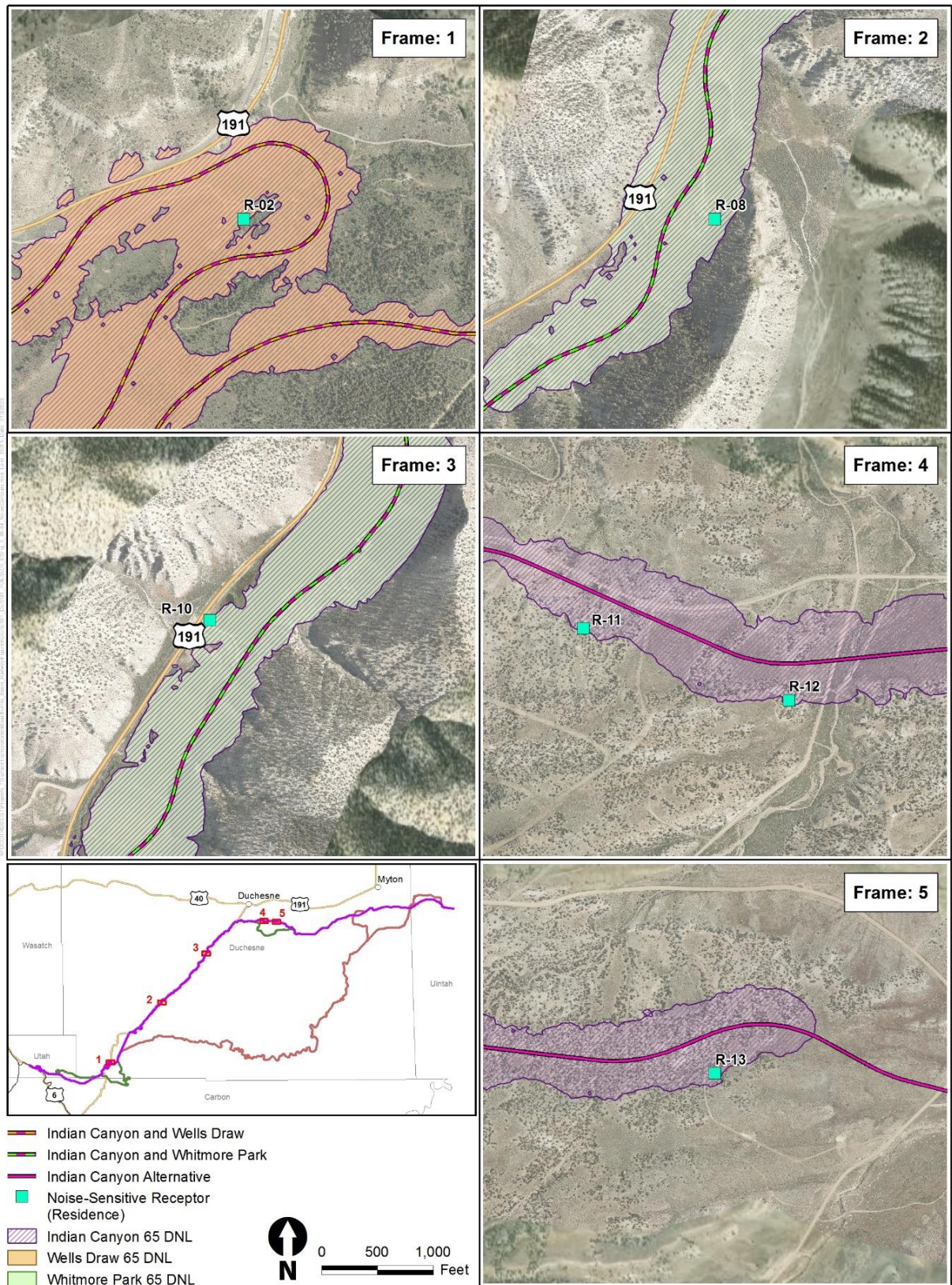
To minimize operations-related noise impacts, OEA is recommending mitigation requiring the Coalition to install rail lubrication systems at curves along the rail line where doing so would reduce noise associated with wheel squeal for residential or other noise-sensitive receptors and to regularly inspect and maintain locomotives, rail cars, tracks, and the railbed to control wayside noise (NV-MM-4). Impacts would also be minimized through implementation of the Coalition's voluntary mitigation measure VM-53, which commits the Coalition to comply with FRA regulations establishing decibel limits for train operation. In addition, OEA is recommending mitigation requiring the Coalition to install noise insulation for sensitive receptors that would experience an increase in noise levels that would exceed the Board's thresholds, as appropriate and feasible (NV-MM-3).

3.6.3.3 No-Action Alternative

Under the No-Action Alternative, the Coalition would not construct and operate the proposed rail line and there would be no noise or vibration impacts.

3.6.4 Mitigation and Unavoidable Environmental Effects

Construction and operation of the proposed rail line would result in noise and vibration impacts. During construction, noise from general construction equipment and pile-driving would not exceed FTA thresholds for residential areas under any of the Action Alternatives, provided that pile-driving activities are performed during the day. Vibration from construction activity would not exceed thresholds for building damage at any sensitive receptors under any of the Action Alternatives. If the Coalition's voluntary mitigation measures and OEA's recommended mitigation measures for construction-related noise and vibration (Chapter 4, *Mitigation*) are implemented, OEA concludes that construction of the proposed rail line would not result in significant noise and vibration impacts. Some minor to moderate increases in noise and vibration in the project study area would, however, be unavoidable during construction.

Figure 3.6-3. Noise-Sensitive Receptors (Residences) within 65 DNL Contours

During rail operations, vibration would not exceed thresholds for building damage or human annoyance at any sensitive receptors. Depending on the volume of rail traffic on the proposed rail line, wayside and horn noise could adversely affect sensitive receptors (i.e., residences). Under the high rail traffic scenario, wayside and horn noise would increase noise levels by 3 dBA or more at 68 residences under the Indian Canyon Alternative, 51 residences under the Wells Draw Alternative, and 28 residences under the Whitmore Park Alternative. OEA concludes that most of those residences would not experience adverse noise impacts because noise levels would remain under 65 DNL even with an increase of 3 dBA or more. If rail traffic were high (such as under the high rail traffic scenario), wayside noise could cause noise levels to exceed OEA's threshold of 65 DNL at up to six residences under the Indian Canyon Alternative, up to two residences under the Whitmore Park Alternative, and up to one residence under the Wells Draw Alternative. Implementation of OEA's recommended mitigation measures and the Coalition's voluntary mitigation measure would minimize operations-related noise impacts (Chapter 4, *Mitigation*), but increases in noise in the project study area, including at sensitive noise receptors, would be unavoidable during rail operations.