3.8 Noise

3.8.1 Summary of Draft Tier 1 EIS

Noise is generally defined as unwanted or undesirable sound. Some of the most pervasive sources of noise in the environment can come from transportation systems. Noise barriers along a highway are most effective for homes within about 300 feet of the highway. Beyond that, noise barriers are less effective, but the natural decrease in noise with distance usually reduces noise levels to acceptable levels. Noise levels decrease by about 3 to 4.5 decibels for each doubling of the distance from the source roadway.

Ground vibration was not evaluated as part of the Tier 1 analysis. No federal requirements specifically address highway traffic-induced vibration. Studies that highway agencies have completed to assess the impact of operational traffic-induced vibrations showed that both measured and predicted vibration levels are less than any known criteria for structural damage to buildings. In fact, normal living activities (e.g., closing doors, walking across floors, operating appliances) within a building have been shown to create greater levels of vibration than highway traffic. Vibration concerns would be addressed on a case-by-case basis during Tier 2, as deemed appropriate.

FHWA assesses noise impacts in accordance with 23 CFR 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise. The noise evaluation conducted for the I-11 Corridor is consistent with FHWA guidelines for assessing highway traffic noise (FHWA 2011b) and the most current version of ADOT *Noise Abatement Requirements* (NAR) (ADOT 2017m). The goal of the traffic noise analysis was to determine the total number of receptors where future noise levels would approach or exceed the applicable Noise Abatement Criteria (NAC), potentially warranting consideration of noise abatement measures during Tier 2 analysis. The procedure used to evaluate potential noise impacts at the Tier 1 level included the following steps:

1. Identify noise sensitive land uses within the analysis area in accordance with the FHWA NAC Table (FHWA 2011b).
2. Establish existing noise levels.
3. Predict future (2040) noise levels using the FHWA Traffic Noise Model (TNM) version 2.5.
4. Determine areas where potential traffic noise impacts at noise sensitive receivers are expected to occur.
5. Describe where potential noise impacts could occur during construction of the Build Corridor Alternatives.
6. Discuss noise mitigation strategies for those areas where noise impacts could potentially occur.
7. Determine the zoning classification of vacant and undeveloped lands within the analysis area to be made available to local planning agencies for their use in land use planning.

The analysis following this procedure was documented in Draft Tier 1 EIS **Appendix E8** (Noise Report). The detailed analysis covered over 1,000 modeled receptors for each noise sensitive land use within the analysis area. A second more generalized approach focused on predicting noise levels at set distances (50, 100, 250, 500, and 1,000 feet) from the edge of the right-of-way. This approach used TNM 2.5 and the same traffic volumes and typical section assumptions as the more detailed analysis. It was intended to provide a high-level summary of noise levels that could be expected at sensitive land uses that fall within those distances. The results of the more generalized approach were presented in Draft Tier 1 EIS **Section 3.8** (Noise).

NAC are used to define the noise levels that are considered an impact for each land use activity category (**Table 3.8-1**). If future noise levels approach or exceed the NAC, they are considered noise impacts under ADOT's NAR. "Approach" is defined as noise levels within one decibel on the A-weighted scale (dBA) of the NAC. In addition, a 15 dBA increase over existing noise levels is considered a substantial increase in noise and would constitute an impact.

Noise sensitive land uses within the South Section (between Nogales and Casa Grande) include residential, places of worship, schools, hotels, and parks/trails. Land uses in the Central and North Sections primarily consist of scattered residences, agricultural land, industrial, and undeveloped areas.

Most noise sensitive land uses within the analysis area are expected to experience potential noise impacts. Noise abatement would need to be evaluated in the Tier 2 analysis at locations under all three Build Corridor Alternatives. All three alternatives may have similar numbers of modeled noise sensitive receiver locations. Examples of noise sensitive areas include residential homes, campgrounds, parks, picnic areas, places of worship, schools, trails, restaurant patios, and hotels. Noise abatement measures can include noise walls, reduced speeds, and truck traffic restrictions.

Table 3.8-1. Noise Abatement Criteria

Activity Category [a]	Activity Leq(h) [b,c]	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	67 (exterior)	Residential.
C	67 (exterior)	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, churches, 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, churches, public meeting rooms, public or nonprofit institutional structures, radio structures, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in categories A–D or F.

Activity Category [a]	Activity Leq(h) [b,c]	Activity Description
F	–	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	–	Undeveloped lands that are not permitted.

SOURCE: FHWA 2011b; 23 CFR 772.

[a] Activity Categories B, C, and E include undeveloped lands permitted for each activity category.

[b] The 1-hour equivalent loudness in dBA, which is the logarithmic average of noise over a 1-hour period.

[c] The Leq(h) activity criteria values are for impact determination only, and are not design standards for noise abatement measures.

3.8.2 Summary of Changes Since Draft Tier 1 EIS

Agency and public feedback regarding noise from the Project focused on impacts to residential areas, including Green Valley, Avra Valley, Casa Grande, Buckeye, and Wickenburg, and increased noise levels throughout the analysis area. There was a high level of concern regarding the impacts of increased noise levels in Saguaro National Park, Tucson Mitigation Corridor, and other sensitive resources, citing sensitive habitat and wildlife present in the park.

3.8.2.1 Revised 2040 Noise Levels for Build and No Build Alternatives

The TNM 2.5 models used to predict 2040 noise levels at set distances from the right-of-way were revised with updated AZTDM traffic volumes. Revised noise modeling results for the Purple, Green, and Orange Build Corridor Alternatives are provided in **Table 3.8-2**. Generally, revised noise levels along Options A, C, I2, L, M, R, and U increased by 1 to 5 dBA due to higher projected traffic volumes in the updated modeling. However, along Option F (Green and Recommended Alternatives), noise levels decreased by 9 to 11 dBA due to a decrease in projected traffic volumes. These results are consistent with the findings of the Draft Tier 1 EIS, which predicted future traffic noise impacts at a majority of the modeled noise receiver locations within the analysis area.

Table 3.8-2. Summary of Predicted 2040 Traffic Noise Levels

Option	Total Right-of-Way Width (feet)	Distance From Edge of Right-of-Way				
		50 feet	100 feet	250 feet	500 feet	1,000 feet
Purple Alternative						
A	300	71	69	64	59	53
C [a]	400	66	65	61	56	50
G	400	74	72	67	62	56
I1	400	70	69	65	60	54
I2	400	70	68	64	60	54
L	400	67	65	62	57	51
N	400	71	69	65	61	55
R	400	70	69	65	60	54
X	400	61	59	55	50	44

Option	Total Right-of-Way Width (feet)	Distance From Edge of Right-of-Way				
		50 feet	100 feet	250 feet	500 feet	1,000 feet
Green Alternative						
A	300	71	69	64	59	53
D [b]	400	59	57	53	48	42
F	400	59	57	52	47	42
I2	400	70	68	65	60	54
L	400	70	68	64	60	54
M	400	70	68	65	60	54
Q2	500	69	67	64	59	53
R	400	74	72	68	64	58
U	400	63	61	57	52	46
Orange Alternative						
A	300	71	69	64	59	53
B (portion along I-19)	300	76	73	67	62	55
B (portion along I-10)	400	78	77	72	67	60
I-10 Connector	400	46	44	39	35	30
G	400	74	72	67	62	56
H	300	67	65	61	56	49
K	300	67	65	61	56	49
Q1	400	64	62	58	53	47
Q2	500	70	68	64	60	54
Q3	300	77	74	69	64	57
S	400	62	61	57	52	46

SOURCE: **Appendix E8** (Technical Memorandum: I-11 Noise Report Addendum).

[a] Noise levels predicted for Option C are representative of noise levels for both Option C along Sandario Road and Option C with the CAP Design Option.

[b] Noise levels predicted for Option D are representative of noise levels for both Option D along Sandario Road and Option D with the CAP Design Option.

Under the Purple Alternative, noise impacts would generally occur within 100 feet of the right-of-way, but potential impacts would occur at greater distances along segments co-located with I-10 and I-8 due to higher combined traffic volumes. Under the Green Alternative, noise impacts are predicted to occur at most locations within 100 feet of the right-of-way. Under the Purple and Green Alternatives, noise levels 1,000 feet away from I-11 are predicted in the range of 42 to 58 dBA, which would not exceed the FHWA NAC for any of the land use categories present. Traffic volumes are directly related to modeled noise level predictions; higher traffic volumes result in higher noise levels.

Noise impacts for the Orange Alternative are likely to occur at representative, frequently used noise sensitive land uses within 250 feet of the edge of the right-of-way. Potential impacts would occur out to 500 feet along some of the corridor options co-located with existing facilities due to higher combined traffic volumes.

Similarly, the TNM 2.5 models used to predict 2040 Build Alternative noise levels at major parks and recreation areas were revised with updated AZTDM traffic volumes. **Table 3.8-3** presents

the revised noise levels, including distance to the point along the park/recreation area boundary closest to the corridor option. Generally, noise levels along Options B (Saguaro National Park near I-10), C, D, CAP Design Option, and Q1 decreased 1 to 6 dBA due to lower traffic volumes. Noise levels along Options B (Tucson Mountain Park along Ajo Way and I-19), F, M, S, U, and X increased 1 to 6 dBA due to higher traffic volumes.

Table 3.8-3. Summary of Predicted 2040 Traffic Noise Levels at Major Parks and Recreation Areas

Alternative/Option	Description	Approximate Distance from Edge of Corridor (feet)	dBA
Orange/B [a]	Saguaro National Park	7,884	43
	Tucson Mountain Park	8,890	46
Purple/C	Saguaro National Park	2,058	45
	Tucson Mountain Park	5,970	39
	Ironwood Forest National Monument	5,965	39
Green/D	Ironwood Forest National Monument	5,965	31
CAP Design Option	Saguaro National Park	1,500[b]	34[c]
	Tucson Mountain Park	210	54[c]
Green/F	Ironwood Forest National Monument	574	49
Orange/H [a]	Sonoran Desert National Monument	50	78
Purple and Green/I2	Sonoran Desert National Monument	14,078	39
Orange/K [a]	Sonoran Desert National Monument	50	78
Purple/L	Sonoran Desert National Monument	500	61
Green/M	Sonoran Desert National Monument	2,820	47
Purple/N	Sonoran Desert National Monument	3,921	46
Orange/Q1 [a]	Sonoran Desert National Monument	2,310	41
Orange/S	Proposed Vulture Mine RMZ	50	75
Green/U	Proposed Vulture Mine RMZ	50	76
Purple/X	Proposed Vulture Mine RMZ	50	74

SOURCE: **Appendix E8** (Technical Memorandum: I-11 Noise Report Addendum).

[a] Option co-located with an existing facility.

[b] The receiver placement at Saguaro National Park was revised to a location 1,500 feet away from the right-of-way to be consistent with the distance to Saguaro National Park cited in Final Tier 1 EIS **Chapter 4** (Draft Preliminary Section 4(f) Evaluation).

[c] In the Draft Tier 1 EIS, data in these two cells were inadvertently omitted. Those noise levels are reported here; however, there was no change to noise models or methodology.

2040 No Build noise levels in the Draft Tier 1 EIS were predicted from the edge of pavement, which placed the receivers closer to the roadway. The predicted 2040 No Build noise levels were revised to be calculated from the edge of right-of-way. **Table 3.8-4** presents revised No Build noise levels.

3.8.2.2 Additional Noise Receivers

Draft Tier 1 EIS **Appendix E8** (Noise Report) presented a detailed analysis of over 1,000 modeled receptors within analysis areas for the Purple, Green, and Orange Alternatives. Additional receptors were identified within noise sensitive land uses in the additional analysis areas for the Recommended and Preferred Alternatives, including Anamax Park shift and the realignment of Option F. Representative noise levels for these areas were characterized based upon the receptors presented in the Draft Tier 1 EIS, and the potential impacts are consistent with the noise levels for the Recommended and Preferred Alternatives set distances (**Appendix E8** [Technical Memorandum: I-11 Noise Report Addendum]).

3.8.3 No Build Alternative

Under the No Build Alternative, I-11 would not be constructed. Noise levels along existing transportation facilities throughout the Study Area would likely increase due to the projected population growth and the accompanying increased future traffic volumes. As shown in **Table 3.8-4**, noise levels exceeding the NAC would potentially occur at most noise sensitive land uses within 250 feet of the edge of the I-11 right-of-way. For the Draft Tier 1 EIS, the No Build predicted noise levels were analyzed at various distances from the existing edge of pavement, and both directions of traffic volumes were combined onto one roadway. For the Final Tier 1 EIS, predicted noise levels were modified and analyzed from the right-of-way at various distances. Updated directional traffic was used based on current projected volumes. In comparing 2040 No Build predicted noise levels to the 2040 Build Alternative predicted noise levels, at 100 feet from the edge of the right-of-way along I-19 (from Nogales to I-10), the 2040 No Build predicted noise levels are generally 1 to 2 dBA lower than the 2040 Build Alternative predicted noise levels. Along I-10 and I-8 (Option G), the 2040 No Build predicted noise levels are generally 2 to 3 dBA lower than the 2040 Build Alternative predicted noise levels. Along I-8 (Option H), the 2040 No Build predicted noise levels are generally 2 dBA higher than the 2040 Build Alternative predicted noise levels. Along SR 85 south of I-10, the 2040 No Build predicted noise levels are up to 2 dBA higher than the 2040 Build Alternative predicted noise levels. Along SR 85 north of I-10, the 2040 No Build predicted noise levels are generally 3 dBA lower than the 2040 Build Alternative predicted noise levels.

As a general matter, new highway alignments constructed in otherwise quiet noise environments, such as those in the undeveloped areas of the corridor, will often result in a substantial noise increase at nearby residences (i.e., 15 dBA or greater increases over existing noise levels) compared to the No Build Alternative. Draft Tier 1 EIS **Table 3.8-3** includes existing noise levels measured in rural areas not near an existing highway. Measured noise levels in rural areas ranged from 39 dBA (along the west option in Pima County) to 49 dBA (along the Recommended Alternative in Buckeye). While 2040 No Build noise levels could be similar to existing measured noise levels, they may be higher due to new noise sources introduced by continued growth and development. More detailed noise analysis will be completed in future Tier 2 environmental reviews.

Table 3.8-4. Summary of Predicted 2040 Traffic Noise Levels – No Build Alternative

Option	Distance From Edge of Right-of-Way				
	50 feet	100 feet	250 feet	500 feet	1,000 feet
I-19 (Nogales to Sahuarita)	70	68	63	58	52
I-19 (Sahuarita to I-10)	73	71	66	61	55
I-10 (I-19 to Marana)	76	74	70	65	59
I-10 (Marana to I-10 Connector)	72	70	66	61	55
I-8 (I-10 Connector to Gila Bend)	69	67	63	58	52
SR 85 (Q1, Gila Bend to Buckeye Hills)	65	62	57	52	46
SR 85 (Q2, near Buckeye Hills)	72	70	65	60	54
SR 85 and I-10 (coincident with Option Q3)	73	71	66	61	55

SOURCE: **Appendix E8** (Technical Memorandum: I-11 Noise Report Addendum).

3.8.4 Recommended Alternative

Based on the TNM results for both the Recommended and Preferred Alternatives, future traffic noise levels at most noise sensitive land uses (Categories B, C, and E) within 100 to 500 feet of the I-11 right-of-way are predicted to exceed FHWA NAC. If future noise levels approach or exceed the NAC, they are considered noise impacts under ADOT's NAR and warrant further consideration of noise abatement. **Table 3.8-5** summarizes where future noise levels would approach or exceed the NAC along the Recommended and Preferred Alternatives. Generally, noise impacts could occur at noise sensitive land uses within 100 feet of the edge of the right-of-way. For both alternatives, future noise levels as far as 500 feet away from the right-of-way could potentially exceed the NAC. Perceptible changes in noise levels along the west option in Pima County could extend a greater distance in the Saguaro National Park, Tucson Mountain Park, Ironwood Forest National Monument, and designated wilderness areas due to the relatively low existing noise levels. In general, new highway alignment constructed in a quiet or undeveloped area would typically result in an increase of 15 dBA or greater, which would warrant consideration of mitigation measures for noise impacts during Tier 2 studies.

Table 3.8-5. Summary of Potential Noise Impacts for the Recommended and Preferred Alternatives

Geography	Recommended Alternative	Preferred Alternative with West Option in Pima County	Preferred Alternative with East Option in Pima County
Nogales to Sahuarita	200–500 feet of ROW	250–500 feet of ROW	250–500 feet of ROW
Sahuarita to Marana	Within 250 feet of ROW	Within 250 feet of ROW	250–500 feet of ROW
Marana to Casa Grande	Within 100 feet of ROW	Within 100 feet of ROW	Within 100 feet of ROW
Casa Grande to Buckeye	Within 100 feet of ROW	Within 250 feet of ROW	Within 250 feet of ROW
Buckeye to Wickenburg	Within 100 feet of ROW	Within 100 feet of ROW	Within 100 feet of ROW

SOURCE: **Appendix E8** (Technical Memorandum: I-11 Noise Report Addendum).
ROW = right-of-way
NOTE: If future noise levels approach or exceed the NAC, they are considered noise impacts under ADOT's NAR and warrant further consideration of noise abatement.

3.8.5 Preferred Alternative

The Preferred Alternative would result in increased noise levels, impacting communities surrounding the corridor. **Table 3.8-5** summarizes where future noise levels would approach or exceed the NAC along the Recommended and Preferred Alternatives. Compared to the Recommended Alternative, the changes incorporated into the Preferred Alternative would result in fewer noise impacts in one location but more noise impacts in another. Near Casa Grande, while there would be fewer noise impacts near SR 84 and Burris Road, the Preferred Alternative would result in higher noise levels along Montgomery Road. Compared to the Recommended Alternative in Goodyear, the Preferred Alternative would result in fewer impacts to the CantaMia residential community but may result in higher noise levels to the sensitive receivers adjacent to SR 85. Compared to the Recommended Alternative in Wickenburg, the Preferred Alternative would most likely result in lower noise levels to the Vista Royale residential community than those under the Recommended Alternative.

- **Nogales to Sahuarita**: Noise levels could increase in residential, commercial, and recreational areas along co-located I-10. If the Tier 2 noise analysis determines that noise sensitive receivers are at or above the NAC or if noise levels increase substantially (15 dBA or more) from existing noise levels due to I-11, ADOT will evaluate noise abatement measures in accordance with the ADOT NAR.

- **Sahuarita to Marana**: The Preferred Alternative with east option in Pima County would increase noise levels in residential, commercial, cultural/historic, and recreational areas, which would affect residential areas/sites in downtown Tucson. The Preferred Alternative with east option in Pima County would result in fewer permanent impacts to recreation areas/sites (e.g., Saguaro National Park) because I-11 would be co-located with existing interstate facilities. The west option would increase noise levels and alter the soundscape in residential and recreational areas that have lower existing ambient noise levels. The relocated I-10 interconnection, which extends through undeveloped land, would impact fewer residential areas in Marana.

- **Marana to Casa Grande**: The Preferred Alternative would alter the soundscape in areas in Marana and Eloy that have low, rural existing ambient noise levels. The Preferred Alternative would result in increased noise levels in residential areas along Montgomery Road.

- **Casa Grande to Buckeye**: The Preferred Alternative would alter the soundscape in rural areas that have low existing ambient noise levels. Compared to the Recommended Alternative, the Preferred Alternative would avoid noise impacts in CantaMia, Estrella Mountain Ranch, and along Beloat Road north of the Gila River in Buckeye, Palo Verde, and Tonopah. Instead, the Preferred Alternative would result in noise impacts along SR 85 and I-10 in Buckeye, Palo Verde, and Tonopah, where there are fewer noise sensitive receivers along the existing highway facilities than along the Recommended Alternative.

- **Buckeye to Wickenburg:** The Preferred Alternative could increase noise levels for residential and recreational areas near Wickenburg. Compared to the Recommended Alternative, the Preferred Alternative would result in lower noise levels in the Vista Royale residential community.

3.8.6 Mitigation and Tier 2 Analysis

3.8.6.1 Tier 2 Analysis Commitments

FHWA and ADOT completed an initial level of analysis in this Final Tier 1 EIS to identify a 2,000-foot-wide preferred Build Corridor Alternative. Additional analysis in Tier 2 will inform (1) the selection of a specific alignment (approximately 400 feet wide) within the selected 2,000-foot-wide corridor and (2) the selection of the west option or east option in Pima County. Tier 2 analysis will include detailed noise modeling based on the engineering design, impact and mitigation analysis, and measures to avoid, minimize, or mitigate noise impacts. Specifically, ADOT commits to carrying out the following analysis during the Tier 2 process:

- **T2-Noise-1**: Conduct a Tier 2 traffic noise analysis in accordance with the current ADOT NAR as well as 23 CFR 772. The Tier 2 analysis will include conducting noise measurements to characterize the existing noise environment in areas adjacent to segments of I-11 that consist of a new highway on new alignment where a substantial noise increase (a 15 dBA increase over existing noise levels) would be likely. Noise abatement measures will be considered where traffic noise impacts are identified, and abatement measures found to be both feasible and reasonable will be incorporated into the project.

- **T2-Noise-2**: Evaluate potential construction noise impacts and assess construction noise mitigation, as needed and in accordance with current ADOT NAR. ADOT will determine whether any additional measures are needed in the plans or specifications to minimize or eliminate adverse impacts from construction noise.

3.8.6.2 Mitigation Commitments

As required by NEPA, FHWA and ADOT considered measures to avoid, minimize, and mitigate noise impacts from the Project (generally referred to as mitigation measures) during this Tier 1 process. Specific mitigation that ADOT is committing to implement if a Build Alternative is selected includes:

- **MM-Noise-1**: Consider noise abatement measures where traffic noise impacts are identified during Tier 2 analysis. Abatement measures found to be both feasible and reasonable will be incorporated into the project.

3.8.6.3 Additional Mitigation to be Evaluated in Tier 2

During the Tier 2 process, ADOT will evaluate mitigation measures in addition to those listed above, to include best practices, permit requirements, and/or other mitigation strategies suggested by agencies or the public. Examples of measures that ADOT may evaluate in Tier 2 include:

- Noise barriers
- Earthen berms
- Refinement of horizontal and vertical alignments
- Reduced speeds
- Truck traffic restrictions

This page intentionally left blank.