FrontRunner Forward Technical Memorandum

To: Utah Transit Authority

From: Lance Meister, Cross-Spectrum Acoustics, Inc.

Date: May 18, 2023

Subject: FrontRunner Forward Corridor Level Noise and Vibration Analysis

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The purpose of this memorandum is to summarize the noise and vibration assessment for the Utah Transit Authority (UTA) FrontRunner Forward corridor level analysis. The Project will approximately double the number of commuter train trips on the FrontRunner Corridor between Provo and Ogden. The Project would add 28 to 34 FrontRunner trains to the heavily used freight and commuter rail corridor by increasing service from 30-minute headways to 15-minute headways during the peak periods. The noise and vibration technical analysis assessed the effects at a corridor level of the increase in FrontRunner service. No changes to the freight services were assumed in the assessment.

Summary

The results of the noise assessment indicated that there would be no noise impacts at any location along the FrontRunner corridor. The projected moderate noise impact contours for the increased service extend from the centerline of the tracks to between 20 and 62 feet away from the centerline of the UTA FrontRunner tracks depending on the location along the corridor. There are no noise sensitive receivers identified within the moderate impact contours. The results of the vibration assessment indicate that there would be no vibration impacts due to the project because of the high volume of existing train traffic in the corridor.

Additionally, the changes to the FrontRunner rail corridor in the double track project locations would not affect the results of this assessment because changes in noise and vibration levels due to the double track projects would not increase the distance to impact at the corridor level. The only locations on the double track projects where there would be the potential for noise and vibration impacts are at the new turnout locations, and those were studied and documented as a part of the double track project assessments.

FTA Noise and Vibration Impact Criteria

Noise

The FTA noise and vibration criteria for transit projects are detailed in the FTA's noise and vibration guidance manual.[1]

[1] Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, FTA Report No. 0123, September 2018.

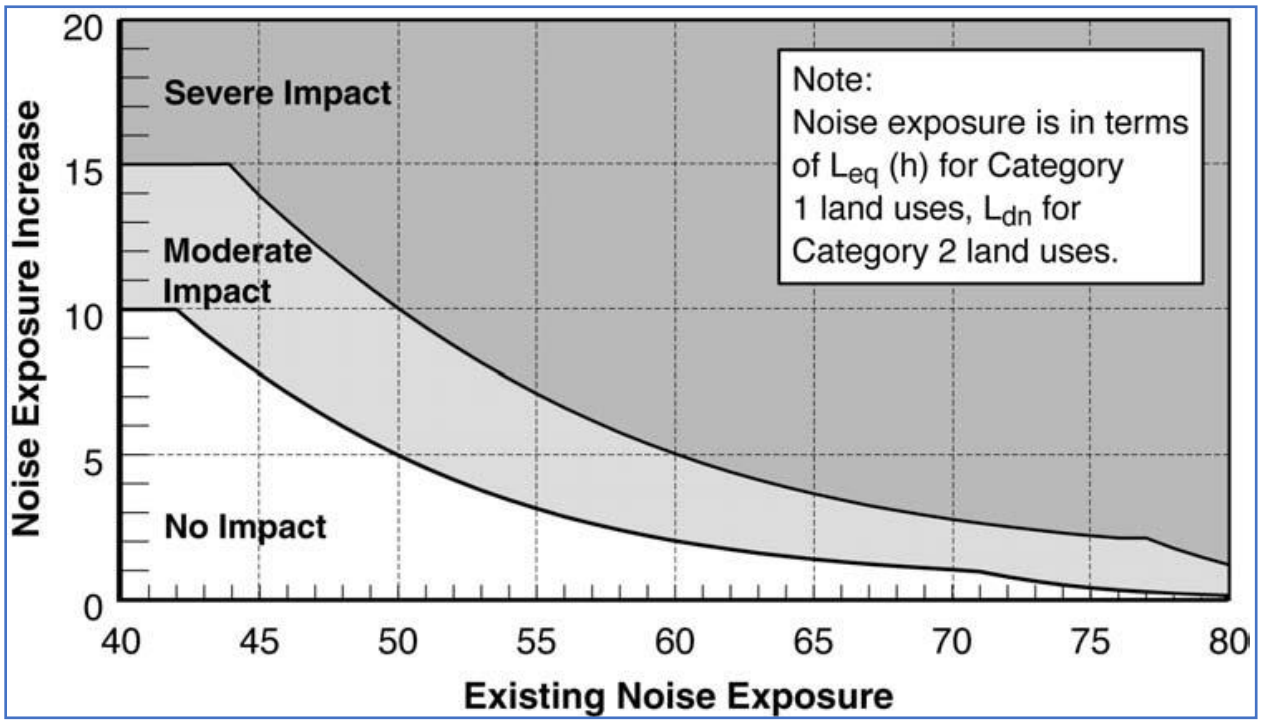
The FTA noise criteria are based on the land use category of the sensitive receptor. The descriptors and criteria for assessing noise impact vary according to land use categories adjacent to the project. For Category 2, land uses where people live and sleep (e.g., residential neighborhoods, hospitals, and hotels), the Ldn[2] is the assessment parameter. For other land use types (Category 1 or 3) where there are noise-sensitive uses (e.g., outdoor concert areas, schools, and libraries), the Leq[3] for an hour of noise sensitivity that coincides with train activity is the assessment parameter.

The noise impact criteria are defined by the two curves in Figure 1, which compares the change in noise due to the project to the existing noise before the introduction of the project. These criteria are used in projects where there is not a new project, but where there can be changes in noise, such as with the introduction of a second track or addition of more trains. The FTA noise impact criteria include three levels of impact, as shown in Figure 1. The three levels of impact include:

- **No Impact:** In this range, the project is considered to have no impact since, on average, the introduction of the project will result in an insignificant increase in the number of people highly annoyed by the new project noise.
- **Moderate Impact:** Project-generated noise in this range is considered to cause impact at the threshold of measurable annoyance. Moderate impacts serve as an alert to project planners for potential adverse impacts and complaints from the community. Mitigation should be considered at this level of impact based on project specifics and details concerning the affected properties.
- **Severe Impact:** Project-generated noise in this range is likely to cause a high level of community annoyance. Noise mitigation should be applied for severe impacts where feasible.

[2] The Day-Night Sound Level (Ldn) is a 24-hour cumulative A-weighted noise level that includes all noises that happen within a day, with a 10 dB penalty for nighttime noise (10 p.m. to 7 a.m.).
[3] The "equivalent" sound level (Leq) represents the cumulative sound level over a period of time, typically one hour or 24 hours in transit noise assessments.

Figure 1. FTA Cumulative Noise Impact Criteria



SOURCE: FTA 2018

Vibration

When a project is using an existing rail corridor, there are several scenarios for how to proceed in assessing vibration impact relative to the vibration events from existing trains. Representative scenarios for existing vibration can be assessed using the following methods.

- **Infrequently used rail route:** Use the standard FTA vibration criteria when the existing rail traffic consists of four trains or fewer per day.
- **Moderately used rail route:** If the existing rail traffic consists of 5 to 12 trains per day with vibration that substantially exceeds the impact criteria, there would be no effect as long as the project vibration levels are at least 5 VdB less than the existing vibration. Vibration from existing trains can be estimated using the General Assessment procedures in Section 6 of the FTA guidelines.
- **Heavily used rail route:** If the existing traffic exceeds 12 trains per day and if the project would not substantially increase the number of vibration events (less than doubling the number of trains is usually considered not substantial), there would be no additional effect unless the project vibration, estimated using the procedures of Section 6 of the FTA guidelines, would be higher than the existing vibration. In locations where the new trains would be operating at higher speeds than the existing rail traffic, the trains would likely generate substantially higher

levels of groundborne vibration. When the project would cause vibration more than 5 VdB greater than the existing source, the existing source can be ignored, and the standard FTA vibration criteria can be applied to the project.

For this project, the corridor would be considered a heavily used rail route for the vibration assessment.

Noise and Vibration Assessment Methodology

Noise

Noise from the Project was assessed using the methods described in the FTA guidance manual.

The Project would roughly double the number of UTA FrontRunner trains operating in the corridor from Ogden to Provo (see Table 1). The noise assessment is based on the increase in noise at sensitive receptors due to the addition of the new trains. The model assumes that the trains will follow the same route as the current service and that the entire corridor is a quiet zone, and no horns will be sounded in normal operations.

To model the existing noise along the corridor, operations information was obtained from the Federal Railroad Administration (FRA) database, the UTA FrontRunner website, the project team and field observations. The information included the number of Union Pacific Railroad (UPRR) freight trains per day, the speed of the freight trains and the number of freight train locomotives and cars. The assessment assumed that the freight operations would not change as a part of the Project. The information also included the number of existing and future FrontRunner trains, the speeds of the trains and the number of locomotives and cars in each FrontRunner train. The speeds and consists (the number of locomotives and cars) for both UTA FrontRunner and UPRR trains were assumed to be consistent throughout the corridor, and are as follows:

- UPRR trains:
  - 5 locomotives and 120 cars per train on average from field observations and Google Earth imaging
  - 40 mph speeds from the FRA database
- UTA FrontRunner:
  - 4 rail cars and 1 locomotive per train (typical FrontRunner trainset configuration)
  - 79-mph train speed (maximum speed on Class 4 track per FRA regulation 49 CFR § 213.9)

The daily schedule for both UTA and UPRR trains varies along the 82-mile-long corridor from Ogden to Provo. Because of this, the corridor was broken up into nine different segments with similar FrontRunner and UPRR operations to properly assess the noise. These segments include, from north to south:

- Ogden Station to Interstate 15
- Interstate 15 to Clearfield Station
- Clearfield Station to North Temple Station
- North Temple Station to Salt Lake Central Station
- Salt Lake Central Station to Murray Central Station

- Murray Central Station to Draper Station
- Draper Station to Lehi Station
- Lehi Station to Orem Central Station
- Orem Central Station to Provo Central Station

Table 1 contains number of daytime and nighttime trains for the existing UPRR and UTA FrontRunner operations and the number of additional daytime and nighttime FrontRunner train operations being added as a part of the Project, broken into daytime (7am-10pm) and nighttime (10pm-7am), for each of the nine segments. The limits of these segments are shown in Figure 2. The information about existing FrontRunner operations is based on the FrontRunner operating schedule effective April 17, 2022[4].

Table 1. UPRR and UTA FrontRunner Operations Number of Trains

Segment	Existing UTA FrontRunner Daytime	Existing UTA FrontRunner Nighttime	UPRR Daytime	UPRR Nighttime	Additional UTA Daytime Trains Due to Project	Additional UTA Nighttime Trains Due to Project
Ogden Station to I-15	42	10	19	12	23	5
I-15 to Clearfield Station	42	10	16	10	24	4
Clearfield Station to North Temple Station	42	10	16	10	24	4
North Temple Station to Salt Lake Central Station	47	12	16	9	28	5
Salt Lake Central Station to Murray Central Station	47	12	4	3	31	3
Murray Central Station to Draper Station	44	10	6	3	31	3
Draper Station to Lehi Station	44	10	4	3	31	3
Lehi Station to Orem Central Station	44	10	6	3	30	4
Orem Central Station to Provo Central Station	44	10	6	4	30	4

* Daytime hours are between 7am and 10pm. Nighttime hours are between 10pm and 7am.

[4] Schedule for FrontRunner Route 750. https://www.rideuta.com/Rider-Tools/Schedules-and-Maps/750-FrontRunner. Effective April 17, 2022.

Figure 2. Noise Assessment Operational Segments

The reference noise levels for the UPRR trains were obtained from FRA's CREATE Railroad Noise Model[5] assessment spreadsheet for freight operations and the reference noise levels for the UTA FrontRunner commuter trains were obtained from the FTA guidance manual. The existing noise levels for the FrontRunner and UPRR trains were calculated, along with the change in noise level due to the increase in FrontRunner operations. The existing noise levels and changes in noise level due to the Project in each segment were used to calculate the distances to both the severe and moderate noise impact contour relative to the centerline of the tracks.

Vibration

Vibration from the Project was assessed using the FTA vibration criteria for locations with existing vibration. Because of the high volume of existing train traffic in the area, between 61 and 84 total trains per day, the entire corridor is classified as a heavily used rail corridor, per FTA guidance. The increase in passenger service would not substantially increase the number of vibration events (defined as at least a doubling). Additionally, as vibration levels are evaluated on an individual event basis, the vibration of the additional trains would not be higher than the vibration levels of existing trains. Because of this, there would be no vibration impact, and no further assessment of vibration is required.

Affected Environment

The FrontRunner corridor services fifteen cities over 83 miles roughly paralleling the I-15 corridor. There is a mixture of commercial, industrial, institutional, agricultural, and residential land use along the whole corridor. A more detailed description of the land use in each of the nine segments identified above is described below.

Ogden Station to I-15 (1.5 miles): The land use along the segment between Ogden Station and the first crossing of I-15 is a mixture of commercial and industrial. There are no noise sensitive land uses in this segment.

I-15 to Clearfield Station (10 miles): The land use along the segment between I-15 and Clearfield Station is a mixture of industrial, agricultural, residential, and institutional. The noise sensitive land uses in the segment include single- and multi-family housing. North of SR-79, the majority of the land use is industrial and there are no noise sensitive receivers. South of SR-79, the majority of the land use is residential, with some municipal buildings.

Clearfield Station to North Temple Station (25 miles): The land use along the segment between Clearfield Station and North Temple station is a mixture of residential, commercial, and industrial. The noise sensitive land uses in the segment include single- and multi-family housing and churches. From the Clearfield Station to West Bountiful, the land use is residential and commercial. From West Bountiful to I-215, the land use is a mix of residential and industrial. The land use is industrial from I-215 to 600 N. From 600 N to the North Temple Station, the land use is a mixture of commercial and residential.

[5] https://railroads.dot.gov/environment/noise-vibration/guidance-assessing-noise-and-vibration-impacts

North Temple Station to Salt Lake Central Station (0.7 miles): The land use along the segment between North Temple Station and Salt Lake Central Station is a mix of commercial and residential. The noise sensitive land use in the segment is multi-family housing.

Salt Lake Central Station to Murray Central Station (7 miles): The land use along the segment between Salt Lake Central Station and Murray Central Station is a mixture of industrial, commercial, and residential. The noise sensitive land use along in the segment is multi-family housing. There are a few multi-family residences along the alignment south of 3900 S. The land use north of 3900 S is industrial and commercial.

Murray Central Station to Draper Station (10 miles): The land use along the segment between Murray Central Station and Draper Station is a mixture of commercial, industrial, and residential. The noise sensitive land uses in the segment include single- and multi-family housing and a few hotels. Between Murray Central Station and 7200 S, the land use is commercial and industrial with a few residential land uses. South of 7200 S, the land use is a mixture of commercial and residential to the Draper Station.

Draper Station to Lehi Station (8 miles): The land use along the segment between Draper Station and Lehi Station includes residential, commercial, and agricultural. The noise sensitive land uses in the segment include churches, single-family homes, multi-family homes

Lehi Station to Orem Central Station (14 miles): The land use along the segment between Lehi Station and Orem Central Station is residential, industrial, institutional, agricultural, and commercial. The noise sensitive land uses in the segment include single- and multi-family housing, churches, and schools. Between W 6800 N in American Fork and Vineyard Connector Road in Orem, there are no noise sensitive land uses.

Orem Central Station to Provo Central Station (5.4 miles): The land use along the segment between Orem Central Station and Provo Central Station is residential, commercial, agricultural, and industrial. The noise sensitive land uses in the segment include single- and multi-family housing. From Orem Central Station to I-15, the land use is a mixture of agricultural, residential, and some industrial. Between I-15 and Highway 114, there are no noise sensitive land uses. South of Highway 114, the land use is a mixture of commercial, industrial, and residential.

Existing Noise

The existing noise was modeled using procedures detailed in the FTA guidance manual and the assumptions listed above. The noise was projected from the center of the shared UTA FrontRunner/UPRR right-of-way. With the exception of the area between W 2000 S St in Orem and W Center St in Provo where the UPRR tracks diverge from the UTA FrontRunner tracks by up to 385 feet, the UPRR and FrontRunner trains share the same corridor. The modeled existing noise at 50 feet ranges from 66 dBA to 79 dBA Ldn, depending primarily on the number of UPRR trains per segment.

Impact Assessment

Noise

The results of the noise assessment are shown in Table 2 for each of the nine segments described above. The table includes the change in noise level due to the Project and the distance from the centerline of

the tracks to the moderate noise impact contour. It should be noted, the distance to the severe noise impact contour is less than 20 feet from the centerline of the tracks for the entire corridor, which would not extend outside the existing railroad right-of-way. The severe noise impact contour, therefore, will not reach any noise sensitive receivers.

Because of the high existing noise levels in the entire corridor, the change in noise due to the increased service of the Project for the UTA FrontRunner trains is minimal, resulting in moderate noise contours that do not extend outside the right-of-way in most cases. Therefore, the distance to moderate noise impact in the corridor does not extend to the nearest noise sensitive receivers at any location in any of the nine segments. Figures 3 through 10 show the moderate noise impact contours at representative locations in each of the eight segments with noise sensitive land uses.

Figure 11 shows the area between W 2000 S St in Orem and W Center St in Provo, where the UPRR tracks diverge from the UTA FrontRunner tracks. At this location, the existing noise from the UPRR trains is further away but still significant for the receivers and included in the model. Additionally, because the UPRR trains are further from the sensitive receivers, the change in noise from UTA Frontrunner trains has a greater effect on the moderate noise impact contour. As shown in Figure 11, the moderate noise impact contour in this area extends into the backyard of the residences in one neighborhood but does not reach the façade of the buildings, and therefore there would be no noise impacts at this location.

Vibration

Due to the high number of existing trains along the corridor, no vibration impacts are projected at any locations as a result of the increased service for the Project.

Mitigation

Because no noise or vibration impacts were identified, no mitigation is necessary.

Table 2. Noise Impact Assessment Results by Segment

SEGMENT	CHANGE IN NOISE LEVEL AT 50 FEET (Ldn dB)	DISTANCE FROM THE TRACK CENTERLINE TO MODERATE NOISE IMPACT (FT)
Ogden Station to I-15*	0.1	36
I-15 to Clearfield Station	0.1	<20
Clearfield Station to North Temple Station	0.2	<20
North Temple Station to Salt Lake Central Station	0.1	<20
Salt Lake Central Station to Murray Central Station	0.2	24
Murray Central Station to Draper Station	0.3	32
Draper Station to Lehi Station	0.3	32
Lehi Station to Orem Central Station	0.3	35
Orem Central Station to Provo Central Station	0.3	35
Orem Central Station to Provo Central Station**	1.4	62

*No noise sensitive land use.

**Includes 385-foot UPRR track shift between W 2000 S St in Orem and W Center St in Provo

Figure 3. Representative Moderate Noise Impact Contours for I-15 to Clearfield Station

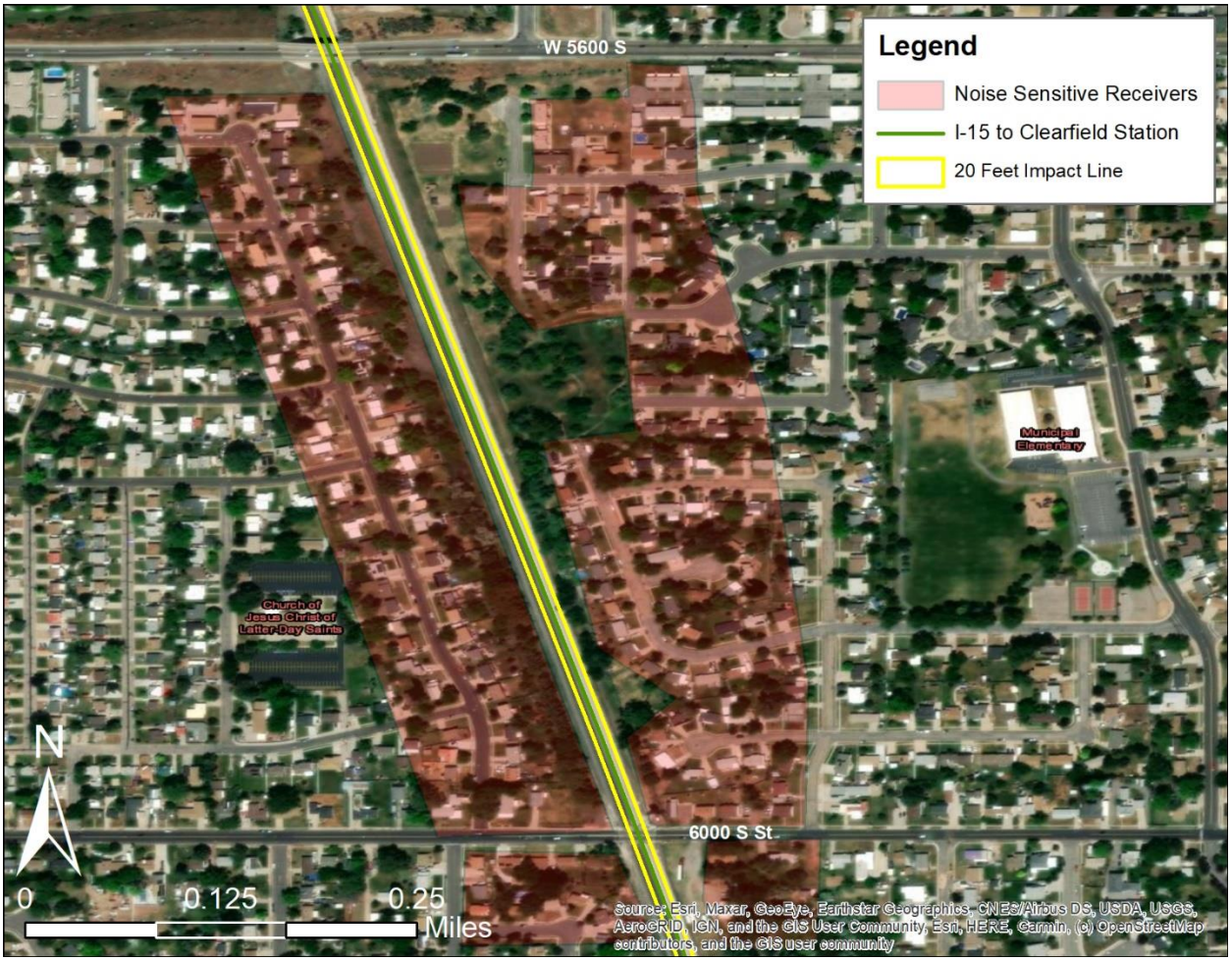


Figure 4. Representative Moderate Noise Impact Contours for Clearfield Station to North Temple Station

Figure 5. Representative Moderate Noise Impact Contours for North Temple Station to Salt Lake Central Station

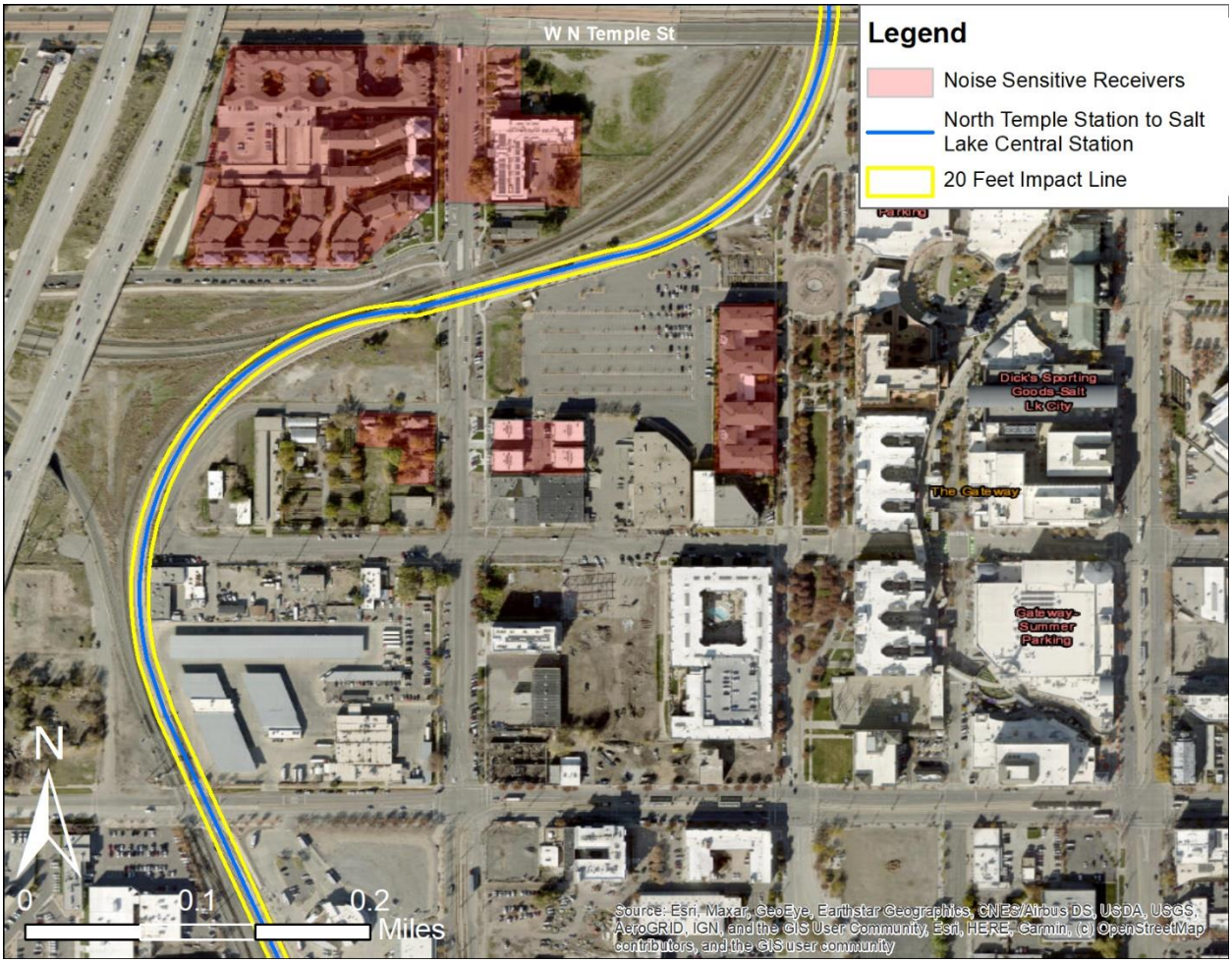


Figure 6. Representative Moderate Noise Impact Contours for Salt Lake Central Station to Murray Central Station

Figure 7. Representative Moderate Noise Impact Contours for Murray Central Station to Draper Station

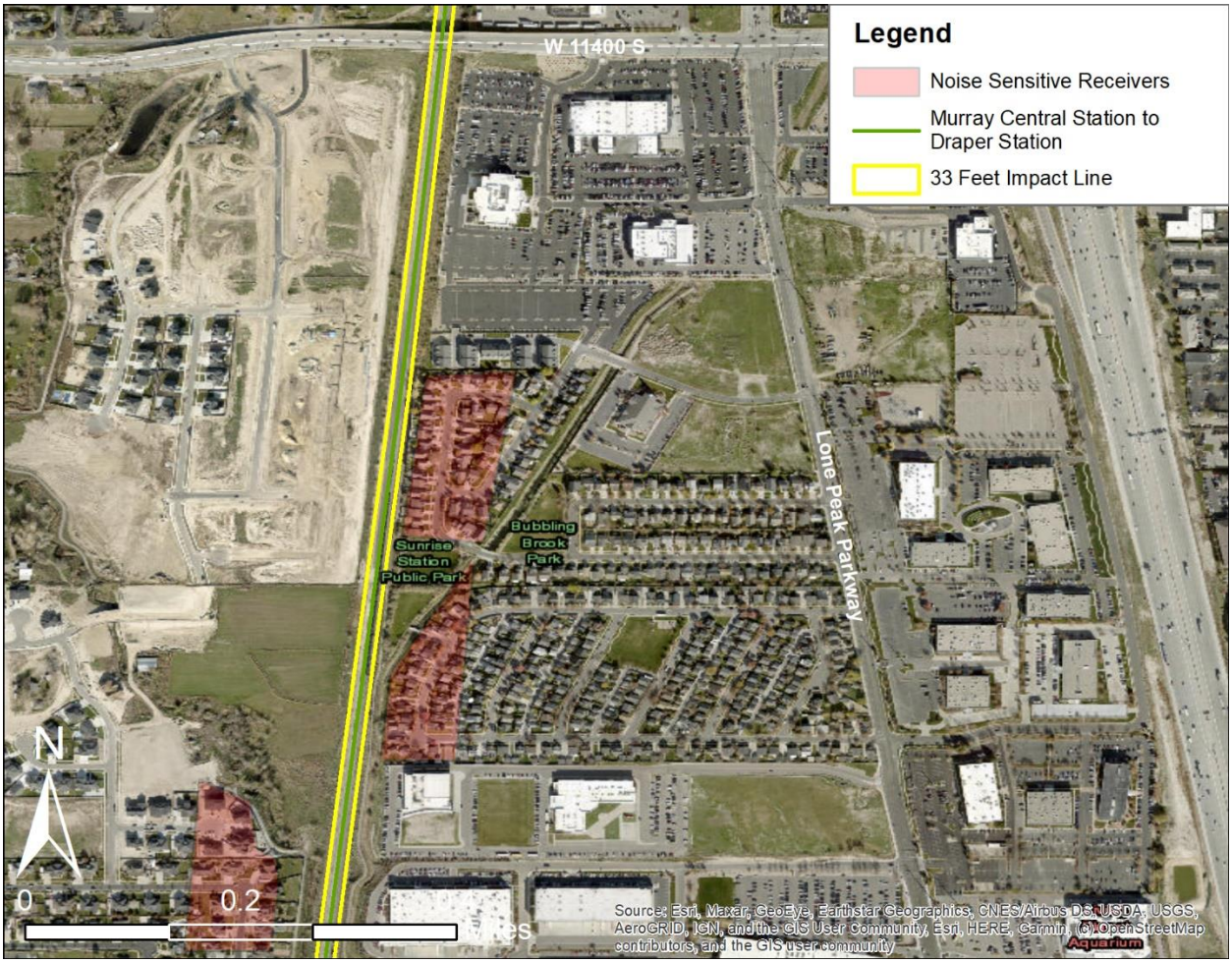


Figure 8. Representative Moderate Noise Impact Contours for Draper Station to Lehi Station

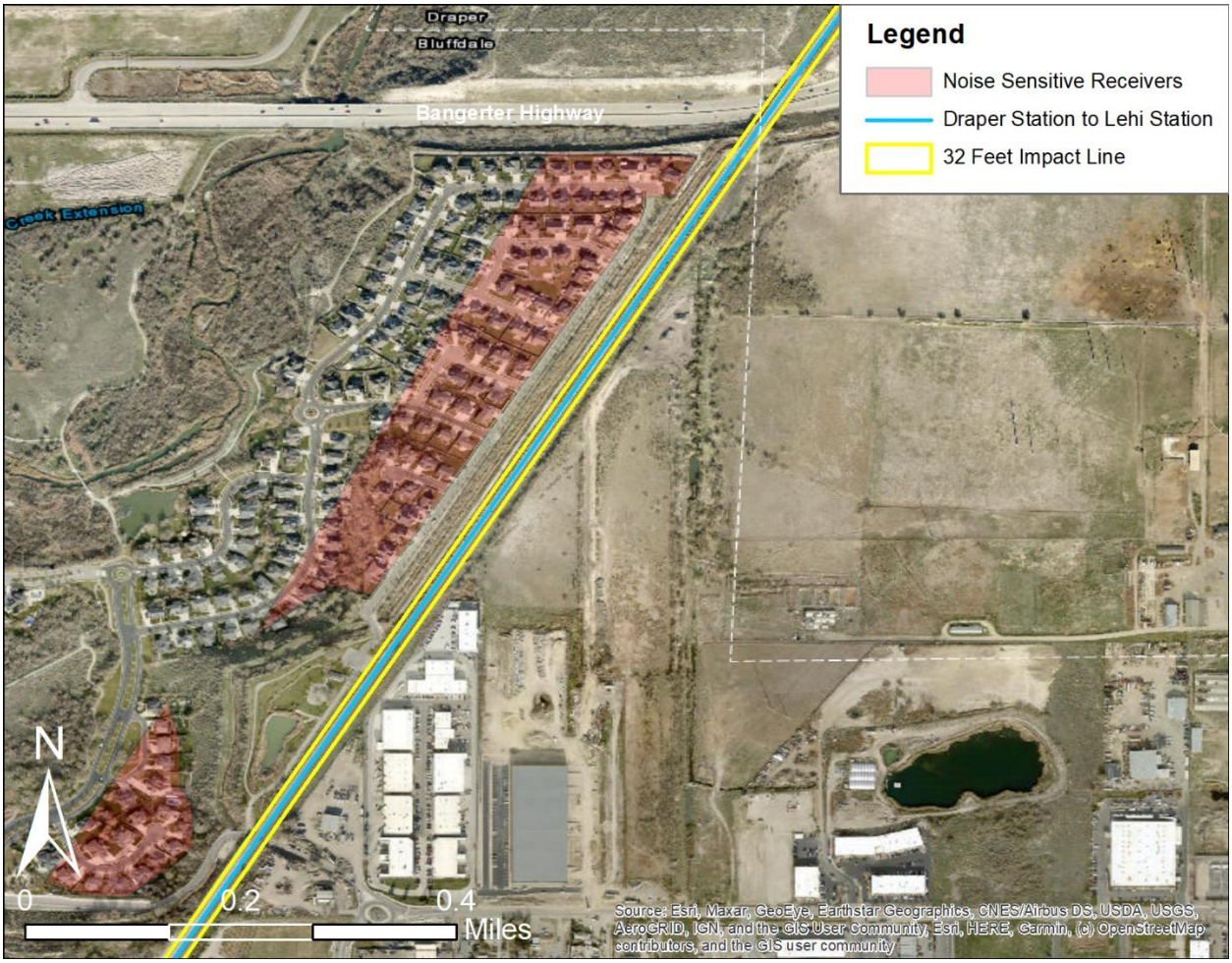


Figure 9. Representative Moderate Noise Impact Contours for Lehi Station to Orem Central Station

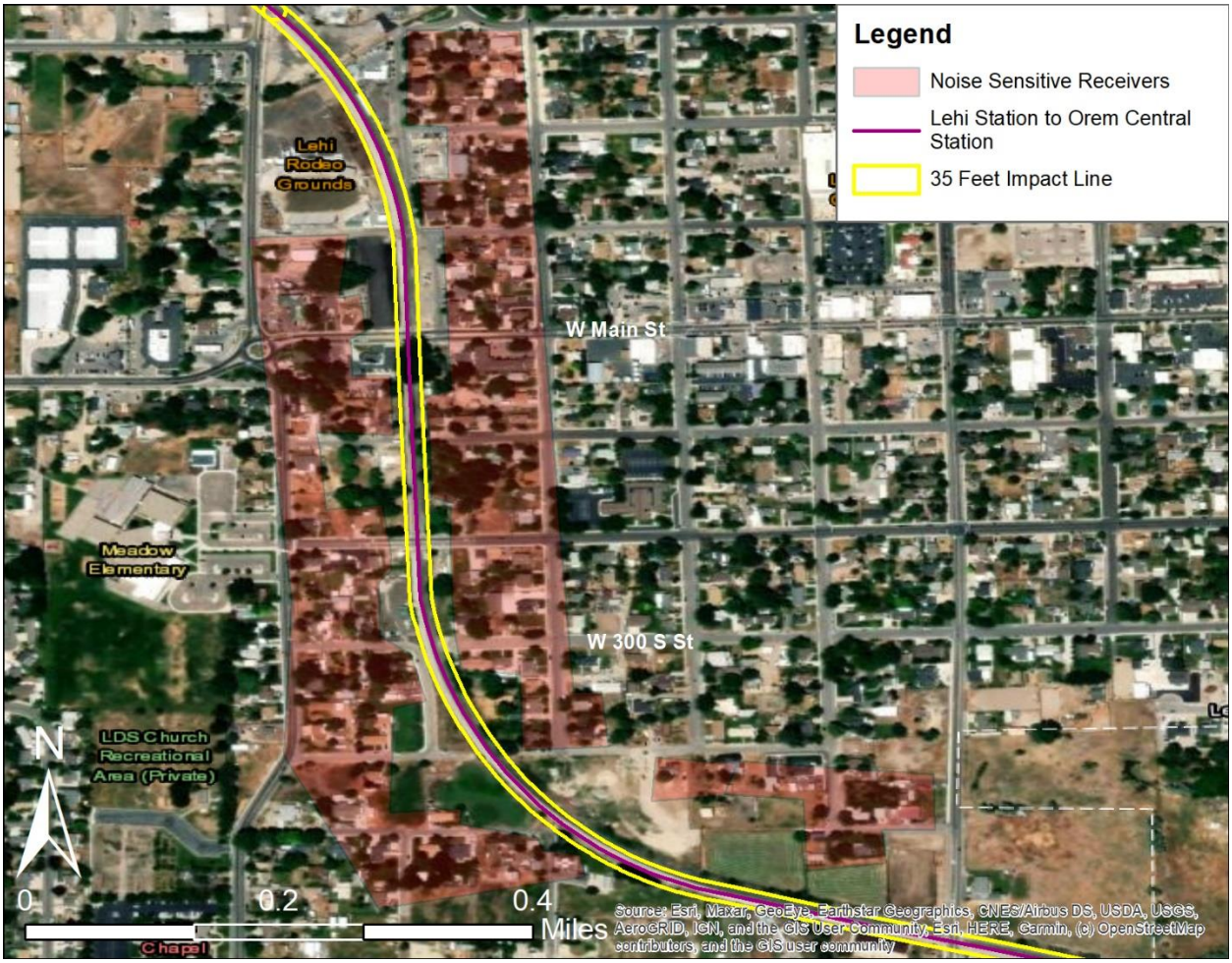


Figure 10. Representative Moderate Noise Impact Contours for Orem Central Station to Provo Central Station

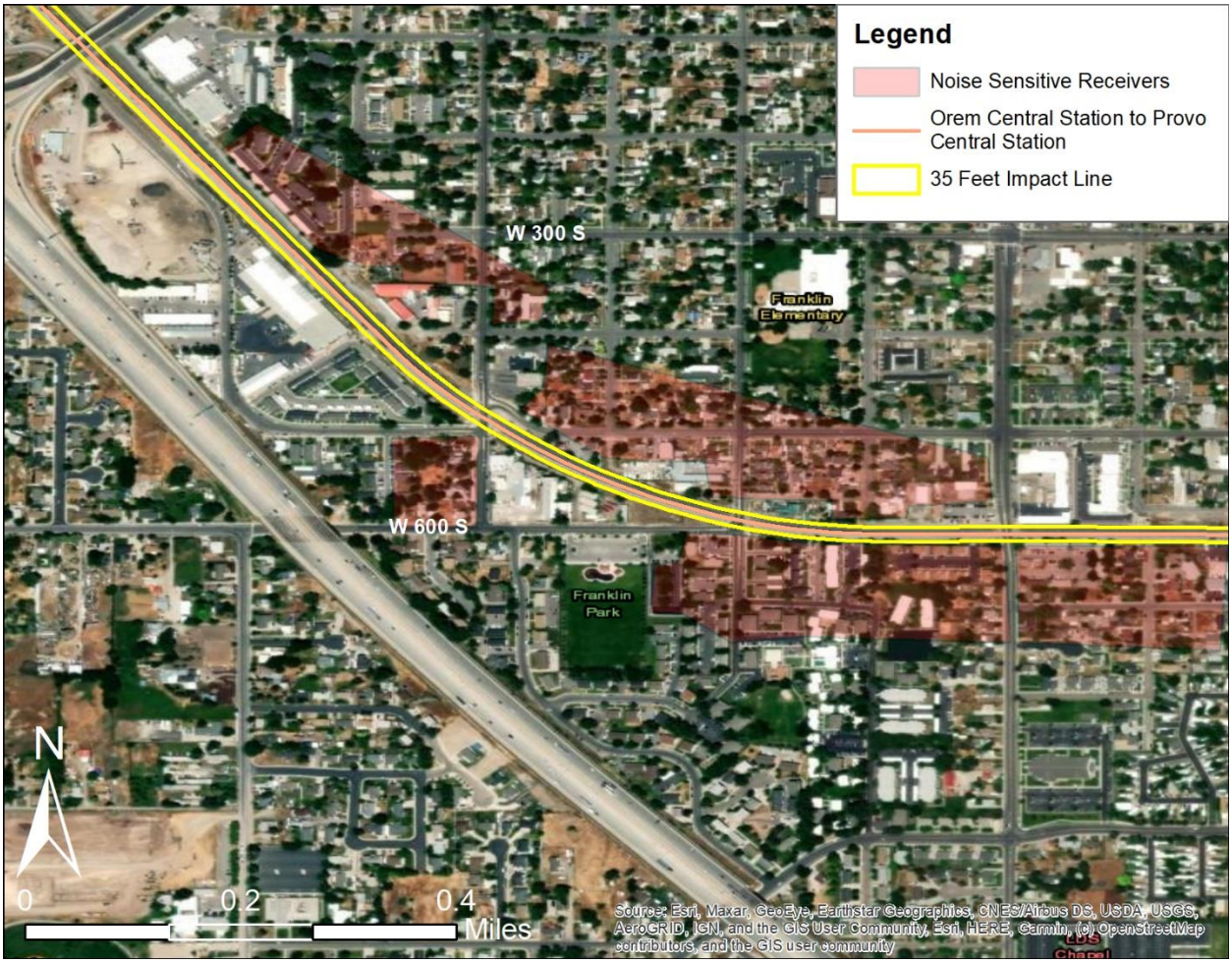


Figure 11. Moderate Noise Impact Contours for Orem Central Station to Provo Central Station with 385 Foot UPRR Track Shift

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	85.3	85.4	0.040	0.387	0.103	Moderate
21	21	79	40	85.0	85.1	0.044	0.423	0.103	Moderate
22	22	79	40	84.7	84.8	0.047	0.452	0.103	Moderate
23	23	79	40	84.3	84.4	0.051	0.482	0.103	Moderate
24	24	79	40	84.0	84.1	0.054	0.515	0.102	Moderate
25	25	79	40	83.7	83.8	0.058	0.550	0.102	Moderate
26	26	79	40	83.5	83.6	0.062	0.586	0.102	Moderate
27	27	79	40	83.2	83.3	0.067	0.625	0.102	Moderate
28	28	79	40	82.9	83.0	0.070	0.653	0.102	Moderate
29	29	79	40	82.7	82.8	0.075	0.696	0.102	Moderate
30	30	79	40	82.4	82.5	0.078	0.726	0.102	Moderate
31	31	79	40	82.2	82.3	0.084	0.774	0.102	Moderate
32	32	79	40	82.0	82.1	0.088	0.807	0.102	Moderate
33	33	79	40	81.8	81.9	0.092	0.841	0.102	Moderate
34	34	79	40	81.5	81.6	0.096	0.877	0.102	Moderate
35	35	79	40	81.3	81.4	0.101	0.915	0.102	Moderate
36	36	79	40	81.1	81.2	0.105	0.953	0.102	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	84.6	84.7	0.135	1.193	0.106	--
21	21	79	40	84.3	84.4	0.135	1.193	0.106	--
22	22	79	40	83.9	84.0	0.135	1.193	0.106	--
23	23	79	40	83.6	83.7	0.135	1.193	0.106	--
24	24	79	40	83.3	83.4	0.135	1.193	0.106	--
25	25	79	40	83.0	83.1	0.135	1.193	0.106	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	84.7	84.6	0.135	1.193	0.106	--
21	21	79	40	84.4	84.3	0.135	1.193	0.106	--
22	22	79	40	84.0	83.9	0.135	1.193	0.106	--
23	23	79	40	83.7	83.6	0.135	1.193	0.106	--
24	24	79	40	83.4	83.3	0.135	1.193	0.106	--
25	25	79	40	83.1	83.0	0.135	1.193	0.106	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	84.5	84.6	0.135	1.193	0.133	--
21	21	79	40	84.1	84.3	0.135	1.193	0.133	--
22	22	79	40	83.8	83.9	0.135	1.193	0.133	--
23	23	79	40	83.5	83.6	0.135	1.193	0.133	--
24	24	79	40	83.2	83.3	0.135	1.193	0.132	--
25	25	79	40	82.9	83.0	0.135	1.193	0.132	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	79.7	79.9	0.148	1.293	0.196	Moderate
21	21	79	40	79.3	79.5	0.158	1.372	0.196	Moderate
22	22	79	40	79.0	79.2	0.173	1.484	0.196	Moderate
23	23	79	40	78.7	78.8	0.186	1.573	0.196	Moderate
24	24	79	40	78.3	78.5	0.199	1.666	0.195	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	80.4	80.7	0.135	1.193	0.260	Moderate
21	21	79	40	80.1	80.4	0.135	1.193	0.260	Moderate
22	22	79	40	79.8	80.0	0.145	1.267	0.260	Moderate
23	23	79	40	79.4	79.7	0.155	1.345	0.260	Moderate
24	24	79	40	79.1	79.4	0.166	1.427	0.260	Moderate
25	25	79	40	78.8	79.1	0.177	1.513	0.259	Moderate
26	26	79	40	78.6	78.8	0.190	1.604	0.259	Moderate
27	27	79	40	78.3	78.6	0.203	1.699	0.259	Moderate
28	28	79	40	78.0	78.3	0.212	1.764	0.259	Moderate
29	29	79	40	77.8	78.0	0.227	1.867	0.259	Moderate
30	30	79	40	77.5	77.8	0.238	1.938	0.259	Moderate
31	31	79	40	77.3	77.6	0.248	2.011	0.259	Moderate
32	32	79	40	77.1	77.3	0.266	2.041	0.259	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	79.5	79.9	0.151	1.319	0.319	Moderate
21	21	79	40	79.2	79.5	0.166	1.427	0.319	Moderate
22	22	79	40	78.8	79.2	0.177	1.513	0.318	Moderate
23	23	79	40	78.5	78.8	0.190	1.604	0.318	Moderate
24	24	79	40	78.2	78.5	0.203	1.699	0.318	Moderate
25	25	79	40	77.9	78.2	0.217	1.798	0.318	Moderate
26	26	79	40	77.6	78.0	0.232	1.902	0.318	Moderate
27	27	79	40	77.4	77.7	0.248	2.011	0.318	Moderate
28	28	79	40	77.1	77.4	0.260	2.086	0.318	Moderate
29	29	79	40	76.9	77.2	0.278	2.056	0.317	Moderate
30	30	79	40	76.6	76.9	0.291	2.071	0.317	Moderate
31	31	79	40	76.4	76.7	0.311	2.094	0.317	Moderate
32	32	79	40	76.2	76.5	0.325	2.110	0.317	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	80.4	80.7	0.135	1.193	0.297	Moderate
21	21	79	40	80.1	80.4	0.135	1.193	0.297	Moderate
22	22	79	40	79.8	80.1	0.145	1.267	0.297	Moderate
23	23	79	40	79.4	79.7	0.155	1.345	0.297	Moderate
24	24	79	40	79.1	79.4	0.166	1.427	0.297	Moderate
25	25	79	40	78.8	79.1	0.177	1.513	0.296	Moderate
26	26	79	40	78.6	78.9	0.190	1.604	0.296	Moderate
27	27	79	40	78.3	78.6	0.203	1.699	0.296	Moderate
28	28	79	40	78.0	78.3	0.212	1.764	0.296	Moderate
29	29	79	40	77.8	78.1	0.227	1.867	0.296	Moderate
30	30	79	40	77.5	77.8	0.238	1.938	0.296	Moderate
31	31	79	40	77.3	77.6	0.248	2.011	0.296	Moderate
32	32	79	40	77.1	77.4	0.266	2.041	0.296	Moderate
33	33	79	40	76.9	77.1	0.278	2.056	0.295	Moderate
34	34	79	40	76.6	76.9	0.291	2.071	0.295	Moderate
35	35	79	40	76.4	76.7	0.304	2.086	0.295	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	20	79	40	80.8	81.1	0.135	1.193	0.272	Moderate
21	21	79	40	80.5	80.8	0.135	1.193	0.272	Moderate
22	22	79	40	80.2	80.4	0.135	1.193	0.272	Moderate
23	23	79	40	79.8	80.1	0.141	1.242	0.272	Moderate
24	24	79	40	79.5	79.8	0.151	1.319	0.272	Moderate
25	25	79	40	79.2	79.5	0.162	1.399	0.271	Moderate
26	26	79	40	79.0	79.2	0.173	1.484	0.271	Moderate
27	27	79	40	78.7	79.0	0.186	1.573	0.271	Moderate
28	28	79	40	78.4	78.7	0.194	1.635	0.271	Moderate
29	29	79	40	78.2	78.4	0.208	1.731	0.271	Moderate
30	30	79	40	77.9	78.2	0.217	1.798	0.271	Moderate
31	31	79	40	77.7	78.0	0.232	1.902	0.271	Moderate
32	32	79	40	77.5	77.7	0.243	1.974	0.271	Moderate
33	33	79	40	77.2	77.5	0.254	2.048	0.271	Moderate
34	34	79	40	77.0	77.3	0.266	2.041	0.270	Moderate
35	35	79	40	76.8	77.1	0.278	2.056	0.270	--

Distance to Front Runner (ft)	Distance to Union Pacific (ft)	Speed of FrontRunner (mph)	Speed of Union Pacific (mph)	Calculated Existing Noise at Distance (dBA)	Calculated Future Noise at Distance (dBA)	Moderate Impact Criteria (dB)	Severe Impact Criteria (dB)	Change (dB)	Impact
20	405	79	40	72.3	73.9	0.757	2.484	1.658	Moderate
21	406	79	40	71.9	73.6	0.807	2.519	1.653	Moderate
22	407	79	40	71.6	73.3	0.859	2.555	1.648	Moderate
23	408	79	40	71.3	73.0	0.915	2.591	1.643	Moderate
24	409	79	40	71.0	72.7	0.973	2.629	1.638	Moderate
25	410	79	40	70.7	72.4	1.013	2.668	1.633	Moderate
26	411	79	40	70.5	72.1	1.027	2.708	1.627	Moderate
27	412	79	40	70.2	71.8	1.038	2.735	1.622	Moderate
28	413	79	40	70.0	71.6	1.053	2.777	1.617	Moderate
29	414	79	40	69.7	71.3	1.064	2.805	1.611	Moderate
30	415	79	40	69.5	71.1	1.075	2.834	1.606	Moderate
31	416	79	40	69.3	70.9	1.092	2.879	1.600	Moderate
32	417	79	40	69.1	70.7	1.104	2.909	1.595	Moderate
33	418	79	40	68.9	70.5	1.116	2.940	1.589	Moderate
34	419	79	40	68.7	70.3	1.128	2.972	1.583	Moderate
35	420	79	40	68.5	70.1	1.141	3.004	1.578	Moderate
36	421	79	40	68.3	69.9	1.147	3.020	1.572	Moderate
37	422	79	40	68.1	69.7	1.160	3.053	1.566	Moderate
38	423	79	40	68.0	69.5	1.173	3.087	1.560	Moderate
39	424	79	40	67.8	69.3	1.187	3.121	1.554	Moderate
40	425	79	40	67.6	69.2	1.194	3.138	1.549	Moderate
41	426	79	40	67.5	69.0	1.208	3.174	1.543	Moderate
42	427	79	40	67.3	68.8	1.215	3.191	1.537	Moderate
43	428	79	40	67.2	68.7	1.230	3.228	1.531	Moderate
44	429	79	40	67.0	68.5	1.237	3.246	1.525	Moderate
45	430	79	40	66.9	68.4	1.253	3.283	1.519	Moderate
46	431	79	40	66.7	68.2	1.260	3.302	1.514	Moderate
47	432	79	40	66.6	68.1	1.276	3.340	1.508	Moderate
48	433	79	40	66.5	68.0	1.284	3.360	1.502	Moderate
49	434	79	40	66.3	67.8	1.292	3.379	1.496	Moderate
50	435	79	40	66.2	67.7	1.300	3.399	1.490	Moderate
51	436	79	40	66.1	67.6	1.317	3.439	1.484	Moderate
52	437	79	40	66.0	67.4	1.325	3.459	1.478	Moderate
53	438	79	40	65.8	67.3	1.334	3.479	1.472	Moderate
54	439	79	40	65.7	67.2	1.343	3.500	1.467	Moderate
55	440	79	40	65.6	67.1	1.352	3.521	1.461	Moderate
56	441	79	40	65.5	67.0	1.360	3.542	1.455	Moderate
57	442	79	40	65.4	66.9	1.369	3.563	1.449	Moderate
58	443	79	40	65.3	66.7	1.388	3.606	1.443	Moderate
59	444	79	40	65.2	66.6	1.397	3.628	1.437	Moderate
60	445	79	40	65.1	66.5	1.406	3.650	1.432	Moderate
61	446	79	40	65.0	66.4	1.416	3.672	1.426	Moderate
62	447	79	40	64.9	66.3	1.426	3.694	1.420	--