Technical Memo

To	Utah Department of Transportation and Utah Transit Authority
From	Lance Meister, Cross-Spectrum Acoustics, Inc.
Date	January 2026
Re	North of American Fork Double Track Project Noise and Vibration Mitigation Assessment

Summary

The purpose of this memorandum is to summarize the noise and vibration mitigation assessment for the North of American Fork Double Track Project. The project consists of double tracking approximately 8 miles of the FrontRunner Commuter Rail system. The original project proposed extending from north of the American Fork Station to the south side of 2100 North in Lehi (about 4.2 miles). The updated project extends the double track section to the south from the American Fork station to approximately 1 mile north of W. Vineyard Road (added about 3.8 miles).

Noise and vibration assessments were completed for this project in 2022 and 2025[1] to determine impacts from infrastructure changes (adding the double track). In addition, corridor-level noise and vibration assessments were completed in 2023 and 2025[2] for the entire FrontRunner corridor to determine impacts from service increase (15-min at peak, 30-min off-peak). Noise and vibration impacts were identified, and mitigations were recommended. This mitigation assessment is a detailed review of reasonable and feasible mitigation measures that will be implemented as part of the project.

The results of the mitigation assessment indicate that there would need to be two ballast mats installed to fully mitigate all vibration impacts. The ballast mats would need to be installed parallel to the locations with existing ballast mats in Lehi from Station 1240+50 to 1250+50 (1000 feet long) and in American Fork from Station 975+50 to 993+00 (1,800 feet long) under the new track on top of an HMA concrete slab. Stationing is referenced to the FrontRunner South plans and is very similar to the current double track project. If the existing FrontRunner track with ballast mat will be shifted, the ballast mat will need to be replaced and installed under the track in the new location.

In addition, sound insulation testing is needed to determine if improvements are necessary at the following four residences:

- 655 Sunset Fields Cir, Lehi, UT 84043
- 205 E 700 S, Lehi, UT 84043
- 284 S Storrs Ave, American Fork, UT 84003
- 287 S Storrs Ave, American Fork, UT 84003

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[1] Utah Transit Authority, North of American Fork Double Track Project Noise and Vibration Assessment, November 2022; and Utah Transit Authority, North of American Fork Double Track Project Noise and Vibration Assessment – Design Change to Extend Southern Section and Ballast Mat Vibration Update, July 21, 2025.

[2] Utah Transit Authority, FrontRunner Forward Corridor Level Noise and Vibration Assessment, May 18, 2023; and Utah Transit Authority, FrontRunner Forward Corridor Level Noise and Vibration Assessment Addendum, May 20, 2025.

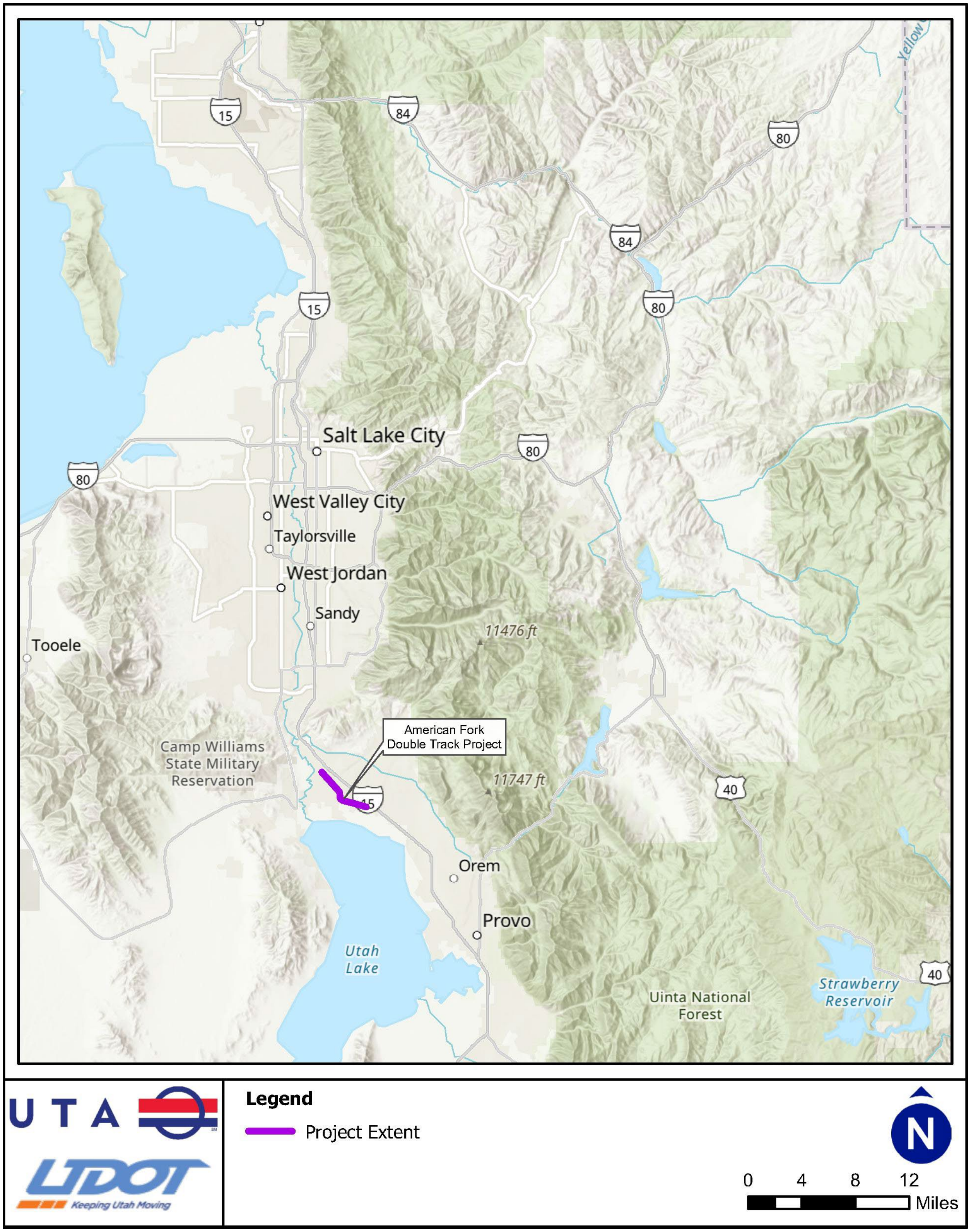

Figure 1. North of American Fork Double Track Project Overview

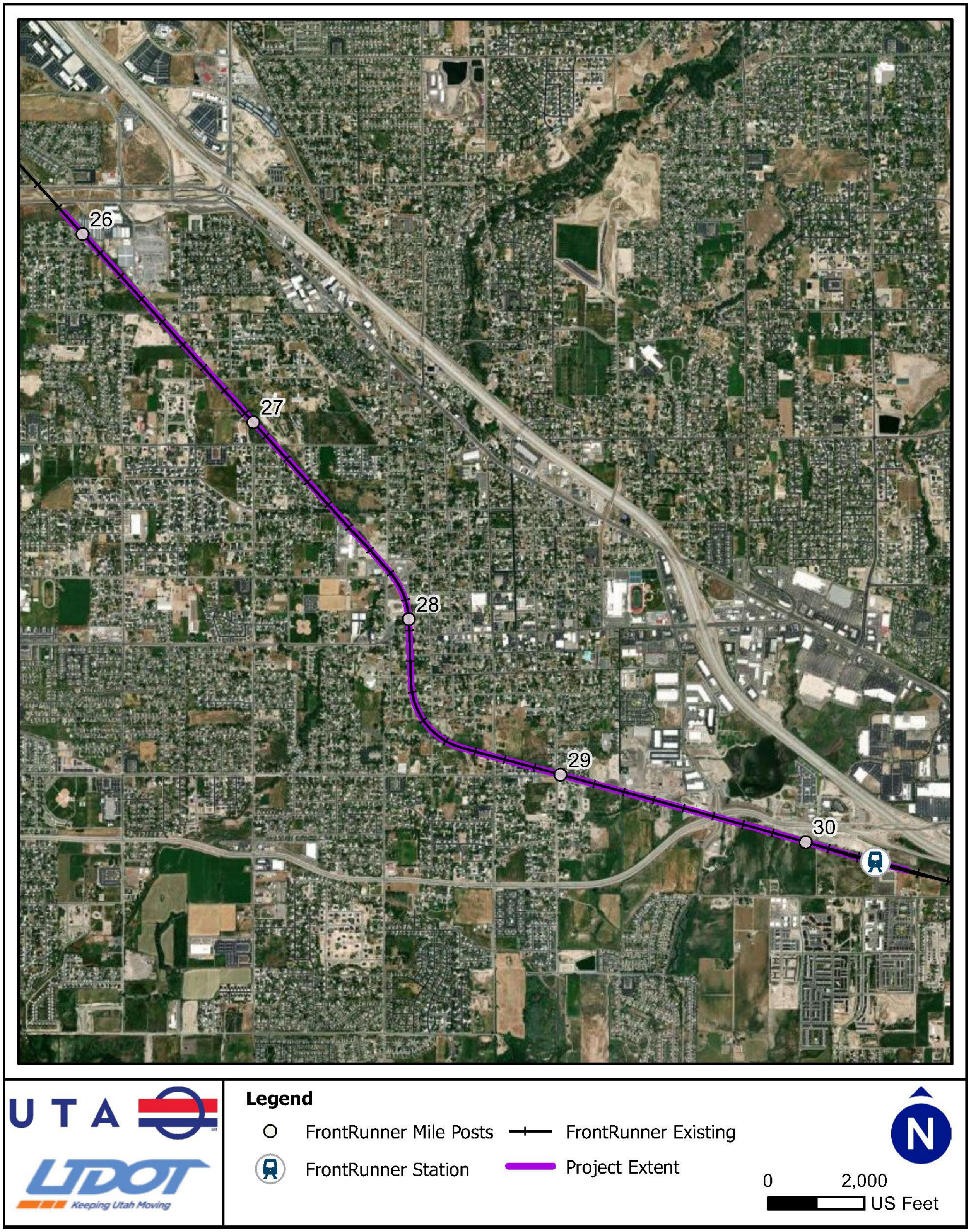

Figure 2. North of American Fork Double Track Project Area

Noise

The Federal Transit Administration (FTA) noise and vibration guidance manual[3] was used in the assessment of impacts and the design of the noise mitigation. There were four moderate noise impacts identified in the North of American Fork Double Track Project area due to the combined effects of the double track project and the service increase. The locations of the impacts are shown in Figures 3 and 4.

The moderate noise impacts meet the threshold established in the UTA noise assessment and mitigation policy[4] because the existing noise levels are above 65 dBA Ldn. Where feasible or cost effective, noise barriers can be considered for noise mitigation. If noise barriers are not effective, feasible or cost effective, sound insulation would be considered.

At the location in Figure 3 (east of Center St. in Lehi), the noise barrier would not meet the cost effectiveness criterion of $30,000 per benefitted receiver[5]. The two impacted receivers are located 500 ft apart, and the barrier would need to be approximately 10 feet high, and approximately 800 feet long. At a cost of $20/square foot, based on the UDOT noise barrier unit costs[6], the barrier would cost a minimum of $160,000, which would result in a cost per benefitted receiver of $80,000.

At the location in Figure 4 (near Storrs Ave. in American Fork), because the two impacted receivers are located directly adjacent to a grade crossing, barriers would not be feasible to construct. Noise barriers need to extend past the receivers to meet the effectiveness criterion of a 5 dB reduction in noise levels, per the UTA noise assessment and mitigation policy. The barriers would need to extend into the roadway to be effective, which would not be feasible.

At all four residences, the mitigation recommendation is to conduct sound insulation testing to determine the effectiveness of the existing structures at reducing noise from outdoors to indoors. The FTA guidance manual has an interior noise criterion of 45 dBA Ldn, and sound insulation testing can determine whether a building already meets that criterion. If the building does not meet the interior criterion, improvements (typically acoustically rated windows) would be considered for mitigation.

Sound insulation testing is recommended for the following residences:

- 655 Sunset Fields Cir, Lehi, UT 84043
- 205 E 700 S, Lehi, UT 84043
- 284 S Storrs Ave, American Fork, UT 84003
- 287 S Storrs Ave, American Fork, UT 84003

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

[4] Utah Transit Authority Office of Capital Services SOP, No. OCS.01.01, Noise assessment and Mitigation, May 1, 2020.

[5] A receiver is defined as one household.

[6] Utah Department of Transportation Noise Abatement Report, 08A2-01, May 28, 2020.

Figure 3. North of American Fork Double Track Project, Noise Impact Locations – Lehi

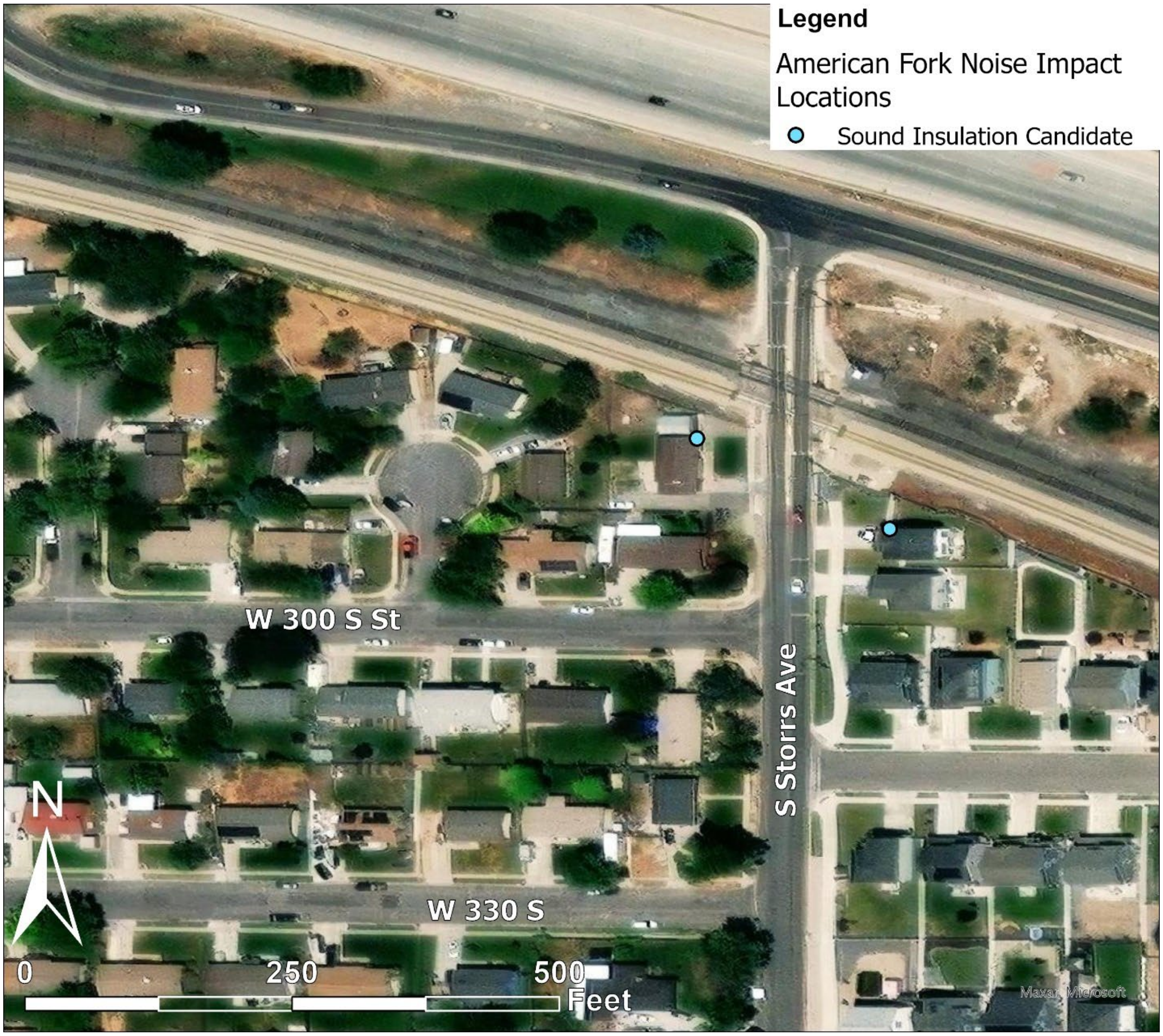

Figure 4. North of American Fork Double Track Project, Noise Impact Locations – American Fork

Vibration

The Federal Transit Administration (FTA) noise and vibration guidance manual was used in the assessment of impacts and the design of the vibration mitigation. At most locations, the change in vibration levels due to the additional track would not be above the impact threshold for an increase of 3 VdB, due to the small change in distance to sensitive receivers.

However, there are two locations in the American Fork Double Track Project area where ballast mats were installed as a part of the Front Runner South project (2008-2012) to mitigate vibration impacts identified during that project, as shown in Figures 5 and 6. The locations are near 1835 N in Lehi, and between 500 W and Storrs Ave in American Fork. At these locations, because the existing vibration is lower due to the ballast mats, the increase in the vibration levels with the new track without a ballast mat would be greater than 3 VdB, and there would be vibration impacts due to the new track. The vibration mitigation at these two locations would be to provide identical ballast mats as those previously installed, which would lower the increase in vibration level due to the new track to less than 3 VdB.

Vibration measurements of existing FrontRunner trains were conducted on July 29 and 30, 2025 in the cul-de-sac at N 1935 W Street that backs up to the FrontRunner track (with the existing ballast mat) and in the new cul-de-sac directly to north at 1960 N Street that also backs up to the FrontRunner track (where there is no ballast mat), as shown in Figure 7. The vibration measurements followed the procedures outlined in Section 6.5 of the FTA guidance manual.

At both locations, accelerometers were mounted on paving bricks set on the ground at 30 feet from the FrontRunner tracks and a series of passbys of FrontRunner trains were measured, in both the northbound and southbound directions, since there was a measured difference in speed based on the direction of travel. The measurements included:

- 5 trains in the northbound direction on the ballast mat
- 5 trains in the southbound direction on the ballast mat
- 4 trains in the northbound direction off the ballast mat
- 4 trains in the southbound direction off the ballast mat

The data was analyzed after the measurements to determine the maximum overall vibration levels and the vibration levels at each frequency band between 6.3 Hz and 250 Hz at each location (the frequency data is summed to get the overall vibration level). The results of the measurements are shown in Figures 8 and 9 and Table 1.

The data shown in Table 1 and Figures 8 and 9 represent the average of the FrontRunner passbys, including the overall level and each frequency, for both directions both on and off the ballast mat. The ballast mat performance was calculated by subtracting the ballast mat vibration levels from the no ballast mat levels for both speeds separately, and then the two results were averaged to get an overall performance for the ballast mat. Positive numbers indicate a reduction in vibration levels and negative numbers represent an increase in vibration levels.

Table 1. Vibration Measurement Results by Frequency

Location	Direction (NB/SB)	Speed (mph)	Overall Vibration Level (VdB)	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz
Ballast Mat	NB	75	87.2	50.8	55.8	62.0	73.9	72.4	70.2	69.2	72.1	75.4	85.8	70.7	63.8	68.7	56.0	33.0	28.2	24.3
No Ballast Mat	NB	75	92.0	67.5	68.1	72.6	73.2	74.5	71.4	72.2	70.2	77.9	89.2	75.3	76.0	86.8	66.3	56.7	51.1	44.7
Ballast Mat	SB	65	86.1	56.4	62.0	69.1	64.8	64.9	69.2	68.6	73.3	83.2	80.8	67.3	63.0	65.7	53.8	36.3	27.1	23.5
No Ballast Mat	SB	65	87.7	57.0	63.8	69.2	68.6	68.1	69.5	68.9	74.2	85.9	79.8	67.8	70.4	72.6	62.6	49.2	37.4	30.1
Ballast Mat Performance	--	--	2-5 VdB	0.0*	0.0*	0.0*	1.6	2.6	0.7	1.6	-0.5	2.6	1.2	2.5	9.8	12.5	9.5	15.0**	15.0**	13.5

* The data at 6.3 Hz, 8 Hz and 10 Hz was excluded from the ballast mat performance calculation and set at 0. At very low frequencies, the data at close distances can have unusual results which are not valid. In this case, the on ballast mat measurements at 75 mph are showing a significant reduction in the vibration levels at these frequencies, which is not possible with a ballast mat. The data was excluded at these frequencies, and the performance was set to zero. Because the vibration levels are much lower at these frequencies, there is no effect on the overall vibration level.

** For the purposes of ballast mat performance for other locations, a maximum reduction of 15 VdB was applied at each frequency. Reductions greater than 15 VdB at any frequency are not typical for ballast mats.

The measurements were used to determine the performance of the existing ballast mat at this location and to determine if the ballast mat has a resonance frequency that might increase vibration levels[7]. The ballast mat performance, shown in Figure 10 shows that there is only a small reduction in vibration levels at frequencies below 50 Hz, and more significant reductions at 80 Hz and above, which is consistent with typical ballast mat performance. Additionally, there is a potential small resonance at 31.5 Hz, but the increase is less than 1 VdB.

Based on the results of the measurements, the existing ballast mats are reducing the vibration levels at this location by approximately 2-5 VdB, depending on individual trains. With the installation of a ballast mat with similar characteristics as those installed for the FrontRunner South project, the vibration levels would be comparable to the existing vibration levels, and below the impact threshold increase of 3 VdB. To mitigate the vibration impacts identified for the Project, ballast mats would need to be installed parallel to the locations with existing ballast mats in Lehi from Station 1240+50 to 1250+50 (1000 feet long) and in American Fork from Station 975+50 to 993+00 (1,800 feet long) under the new track on top of an HMA concrete slab. Stationing is referenced to the FrontRunner South plans and is very similar to the current double track project. If the existing FrontRunner track with ballast mat will be shifted, the ballast mat would need to be replaced and installed under the track in the new location.

[7] A resonance occurs when the input vibration from the train matches the ballast mat's natural resonant frequency. This resonance provides an excitation which increases the vibration levels at that frequency and can increase the overall vibration levels, depending on the frequency content of the vibration. All vibration mitigation materials have a resonance frequency. Generally, below that frequency, the mitigation does not provide any reduction in vibration levels.

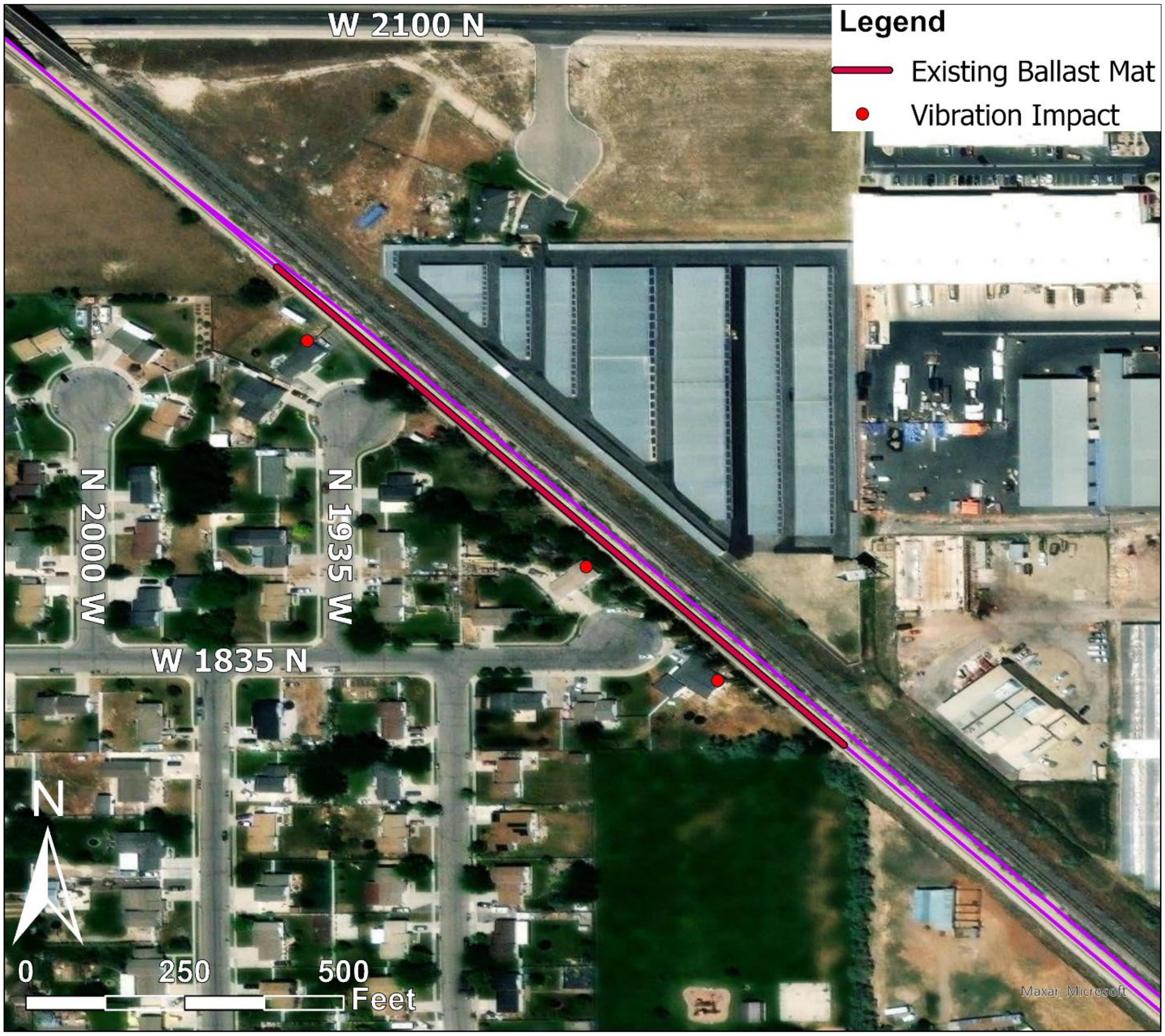

Figure 5. North of American Fork Double Track Project, Vibration Impact Locations – Lehi

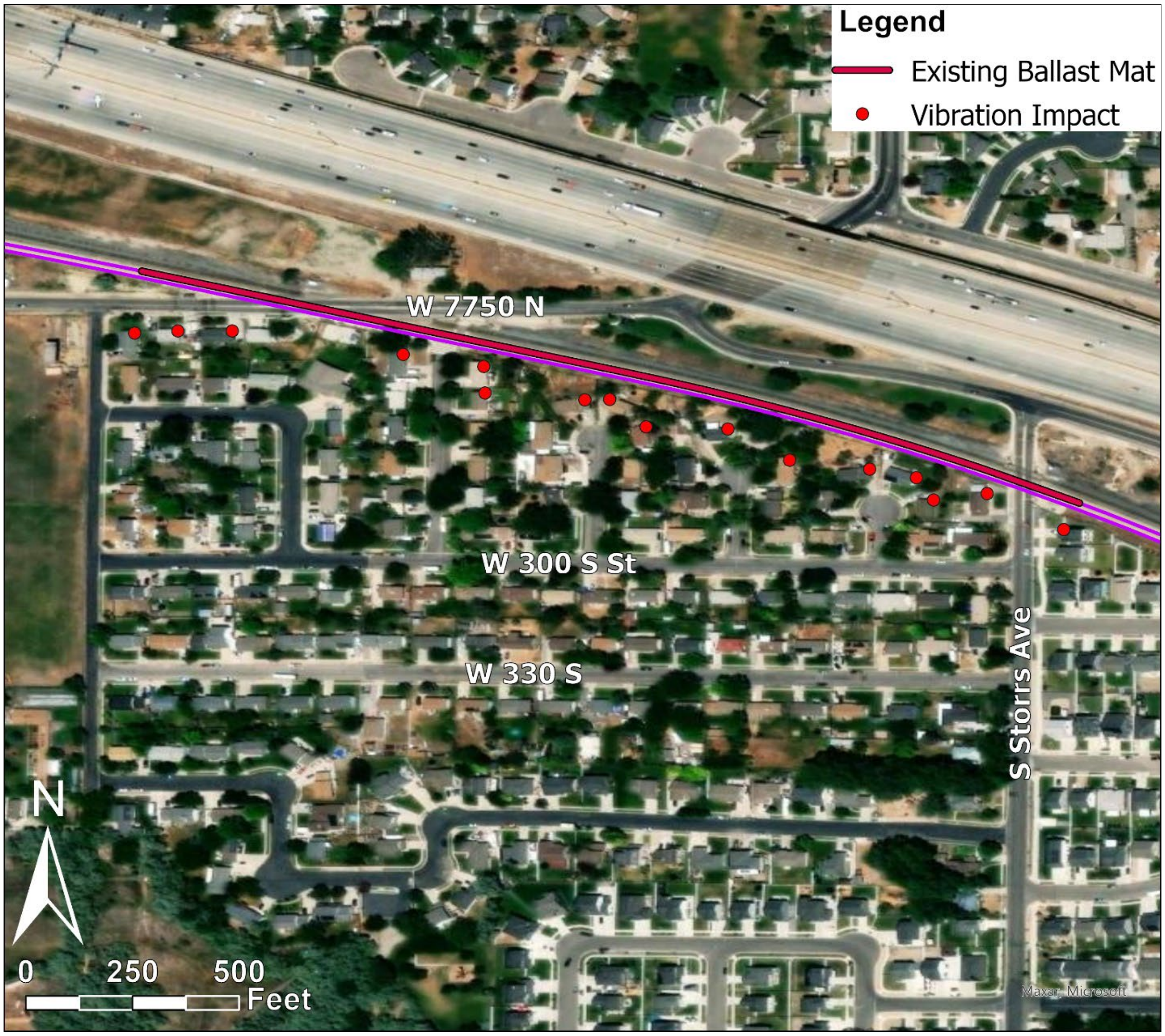

Figure 6. North of American Fork Double Track Project, Vibration Impact Locations – American Fork

Figure 7. North of American Fork Double Track Project, Vibration Measurement Locations – Lehi

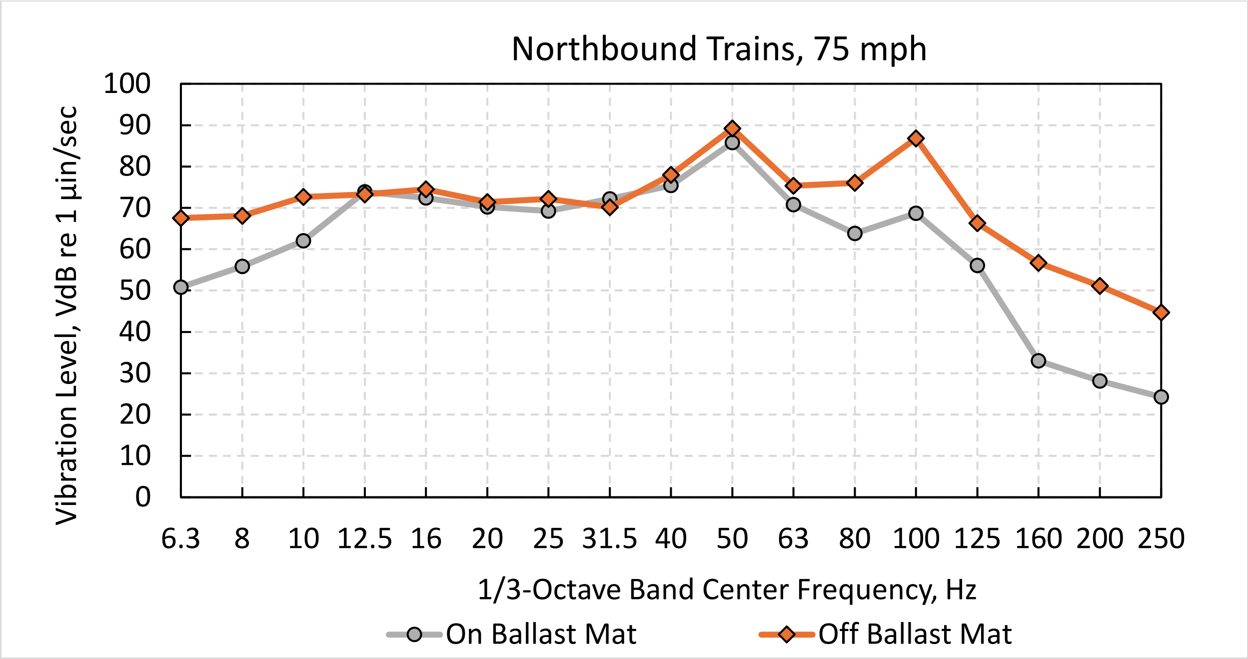

Figure 8. Vibration Measurement Results, Northbound Trains

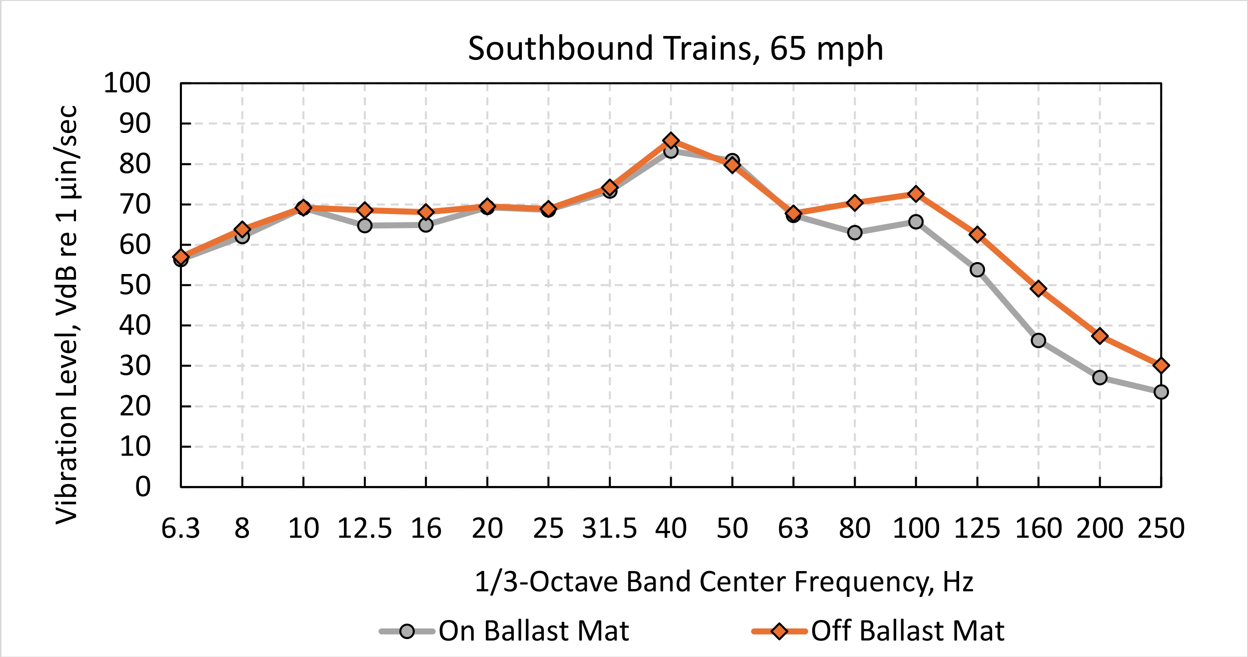

Figure 9. Vibration Measurement Results, Southbound Trains

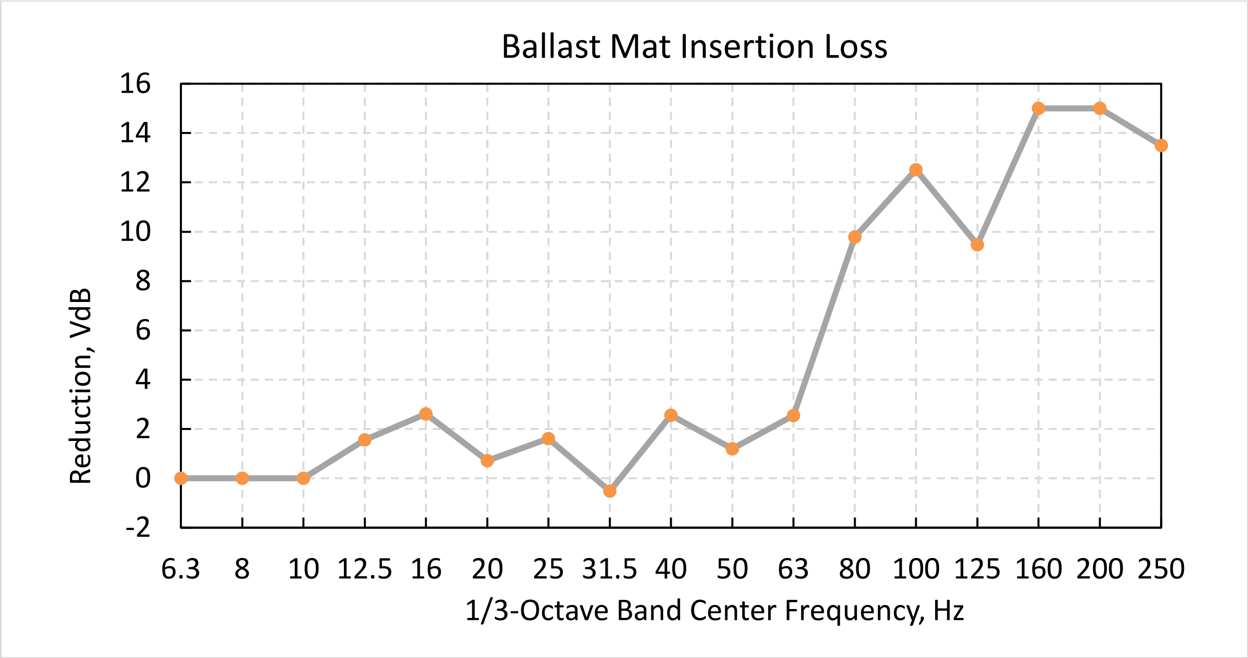

Figure 10. Existing Ballast Mat Performance