APPENDIX 13B

Expected Transit Noise Impacts

Appendix 13B: Expected Transit Noise Impacts

Residential Location	Side of Track	Distance to Centerline (ft)	Privacy Wall?	Existing Noise Level (dBA)	Transit Noise Level [with Privacy Wall] (dBA)	FTA Impact Criteria (dBA)		Number of Impacts	
						Moderate	Severe	Moderate	Severe
Residences Salt Lake International Airport to 4700 South									
Condominiums south of Parkway Boulevard	West	200	Yes	60	53	58–63	>63	0	0
Residences north and south of Hunter Drive	East	75–100	Yes	60	59 [54]	58–63	>63	0	0
Residences 3500 South to 4100 South	East/West	75–100	No	65	59	61–66	>66	0	0
Residences 4100 South to 4700 South	East/West	75–100	Yes	60	59 [54]	58–63	>63	0	0
Residences 4700 South to 5400 South									
Townsend Way to Planada Way	East	75–100	No	65	59	61–66	>66	0	0
Planada Way to Mountain View Drive (5100 South)	East	75–100	Yes	60	59 [54]	61–66	>66	0	0
Mountain View Drive (5100 South) to 5400 South	East	75–100	No	65	59	61–66	>66	0	0

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Residential Location	Side of Track	Distance to Centerline (ft)	Privacy Wall?	Existing Noise Level (dBA)	Transit Noise Level [with Privacy Wall] (dBA)	FTA Impact Criteria (dBA)		Number of Impacts	
						Moderate	Severe	Moderate	Severe
Residences 5400 South to 6200 South									
5400 South to Vista Ridge Way	East	75–100	Yes	60	59 [54]	61–66	>66	0	0
Vista Ridge Way to Lodestone Avenue	East	75–100	No	65	59	61–66	>66	0	0
Vista Ridge Way to Sunkist Drive	West	75–100	No	65	59	61–66	>66	0	0
South of Thomas Jefferson Middle School to Lodestone Avenue	West	75–100	No	65	59	61–66	>66	0	0
Lodestone Avenue to 6200 South	West	75–100	No	65	59	61–66	>66	0	0
Residences 6200 South to Old Bingham Highway									
6200 South to 7000 South	East	75–100	Yes	60	59 [54]	61–66	>66	0	0
7000 South to 7800 South	West	75–100	Yes	60	59 [54]	61–66	>66	0	0
7800 South to New Bingham Highway	East/West	75–100	Yes	60	59 [54]	61–66	>66	0	0
New Bingham Highway to Old Bingham Highway	East/West	75–100	Yes	60	59 [54]	61–66	>66	0	0

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APPENDIX 13C

Vibration

Appendix 13C: Vibration

13C.1 Introduction

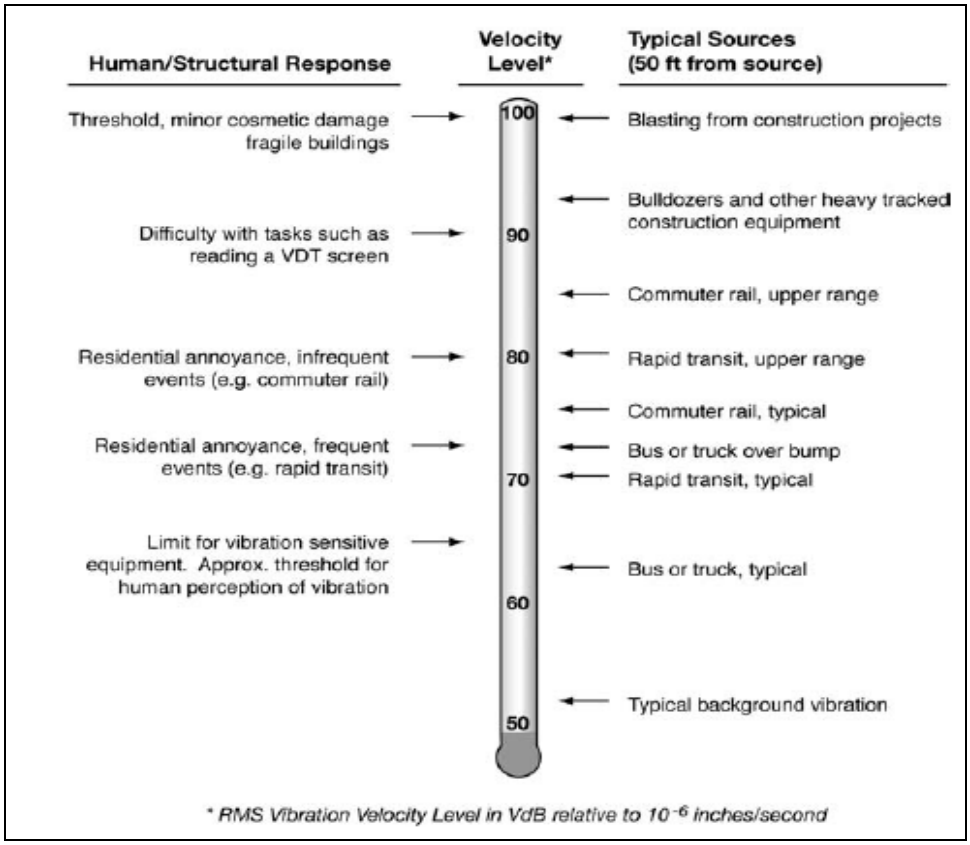
This appendix describes the expected ground-borne vibration impacts from the 5600 West Transit Alternative between Herriman and the Salt Lake City International Airport. The vibration analysis was prepared using methods and procedures specified in the Federal Transit Administration's (FTA) *Transit Noise and Vibration Impact Assessment* guidance document (FTA 2006).

Ground-borne vibration is the motion of the ground relative to a non-moving position. The most common measure used to quantify vibration amplitude is the peak particle velocity (PPV), which is defined as the maximum instantaneous peak of the vibratory motion. PPV is typically used in monitoring blasting and other types of construction-generated vibration since it is related to the stresses experienced by building components. Although PPV is appropriate for evaluating building damage, it is less suitable for evaluating human responses to vibration, which are better related to the average vibration amplitude. The ground-borne vibration from transit trains is usually characterized in terms of the "smoothed" root mean square (rms) vibration velocity level, in decibels (VdB), with a reference quantity of one micro-inch per second.

In contrast to airborne noise, ground-borne vibration is not a phenomenon that most people experience everyday. The background vibration level in residential areas is usually 50 VdB or lower, well below the threshold of perception for humans, which is around 65 VdB. Most perceptible indoor vibration is caused by sources within a building such as the operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled

trains, and traffic on rough roads. Figure 13C-1 illustrates common vibration sources and the human and structural response to ground-borne vibration.

Figure 13C-1. Typical Levels of Ground-borne Vibration



Source: FTA 2006

13C.2 Regulatory Setting

FTA has established three land-use categories for assessing vibration impacts.

- **Land Use Category 1 – High Vibration Sensitivity.** This category includes buildings where low ambient vibration is essential for the operations inside the building. Typical Category 1 land uses are vibration-sensitive research and manufacturing facilities, hospitals, and university research facilities.
- **Land Use Category 2 – Residential.** This category includes all residential land uses and any buildings where people sleep, such as hotels.
- **Land Use Category 3 – Institutional.** This category includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment but have activities that could be disturbed by vibration.

Table 13C.2-1 lists FTA's ground-borne vibration impact criteria for land use Categories 1, 2, and 3 as well as the criteria for special uses such as recording studios.

Table 13C.2-1. Ground-borne Vibration Impact Criteria

Land-Use Category	Ground-borne Vibration Impact Levels (VdB)		
	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Category 1	65	65	65
Category 2	72	75	80
Category 3	75	78	83
Recording studios	65	65	65

[a] More than 70 vibration events from the same source per day. Includes most rapid-transit projects.

[b] Between 30 and 70 vibration events from the same source per day.

[c] Fewer than 30 vibration events from the same source per day.

Source: FTA 2006

13C.3 Affected Environment

Land uses along the proposed 5600 West Transit Alternative consist of a mix of undeveloped open space, commercial and industrial facilities, and residential developments on both sides of the alignment. Most of the alignment would be within the existing 5600 West roadway, which is the dominant source of vibration in the corridor.

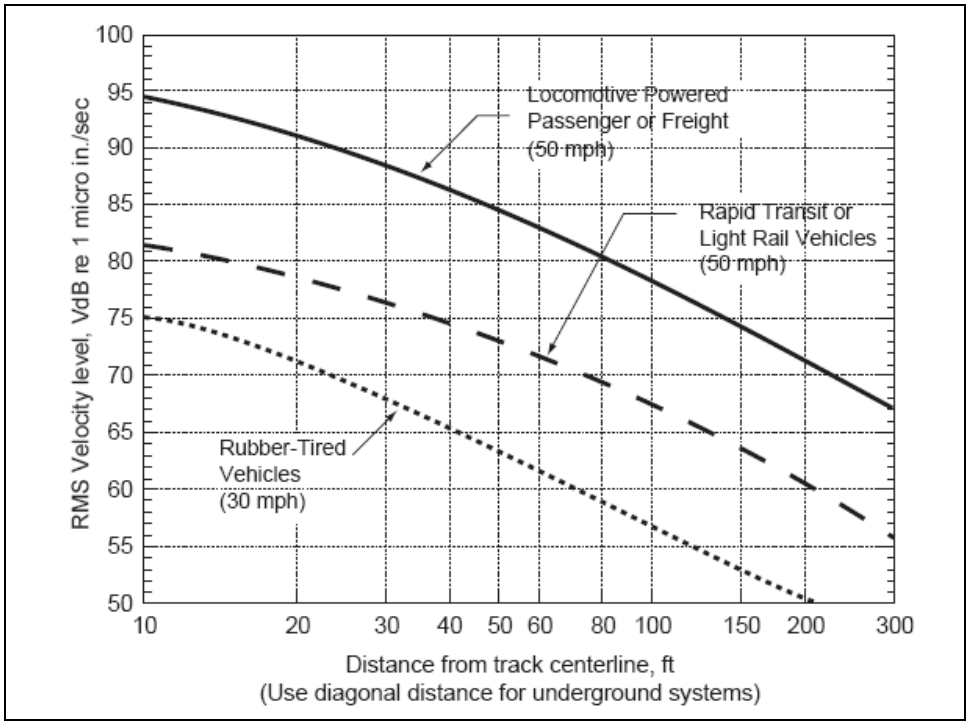
13C.4 Environmental Consequences

This section describes the vibration impacts associated with the 5600 West Transit Alternative. Vibration impacts were evaluated using guidelines and procedures from FTA. The impacts of construction activities would be temporary and are discussed in Chapter 21, Construction Impacts.

13C.4.1 Methodology

The FTA general vibration assessment methodology was used to evaluate vibration impacts from the 5600 West Transit Alternative. The general vibration assessment uses generalized data to develop a curve of vibration levels as a function of distance from the track. Figure 13C-2 below shows the unadjusted surface vibration curves used in the FTA general vibration assessment.

Figure 13C-2. Generalized Ground Surface Vibration Curves



Source: FTA 2006

The vibration levels at specific distances from the alignment are estimated from the curve after applying adjustments to account for other factors such as vehicle speed, track support system, and track and wheel condition.

The purpose of the general vibration assessment is to provide a straightforward method of developing estimates of the overall levels of ground-borne vibration that can then be compared to the FTA impact criteria shown in Table 13C.2-1 above, Ground-borne Vibration Impact Criteria. Where vibration impacts could occur, a detailed vibration analysis should be undertaken during the final design of the alternative to accurately define the level of impact and to design mitigation measures.

The Rapid Transit or Light Rail Vehicles (50 mph) curve in Figure 13C-2 above was used as the baseline curve for assessing vibration impacts. Adjustment factors described in the FTA guidance were used to develop project-specific vibration projections at specific locations from the light-rail transit alignment.

Adjustment factors that most affect the levels of ground-borne vibration include the physical parameters of the facility and the geology of the area. The physical parameters are described below.

Operational and Vehicle Factors. These factors include all of the activities that relate to the vehicle and operational characteristics of the transit systems including speed, vehicle suspension, and flat or worn wheels that increase the potential for ground-borne vibration.

The generalized ground surface vibration curve (see Figure 13C-2 above, Generalized Ground Surface Vibration Curves) was adjusted from the reference speed of 50 miles per hour (mph) to an average operational speed of 30 mph. The transit vehicles that will be used on the system are assumed to be new and not have wheel flats that could increase vibration levels. No adjustments were made for flat or worn wheels. It is also assumed that the transit vehicles will have relatively soft primary suspensions as do most newer North American light-rail systems.

Guideway. The type and condition of the rails, the type of guideway, the rail support system, and the mass and stiffness of the guideway structure also have an effect on the level of ground-borne vibration. Jointed or worn rails and wheel impacts at special track work (for example, at crossovers) can all increase ground-borne vibration. For this analysis, it is assumed that the track will be new, continuously welded rail and will be in good condition without wearing or corrugations that can increase vibration.

Geology. Soil and subsurface conditions can have a strong influence on ground-borne vibrations. Ground-borne vibrations are more efficient in stiff clay soils, and shallow rock layers concentrate vibration energy close to the surface, resulting in ground-borne vibration problems at larger distances from the track. The regional geology consists mostly of sandy soils resulting from ancient Lake Bonneville; therefore, no adjustments were made for soil type.

13C.4.2 No-Action Alternative

Under the No-Action Alternative, the Mountain View Corridor project would not be built and the 5600 West Transit Alternative would not be constructed as part of that project. There would be no vibration impacts associated with the alternative under the No-Action Alternative.

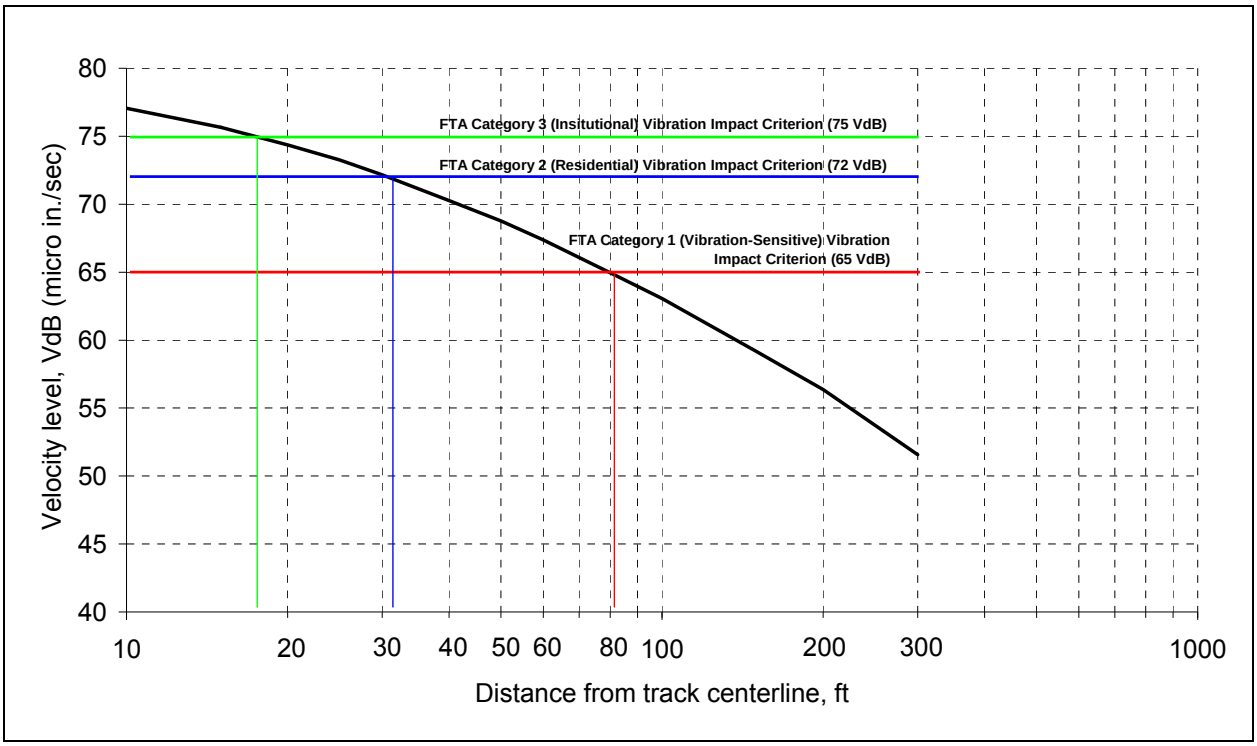
13C.4.3 5600 West Transit Alternative

As described in Chapter 2, Alternatives, two transit options are under consideration along 5600 West in Salt Lake County. For the Mountain View Corridor project, the final build is assumed to be a light-rail system, but the project could start as a bus rapid transit system. From a vibration perspective, the rubber tires and suspension systems of buses isolate vibrations and do not generally cause ground-borne vibrations.

The ground-borne vibration impacts discussed below are those that would be associated with a center-running light-rail transit system on 5600 West.

Figure 13C-3 shows the speed-adjusted ground surface vibration curves for the 5600 West Transit Alternative. Under the 5600 West Transit Alternative, the speed-adjusted impact thresholds for Category 1 (highly sensitive), Category 2 (residential), and Category 3 (institutional) land uses are 80 feet, 31 feet, and 18 feet, respectively.

Figure 13C-3. Speed-Adjusted MVC Light-Rail Transit Vibration Levels (VdB)



Vibration impacts were identified by overlaying threshold distances on aerial photographs of the alignment corridor to determine if Category 1, 2, or 3 land uses were within the respective distance contours from the alignment.

The impact analysis did not identify any Category 1 (highly sensitive) land uses within about 80 feet of the centerline of the proposed transit alignment. The Category 2 threshold distance was near the edge of the 5600 West right-of-way, and the Category 3 vibration threshold was in the 5600 West alignment itself.

There were no vibration impacts associated with the proposed transit alternative.

13C.4.4 Mitigation Measures

No mitigation measures are proposed.

13C.4.5 Cumulative Impacts

The 5600 West Transit Alternative would not contribute to regional vibration issues.

13C.4.6 Summary of Impacts

There would be no vibration impacts associated with the 5600 West Transit Alternative.

13C.5 References

[FTA] Federal Transit Administration
2006 Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06.