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BART – Oakland International Airport Connector

Supplemental Noise and Vibration Technical Report – Rev. 0

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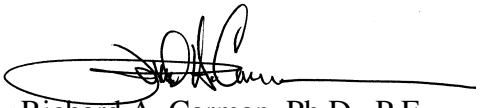

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Executive Summary

This report by Wilson, Ihrig and Associates, Inc. (WIA) presents results of a noise and vibration analysis for transit train operations for the BART Oakland International Airport Connector Automated Guideway Transit (AGT). This study evaluates proposed alignment changes, facility re-location, and construction noise and vibration related issues for the revised alignment subsequent to preparation and certification of the project FEIR/FEIS in 2002.

The evaluation performed by WIA was focused on the areas where project changes might result in an increase in wayside noise and groundborne vibration levels and therefore possibly cause significant noise and/or vibration impacts. Moreover a direct comparison has been made to the proposed median option presented in the FEIR/FEIS document.

The vehicle technologies included in the WIA study were steel-wheel and rubber-tired vehicles. Construction activities such as drilling, pile driving, excavation, loaded truck movement among other equipment were analyzed and compared with the corresponding applicable noise and vibration policies relevant to the project. Information for the preparation of this report was obtained from different sources such as the revised alignment drawing (Ref. 1), the Draft EIR/EIS (Ref. 2) environmental report, and the Final EIR/EIS (Ref. 3).

Results for the wayside noise and groundborne vibration analysis from AGT operations showed no additional significant impacts beyond those identified in the FEIR/FEIS with the proposed revised alignment.

Without noise mitigation, noise from the proposed re-located maintenance facility is expected to cause significant impact at the former Edgewater West Hotel (now called the Ibiza Hotel) due primarily to the vehicle wash. On the other hand, noise impacts from the proposed power distribution stations are expected to result in less than significant impacts at all receptors except for the Edgewater West Hotel. Without noise mitigation, impact at the Hotel's closest building façade is projected to be significant. Noise mitigation measures presented in FEIR/FEIS will reduce impact from the maintenance facility to a level that is less than significant.

Construction noise and vibration is expected to exceed the BART criteria during short-term construction activities and cause significant unavoidable impacts. The impacts were identified in the 2002 FEIR/FEIS document. Specifically, during pile driving, noise and vibration sensitive receptors next to the alignment would be exposed to levels that result in potentially significant impacts. Mitigation measures from the FEIR/FEIS for short-term activities are re-presented in this report. Long-term construction activities associated with the revised alignment are expected to cause no additional significant noise impacts compared with those presented in the 2002 FEIR/FEIS document. Finally, vibration impacts from sustained construction operations are expected to result in levels that are less than significant for the revised alignment. Therefore, no additional significant impacts are expected for the revised alignment.

Revised Alignment Noise and Vibration Assessment

Noise and Vibration Impact Assessment from Alignment Changes

The following discussion addresses the results of the noise and vibration study for the revised alignment compared to the original median option contained in the FEIR/FEIS. Moreover, the areas where the proposed revised alignment has changed and could result in the potential for noise and vibration impacts to nearby sensitive receptors are:

1. Oakland International Airport (sta. 10+00 to 41+00)
2. Hegenberger Road between Edgewater Drive and Collins Drive (sta. 112+00 to 150+00)
3. Hegenberger Road at Baldwin Street (sta. 158+00 to 164+00)
4. BART Coliseum Station

Existing Ambient Noise

Ambient noise in the vicinity of the project corridor is dominated by heavy vehicle traffic on Interstate 880 as well as traffic on local roads such as Hegenberger Road, Airport Drive, and Doolittle Drive. The percentage of heavy trucks observed (Ref 3) is about 5% of the total vehicle traffic. Aircraft at the Oakland International Airport (OIA) are another important source of ambient noise in the vicinity of the alignment. In the proximity of the Coliseum BART Station, ambient noise is dominated by train noise from both BART and UPRR trains as well as noise from traffic on Hegenberger Road.

The existing traffic volume along I-880 is approximately 230,000 daily vehicles based on Annual Average Daily Traffic (AADT) reported by CALTRANS (Ref 5). Compared with traffic volumes presented in the 2002 FEIR/FEIS document, the increase is approximately 20%, which results in noise levels above 70 Ldn for unobstructed receptors up to distances of 1,000 feet (Ref. 4) away from I-880. Along Hegenberger Road, the 70 Ldn contour falls about 80 feet from road centerline for locations near Doolittle Drive, and about 160 feet for locations near I-880. We have estimated, using a simple FHWA TNM model (Ref 6) and the CALTRANS 2004 traffic volumes, that along Doolittle Drive the ambient noise levels are higher than 65 Ldn for unobstructed receptors closer than 200 feet. The existing hourly equivalent noise levels (Leq) along Hegenberger Road are 72 to 74 dBA (Ref. 4)

Ambient noise data used to prepare the 2002 FEIR/FEIS document were obtained at four locations. Short-term measurements were obtained along Hegenberger Road, Airport Access Road, Edes Avenue, and at the Coliseum BART Station. Along Hegenberger Road, ambient noise levels obtained at a distance of 85 feet from the road centerline indicated a 68 Ldn and peak hour Leq of 68 dBA. At the Airport Access Road location, the measured Ldn was 69 with an Leq of 67 dBA.

Aircraft noise from the North Field contributes to noise levels of 60 to 65 CNEL in the vicinity of Doolittle Drive and Airport Access Road, as well as some areas over 65 CNEL at the Lew F. Galbraith Municipal Golf Course (Ref. 7). The Community Noise Equivalent Level (CNEL) is a metric to described the L_{eq} of the A-weighted noise level over a 24-hour period with a 5 dB penalty applied to noise levels between 7 p.m. and 10 p.m. and a 10 dB penalty applied to noise levels

between 10 p.m. and 7 a.m. Typically, the CNEL is one or two dB higher than the Ldn at a given location.

Current ambient noise levels in the vicinity of North Field are lower than those originally reported in the 2002 document, apparently due to the noise abatement program recently implemented by the OIA.

On the other hand, existing ambient noise levels along the remainder of the alignment have increased slightly from those reported in the 2002 FEIR/FEIS document. The increase between year 2000 and 2005 has occurred mostly along Hegenberger Road. The increase in the Ldn is about 2dBA. Moreover, this increase was anticipated during preparation of the original environmental document. It was anticipated that due to traffic noise an increase of 2 dBA will occur between the exiting condition in 2000 and 2005, and an increase of 3 dBA between the year 2000 and 2020. The assumptions made for the 2002 FEIR/FEIS document, have been confirmed by the noise data obtained from the recently revised City of Oakland Noise Element (Ref. 4).

For the purpose of the analysis presented herein, the updated ambient noise levels have been used to predict changes in cumulative noise levels. Some changes were found based on the updated ambient noise information. Specifically, the FTA criteria allows a maximum increase in noise levels generated by the project of 2.8 dBA for *Severe Impact* when the existing noise is over 70 Ldn instead of 3.1 dBA when the Ldn is only 68. Secondly, the project in 2002 accounted for a future increase of 3 dBA in the year 2020, 2 dBA of which has apparently already occurred.

Our cumulative analysis presented herein is based on the existing ambient condition today, for which there is a 1 dBA increase projected in the future year 2020. Finally, the cumulative noise analysis for AGT operation was identified as an unavoidable significant impact in the 2002 FEIR/FEIS document. Based on a cumulative analysis starting with the existing ambient noise condition today (2006) as the baseline, no additional significant impact would occur within the study area.

Applicable Noise and Vibration Policies

BART Design Criteria

The BART noise and vibration design criteria (Ref 8) are based on the maximum rms (root mean square) noise and vibration levels generated by a single train passby at the location of the noise sensitive receptor. Table 1 and Table 2 indicate the design criteria that apply to wayside noise and vibration respectively. The appropriate noise and vibration criterion depends on the type of receptor (e.g., residential) and the community area category. Subsequent to the 2002 FEIR/FEIS, BART adopted the FRA noise criteria as its own design criteria (BART Facilities Standards). The FRA criteria are essentially identical to the FTA noise criteria. However, to be consistent with the analysis in the 2002 FEIR/FEIS, both criteria are addressed in this report.

The area category has a close relationship with its characteristic ambient noise. Table 3 shows community area categories found along typical rail corridors by different land-use and the normal expected range of ambient noise levels for such areas. The existing ambient noise in the communities next to the Connector corresponds to a land use that can be classified by the BART criteria as either Area Category IV or Area Category V. Both of these Area Categories can have land use that is residential in nature (i.e., where people normally sleep at night) including hotels.

Table 1 - BART Design Criteria for Maximum Wayside Noise from Transit Operations

Residences and Commercial Buildings				
		Maximum Passby Noise Level (dBA ref. 20 µPa)		
Community Area Category		**Single Family Dwellings**	**Multi-Family Dwellings**	**Commercial Buildings**
I	Low Density Residential	70	75	80
II	Average Residential	75	75	80
III	High Density Residential	75	80	85
IV	Commercial	80	80	85
V	Industrial/Highway	80	85	85

Specific Types of Buildings	
Building or Occupancy Type	**Maximum Passby Noise Level (dBA)**
Amphitheatres	65
"Quiet" Outdoor Recreation Areas	70
Concert Halls, Radio and TV Studios	70
Churches, Theaters, Schools, Hospitals, Museums, Libraries	75

Source: BART Extensions Program Design Criteria, March 1992.

Table 2 - BART Design Criteria for Maximum Wayside Vibration from Transit Operations

Residences and Buildings with Sleeping Areas				
		Maximum Vibration Velocity Level (dB re. 10^{-6} in/sec)		
Community Area Category		**Single-Family Dwellings**	**Multi-Family Dwellings**	**Hotel/Motel Buildings**
I	Low Density Residential	70	70	70
II	Average Residential	70	70	75
III	High Density Residential	70	75	75
IV	Commercial	70	75	75
V	Industrial/Highway	75	75	75
Special Function Buildings				
Type of Building or Room		**Maximum Vibration Velocity Level (dB re. 10^{-6} in/sec)**		
Concert Halls and TV Studios		65		
Auditorium and Music Rooms		70		
Churches and Theatres		70-75		
Hospitals		70-75		
Courtrooms		75		
Schools and Libraries		75		
University Buildings		75-80		
Offices		75-80		
Commercial and Industrial Buildings		75-85		
Vibration Sensitive Uses		60-70		

Source: BART Extensions Program Design Criteria, March 1992.

Table 3 - General Categories of Communities along Rail System Corridors for the BART Criteria

Area Category	Area Description	Typical (Average or L_{50}*) Ambient Noise Level (dBA)	Typical Day/Night Exposure Levels (L_{dn}**)
I	**Low Density** urban residential, open space park, suburban residential or quiet recreation area. No nearby highways or boulevards.	40-50/day 35-45/night	Below 55
II	**Average** urban residential, quiet apartments and hotels, open space, suburban residential, or occupied outdoor areas near busy streets.	45-55/day 40-50/night	50-60
III	**High Density** urban residential, average semi-residential/ commercial areas, parks, museum, and non-commercial public building areas.	50-60/day 45-55/night	55-65
IV	**Commercial** areas with office buildings, retail stores, etc., primarily daytime occupancy. Central Business Districts.	60-70	Over 60
V	**Industrial** areas or Freeway and Highway Corridors.	Over 60	Over 65

* L_{50} is the long-term statistical median noise level.
** L_{dn} is the day-night sound level
Source: BART Extensions Program Design Criteria, March 1992.

The following discussion is presented to correct a technical interpretation of the BART criteria presented in Section 3.11 of the 2002 FEIR/FEIS document, on the AGT wayside noise analysis over five hotel buildings located next to the alignment and south of I-880.

The Courtyard by Marriott, Park Plaza, and Hilton hotel buildings located on Hegenberger Road are exposed to existing ambient noise levels equivalent to an Area Category IV, as described by the BART Criteria (see above Table 3). The general land use in this are is also consistent with an Area Category IV. This categorization has been correctly applied as well as shown in Table 3.11-4 of the FEIR/FEIS document. However, the corresponded applicable criterion for wayside noise due to a train passby is 80 dBA instead of the 85 dBA as presented in Table 3.11-11. On the other hand, for the hotel buildings directly adjacent to I-880, such as the vacant Holiday Inn and the Clarion hotel located on Edes Avenue, the applicable land use Area Category for this area is Category V and not IV as in Table 3.11-4.

The impact for the hotel buildings on Edes Avenue would be less than significant with either the 80 dBA or the 85 dBA criterion. Similarly, for the hotels buildings south of I-880, the projected wayside noise levels projected in the FEIR/FEIS with the updated 80 dBA criterion results in an impact that is less than significant. However, the noise impact at the Edgewater West hotel, which is located at approximately 50 feet from the alignment, would be significant due to AGT operation.

The maximum noise level at the nearest façade of the Edgewater West Hotel is expected to be about 3 dBA in excess to the 80 dBA criterion. Therefore noise mitigation should be implemented. The Edgewater West Hotel was indicated in the FEIR/FEIS as being impacted according to the FTA Criteria. Since the 2002 FEIR/FEIS utilized both FTA and BART criteria, the corrected finding that the impact at the Edgewater Hotel is also significant under BART criteria does not represent a new noise impact.

Noise mitigation measure NV-1(i) presented in the 2002 FEIR/FEIS document would reduce the impact to a level that is less than significant.

FTA Criteria

The FTA provides guidelines to assess project noise and vibration levels from mass transit systems, as well as noise and vibration criteria for determining the level of impact. The FTA Guidelines (Ref. 9) group noise sensitive land-use into three categories (unrelated to the BART Area Categories): Category 1, Category 2 and Category 3. The FTA Guidelines specify a particular noise metric to be used depending on the specific land-use (e.g., residential). Table 4 describes the FTA land-use categories. Most noise sensitive receptors along the Connector alignment are commercial buildings, with the exception of hotel buildings which are Category 2.

Table 4 - FTA Land Use Categories and Metrics for Transit Noise Impact Criteria

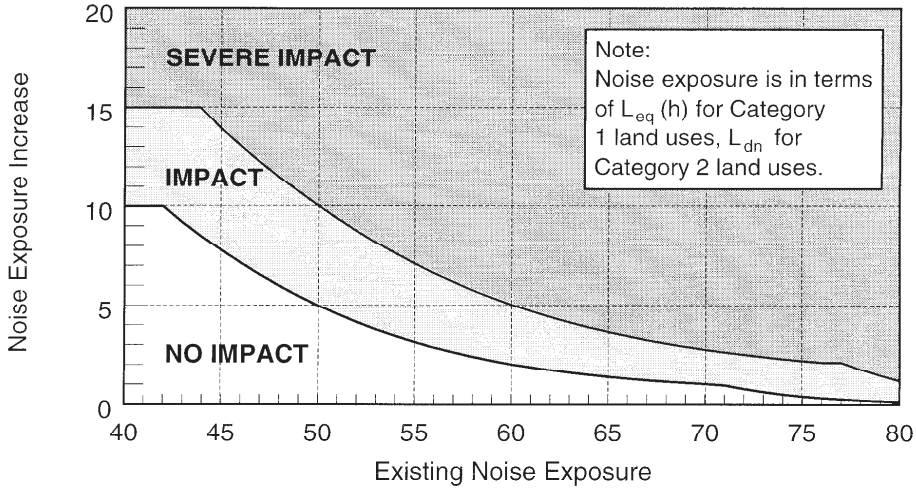
Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(h)*	Tracts of land where quiet is an essential element in the EIS/EIR intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq (h)*	Institutional land uses primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks and recreational facilities are also included.

(*) Leq for the noisiest hour of transit-related activity during hours of noise sensitivity
Source: FTA Transit Noise and Vibration Impact Assessment, April 1995.

The FTA noise impact thresholds, as shown graphically in Figure 1 below, are based on noise exposure increases over existing ambient noise exposure levels that would be associated with the projected future noise level created by the project or combination of new projects (cumulative impact). Two "levels" of noise impact are defined by the FTA guidelines: *Impact* and *Severe Impact*. The range between both the upper (*Severe Impact*) and lower curves (*Impact*) represents an area where it has been observed that the increase in cumulative noise exposure is noticeable, but generally not sufficient to cause an adverse reaction on the surrounding communities. The FTA Guidelines established the threshold of the upper area (Severe Impact curve) as the limit above which a substantial percentage of receptors in the vicinity of the Project may be highly annoyed.

For the BART Connector project, as stated in the 2002 FEIR/FEIS, significant cumulative noise impacts are indicated when noise exposure level increases exceed the threshold for *Severe Impact* as defined by the FTA Guidelines.

Figure 1 – Increase in cumulative noise levels allowed by the FTA Criteria for Cat.1 and Cat.2



Source: FTA Transit Noise and Vibration Impact Assessment, April 1995.

In the same manner as the BART criteria, the FTA criteria for vibration are based on the maximum rms (root mean square) vibration level generated by a single train passby at the location of the vibration sensitive receptor. A significant difference between the FTA and BART criteria is that the FTA criteria differentiate between the number of train passbys per day. The BART vibration criteria inherently assume a level of service such as BART with numerous trains per day. One set of FTA criteria is given for "Frequent Events" defined as more than 70 vibration events (i.e. passbys) per day, another set is given for "Infrequent Events" (less than 70 events per day). Table 5 indicates the FTA criteria for vibration for both frequent and infrequent events. The level of service expected for AGT would be classified as "Frequent Events" or more than 70 trains per day.

Table 5 - FTA Impact Criteria for Groundborne Vibration

Land Use Category	Groundborne Vibration Impact Levels (VdB re. 10^{-6} in/sec)	
	Frequent Events	Infrequent Events
Category 1: Buildings where low ambient vibration is essential for interior operations and lands set aside for serenity and quiet.	65 VdB	65 VdB
Category 2: Residences and buildings where people normally sleep.	72 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use.	75 VdB	83 VdB
Notes: "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Vibration sensitive equipment is not sensitive to groundborne noise.		

Source: FTA Transit Noise and Vibration Impact Assessment, April 1995.

Methodology

In the current study, noise and vibration analyses from AGT operations were focused on those areas where the proposed revised alignment has changed since the publication of the FEIR/FEIS compared with the alignments presented therein. The methodology to assess wayside noise impacts (impacts NV-1 and NV-1A) as well as groundborne vibration (Impact NV-2) was based on the general assessment procedure described in the FTA Guidance Manual.

There is no vehicle technology specified for use on the Connector Project. Vehicles technologies with an electrical powered AGT system could include steel-wheel, rubber-tired, or maglev. Consequently, WIA has considered these alternative technologies and how they might contribute to adverse wayside noise and vibration levels in the nearby community areas. Specifically, to assess wayside noise and vibration, two AGT technologies were evaluated: steel-wheel-on-rail and monorail vehicles. Noise emission levels for vehicles with Maglev technology are quieter than steel-wheel and rubber-tired vehicles due to primarily the absence of contact and associated friction on moving parts. Higher noise emission levels are normally expected from AGT vehicles with steel-wheel as well as from monorail, when compared with standard rubber tired vehicle. According to data in the FTA Guidelines, steel-wheel vehicles on an aerial concrete guideway, generate a sound exposure level (SEL) equivalent to 80 dBA with a maximum passby level (Lmax) of 78 dBA traveling at 50 mph, when measured at 50 feet from the guideway track centerline. Monorail vehicles on concrete straddle beam generate 2 dBA higher SEL and Lmax, at 50 feet and with a 50 mph train speed. Even though, noise measurements performed by WIA for the Disney World monorail and from published data available for the Seattle Monorail Project Green Line (Ref. 10), have demonstrated significantly lower maximum levels than those provided by FTA, we have used the noise exposure level recommended by the FTA Guidance Manual as a conservative approach.

The vehicle assumptions are for a vehicle length not to exceed 50 feet for an individual vehicle, a maximum 2-Car consist, and a design maximum vehicle speed of 45 mph. Wayside noise level increases to account for train turnout switch frogs were included in our analysis as well. The operational schedule for the cumulative noise analysis accounted for a total of approximately 300 AGT trains per day traveling one direction, with 3.5 minutes headway during peak-hour operations. (Year 2020 proposed operational schedule). The intermediate stop at Edgewater has been eliminated from the project since the FEIR/FEIS.

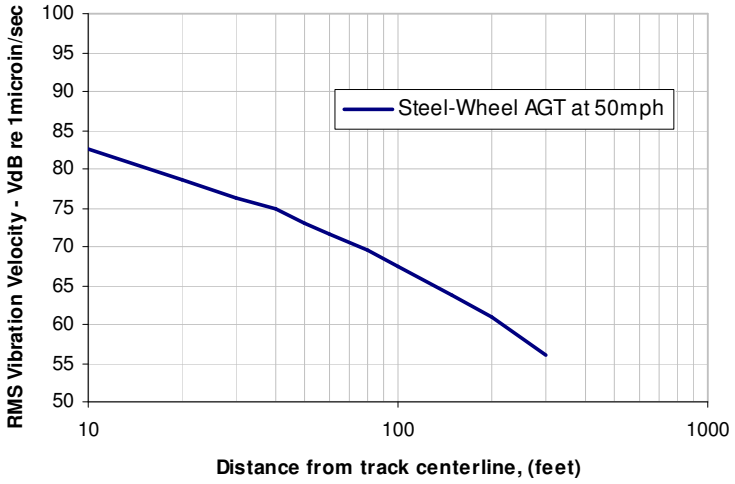
Table 6 – Summary of the AGT operational schedule and headways for Year 2020.

Time	No of Trains Operating	Headway (min)
5am - 6am	1 (single vehicle)	14
6am - 8pm	4 (two vehicle)	3.5
8pm - midnight	3 (single vehicle)	4.7
midnight - 1am	1 (single vehicle)	14

Source: FEIR/FEIS, March 2002 - Table 2.2-3, Section 2.2.

To assess the potential for the groundborne vibration impact (Impact NV-2), a general ground surface vibration curve for light rail vehicles was used and is presented in Figure 2. The curve of vibration level vs. distance was adjusted to account for train speed, operation on an elevated guideway, and possible increases due to local soil, vibration propagation characteristics and building vibration response (BVR) characteristics, which generally amplify groundborne vibration.

Figure 2 – Generalized ground surface vibration curve for Steel-Wheel AGT



Source: FTA Transit Noise and Vibration Impact Assessment, April 1995.

Impact NV-1: Impact from Vehicle Passby (BART Criteria)

A noise impact from AGT vehicle passby would be considered significant if the wayside noise level exceeds the corresponding criterion presented in Table 1.

The revised alignment in the area of the Oakland International Airport starts in between Terminals 1 and 2, and it is projected to run straight over the existing daily parking lot until it encounters Airport Road. No noise sensitive receptors were found at the Oakland Airport, but there is one commercial/office building (LSG Sky Chefs) at civil station 28+50, located at a distance of 160 feet from the proposed revised alignment. The wayside noise level from the AGT is expected to be 12 dBA below the 85 dBA BART criterion at the location of this commercial/office building. Therefore AGT operation would result in a less than significant impact.

Along Hegenberger Road, in the area of Edgewater, the revised alignment is about 70 feet closer to office buildings located east of the alignment between civil station 112+00 and 124+00. Both the Union Bank of California and the Oakland SPCA buildings are at a distance of 100 feet from the alignment centerline. The maximum wayside noise level from AGT passbys is expected to be about 77 dBA, or 8 dBA below the criterion. Therefore, a less than significant impact is projected for these commercial buildings.

North of I-880, the alignment swings to the east at station 139+50 until it joins with the old median option at civil station 149+00. Buildings here are primarily restaurants and gas stations; however, there is one hotel at station 142+00 (Days Inn) located on Edes Avenue at approximately 360 feet from the revised alignment. For this receptor, wayside noise levels are projected to be 14 dBA below the BART Criteria. The project is expected to cause a less than significant noise impact to these receptors. Three additional hotel buildings are located along Edes Ave, although one of them is currently vacant (Holiday Inn). The revised alignment in the vicinity of these hotels is proposed to be about 40 feet further than the original median option alignment. A less than significant noise impact was projected in 2002, and therefore a less than significant impact is projected with the revised alignment.

Between station 158+00 and 163+00, the alignment continues in the Hegenberger Road median for another 300 feet before crossing to the western side of the road. The proposed alignment shift would benefit the office building located on the west side of AGT alignment at 675 Hegenberger Road by reducing passby noise levels approximately 4 dBA. Noise sensitive receptors east of the AGT alignment are commercial and are located at a distance of 200 feet from the near track centerline. Maximum wayside noise levels for this receptor are projected to be 71 dBA or lower. Therefore, a less than significant impact is projected for receptors on the eastern side of the alignment. One single family residence has been identified at 690 Hegenberger Road. At the single family residence, which is located in an Area Category IV per the BART criteria, the maximum passby noise from AGT operation is projected to be 69 dBA. This will be less than the BART impact criterion of 80 dBA.

The last group of noise sensitive receptors is located near the Coliseum BART station. With the revised alignment, single family residences located on 70th and 71st near Hawley Street would be more than 900 feet from the proposed AGT station. Moreover, the proposed maintenance facility has been eliminated at the Coliseum Station. Maximum wayside noise levels from AGT operation is expected to be less than 58 dBA at these residences, or less than the BART criterion of 75 dBA, and therefore a less than significant impact is projected.

Table 7 – Summary of the projected maximum wayside noise levels from AGT operations with the revised median alternative

Location - Description	Civil Station	Land Use	App. distance to track centerline	BART Cat.	BART Criteria	Maximum Wayside Noise Level (dBA)*	Level of Impact
Homes on 70th and 71st Street, near BART Coliseum Station and Hawley Street.	n/a	SFR	900	III	75	<58	LTS
675 Hegenberger Rd - Employment Development Dept	160+00	Medical Office	80	IV	85	78	LTS
690 Hegenberger Rd - Residential	163+00	SFR	250	IV	80	69	LTS
595 Hegenberger Rd – Sam's Hofbrau (Demolished)	147+50	--	--	n/a	n/a	--	n/a
580 Hegenberger Rd - Burger King	148+00	Rest	100	IV	85	77	LTS
601 Hegenberger Rd - Denny's Restaurant	148+00	Rest	95	IV	85	77	LTS
8350 Edes Ave - Days Inn	142+50	Hotel	360	IV	80	66	LTS
500 Hegenberger Rd - Holiday Inn (vacant)	136+00	Hotel	450	V	80	64	LTS
460 Hegenberger Rd - Union Bank of California	118+00	Office	100	V	85	77	LTS
LSG Sky Chefs at OAK	28+50	Office	160	V	85	73	LTS

LTS: Less-than-significant impact
n/a: significance is not applicable or building not longer in place.
SFR: single-family residence; Rest: restaurant building
(*) dBA ref $20x10^{-5}$ Pa
Source: WIA

Impact NV-1A: Cumulative Noise Impact (FTA Criteria)

The following discussion for the cumulative noise analysis is focused on noise sensitive receptors for which changes to the proposed revised alignment could cause noise impacts based on the FTA criteria. Receptors along Hegenberger Road are primarily commercial (e.g., stores, gas stations and chain restaurants), office buildings, and hotel buildings. According to the guidelines provided by the FTA, the cumulative noise impact analysis is applicable only to the office and hotel buildings.

Cumulative noise impacts would be considered significant if AGT operations exceed the threshold for *Severe Impact* as described by FTA and presented in Figure 1 herein. The FTA criteria threshold for impact is based on the noise exposure increase from the existing ambient noise. The future noise increase is that associated with project operation in combination with other programmed projects in the study area.

Future noise levels in the area of the alignment studied are expected to increase by 1 dBA independent of the connector project. This increase is predicted due to the growth in traffic along Hegenberger Road and I-800.

Receptors along Hegenberger Road are exposed to existing ambient noise levels of 70 to 74 Ldn. According to the FTA threshold for impact, significant impacts would occur for Category 2 type receptors such as hotel buildings, if the ambient noise levels are increased by 2.6 dBA (at low end) and 2.2 dBA (at high end) respective to this range of existing ambient noise levels. For receptors with daytime occupancy only (i.e., FTA Category 3), the increase would be considered significant if it exceeds about 5 dBA.

However, the expected increase over the existing ambient noise due to AGT operations is expected to be between 1.0 and 1.8 dBA. Therefore, the level of impact expected to occur is *Impact,* as defined by FTA. Consequently, based on the significance threshold defined for the Oakland Connector, operation with the revised alignment is projected to cause a less than significant impact.

The cumulative passby noise for AGT alone, with the proposed schedule for Year 2020 (Table 6), is expected to generate noise exposure levels equivalent to 64 Ldn or 65 dBA Leq at the typical setback location of sensitive receptors.

Results of the noise analysis for the revised alignment showed no additional significant impacts beyond those identified in the 2002 Project FEIR/FEIS. Moreover, fewer significant impacts are expected for the nearby receptors based on the single train passby noise (BART) and cumulative noise (FTA) criteria, when the analysis is based on the current (2006) ambient noise conditions. When the analysis is based on the ambient conditions existing in 2001 and the current Project alignment, there would be a minor increase in the impact level according to the FTA criteria, and there would be significant and unavoidable noise impacts as was established in the 2002 FEIS/FEIR. No additional noise mitigation beyond those described in NV-1(i) in the 2002 FEIS/FEIR document are necessary.

Impact NV-2: Groundborne Vibration Impact (BART and FTA Criteria)

The following discussion presents the results of the analysis for groundborne vibration performed for the revised median alternative for the Connector, specifically in areas where the revised alignment has changed from the original median option presented in the FEIR/FEIS 2002 document. Groundborne vibration impact from AGT vehicle would be considered significant if projected vibration levels exceed the corresponding criteria presented in Table 2 or Table 5 for the BART and FTA Criteria respectively.

For the revised alignment, there are five sensitive receptors which required evaluation. Three of them are classified as nighttime occupancy and two as daytime occupancy (office buildings). An AGT vehicle passby is expected to generate groundborne vibration of about 72 dB at 100 feet from any of the aerial guideway support columns. In the vicinity of the OIA, there are no vibration sensitive receptors closes enough to be impacted by AGT operations. Between civil station 112+00 and 124+00, groundborne vibration is expected to be 8 dB below the 80 dB BART criterion at the location of one office building. Therefore, AGT operations are projected to cause less than significant impact in this segment of the alignment. North of I-880, for the hotel buildings located along Edes Avenue, AGT operations are expected to generate vibration levels below 57 dB and therefore result in a less than significant impact.

Two other receptors evaluated are on Hegenberger Road, one medical office building at station 160+00, and a single-family residence at station 163+00. Groundborne vibration is expected to be 9 to 11 dB below the BART and FTA criteria respectively at the single-family residence. At the

medical building located on 675 Hegenberger Road, groundborne vibration from AGT operations is expected to be 74 dB. Based on both the BART and FTA criteria, a less than significant impact is projected for this receptor.

Table 8 – Summary of the projected groundborne vibration from AGT operation for the revised median alternative

Location	Station	Land Use	BART Criteria	FTA Criteria	Groundborne Vibration Level (dB ref 10^{-6} in/sec)	BART Impact	FTA Impact
675 Hegenberger Rd – Employment Development Dept.	160+00	Medical Office	80	75	74	LTS	LTS
690 Hegenberger Rd - Residential	163+00	SFR	70	72	61	LTS	LTS
8350 Edes Ave - Days Inn	142+50	Hotel	75	72	57	LTS	LTS
500 Hegenberger Rd - Holiday Inn (vacant)	136+00	Hotel	75	72	56	LTS	LTS
460 Hegenberger Rd - Union Bank of California	118+00	Office	80	n/a	72	LTS	n/a

LTS: Less-than-significant impact
n/a: significance is not applicable.
SFR: single-family residence
Source: WIA

The analysis results for the revised alignment show that no additional significant impacts would be generated and a less than significant impact would occur in the areas of the alignment changes. No additional vibration mitigation measures to those presented as NV-2(i), NV-2(ii), and NV-2(iii) in the 2002 FIER/FEIS document are recommended.

Ancillary Facilities

Noise Assessment for Ancillary Facilities

Area of Study

This Section addresses the potential impact from ancillary facilities along the Oakland International Airport Connector alignment. Furthermore, the noise analysis is focused on areas where the revised alignment for the median option could generate new significant impacts from the project.

There are three types of project facilities that must be analyzed: the Doolittle Maintenance Facility, various power distribution stations, and a vent shaft.

Methodology

Assumptions necessary to re-assess the potential for significant impact due to ancillary facilities (Impact NV-3 in the FEIR/FEIS) are based on noise data for stationary sources obtained from the FTA Guidance Manual, and from measurements performed by WIA on previous BART extension projects. Table 9 provides some of the reference maximum noise levels used for calculations. Sound power data for typical BART emergency ventilation fans and subway train passbys were obtained by WIA from work on previous BART extensions and are used as reference values for noise projections. Additionally, a 15 feet long (minimum length) "untreated" ventilation shaft has been assumed to assess noise emitted from vent shafts.

Operations for emergency fan and maintenance facilities have been assumed to occur during the nighttime to address the greatest potential noise impact condition.

Table 9 – Reference noise levels at 50 feet for stationary sources

Source	Reference SEL (dBA)	Approximate Lmax (dBA)
Car Washes	111	75
Substations	99	63
Wheel truing	n/a	64

Source FTA Transit Noise and Vibration Impact Assessment, April 1995.

Applicable Noise Policies

The noise criteria applicable to ancillary facilities for the Connector are contained in the BART 1992 *Extensions Program Design Criteria* (Ref. 8) and are presented in the following Table 10. The criteria are based on the existing ambient noise environment as well as the type of land use in the areas adjacent to the facilities, similar to the BART criteria for wayside noise and groundborne vibration. The community area categories are presented in Table 3.

Table 10 – BART Design Criteria for noise from transit system ancillary facilities

Community Area Category		Maximum Noise Level, dBA (re. $2x10^{-5}$ Pa)	
		Transient	Continuous
I	Low Density Residential	50	40
II	Average Residential	55	45
III	High Density Residential	60	50
IV	Commercial	65	55
V	Industrial/Highway	75	65

Source: BART Extensions Program Design Criteria, March 1992.

The existing ambient noise in the community areas next to the Connector alignment corresponds to land uses that can be classified as either Area Category IV or Area Category V, depending on the local circumstances. For maintenance facilities and power distribution stations, the applicable criteria for maximum noise levels are those presented in the above table for *continuous* activities. Additionally, the criteria for power distribution station noise shall be reduced by 5 dBA from the corresponding criteria in Table 10 to account for "tonal components" in the noise. For the noise analysis of the vent shaft, two sources for potential noise impact were independently evaluated and compared with the *transient* and *continuous* criteria. Noise generated by emergency ventilation fans was compared with the corresponded *continuous* criteria while noise occurring during train passby with the *transient* criteria. Emergency ventilation fan noise, although infrequent, is considered to be a "continuous" source because the duration over which the fan is on when tested or used is substantial enough.

Impact NV-3: Noise from ancillary facilities

Noise impact from ancillary facilities would be considered significant if noise levels exceed the corresponding maximum criterion presented in Table 10, otherwise the impact would be considered less than significant.

Impact NV-3.1 - Maintenance Facility

The maintenance facility would be relocated to the northwest corner of Airport Access Road and 98th Street. The relocation would benefit residences located on 70th and 71st Street near the Coliseum BART station. With the original alignment alternative, residences would likely be exposed to a significant impact due to ancillary facility operations. However, with the maintenance facility relocated, a less than significant impact is projected.

At the proposed relocated maintenance facility (Doolittle Maintenance Facility), and based on the layout provided (Ref. 11), noise generating activities such as vehicle washing and wheel truing were used as sources from which to project noise at the closest noise sensitive receptors. At this time, it is not clear whether wheel truing would happen at the proposed Doolittle facility. However, if wheel truing is implemented, it would potentially be the noisiest activity inside the building. Car wash operations were assumed to take place outside the building. Moreover, in the course of final design, the decision may be made to relocate car washing operations inside the building. Therefore, this

assumption represents a worst case condition for modeling purposes. The third noisiest source at the Doolittle site is the power distribution station, which is proposed for a location that is a distance of approximately 100 feet from the Edgewater West Hotel building.

The maximum noise level from the Doolittle Maintenance Facility, without implementing noise mitigation measures, is expected to be approximately 63 dBA at the nearest façade of the Edgewater West Hotel. The maximum noise level is due primarily to the vehicle wash. Additionally, noise from the proposed power distribution station is expected to be greater than the applicable 50 dBA criterion as well. The maximum noise level from the Doolittle maintenance facility is projected to cause a significant impact for the Edgewater West Hotel and therefore mitigation measures should be implemented. In terms of cumulative noise, operations from the Doolittle facility is expected to produce about 67 Ldn at the Hotel nearest building facade. However, this projected value assumes a worst-case scenario with all washing operations occurring at night and an outdoor car wash.

The next closest noise sensitive receptors in the area of the Doolittle maintenance facility are the Hilton hotel located along Hegenberger Road and the Holiday Inn Express located on Airport Access Road. These hotel buildings would be approximately 600 to 700 feet from the Doolittle maintenance facility. The projected cumulative noise due to maintenance facilities operations is 56 to 57 Ldn. The Hilton hotel is currently exposed to an Ldn level of about 70 dBA, while the Holiday Inn Express to a level of approximately 69 Ldn. Maximum noise is expected to be about 53 dBA or lower without implementing mitigation measures. Consequently, the noise impacts are projected to be less than significant at both of these hotels for this project source.

Impact NV-3.2 - Power Distribution Station and Vent Shaft

Five power distribution stations are proposed for the revised project alignment. Site locations are along the Airport Access Road at civil station 27+00, at station 83+00 (part of the previously addressed Doolittle maintenance facility), at station 141+00 next to the I-880 and GM truck center, near the Coliseum BART Station at civil stations 173+00, and an alternative location at station 122+50 next to I-800 and Union Bank of California building.

In contrast with the locations for power distribution stations analyzed and presented in the 2002 FEIR/FEIS document, all proposed new locations are in areas of commercial land use, for which a 50 dBA criterion for *continuous* operation applies (including the 5 dBA penalty). Maximum noise levels from power distribution stations are expected to be 4 to 5 dBA below the criterion at all locations, and therefore a less than significant impact is projected due to operations for this project noise source.

Southeast of Doolittle Drive and Airport Access Road is the proposed location for the ventilation shaft for the Doolittle tunnel. The location of the structure is approximately 400 feet from the closest noise sensitive receptor (Holiday Inn Express located on Airport Access Road). The maximum noise level from operations would be that generated by the emergency fan, which normally and on a regular basis would be operated at night during testing. Testing of emergency ventilation fans would only occur once a month when the fans run for approximately 30 minutes. The maximum noise level expected would be 54 dBA at the closest point of the Holiday Inn Express building and therefore a less than significant impact is expected to occur for this project noise source.

Mitigation Measures for Ancillary Facilities

Significant impacts were anticipated to occur for noise sensitive receptors in the vicinity of the maintenance facility during the 2002 FEIR/FEIS document. Relocating the maintenance facility will result in significant impact for the Edgewater West Hotel. However, by implementing noise mitigations NV-2(i) and NV-2(ii) as described in section 3.11 of the FEIR/FEIS document (Ref 3), would reduce noise from ancillary facilities to a level that is less than significant.

Construction Noise and Vibration

Noise and Vibration Assessment during Construction

The following discussion presents results from the analysis of noise and vibration expected during construction of the BART Oakland International Airport Connector. Specifically, it addresses potential significant impacts due to the revised alignment.

Applicable Noise and Vibration Policies

The 2002 FEIR/FEIS evaluated the potential for impacts from construction noise and vibration. The significance criteria for construction vibration, are specified in terms of sustained and transient events. Maximum allowable noise and vibration levels presented in Table 11 and Table 13 respectively were presented in the FEIR/FEIS. The FTA criteria for construction noise is specified in terms of one-hour equivalent noise levels (Leq), work-shift equivalent noise levels (8-hours Leq), and 24-hour noise levels (Ldn). All these metrics account for the duration the equipment is in use and the activities they engage in. The BART criteria are more restrictive than the FTA criteria. Therefore it is sufficient to evaluate the significance of noise and vibration impacts against the BART criteria only.

Even though there are other policies and regulations in addition to the BART criteria to evaluate noise and vibration during construction, the analysis results presented in this section are compared only against the BART criteria. This assumption, consistent with the analysis presented for the 2002 FEIR/FEIS document, was assumed because of state law, which exempts BART from complying with land use regulations.

Table 11 – BART limits for continuous and intermittent construction noise

Affected Structure or Area	Maximum Allowable Noise Levels (dBA re. $2x10^{-5}$ Pa)			
	Continuous		Intermittent	
	Daytime	Nighttime	Daytime	Nighttime
Residential				
Single-family residence	60	50	75	60
Along an arterial or in multi-family residential areas, including hospitals	65	55	75	65
In semi-residential/commercial areas, including hotels	70	60	80	70
Commercial	At All Times			
In semi-residential/commercial areas, including schools	65		80	
In commercial areas with no nighttime residency	70		85	
Industrial				
All locations	80		90	

Source: BART Extensions Program Design Criteria, March 1992.

Table 12 – City of Oakland maximum allowable receiving noise levels

	Maximum Noise Levels , dBA (re. $2x10^{-5}$ Pa)			
	Daily 7 a.m. to 7 p.m.		Weekends 9 a.m. to 8 p.m.	
	Short-Term Operation	Long-Term Operation	Short-Term Operation	Long-Term Operation
Residential	80	65	65	55
Commercial, Industrial	85	70	70	60

Source: City of Oakland Planning Code, Section 17.120.050

Table 13 – BART limits for construction vibration

Vibration Type and Permissible Aggregate Duration	Limit
Sustained ($\geq$ 1 hr/day)	0.01 in/sec (80 dB re 10^{-6} in/sec)
Transient (< 1 hr/day)	0.03 in/sec (90 dB re 10^{-6} in/sec)
Transient (< 10 min/day)	0.10 in/sec (100 dB re 10^{-6} in/sec)

Source: BART Extensions Program Design Criteria, March 1992.

Methodology

WIA has revisited the issue of construction noise and vibration impacts to corroborate the findings of the FEIR/FEIS. The methodology used by WIA to assess the potential for significant impact NV-4 for construction noise and NV-5 for construction vibration for the BART Oakland International Airport Connector is based on the standard procedure described in the FTA Guidance Manual. Additionally, noise and vibration reference data as well as typical percentages for equipment usage were obtained from the FHWA RCNM model (Ref 13).

Activities such as drilling and pile driving normally occur during the first phase of construction. Projected noise and vibration levels from these activities were compared with the transient and intermittent criteria. On the other hand, noise and vibration from excavators, cranes, dozer, soil compaction equipment, and passbys of loaded trucks were projected at sensitive receptor locations and compared with the corresponding *Continuous* and *Sustained* criteria. These two types of activities were independently evaluated and possible levels projected at the locations of sensitive receptors. A discussion of the results is presented in the following section and in Table14 and Table 15.

When projected noise and/or vibration levels exceeded the limits presented in Table 11 and Table 13, construction activities for the Connector is considered to cause significant impact.

Impact NV-4: Construction Noise

Construction noise from intermittent activities such pile driving are expected to generate levels in excess of 85 dBA at receptors with no intervening acoustic shielding at a distance of approximately 300 feet, and in excess of 75 dBA for unobstructed receptors located at a distance of about 1,000 feet.

Table14 shows that all noise sensitive receptors in the vicinity of the revised alignment for the median option would be exposed to intermittent noise levels in excess of the BART criteria due to pile driving. Therefore, they would be exposed to a potentially significant impact.

During the construction phase, for which continuous use of heavy equipment would be necessary (e.g. guideway lifting), noise levels are expected to be equal to and above 70 dBA at a distance of approximately 380 feet. Continuous operation during construction of the revised median alternative right-of-way is expected to cause noise levels in excess of the BART criteria at most noise sensitive receptors, except at the hotel buildings located along Edes Avenue and those more distant than 400 feet from the AGT alignment.

During construction of the Doolittle Maintenance Facility, noise from pile driving is expected to generate the highest levels and to exceed the BART limits for intermittent noise by 2 to 9 dBA. Noise impact is expected to be significant for short-term operations in the vicinity of the Hilton and Edgwater West hotel buildings, United Labor Bank, and Gateway business center. Moreover, noise levels associated with long-term construction activity on the Doolittle Facility are expected to be about 5 to 8 dBA above the 70 dBA BART criteria.

Table 14 – Summary of projected construction noise with the revised median alternative alignment

Location	Civil Station	Land Use	BART limits for daytime operations		Estimated Maximum Noise Levels (dBA re. $2x10^{-5}$ Pa)			
			Int.	Cont.	Int.	BART Impact	Cont.	BART Impact
AGT Alignment Construction								
Homes on 70th and 71st Street, near BART Coliseum Station and Hawley Street	n/a	SFR	75	65	76	S	63	LTS
675 Hegenberger - Employment Development Dept	160+00	Medical Office	85	70	97	S	84	S
690 Hegenberger - Residential	163+00	SFR	80	70	87	S	74	S
595 Hegenberger Rd - Sam's Hofbrau (Demolished)	163+00	--	n/a	n/a	--	n/a	--	n/a
580 Hegenberger Rd - Burger King	147+50	n/a	85	70	95	S	82	S
601 Hegenberger Rd - Denny's Restaurant	148+00	Rest	85	70	95	S	82	S
8350 Edes Ave - Days Inn	142+50	Hotel	80	70	84	S	71	S
500 Hegenberger - Holliday Inn (vacant)	136+00	Hotel	80	70	82	S	69	LTS
460 Hegenberger Rd - Union Bank of California	118+00	Office	85	70	95	S	82	S
Airport - LSG Sky Chefs	29+00	Office	85	70	91	S	78	S
Doolittle Maintenance Facility Construction								
100 Hegenberger Rd - United Labor Bank	89+00	Office	85	70	88	S	75	S
99 Hegenberger Rd - Warehouse Union	89+00	Office	85	70	84	LTS	71	S
Edgewater West: Doolittle Gateway Site – Hotel	82+00	Hotel	80	70	89	S	76	S
1 Hegenberger Rd - Hilton Hotel	87+00	Hotel	80	70	82	S	69	LTS
Airport Dr and 98th Ave - Gateway Business Center	79+00	Office	85	70	91	S	78	S

Int., Cont: Intermittent or Continuous construction noise
S: Significant impact
LTS: Less-than-significant impact
Source: WIA

The original median alignment option presented in the 2002 FEIR/FEIS report, identified pile driving as a cause of significant impact at noise sensitive receptors within 650 feet of the project right-of-way. All sensitive receptors in the proximity of the revised alignment were part of the 650 foot buffer for a potentially significant impact with the original alignment and therefore previously identified as being impacted. Consequently, no additional significant impacts are expected due to short-term construction noise levels. However, significant short-term impacts would occur and mitigation measures need to be implemented.

Similarly, significant impacts due to long-term construction activities were accounted for in the FEIR/FEIS. These impacts were projected to occur at noise sensitive receptors in the vicinity of the original median option alignment. The revised alignment would result in no additional long-term impacts. However, significant long-term noise impacts would occur and mitigation measures need to be implemented.

Construction of the Doolittle Maintenance Facility would eliminate the previously identified significant noise impact during long-term construction with regard to the single-family residences located on 70th and 71st Street. However, significant impacts during pile drive are likely to remain for these single-family homes. At the new proposed Doolittle Facility location, receptors such the Edgewater West Hotel, Hilton Hotel, United Labor Bank, and Gateway Business Center would likely receive significant impact due to guideway construction. Thus, no additional impacts were determined due to construction of the proposed Doolittle Maintenance Facility. Nevertheless, mitigations measures will be implemented.

The FEIR/FEIS identified one construction noise impact (C-NV-1) involving numerous receptors along the Connector alignment. In general, the revised alignment changes would result in minor changes in proximity of construction equipment to noise sensitive receptors. Consequently there are no new construction noise impacts projected for construction of the AGT guideway structure with the revised alignment.

In summary, the construction of the Doolittle Facilities will result in noise impacts similar to those associated with guideway construction as they would affect the Edgewater West Hotel. Therefore no new noise impacts are projected for the facility construction beyond those identified for the guideway construction.

Mitigation Measures for Construction Noise

Construction activities should be carried out in such a manner so as to be in compliance with the BART criteria. Noise mitigation measures C-NV-1(i), C-NV-1(ii), and C-NV-1(iii), presented in Section 3.16 of the 2002 FEIR/FEIS document should be implemented by the contractor to reduce the potential for significant impact to nearby noise sensitive receptors. However, noise mitigation would not be sufficient to reduce all noise impacts to a level that is less than significant. Therefore, there would remain, as described in the 2002 FEIR/FEIS document, significant unavoidable (SU) impacts.

The same noise mitigation measures in the FEIR/FEIS apply to construction of the Doolittle Facility at the proposed location. The mitigation measures, namely *C-NV-1 (i), (ii) and (iii)*, identified in the FEIR/FEIS are still applicable.

Impact NV-5: Construction Vibration

The FEIR/FEIS identified two construction vibration impacts (C-NV-2 and C-NV-3). Impact CN-V-2 relates to construction vibration annoyance. Impact CN-NV-3 relates to potential building damage due to construction vibration.

Groundborne vibration from short-term construction activity such as pile driving is expected to be about 100 VdB at a distance equivalent to the typical building setback along Hegenberger Road. However, vibration level depends directly upon the local soil conditions characteristics and the technique used for pile driving.

For construction activities, grouped as long-term effects such as excavation, movement of dozers and loaded trucks, maximum groundborne vibration is expected to be about 76 VdB along Hegenberger Road. Furthermore, at distances further than 60 feet, vibration levels are expected to be below the 80 VdB criteria for sustained construction activities and therefore projected to cause less than a significant impact.

Results of the vibration analysis for short-term construction operations result in a significant impact at sensitive receptors. However, with the revised median alignment no additional significant vibration impacts beyond those identified in the 2002 FEIR/FEIS document are projected.

During long-term construction activities, a less than significant impact is expected to occur at receptors closer to the revised alignment such the Union Bank of California and the LSG Sky Chefs building. However, vibration mitigation measures would be required where feasible so as to reduce potential significance impacts in areas where significant impact has been determined for the original alignment to a level that is less than significant.

Table 15 - Summary of projected construction vibration with the revised median alternative alignment

Location	Civil Station	Land Use	BART vibration limits		Estimated Construction Vibration Levels VdB (re 10^{-6} in/sec)			
			transient	Sustained	Transient	Impact	Sustained	Impact
AGT Alignment Construction								
675 Hegenberger - Employment Development Dept	160+00	Medical Office	90	80	102	S	77	LTS
690 Hegenberger - Residential	163+00	SFR	90	80	92	S	67	LTS
595 Hegenberger Rd - Sam's Hofbrau (Demolished)	147+50	n/a	n/a	n/a	---	n/a	---	n/a
580 Hegenberger Rd - Burger King	148+00	Rest	90	80	100	S	75	LTS
601 Hegenberger Rd - Denny's Restaurant	148+00	Rest	90	80	100	S	75	LTS
8350 Edes Ave - Days Inn	142+50	Hotel	90	80	89	LTS	64	LTS

Location	Civil Station	Land Use	BART vibration limits		Estimated Construction Vibration Levels VdB (re 10^{-6} in/sec)			
			transient	Sustained	Transient	Impact	Sustained	Impact
500 Hegenberger - Holliday Inn (vacant)	136+00	Hotel	90	80	87	LTS	62	LTS
460 Hegenberger Rd - Union Bank of California	118+00	Office	90	80	100	S	75	LTS
Airport - LSG Sky Chefs	29+00	Office	90	80	96	S	71	LTS
Doolittle Maintenance Facility Construction								
100 Hegenberger Rd - United Labor Bank	89+00	Office	90	80	93	S	68	LTS
99 Hegenberger Rd - Warehouse Union	89+00	Office	90	80	89	LTS	64	LTS
Hegenberger Rd - Edgewater West: Doolittle Gateway Site - Hotel	82+00	Hotel	90	80	94	S	69	LTS
1 Hegenberger Rd - Hilton Hotel	87+00	Hotel	90	80	87	LTS	62	LTS
Airport Dr and 98th Ave - Gateway Business Center	79+00	Office	90	80	96	S	71	LTS

S: Significant impact
LTS: Less-than-significant impact
Source: WIA

Mitigation Measures for Construction Vibration

Vibration mitigation measures C-NV-2(i) andC-NV-3(i), presented in Section 3.16 of the 2002 FEIR/FEIS document, should be implemented by the contractor to reduce the potential for significant impacts to nearby sensitive receptors. As stated in the 2002 FEIR/FEIS document, vibration mitigation would reduce the effect of the vibration impact, although the impact would remain a significant unavoidable (SU) impact as identified in the 2002 document.

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