SAN JOSÉ 60-INCH SEWER INTERCEPTOR, PHASE VIA CONSTRUCTION NOISE ASSESSMENT SAN JOSÉ, CALIFORNIA

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INTRODUCTION

This report presents the results of the construction noise impact assessment completed for the San José 60-inch Sewer Interceptor Phase VIA project. The project involves replacing the existing 54-inch interceptor, beginning upstream at the intersection of Commercial Street and North 5th Street, with a new 84-inch interceptor. The project limits span a distance of 4,200 feet along North 4th Street and 350 feet along Commercial Street.

This report first presents the fundamentals of noise and vibration for those who are not familiar with acoustical terminology and concepts. The report then summarizes ambient noise conditions in the project vicinity, and provides an evaluation of the potential significance of noise and vibration related impacts that would result from the project. A list of best management construction practices is presented to reduce construction noise levels as low as feasible.

SETTING

Fundamentals of Environmental Noise

Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in decibels (dB) with 0 dB corresponding roughly to the threshold of hearing. Decibels and other technical terms are defined in Table 1.

Most of the sounds, which we hear in the environment, do not consist of a single frequency, but rather a broad band of frequencies, with each frequency differing in sound level. The intensities of each frequency add together to generate a sound. The method commonly used to quantify environmental sounds consists of evaluating all of the frequencies of a sound in accordance with a weighting that reflects the facts that human hearing is less sensitive at low frequencies and extreme high frequencies than in the frequency mid-range. This is called "A" weighting, and the decibel level so measured is called the A-weighted sound level (dBA). In practice, the level of a sound source is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting curve. Typical A-weighted levels measured in the environment and in industry are shown in Table 2 for different types of noise.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a conglomeration of noise from distant sources, which create a relatively steady background noise in which no particular source is identifiable. To describe the time-varying character of environmental noise, the statistical noise descriptors, L_{01}, L_{10}, L_{50}, and L_{90}, are commonly used. They are the A-weighted noise levels equaled or exceeded during 1%, 10%, 50%, and 90% of a stated time period. A single number descriptor called the L_{eq} is also widely used. The L_{eq} is the average A-weighted noise level during a stated period of time.

In determining the daily level of environmental noise, it is important to account for the difference in response of people to daytime and nighttime noises. During the nighttime, exterior background noises are generally lower than the daytime levels. However, most household noise also decreases at night and exterior noise becomes very noticeable. Further, most people sleep at night and are very sensitive to noise intrusion. To account for human sensitivity to nighttime noise levels, a descriptor, L_{dn} (day/night average sound level), was developed. The L_{dn} divides the 24-hour day into the daytime of 7:00 AM to 10:00 PM and the nighttime of 10:00 PM to 7:00 AM. The nighttime noise level is weighted 10 dB higher

than the daytime noise level. The Community Noise Equivalent Level (CNEL) is another 24-hour average, which includes both an evening and nighttime weighting.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One is the Peak Particle Velocity (PPV) and another is the Root Mean Square (RMS) velocity. The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. The RMS velocity is defined as the average of the squared amplitude of the signal. The PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration. In this section, a PPV descriptor with units of mm/sec. or in/sec. is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous vibration levels produce. The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at much lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying.

Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high noise environments, which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

Existing Noise Environment

Illingworth & Rodkin, Inc. performed a noise monitoring survey to quantify ambient noise levels along the project alignment on Wednesday, May 12, 2010. The noise monitoring survey included four short-term noise measurements. Three of the four noise measurements were made along North 4th Street, which is the predominant noise source in the project vicinity. Short-term noise measurements were made adjacent to sensitive uses bordering the proposed project alignment for periods of ten minutes. One short-term noise measurement (ST-5) was made as part of a previous project. Figure 1 shows the site vicinity and noise monitoring locations selected by Illingworth & Rodkin, Inc. Data collected during these measurements are summarized in Table 4.

Noise measurements were made with a Larson Davis Model 820 Integrating Sound Level Meter set at “slow” response. The sound level meter was equipped with a G.R.A.S. Type 40AQ ½ - inch random incidence microphone fitted with a windscreen. All instrumentation used meets the requirements of the American National Standards Institute (ANSI) SI.4-1983 for Type 1 use. The sound level meter was calibrated prior to the noise measurements using a Larson Davis Model CAL200 acoustical calibrator. The response of the system was checked after each measurement session and was always found to be within 0.2 dBA.

Table 1 Definitions of Acoustical Terms Used in this Report

Term	Definitions
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998

Table 2 Typical Noise Levels in the Environment

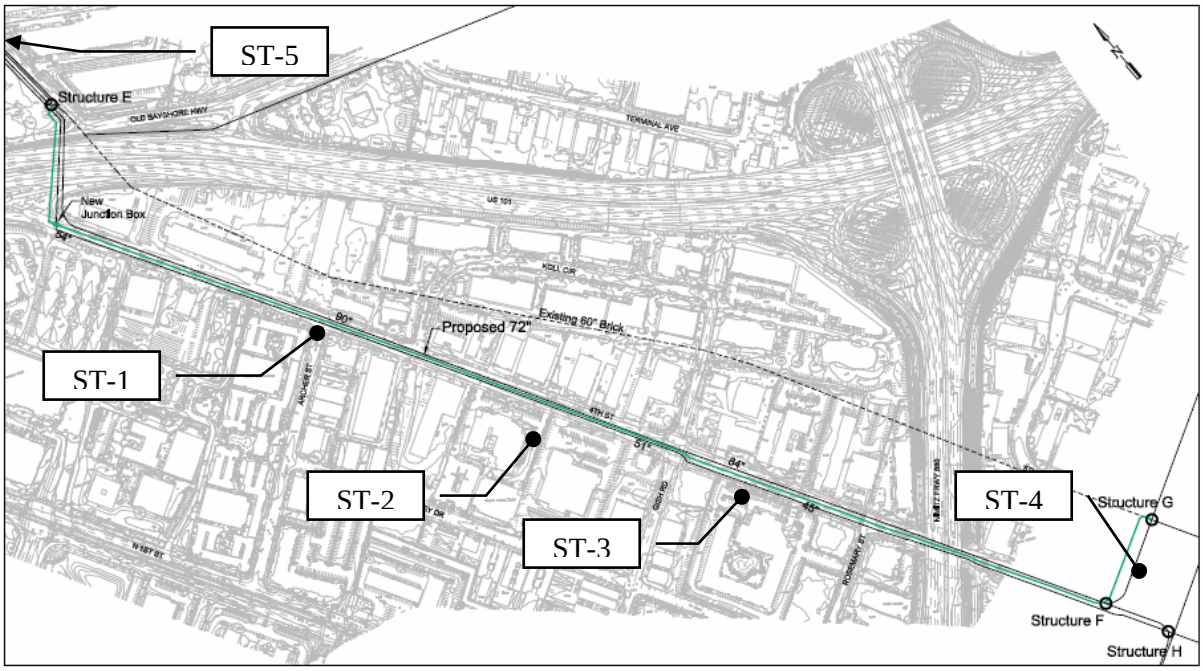
Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), Caltrans, November 2009.

Table 3 Reaction of People and Damage to Buildings for Continuous Vibration Levels[1]

Vibration Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.006 to 0.019	Threshold of perception, Possibility of intrusion	Vibration unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk of "architectural" damage to normal dwellings such as plastered walls or ceilings.
0.4 to 0.6	Vibrations considered unpleasant by people subjected to continuous vibrations	Vibration at this level would cause "architectural" damage and possibly minor structural damage.

Figure 1 Noise Measurement Locations



[1] Transportation Related Earthborne Vibrations (Caltrans Experiences), Technical Advisory, Vibration TAV-02-01-R9601, California Department of Transportation, February 20, 2002.

Table 4 Summary of Short-Term Noise Measurement Data

Location	Date - Time	A-Weighted Noise Level (dBA)					
		L_{eq}	L_{max}	L_{01}	L_{10}	L_{50}	L_{90}
ST-1 – 50 feet from the center of N. 4th St., 600 feet from the center of Hwy 101.	5/12/10 4:00 PM	68	76	75	71	66	62
ST-2 – 110 feet from the center of N. 4th St., 480 feet northwest of E. Gish Rd.	5/12/10 4:20 PM	61	68	67	64	60	59
ST-3 – 95 feet from the center of N. 4th St., 290 feet southeast of E Gish Rd.	5/12/10 3:40 PM	62	70	68	64	61	59
ST-4 – 55 feet from the center of Commercial Street at W. 5th Street.	5/12/10 3:20 PM	65	77	72	67	64	62
ST-5 – Staybridge Suites Extended Stay Hotel, along Crane Ct., about 850 feet north of Hwy 101.	10/15/09 11:50 AM	63	68	65	63	60	66

When normalized to a reference distance of 50 feet from the roadway center, average traffic noise levels along North 4th Street typically ranged from 67 to 69 dBA L_{eq}. A comparison of these short-term data and daily noise level data collected at a nearby site indicate that nighttime average traffic noise levels are typically 5 to 10 dBA lower than the traffic noise levels occurring during daytime hours. Daytime noise levels in noise sensitive areas nearest Highway 101 and Commercial Street ranged from 63 to 66 dBA L_{eq}. Similarly, nighttime noise levels in these areas would be expected to be 5 to 10 dBA lower than the levels occurring during daytime hours.

IMPACT DISCUSSION

Topic:	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*	*Not Applicable*
NOISE—Would the project:					
a) Result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐	☐
b) Result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐	☐
c) Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☐	☒
d) Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐	☐
e) For a project located within an airport land use plan area, or, where such a plan has not been adopted, in an area within two miles of a public airport or public use airport, would the project expose people residing or working in the area to excessive noise levels?	☐	☐	☐	☐	☒
f) For a project located in the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☐	☒

a) *Less than Significant Impact.* The City of San José does not regulate construction noise through a Noise Ordinance. Policy 9 of the Noise Element of the City's General Plan states that construction operations should use available noise suppression devices and technology. Reasonable and feasible noise control measures implemented at the site as discussed under Item d) would satisfy this policy. The incorporation of these controls would reduce the impact to a less than significant level.

b) *Less than Significant Impact*. The project result would not result in exposure of persons to or generation of excessive groundborne vibration levels.

The following significance criteria are used to assess potential vibration impacts:

- Vibratory equipment and impact pile drivers (pertains to cosmetic or structural damage of buildings): 0.2 in/sec PPV

The majority of project construction activities would employ open trench construction methods to install new pipe sections or to replace existing pipelines. Activities with the potential of generating perceptible vibration levels would include the removal of pavement and soil, shoring, and the compacting of backfill after the new pipeline is installed. Similar vibration generating construction activities would be expected in excavation of ground for the tunneling of a trenchless crossing. The proposed project would at times bring construction activities within about 25 feet of sensitive land uses along the project alignment. Table 5 summarizes typical vibration levels associated with varying pieces of construction equipment at a distance of 25 feet.

Equipment anticipated during project construction would include: backhoes, excavators, cranes, dump trucks, front end loaders, water trucks, dozers, and various passenger vehicles. A review of the proposed

equipment and the vibration level data provided in Table 5 indicates that vibration levels generated by the majority of proposed equipment would be equal to or below the 0.2 in/sec PPV criteria to assess the potential for cosmetic or structural damage. Impact and vibratory pile driving is not proposed as part of the construction of the project. Vibration levels would be below 0.2 in/sec PPV when located at a distance of 25 feet from sensitive receivers and damage would not be expected.

The impact resulting from the project would be considered less-than-significant as vibration levels would not exceed the 0.2 in/sec PPV criteria established to evaluate the risk for cosmetic or structural damage to fragile buildings. Further, planned construction hours are during the daytime, limiting the possibility of annoyance due to off-site vibration.

Table 5 Vibration Source Levels for Construction Equipment[2]

Equipment		PPV at 25 ft. (in/sec)
Pile Driver (Impact)	upper range	1.158
	typical	0.644
Pile Driver (Sonic)	upper range	0.734
	typical	0.170
Clam shovel drop		0.202
Hydromill (slurry wall)	in soil	0.008
	in rock	0.017
Vibratory Roller		0.210
Hoe Ram		0.089
Large bulldozer		0.089
Caisson drilling		0.089
Loaded trucks		0.076
Jackhammer		0.035
Small bulldozer		0.003

c) *Not Applicable.* The operation of the project would not result in measurable noise levels above ground. Therefore, this significance criterion is not applicable to the proposed project.

d) *Less than Significant Impact*. The project result would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

Project construction is anticipated to begin in late 2011 and last up to 24 months. Mobilization of equipment and site clearing and preparation will take approximately two months and will overlap with pipeline and junction structure installation (22 months). Pipeline installation will take approximately 16 months while junction structures will take approximately 2 months to construct. The rate of pipeline installation is approximately 60 feet per day. The tunneling portion of the project duration is anticipated to be 4 months. Site restoration is anticipated to last 1 month. Noise levels at sensitive receivers adjacent to the project alignment would increase during the construction period. Construction noise would be temporary and would only occur during the daytime.

Noise impacts from project construction activities are a function of the level of noise generated by individual pieces of construction equipment, the amount of equipment operating at any given time, the distance and sensitivities of nearby land uses, the presence of noise barriers or other structures that provide

[2] Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006.

acoustical shielding, and the timing and duration of the noise-generating activities. Where noise from construction activities exceeds 60 dBA L_{eq} and exceeds the ambient noise environment by at least 5 dBA L_{eq} at noise-sensitive residential uses in the project vicinity for a period of more than one construction season, the impact would be considered significant.

Construction noise would primarily consist of the operation of vehicles and equipment during pavement removal, excavation, pipeline installation, backfill operations, and the repaving of the portion of the street disturbed by the project. Table 6 presents the typical range of hourly average noise levels generated by different phases of construction measured at a distance of 50 feet. Hourly average noise levels generated by public works-type projects typically range from 79 to 88 dBA L_{eq} measured at a distance of 50 feet from the center of a busy construction site.

Table 6 Typical Ranges of Noise Levels at 50 Feet from Construction Sites (dBA Leq)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I - All pertinent equipment present at site.
II - Minimum required equipment present at site.
Source: United States Environmental Protection Agency, 1973, Legal Compilation on Noise, Vol. 1, p. 2-104.

During construction activities, maximum instantaneous noise levels would vary depending on the specific pieces of equipment operating on site. The typical range of maximum instantaneous noise levels would be 75 to 82 dBA L_{max} at a distance of 50 feet. Construction generated noise levels drop off at a rate of about 6 dBA per doubling of distance between the source and receptor. Shielding provided by barriers or structures can provide an additional 5 to 10 dBA noise reduction at distant receivers.

Representative sound levels for the most common types of construction equipment and usage factors, contained in FHWA's Roadway Construction Noise Model, were used to calculate noise levels related to planned construction activities. The cumulative noise level would assume all pieces of construction equipment were operating simultaneously at the site and represents a conservative worst-case prediction of site construction noise levels during each construction phase, along multiple road segments. These data are summarized in Table 7.

The open trench installation of pipelines would result in average noise levels of approximately 85 dBA L_{eq} at a distance of 50 feet. Maximum instantaneous noise levels during this phase would reach 82 dBA L_{max} at a distance of 50 feet assuming that a jack hammer would be required to remove the existing pavement. The tunneling of a trenchless crossing would result in average noise levels of approximately 83 dBA L_{eq} at a distance of 50 feet and maximum instantaneous noise levels would reach approximately 81 dBA L_{max} at a distance of 50 feet.

Hourly average noise levels resulting from the construction of the project would range from 83 to 85 dBA L_{eq} at a distance of 50 feet. These hourly average noise levels would exceed ambient traffic noise levels at

receivers along North 4th Street and Commercial Street by 17 to 19 dBA L_{eq}. The pipeline installation would occur at a rate of approximately 60 feet per day. Therefore, construction noise levels would only exceed the significance criterion at any individual receiver or group of receivers over a short period of time, often for less than three weeks. This would be considered a less than significant noise impact recognizing the relatively short duration of project construction activities anticipated along North 4th Street, Commercial Street, and Zanker Road. Pipeline construction activities are calculated to generate noise levels 7 dBA L_{eq} above the ambient noise environment near the southernmost terminus of Zanker Road. However, construction activities near Structure E would be further than 500 feet from the nearest noise sensitive receiver and would not exceed the projected ambient noise environment by 5 dBA L_{eq} or more.

Table 7 Construction Noise Levels at 50 feet

	Noise Level (dBA)			
Roadway Segment	**Maximum Instantaneous Noise Level (L_{max})**	**Average Noise Level (L_{eq})**	**Typical Daytime Ambient (L_{eq})**	**Noise Increase above Ambient**
N. 4th St., Hwy 101 ramps to Archer St.	82	85	68	17
N. 4th St., Koll Cir. to E. Gish Rd.			67	18
N. 4th St., E. Gish Rd. to I-880 overpass.			67	18
Commercial St., N. 4th St. to N. 5th St.			66	19
Zanker Rd., Reynolds Cir. Adjacent to Hwy 101	81	83	76	7

Source: RCNM

The following standard controls are assumed to be included in the project to reduce construction noise levels as low as practical:

- Use the best available noise control techniques (including mufflers, intake silencers, ducts, engine enclosures, and acoustically attenuating shields or shrouds) for all equipment and trucks to minimize construction noise impacts.

- Locate stationary noise sources as far from sensitive receptors as feasible. If they must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) will be used as necessary to comply with local noise ordinance daytime noise limits. Any enclosure openings or venting will face away from sensitive receptors.

- Locate material stockpiles as well as maintenance/equipment staging and parking areas as far as feasible from residential receptors.

- Designate a project liaison that will be responsible for responding to noise complaints during the construction phase. The name and phone number of the liaison will be conspicuously posted at construction areas and on all advanced notifications. This person will take steps to resolve complaints, including periodic noise monitoring, if necessary. Results of noise monitoring will be presented at regular project meetings with the project contractor, and the liaison will coordinate with the contractor to modify any construction activities that generated excessive noise levels to the extent feasible.

- Require a reporting program that documents complaints received, actions taken to resolve problems, and effectiveness of these actions.

With the implementation of the above feasible noise control measures, and recognizing that construction activities would occur less than one year in duration, the impact would be less than significant.

e) *Not Applicable*. The project site is located within an airport land use plan area or within two miles of a public airport, but is not a noise sensitive land use. Therefore, this significance criterion is not applicable to the proposed project.

f) *Not Applicable.* The project site is not located within the vicinity of a private airstrip. Therefore, this significance criterion is not applicable to the proposed project.