HOUSING ELEMENT UPDATE
NOISE AND VIBRATION ASSESSMENT

San Bruno, California

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INTRODUCTION

The purpose of this report is to assess potential noise and vibration impacts associated with the proposed 2023-2031 Housing Element Update (HEU). The proposed 2023-2031 Housing Element will replace the existing 2015-2023 Housing Element and serve as the City of San Bruno's guiding policy document for meeting the City's future housing needs at all economic levels. As a policy document, the Housing Element does not result in direct physical changes to the environment but would indirectly lead to physical environmental changes by enabling the development of approximately 2,708 additional housing units within the City's jurisdiction. All future housing development in the City must comply with the General Plan, zoning ordinance, state and federal permits, and local development standards. In addition, future discretionary actions (i.e., use permits, site plan review) require independent and project-specific environmental review to comply with CEQA.

The Noise and Vibration Assessment includes a Setting section providing a brief description of the fundamentals of environmental noise and vibration, summarizes the applicable regulatory criteria, and discusses the results of ambient noise monitoring surveys completed to document existing conditions. The General Plan Consistency section evaluates the noise environment at each of the 23 housing opportunities sites. The Impacts and Mitigation Measures section describes the significance criteria used to evaluate potential impacts, provides a description of each impact, and presents mitigation measures where necessary to provide a guideline for the implementation of the HEU for the City of San Bruno.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level* (*L_{dn} or DNL*) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn} with open windows and 65-70 dBA L_{dn} if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60-70 dBA. Between a L_{dn} of 70-80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
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 micro Pascals.
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 (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

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 method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, 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 or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from “Historic and some old buildings” to “Modern industrial/commercial buildings.” Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at 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.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

REGULATORY BACKGROUND

Regulatory Background - Noise & Vibration

This section describes the relevant guidelines, policies, and standards established by State Agencies and the City of San Bruno. The California Environmental Quality Act (CEQA) Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State CEQA Guidelines. CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

(b) Generation of excessive groundborne vibration or groundborne noise levels;

(c) For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

2019 California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels in multi-family residential units attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA L_{dn} in any habitable room.

Comprehensive Airport Land Use Compatibility Plan for the Environs of San Francisco International Airport. Noise compatibility policies established in this document were designed to protect the public health, safety, and welfare by minimizing the exposure of residents and occupants of future noise-sensitive development to excessive noise and to protect the public interest in providing for the orderly development of SFO by ensuring that new development in the Airport environs complies with all requirements necessary to ensure compatibility with aircraft noise in the area. The intent is to avoid the introduction of new incompatible land uses into the Airport's "noise impact area" so that the Airport will continue to be in compliance with the State Noise Standards for airports (California Code of Regulations, Title 21, Sections 5012 and 5014).1 The following noise compatibility policies (NP) shall apply to the ALUCP and are applicable to this project:

NP-1: Noise Compatibility Zones. For the purposes of this ALUCP, the projected 2020 CNEL noise contour map from the Draft Environmental Assessment for the Proposed Runway Safety Area Program shall define the boundaries within which noise compatibility policies described in this Section shall apply.2 Exhibit IV-5 depicts the noise compatibility zones. More detail is provided on Exhibit IV-6. The zones are defined by the CNEL 65, 70 and 75 dB contours.

NP-2: Airport Noise/Land Use Compatibility Criteria. The compatibility of proposed land uses located in the Airport noise compatibility zones shall be determined according to the noise/land use compatibility criteria shown in Table IV-1. The criteria indicate the maximum acceptable airport noise levels, described in terms of Community Noise Equivalent Level (CNEL), for the indicated land uses. The compatibility criteria indicate whether a proposed land use is "compatible," "conditionally compatible," or "not compatible" within each zone, designated by the identified CNEL ranges.

- "Compatible" means that the proposed land use is compatible with the CNEL level indicated in the table and may be permitted without any special requirements related to the attenuation of aircraft noise.

- "Conditionally compatible" means that the proposed land use is compatible if the conditions described in Table IV-1 are met.

- "Not compatible" means that the proposed land use is incompatible with aircraft noise at the indicated CNEL level.

[1] In 2002, the San Mateo County Board of Supervisors declared that the Airport had eliminated its "noise impact area," as defined under state law -- California Code of Regulations, Title 21, Sections 5012 and 5014.
[2] URS Corporation and BridgeNet International. Draft Environmental Assessment, Proposed Runway Safety Area Program, San Francisco International Airport, June 2011.

Table IV-1 Noise/Land Use Compatibility Criteria

	COMMUNITY NOISE EQUIVALENT LEVEL (CNEL)			
LAND USE	**BELOW 65 dB**	**65-70 dB**	**70-75 dB**	**75 dB AND OVER**
Residential				
Residential, single family detached	Y	C	N *(a)*	N
Residential, multi-family and single family attached	Y	C	N *(a)*	N
Transient lodgings	Y	C	C	N
Public/Institutional				
Public and Private Schools	Y	C	N	N
Hospitals and nursing homes	Y	C	N	N
Places of public assembly, including places of worship	Y	C	N	N
Auditoriums, and concert halls	Y	C	C	N
Libraries	Y	C	C	N
Outdoor music shells, amphitheaters	Y	N	N	N
Recreational				
Outdoor sports arenas and spectator sports	Y	Y	Y	N
Nature exhibits and zoos	Y	Y	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N
Golf courses, riding stables, and water recreation	Y	Y	Y	Y
Commercial				
Offices, business and professional, general retail	Y	Y	Y	Y
Wholesale; retail building materials, hardware, farm equipment	Y	Y	Y	Y
Industrial and Production				
Manufacturing	Y	Y	Y	Y
Utilities	Y	Y	Y	Y
Agriculture and forestry	Y	Y *(b)*	Y *(c)*	Y *(c)*
Mining and fishing, resource production and extraction	Y	Y	Y	Y

Notes:

CNEL = Community Noise Equivalent Level, in A-weighted decibels.

Y (Yes) = Land use and related structures compatible without restrictions.

C (conditionally compatible) = Land use and related structures are permitted, provided that sound insulation is provided to reduce interior noise levels from exterior sources to CNEL 45 dB or lower and that an avigation easement is granted to the City and County of San Francisco as operator of SFO. See Policy NP-3.

N (No) = Land use and related structures are not compatible..

(a) Use is conditionally compatible only on an existing lot of record zoned only for residential use as of the effective date of the ALUCP. Use must be sound-insulated to achieve an indoor noise level of CNEL 45 dB or less from exterior sources. The property owners shall grant an avigation easement to the City and County of San Francisco prior to issuance of a building permit for the proposed building or structure. If the proposed development is not built, then, upon notice by the local permitting authority, SFO shall record a notice of termination of the avigation easement.

(b) Residential buildings must be sound-insulated to achieve an indoor noise level of CNEL 45 dB or less from exterior sources.

(c) Accessory dwelling units are not compatible.

SOURCES: Jacobs Consultancy Team 2010. Based on State of California General Plan Guidelines for noise elements of general plans; California Code of Regulations, Title 21, Division 2.5, Chapter 6, Section 5006; and 14 CFR Part 150, Appendix A, Table 1.
PREPARED BY; Ricondo & Associates, Inc., June 2012.

NP-3: Grant of Avigation Easement. Any action that would either permit or result in the development or construction of a land use considered to be conditionally compatible with aircraft noise of CNEL 65 dB or greater shall be subject to this easement requirement. The determination of conditional compatibility shall be based on the criteria presented in Table IV-1 "Noise/Land Use Compatibility Criteria."

The San Mateo County Airport Land Use Commission (the C/CAG Board) deems it necessary to: (1) ensure the unimpeded use of airspace in the vicinity of SFO; (2) to ensure that new noise-sensitive land uses within the CNEL 65 dB contour are made compatible with aircraft noise, in accordance with California Code of Regulations, Title 21, Section 5014; and (3) to provide notice to owners of real property near the Airport of the proximity to SFO and of the potential impacts that could occur on the property from airport/aircraft operations. Thus, C/CAG shall condition its approval of proposed development upon the owner of the subject property granting an avigation easement to the City and County of San Francisco, as the proprietor of SFO. The local government with the ultimate permitting and approval authority over the proposed development shall ensure that this condition is implemented prior to final approval of the proposed development. If the approval action for the proposed development includes construction of a building(s) and/or other structures, the local permitting authority shall require the grant of an avigation easement to the City and County of San Francisco prior to issuance of a building permit(s) for the proposed building or structure. If the proposed development is not built, then, upon notice by the local permitting authority, SFO shall record a notice of termination of the avigation easement.

The avigation easement to be used in fulfilling this condition is presented in Appendix G.

NP-4: Residential Uses Within CNEL 70 dB Contour. As described in Table IV-1, residential uses are not compatible in areas exposed to noise above CNEL 70 dB and typically should not be allowed in these high noise areas.

> *NP-4.1: Situations Where Residential Use Is Conditionally Compatible.* Residential uses are considered conditionally compatible in areas exposed to noise above CNEL 70 dB only if the proposed use is on a lot of record zoned exclusively for residential use as of the effective date of the ALUCP. In such a case, the residential use must be sound-insulated to achieve an indoor noise level of CNEL 45 dB or less from exterior sources. The property owner also shall grant an avigation easement to the City and County of San Francisco in accordance with Policy NP-3 prior to issuance of a building permit for the proposed building or structure.

City of San Bruno General Plan. The City of San Bruno's General Plan includes a Noise section within the Health and Safety Element which provides guidelines to achieve the goal of maintaining an acceptable community noise level. The following general plan policies are applicable to the project:

> HS-32 Encourage developers to mitigate ambient noise levels adjacent to major noise sources by incorporating acoustical site planning into their projects. Utilize the City's Building Code to implement mitigation measures, such as:

- Incorporating buffers and/or landscaped berms along high-noise roadways or railways;
- Incorporating traffic calming measures and alternative intersection design within and/or adjacent to the project;
- Using reduced-noise pavement (rubberized asphalt); and
- Incorporating state-of-the-art structural sound attenuation measures.

HS-33 Prevent the placement of new noise-sensitive uses unless adequate mitigation is provided. Establish insulation requirements as mitigation measures for all development, per the standards in Table 7-1.

HS-35 Require developers to comply with relevant noise insulation standards contained in Title 24 of the California Code of Regulations (Part 2, Appendix Chapter 12A).

HS-36 Encourage developers of new residential projects to provide noise buffers other than sound walls, such as vegetation, storage areas, or parking, as well as site planning and locating bedrooms away from noise sources.

HS-37 Require that all sponsors of new housing (residential and senior housing units) record a notice of Fair Disclosure, regarding the proximity of the proposed development to San Francisco International Airport and of the potential impacts of aircraft operation, including noise impacts, per Ordinance 1646 and AB 2776.

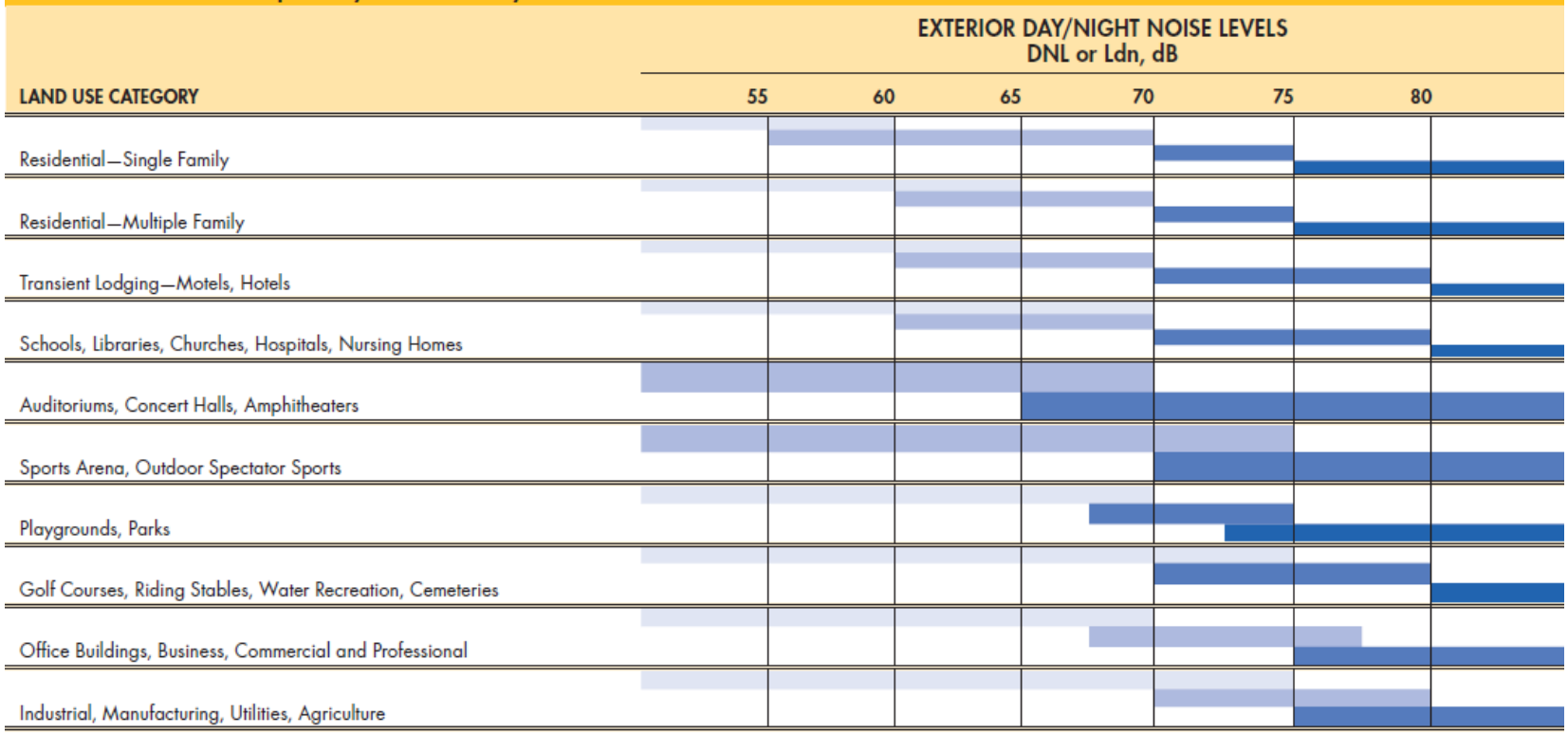
HS-38 Require developers to mitigate noise exposure to sensitive receptors from construction activities. Mitigation may include a combination of techniques that reduce noise generated at the source, increase the noise insulation at the receptor, or increase the noise attenuation rate as noise travels from the source to the receptor.

Areas outside of 60 dB or greater airport noise contours are subject to land use compatibility noise standards shown in Table 7-2.

HS-40 Prohibit new residential development within the 70+ Airport CNEL areas, as dictated by Airport Land Use Commission infill criteria.

HS-42 Require new residential development within the 65 dBA CNEL SFO noise contour to submit an avigation easement to the airport. Specific avigation easement requirements shall be consistent with the County of San Mateo Comprehensive Airport-Land Use Compatibility Plan for SFO.

TABLE 7-2: Land Use Compatibility For Community Noise Environments



INTERPRETATION

Normally Acceptable	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
Conditionally Acceptable	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design.
Normally Unacceptable	New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
Clearly Unacceptable	New construction or development should not be undertaken.

HEALTH AND SAFETY ELEMENT 7-17

Source: San Bruno General Plan, 2009

City of San Bruno Municipal Code. San Bruno's Noise Ordinance is contained in Title 6 of the San Bruno Municipal Code. The ordinance places limits on noise levels in residential zones, limits construction activity noise levels near residential zones, establishes machinery noise level limits, and addresses amplified sounds. The following ordinances are applicable to the project:

> 6.16.030 Ambient noise level limits. When the ambient noise level is less than designated in this section, the respective noise level in this section shall govern.

TABLE 4 San Bruno Municipal Code Ambient Noise Level Limits (dBA)

Zone	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Residential	60	45

> 6.16.050 Noise levels exceeding ambient base level. Any noise level exceeding the zone ambient base level at the property plane of any property, or exceeding the zone ambient base level on any adjacent residential area zone line or at any place of other property (or, if a condominium or apartment house, within any adjoining apartment) by more than ten decibels shall be deemed to be prima facie evidence of a violation of the provisions of this chapter. However, during the period of seven a.m. to ten p.m. the ambient base level may be exceeded by twenty decibels for a period not to exceed thirty minutes during any twenty-four-hour period.

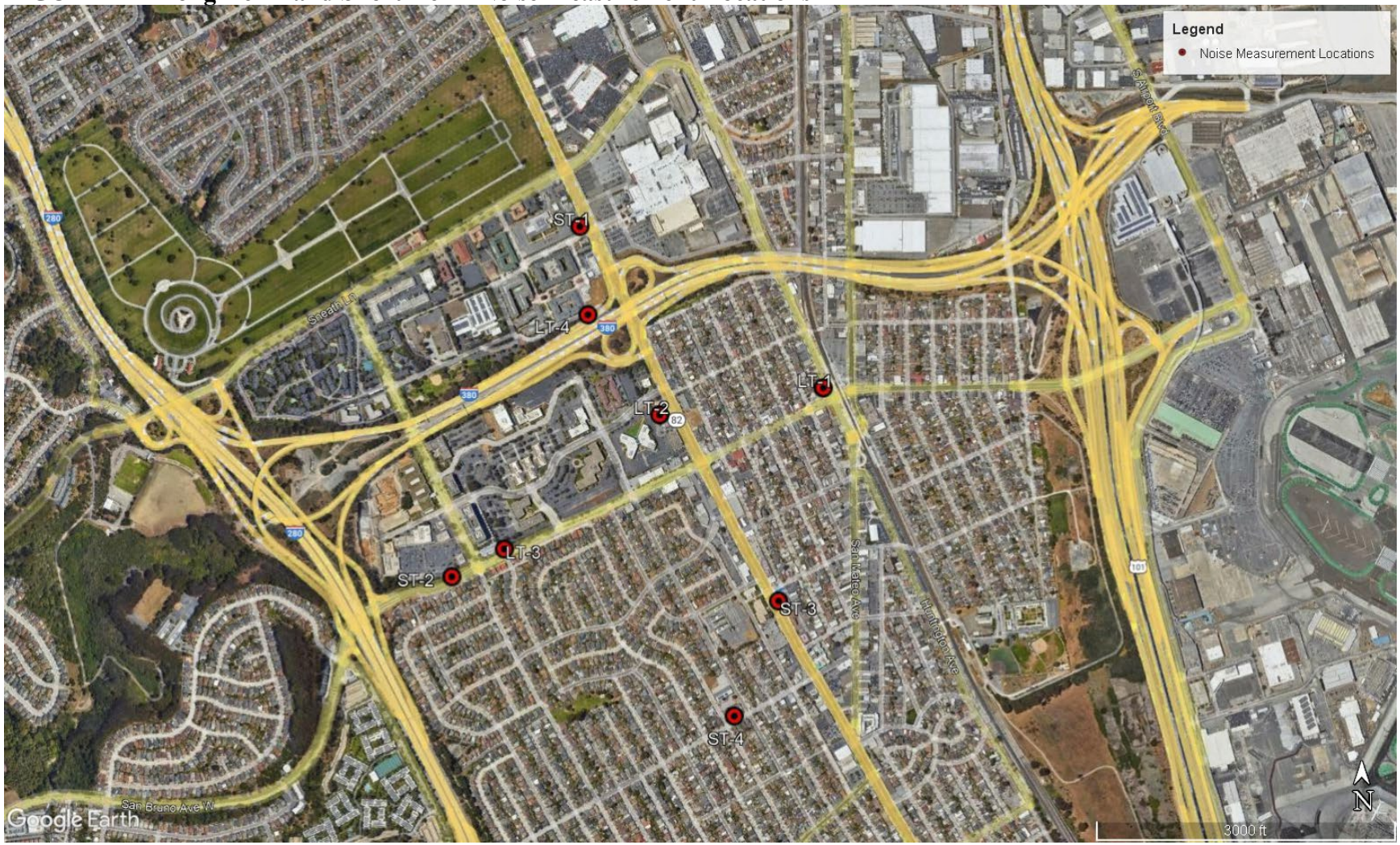
> 6.16.060 Machinery noise levels. No person shall operate any machinery, equipment, pump, fan, air conditioning apparatus or similar mechanical device in any manner so as to create any noise which would cause the noise level at the property plane of any property to exceed the ambient base noise level by more than ten decibels. However, during the period of seven a.m. to ten p.m. the ambient noise level may be exceeded by twenty decibels for a period not to exceed thirty minutes during any twenty-four-hour period.

> 6.16.070 Construction of buildings and projects. No person shall, within any residential zone, or within a radius of five hundred feet therefrom, operate equipment or perform any outside construction or repair work on any building, structure, or other project, or operate any pile driver, power shovel, pneumatic hammer, derrick, power hoist, or any other construction-type device which shall exceed, between the hours of seven a.m. and ten p.m., a noise level of eighty-five decibels as measured at one hundred feet, or exceed between the hours of ten p.m. and seven a.m. a noise level of sixty decibels as measured at one hundred feet, unless such person shall have first obtained a permit therefor from the director of public works. No permit shall be required to perform emergency work.

NOISE MEASUREMENT SURVEY

A noise monitoring survey was performed from Wednesday, August 17, 2022, through Friday, August 19, 2022. The survey included four (4) long-term (LT) noise measurements and four (4) short-term (ST) noise measurements to quantify existing ambient noise levels in and around the identified housing opportunity sites. Long-term noise measurement data is provided in Appendix A. Noise measurement locations are shown in Figure 1.

FIGURE 1 Long-Term and Short-Term Noise Measurement Locations



Source: Google Earth 2022

Long-Term Noise Measurements

Noise measurement LT-1 was at Housing Opportunity Site 21. LT-1 was located about 45 feet west of the Huntington Avenue centerline. Traffic along Huntington Avenue, railroad noise from the UPRR tracks, and aircraft noise from San Francisco International Airport were the primary sources of noise in the area. Hourly average noise levels ranged from 65 to 73 dBA L_{eq} during the day and from 57 to 71 dBA L_{eq} at night. The average noise exposure level at this location on Thursday, August 18, 2022 was 73 dBA L_{dn}. Figures A1 through A3 in Appendix A show the trend in noise levels throughout the measurement period from August 17, 2022 to August 19, 2022.

Noise measurement LT-2 was at Housing Opportunity Site 20. LT-2 was located about 140 feet west of the El Camino Real centerline. Traffic along El Camino Real and aircraft noise from San Francisco International Airport were the primary sources of noise in the area. Hourly average noise levels ranged from 64 to 68 dBA L_{eq} during the day and from 58 to 68 dBA L_{eq} at night. The average noise exposure level at this location on Thursday, August 18, 2022 was 71 dBA L_{dn}. Figures A4 through A6 in Appendix A show the trend in noise levels throughout the measurement period from August 17, 2022 to August 19, 2022.

Noise measurement LT-3 was at Housing Opportunity Site 13. LT-3 was located about 65 feet north of the San Bruno Avenue centerline. Traffic along San Bruno Avenue was the primary source of noise in the area. Hourly average noise levels ranged from 64 to 72 dBA L_{eq} during the day and from 56 to 65 dBA L_{eq} at night. The average noise exposure level at this location on Thursday, August 18, 2022 was 69 dBA L_{dn}. Figures A7 through A9 in Appendix A show the trend in noise levels throughout the measurement period from August 17, 2022 to August 19, 2022.

Noise measurement LT-4 was made at a location representative of Housing Opportunity Site 14. LT-4 was located about 165 feet north of the I-380 centerline. Traffic along I-380 was the primary source of noise in the area. Hourly average noise levels ranged from 68 to 72 dBA L_{eq} during the day and from 62 to 71 dBA L_{eq} at night. The average noise exposure level at this location on Thursday, August 18, 2022 was 75 dBA L_{dn}. Figures A10 through A12 in Appendix A show the trend in noise levels throughout the measurement period from August 17, 2022 to August 19, 2022.

Short-Term Noise Measurements

A series of four attended short-term (ST) 10 – minute duration measurements were also made to identify the noise sources that occurred during the measurement and to note the level of noise associated with these identifiable events. The attended measurements assist in quantitatively and qualitatively characterizing the noise environments along the major roadways and in the quieter areas of the city.

Short-term noise measurement ST-1 was conducted on Wednesday, August 17, 2022, between 11:40 a.m. and 11:50 a.m. to document typical noise levels expected at Housing Opportunity Site 19. This location was approximately 85 feet from the centerline of El Camino Real. El Camino Real traffic typically produced noise levels ranging from 58 to 81 dBA, and a jet flyover produced noise levels up to 82 dBA. The 10-minute L_{eq} measured at ST-1 was 71 dBA.

Short-term noise measurement ST-2 was conducted on Wednesday, August 17, 2022, between 12:30 p.m. and 12:40 p.m. to document typical noise levels expected at Housing Opportunity Site 3. This location was approximately 50 feet from the centerline of San Bruno Avenue. San Bruno Avenue traffic typically produced noise levels ranging from 62 to 80 dBA. The 10-minute L_{eq} measured at ST-2 was 70 dBA.

Short-term noise measurement ST-3 was conducted on Friday, August 19, 2022, between 9:20 a.m. and 9:30 a.m. to document typical noise levels expected at Housing Opportunity Site 9. This location was approximately 65 feet from the centerline of El Camino Real. El Camino Real traffic typically produced noise levels ranging from 57 to 76 dBA, and a jet flyover produced noise levels up to 76 dBA. The 10-minute L_{eq} measured at ST-3 was 69 dBA.

Short-term noise measurement ST-4 was conducted on Friday, August 19, 2022, between 9:40 a.m. and 9:50 a.m. to document typical noise levels expected at Housing Opportunity Site 8. This location was approximately 55 feet from the centerline of Jenevein Avenue. Jenevein Avenue traffic typically produced noise levels ranging from 53 to 68 dBA, and two jets produced noise levels ranging from 53 to 55 dBA. The 10-minute L_{eq} measured at ST-4 was 57 dBA. Data collected at short-term sites ST-1 through ST-4 are summarized in Table 5.

TABLE 5 Summary of Short-Term Noise Measurement Data

Noise Measurement Location (Date, Time)	Measured Noise Level, dBA						
	L_{max}	L_{min}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: ~85 feet from El Camino Real centerline (8/17/2022, 11:40 – 11:50 am)	82	58	80	74	68	60	71
ST-2: ~50 feet from San Bruno Avenue centerline (8/17/2022, 12:30 – 12:40 pm)	84	57	80	72	66	61	70
ST-3: ~65 feet from El Camino Real centerline (8/19/2022, 9:20 – 9:30 am)	82	55	76	74	64	58	69
ST-4: ~55 feet from Jenevein Avenue centerline (8/19/2022, 9:40 – 9:50 am)	71	44	67	60	54	47	57

GENERAL PLAN CONSISTENCY ANALYSIS

The noise exposures of housing projects facilitated by the HEU are not considered under CEQA. This section addresses Noise and Land Use Compatibility for consistency with the policies set forth in the City's General Plan.

Noise and Land Use Compatibility

The applicable San Bruno General Plan policies were presented in detail in the Regulatory Background section. Noise and Land Use Compatibility guidelines for new development are identified in General Plan Table 7-2. Single-family residential is considered "Normally Acceptable" up to 60 dBA L_{dn} and multiple-family residential is considered "Normally

Acceptable" up to 65 dBA L_{dn}. In the following discussion, the noise and land use compatibility is evaluated for HEU site. Noise control measures are discussed including site planning, sound walls, and detailed analysis per the requirements of the State Building Code leading to building sound insulation treatments.

El Camino Real Corridor. Housing opportunity sites 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 14, 16, 17, 18, 19, 20, 22, and 23 are proposed along the El Camino Real corridor. The noise exposure produced by ground transportation at sites adjoining El Camino Real is 70 – 75 dBA L_{dn}. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design." The noise exposure at sites along the El Camino Real corridor, not immediately adjacent to the roadway, is 65 – 70 dBA L_{dn}. The noise and land use compatibility designation is "Conditionally Acceptable" where "new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design."

San Bruno Avenue Corridor. Housing opportunity sites 1, 3, 13, 15, and 21 are proposed along the San Bruno Avenue corridor. The noise exposure produced by ground transportation at sites adjoining San Bruno Avenue is 70 – 75 dBA L_{dn}. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design."

I-280 Corridor. Housing opportunity sites 3 and 6 are proposed along the I-280 corridor, and the noise exposure produced by ground transportation at these sites is 70 – 75 dBA L_{dn}. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design."

I-380 Corridor. Housing opportunity sites 14, 18, and 19 are proposed along the I-380 corridor, and the noise exposure produced by ground transportation at these sites is 70 – 75 dBA L_{dn}. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design."

General Plan policies HS-32, HS-33, HS-35, and HS-36 establish a framework that will result in new housing included in the HEU to be compatible with the noise environments where they would be located. The following measures, applied individually or in combination, are recommended to implement the policies:

1) Utilize site planning to minimize noise impacts to outdoor activity areas. Consider locating non-noise sensitive uses, such as parking (e.g., carports), adjacent to roadways, and using

the residential buildings to provide shielding for common outdoor use areas. Site planning is critical for sites proposed in "Normally Unacceptable" noise environments.

2) Construct noise barriers where necessary to shield outdoor activity areas from local street traffic noise. Barriers 6 - 10 feet high can provide the 5 – 10 dBA of the noise reduction necessary to make the "Conditionally Acceptable" noise environment compatible. The final location, heights, and designs of barriers will be determined during development of the site plan.

3) General Plan policy HS-35 stipulates that residential developers shall comply with relevant noise insulation standards to maintain indoor noise levels at or below 45 dBA Ldn. Where exterior noise levels would exceed 60 dBA L_{dn}, an analysis detailing the treatments incorporated into the building plans shall be prepared and submitted to the City Building Department prior to issuance of a building permit. The report shall demonstrate that the design would achieve an interior level of 45 dBA L_{dn} or less in all habitable residential areas.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise and vibration resulting from the project:

1. **Temporary or Permanent Noise Increases in Excess of Established Standards.** A significant impact would be identified if project construction or operations would result in a substantial temporary or permanent increase in ambient noise levels at sensitive receivers in excess of the local noise standards contained in the San Bruno General Plan or Municipal Code, as follows:

    - Temporary Noise Increase. A significant temporary noise impact would be identified if construction noise levels would exceed the noise limits specified in the San Bruno Municipal Code . Pursuant to Section 6.16.070, noise from construction activities within any residential zone, or within 500 feet of any residential zone, is limited to 85 dBA, as measured at 100 feet from the source between the hours of 7:00 a.m. and 10:00 p.m., unless a permit has been obtained to exceed this level. Between the hours of 10:00 p.m. and 7:00 a.m., construction noise is limited to 60 dBA at 100 feet from the source, unless a permit is obtained.

    - Permanent Noise Increase. A significant impact would be identified if traffic or school activity noise generated by the project would substantially increase noise levels at sensitive receivers in the vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less

than 60 dBA L_{dn}, or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater.

2. **Generation of Excessive Groundborne Vibration.** A significant impact would be identified if the construction of the project would generate excessive vibration levels. Groundborne vibration levels exceeding 0.25 in/sec PPV would be considered excessive as such levels would have the potential to result in cosmetic damage to historic and some old buildings. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to buildings that are found to be structurally sound but where structural damage is a major concern, and groundborne vibration levels exceeding 0.5 in/sec PPV would have the potential to result in cosmetic damage to buildings that are structurally sound and designed to modern engineering standards.

Impact 1: **Permanent or Temporary Noise Increases in Excess of Established Standards.** Increased vehicle traffic due to the HEU would not result in a substantial permanent increase traffic noise levels along area roadways. Construction activities facilitated by the HEU would not result in substantial temporary noise increases that would be in excess of applicable local standards at nearby sensitive receptors. **This is a less-than-significant impact.**

Permanent Noise Increases from Project Traffic

Increases in traffic noise gradually degrade the environment in areas sensitive to noise. According to CEQA, "a substantial increase" is necessary to cause a significant environmental impact. An increase of 3 dBA L_{dn} is considered substantial as it would represent a just-noticeable difference. Vehicular traffic on roadways in the City would increase as development occurs and the City's population increases. These projected increases in traffic would, over time, increase noise levels throughout the community.

The results presented in Table 6 indicate that project-generated traffic noise levels would generally increase by 0 to 1 dBA L_{dn} due to anticipated traffic volume increases along major roadways in San Bruno. The traffic noise increases attributable to the implementation of the HEU would not result in a substantial permanent increase noise levels in the community. This is a less-than-significant impact.

TABLE 6 PM Peak Hour Traffic Volumes and Project-Generated Traffic Noise Increases

Roadway	Location	PM Peak Hour Volumes				Project Noise Increase (dBA)	
		Existing	Existing + Project	Background	Background + Project	Versus Existing	Versus Background
Sneath Lane	W. of I-280 SB Ramp	896	986	1,335	1,425	0.4	0.3
Sneath Lane	E. of I-280 NB Ramp	1,448	1,534	2,486	2,572	0.3	0.1
El Camino Real	N. of I-380 WB Ramp	4,562	4,922	4,676	5,036	0.3	0.3
El Camino Real	S. of I-380 EB Ramp	3,673	3,901	5,028	5,256	0.3	0.2
El Camino Real	N. of Crystal Springs	3,180	3,349	3,978	4,147	0.2	0.2
El Camino Real	S. of Crystal Springs	3,382	3,542	4,180	4,340	0.2	0.2
San Bruno Avenue	W. of El Camino Real	1,607	1,899	3,068	3,360	0.7	0.4
San Bruno Avenue	E. of El Camino Real	1,531	1,645	2,052	2,166	0.3	0.2
Huntington Avenue	N. of San Mateo Avenue	1,226	1,232	1,229	1,235	0.0	0.0
San Mateo Avenue	S. of Huntington	715	721	715	721	0.0	0.0
Crystal Springs	W. of El Camino Real	802	811	802	811	0.0	0.0

Note: As of November 18, 2022, the project assumes 138 single-family detached, 835 low-rise apartment, and 1,735 mid-rise apartment units. This results in an increase of 356 daily trips distributed throughout the City. A new trip distribution analysis was not prepared, but this very minor increase in daily trips would not change the noise analysis or conclusions.

Temporary Noise Increases from Project Construction

Background Information on Construction Noise

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas near noise-sensitive land uses, or when construction lasts over extended periods of time.

Typically, construction activities would be carried out in stages. During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary within stages, based on the amount of equipment in operation and the location at which the equipment is operating. Typical construction noise levels at a distance of 50 feet are shown in Tables 7 and 8. Table 7 shows the average noise level ranges, by construction phase, and Table 8 shows the maximum noise level ranges for different construction equipment. Most demolition and construction noise falls in the range of 80 to 90 dBA at 50 feet from the source. Construction-generated noise levels drop off/increase at a rate of about 6 dBA per doubling/halving of the distance between the source and receptor. Shielding by buildings or terrain can provide an additional 5 to 10 dBA noise reduction at distant receptors.

TABLE 7 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	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: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 8 Construction Equipment 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)1,2	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Ballast Equalizer[3]	82	Continuous
Ballast Tamper[3]	83	Continuous
Bar Bender	80	Continuous
Chain Saw	85	Continuous
Compressor (air)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rail Saw[3]	90	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tie Cutter[3]	84	Continuous
Tie Handler[3]	80	Continuous
Tie Inserter[3]	85	Continuous
Tractor	84	Continuous
Truck	84	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes: [1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant. [2]Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.[3] Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, FTA Report No. 0123, September 2018., [4] Mitigation of Nighttime Construction Noise, Vibrations and Other Nuisances, National Cooperative Highway Research Program, 1999.

Construction Noise Criteria

A significant temporary noise impact would be identified if construction noise levels would exceed the noise limits specified in the Municipal Code. Pursuant to San Bruno Municipal Code Section 6.16.070, noise from construction activities within any residential zone, or within 500 feet of any residential zone, is limited to 85 dBA, as measured at 100 feet from the source between the hours of 7:00 a.m. and 10:00 p.m., unless a permit has been obtained to exceed this level. Between the hours of 10:00 p.m. and 7:00 a.m., construction noise is limited to 60 dBA at 100 feet from the source, unless a permit is obtained.

Construction Noise Impact Assessment

Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels for each phase of construction, assuming the two loudest pieces of equipment would operate simultaneously, as recommend by the FTA for construction noise evaluations. This construction noise model includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power.

For the purposes of analyzing a credible worst-case scenario, the construction equipment and phasing information of an example 90-unit multi-family project was used to calculate construction noise levels on an hourly basis (Hourly L_{eq}). The construction noise levels would represent the majority of residential construction projects anticipated under the HEU, although the duration of the project would vary depending on the size of the project. Equipment expected to be used in each construction phase are summarized in Table 9, along with the quantity of each type of equipment, the reference noise level at 50 feet assuming the operation of the two loudest pieces of construction equipment, and the estimated noise levels at the nearest property lines projected from the center of the construction activity by phase. Construction noise levels were also calculated at distances of 100, 200, 400, and 500 feet. As shown in Table 9, credible worst-case construction noise levels are expected range from 71 to 80 dBA L_{eq} at 100 feet from the noise source. These levels are below the City's daytime construction noise standard of 85 dBA at a distance of 100 feet.

TABLE 9 Construction Noise Levels

Phase	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} and L_{dn} (dBA) From Operation of Two Loudest Pieces of Construction Equipment				
		Noise Level at 50 feet	Noise Level at 100 feet	Noise Level at 200 feet	Noise Level at 400 feet	Noise Level at 500 feet
Demolition	Concrete/Industrial Saw (1)* Excavator (2) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (2)*	85	79	73	67	65
Site Preparation	Grader (2)* Rubber-Tired Dozer (2) Tractor/Loader/Backhoe (2)	84	78	72	66	64
Grading/ Excavation	Excavator (4) Grader (2) Rubber Tired Dozer (1) Concrete/Industrial Saw (2)* Tractor/Loader/Backhoe (2)	86	80	74	68	66
Trenching/ Foundation	Excavator (2)* Tractor/Loader/Backhoe (2)*	82	76	70	64	62
Building Exterior	Crane (3) Forklift (2) Generator Set (1)* Tractor/Loader/Backhoe (2)* Welders (2)	82	76	70	64	62
Building Interior/ Architectural Coating	Aerial Lift (2) Air Compressor (10)*	77	71	65	59	57
Paving	Cement and Mortar Mixer (4) Paver (4) Paving Equipment (4) Roller (4) Tractor/Loader/Backhoe (4)*	83	77	71	65	63

*Denotes two loudest pieces of construction equipment per phase

Although, the impact resulting from project construction would be less-than-significant, a series of construction noise control best practices are included in order to reduce construction noise levels as low as possible:

- Require noise reduction measures during all phases of construction activity to minimize the exposure of neighboring properties to excessive noise levels. Construction activities shall be required to comply with the City's Municipal Code noise level limitations during hours of operation;

- Construction equipment shall be well-maintained and used judiciously to be as quiet as practical;

- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment;

- Utilize "quiet" models of air compressors and other stationary noise sources where technology exists;

- Locate all stationary noise-generating equipment, such as air compressors and portable power generators, away from noise-sensitive receptors;

- Locate staging areas and construction material areas away from noise-sensitive receptors;

- Prohibit all unnecessary idling of internal combustion engines;

- Consider temporary noise barriers during construction phases involving earth moving equipment (e.g., grading operations) where they would be effective in reducing the construction noise impact, when directly adjoining sensitive receptors. An eight-foot plywood noise barrier could reduce noise levels by at least 5 dBA.

- Designate a "disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and will require that reasonable measures warranted to correct the problem be implemented. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule.

Implementation of the best management practices above would limit construction hours and reduce construction noise levels at noise sensitive locations to the extent feasible. Since construction noise is expected to be below the applicable City limits during daytime hours, and construction activities would not be expected at night, daytime construction noise from the HEU would not result in a substantial temporary increase in noise levels that would be in excess of applicable local standards, resulting in a less-than-significant impact.

Mitigation Measures: **No additional measures are required.**

Impact 2: **Exposure to Excessive Groundborne Vibration during Construction.** Construction activities occurring as part of the project could expose sensitive land uses to excessive groundborne vibration. This is a **significant** impact.

The California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV to avoid damage to buildings that are structurally sound and designed to modern engineering standards, a vibration limit of 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a vibration limit of 0.25 in/sec PPV for historic and some old buildings.

Construction equipment such as pile drivers are known to generate substantial vibration levels that if used in the vicinity of sensitive land uses may expose persons to excessive vibration levels as well as have the potential to damage buildings. Other construction equipment such as bulldozers and vibratory rollers do not create the vibration levels of pile drivers; however, these types of equipment are more likely to operate continuously and closer to sensitive receptors, and they may expose persons to excessive vibration levels. Foundation construction techniques involving impact or vibratory pile driving equipment, which can cause excessive vibration, are not expected with the proposed HEU.

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 10 presents typical vibration levels that could be expected from construction equipment at a distances of 25 feet to 100 feet. Vibration levels would be higher at distances less than 25 feet and lower at distances greater than 100 feet. Vibration levels would also vary depending on soil conditions, construction methods, and equipment used. Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet.

TABLE 10 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	PPV at 50 ft. (in/sec)	PPV at 100 ft. (in/sec)
Clam shovel drop		0.202	0.094	0.044
Hydromill (slurry wall)	in soil	0.008	0.004	0.002
	in rock	0.017	0.008	0.004
Vibratory Roller		0.210	0.098	0.046
Hoe Ram		0.089	0.042	0.019
Large bulldozer		0.089	0.042	0.019
Caisson drilling		0.089	0.042	0.019
Loaded trucks		0.076	0.035	0.017
Jackhammer		0.035	0.016	0.008
Small bulldozer		0.003	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., August 2022.

Table 11 summarizes the minimum safe setback distances to maintain in order to achieve the 0.25 in/sec PPV threshold for historical buildings and the 0.3 in/sec and 0.5 in/sec PPV thresholds for modern buildings.

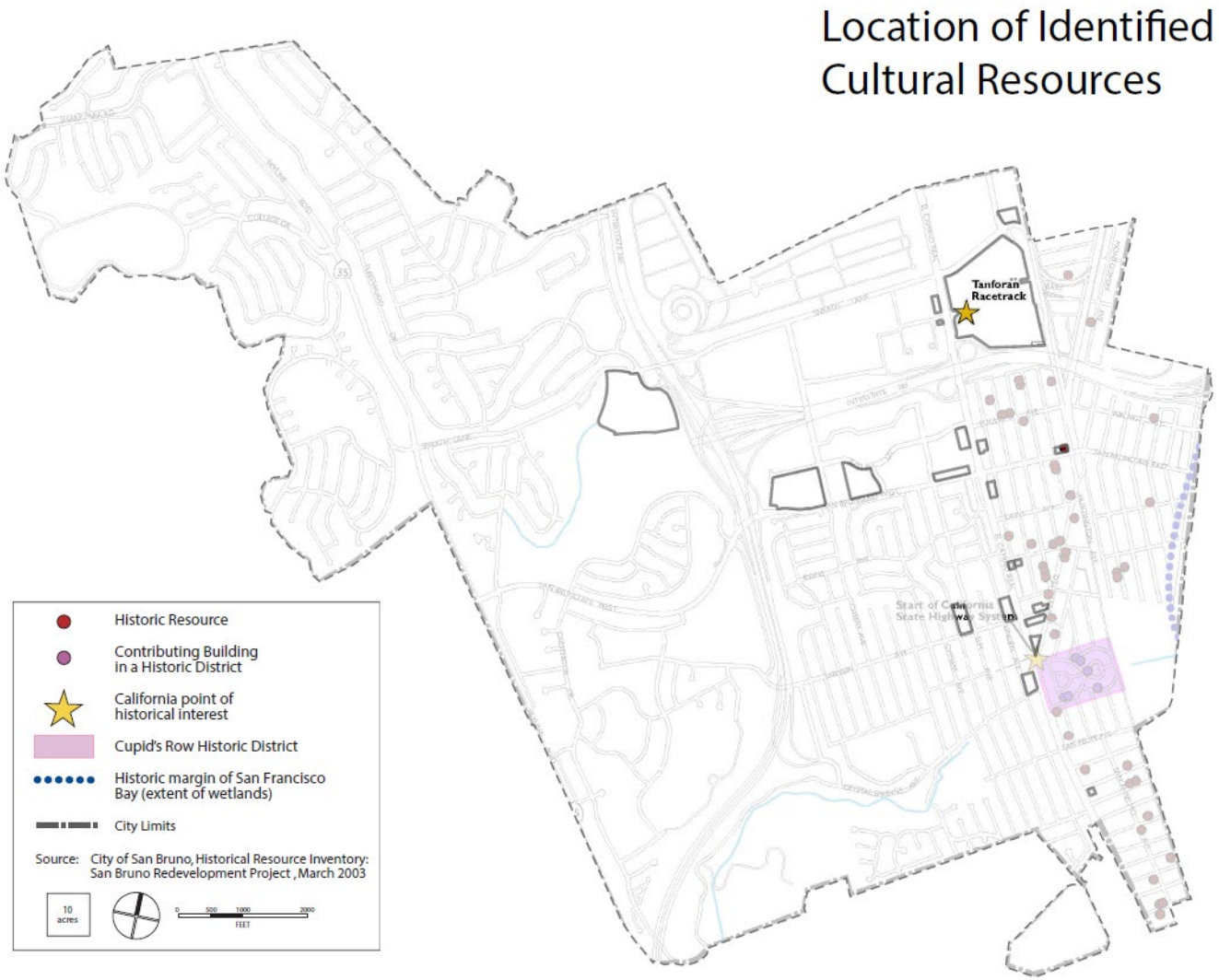
TABLE 11 Vibration Source Levels for Construction Equipment and Minimum Safe Setbacks

Equipment		Minimum Safe Setback (feet) 0.25 in/sec PPV	Minimum Safe Setback (feet) 0.30 in/sec PPV	Minimum Safe Setback (feet) 0.50 in/sec PPV
Clam shovel drop		21	18	11
Hydromill (slurry wall)	in soil	<1	<1	<1
	in rock	3	2	2
Vibratory Roller		22	19	12
Hoe Ram		10	9	6
Large bulldozer		10	9	6
Caisson drilling		10	9	6
Loaded trucks		9	8	5
Jackhammer		5	4	3
Small bulldozer		<1	<1	<1

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., August 2022.

Figure 3 shows the location of the HEU sites and the mapped historic resources identified in the City's General Plan EIR.

FIGURE 3 HEU Sites and Mapped Historic Resources



A review of Figure 3 shows that HEU Sites 15 and 21 would occupy the same site or replace an existing historic resource (Yeo Lai Sah Buddhist Temple) at the northwest corner of the Huntington Avenue/San Bruno Avenue West intersection. All other HEU sites would be 40 feet or further from existing historic resources, but would be bordered by modern buildings. Since specific future projects within the City are unknown at this time, it is conservatively assumed that the construction areas associated with these future projects could be located within the minimum safe setback distances identified in Table 11. For projects that produce vibration levels exceeding the thresholds, construction vibration would be expected to cause both human annoyance and the possibility of cosmetic damage, resulting in a significant impact.

Mitigation Measure 2:

Groundborne vibration studies shall be prepared by qualified professionals in accordance with industry-accepted methodology where heavy construction activities involving significant site grading, underground, or foundation work will occur within 25 feet of residential or other vibration sensitive uses. The industry-accepted methodologies include the recommended vibration assessment procedure and thresholds provided by public agencies such as Caltrans or the Federal Highway Administration. The studies should identify necessary construction vibration controls to reduce both human annoyance and the possibility of cosmetic damage. Controls shall include, but not be limited to, the following measures:

- A list of all heavy construction equipment to be used for this project known to produce high vibration levels (tracked vehicles, vibratory compaction, jackhammers, hoe rams, etc.) shall be submitted to the City by the contractor. This list shall be used to identify equipment and activities that would potentially generate substantial vibration and to define the level of effort for reducing vibration levels below the thresholds.

- Place operating equipment on the construction site as far as possible from vibration-sensitive receptors.

- Use smaller equipment to minimize vibration levels below the limits.

- Avoid using vibratory rollers and tampers near sensitive areas.

- Select demolition methods not involving impact tools.

- Modify/design or identify alternative construction methods to reduce vibration levels below the limits.

- Avoid dropping heavy objects or materials.

With the implementation of mitigation, short-term construction activities would not expose persons to excessive vibration levels, resulting in a less-than-significant impact.

Impact 3: **Excessive Aircraft Noise.** Proposed housing opportunity sites would be subject to noise levels produced by San Francisco International Airport operations exceeding 65 dBA CNEL. This is a **significant** impact.

Figure 4 shows the proposed housing opportunity sites with respect to the noise exposure contours of San Francisco International Airport. Sites 14, 15, 18, 19, and 21 would be located within the 70 dB CNEL noise contour, while Sites 1, 2, 5, 7, 9, 11, 12, and 20 would be located between the 65 dB and 70 dB CNEL noise contours. Aircraft noise exposures at Sites 1, 2, 5, 7, 9, 11, 12, 14, 15, 18, 19, 20 and 21 would result in a significant noise impact due to aircraft noise exposures.

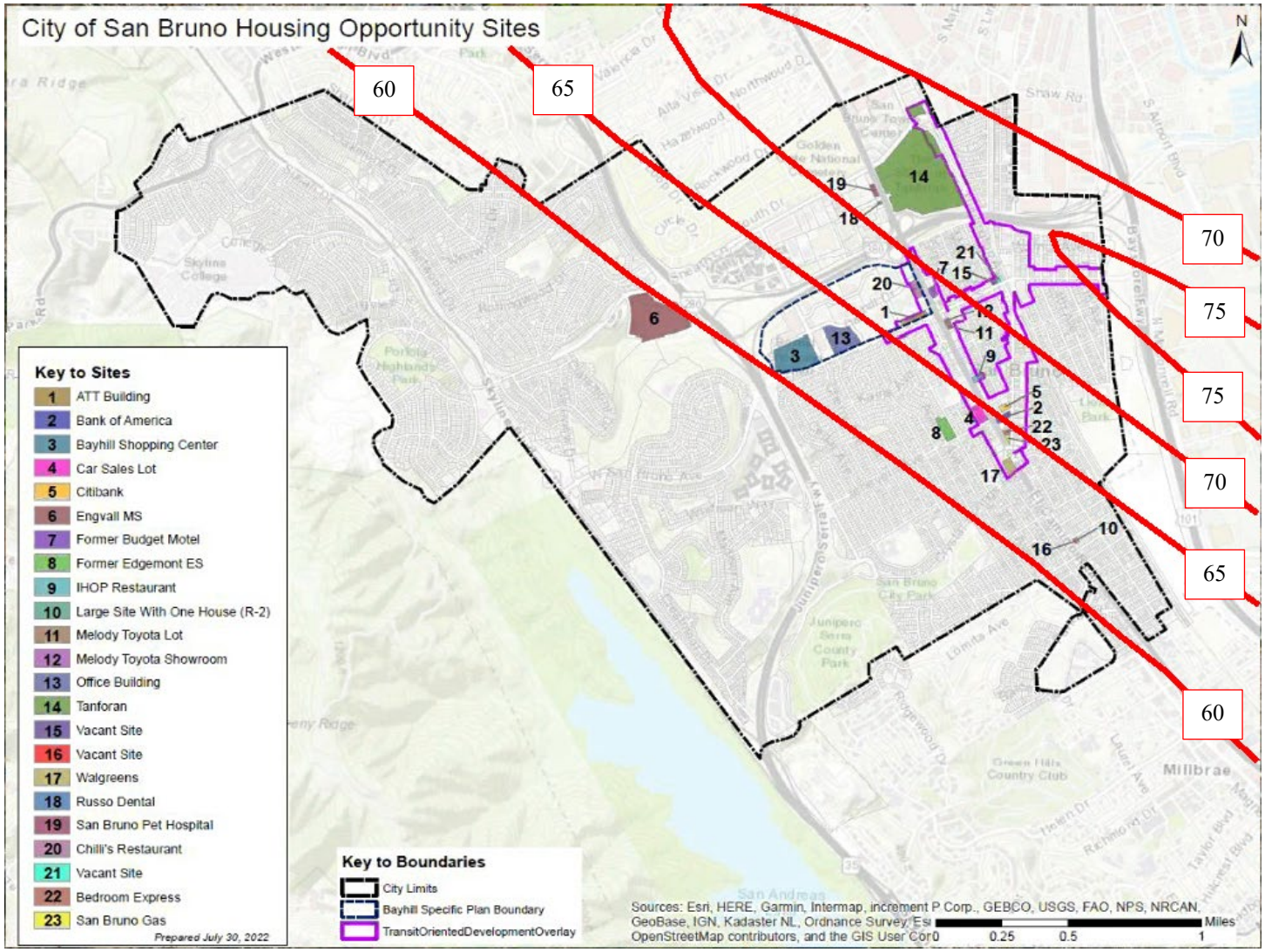
Sites 3, 4, 6, 8, 10, 13, 16, 17, 22, and 23 would be located between the 60 dB and 65 dB CNEL noise contours, which is considered compatible for residences. This is a less-than-significant noise impact.

Mitigation Measure 3:

Implement General Plan Policies HS-33, HS-35, HS-37, HS-40, and HS-42, and Airport Land Use Compatibility Plan Policies NP-1, NP-2, NP-3, and NP-4.

The required safe and compatible threshold for exterior noise levels due to aircraft would be at or below 65 dBA CNEL. Consistent with General Plan Policy HS-42 and Airport Land Use Compatibility Plan Policy NP-3, new residential development within the 65 dBA CNEL noise contour would be required to submit an avigation easement to the airport, and shall be consistent with the County of San Mateo Comprehensive Airport-Land Use Compatibility Plan for SFO. General Plan Policy HS-40 and Airport Land Use Compatibility Plan Policy NP-4 would prohibit new residential development within the 70 dB CNEL noise contour, as dictated by Airport Land Use Commission infill criteria. However, Airport Land Use Compatibility Plan Policy NP-4.1 would allow residential uses in areas exposed to noise above CNEL 70 dB only if the proposed use is on a lot of record zoned exclusively for residential use as of the effective date of the ALUCP and if the residential use is sound-insulated to achieve an indoor noise level of CNEL 45 dB or less from exterior sources. Site 14 is not zoned exclusively for residential use, but noise insulation methods are available to reduce aircraft noise levels at sites within the 70 dB to 75 dB CNEL noise contours to achieve an indoor noise level of 45 dB CNEL or less. General Plan Policy HS-35 would require developers to comply with relevant noise insulation standards to achieve an indoor noise level of 45 dB CNEL or less. The implementation of General Plan and Airport Land Use Compatibility Plan policies and adequate noise insulation would reduce the impact to a less-than-significant level.

FIGURE 4 Housing Opportunity Sites and San Francisco International Airport 2020 Noise Exposure Contours (dB, CNEL)



Noise Contour Source: Comprehensive Airport Land Use Compatibility Plan for the Environs of San Francisco International Airport, Rincondo Associates, November 2012.

Appendix A – Long-Term Noise Data

Noise Levels at Noise Measurement Site LT-1
~45 feet West of the Centerline of Huntington Avenue, San Bruno, CA
Wednesday, August 17, 2022

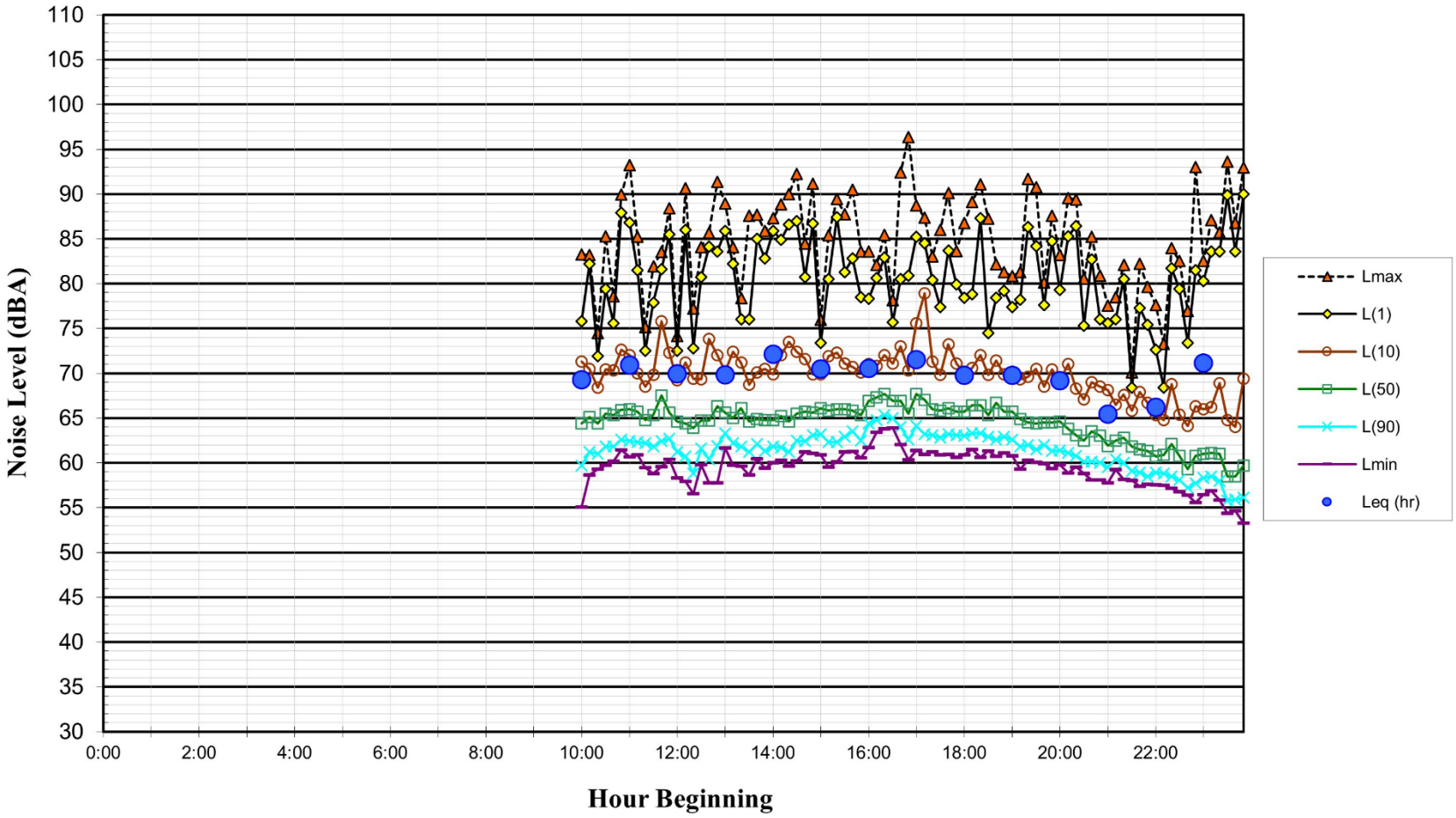


FIGURE A1

Noise Levels at Noise Measurement Site LT-1
~45 feet West of the Centerline of Huntington Avenue, San Bruno, CA
Thursday, August 18, 2022

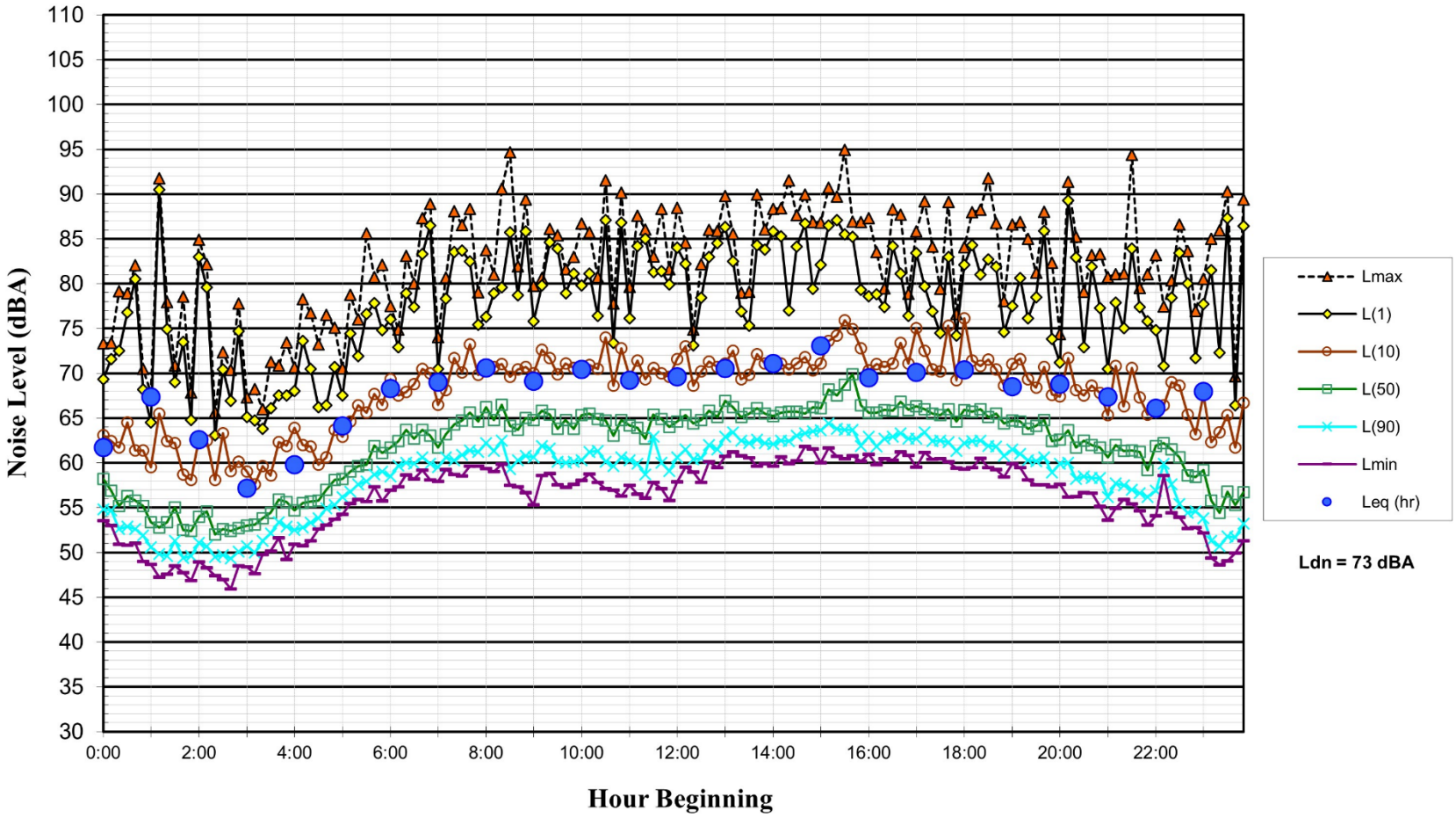


FIGURE A2

Noise Levels at Noise Measurement Site LT-1
~45 feet West of the Centerline of Huntington Avenue, San Bruno, CA
Friday, August 19, 2022

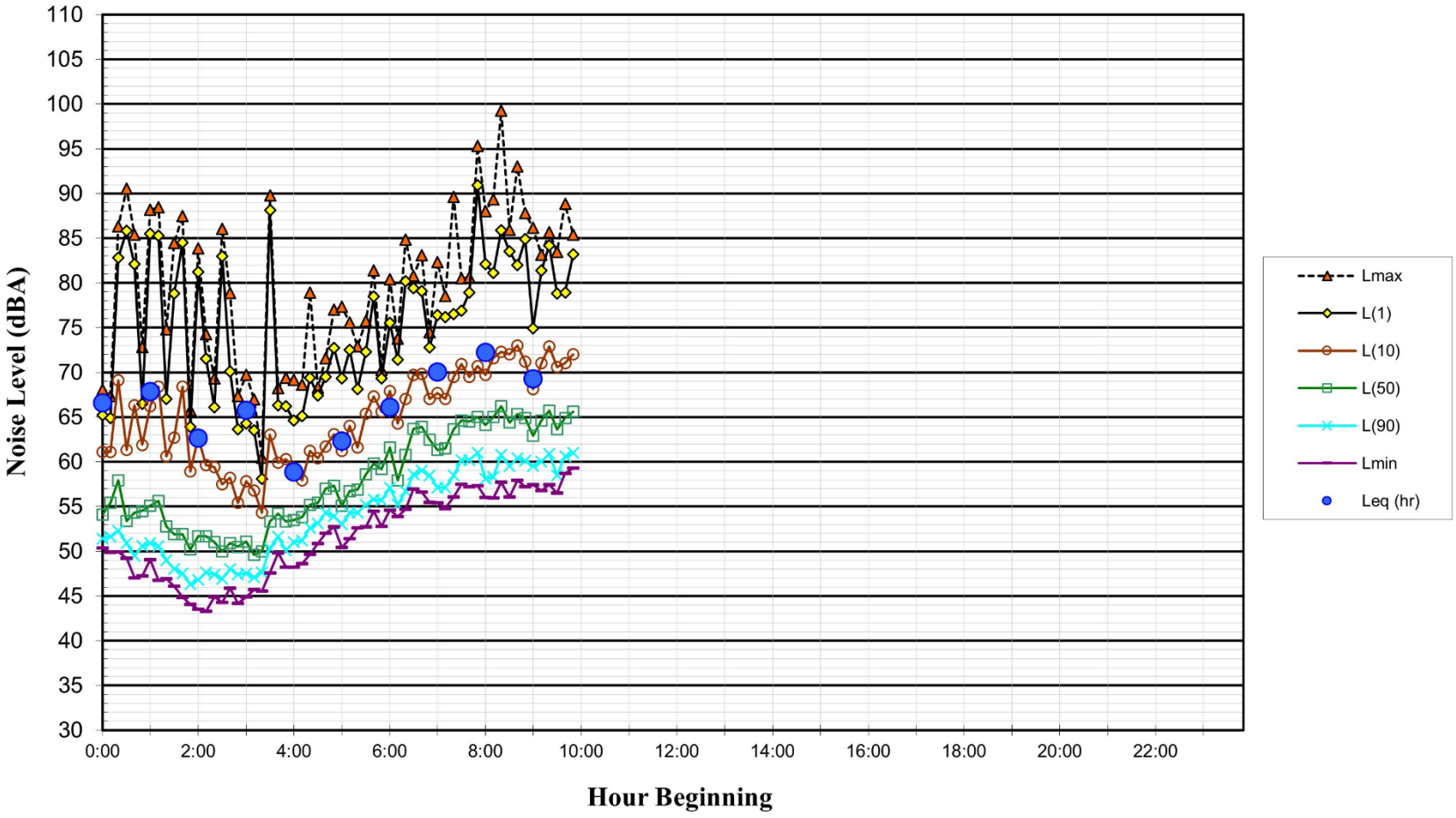


FIGURE A3

Noise Levels at Noise Measurement Site LT-2
~140 feet West of the Centerline of El Camino Real, San Bruno, CA
Wednesday, August 17, 2022

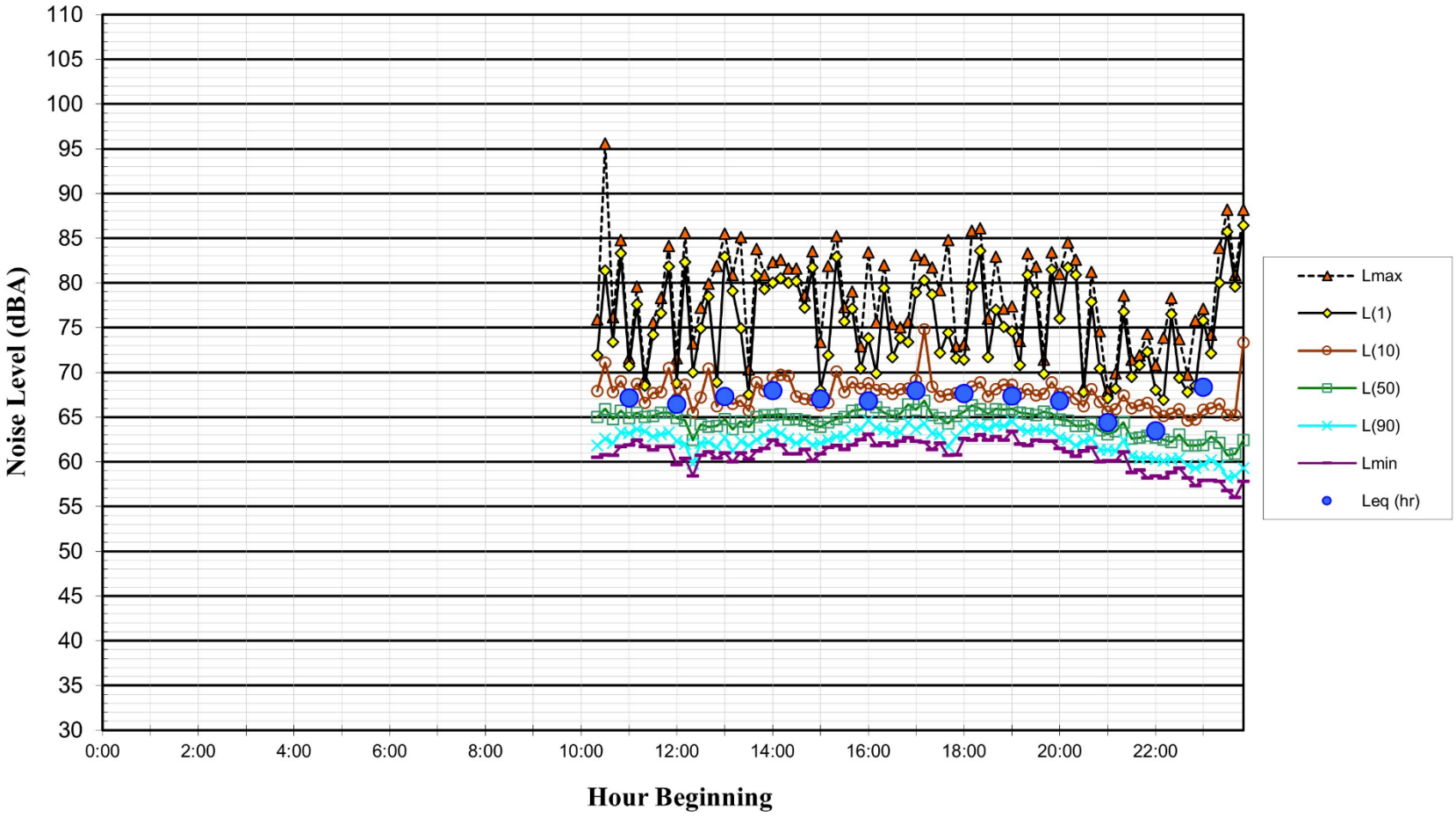
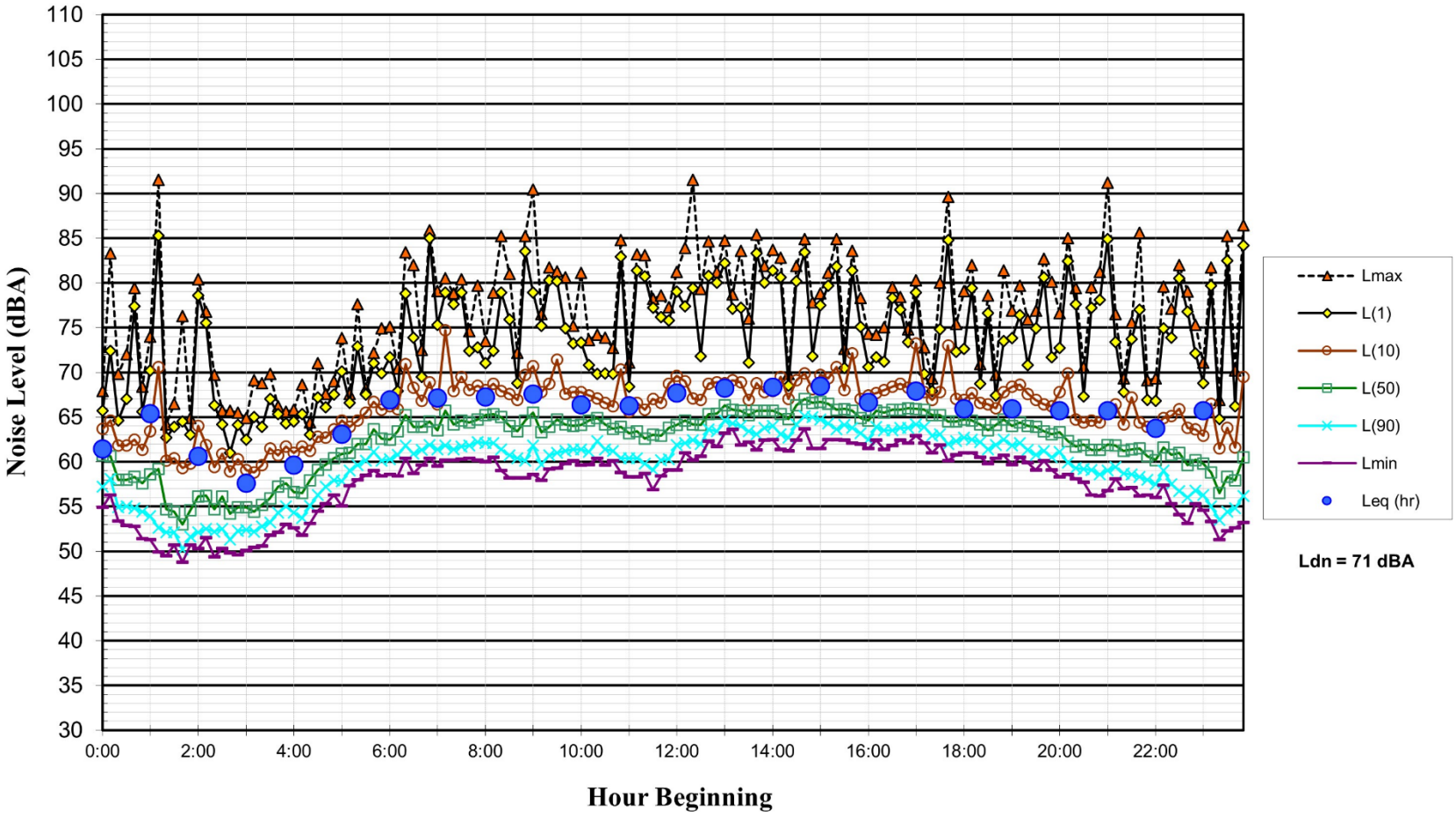


FIGURE A4

Noise Levels at Noise Measurement Site LT-2
~140 feet West of the Centerline of El Camino Real, San Bruno, CA
Thursday, August 18, 2022



Ldn = 71 dBA

FIGURE A5

Noise Levels at Noise Measurement Site LT-2
~140 feet West of the Centerline of El Camino Real, San Bruno, CA
Friday, August 19, 2022

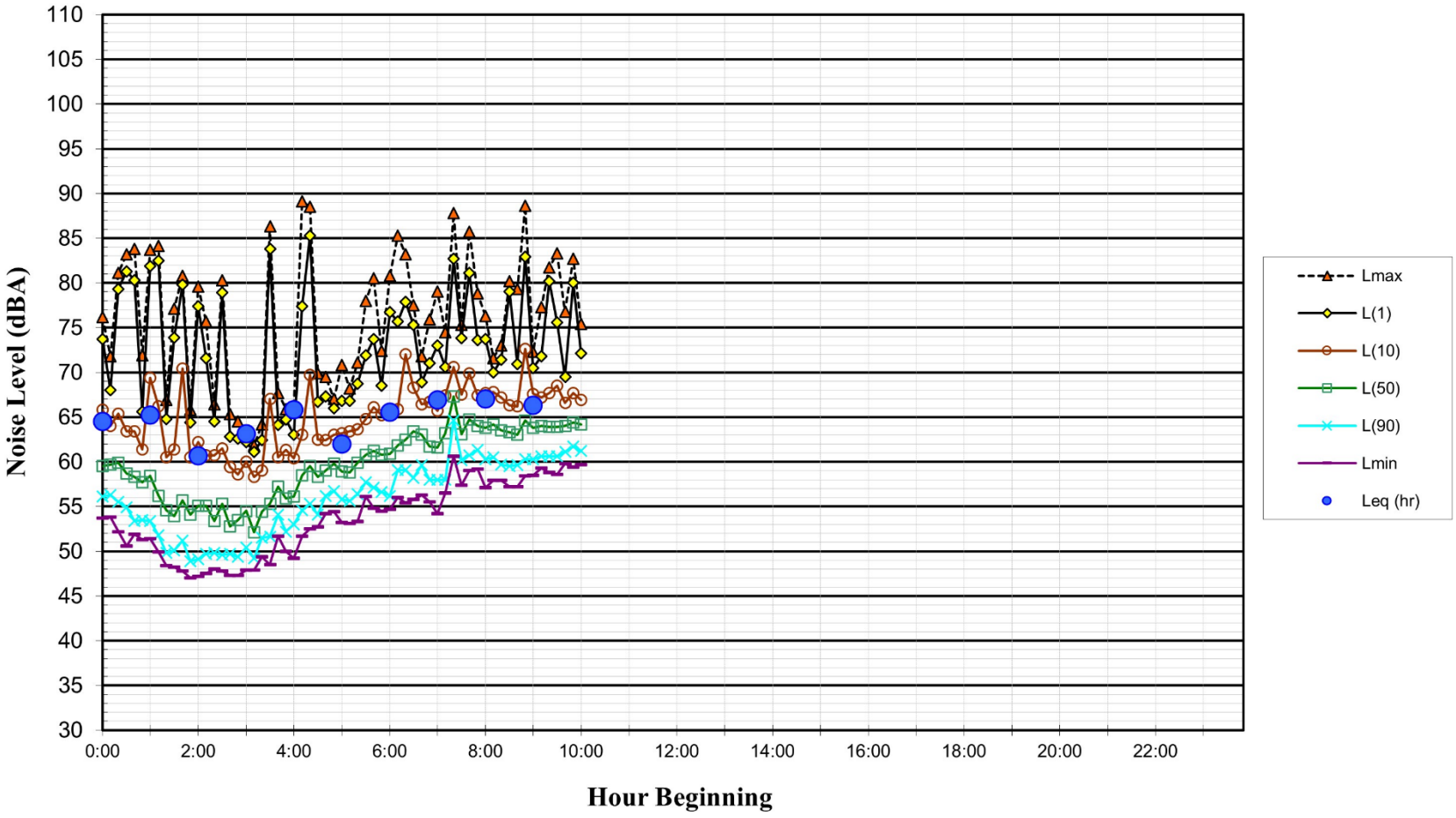


FIGURE A6

Noise Levels at Noise Measurement Site LT-3
~65 feet North of the Centerline of San Bruno Avenue, San Bruno, CA
Wednesday, August 17, 2022

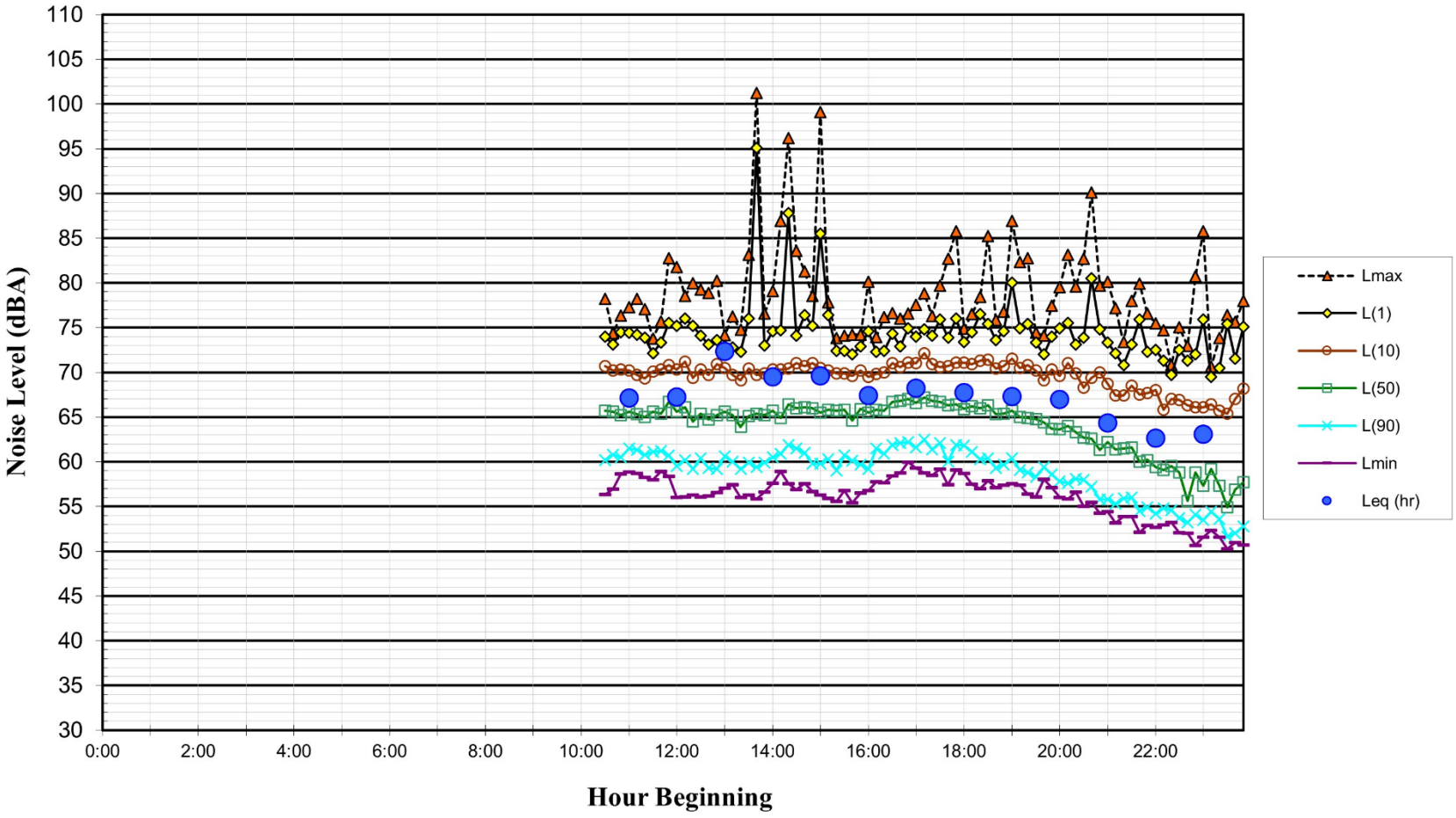


FIGURE A7

Noise Levels at Noise Measurement Site LT-3
~65 feet North of the Centerline of San Bruno Avenue, San Bruno, CA
Thursday, August 18, 2022

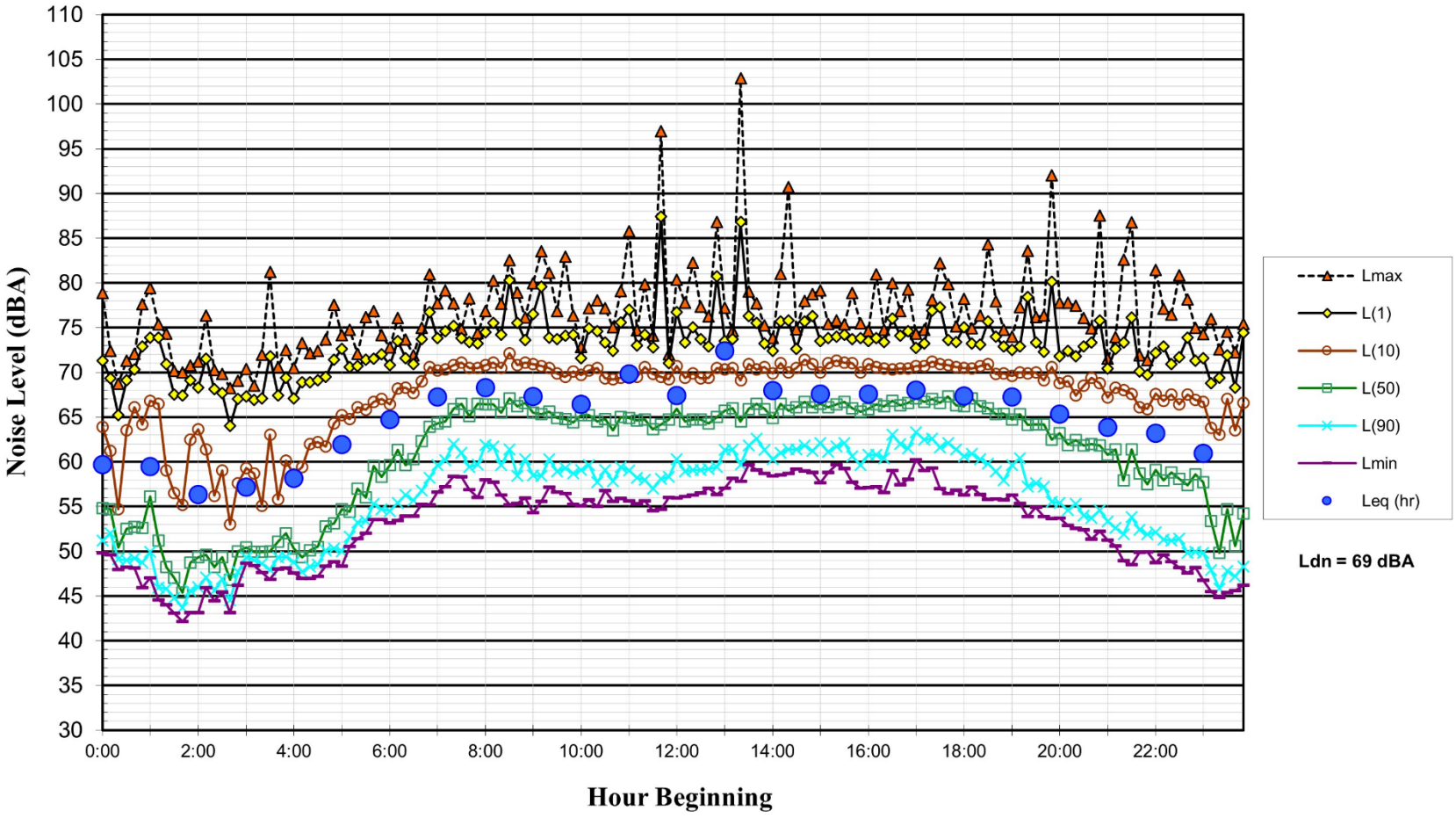


FIGURE A8

Noise Levels at Noise Measurement Site LT-3
~65 feet North of the Centerline of San Bruno Avenue, San Bruno, CA
Friday, August 19, 2022

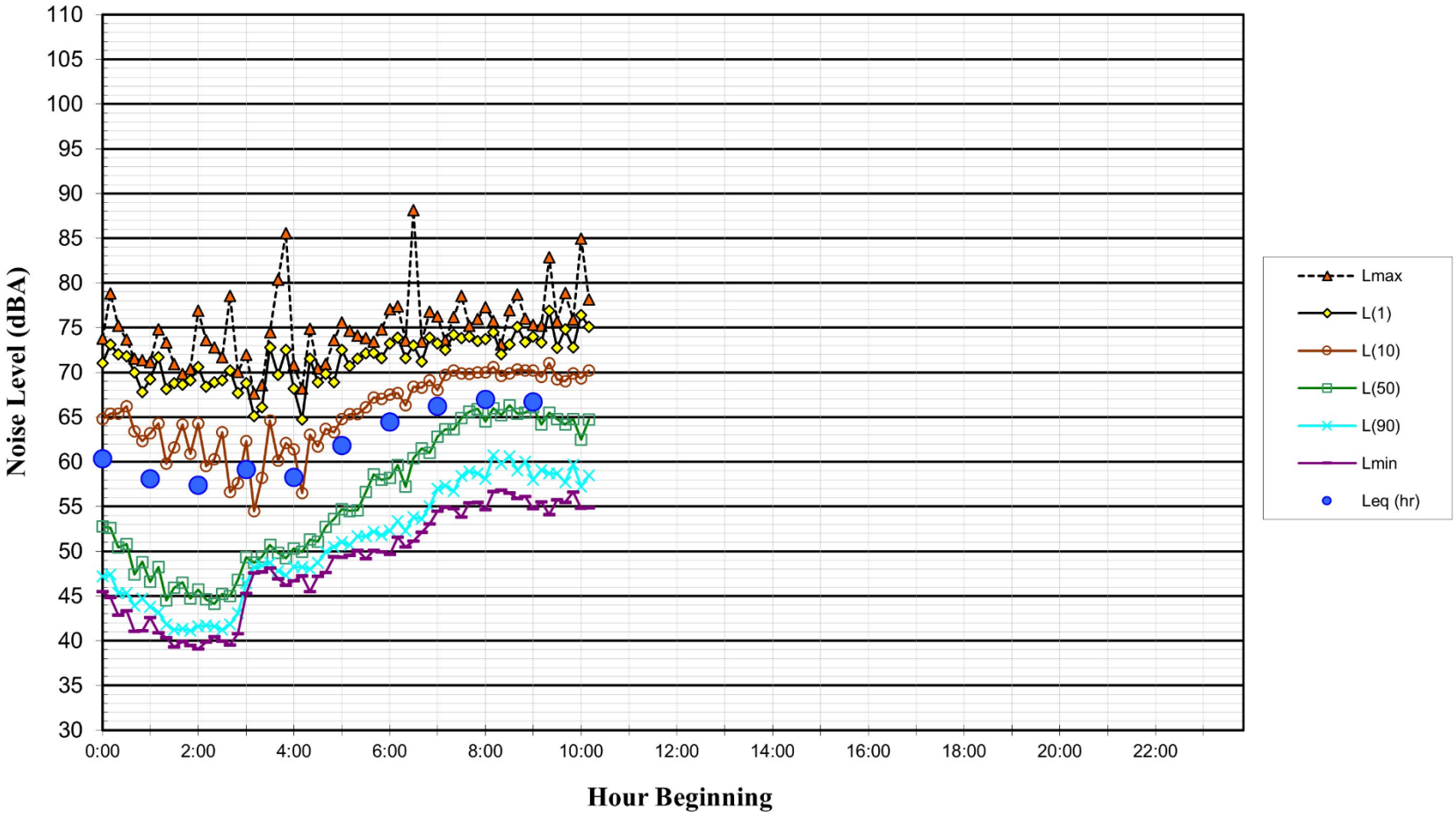


FIGURE A9

Noise Levels at Noise Measurement Site LT-4
~165 feet North of the Centerline of I-380, San Bruno, CA
Wednesday, August 17, 2022

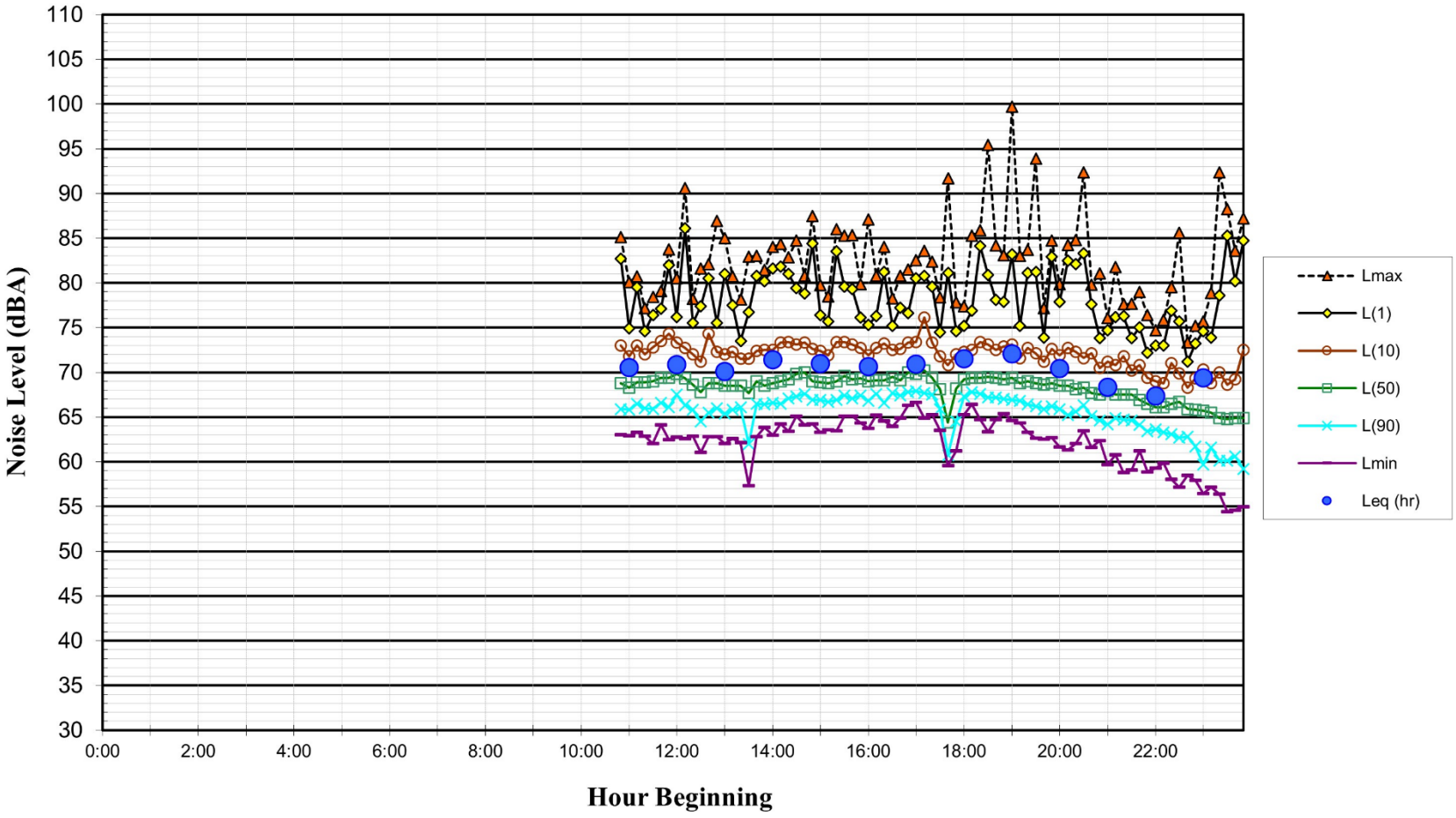


FIGURE A10

Noise Levels at Noise Measurement Site LT-4
~165 feet North of the Centerline of I-380, San Bruno, CA
Thursday, August 18, 2022

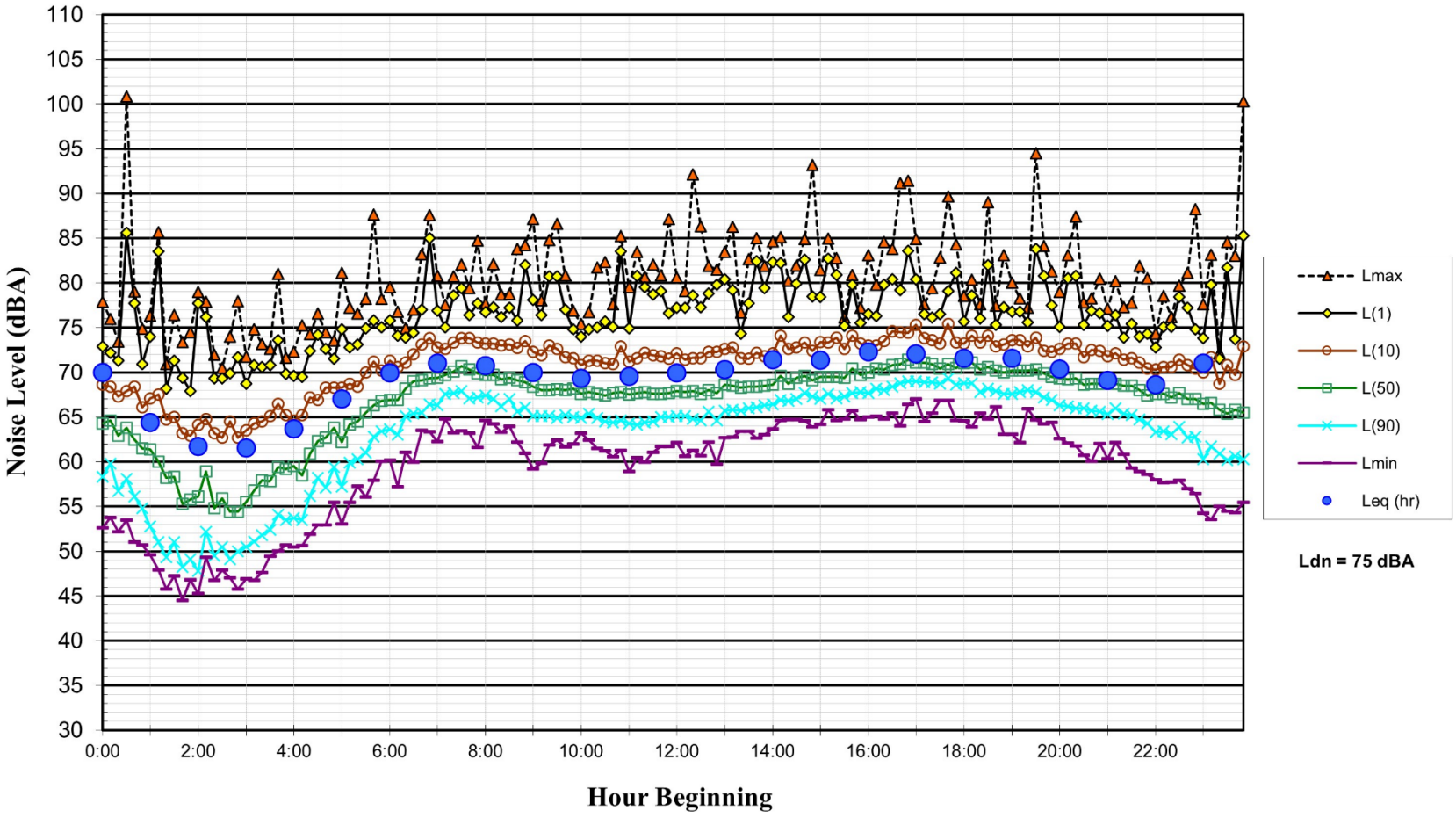


FIGURE A11

Noise Levels at Noise Measurement Site LT-4
~165 feet North of the Centerline of I-380, San Bruno, CA
Friday, August 19, 2022

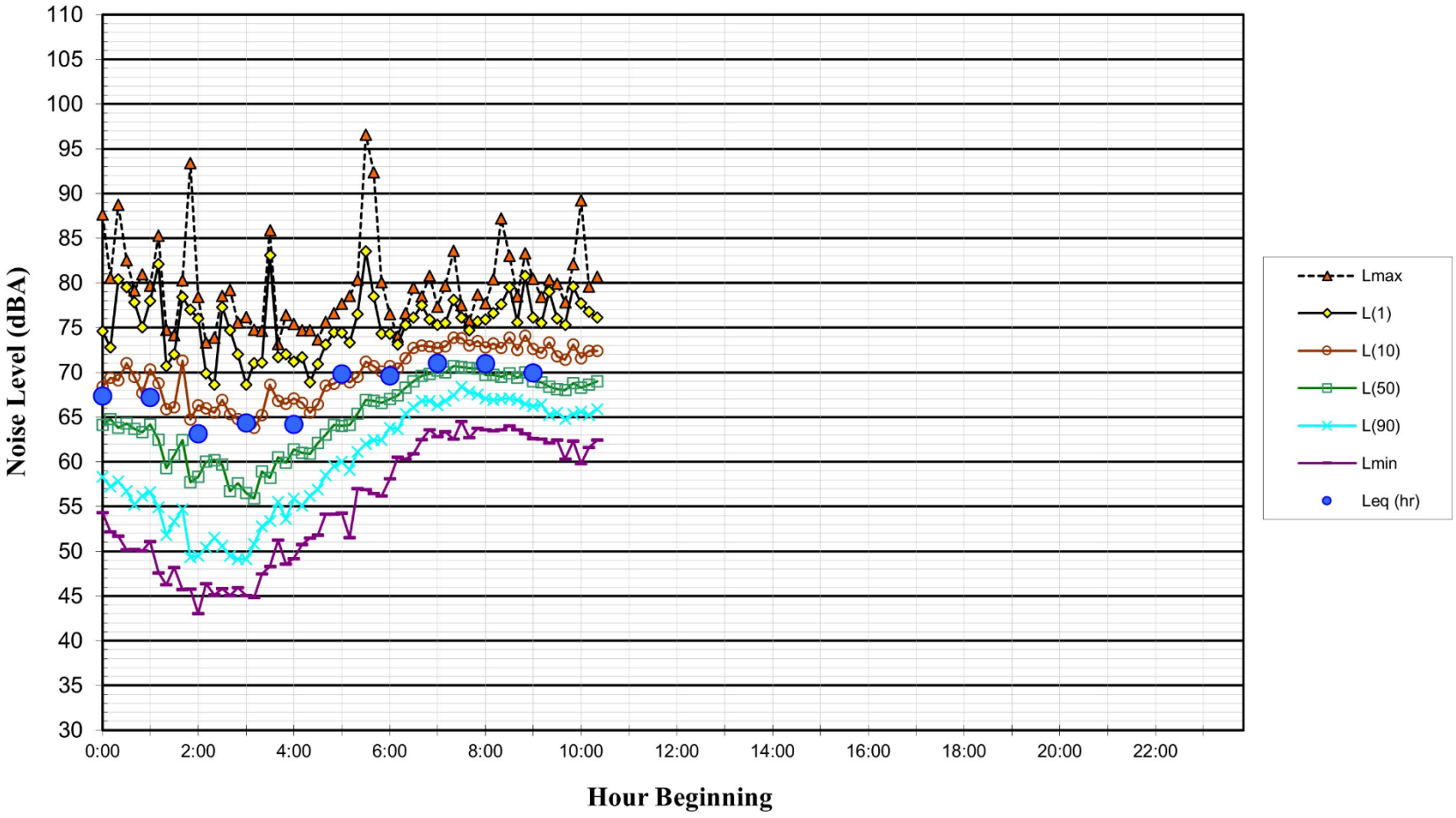


FIGURE A12