BRADSHAW TERMINAL EXPANSION NOISE AND VIBRATION ASSESSMENT

Rancho Cordova, California

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INTRODUCTION

Kinder Morgan operates the existing Bradshaw Terminal located in Rancho Cordova, California. The terminal currently receives refined petroleum, biodiesel and blending products through pipelines and trucks for storage and distribution. The objective of this project is to increase the terminals renewable products throughput by designing and constructing new renewable and bio diesel railcar unloading systems, storage tanks, and truck loading systems.

The project involves the design of new rail spurs and unloading equipment on the east side of the terminal limits, with a capacity to offload up to 22 railcars per day. All 22 offloading spots will be capable of offloading Renewable Diesel. Two locations are capable of offloading both Renewable Diesel and B100 Bio diesel. A third location will be dedicated to offload Renewable Diesel but includes a connection for B100 Bio diesel to offload any out of place bio railcars. Renewable diesel will be discharged to a new 80,000-barrel (BBL) storage tank (70,000 BBL working cap), while B100 biodiesel will be stored at either the existing 5,000 BBL B-7 tank, or a new 15,000 BBL tank. The new storage tanks will be installed at the northwest side of the terminal within an existing containment area. The Bradshaw Terminal expansion will also involve construction of a new truck rack capable of loading up to 20,000 BBLs/day of renewable, California Air Resources Board (CARB), and B100 bio diesel through two bays. A new rail spur will be constructed into the terminal that connects to the existing Union Pacific Railroad (UPRR) track located within the existing Sacramento Regional Transit Authority (SacRT) right-of-way immediately north of the terminal. A new railcar run-around track will be constructed off the existing UPRR track in the existing SacRT right-of-way east of the terminal.

This report evaluates the Project's potential to result in significant noise and vibration impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into two sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise and vibration, summarizes applicable regulatory criteria, and discusses the results of the ambient noise and vibration monitoring surveys completed to document existing conditions; and, 2) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents mitigation measures, where necessary, to reduce the identified impacts to a less-than-significant level.

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 p.m. - 10:00 p.m.) and a 10 dB addition to nocturnal (10:00 p.m. - 7:00 a.m.) noise levels. The *Day/Night Average Sound Level* (L_{dn}) 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.

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.

Railroad and light-rail operations are potential sources of substantial ground vibration depending on distance, the type and the speed of trains, and the type of railroad track. People's response to ground vibration has been correlated best with the average velocity of the ground. Because the net average of a vibration signal is zero, the Root-mean-square (RMS) amplitude is used to describe smoothed vibration amplitude. Although it is not universally accepted, vibration is commonly expressed in decibel notation using a reference velocity of 1 x 10^{-6} in./sec. RMS, which equals 0 VdB, and 1 in./sec. equals 120 VdB. The abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans. Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside residences. Table 4 illustrates some common sources of vibration and the association to human perception or the potential for structural damage.

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 p.m. and 7:00 a.m.
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 p.m.to 10:00 p.m. and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.
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.

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.

TABLE 4 Typical Levels of Groundborne Vibration

Human/Structural Response	Velocity Level, VdB	Typical Events (50-foot setback)
Threshold, minor cosmetic damage for fragile buildings	100	Blasting from construction projects
		Bulldozers and other heavy tracked construction equipment
Difficulty with tasks such as reading a computer screen	90	
		Commuter rail, upper range
Residential annoyance, infrequent events	80	Rapid transit, upper range
Residential annoyance, occasional events		Commuter rail, typical Bus or truck over bump
Residential annoyance, frequent events	70	Rapid transit, typical
Limit for vibration sensitive equipment, Approximate threshold for human		Bus or truck, typical
	60	
		Typical background vibration
	50	

Source: Transit Noise and Vibration Impact Assessment, US Department of Transportation Federal Transit Administration, September 2018.

Regulatory Background

This section describes the relevant guidelines, policies, and standards established by State Agencies and the City of Rancho Cordova. FTA vibration impact assessment criteria for evaluating vibration impacts associated with transit projects are also described. The State 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 (not applicable).

City of Rancho Cordova General Plan: The Noise Element of the Rancho Cordova General Plan specifies the following regarding construction and operational activities:

> **Action N.1.4.1** – Limit construction activity to the hours of 7:00 a.m. to 7:00 p.m. weekdays and 8:00 a.m. to 6:00 p.m. weekends when construction is conducted in proximity to residential uses.
>
> **Policy N.2.2** - Ensure that operational noise levels of new roadway projects will not result in significant noise impacts.
>
> **Action N.2.2.1** - Assess the significance of the noise increase of all roadway improvement projects in existing areas according to the following criteria:
>
> - Where existing traffic noise levels are less than 60 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +5 dB L_{dn} increase in noise levels due to roadway improvement projects will be considered significant; and

- Where existing traffic noise levels range between 60 and 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +3 dB L_{dn} increase in noise levels due to roadway improvement projects will be considered significant; and
- Where existing traffic noise levels are greater than 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +1.5 dB L_{dn} increase in noise levels due to roadway improvement projects will be considered significant.

Table N-1 and N-2 from the City's General Plan specify the following noise thresholds for new projects that include stationary noise sources (Table N-1) or new noise-sensitive land uses (Table N-2).

Table N-1 City Noise Standards – Noise Level Performance Standards for new projects affected by or including non-transportation noise sources

Stationary Noise Source	Noise Level Descriptor	Daytime Maximum (7 a.m. to 10 p.m.)	Nighttime Maximum (10 p.m. to 7 a.m.)
Typical	Hourly L_{eq}, dB	55	45
Tonal, impulsive, repetitive, or consist primarily of speech or music	Hourly L_{eq}, dB	50	40

The City may impose noise level standards which are more or less restrictive than those specified above based upon determination of existing low or high ambient noise levels.

Table N-2 Maximum Transportation Noise Exposure

Land Use	Outdoor Activity areas[1] L_{dn}/CNEL, dB	Interior Spaces	
		L_{dn}/CNEL, dB	Leq, dB[2]
Residential	60[3]	45	--
Residential subject to noise from railroad tracks, aircraft overflights, or similar noise sources which produce clearly identifiable, discrete noise events (e.g., the passing of a single train)	60[3]	40[5]	--
Transient lodging	60[4]	45	--
Hospitals, nursing homes	60[3]	45	--
Theaters, auditoriums, music halls	--	--	35
Churches, meeting halls	60[3]	--	40
Office buildings	--	--	45
Schools, libraries. Museums	--	--	45
Playgrounds, neighborhood parks	70	--	--

[1] *Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use. Where it is not practical to mitigate exterior noise levels at patio or balconies of apartment complexes, a common area such as a pool or recreation area may be designated as the outdoor activity area.*

[2] *As determined for a typical worst-case hour during periods of use.*

[3] *Where it is not possible to reduce noise in outdoor activity areas to 60 dB Ldn/CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB Ldn/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.*

[4] *In the case of hotel/motel facilities or other transient lodging, outdoor activity areas such as pool areas may not be included in the project design. In these cases, only the interior noise level criterion will apply.*

[5] *The intent of this noise standard is to provide increased protection against sleep disturbance for residences located near railroad tracks.*

Rancho Cordova Municipal Code: The following standards have been established in the Code of Ordinances published by the City of Rancho Cordova.

6.68.070 Exterior Noise Standards

a. The following noise standards, unless otherwise specifically indicated in this chapter, shall apply to all properties within a designated noise area.

Noise Area	County Zoning Districts	Time Period	Exterior Noise Standard
1	RE-1, RD-1, RE-2, RD-2, RE-3, RD-3, RD-4, R-1-A, RD-5, R-2, RD-10, R-2A, RD-20, R-3, R-D-30, RD-40, RM-1, RM-2, A-1-B, AR-1, A-2, AR-2, A-5, AR-5	7 a.m.—10 p.m.	55 dBA
		10 p.m.—7 a.m.	50 dBA

b. It is unlawful for any person at any location within the County to create any noise which causes the noise levels on an affected property, when measured in the designated noise area, to exceed for the duration of time set forth following, the specified exterior noise standards in any one hour by:

Cumulative Duration of the Intrusive Sound	Allowance Decibels
1. Cumulative period of 30 minutes per hour	0
2. Cumulative period of 15 minutes per hour	+ 5
3. Cumulative period of 5 minutes per hour	+10
4. Cumulative period of 1 minute per hour	+15
5. Level not to be exceeded for any time per hour	+20

c. Each of the noise limits specified in subdivision (b) of this section shall be reduced by five dBA for impulsive or simple tone noises, or for noises consisting of speech or music.

d. If the ambient noise level exceeds that permitted by any of the first four noise-limit categories specified in subdivision (b), the allowable noise limit shall be increased in five dBA increments in each category to encompass the ambient noise level. If the ambient noise level exceeds the fifth noise level category, the maximum ambient noise level shall be the noise limit for that category.

6.68.090 Exemptions. The following activities shall be exempted from the provisions of this chapter:

e. Noise sources associated with construction, repair, remodeling, demolition, paving or grading of any real property, provided said activities do not take place between the hours of eight p.m. and six a.m. on weekdays and Friday commencing at eight p.m. through and including seven a.m. on Saturday; Saturdays commencing at eight p.m. through and including seven a.m. on the next following Sunday and on each Sunday after the hour of eight p.m. Provided, however, when an unforeseen or unavoidable condition occurs during a construction project and the nature of the project necessitates that work in process be continued until a specific phase is completed, the contractor or owner shall be allowed to continue work after eight p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner;

6.68.120 Machinery, Equipment, Fans and Air Conditioning.

a. It is unlawful for any person to operate any mechanical equipment, pump, fan, air conditioning apparatus, stationary pumps, stationary cooling towers, stationary compressors, similar mechanical devices, or any combination thereof installed after July 1, 1976 in any manner so as to create any noise which would cause the maximum noise level to exceed:

1. Sixty dBA at any point at least one foot inside the property line of the affected residential property and three to five feet above ground level;
2. Fifty-five dBA in the center of a neighboring patio three to five feet above ground level;
3. Fifty-five dBA outside of the neighboring living area window nearest the equipment location. Measurements shall be taken with the microphone not more than three feet from the window opening but at least three feet from any other surface.

b. Equipment installed five years after July 1, 1976 must comply with a maximum limit of fifty-five dBA at any point at least one foot inside the property line of the affected residential property and three to five feet above ground level.

c. Equipment installed before December 17, 1970 must comply with a limit of sixty-five dBA maximum in sound level at any point at least one foot inside the affected property line and three to five feet above ground level by January 1, 1977. Equipment installed between December 16, 1970 and July 1, 1976 must comply with a limit of sixty-five dBA maximum sound level at any point at least one foot inside the property line of the affected residential property and three to five feet above ground level.

Federal Transit Administration (FTA). The City of Rancho Cordova has not identified quantifiable vibration limits that can be used to evaluate vibration levels generated by railroad trains. Although there are no local standards for the allowable vibration in a new residential development, the FTA has developed vibration impact assessment criteria for evaluating vibration impacts associated with transit projects.[1] The FTA has proposed vibration impact criteria, based on maximum overall levels for a single event. The impact criteria for vibration are shown in Table 5. Note that there are criteria for frequent events (more than 70 events of the same source per day), occasional events (30 to 70 vibration events of the same source per day), and infrequent events (less than 30 vibration events of the same source per day).

TABLE 5 Indoor Groundborne Vibration (GBV) Impact Criteria for General Vibration Assessment

Land Use Category	**GBV Impact Levels (VdB re 1 µinch/sec, RMS)**		
	Frequent Events[1]	**Occasional Events[2]**	**Infrequent Events[3]**
Category 1 Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2 Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3 Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. For equipment that is more sensitive, a Detailed Vibration Analysis must be performed.

Source: 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.

[1] 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.

Existing Noise and Vibration Environment

The project area includes the existing Bradshaw Terminal, owned by Kinder Morgan, and the south side of the Sacramento Regional Transit (SacRT) rail corridor to the east where the run-around track is proposed to be constructed. The area is bounded by Folsom Boulevard, SacRT, and UPRR tracks to the north, Bradshaw Road to the west, commercial uses to the east, and light industrial uses to the south. The primary sources of noise in the area are light-rail and conventional trains along the SacRT rail corridor and vehicular traffic along Folsom Boulevard and Bradshaw Road. Trains are a source of ground vibration near the tracks. Based on a review of the SacRT schedule, about 134 light-rail passenger trains travel along the rail line each weekday between 4:19 a.m. and 11:59 p.m. There are also four unscheduled freight trains per day that utilize the UPRR rail line[2].

Figures 1, 2 and 3 show the overall area and the two sub-areas, respectively, where noise monitoring was conducted. Area A corresponds to the area near the existing terminal and Area B corresponds to the locations near the proposed rail run-around track.

Noise Monitoring Survey

A noise monitoring survey was performed from Wednesday, January 12, 2022, through Wednesday, January 19, 2022. The survey included four long-term (LT) noise measurements and seven short-term (ST) noise measurements to quantify existing ambient noise levels. Long-term noise measurement data is provided in Appendix A.

Measurement position LT-1 was located in Area A, near the northeast corner of the proposed site, and about 90 feet from the centerline of the SacRT railroad tracks and about 65 feet from the center of the UPRR track. This site was selected to characterize the ambient noise levels in the vicinity of the VCA Sacramento Veterinary Referral center. The primary noise source at this location was trains traveling along the adjacent tracks and traffic along Folsom Boulevard. Trains typically generated maximum instantaneous noise levels of 70 to 76 dBA L_{max} at this location, with occasional trains generating maximum instantaneous noise levels as high as 91 dBA L_{max}. Trains sound their horns near road intersections and the higher noise levels are likely associated with closer soundings of the horn. Daytime hourly average noise levels, which included all train activity, ranged from 54 to 78 dBA L_{eq} during the weekdays and 52 to 68 dBA L_{eq} during Saturdays and Sundays. Nighttime hourly average noise levels during periods without train activity were as low as 47 dBA L_{eq}. The day-night average noise level at this location was calculated to range from 62 to 65 dBA L_{dn}.

Monitoring location LT-2 was in Area B, behind an existing noise barrier on Froom Circle, at the northwest corner of Park Royal Mobile Estates. This location is about 60 feet from the centerline

[2] Federal Railroad Administration – 'U.S. DOT Crossing Inventory Form' for the Union Pacific Railroad Company

of the SacRT railroad tracks and about 30 feet from the center of UPRR tracks. The centerline of Folsom Boulevard is about 140 feet away from this position. Traffic noise from Folsom Boulevard, along with occasional train passbys are the main contributors to the ambient noise environment in the area. Trains typically generated maximum instantaneous noise levels of 68 to 75 dBA L_{max} at this location, with occasional trains generating maximum instantaneous noise levels as high as 85 dBA L_{max}. Daytime hourly average noise levels, which included all train activity, ranged from 49 to 76 dBA L_{eq} during the weekdays and from 45 to 63 dBA L_{eq} on Saturday and Sunday. Nighttime hourly average noise levels during periods without train activity were as low as 41 dBA L_{eq}. The day-night average noise level at this location was calculated to range from 57 to 60 dBA L_{dn}.

Measurement location LT-3 was also in Area B, on a light pole adjacent to Folsom Boulevard between Tiffany Way and Rod Beaudry Drive. The centerline of Folsom Boulevard is about 40 feet away from the measurement location and the center of the SacRT railroad tracks is about 130 feet away. Traffic noise along Folsom Boulevard and train noise from the railroad tracks were the predominant noise sources at this location. Trains and traffic along Folsom Boulevard typically generated maximum instantaneous noise levels of 80 to 84 dBA L_{max} at this location, with occasional maximum instantaneous noise levels as high as 100 to 102 dBA L_{max}. Daytime hourly average noise levels, which included all train activity, ranged from 55 to 81 dBA L_{eq} during the weekdays and from 52 to 78 dBA L_{eq} during Saturday and Sunday. Nighttime hourly noise levels during periods without train activity were 50 dBA L_{eq}. The day-night average noise level at this location was calculated to range from 71 to 73 dBA L_{dn}.

Measurement LT-4 was conducted in Area A, on a light pole behind the homes on Londonderry Drive, at a similar setback from both the train tracks (130 feet) and Folsom Boulevard (40 feet) as LT-3. This measurement was located between Bradshaw Road and Horn Road. Trains and traffic along Folsom Boulevard typically generated maximum instantaneous noise levels of 82 to 85 dBA L_{max} at this location, with occasional maximum instantaneous noise levels as high as 100 to 102 dBA L_{max}. Daytime hourly average noise levels, which included all train activity, ranged from 60 to 81 dBA L_{eq} during the weekdays and from 56 to 78 dBA L_{eq} during Saturday and Sunday. Nighttime hourly noise levels during periods without train activity were 53 dBA L_{eq}. The day-night average noise level at this location was calculated to range from 73 to 74 dBA L_{dn}.

FIGURE 1 Noise Monitoring Locations - Area A and B (Source: Google Earth 2022)

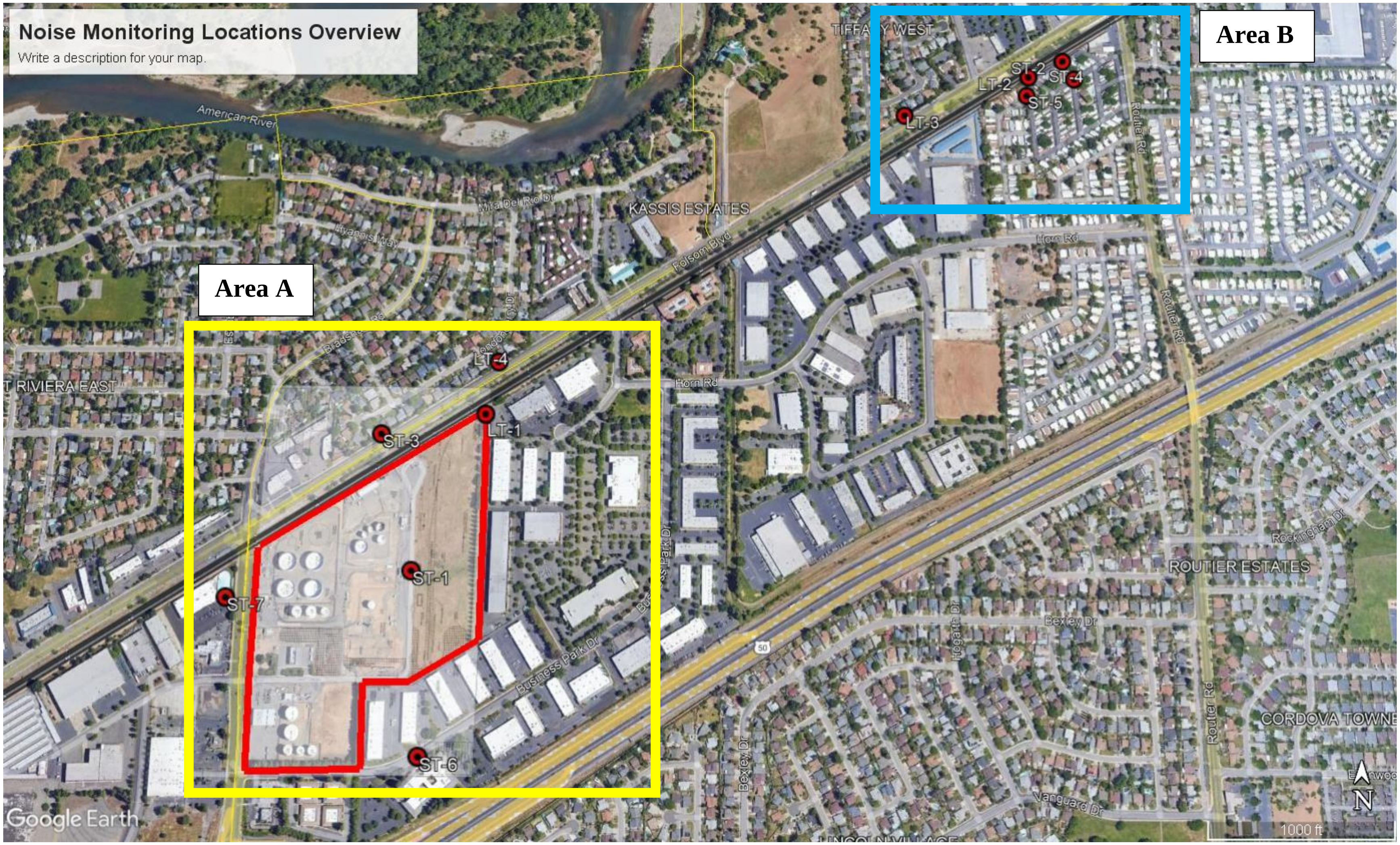


FIGURE 2 Noise Monitoring Locations at Area A (Source: Google Earth 2022)

FIGURE 3 Noise Monitoring Locations at Area B (Source: Google Earth 2022)

Seven short term noise measurements (ST-1 to ST-7) were conducted at the locations shown in Figures 1 through 3 to complete the noise survey. Table 6 summarizes the results of the short-term measurements.

TABLE 6 Summary of Short-Term Noise Measurement Data, January 12 and 19, 2022

ID	Location (Date, Time)	Measured Noise Levels, dBA					
		L_1	L_{10}	L_{50}	L_{90}	L_{eq}	
ST-1	Towards center of site on Gore Road (1/12/22, 9:00 a.m. to 9:10 a.m.)	84	71	60	57	71	Truck activities at Bradshaw Terminal
ST-2	On Froom Circle (Park Royal Estates), Behind existing noise barrier, ~75 ft away from railroad tracks, ~175 ft away from centerline of Folsom Boulevard (1/12/22, 9:50 a.m. to 10:00 a.m.)	61	53	49	45	51	Traffic noise from Folsom Boulevard and passing trains
ST-3	On Folsom Boulevard, ~35 ft away from centerline of road, ~130 ft from railroad tracks (1/12/22, 11:40 a.m. to 11:50 a.m.)	83	78	65	54	73	Traffic noise from Folsom Boulevard and passing trains
ST-4	On Ketcham Drive (Park Royal Estates), ~200 ft away from railroad tracks (1/12/22, 12:20 p.m. to 12:30 p.m.)	64	51	46	42	54	Passing trains and distant traffic noise from Folsom Boulevard
ST-5	Intersection between Froom Circle and Briarwood Mobile Home Park (Park Royal Estates), ~140 ft away from railroad tracks (1/12/22, 12:20 p.m. to 12:30 p.m.)	67	54	48	44	54	Traffic noise from Folsom Boulevard and passing trains
ST-6	In front of American River Bank on Business Park Drive, ~25 ft from centerline of road (1/19/22, 10:20 a.m. to 10:30 a.m.)	78	71	64	53	68	Traffic noise from Business Park Drive.
ST-7	In front of ‘The Rink’, ~90 ft away from centerline of Bradshaw Road (1/19/22, 10:50 a.m. to 11:00 a.m.)	71	66	59	53	62	Traffic noise from Bradshaw Dr, trains crossing at Bradshaw and Folsom Road intersection

Vibration Monitoring Survey

Observed and recorded vibration measurements of individual SacRT light-rail train passby’s were conducted on January 12, 2022, between 10:27 a.m. and 11:58 a.m. at setbacks of 45 feet (V-1) and 90 feet (V-2) from the eastbound light-rail track (Figure 4). The instrumentation used to conduct the measurements included a Roland R-05 solid state recorder and seismic grade, low noise accelerometers firmly fixed to the ground. This system is capable of accurately measuring very low vibration levels.

FIGURE 4 Aerial Photo Showing Vibration Measurement Locations

A total of thirteen (13) individual light-rail passenger train passbys, including seven (7) eastbound and six (6) westbound passbys, were observed and recorded at each measurement setback. The two setbacks were used to develop a drop-off rate for ground vibration with distance. Vibration levels were measured in the vertical axis because ground vibration is typically most dominant on this axis. Train vibration levels ranged from approximately 57 to 77 VdB at a distance of 45 feet and 54 to 69 VdB at 90 feet from the eastbound tracks. Overall vibration levels measured during train passby events are summarized in Table 7. Frequency spectra (1/3rd octave band) vibration levels for each passby event are provided in Appendix B.

TABLE 7 Results of SacRT Light-Rail Vibration Measurements

Event	Overall Vibration Level (VdB re 1μinch/sec, RMS)	
	Position V-1	Position V-2
EB Light-rail (40 mph)	75 VdB	67 VdB
WB Light-rail (50 mph)	72 VdB	67 VdB
EB Light-rail (45 mph)	76 VdB	67 VdB
WB Light-rail (45 mph)	64 VdB	62 VdB
EB Light-rail (45 mph)	57 VdB	54 VdB
WB Light-rail (50 mph)	69 VdB	66 VdB
EB Light-rail (45 mph)	75 VdB	65 VdB
WB Light-rail (50 mph)	72 VdB	68 VdB
EB Light-rail (45 mph)	77 VdB	69 VdB
WB Light-rail (50 mph)	68 VdB	66 VdB
EB Light-rail (50 mph)	74 VdB	69 VdB
WB Light-rail (50 mph)	71 VdB	69 VdB
EB Light-rail (45 mph)	72 VdB	64 VdB

Notes: V-1: 45 feet from the center of the eastbound tracks and 60 feet from the center of the westbound tracks.
V-2: 90 feet from the center of the eastbound tracks and 105 feet from the center of the westbound tracks.
RMS – root-mean-square

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 resulting from the project:

1. **Temporary or Permanent Noise Increases in Excess of Established Standards.** A significant impact would be identified if project operations or construction 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 Rancho Cordova General Plan or Municipal Code, as follows:

- Operational Noise in Excess of Standards. A significant noise impact would be identified if the project operations would generate noise levels that would exceed applicable noise standards presented in the Rancho Cordova General Plan or Municipal Code.

- Permanent Noise Increase. A significant permanent noise increase would be identified if traffic generated by the project or project improvements/operations would substantially increase noise levels at sensitive receivers in the vicinity. The City of Rancho Cordova defines a substantial increase in Policy N-2.2.

- Temporary Noise Increase. A significant noise impact would be identified if temporary construction activities noise would cause a substantial increase in ambient noise levels at sensitive receptors. Large or complex projects involving substantial on-going noise-generating construction activities are considered significant when noise levels would exceed 80 dBA L_{eq} at residential land uses near the site or 90 dBA L_{eq} at commercial land uses near the site for more than 12 months within the allowable workdays and work hours.

2. **Generation of Excessive Groundborne Vibration due to Construction.** A significant impact would be identified if the construction of the project and train activities would generate vibration levels in excess of thresholds established by the Federal Transit Administration (FTA) as summarized below:

    - Groundborne vibration levels exceeding 0.3 in/sec PPV for buildings of conventional construction and 0.12 in/sec PPV for old buildings[3] susceptible to vibration damage.

    - Groundborne vibration levels exceeding 98 VdB for buildings of conventional construction and 90 VdB for old buildings susceptible to vibration damage. Vibration levels exceeding the 80 VdB vibration for residences and 83 VdB for institutional land uses with primarily daytime uses, would potentially result in human annoyance.

[3] Section 7.2 – Construction Vibration Assessment, 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.

Impact 1: Temporary or Permanent Noise Increases in Excess of Established Standards. Project operations and truck traffic would not generate noise levels that exceed the applicable noise thresholds or result in a substantial permanent noise level increase at existing noise-sensitive land uses in the project vicinity. Existing noise-sensitive land uses would be exposed to construction noise levels in excess of the temporary increase significance thresholds for a period of less than one year. **This is a less-than-significant impact.**

Operational Noise

Operational noise sources include rail noise, truck loading and circulation, and mechanical equipment operating at the terminal. Rail noise sources include rail activity at the terminal, the proposed run-around track, and the length of the UPRR track connecting the two. Figure 5 shows the location of the project site and the proposed run-around track.

Delivery and pickup of up to one train per day (with 22 railcars) is proposed via a new rail run-around on the SacRT right-of-way located approximately 14 feet from the center of the existing UPRR rail line. Railcars will be delivered from west to east and empty railcars would leave the terminal from east to west. These railcars are expected to travel at approximately 5-10 miles per hour. The following sequence of train operations are expected to occur over a period of 45 minutes to 1 hour for each delivery per day:

- Full rail cars dropped at the run-around
- Train engine taken to the terminal site
- Empty rail cars pulled out to the run-around
- Full rail cars taken to the terminal site
- Empty rail cars picked up from the run-around and hauled out of the area

It is anticipated that the rail deliveries and pickup operations will occur between 7 p.m. and 9 p.m., up to 5 times a week. The primary sources of noise anticipated would be switcher engine and railcar movements, idling locomotives, and horns sounded at grade crossings. Based on Report WCR 73-5[4], typical noise levels produced by switcher engine movements when transferring railcars to and from a run-around are about 76 to 80 dBA at 100 ft, while idling locomotives produce a noise level of about 65 to 71 dBA at 100 ft. Railcar impacts of single or multiple cars into parked cars or chain reaction impacts could produce maximum noise levels of up to 91 dBA at 100 ft.

[4] "Assessment of Noise Environments Around Railroad Operations", Wyle Laboratories, WCR 73-5, July 1973.

FIGURE 5 Location of the project site and run-around track (Source: Google Earth 2022)[5]

The closest residences along the proposed run-around track include residences at the mobile home park (Park Royal Estates and Briarwood Mobile Homes) and commercial properties to the south,

[5] Based on client provided project plans dated April 7, 2022

and residences along Black Coral Way to the north across Folsom Boulevard. Residences along Londonderry Drive to the north across Folsom Boulevard and the VCA Sacramento Veterinary Referral Center south of the existing UPRR tracks are the nearest receptors to the terminal. Table 8 shows the summary of noise levels anticipated from the sequence of operations mentioned above along with the calculated noise levels at the nearest receptors.

TABLE 8 Summary of Typical Maximum Noise Levels from Rail Activities

Noise Source	Noise Levels at 100 ft from Source (L_{max}, dBA)	Calculated Noise Levels (dBA)			
		Commercial Properties and Mobile Homes adjacent to Run-Around Track (At 30 feet)	Commercial VCA Veterinary Referral Center*	Residences along Londonderry Drive/ (At 200 ft)	Residences along Black Coral Way (At 200 ft)
Switcher engine movements	76 to 80	87 to 91	77 to 81	70 to 74	70 to 74
Idling locomotives	65 to 71	--**	50 to 56	59 to 65	59 to 65
Intermittent railcar impacts	91	101	76	85	85

* Switcher engine movements for the VCA center are about 85 feet away while noise from idling locomotives and intermittent railcar impacts are about 580 feet away.
** Idling locomotives are not expected at the run-around track.

Residences across Folsom Boulevard (on Londonderry Drive and Black Coral Way) and at the mobile home park would benefit from existing noise barriers that would reduce the calculated noise levels in Table 8 by at least 5 dB. Noise from switcher engine movements and railcar impacts would be intermittent and occur only a few times within one hour each evening with no anticipated nighttime events. Train horns are not expected during onsite rail activities.

<u>Operational noise at the terminal site</u>

Noise from train and truck activities at the terminal are assessed using the applicable thresholds established in Table N-1 and Policy N.2.2 from the City's General Plan.

For the VCA Veterinary Referral Center, hourly average noise levels calculated from the maximum train noise levels anticipated in Table 8 would be about 50 dBA L_{eq}. Existing ambient noise levels around the anticipated hours of train operations are measured to be 60 dBA L_{eq}.

Residences along Londonderry Drive would experience hourly average noise levels of about 48 dBA L_{eq} based on maximum train noise levels anticipated in Table 8. Existing ambient noise levels around the anticipated hours of train operations are measured to range from 60 to 65 dBA L_{eq} adjusted for the shielding from the existing noise barrier.

Truck activities (loading, offloading, staging and circulation) are expected to occur throughout the terminal, with new staging and turn around areas proposed towards the southern end. Trucks maneuvering at the different existing and proposed loading racks would generate a combination of engine, exhaust, tire noise, as well as intermittent sounds from truck fuel filling, back-up alarms and releases of compressed air associated with truck/trailer air-brakes. Short term noise measurements at the site next to the current truck filling station show noise levels ranging from 60 to 70 dBA at 50 feet for loading, 70 to 80 dBA at 50 feet for trucks passing by. Back up alarms and brake releases generate maximum noise levels typically in the range of 80 to 90 dBA at 5 feet.

Truck filling operations would take place towards the eastern portion of the terminal close to the proposed rail spurs, with trucks circulating throughout the site. For the purposes of modelling the worst-case scenario, noise from trucks is modeled from the staging and turnaround locations closest to corresponding residential or commercial properties.

Residences along Londonderry Drive are located about 500 feet from the nearest existing truck loading rack. Future proposed areas of truck activities would be positioned at a distance of more than 1,000 feet away from these residences. Commercial properties along Business Park Drive would be located about 200 feet from the closest proposed truck staging and turnaround areas. Table 9 shows the summary of noise levels anticipated from truck operations along with the calculated noise levels at the nearest receptors.

TABLE 9 Summary of typical maximum noise levels from truck activities

Noise source	Noise levels at 50 ft from source (L_{max}, dBA)	Calculated noise levels (dBA)	
		Commercial properties (At 200 ft)	Residences along Londonderry Dr (At 500 ft)
Truck Filling	60 to 70	48 to 58	40 to 50
Truck passing by	70 to 80	58 to 68	50 to 60
Back up alarms and brake releases	80 to 90*	48 to 58	40 to 50

* Measured at 5 feet

As discussed before, the closest residences across Folsom Boulevard (on Londonderry Drive) would benefit from the existing noise barrier which would provide a noise reduction of up to 5 dBA for sounds propagating due to truck activities from the site.

For residences and commercial properties located near the terminal, noise levels calculated from truck loading and circulation activities would be significantly below noise levels anticipated from rail activities at the terminal. Truck activities do not make a significant contribution to the total noise emanating from the terminal resulting from both train and truck noise sources.

Noise generating mechanical equipment included in the project would be limited to pump loading and offloading activities throughout the site. These would not make a significant contribution to total noise emanating from the terminal.

Noise levels from operations at the terminal will be less than the established 50 dBA hourly L_{eq} thresholds in Table N-1 from the City's General Plan and less than existing ambient noise levels ranging from 55 to 65 dBA L_{eq} during the operating hours. For an existing noise environment ranging from 60 to 65 dBA L_{dn} at the nearest residential and commercial receptors, a 3 dB L_{dn} increase in noise levels would be considered significant based Policy N.2.2. from the City's General Plan. Noise from train and truck activities at the terminal would be calculated to result in a noise increase of 1 dBA L_{dn} or less.

Noise thresholds established by the standards under Table N-1 and Policy N.2.2., along with existing ambient noise conditions in the area, are not expected to be exceeded by operations at the terminal. This is a **less-than-significant** impact.

Operational Noise at the Rail Run-Around

Noise generating activities accommodated by UPRR within the SacRT right-of-way, are assessed using the applicable thresholds established in Policy N.2.2 from the City's General Plan.

Noise propagating from the terminal, elaborated above, would not contribute to noise levels experienced at the residences along Black Coral Way. The main source of noise at this location would be noise from train activities at the run-around track. Table 8 shows a summary of noise levels anticipated from the sequence of train operations on the run-around track. Hourly average noise levels calculated from the maximum noise levels in Table 8 would be about 51 dBA L_{eq}. The existing ambient hourly noise level from traffic along Folsom Boulevard and through trains, during the proposed hours of operation, is about 63 dBA L_{eq} when adjusted for the acoustical shielding provided by the existing noise barrier. The existing daily average noise level at the vicinity of the residences ranges from 66 to 68 dBA L_{dn} when adjusted for the acoustical shielding provided by the existing noise barrier. Based on Policy N.2.2, for an existing noise environment with a daily average level of greater than 65 dB L_{dn}, a 1.5 dB L_{dn} increase in noise levels would be considered significant. Noise from train activities on the run-around track is calculated to result in a noise increase of less than 1 dBA L_{dn} for residences across Folsom Boulevard along Black Coral Way.

At the mobile home parks (Park Royal Estates, Briarwood Mobile Home Parks) located adjacent to the run-around track, maximum intermittent noise levels from rail activities are calculated to range from 82 to 96 dBA L_{max} (assuming shielding from the existing noise barrier). Existing maximum noise levels resulting from traffic and through trains range from 75 to 80 dBA L_{max} throughout the day. These new noise sources would be of a different character than the noise from existing trains and traffic in the area and therefore would be noticeable near the run-around track.

The hourly average noise level calculated from these maximum noise levels would be about 66 dBA L_{eq} during the hour of train operations. This would correspond to a daily average noise level increase of 1 dBA L_{dn}. The existing daily average noise level in the area is calculated to be 60 dBA L_{dn}. Based on Policy N.2.2, for an existing noise environment with a daily average level between 60 and 65 dBA L_{dn}, a 3 dB L_{dn} increase in noise levels would be considered significant. Therefore, a **less-than-significant** impact would result from rail activities anticipated along the proposed run-around.

Permanent Noise Increases from Project Traffic and Increased Train Activity Outside the Immediate Project Area

Noise generating activities from rail or truck traffic are assessed using the applicable thresholds established in Policy N.2.2 from the City's General Plan. The project's proposed increase in fuel throughput would result in 112 new truck loads which correspond to 224 new truck trips per day. The project's 3 to 5 employees would generate 10 daily non-truck trips. Based on the traffic study memo[6], noise levels for peak hour truck trips and light vehicle trips were modelled and compared to the existing ambient environment in the vicinity of the project. Projected noise level increases from increased truck trips and light vehicles around the project site would result in a noise level increase of less than 1 dBA L_{dn}. This increase is less than the most restrictive criterion established in Policy N.2.2 (+1.5 dBA L_{dn}).

Based on the U.S. DOT Crossing Inventory for the Rancho Cordova area, a total of 4 switching trains per day travel on the UPRR tracks near the terminal. A total of 134 SacRT light-rail trains travel on the SacRT train tracks adjacent to the UPRR tracks. With the construction of the new rail spurs and run-around tracks for the project, the UPRR tracks will accommodate one more train (with 22 railcars) up to 5 times a week between 7 p.m. to 9 p.m. for about 45 minutes to an hour. An addition of one train to the existing train movements (134 SacRT trains plus 4 switching trains) in the area would not result in an increase in noise levels above the measured ambient levels in the vicinity of the terminal.

[6] VMT and Trip Generation Memorandum, GHD – January 19, 2022

Permanent noise increases from project traffic and increased train activity would result in a **less-than-significant** impact.

Temporary Noise Increases from Project Construction

A significant noise impact would be identified if the project would generate a substantial temporary or permanent noise level increase over ambient noise levels at existing noise-sensitive receptors surrounding the project site and that would exceed applicable noise standards presented in the General Plan at existing noise-sensitive receptors surrounding the project site.

Action N.1.4.1 of the City of Rancho Cordova General Plan limits construction to weekdays between 7:00 a.m. and 7:00 p.m., and weekends between 8:00 a.m. to 6:00 p.m., when construction is conducted in proximity to residential uses. Noise limits identified by the Federal Transit Administration (FTA) are used to identify the potential for impacts due to substantial temporary construction noise. A significant noise impact would be identified if temporary construction activity would cause a substantial increase in ambient noise levels at sensitive receptors. Large or complex projects involving substantial on-going noise-generating construction activities are considered significant when noise levels would exceed 80 dBA L_{eq} at residential land uses near the site or 90 dBA L_{eq} at commercial land uses near the site for more than 12 months within the allowable workdays and work hours.

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 immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Project construction is anticipated to begin in 2022, with the facilities in operation by first quarter of 2023. Construction staging would occur within the Bradshaw Terminal and rail run-around boundaries. Minimal earth moving is anticipated at the terminal site, as the site is flat and underlain with suitable soils. Clearing and grubbing is anticipated at the Bradshaw Terminal rail footprint, and soils would be balanced onsite. Installation of the proposed above ground pipeline would include construction of concrete footings along the length of pipe. The hauling of excavated materials and construction materials would generate truck trips on local roadways as well. Pile driving is not anticipated in any phase of construction of the project.

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 10 and 11. Table 10 shows the average noise level ranges, by construction phase and Table 11 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 10 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 11 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

Equipment Category	L_{max} Level (dBA)1,2	Impact/Continuous
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.

The proposed project involves construction of the following components within the Bradshaw Terminal limits:

- New rail spurs with a capacity to offload up to 22 railcars per day, dedicated for Biodiesel and Renewable diesel offloading. These rail spurs will be constructed into the terminal that connects the existing UPRR track located within the existing SacRT right-of-way immediately north of the terminal
- Two new ground storage tanks within the existing tank farm and secondary containment area consisting of an 80,000 BBL Renewable diesel and 15,000 BBL communal Biodiesel storage tank
- Two lane truck blending and loading rack with new rack pumps
- Installation of a new rail run-around on SacRT right-of-way for railcar delivery designed to accommodate 22 railcars.
- New interior road extension and truck turnaround constructed towards the southern portion of the terminal site to accommodate existing and proposed truck movement. In addition, a new asphalt paved truck staging area would be installed adjacent to the existing interior terminal road and proposed new truck loading rack.
- A modular office/control building (approx. 1,000 sq. feet) will be installed on the northern portion of the terminal site

Construction for the above components would include clearing and grubbing, grading, paving, tank installation, trenching/piping, and rail installation phases. Hourly average noise levels resulting from standard construction equipment used for these phases was calculated to range from 80 to 90 dBA L_{eq} at 50 feet using the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM). Construction equipment would likely be spread throughout the site, but for the purposes of modelling the worst-case scenario, all equipment was assumed to be operating relatively in the same area around the south and southeastern portion of the terminal near the proposed new rail spurs and new road extension areas for truck circulation and staging. Noise propagation distances were estimated from this 'acoustic center' to the property lines of surrounding receptors. No shielding effects were assumed.

For the construction of the proposed rail run-around, a range of anticipated noise levels is presented to account for both the worst-case scenario when construction occurs closest to the adjacent properties at about 20 feet and the situation where construction proceeds linearly and would occur further away at a distance of about 300 feet from the same properties along the run-around.

Residential properties closest to the terminal (along Londonderry Dr) are located about 1,000 feet away and the nearest commercial properties are positioned about 500 feet away. At these distances, construction noise levels would range from 55 to 65 dBA L_{eq} at the nearest residences and from 60 to 70 dBA L_{eq} at the nearest commercial properties for construction noise emanating from the terminal.

Noise levels emanating from the construction of the proposed rail run-around would range from 88 to 98 dBA L_{eq} at a distance of 20 feet and from 65 to 75 dBA L_{eq} at a distance of 300 feet from the closest commercial properties, as the rail construction proceeds to completion adjacent to the UPRR tracks. For residences across Folsom Boulevard along Black Coral Way, noise levels from the construction of the run-around would range from 68 to 78 dBA L_{eq} at a distance of about 200 feet.

The following best management practices would reduce construction noise levels emanating from the site, limit construction hours and minimize disruption and annoyance:

- Construction activities shall be limited to the hours between 7:00 am and 7:00 pm, Monday through Friday, 8:00 am and 6:00 pm on weekends in accordance with the City's General Plan, unless permission is granted with a development permit or other planning approval.

- Construct solid plywood fences around construction sites adjacent to operational business, residences, or other noise-sensitive land uses.

- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Prohibit unnecessary idling of internal combustion engines.
- Locate stationary noise-generating equipment such as air compressors or portable power generators as far as possible from sensitive receptors. Construct temporary noise barriers to screen stationary noise-generating equipment when located near adjoining sensitive land uses.
- Utilize "quiet" air compressors and other stationary noise sources where technology exists.
- Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.
- Notify all adjacent business, residences, and other noise-sensitive land uses of the construction schedule, in writing, and provide a written schedule of "noisy" construction activities to adjacent land uses and nearby residences.
- If complaints are received or excessive noise levels cannot be reduced using the measures above, erect a temporary noise control blanket barrier along surrounding building facades that face the construction sites.
- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to current the problem. 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.

With the implementation of these measures and recognizing that noise generated by construction activities would occur over a temporary period of less than one year, the impact would be **less-than-significant**.

Impact 2: **Exposure to Excessive Groundborne Vibration.** Construction related and project generated vibration levels would not exceed 0.3 in/sec PPV vibration damage threshold for conventional buildings or the 0.12 in/sec PPV threshold for old buildings at the Old Mills Winery building. The FTA train vibration annoyance thresholds would not be exceeded for operations along the proposed run-around. **This is a less-than-significant impact.**

Impact 2a – Vibration Impacts due to Construction

The City of Rancho Cordova does not specify a construction vibration limit. The Federal Transit Administration's (FTA) Noise and Vibration Impact Assessment Manual includes Construction Vibration Damage Criteria to be used in assessing construction vibration impacts (Table 12). The FTA manual also discusses vibration annoyance criteria as discussed above (Table 5).

TABLE 12 Vibration Damage Criteria

Building/Structural Category	PPV, in/sec	Approximately L_v[a]
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

[a] RMS velocity in decibels, VdB re 1 µin/sec
Source: 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.

The 0.3 in/sec PPV vibration limit (or 98 VdB) would be applicable to the majority of buildings in the vicinity of the project. The 0.12 in/sec PPV (or 90 VdB) vibration limit would only apply to the vibration levels expected at the Old Mills Winery building located near the proposed rail run-around adjacent to the existing UPRR tracks.

The construction of the project may generate perceptible vibration when heavy equipment or impact tools (e.g., jackhammers, hoe rams) are used. Construction activities include clearing and grubbing, grading, paving, tank installation, trenching/piping, and rail installation phases. Pile driving is not anticipated for the proposed project. Vibration levels would 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 12 presents typical vibration levels that could be expected from construction equipment at 25 feet and summarizes the minimum distances needed from each equipment to meet the 0.12 in/sec PPV and the 0.3 in/sec PPV vibration threshold.

For a worst-case scenario, construction vibration levels (as shown in Table 13) are modeled under the assumption that each piece of equipment would operate along the nearest boundary of the site or proposed run-around. Vibration sensitive structures near project construction include the VCA Veterinary Referral Center (about 75 feet away), CalCap Studios located in the Old Mills Winery building (about 200 feet away) and the Briarwood Mobile Home Park residences (about 20 feet away).

TABLE 13 Vibration Levels for Construction Equipment at Various Distances

Equipment		PPV at 25 ft. (in/sec)	Minimum Distance to Meet Threshold (feet)	
			Old Mills Winery Building *0.12 in/sec PPV*	All Other Buildings *0.3 in/sec PPV*
Clam shovel drop		0.202	**40**	20
Hydromill (slurry wall)	in soil	0.003	<5	<5
	in rock	0.006	<5	<5
Vibratory Roller		0.210	**40**	20
Hoe Ram		0.089	20	10
Large bulldozer		0.089	20	10
Caisson drilling		0.089	20	10
Loaded trucks		0.076	20	10
Jackhammer		0.035	10	<5
Small bulldozer		0.003	<5	<5

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, October 2018 as modified by Illingworth & Rodkin, Inc., March 2022.

Based on the calculated distances to meet the vibration damage thresholds for buildings in the vicinity of the project, vibration due to project construction would fall below the 0.12 in/sec PPV threshold for the Old Mills Winery building (at 200 feet) and at or below the 0.3 in/sec PPV threshold (at distances greater than 20 feet) for all other buildings.

The US Bureau of Mines has analyzed the effects of blast-induced vibration on buildings in USBM RI 8507[7], and these findings have been applied to vibrations emanating from construction equipment on buildings[8]. Figure 6 presents the damage probability, as reported in USBM RI 8507 and reproduced by Dowding, assuming a vibration level of 0.3 in/sec PPV. Based on the data summarized in Figure 6, there would be no observations of “threshold damage,” “minor damage,” or “major damage” at buildings of normal conventional construction when vibration levels were 0.3 in/sec PPV or less.

At these locations and in other surrounding areas where vibration would not be expected to cause structural damage, vibration levels may still be perceptible. However, as with any type of construction, this would be anticipated and would not be considered significant, given the intermittent and short duration of the phases that have the highest potential of producing vibration. By use of administrative controls, such as notifying neighbors of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration during hours with the least potential to affect nearby residences, perceptible vibration can be kept to a minimum.

In summary, the construction of the project would generate vibration levels below the 0.12 in/sec PPV threshold at the ‘historic’ Old Mills Winery Building located about 200 feet away from the

[7] Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration form Surface Mine Blasting, RI 8507, Bureau of Mines Report of Investigations, U.S. Department of the Interior Bureau of Mines, Washington, D.C., 1980.

[8] Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

proposed rail run-around. For all other conventional buildings in the vicinity of the terminal and the run-around, vibration levels would be 0.3 in/sec PPV or less. This is a **less-than-significant** impact.

Impact 2b - Vibration Impacts from Trains

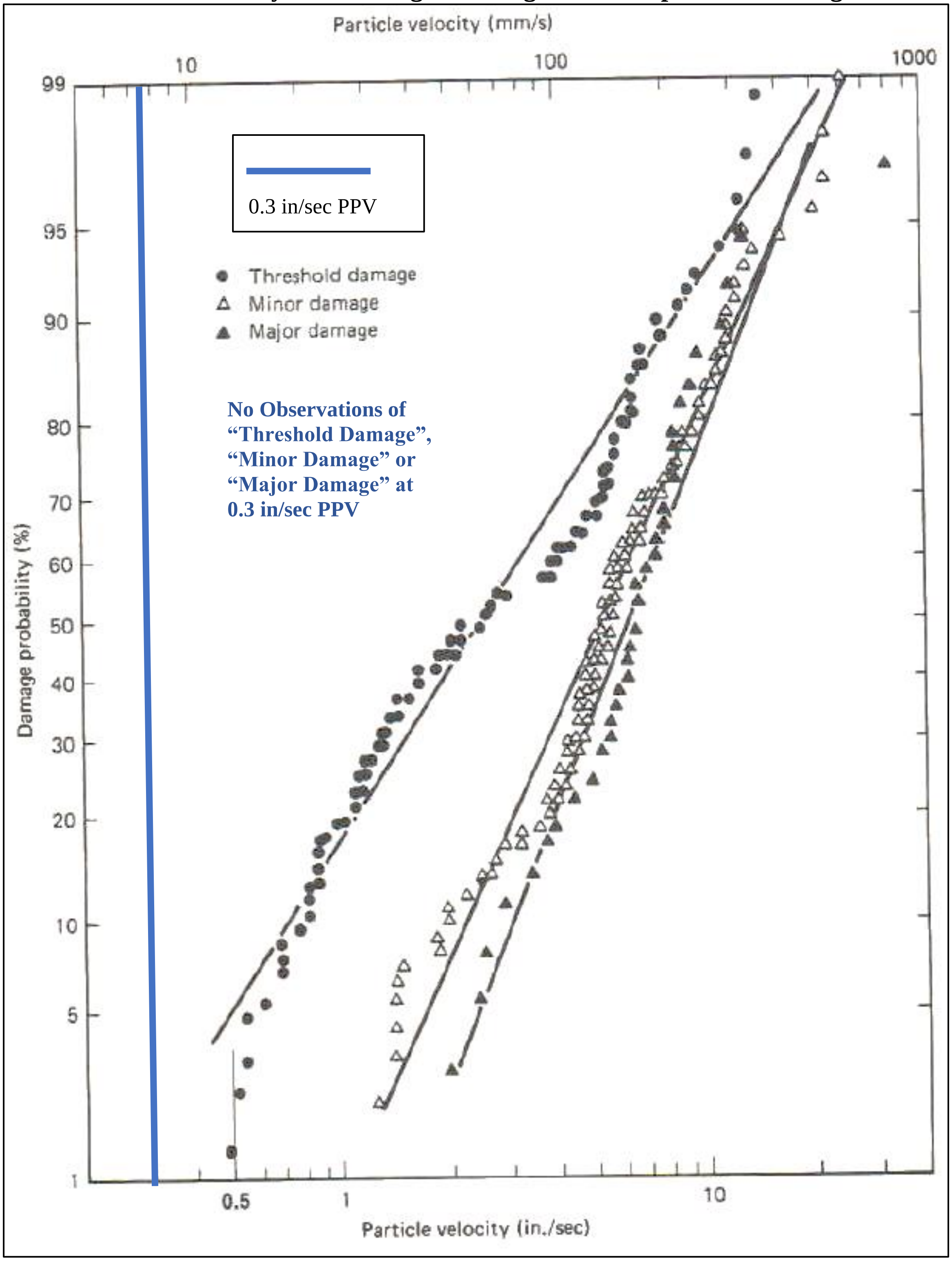
The project would install a new rail run-around on the SacRT right-of-way for railcar delivery purposes. This run-around would be designed to accommodate 22 railcars and would be located about 14 feet from the center of the existing UPRR rail line. Switching operations are expected to occur between the run-around and the Bradshaw Terminal rail spurs. Rail operations on the new spurs and the run-around have the potential to cause impacts on vibration-sensitive land uses in the vicinity of the project site. The VCA Sacramento Veterinary Referral center located about 75 feet from the center of the UPRR tracks, and the CalCap studios within the Old Mills Winery building located about 20 feet from the proposed rail run-around tracks constitute the nearest vibration-sensitive commercial properties. The Briarwood Mobile Homes, positioned about 20 feet away, are the nearest vibration sensitive residences next to the UPRR tracks at the proposed rail run-around.

Based on the General Vibration Assessment outlined in the Transit Noise and Vibration Impact Assessment Manual[9], freight trains moving on the spurs and rail run-around at speeds of 5 to 10 mph would be calculated to generate vibration levels of about 71 to 77 VdB at a distance of 20 feet. These calculated vibration levels fall below the established FTA annoyance thresholds of 80 VdB for Category 2 – Residences and buildings where people normally sleep and 83 VdB for Category 3 – Institutional land uses with primarily daytime for "Infrequent Events" (less than 30 per day) in Table 5. These levels also fall below the vibration damage criteria established in Table 12. Additionally, vibration levels measured for the existing SacRT light-rail trains at about 45 feet from the eastbound tracks are 77 VdB, which equal or exceed project-related operational vibration levels.

In conclusion, vibration from train operations at the terminal and the run-around, when compared with the established vibration damage and annoyance thresholds and the existing vibration environment in the area, would result in a **less-than-significant** impact.

[9] 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.

FIGURE 6 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996 as modified by Illingworth & Rodkin, Inc., March 2022.

Appendix A – Long-Term Noise Data

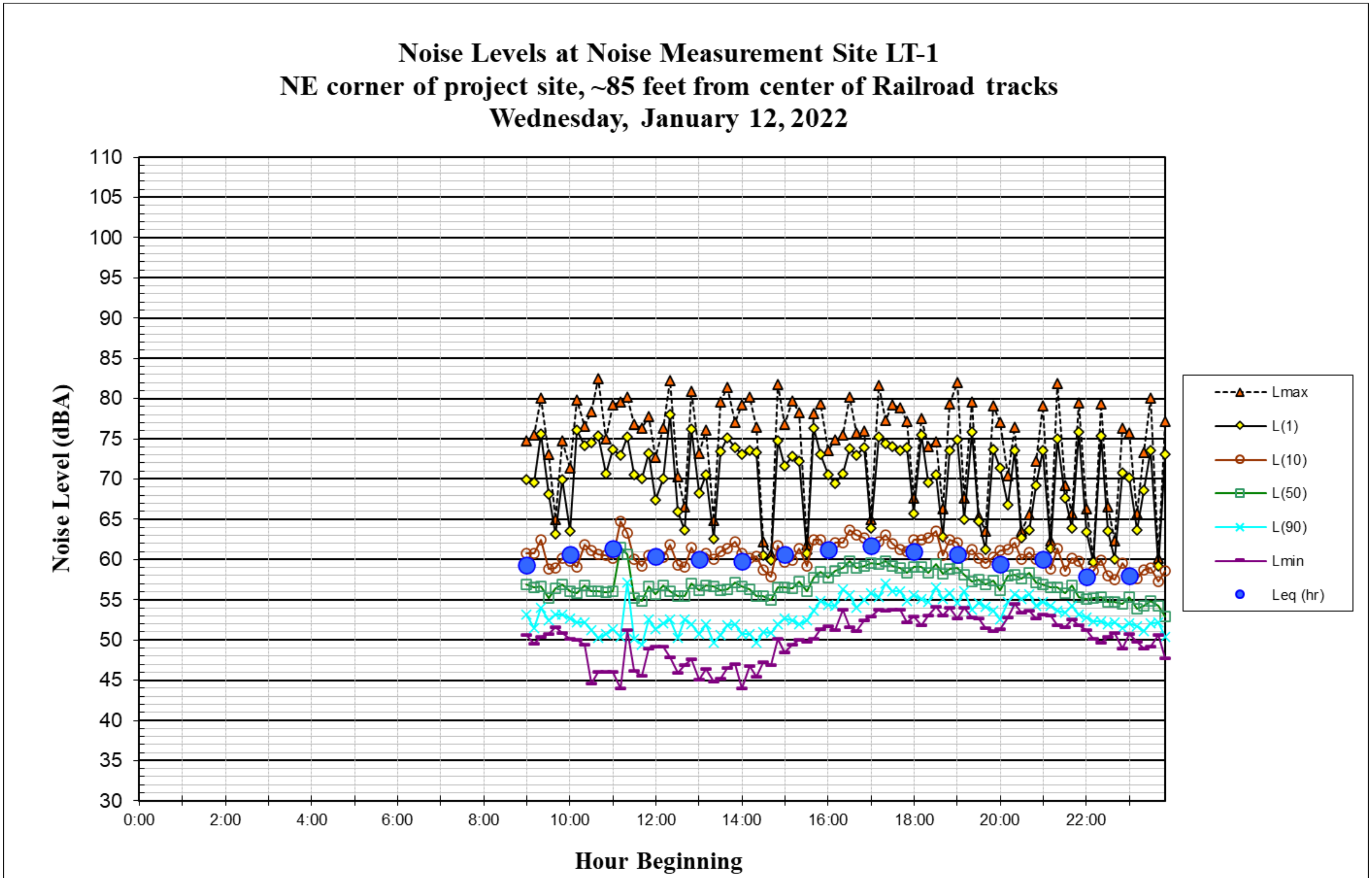

Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Wednesday, January 12, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A1

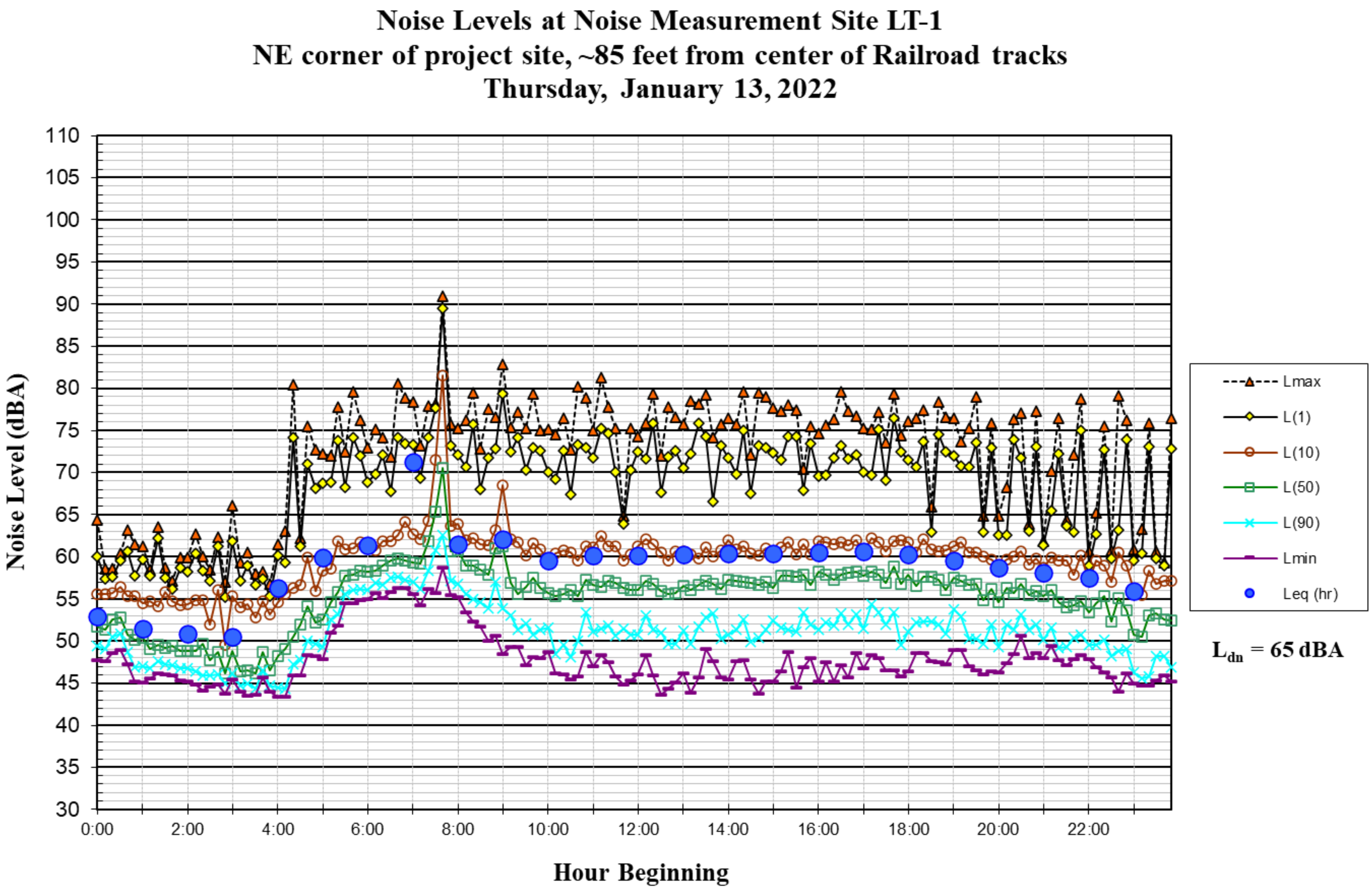

Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Thursday, January 13, 2022
Noise Level (dBA)
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 65 dBA

Figure A2

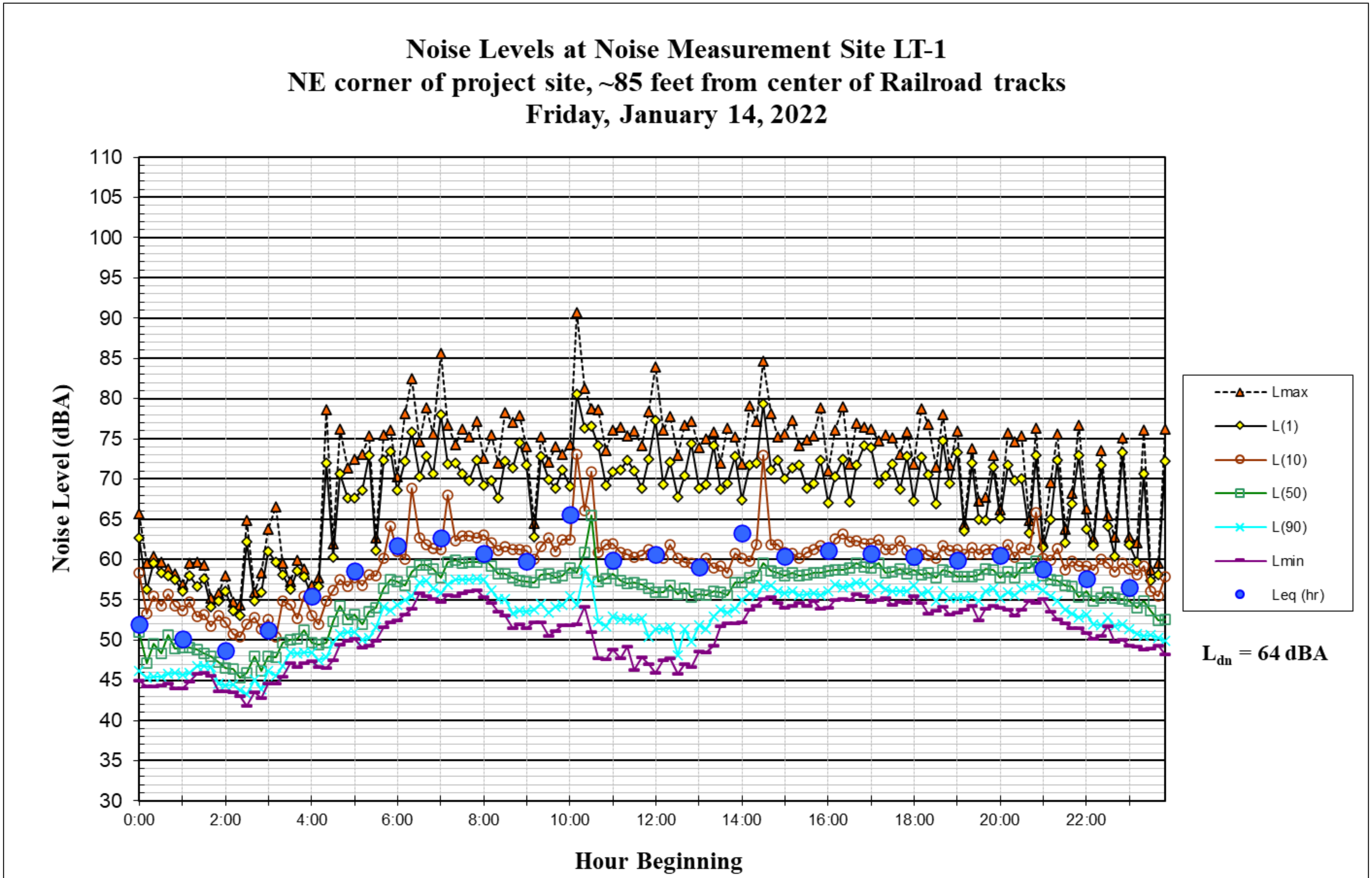

Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Friday, January 14, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 64 dBA

Figure A3

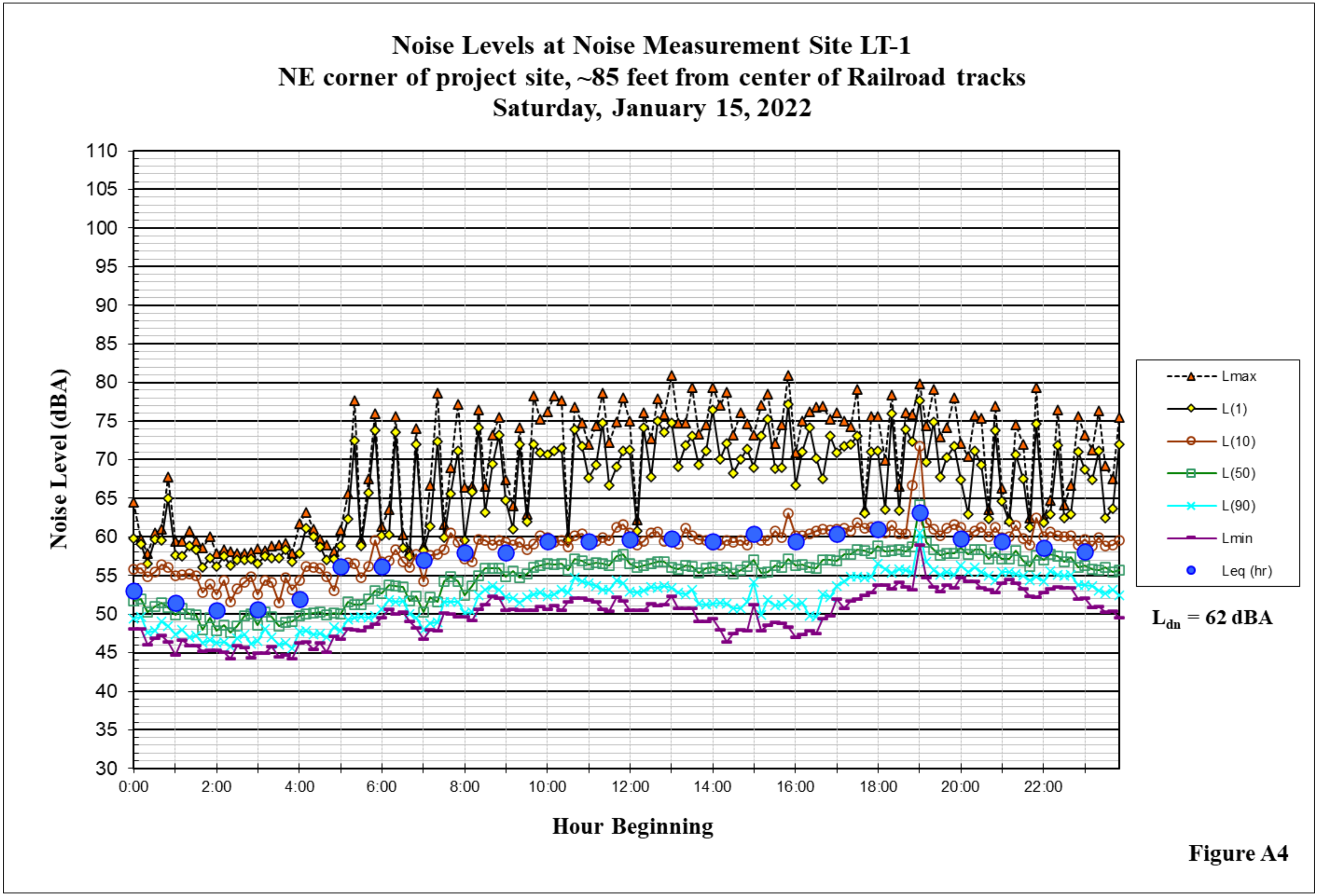

Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Saturday, January 15, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 62 dBA

Figure A4

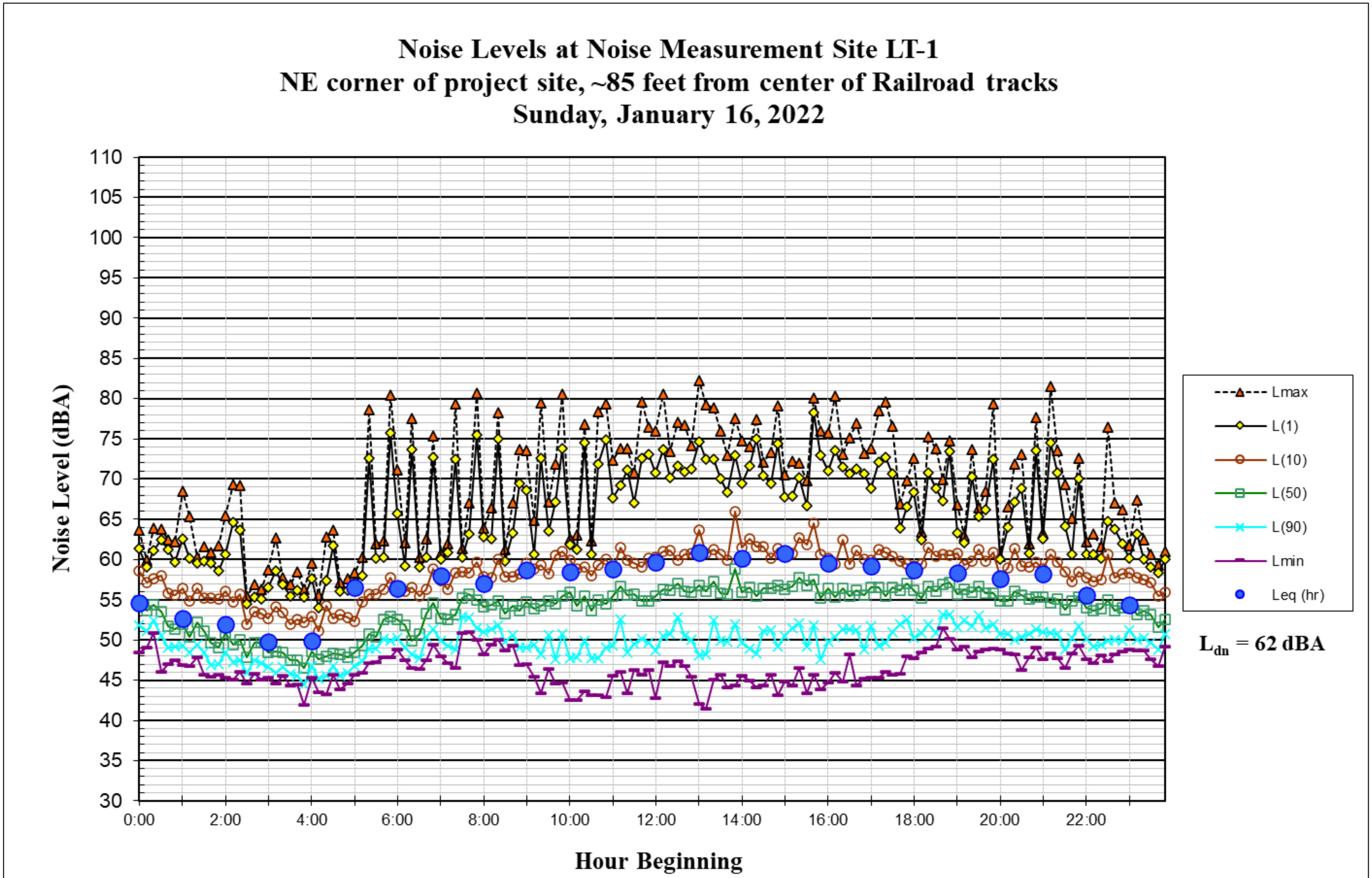
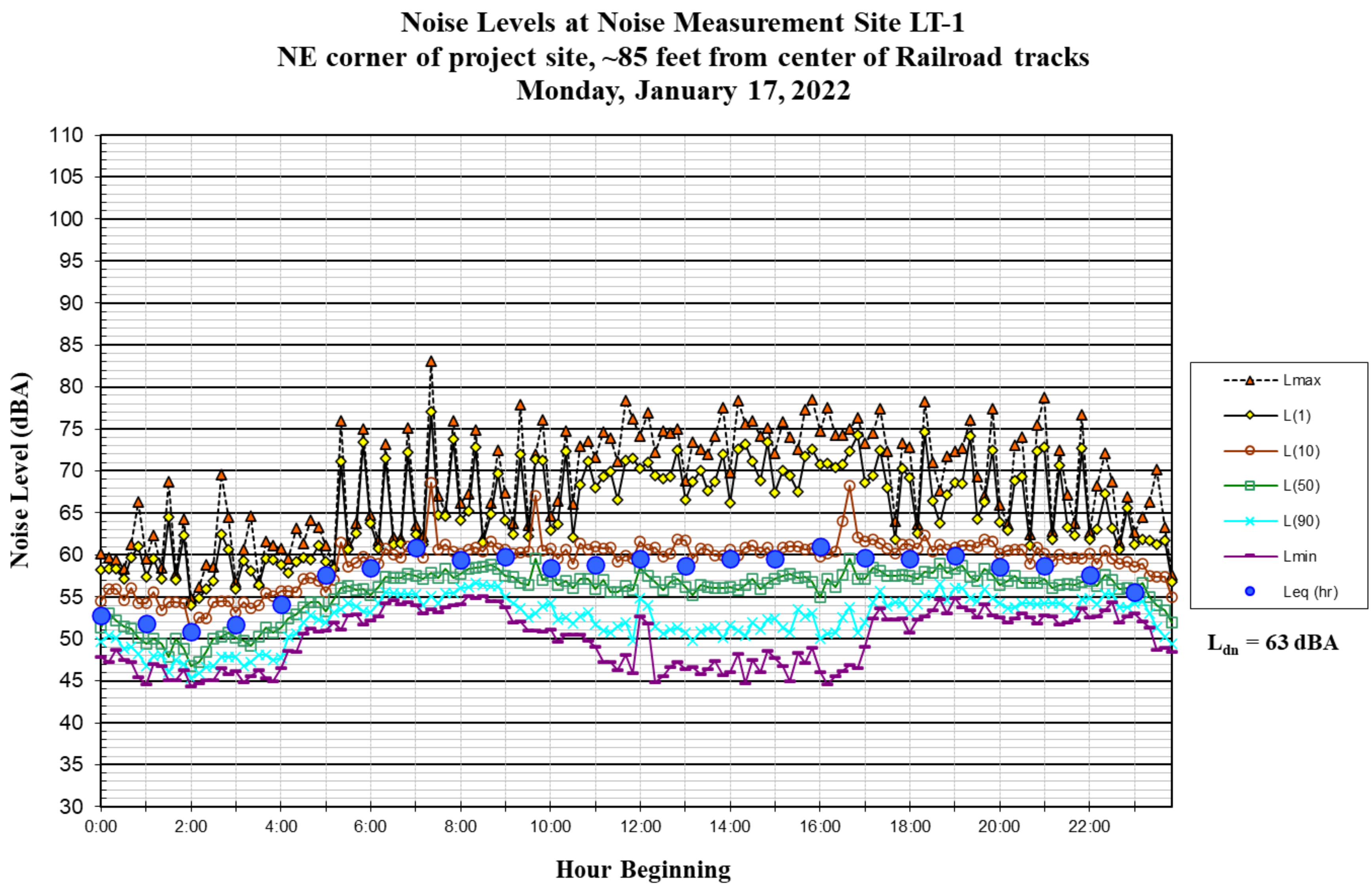
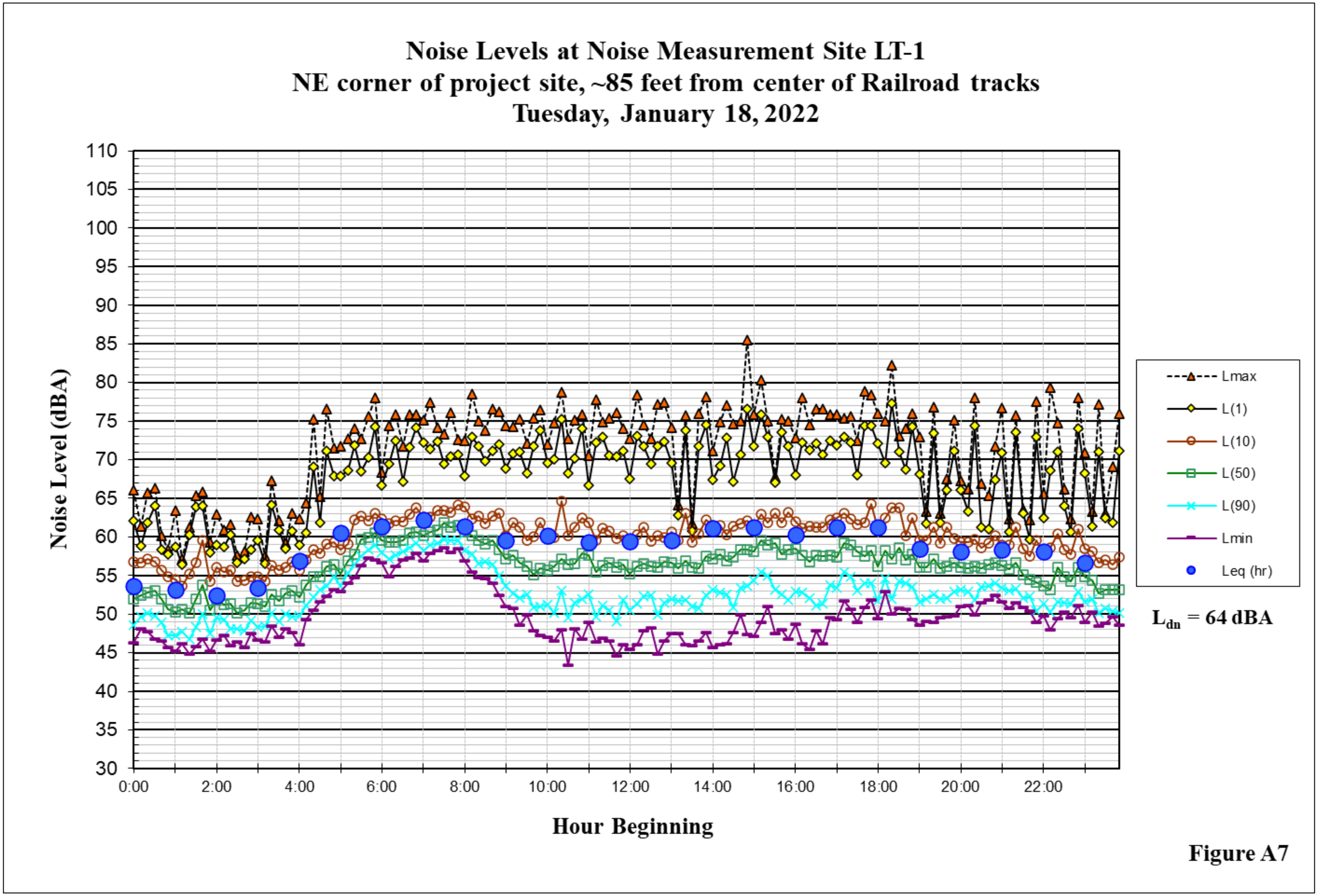

Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Sunday, January 16, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
Ldn = 62 dBA

Figure A5



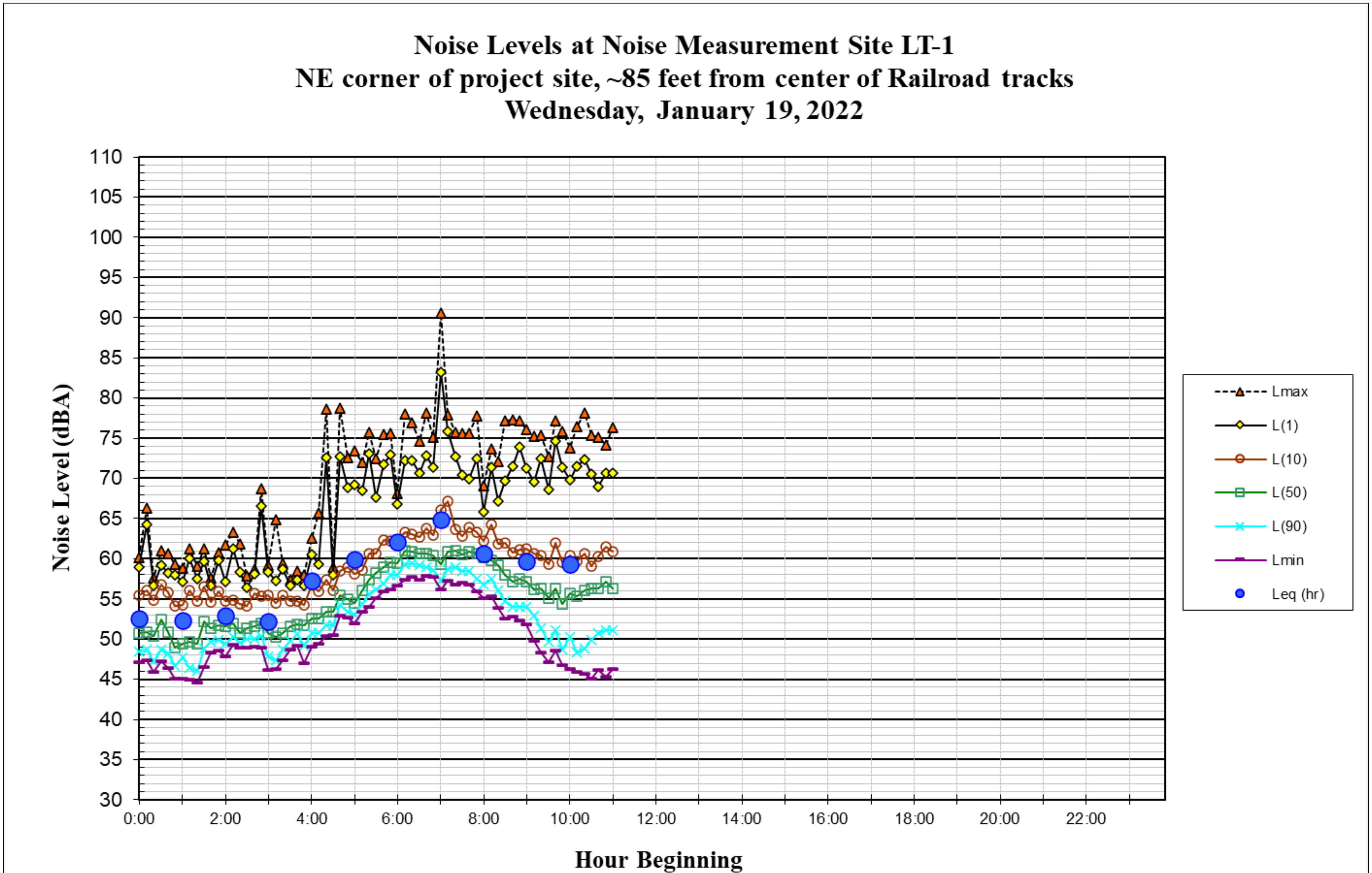
Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Monday, January 17, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L dn = 63 dBA

Figure A6



Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Tuesday, January 18, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
Ldn = 64 dBA

Figure A7



Noise Levels at Noise Measurement Site LT-1
NE corner of project site, ~85 feet from center of Railroad tracks
Wednesday, January 19, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A8

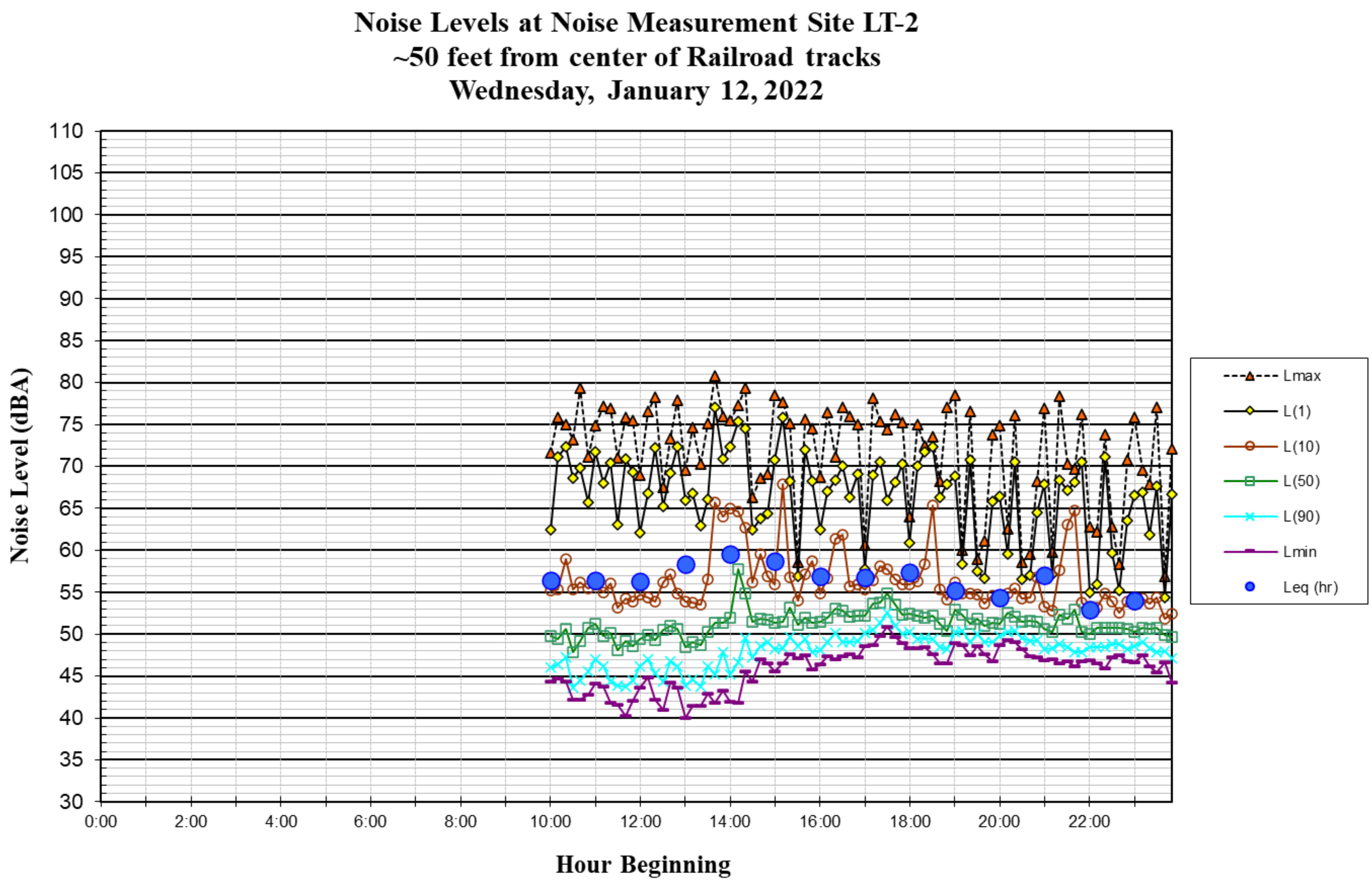

Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Wednesday, January 12, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A9

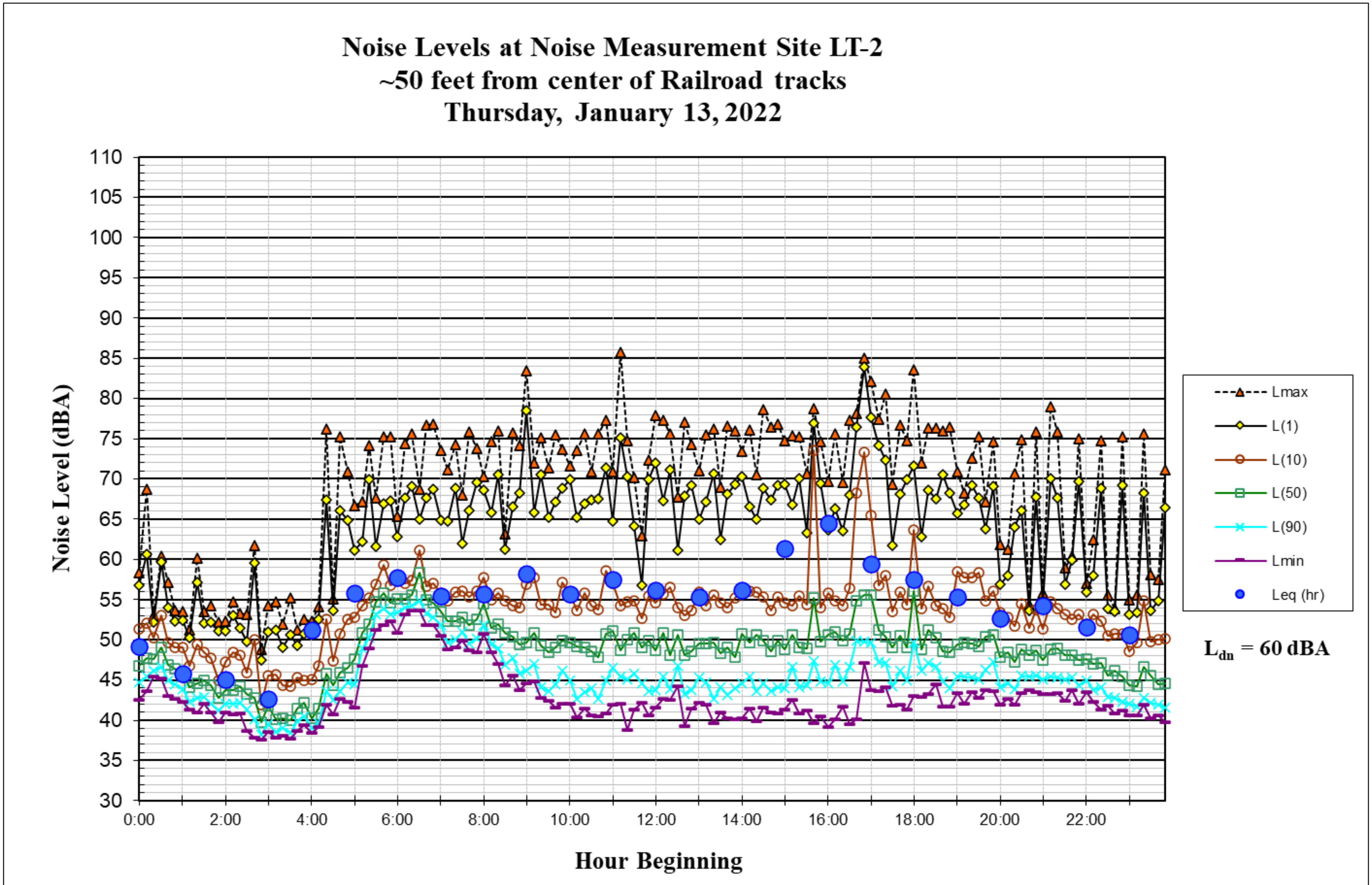

Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Thursday, January 13, 2022
Noise Level (dBA)
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 60 dBA

Figure A10

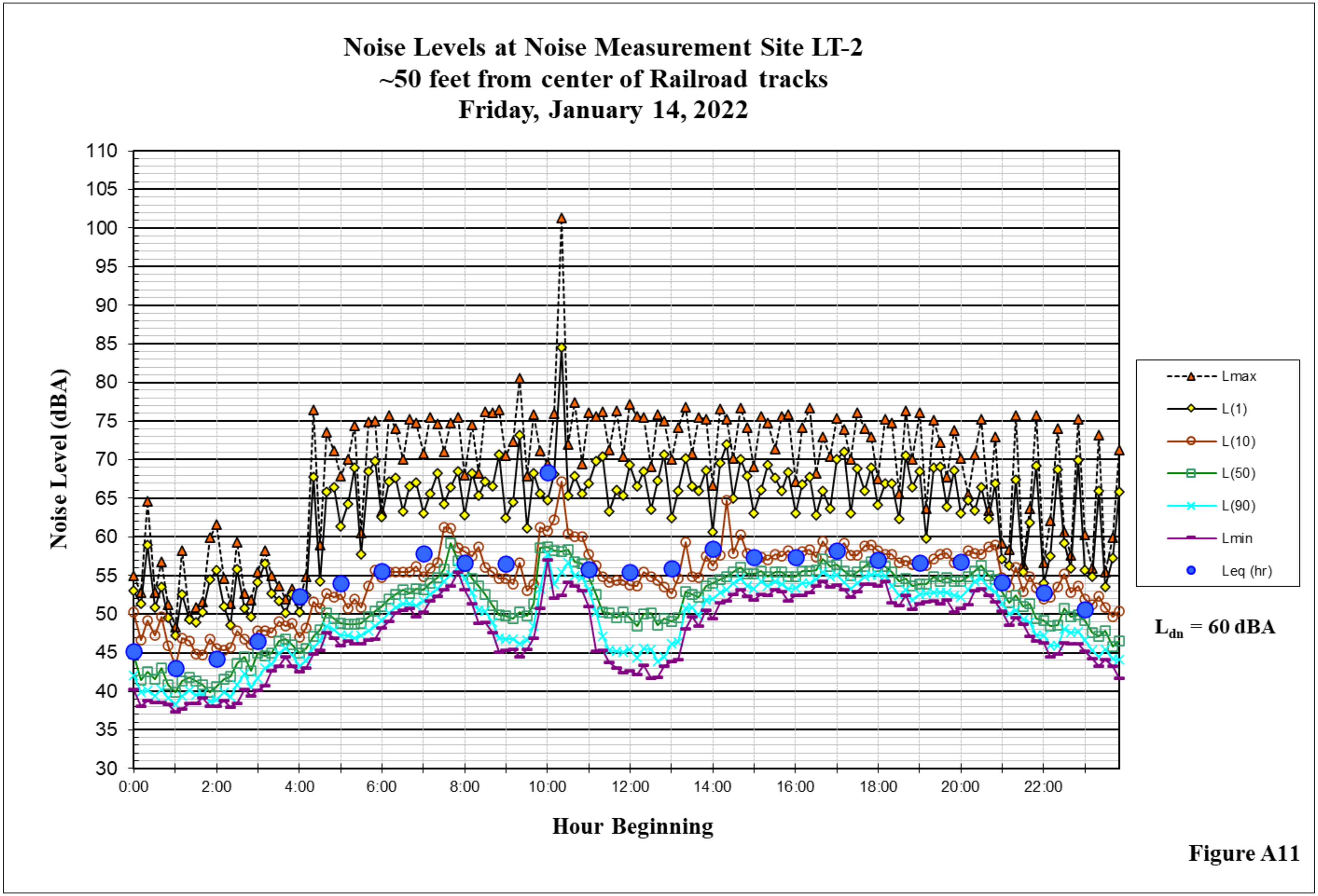
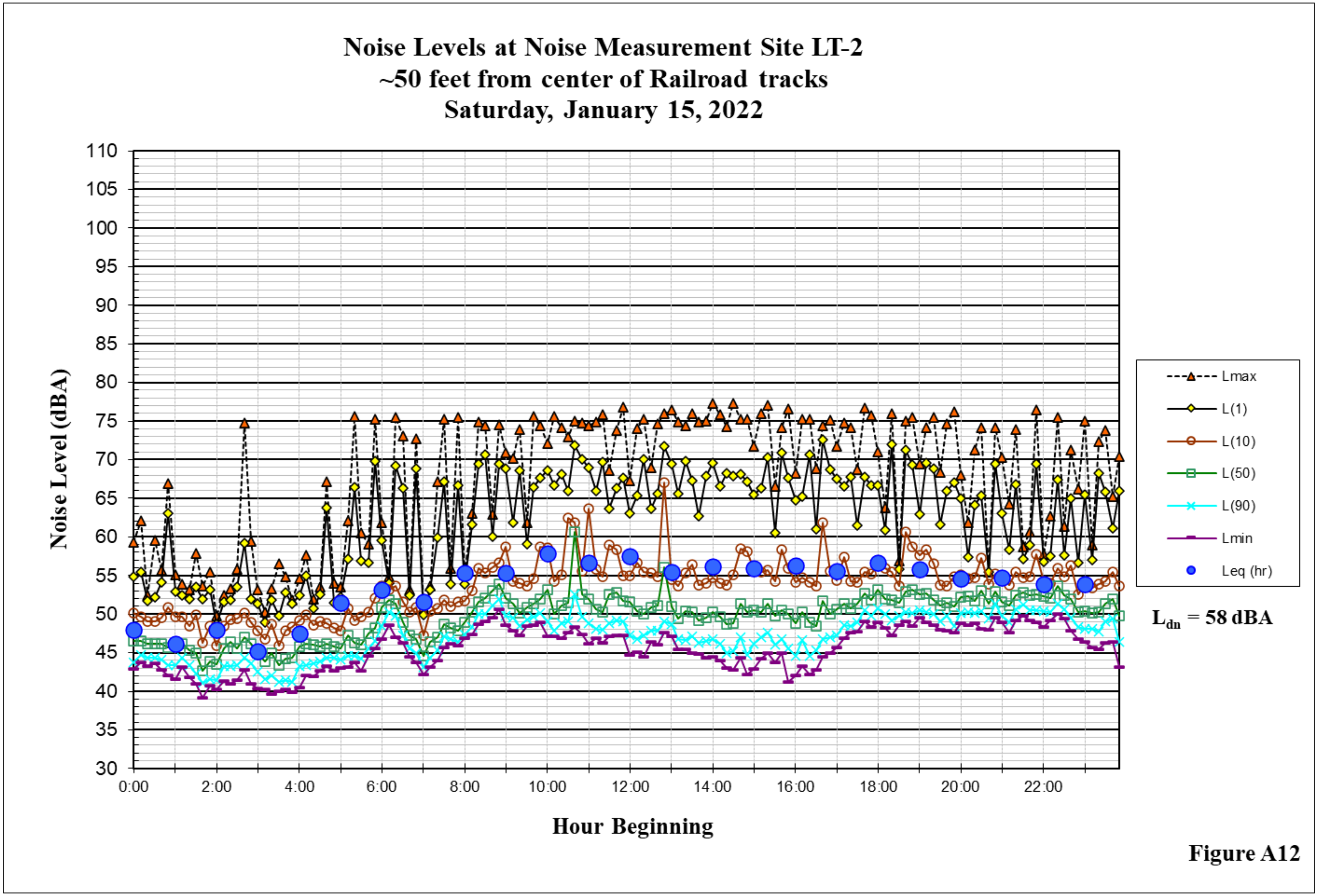

Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Friday, January 14, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 60 dBA

Figure A11



Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Saturday, January 15, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 58 dBA

Figure A12

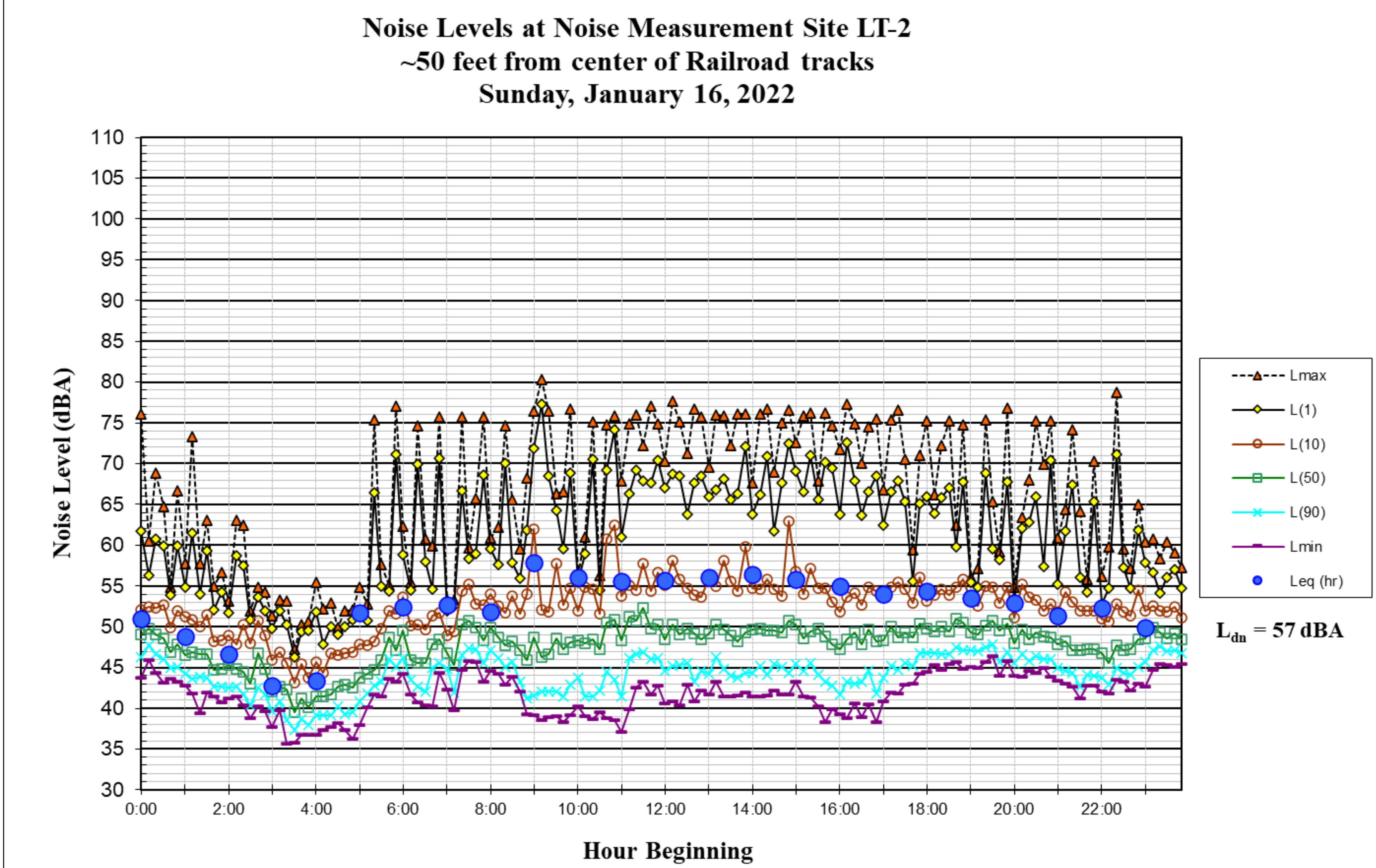
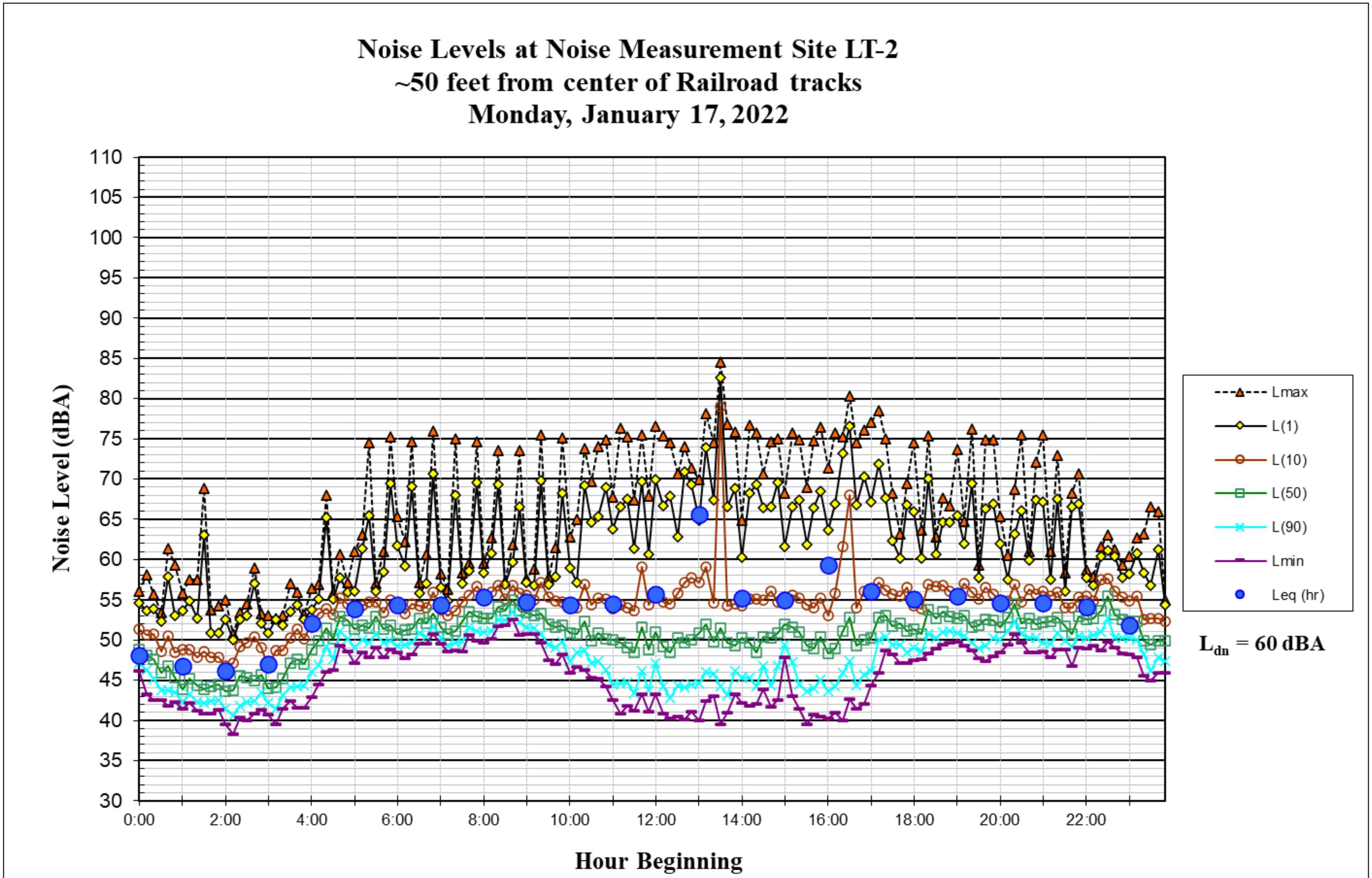
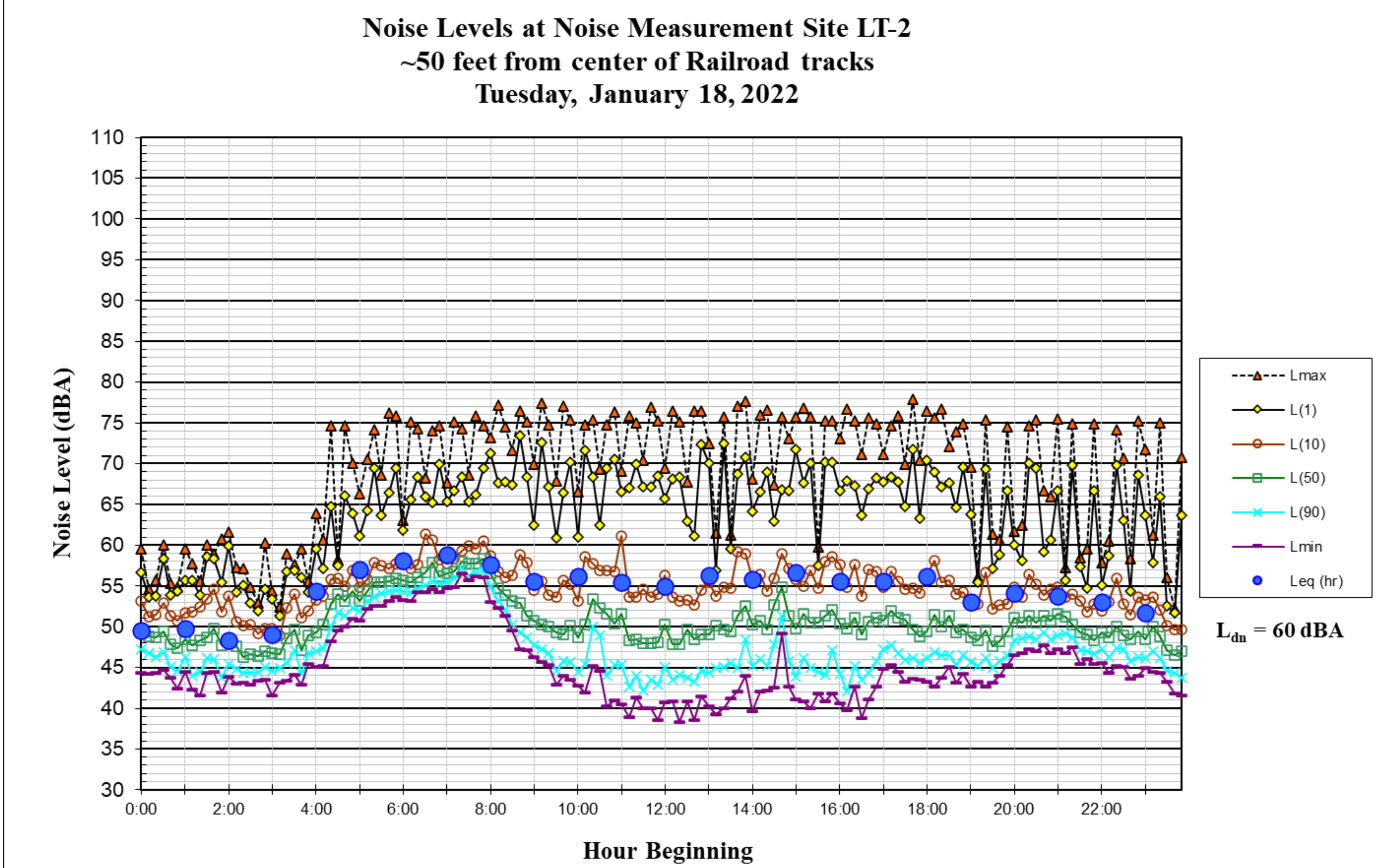

Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Sunday, January 16, 2022
Noise Level (dBA)
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 57 dBA

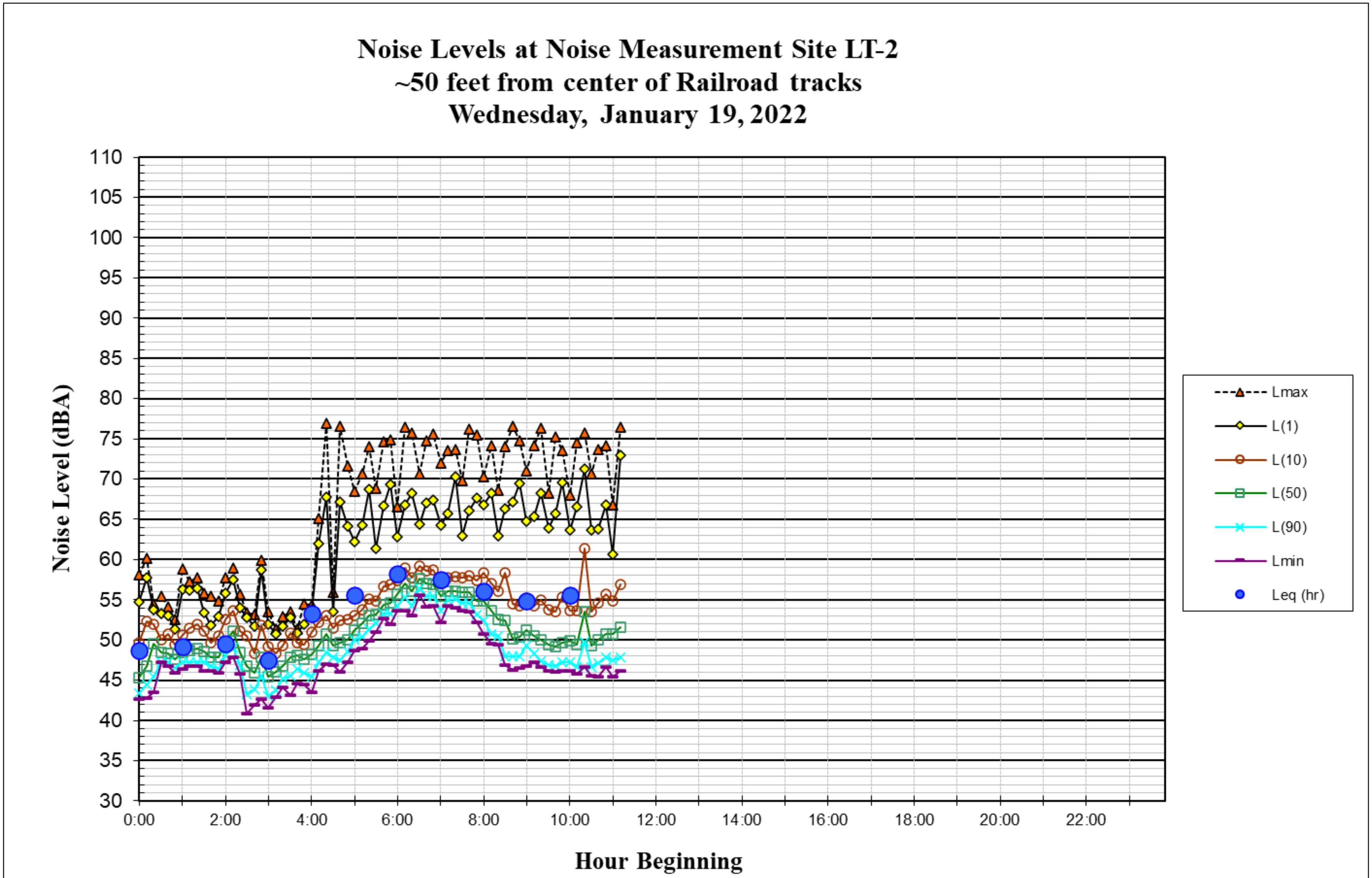
Figure A13


Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Monday, January 17, 2022
Noise Level (dBA)
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 60 dBA
Figure A14



L_{dn} = 60 dBA

Figure A15



Noise Levels at Noise Measurement Site LT-2
~50 feet from center of Railroad tracks
Wednesday, January 19, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A16

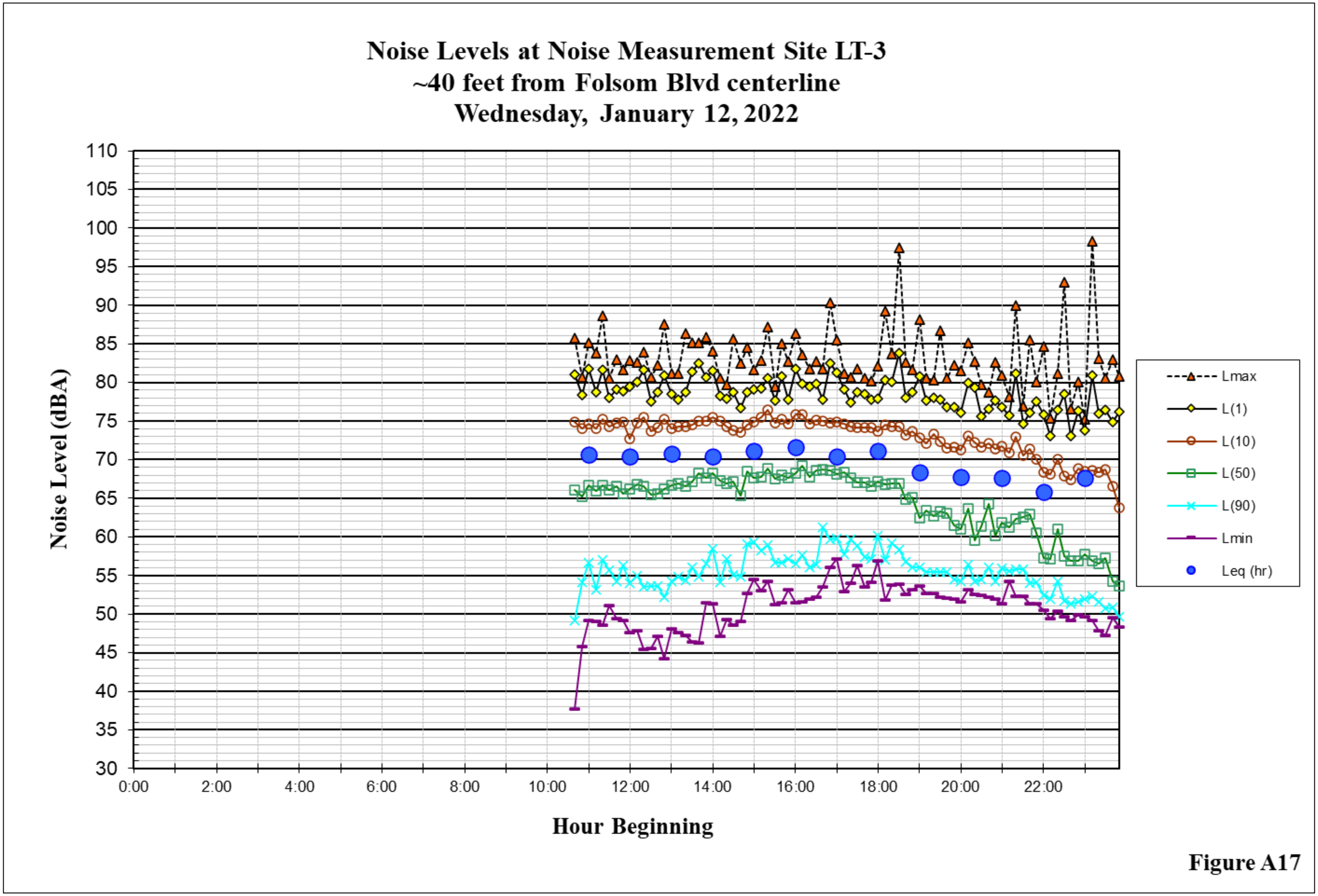
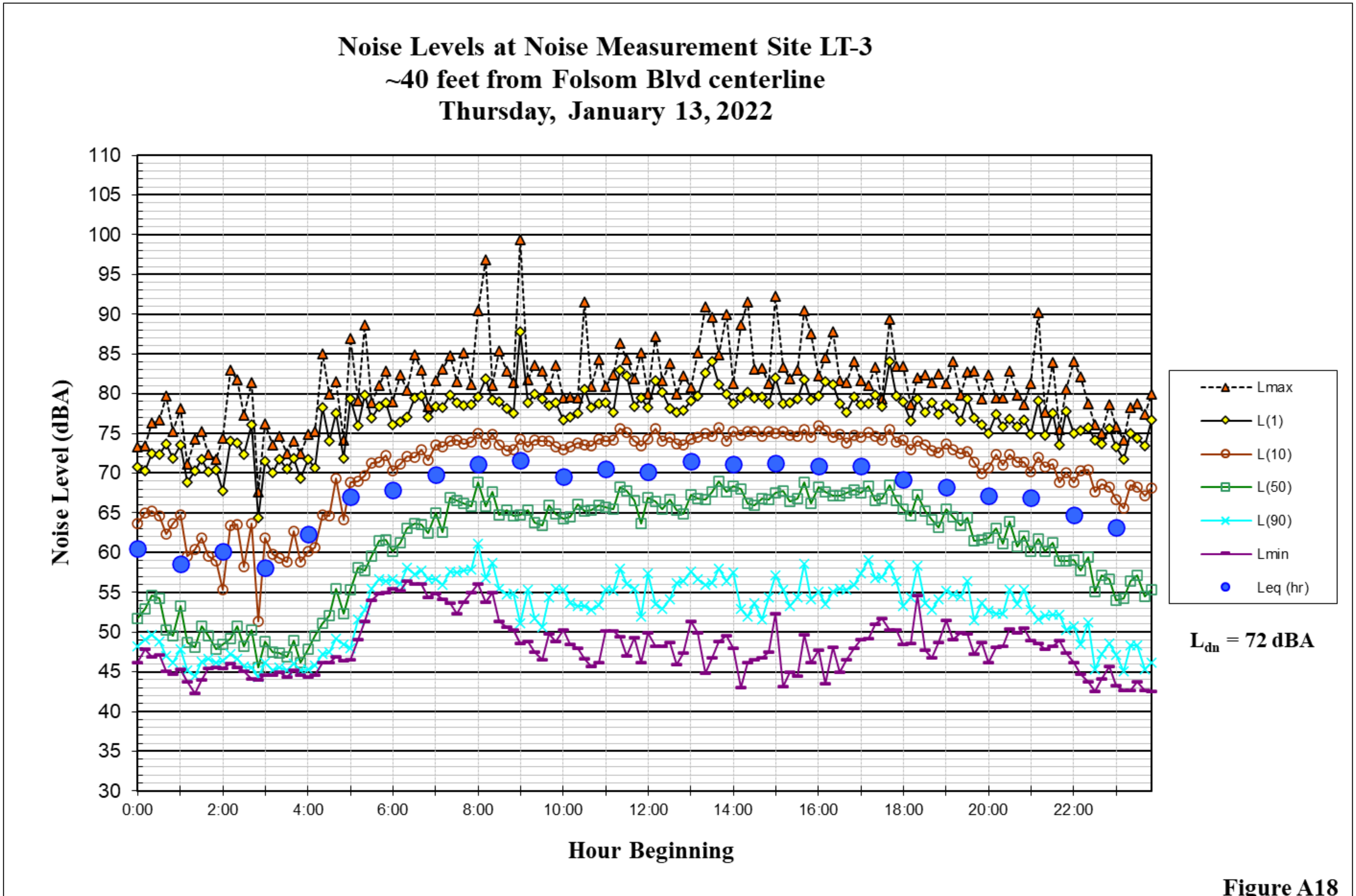
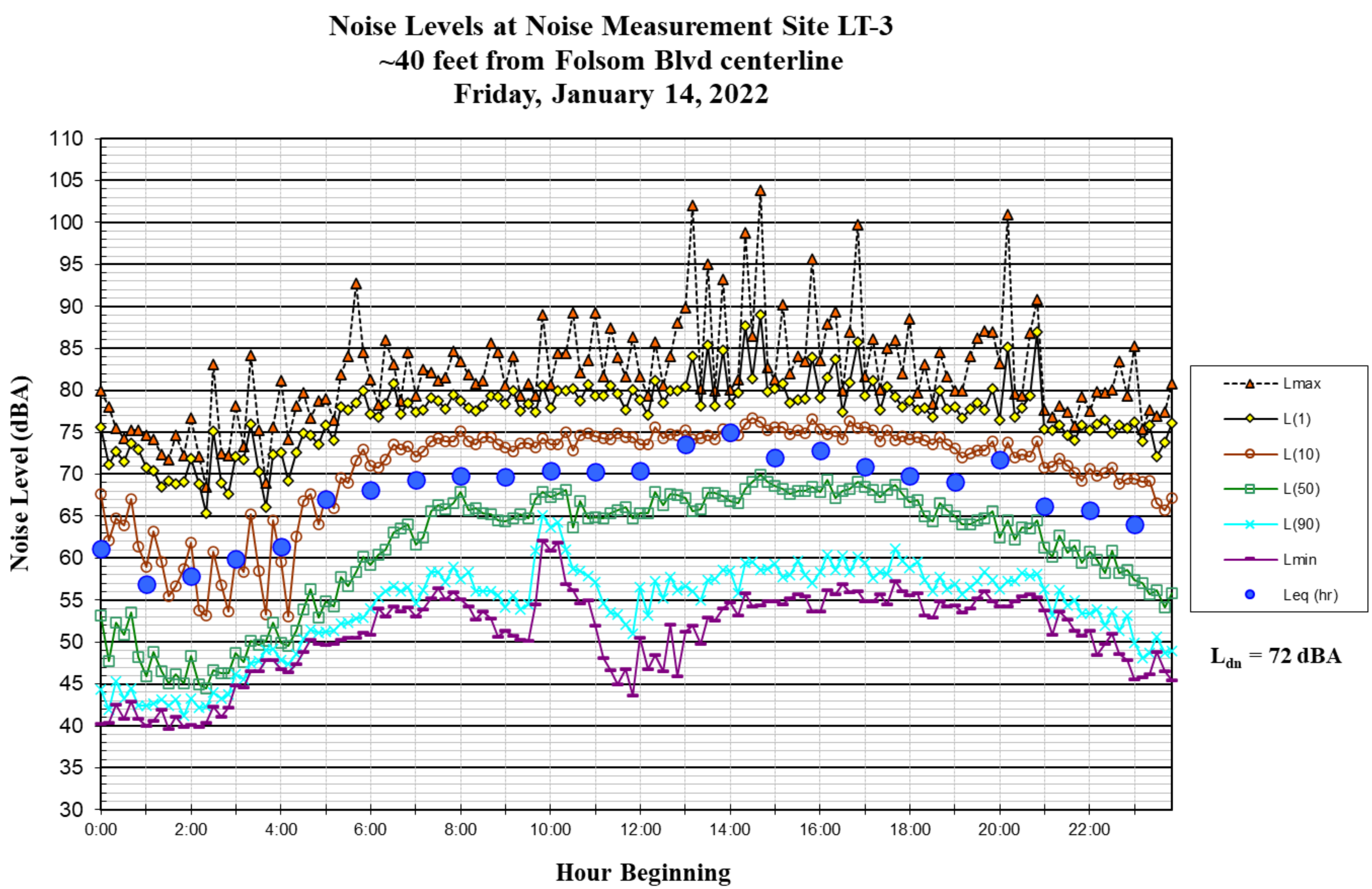

Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Wednesday, January 12, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

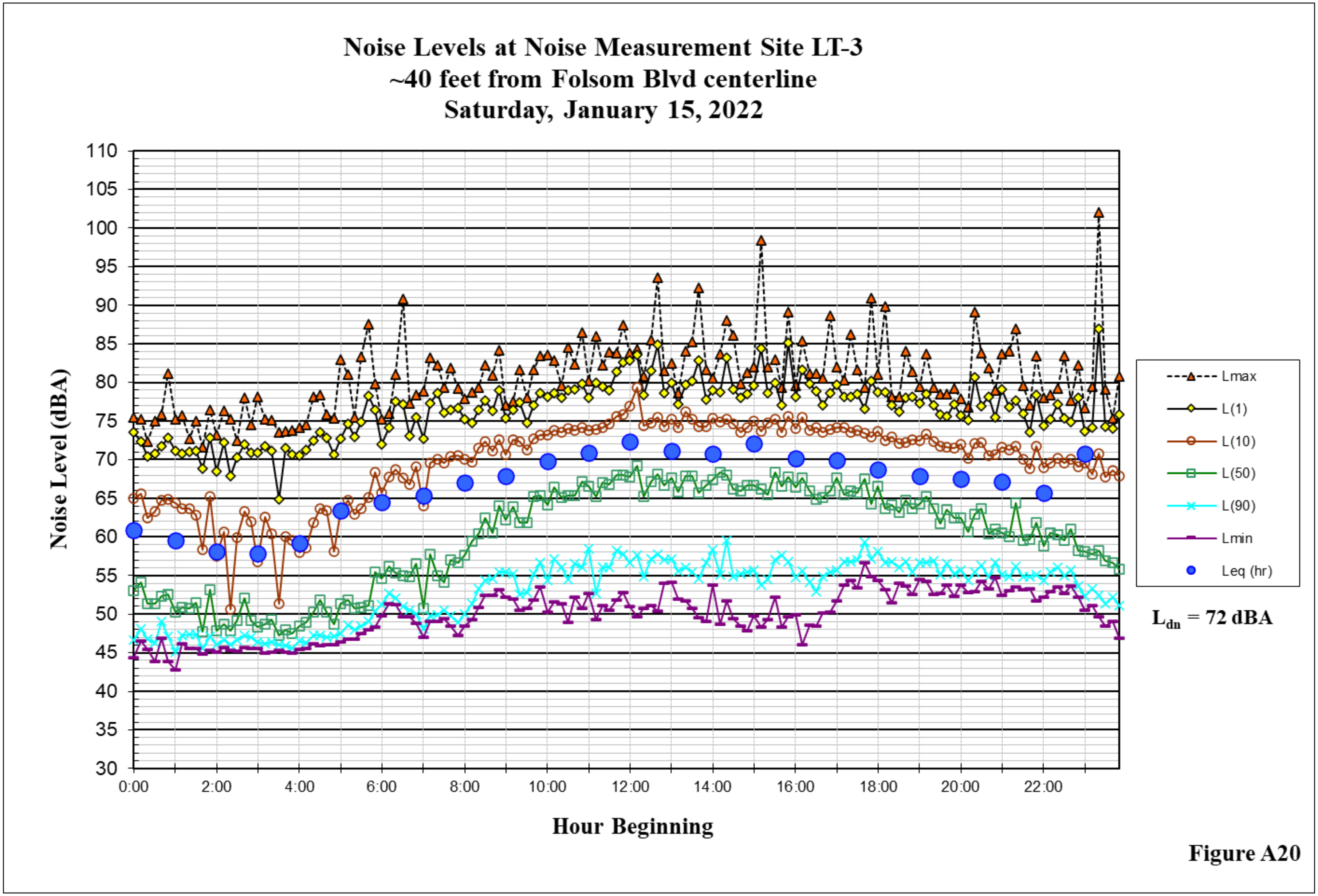
Figure A17



Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Thursday, January 13, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 72 dBA

Figure A18


Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Friday, January 14, 2022
Noise Level (dBA)
Hour Beginning
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
Ldn = 72 dBA
Figure A19



Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Saturday, January 15, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 72 dBA

Figure A20

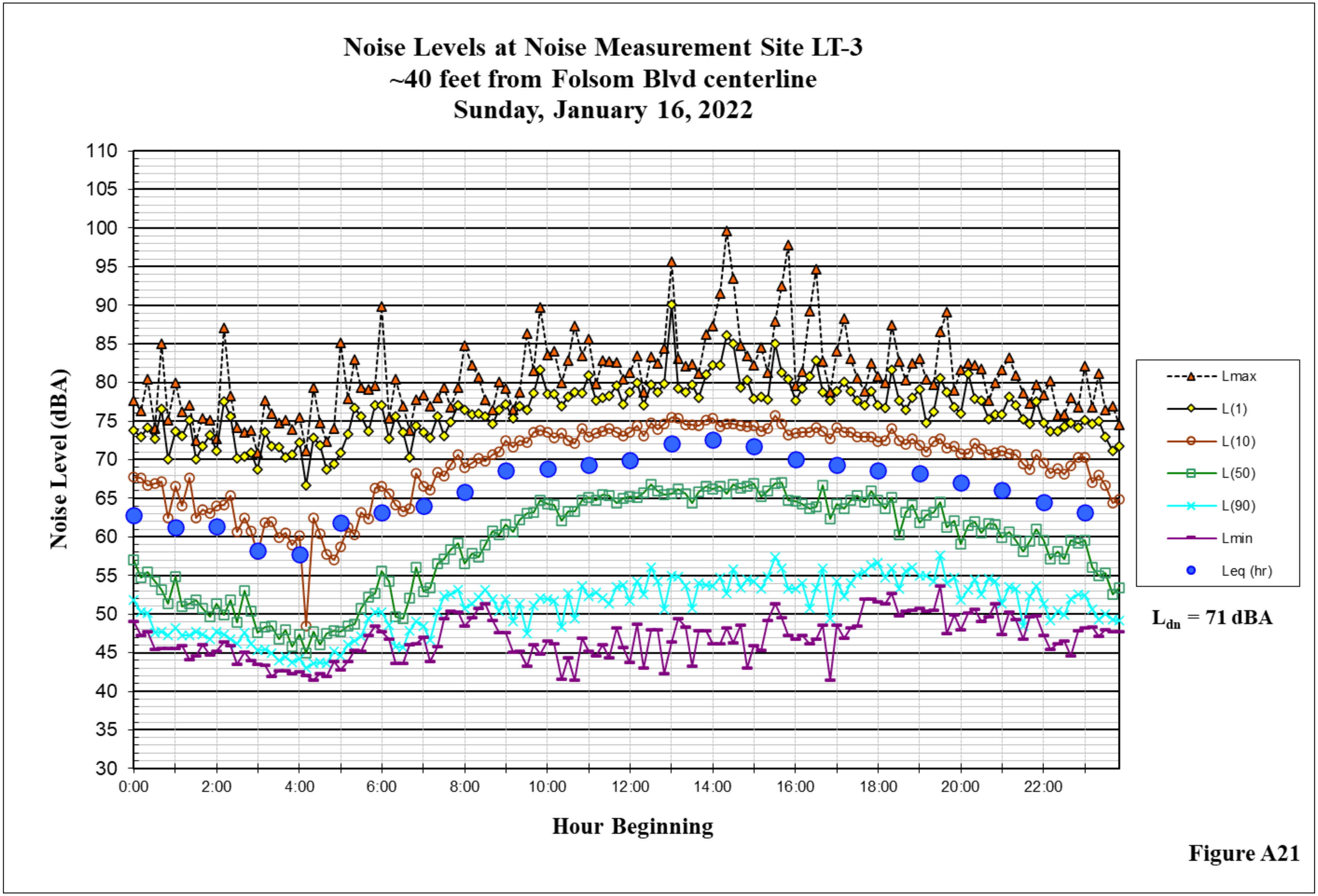
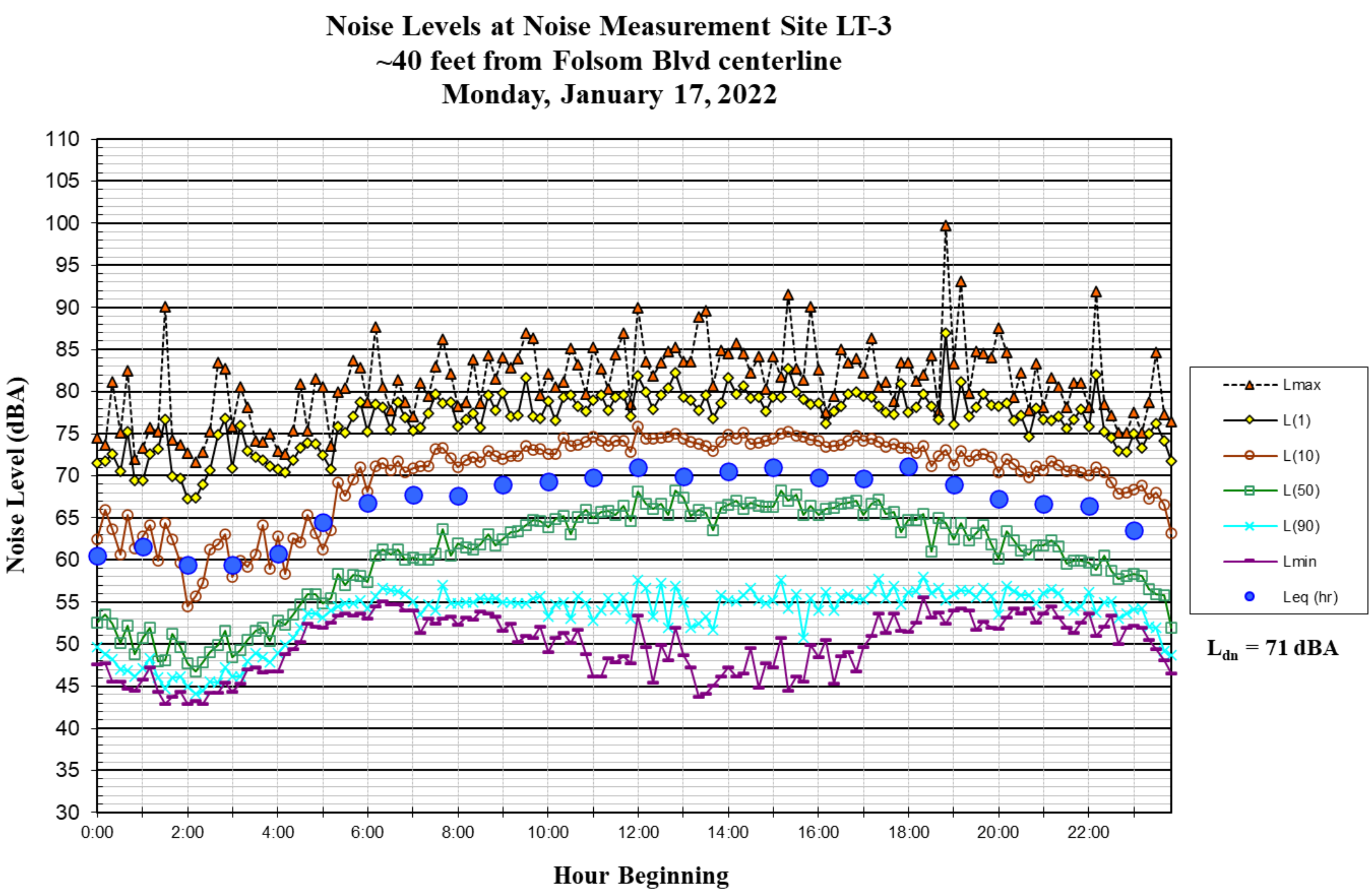

Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Sunday, January 16, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 71 dBA

Figure A21



L_{dn} = 71 dBA

Figure A22

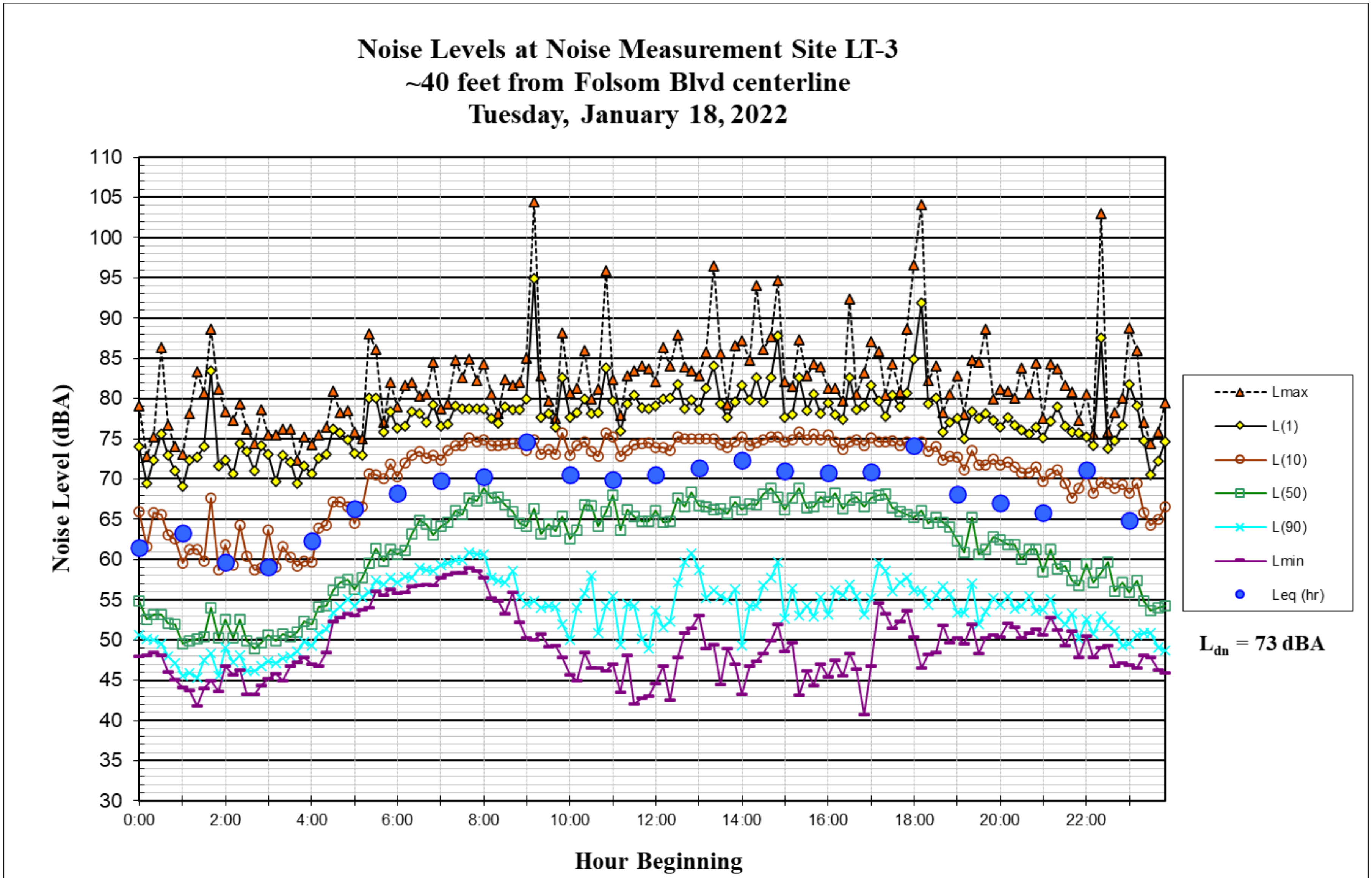

Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Tuesday, January 18, 2022
Noise Level (dBA)
Hour Beginning
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 73 dBA

Figure A23

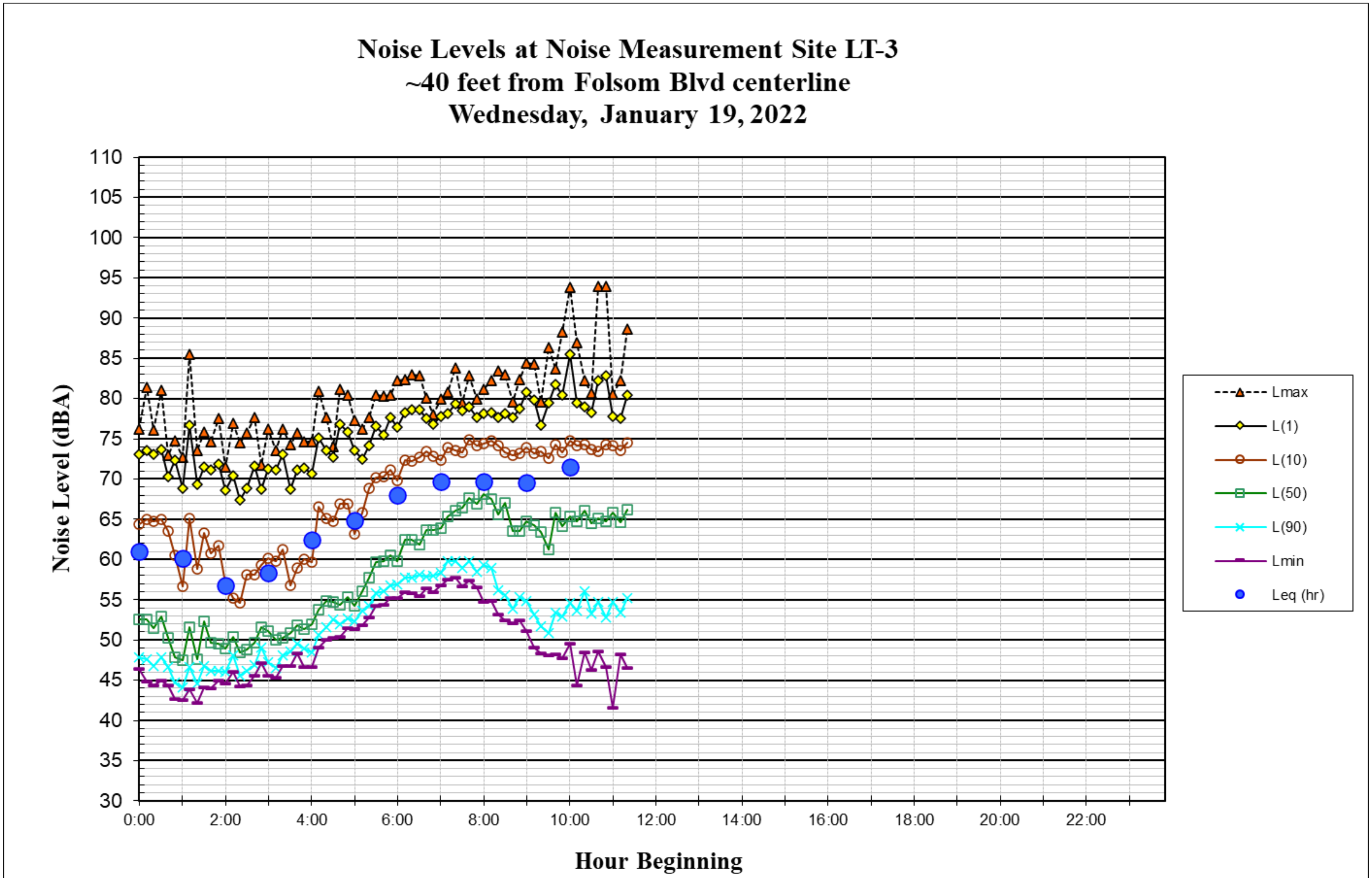
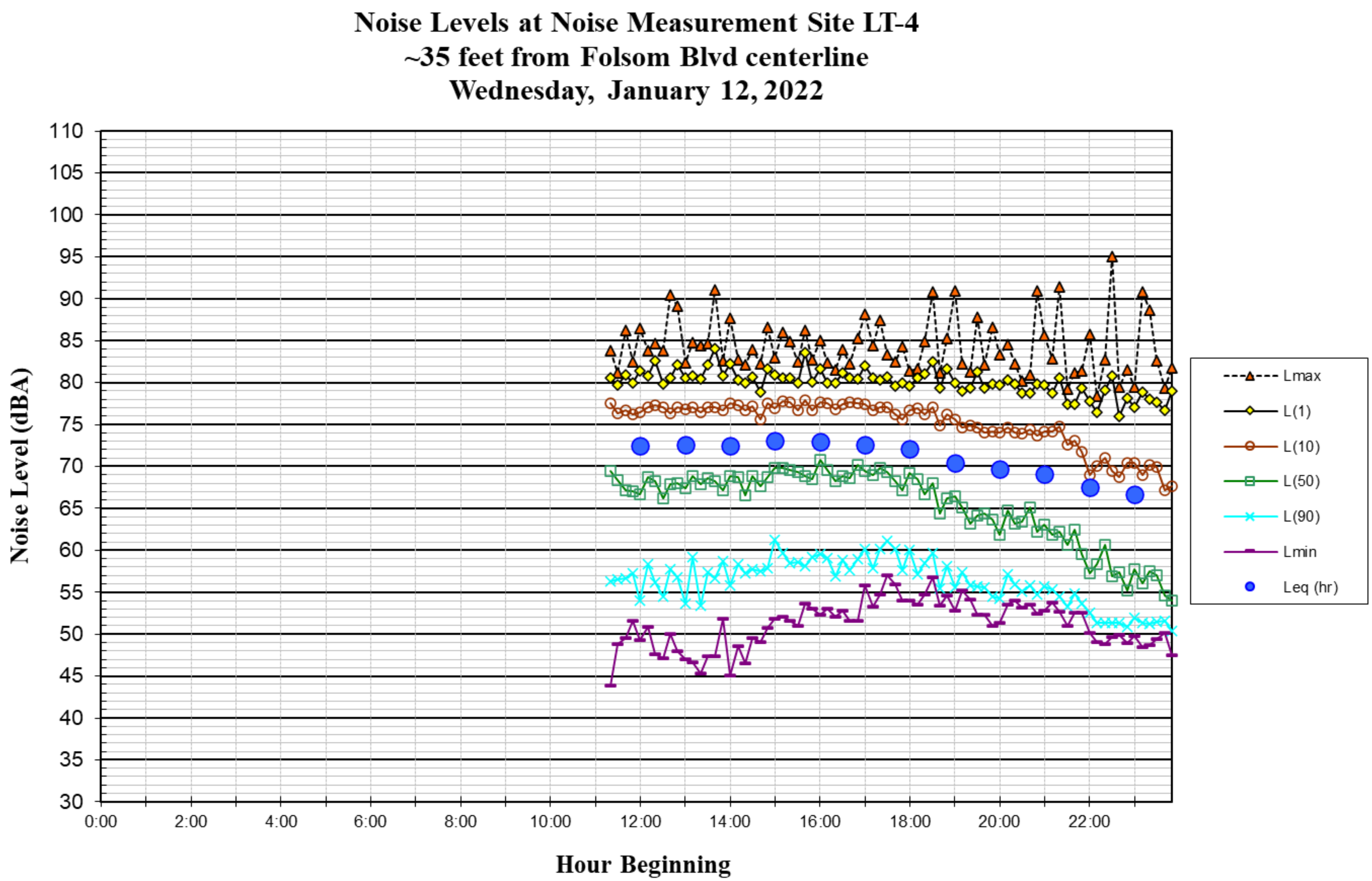

Noise Levels at Noise Measurement Site LT-3
~40 feet from Folsom Blvd centerline
Wednesday, January 19, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A24



Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Wednesday, January 12, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A25

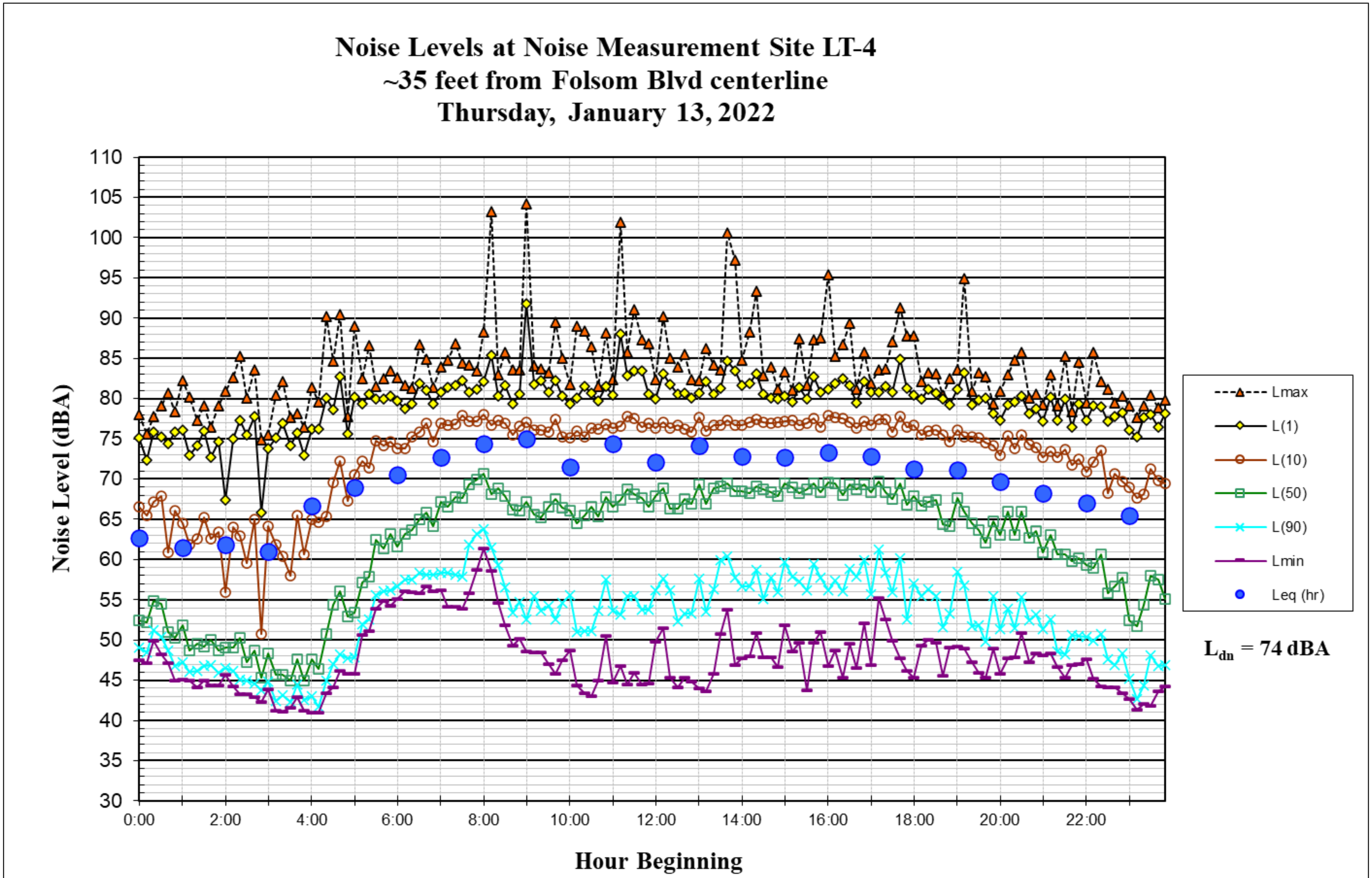

Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Thursday, January 13, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 74 dBA

Figure A26

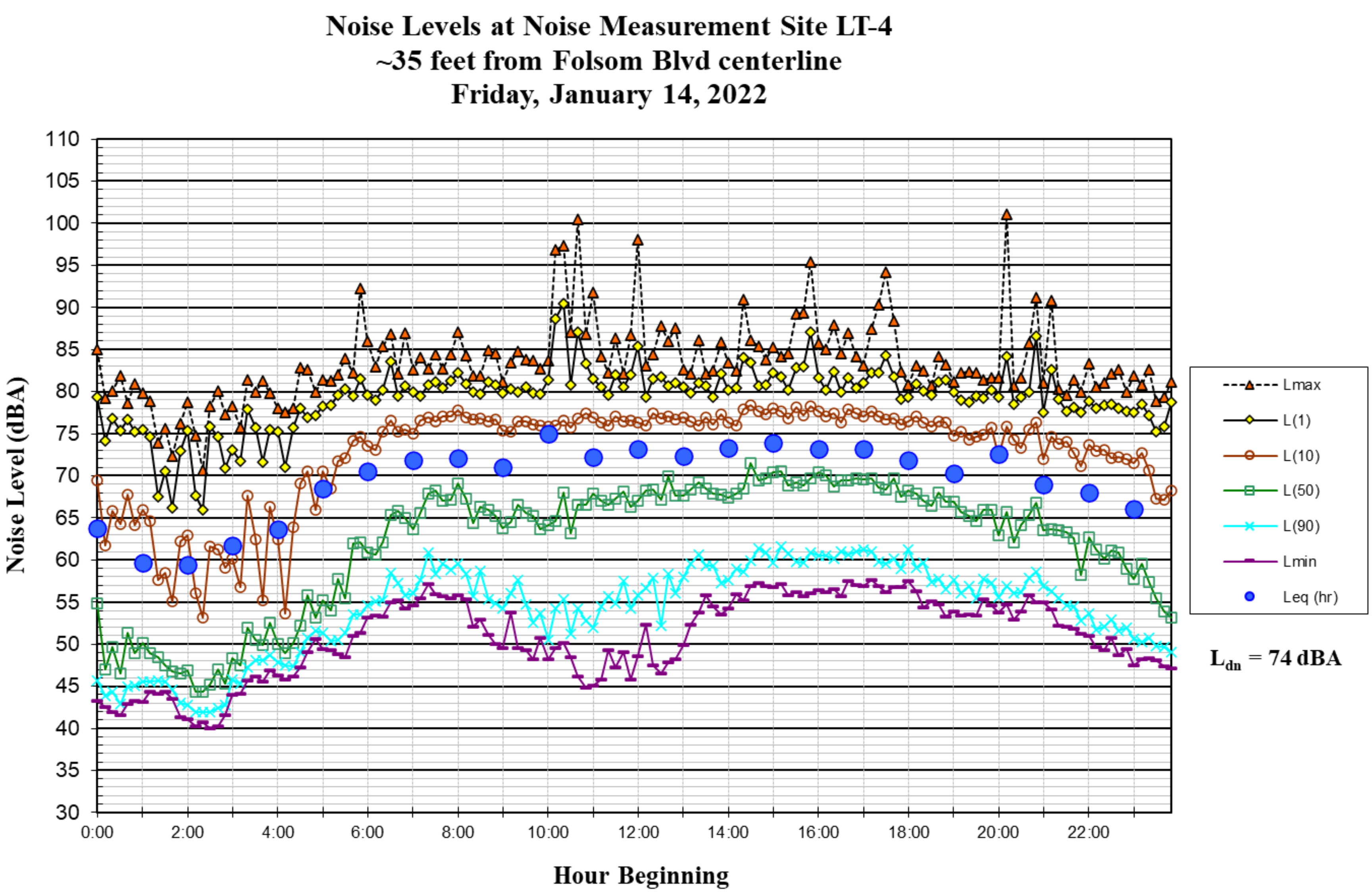

Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Friday, January 14, 2022
Noise Level (dBA)
Hour Beginning
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 74 dBA

Figure A27

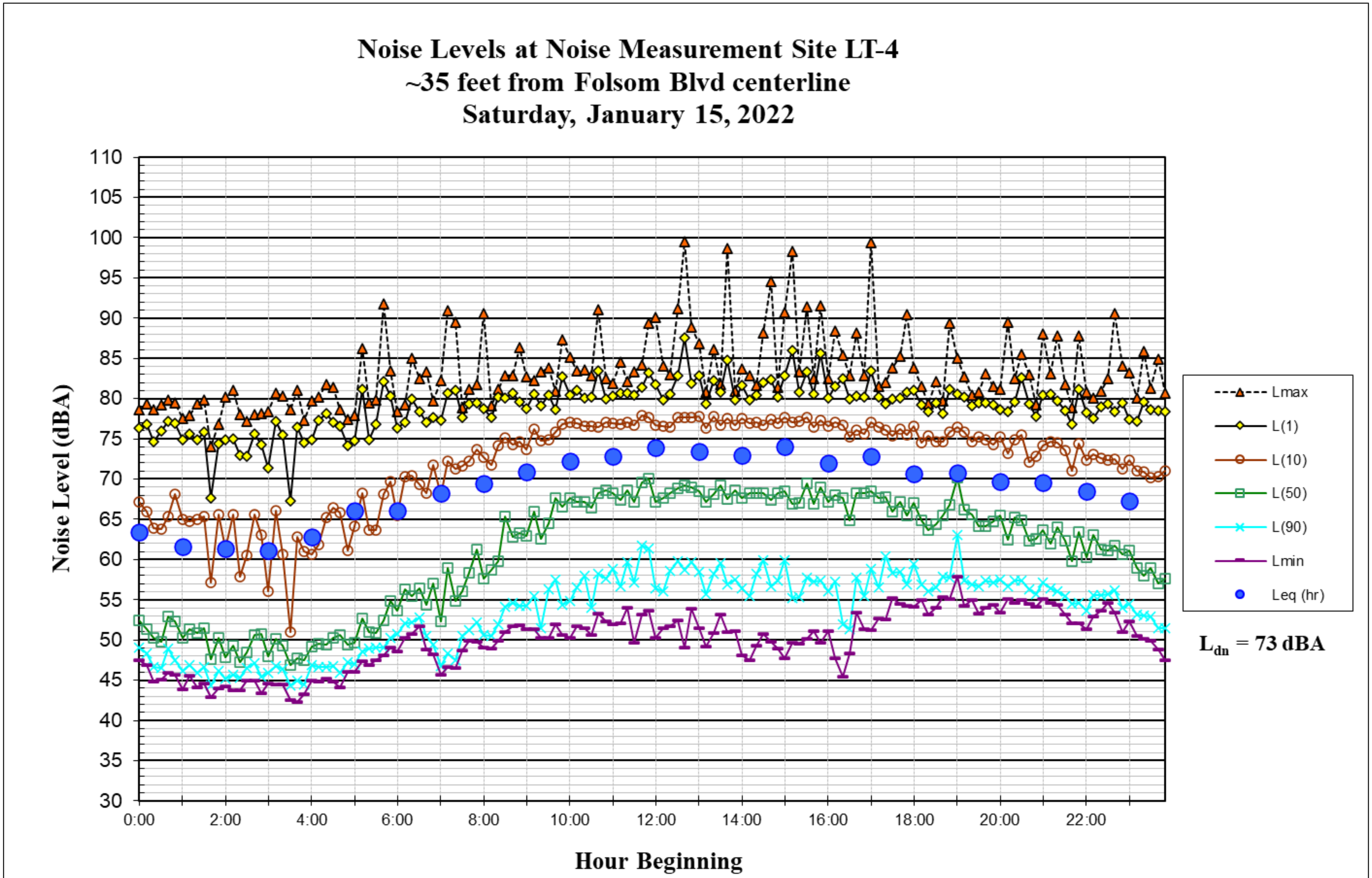
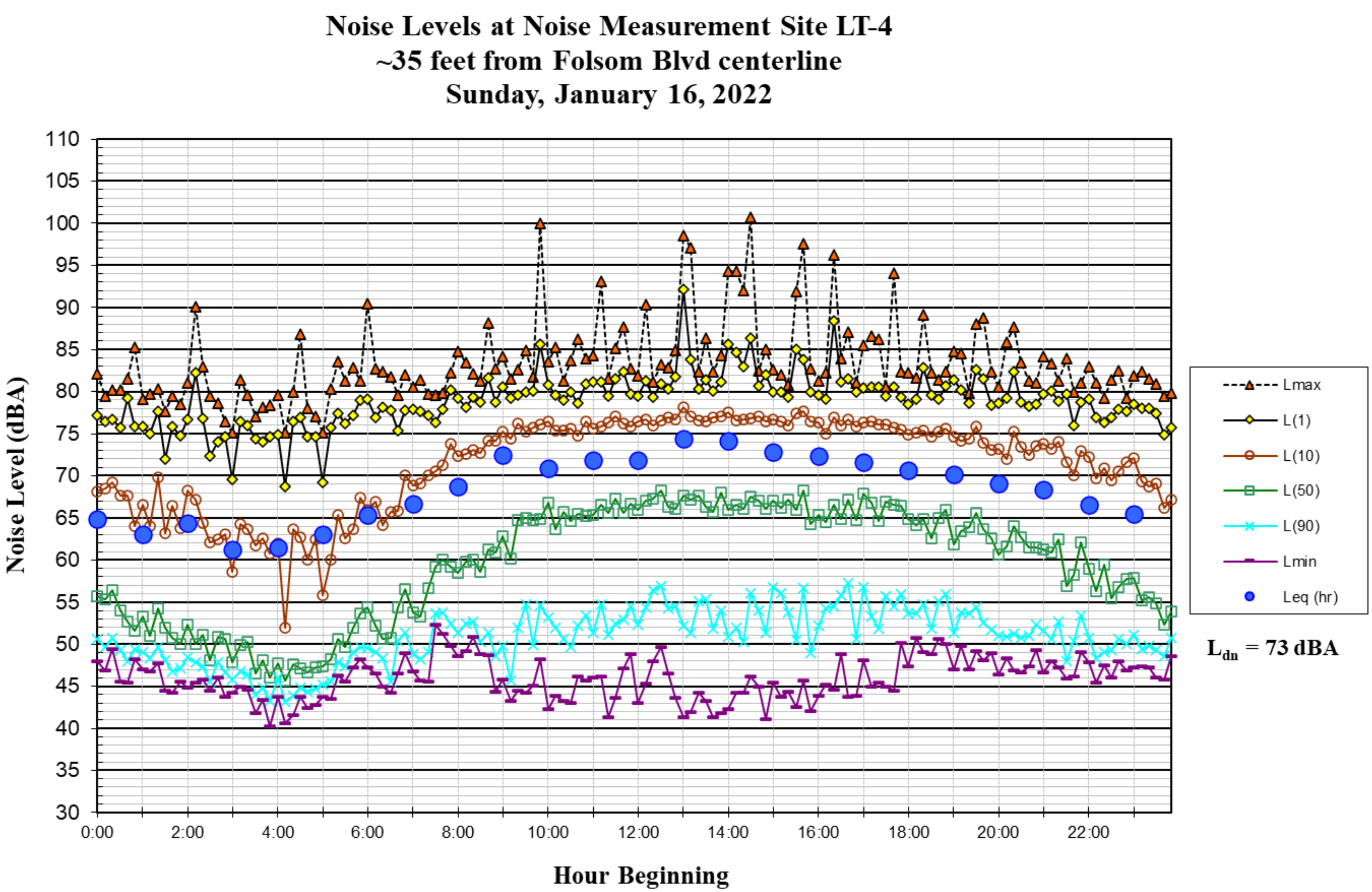

Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Saturday, January 15, 2022
Noise Level (dBA)
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 73 dBA

Figure A28



Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Sunday, January 16, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 73 dBA

Figure A29

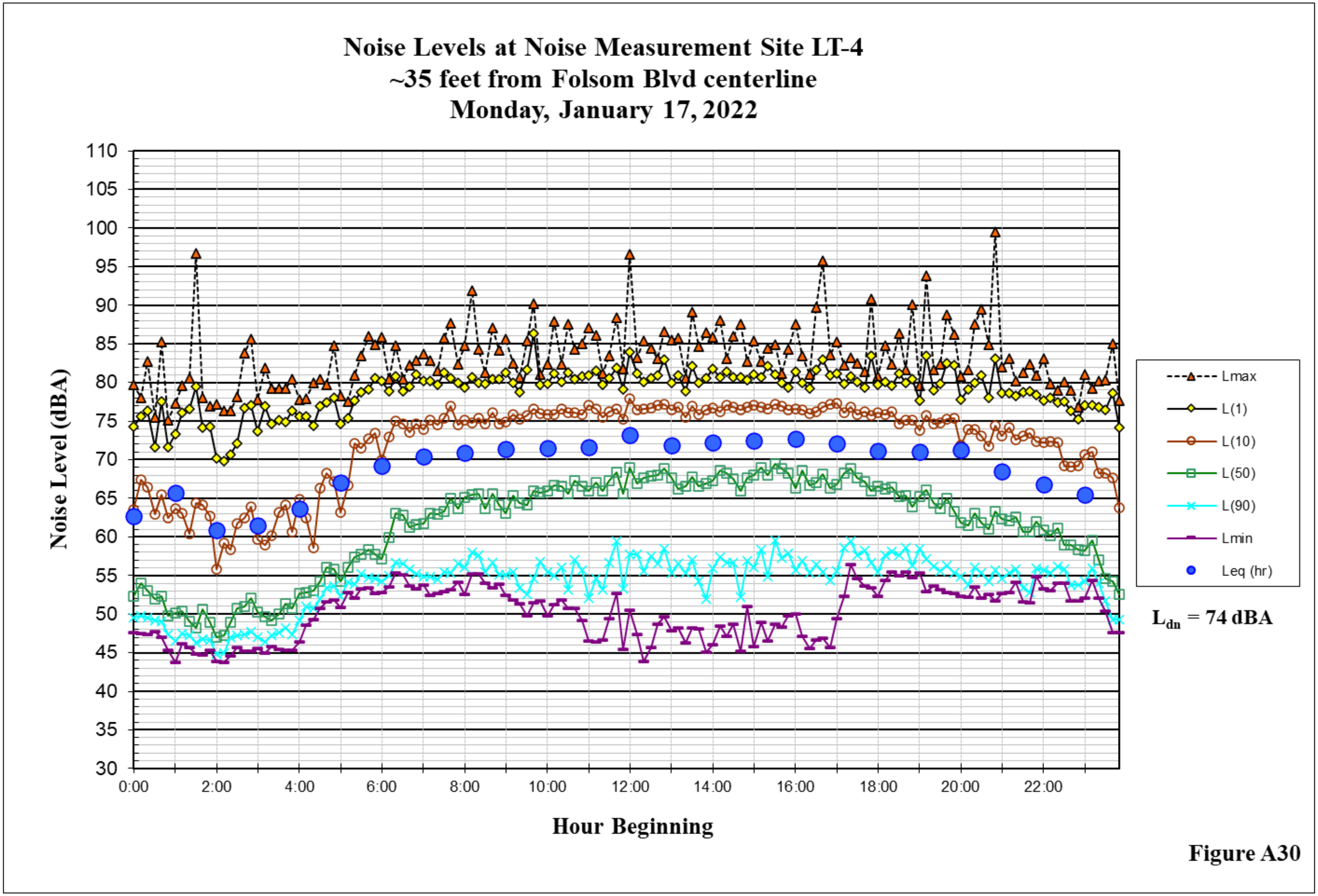
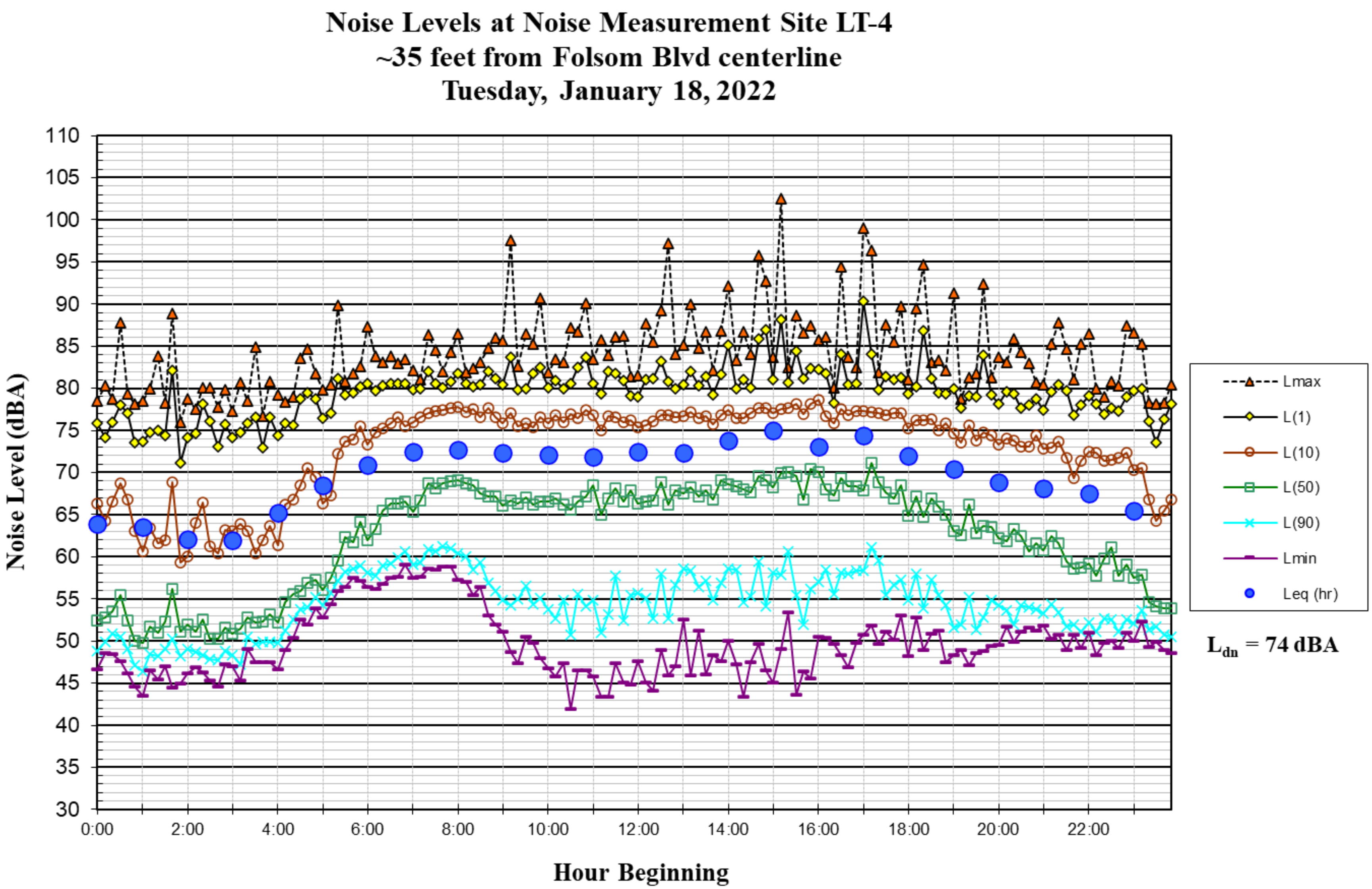
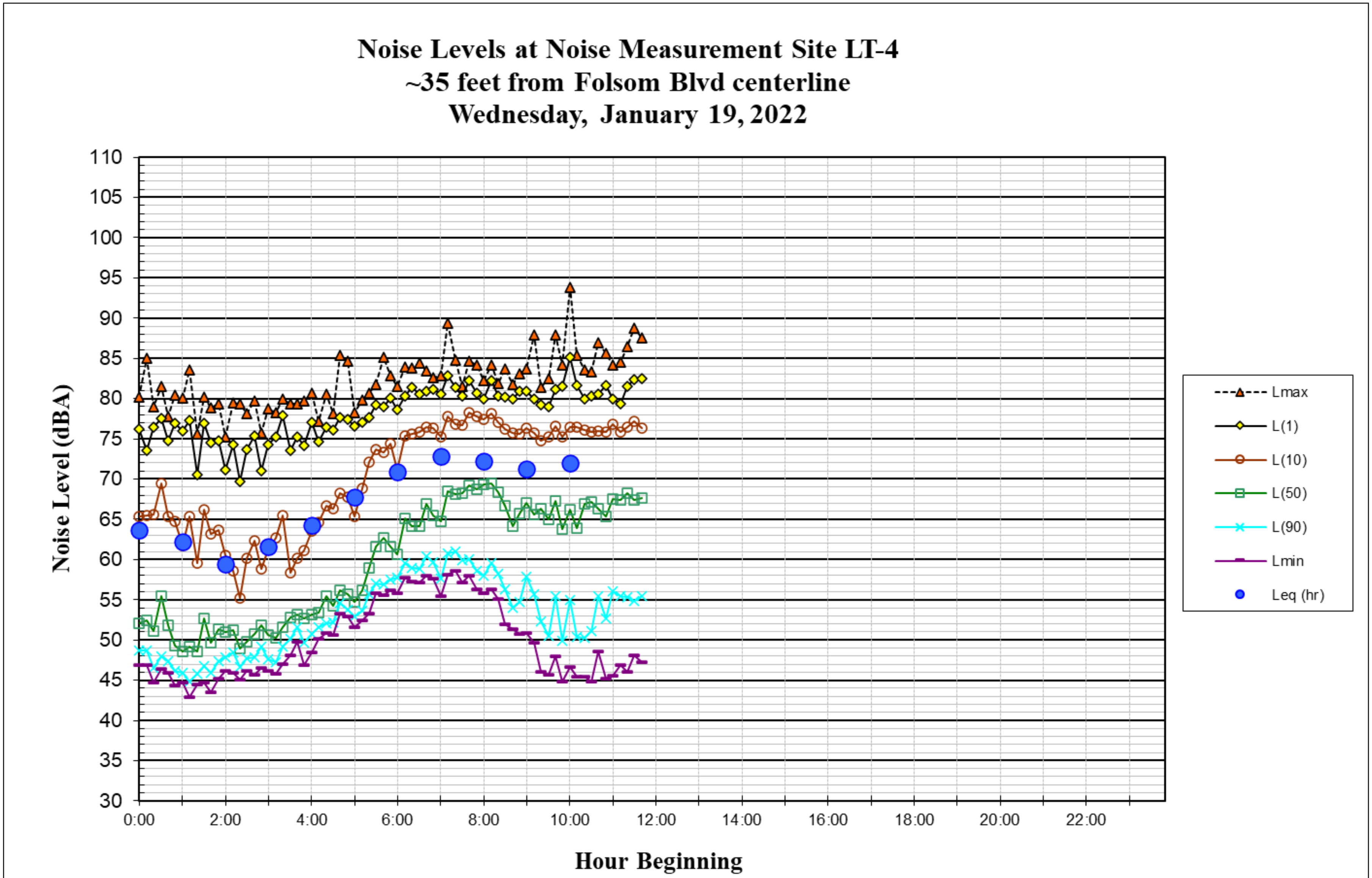

Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Monday, January 17, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)
L_{dn} = 74 dBA

Figure A30



L_{dn} = 74 dBA

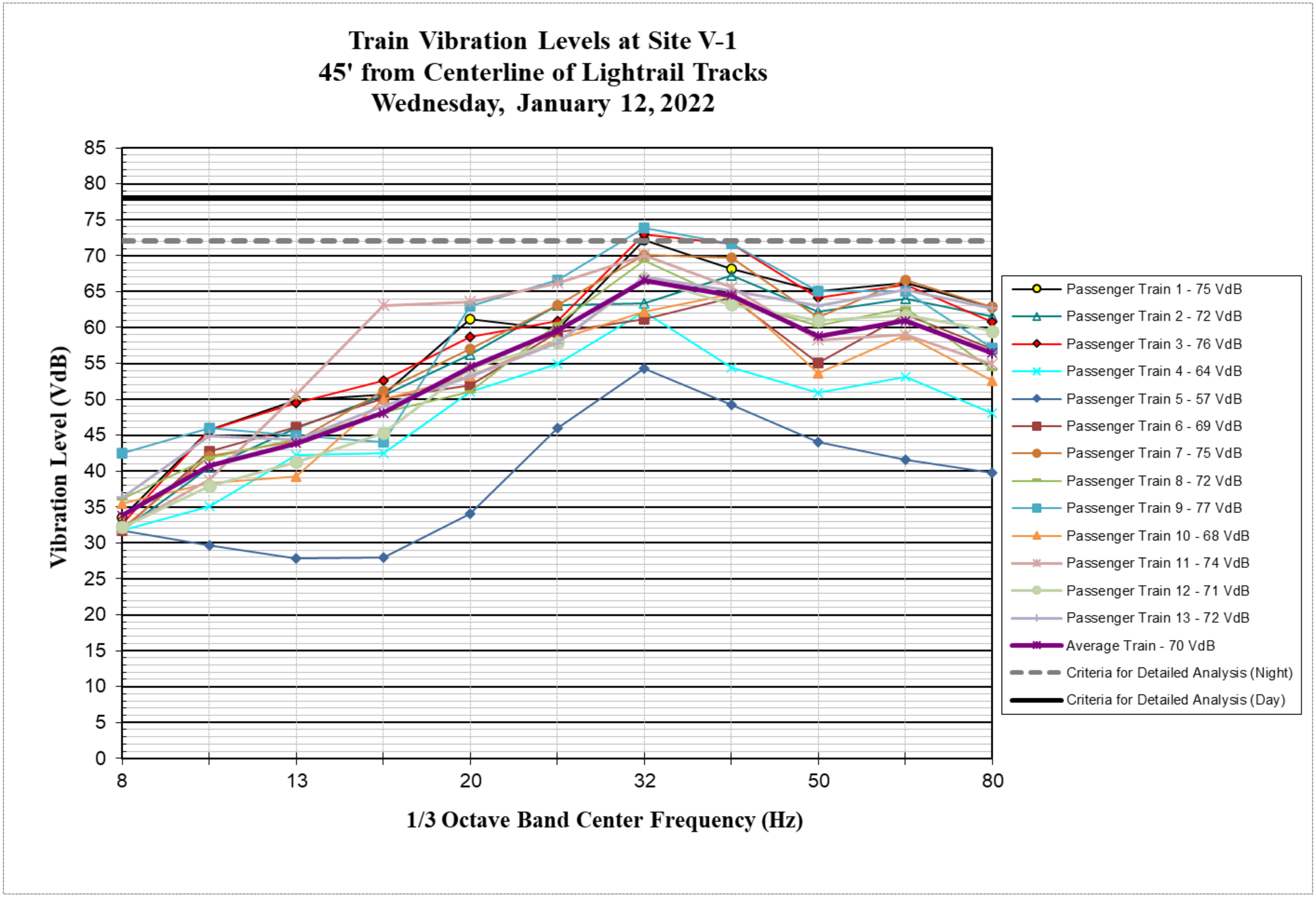
Figure A31

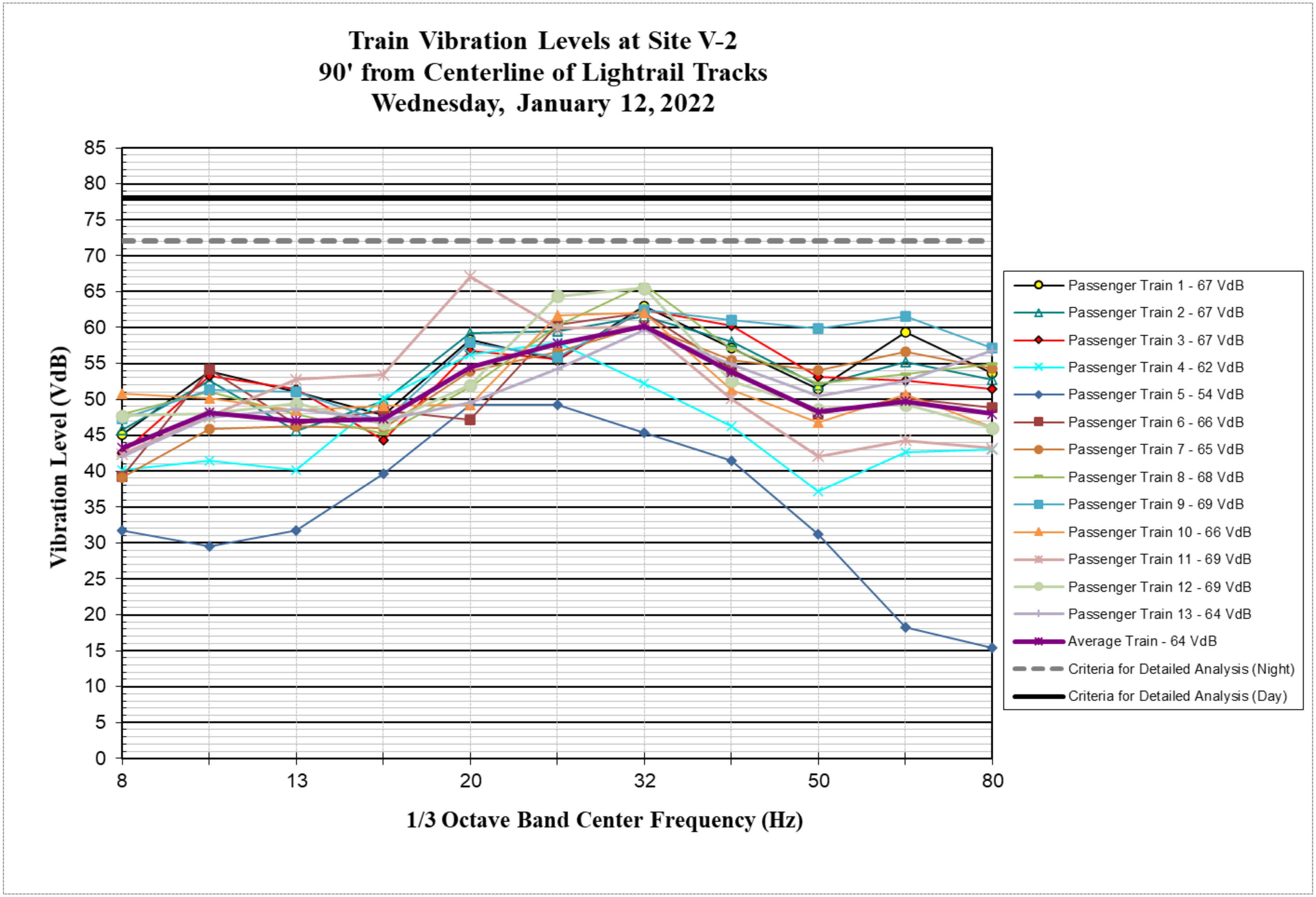


Noise Levels at Noise Measurement Site LT-4
~35 feet from Folsom Blvd centerline
Wednesday, January 19, 2022
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure A32

Appendix B – 1/3rd Octave Band data for Train Vibration measurements


Train Vibration Levels at Site V-1
45' from Centerline of Lightrail Tracks
Wednesday, January 12, 2022
Vibration Level (VdB)
1/3 Octave Band Center Frequency (Hz)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
8
13
20
32
50
80
Passenger Train 1 - 75 VdB
Passenger Train 2 - 72 VdB
Passenger Train 3 - 76 VdB
Passenger Train 4 - 64 VdB
Passenger Train 5 - 57 VdB
Passenger Train 6 - 69 VdB
Passenger Train 7 - 75 VdB
Passenger Train 8 - 72 VdB
Passenger Train 9 - 77 VdB
Passenger Train 10 - 68 VdB
Passenger Train 11 - 74 VdB
Passenger Train 12 - 71 VdB
Passenger Train 13 - 72 VdB
Average Train - 70 VdB
Criteria for Detailed Analysis (Night)
Criteria for Detailed Analysis (Day)


Train Vibration Levels at Site V-2
90' from Centerline of Lightrail Tracks
Wednesday, January 12, 2022
Vibration Level (VdB)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
8
13
20
32
50
80
1/3 Octave Band Center Frequency (Hz)
Passenger Train 1 - 67 VdB
Passenger Train 2 - 67 VdB
Passenger Train 3 - 67 VdB
Passenger Train 4 - 62 VdB
Passenger Train 5 - 54 VdB
Passenger Train 6 - 66 VdB
Passenger Train 7 - 65 VdB
Passenger Train 8 - 68 VdB
Passenger Train 9 - 69 VdB
Passenger Train 10 - 66 VdB
Passenger Train 11 - 69 VdB
Passenger Train 12 - 69 VdB
Passenger Train 13 - 64 VdB
Average Train - 64 VdB
Criteria for Detailed Analysis (Night)
Criteria for Detailed Analysis (Day)