Environmental Noise Assessment

Hazel Ridge Residential Development

Sacramento County, California

BAC Job # 2022-030

Prepared For:

Jel Developments

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Introduction

The Hazel Ridge Residential Development (project) is located east of Hazel Avenue and north of Calvert Avenue in Sacramento County, California. The project proposes 29 single-family residences on the 4.37-acre site. The project area with aerial imagery is shown on Figure 1. The proposed tentative map plan is presented in Figure 2.

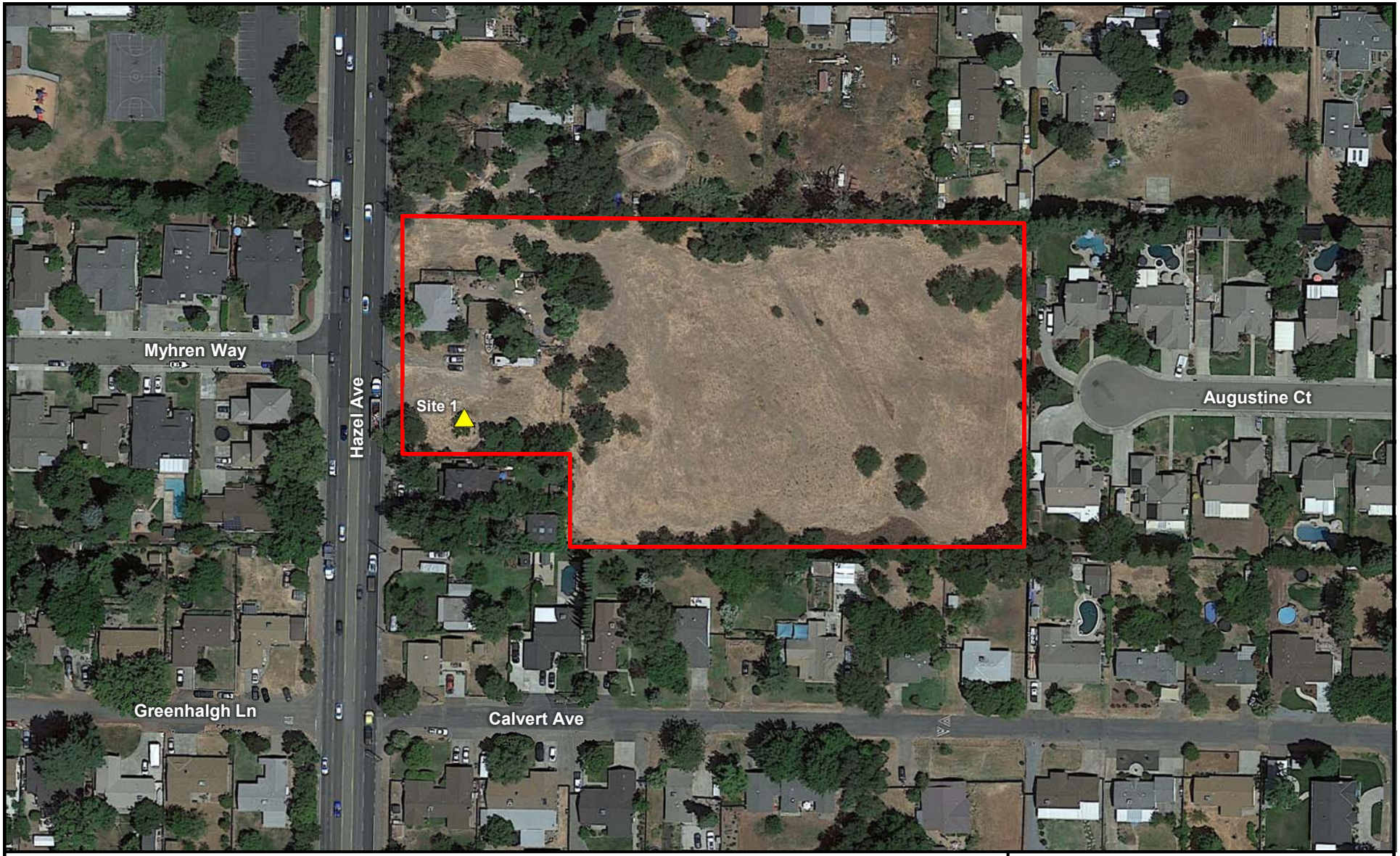
Due to the proximity of the project site to Hazel Avenue, noise from traffic on that roadway could affect the proposed residential development. As a result, Bollard Acoustical Consultants, Inc. (BAC) was retained by the project applicant to prepare this noise assessment. Specifically, the purposes of this assessment are to quantify future noise levels associated with traffic on Hazel Avenue, and to compare those levels against the applicable Sacramento County standards for acceptable noise exposure for new residential uses.

Noise Fundamentals and Terminology

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard, and thus are called sound. Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in levels (dB) correspond closely to human perception of relative loudness. Appendix A contains definitions of Acoustical Terminology. Figure 3 shows common noise levels associated with various sources.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable, and can be approximated by weighing the frequency response of a sound level meter by means of the standardized A-weighing network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels in decibels.

Community noise is commonly described in terms of the “ambient” noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}) over a given time period (usually one hour). The L_{eq} is the foundation of the day-night average level noise descriptor, L_{dn} or DNL, and shows very good correlation with community response to noise.



Legend

Project Border (Approximate)

Long-term Noise Measurement Location

N

Scale (Feet)

0 25 100

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Project Area

Figure 1

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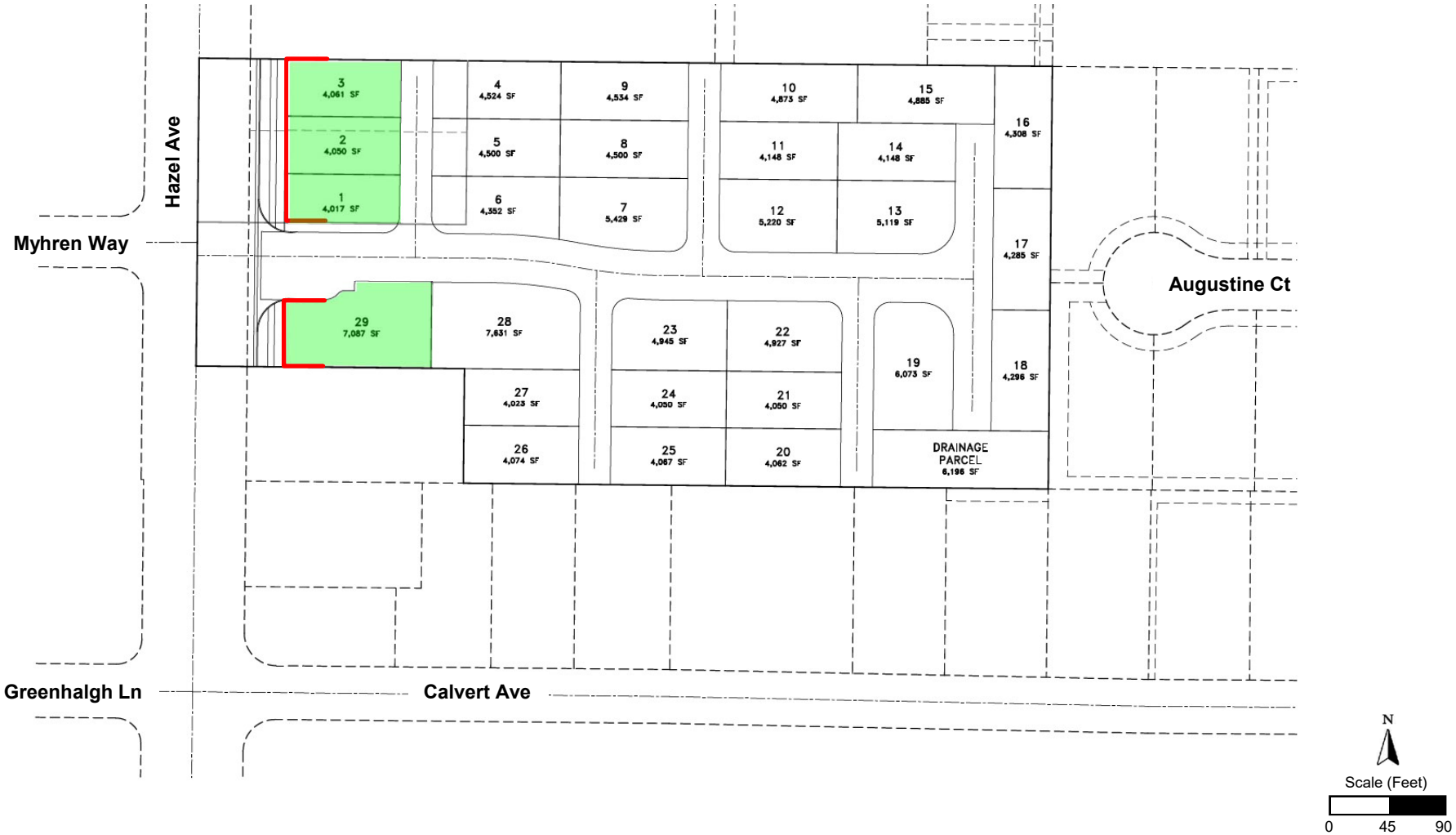

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Required 8-Foot Tall Traffic Noise Barriers

Lots Where STC 32 Window Upgrades Would be Required (north, west and south-facing facades of upper-floors only)

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Site Plan & Mitigation Locations

Figure 2

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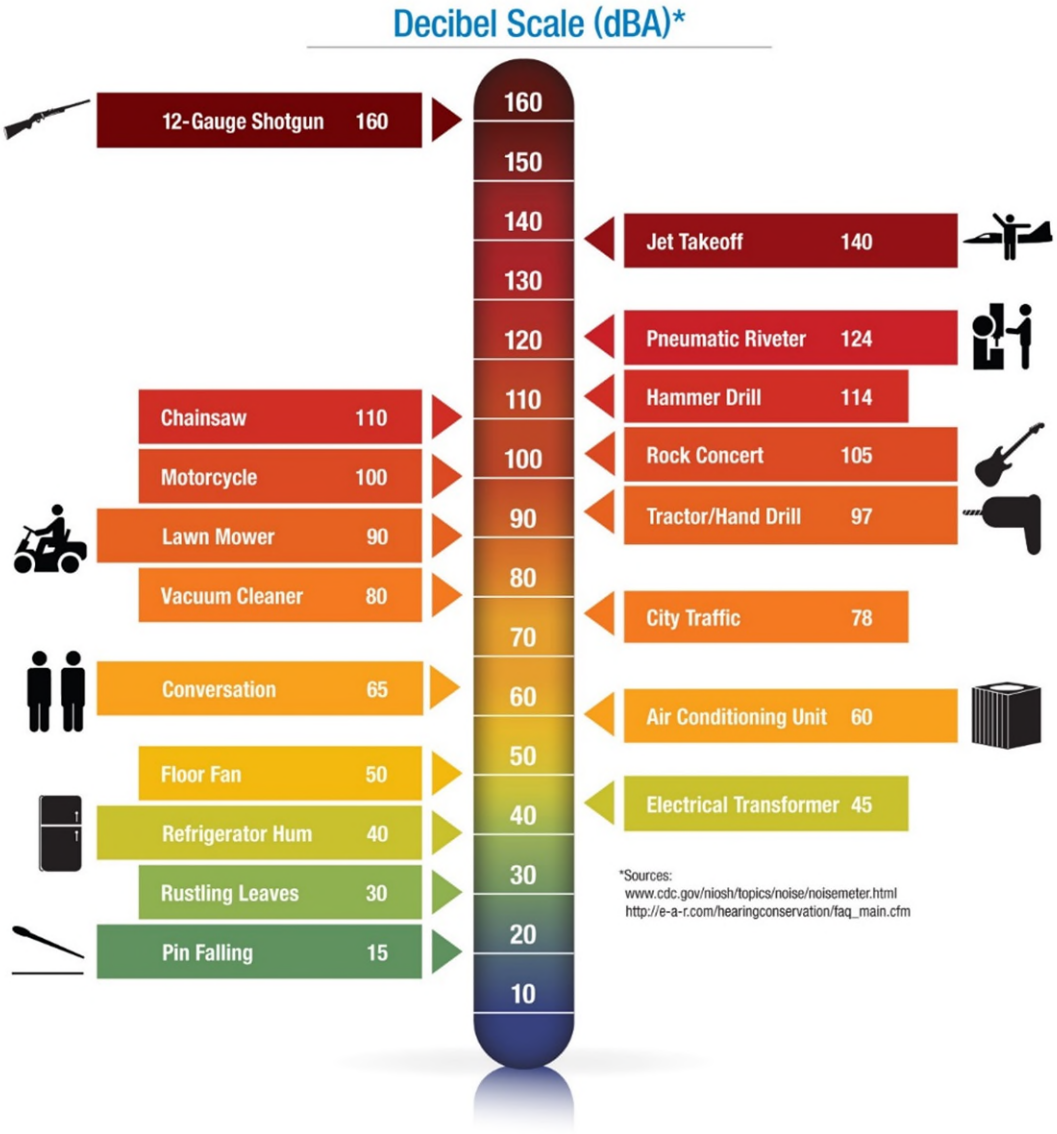
Figure 3
Typical A-Weighted Sound Levels of Common Noise Sources



DNL is based upon the average noise level over a 24-hour day, with a +10-decibel weighting applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because DNL represents a 24-hour average, it tends to disguise short-term variations in the noise environment. DNL-based noise standards are commonly used to assess noise impacts associated with traffic, railroad, and aircraft noise sources.

Criteria for Acceptable Noise Exposure

Sacramento County General Plan

The Noise Element of the Sacramento County General Plan establishes an exterior noise level standard of 65 dB DNL at outdoor activity areas of residential land uses exposed to transportation noise sources (i.e., traffic). The intent of this standard is to provide an acceptable exterior noise environment for outdoor activities. The General Plan also utilizes an interior noise level standard of 45 dB DNL or less within interior spaces of residential uses. The intent of this interior noise limit is to provide a suitable environment for indoor communication and sleep.

Existing Ambient Noise Environment at the Project Site

The existing ambient noise environment at the project site is defined primarily by traffic on Hazel Avenue. To quantify the existing ambient noise level environment at the project site, BAC conducted a long-term (48-hour) noise level survey March 9-10, 2022. The noise survey location is identified on Figure 1. Photographs of the noise level measurement location is provided in Appendix B.

A Larson-Davis Laboratories (LDL) Model 820 precision integrating sound level meter was used to complete the ambient noise level survey. The meter was calibrated immediately before and after use with an LDL Model CAL200 acoustical calibrator to ensure the accuracy off the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4).

The long-term ambient noise level survey results are summarized in Table 1. The detailed results of the ambient noise survey are contained in Appendix B in tabular format and graphically in Appendix C.

Table 1
Summary of Long-Term Noise Survey Measurement Results[1]

			Average Measured Hourly Noise Levels (dBA)			
			Daytime[3]		Nighttime[4]	
Site Description[2]	**Date**	**DNL**	**L_{eq}**	**L_{max}**	**L_{eq}**	**L_{max}**
Site 1: West side of project site, approximately 100' from centerline of Hazel Ave.	3/9/22	70	66	81	63	77
	3/10/22	69	66	81	62	78

[1] Detailed summaries of the noise monitoring results are provided in Appendices C and D.
[2] Long-term noise survey locations are identified on Figure 1.
[3] Daytime hours: 7:00 a.m. to 10:00 p.m.
[4] Nighttime hours: 10:00 p.m. to 7:00 a.m.
Source: Bollard Acoustical Consultants, Inc. (2022)

As shown in Table 1, measured day-night average noise levels (DNL) at the project site exceeded the applicable Sacramento County General Plan 65 dB DNL exterior noise level standard for residential uses. A detailed analysis of future Hazel Avenue traffic noise level exposure at the project site was conducted and that analysis is presented in the following section.

Evaluation of Future Traffic Noise Levels at the Project Site

Traffic Noise Prediction Methodology

The Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA-RD-77-108) was used to predict traffic noise levels at the project site. The FHWA Model is based upon the CALVENO noise emission factors for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The FHWA Model was developed to predict hourly L_{eq} values for free-flowing traffic conditions and is considered to be accurate within 1.5 dB in most situations.

Predicted Future Exterior Traffic Noise Levels

To predict future Hazel Avenue traffic noise level exposure at the project site, BAC adjusted the the long-term ambient data (Table 1) to reflect future traffic conditions as well as the distances from the roadway centerline to the nearest backyard areas and building facades. Future traffic volumes on Hazel Avenue were conservatively assumed to increase by 50% in the future, resulting in a 2 dB increase in traffic noise levels relative to measured existing conditions. The predicted future Hazel Avenue traffic noise levels at the nearest proposed outdoor activity areas (backyards) and building facades of the development are summarized below in Table 2.

Table 2
Predicted Future Exterior Hazel Avenue Traffic Noise Levels at the Project Site

Roadway	Lots	Location Description	Predicted DNL (dB)[1,2]
Hazel Ave	1-3 & 29	Backyards	73
		First-floor facades	72
		Upper-floor facades	74

[1] Predicted future traffic noise levels based on a reference noise level of 72 dB DNL at 100' from centerline of Hazel Avenue, which includes a +2 dB increase to account for increased traffic volumes in the future.

[2] An offset of +2 dB was applied at upper-floor building facades due to reduced ground absorption of sound at elevated positions.

Source: Bollard Acoustical Consultants, Inc. (2022)

Exterior Noise Compliance Evaluation

As indicated in Table 2, predicted future Hazel Avenue traffic noise level exposure is predicted to exceed the applicable Sacramento County General Plan 65 dB DNL exterior noise level standard at the nearest backyards to the roadway. As a result, additional consideration of exterior noise mitigation measures would be warranted for future Hazel Avenue traffic noise at the project site.

To reduce future Hazel Avenue traffic noise levels to a state of compliance with the General Plan 65 dB DNL exterior noise level standard at the project site, the project design should include the construction of 8-foot-tall solid noise barriers along the property boundaries of residences constructed adjacent to the roadway. The recommended barrier height of 8-feet is relative to backyard elevation. The locations of the required traffic noise barriers are illustrated on Figure 2. After consideration of the shielding provided by the recommended 8-foot-tall solid noise barriers, future Hazel Avenue traffic noise levels are calculated to be reduced to approximately 64 dB DNL at the nearest backyards to the roadway, which would satisfy the General Plan 65 dB DNL exterior noise level limit.

The traffic noise barriers could take the form of masonry wall, earthen berm, or a combination of the two. Other materials may be acceptable but should be reviewed by an acoustical consultant prior to use.

Interior Noise Compliance Evaluation

After consideration of shielding that would be provided by the required 8-foot-tall traffic noise barriers as indicated in Figure 2, future Hazel Avenue traffic noise level exposure is predicted to be reduced to approximately 64 dB DNL or less at the nearest first-floor building facades to the roadway. Due to reduced ground absorption of sound at elevated positions, and lack of shielding provided by the recommended traffic noise barriers, noise levels at the upper-floor facades of those residences are predicted to be approximately 74 dB DNL. To satisfy the Sacramento County General Plan 45 dB DNL interior noise level standard, minimum noise reductions of 19 and 29 dB would be required of the first- and upper-floor building facades (respectively) of residences constructed nearest to Hazel Avenue (Lots 1-3 & 29).

Standard residential construction (i.e., stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof), typically results in an exterior to interior noise reduction of approximately 25 dB with windows closed and approximately 15 dB with windows open. This level of noise reduction would be adequate to reduce future Hazel Avenue traffic noise exposure to 45 dB DNL or less within first-floor rooms of the residences constructed adjacent to the roadway but would not be sufficient for second-floor rooms.

To satisfy the General Plan 45 dB DNL interior noise level standard at second-floor rooms, upper-floor window assemblies of residences constructed on Lots 1-3 and 29 from which the roadway would be visible (north, west and south-facing windows) should be upgraded to a minimum STC rating of 32. The lots with upper-floor window upgrade recommendations are illustrated on Figure 2. In addition, mechanical ventilation (air conditioning) should be provided for all residences in this development to allow the occupants to close doors and windows as desired for additional acoustical isolation.

Conclusions and Recommendations

The Hazel Ridge Residential Development is predicted to be exposed to future Hazel Avenue traffic noise level exposure in excess of the Sacramento County General Plan 65 dB DNL exterior noise level standard for residential uses. In addition, standard residential construction (stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof) would be inadequate to reduce future Hazel Avenue traffic noise levels within second-floor rooms of residences constructed on Lots 1-3 & 29 to a state of compliance with the applicable General Plan 45 dB DNL interior noise level standard. As a result, the following specific traffic noise mitigation measures are recommended:

1) To reduce future Hazel Avenue traffic noise exposure to a state of compliance with the General Plan 65 dB DNL exterior noise level standard at the project site, noise barriers measuring 8-feet in height should be constructed at the locations shown on Figure 2. The traffic noise barriers could take the form of masonry wall, earthen berm, or a combination of the two. Other materials may be acceptable but should be reviewed by an acoustical consultant prior to use. The recommended barrier height of 8-feet is relative to backyard elevation.

2) To ensure compliance with the General Plan 45 dB DNL interior noise standard, upper-floor window assemblies of residences constructed adjacent to Hazel Avenue from which the roadway would be visible (north, west and south-facing windows) should be upgraded to a minimum STC rating of 32. The lots with upper-floor window upgrade recommendations are illustrated on Figure 2.

3) Mechanical ventilation (air conditioning) should be provided for all residences within this development to allow the occupants to close doors and windows as desired for additional acoustical isolation.

These conclusions are based on BAC ambient noise level data collected at the project site, the project site plan shown on Figure 2, and on noise reduction data for standard residential dwellings and for typical STC rated window data. Deviations from the resources cited herein could cause future traffic noise levels to differ from those predicted in this assessment. In addition, Bollard Acoustical Consultants, Inc. is not responsible for degradation in acoustic performance of the residential construction due to poor construction practices, failure to comply with applicable building code requirements, or for failure to adhere to the minimum building practices cited in this report.

This concludes BAC's environmental noise assessment for the Hazel Ridge Residential Development in Sacramento County, California. Please contact BAC at (530) 537-2328 or paulb@bacnoise.com with any questions regarding this assessment.

Appendix A
Acoustical Terminology

Acoustics The science of sound.

Ambient Noise The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.

Attenuation The reduction of an acoustic signal.

A-Weighting A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.

Decibel or dB Fundamental unit of sound. A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.

CNEL Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.

Frequency The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.

IIC Impact Insulation Class (IIC): A single-number representation of a floor/ceiling partition's impact generated noise insulation performance. The field-measured version of this number is the FIIC.

L_{dn} Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.

L_{eq} Equivalent or energy-averaged sound level.

L_{max} The highest root-mean-square (RMS) sound level measured over a given period of time.

Loudness A subjective term for the sensation of the magnitude of sound.

Masking The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.

Noise Unwanted sound.

Peak Noise The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.

RT_{60} The time it takes reverberant sound to decay by 60 dB once the source has been removed.

STC Sound Transmission Class (STC): A single-number representation of a partition's noise insulation performance. This number is based on laboratory-measured, 16-band (1/3-octave) transmission loss (TL) data of the subject partition. The field-measured version of this number is the FSTC.

Legend

A Noise Measurement Location Facing West

B Noise Measurement Location Facing East

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Sacramento County, California

Photographs of Noise Survey Location

Appendix B

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Appendix C-1
Long-Term Ambient Noise Monitoring Results
Hazel Ridge Residential Development - Sacramento County, California
Wednesday, March 9, 2022

Hour	Leq	Lmax	L50	L90
12:00 AM	58	75	46	38
1:00 AM	56	75	43	35
2:00 AM	58	79	45	37
3:00 AM	58	77	46	35
4:00 AM	62	77	55	44
5:00 AM	66	78	63	52
6:00 AM	68	81	67	56
7:00 AM	69	82	68	56
8:00 AM	68	86	67	57
9:00 AM	67	79	65	53
10:00 AM	66	79	65	55
11:00 AM	65	77	64	54
12:00 PM	66	82	64	54
1:00 PM	66	81	64	53
2:00 PM	66	78	65	56
3:00 PM	66	84	64	54
4:00 PM	66	77	65	57
5:00 PM	67	80	66	57
6:00 PM	67	88	66	54
7:00 PM	67	90	63	50
8:00 PM	64	80	62	48
9:00 PM	64	79	62	49
10:00 PM	61	82	56	43
11:00 PM	59	73	52	41

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	69	64	66	68	56	63
Lmax (Maximum)	90	77	81	82	73	77
L50 (Median)	68	62	65	67	43	52
L90 (Background)	57	48	54	56	35	42

Computed DNL, dB	70
% Daytime Energy	80%
% Nighttime Energy	20%

GPS Coordinates	38°40'56.85"N
	121°13'30.77"W

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Appendix C-2
Long-Term Ambient Noise Monitoring Results
Hazel Ridge Residential Development - Sacramento County, California
Thursday, March 10, 2022

Hour	Leq	Lmax	L50	L90
12:00 AM	57	75	45	38
1:00 AM	56	74	43	35
2:00 AM	57	75	44	34
3:00 AM	58	77	47	36
4:00 AM	61	79	55	44
5:00 AM	65	83	63	51
6:00 AM	68	82	67	56
7:00 AM	68	78	67	56
8:00 AM	68	85	67	58
9:00 AM	67	79	66	56
10:00 AM	67	90	65	54
11:00 AM	66	76	65	55
12:00 PM	66	82	65	54
1:00 PM	66	84	64	56
2:00 PM	66	86	65	56
3:00 PM	66	78	66	56
4:00 PM	66	86	65	56
5:00 PM	66	79	66	58
6:00 PM	66	80	65	53
7:00 PM	64	80	63	49
8:00 PM	64	77	61	49
9:00 PM	64	79	61	49
10:00 PM	62	78	57	45
11:00 PM	60	80	51	41

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	68	64	66	68	56	62
Lmax (Maximum)	90	76	81	83	74	78
L50 (Median)	67	61	65	67	43	52
L90 (Background)	58	49	54	56	34	42

Computed DNL, dB	69
% Daytime Energy	80%
% Nighttime Energy	20%

GPS Coordinates	38°40'56.85"N
	121°13'30.77"W

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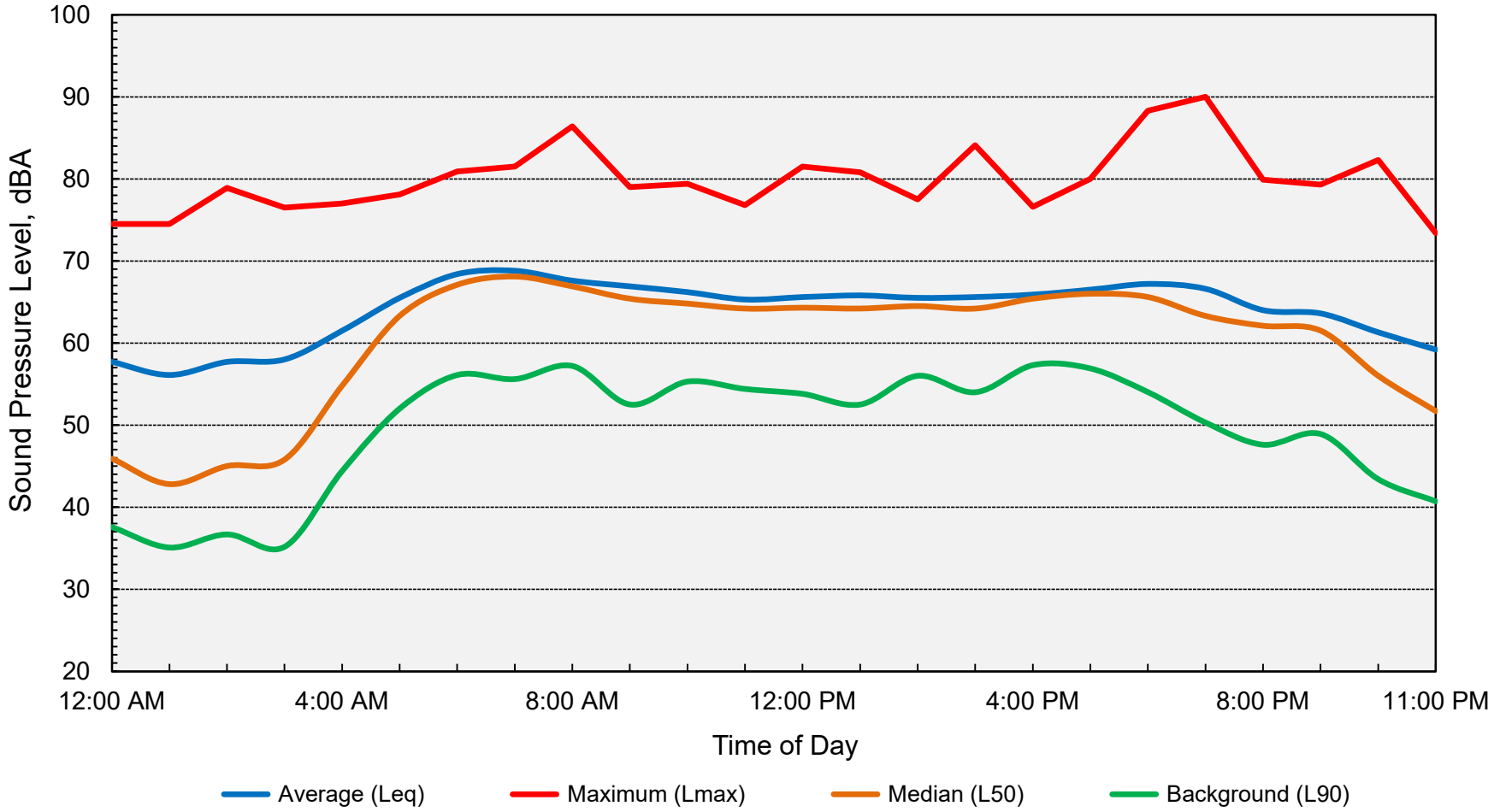

Computed DNL = 70 dB

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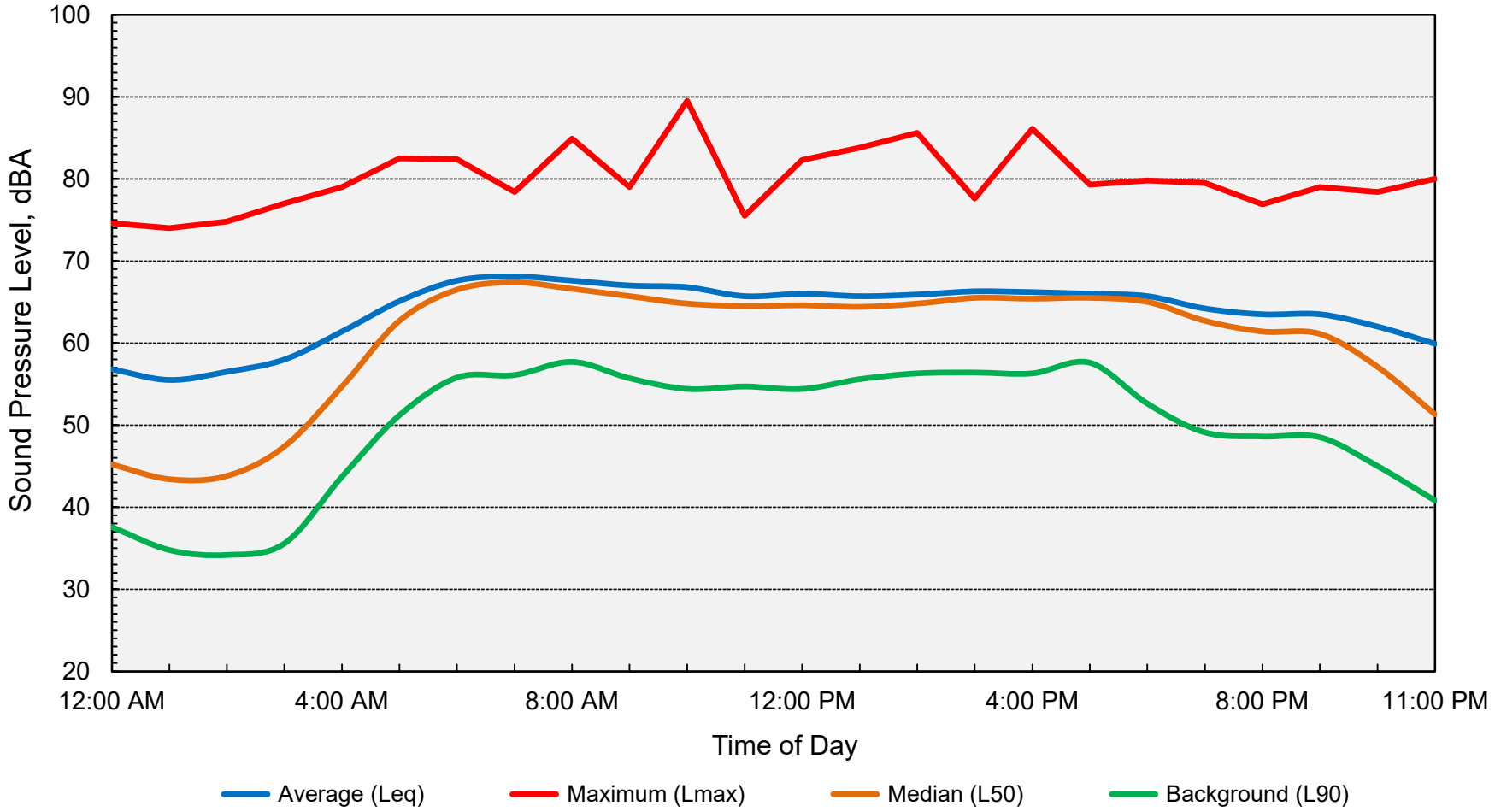
Appendix D-2
Long-Term Ambient Noise Monitoring Results
Hazel Ridge Residential Development - Sacramento County, California
Thursday, March 10, 2022



Computed DNL = 69 dB

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