

Memo

Date: August 9, 2021
To: Jeffrey Redding
From: Michael Thill
SUBJECT: Croix Estate Winery, Sonoma County, California (IR Job # 18-239)

This memo summarizes Illingworth & Rodkin, Inc.'s (I&R) evaluation of outdoor wine tasting noise levels occurring in the garden area west of the proposed tasting room. Wine tasting noise levels are summarized and compared to applicable regulatory criteria established by Sonoma County.

Noise Monitoring Survey

I&R quantified noise levels produced by outdoor wine tasting on the deck of the Administration Building on Saturday, July 17, 2021. The noise measurements were made over a one-hour period, from 2:00 to 3:00 pm, while two parties (a group of four and a group of two) tasted wine. Although only six persons were tasting wine during the measurements, this staged event credibly represented worst-case conditions. Croix Estate Winery purposely limits reservations and then will either seat patrons in the house, in the winery cellar, or on the deck, so as to separate people so that they have a private experience. Reservations never overlap with another as the allocated time per private group/tasting is two hours.

Noise measurements were made with Larson Davis Model LxT1 Integrating Sound Level Meters (SLMs) set at "slow" response. The sound level meters were equipped with PCB Model 377B02 1/2" free-field, prepolarized condenser microphones fitted with windscreens. The sound level meters were calibrated prior to the noise measurements using a Larson Davis Model CAL200 acoustical calibrator. The response of the system was checked after each measurement session and was always found to be within 0.2 dBA. At the completion of monitoring, the noise data were obtained from the SLM using the Larson Davis G4 software program. All instrumentation used during the noise survey met the requirements of the American National Standards Institute (ANSI) SI 4-1983 for Type I use. Weather conditions during the survey were generally good for the purposes of noise monitoring with clear skies, calm to light winds, and seasonable temperatures.

Figure 1 shows the exterior deck of the Administration Building and measurement and observation locations ST-1, ST-2, and ST-3. ST-1 was 50 feet from the center of the wine tasting activity and had direct line of sight to the noise sources (see Figure 2). ST-2 was 55 feet from the center of the wine

tasting activity and was partially shielded from some of the noise by the Administration Building (see Figure 3). ST-3 was 90 feet from the center of the wine tasting activity and had direct line of sight to the noise sources (see Figure 4). Table 1 summarizes the measured noise levels. The group of four were considerably louder than the group of two with more chatter, laughter, clapping, etc. The group of two were barely audible at 50 feet.

TABLE 1 Wine Tasting Noise Levels at Croix Estate Winery

Measurement Location	Average Hourly Noise Level, dBA				
	L02	L08	L25	L50	Leq
ST-1	59	57	53	51	53
ST-2	54	52	49	46	48
ST-3	55	52	50	47	49

Regulatory Criteria

Goals, objectives, and policies designed to protect noise-sensitive uses from exposure to excessive noise are set forth in the Noise Element of the Sonoma County General Plan 2020. The primary goal of the Noise Element is to, “Protect people from the adverse effects of exposure to excessive noise and to achieve an environment in which people and land uses function without impairment from noise.”

Objectives and policies of the Noise Element that are applicable in the assessment of the proposed project are as follows:

Objective NE-1.3: Protect the present noise environment and prevent intrusion of new noise sources which would substantially alter the noise environment.

Objective NE-1.4: Mitigate noise from recreational and visitor serving uses.

Policy NE-1c: Control non-transportation related noise from new projects. The total noise level resulting from new sources shall not exceed the standards in Table NE-2 (Table 2 of this report) of the recommended revised policies as measured at the exterior property line of any adjacent noise sensitive land use. Limit exceptions to the following:

- (1) If the ambient noise level exceeds the standard in Table NE-2, adjust the standard to equal the ambient level, up to a maximum of 5 dBA above the standard, provided that no measurable increase (i.e., +/- 1.5 dBA) shall be allowed.
- (2) Reduce the applicable standards in Table NE-2 by 5 dBA for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises, such as pile drivers and dog barking at kennels.

- (3) Reduce the applicable standards in Table NE-2 by 5 decibels if the proposed use exceeds the ambient level by 10 or more decibels.
- (4) For short-term noise sources, which are permitted to operate no more than six days per year, such as concerts or race events, the allowable noise exposures shown in Table NE-2 may be increased by 5 dB. These events shall be subject to a noise management plan including provisions for maximum noise level limits, noise monitoring, complaint response and allowable hours of operation. The plan shall address potential cumulative noise impacts from all events in the area.
- (5) Noise levels may be measured at the location of the outdoor activity area of the noise sensitive land use, instead of at the exterior property line of the adjacent noise sensitive use where:
 - (a) The property on which the noise sensitive use is located has already been substantially developed pursuant to its existing zoning, and
 - (b) There is available open land on these noise sensitive lands for noise attenuation. This exception may not be used for vacant properties, which are zoned to allow noise sensitive uses.

This exception may not be used on vacant properties which are zoned to allow noise sensitive uses.

TABLE 2 Maximum Allowable Exterior Noise Exposures for Non-Transportation Noise Sources (Table NE-2)

Hourly Noise Metric ¹ , dBA	Daytime 7 am to 10 pm	Nighttime 10 pm to 7 am
L ₅₀ (30 minutes in any hour)	50	45
L ₂₅ (15 minutes in any hour)	55	50
L ₀₈ (5 minutes in any hour)	60	55
L ₀₂ (1 minute in any hour)	65	60
¹ The sound level exceeded n% of the time in any hour. For example, the L ₅₀ is the value exceeded 50% of the time or 30 minutes in any hour; this is the median noise level. The L ₀₂ is the sound level exceeded 1 minute in any hour.		

Noise Evaluation

Figure 5 shows the proposed location of the tasting room south of the administration building and northeast of the winery building. The garden area proposed west of the tasting room building would be used for outdoor wine tasting. The maximum number of daily visitors to the proposed outdoor tasting

venue is 10 persons. Tasting hours are between 8 am and 6 pm, and no amplified music is allowed or proposed.

For the purposes of this assessment, it is assumed that the existing solid wood fence provides a minimum of 5 dBA of noise reduction for the nearest receptor to the east as it blocks the line of sight between the receptor and the noise source. Based on the measured noise data of six persons tasting wine, which credibly represents worst-case conditions assuming a maximum of 10 persons per day, wine tasting noise levels would not exceed the Sonoma County NE-2 noise limits at the nearest property line to the east (see ST-2 and ST-3). In addition, based on the data collected at sites ST-1 and ST-3, unshielded receptors located approximately 275 feet west of the exterior deck would also not be exposed to noise levels exceeding the Sonoma County NE-2 noise limits. Table 3 summarizes the predicted noise levels at the nearest receptors to the west and east.

TABLE 3 Outdoor Garden Area Wine Tasting Noise Levels at Croix Estate Winery

Measurement Location	Average Hourly Noise Level, dBA				
	L02	L08	L25	L50	Leq
ST-1 (adjusted to 275 feet west)	50	48	44	42	44
ST-2 (with barrier attenuation)	50	47	45	42	44
ST-3 (with barrier attenuation)	49	47	44	41	43
NE-2 Limit	60	55	50	45	--
Exceeds Limit?	No	No	No	No	--

Outdoor wine tasting noise levels would not exceed the Sonoma County NE-2 noise limits at the nearest property lines, and additional mitigation is not required.

FIGURE 1 - Noise Measurement Locations Relative to Exterior Deck Used for Wine Tasting



FIGURE 2 - Noise Measurement Location ST-1 – 50 feet from Center of Wine Tasting



FIGURE 3 - Noise Measurement Location ST-2 – Property Line 55 feet from Center of Wine Tasting (Partially Shielded)



FIGURE 4 - Noise Measurement Location ST-3 – Property Line 90 feet from Center of Wine Tasting



FIGURE 5 – Aerial Image and Site Plan Showing Proposed Tasting Room and Outdoor Garden Tasting Area



CROIX ESTATE WINERY ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

Sonoma County, California

April 17, 2019

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Introduction

This report summarizes the evaluation of noise and vibration levels attributable to project construction activities and project operations at nearby residential properties with respect to the regulatory criteria established by the Sonoma County General Plan and the Sonoma County Guidelines for the Preparation of Noise Analysis. The report first describes the project, study area, and existing noise levels in the project vicinity. The report then summarizes the applicable regulatory criteria used in the assessment of project-generated noise and vibration levels. Standard best management practices are recommended to reduce temporary construction noise levels to less-than-significant levels. Based on the analysis, project operational noise levels would not be expected to result in significant impacts upon nearby residential land uses.

A brief discussion of the fundamentals of environmental noise and groundborne vibration is presented in Appendix A for those unfamiliar with acoustical terms or concepts. Appendix B displays the noise data collected at the project site.

Project Description

Croix Estate Winery's current use permit allows the production of a maximum capacity of 5,000 cases of wine per year, wine tasting by appointment only, and participation in up to 10 industry wide events. Existing facilities include a 2,000 square foot building on a 10-acre parcel. The proposed project would expand production from 5,000 to 10,000 cases annually, demolish the existing accessory building, convert the existing on-site residence to winery use (administration and private tastings), and construct new barrel storage and wine tasting room pavilion buildings. Driveway and landscaping improvements would also be made. The project does not propose any changes to the number of guests or events.

Noise Analysis Study Area

The project site is a flat lot developed with the existing winery facilities. Rural uses residential surround the site. Figure 1 is the site plan showing the proposed project, adjacent land uses and receptor locations, and noise monitoring locations selected during the noise survey.

Existing Noise Environment

A noise survey was conducted by Illingworth & Rodkin, Inc. between Friday, January 25th, 2019 and Wednesday, January 30th, 2019 to document existing noise conditions at the site and in the surrounding area. The noise monitoring survey included one long-term (5-day) measurement and one short-term (20-minute) measurement, as shown in Figure 1. Noise measurements were made with Larson Davis Model 820 Integrating Sound Level Meters (SLM) set at "slow" response. The sound level meters were equipped with G.R.A.S. Type 40AQ ½-inch random incidence microphone and fitted with windscreens. The sound level meters were calibrated prior to the noise measurements using a Larson Davis Model CAL200 acoustical calibrator. The response of the

systems were checked after each measurement session and was always found to be within 0.2 dBA. Weather conditions during the measurement period were generally good for noise monitoring.

Measurement site LT-1 was located along the eastern property line of the project site, 195 feet from the centerline of Wood Road. The primary noise source at this location was vehicular traffic on Wood Road. Hourly equivalent noise levels at LT-1 ranged from 46 to 63 dBA L_{eq} during the day and 40 to 56 dBA L_{eq} during the night. The day-night average noise level at LT-1 ranged from 54 to 59 dBA L_{dn} . Ambient daytime and nighttime noise levels for each L_n descriptor are shown in Table 1. The measured noise data are summarized in terms of the metrics appropriate for the Sonoma County noise performance standards. Ambient daytime noise levels were determined based on the average of the four quietest hours (L_{eq}). The daily trends in noise levels at LT-1 are shown in Appendix B.

TABLE 1 Existing Ambient Noise Levels at LT-1

Time Period	Average Hourly Noise Level, dBA ¹				
	L ₀₂	L ₀₈	L ₂₅	L ₅₀	L _{eq}
Daytime	57	52	48	45	49
Nighttime	49	47	44	42	44

¹ Calculated based on the four quietest L_{eq} hours.

Noise measurement ST-1 was made approximately 270 feet from the center of Wood Road, south of the existing parking lot. The average noise level at ST-1 was 53 dBA L_{eq} , resulting primarily from vehicular traffic along Wood Road and occasional aircraft overflights. Maximum instantaneous noise levels produced by aircraft activity ranged from 59 to 67 dBA L_{max} .

Figure 1: Noise Measurement Locations



Regulatory Criteria

Goals, objectives, and policies designed to protect noise-sensitive uses from exposure to excessive noise are set forth in the Noise Element of the Sonoma County General Plan 2020. The primary goal of the Noise Element is to “Protect people from the adverse effects of exposure to excessive noise bad to achieve an environment in which people and land uses function without impairment from noise.”

Objectives and policies of the Noise Element that are applicable in the assessment of the proposed project are as follows:

Objective NE-1.3: Protect the present noise environment and prevent intrusion of new noise sources which would substantially alter the noise environment.

Objective NE-1.4: Mitigate noise from recreational and visitor serving uses.

Policy NE-1b: Avoid noise sensitive land use development in noise impacted areas unless effective measures are included to reduce noise levels. For noise due to traffic on public roadways, railroads and airports, reduce exterior noise to 60 dBA L_{dn} or less in outdoor activity areas and interior noise levels to 45 dBA L_{dn} or less with windows and doors closed. Where it is not possible to meet this 60 dBA L_{dn} standard using practical application of best available noise reduction technology, a maximum level up to 65 dBA L_{dn} may be allowed but interior noise level shall be maintained so as not to exceed 45 dBA L_{dn} . For uses such as Single Room Occupancy, Work-Live, Mixed Use Projects and Caretaker Units, exterior noise levels above 65 dBA L_{dn} or the Table NE-2 standards may be considered if the interior standards of 45 dBA L_{dn} can be met. For schools, libraries, offices, and other similar uses, the interior noise standard shall be 45 dBA L_{eq} in the worst case hours when the building is in use.

Policy NE-1c: Control non-transportation related noise from new projects. The total noise level resulting from new sources shall not exceed the standards in Table NE-2 as measured at the exterior property line of any adjacent noise sensitive land use. Limit exceptions to the following:

- (1) If the ambient noise level exceeds the standard in Table NE-2, adjust the standard to equal the ambient level, up to a maximum of 5 dBA above the standard, provided that no measurable increase (i.e. +/- 1.5 dBA) shall be allowed.
- (2) Reduce the applicable standards in Table NE-2 by 5 dBA for simple tone noises, noises consisting primarily of speech or music, or for

recurring impulsive noises, such as pile drivers and dog barking at kennels.

- (3) Reduce the applicable standards in Table NE-2 by 5 decibels if the proposed use exceeds the ambient level by 10 or more decibels.
- (4) For short-term noise sources, which are permitted to operate no more than six days per year, such as concerts or race events, the allowable noise exposures shown in Table NE-2 may be increased by 5 dB. These events shall be subject to a noise management plan including provisions for maximum noise level limits, noise monitoring, complaint response and allowable hours of operation. The plan shall address potential cumulative noise impacts from all events in the area.
- (5) Noise levels may be measured at the location of the outdoor activity area of the noise sensitive land use, instead of at the exterior property line of the adjacent noise sensitive use where:
 - (a) The property on which the noise sensitive use is located has already been substantially developed pursuant to its existing zoning, and
 - (b) There is available open land on these noise sensitive lands for noise attenuation. This exception may not be used for vacant properties, which are zoned to allow noise sensitive uses.

This exception may not be used on vacant properties which are zoned to allow noise sensitive uses.

TABLE NE-2 Maximum Allowable Exterior Noise Exposures for Non-transportation Noise Sources

Hourly Noise Metric¹, dBA	Daytime 7 am to 10 pm	Nighttime 10 pm to 7 am
L ₅₀ (30 minutes in any hour)	50	45
L ₂₅ (15 minutes in any hour)	55	50
L ₀₈ (5 minutes in any hour)	60	55
L ₀₂ (1 minute in any hour)	65	60
¹ The sound level exceeded n% of the time in any hour. For example, the L ₅₀ is the value exceeded 50% of the time or 30 minutes in any hour; this is the median noise level. The L ₀₂ is the sound level exceeded 1 minute in any hour.		

Noise and Land Use Compatibility

The project proposes an outdoor tasting pavilion to the east of existing shed. The proposed administrative offices and tasting pavilion would be considered noise sensitive indoor spaces. The future exterior noise environment at the project site would continue to result primarily from local traffic and occasional aircraft activity. Based on the results of the noise monitoring survey, the outdoor tasting pavilion would be exposed to a future noise level of 57 dBA L_{dn} . The administrative building, located 65 feet from the centerline of Wood Road, would be exposed to a future noise level of 64 dBA L_{dn} .

As described in Appendix A, approximately 15 dBA of exterior-to-interior noise reduction would be anticipated assuming the windows are partially open for ventilation, and approximately 25 dBA of exterior-to-interior noise reduction would be anticipated with windows closed. Therefore, noise levels inside the tasting pavilion would be considered compatible (45 dBA L_{dn} or less) with standard construction and windows in the open or closed position. Administrative offices would be considered compatible with standard construction and windows closed. The inclusion of adequate forced-air mechanical ventilation would be required to allow occupants the option of closing the windows to control noise.

Noise Impact Analysis

Noise generated by the proposed project was assessed against the Table NE-2 guidelines presented in the County's Noise Element. The primary noise producing activities associated with the project are mechanical equipment noise and the increase in bottling and crushing activities, parking lot activities, and vehicular traffic. No changes are proposed to the number of visitors or events.

Additional Vehicle Trips on Roadway Network

The project proposes an increase from 2 to 8 full time employees. Additionally, a small increase in the number of grape delivery vehicles may occur during a few days of crushing season. The number of guests and events would not change with the project.

A significant permanent traffic noise increase would occur if the project would increase noise levels at noise sensitive receptors by 3 dBA L_{dn} or greater. For reference, a doubling in traffic volumes would result in a 3 dBA traffic noise increase. The addition of up to 6 vehicle trips and occasional grape delivery vehicles would result in a noise increase of less than 0.1 dBA L_{dn} . This noise level increase would not be considered substantial and would not be measurable or perceptible.

Parking Lot Activities

Parking is currently provided in 18 spaces in the central portion of the developed area of the site. The project proposes 8 new parking spaces to the south of proposed Barrel Storage Building. The parking lot would only be used during daytime hours.

Vehicles accessing the parking areas, engine starts, and door slams would be the primary noise sources. Vehicle circulation, engine starts, and door slams would be the primary sources of noise associated with the parking lots. These sources typically produce noise levels that range from 50 to 60 dBA L_{max} at 50 feet. Due to the small size of the parking lot, the cumulative duration of noise from these intermittent sounds would be anticipated to be less than five minutes in any hour, therefore, the L_{02} would be the applicable regulatory threshold used in the analysis.

The center of the proposed parking lot is assumed to credibly represent the acoustic center of the parking lot noise source. The closest residential property lines or outdoor areas to the proposed parking lot are located about 530 feet to the northeast (R1 and R2), 700 feet to the north (R3) and 870 feet to the northwest (R4). Table 2 summarizes the assessment of parking lot noise. The Barrel Storage Building would be anticipated to provide 10 dBA of noise reduction to R3.

TABLE 2 Parking Lot L_{02} Noise Levels

	L_{02}			
	(Noise Level Exceeded 5 Minutes in any Hour)			
	Daytime			
Receptor	R1 530 feet	R2 530 feet	R3 700 feet	R4 870 feet
Unadjusted Table NE-2 Limit	65	65	65	65
Ambient Noise Levels	59	57	64	66
Parking Lot Noise Level	30-40	30-40	17-27	25-35 ¹
NE-2 Adjustments	0	0	0	0
Adjusted Table NE-2 Limit	65	65	65	65
Operations Exceed NE-2?	No	No	No	No

¹ Assumes 5 dBA noise reduction due to acoustical shielding by Barrel Storage Building structure.

As shown in Table 2, parking lot activities would generate noise levels up to 40 dBA L_{02} at the nearest residential property lines (R1 and R2). Parking lot activities would not typically be audible above levels generated by traffic along Wood Road and are not anticipated to exceed the daytime L_{02} noise thresholds at the closest residential property lines. Noise levels at more distant residences would be even lower.

Maintenance and Forklift Operations

Maintenance and forklift operations would be similar in use to current operations, but would occur for more hours as production is increased from 5,000 to 10,000 cases per year. Backup alarms (or beepers), which are repetitive by design, cause intermittent annoyance. Based on experience with other winery operations, non-attenuated L_{08} noise levels from these operations would reach levels of up to 67 dBA at 50 feet. Forklift use and associated backup alarms noise within the building will be attenuated by the structure of the building and would not be anticipated to be audible off-site.

Backup alarms (or beepers) from trucks will also produce intermittent noise. Backup alarms are regulated by CAL OSHA and must generate a noise level at least 5 dBA above the background noise in the vicinity of the rear of the machine where a person would be warned by the alarm. Based on the type of use proposed, it is expected that type D or C back-up alarms would be used, which produce sound levels of 87 and 97 dBA, respectively, at 4 feet from the face of the alarm. Maximum noise levels from such back up alarms would range from 65 to 75 dBA at 50 feet. This analysis assumes a noise level of 70 dBA L_{max} at 50 feet.

Maintenance and forklift operations would occur during regular daytime hours (8:00 a.m. to 6:00 p.m.). The equipment would be operated between the existing winery barn and the proposed Barrel Storage Building, as close as 150 feet from the outdoor use area at R1. Tables 3 and 4 summarize the assessment of noise produced by maintenance and forklift operations.

TABLE 3 Maintenance and Forklift Operations L_{08} Noise Levels

	L_{08}			
	(Noise Level Exceeded 5 Minutes in any Hour)			
	Daytime			
Receptor	R1 150 feet	R2 250 feet	R3 275 feet	R4 450 feet
Unadjusted Table NE-2 Limit	60	60	60	60
Ambient Noise Levels	54	52	59	61
NE-2 Adjustments ¹	0	0	0	1
Forklift Noise Level	58	53	52	48
Adjusted Table NE-2 Limit	60	60	60	60
Operations Exceed NE-2?	No	No	No	No

¹ Limit is adjusted to account for ambient conditions.

TABLE 4 Backup Alarm (Beeper) L_{02} Noise Levels

	L_{02}			
	(Noise Level Exceeded 5 Minutes in any Hour)			
	Daytime			
Receptor	R1 150 feet	R2 250 feet	R3 275 feet	R4 450 feet
Unadjusted Table NE-2 Limit	65	65	65	65
Ambient Noise Levels	59	57	64	66
Beeper Noise Level	60	56	55	51
NE-2 Adjustments ¹	-5	-5	-1	0
Adjusted Table NE-2 Limit	60	60	64	65
Operations Exceed NE-2?	No	No	No	No

¹ Limit is adjusted for reoccurring impulsive noises and to account for ambient conditions.

L₀₈ noise levels from maintenance and forklift operations are calculated to reach 58 dBA L₀₈ at the outdoor use area of R1, 53 dBA L₀₈ at R2, 52 dBA L₀₈ at R3, and 48 dBA L₀₈ at R4. L₀₂ noise levels from backup beepers are calculated to reach 61 dBA L₀₂ at the outdoor use area of R1, 56 dBA L₀₂ at R2, 55 dBA L₀₂ at R3, and 51 dBA L₀₂ at R4.

Maintenance and forklift operations would be below the daytime noise level threshold of 60 dBA L₀₈ and backup beeper noise levels would be at or below the daytime noise level threshold of 60 dBA L₀₂, which includes the 5 dBA penalty for reoccurring impulsive noises, at all adjacent residential areas.

Mechanical Equipment

Mechanical equipment associated with the project would be located within the covered mechanical yard to the south of the Barrel Storage Building and inside the two mechanical equipment rooms proposed within the Barrel Storage Building. Mechanical equipment enclosed within the proposed building would not typically be audible off-site and would not measurably contribute to the noise environment at nearby residences. Outdoor mechanical equipment would include an air compressor and refrigeration unit, located about 450 feet from the outdoor use area for R1, 480 feet from R2, 650 feet from R3, and 840 feet from R4. The Barrel Storage Building would be anticipated to provide 10 dBA of noise reduction to all nearby receptors.

Detailed mechanical equipment information is not available at this time; however, based on manufacturer's data for similar equipment, it is anticipated that the compressor and refrigeration units would produce a noise level of about 60 dBA at 30 feet. Mechanical equipment is assumed to operate under a "worst-case" scenario, with constant operations day and night.

TABLE 5 Mechanical Equipment L₅₀ Noise Levels

	L ₅₀ (Noise Level Exceeded 30 Minutes in any Hour)							
	Daytime				Nighttime			
	R1 450 ft	R2 480 ft	R3 650 ft	R4 840 ft	R1 450 ft	R2 480 ft	R3 650 ft	R4 840 ft
Receptor								
Unadjusted Table NE-2 Limit	50	50	50	50	45	45	45	45
Ambient Noise Levels	47	45	52	54	44	42	49	51
Mechanical Equipment Level ¹	26	26	23	21	26	26	23	21
NE-2 Adjustments ²	0	0	+2	+4	0	0	+4	+5
Adjusted Table NE-2 Limit	50	50	52	54	45	45	49	50
Operations Exceed NE-2?	No	No	No	No	No	No	No	No

¹ Assumes 5 to 10 dBA noise reduction due to acoustical shielding by Barrel Storage Building structure.

² Limit is adjusted to account for ambient conditions.

As shown in Table 5, L₅₀ noise levels would be 26 dBA L₅₀ or less at R1, R2, R3, and R4, taking shielding from the Barrel Storage Building into account. These noise levels would not be audible above ambient noise levels. Mechanical equipment noise levels would not exceed the adjusted L₅₀ noise limit established for daytime or nighttime periods at any surrounding residential properties.

Seasonal Crushing

The proposed improvements to the project site would enable the winery to increase production from 5,000 to 10,000 cases of wine per year. This would result in an increase in seasonal crushing activities. Crush activities are anticipated to occur over two weeks during the harvest period between 8:00 am and 6:00 pm. Crush related activities are expected to occur in the Covered Crush Area, located between the Barrel Storage and Fermentation Buildings. The Covered Crush Area would be open to the east and west. The Barrel Storage Building would be anticipated to provide 5 to 10 dBA of noise reduction to nearby receptors.

Forklifts would be used to offload the grape bins and transport the bins to the crush pad area. During crush, the frequency of noise due to forklifts is greater than the frequency of noise due to forklifts during regular maintenance and operations. Therefore, the L₂₅ would be the appropriate analysis threshold assuming a cumulative duration of 15 to 30 minutes of forklift noise per hour.

TABLE 6 Crushing Related Forklift Operations L₂₅ Noise Levels

	L ₂₅ (Noise Level Exceeded 15 Minutes in any Hour)			
	Daytime			
	R1 350 feet	R2 450 feet	R3 575 feet	R4 750 feet
Receptor				
Unadjusted Table NE-2 Limit	55	55	55	55
Ambient Noise Levels	50	48	55	57
Forklift Noise Level ¹	48	46	39	42
NE-2 Adjustment ²	0	0	0	+2
Adjusted Table NE-2 Limit	55	55	55	57
Operations Exceed NE-2?	No	No	No	No

¹ Assumes 5 to 10 dBA noise reduction due to acoustical shielding by Barrel Storage Building structure.

² Limit is adjusted to account for ambient conditions.

As shown in Table 6, noise levels from these forklift operations during crush are calculated to reach 48 dBA at the outdoor area of R1, 47 dBA at R2, 39 dBA at R3, and 42 dBA at R4, taking into account the shielding provided by the Barrel Storage Building. The predicted noise levels at would be below the daytime noise level thresholds.

The majority of on-site noise sources associated with the crush would include the operation of hoppers, presses, destemmers, separators, crushers, air compressors, forklifts, conveyors, etc.

Average noise levels resulting from the crush are typically constant on an hourly basis. Individual pieces of crush-specific equipment such as the separators and destemmers are relatively quiet with sound levels of around 50 dBA L_{eq} at about 50 feet; however, the composite crush activities typically generate noise levels of about 64 dBA L_{eq} at a distance of 50 feet from the center of operations. During crush, discrete maximum noise events such as the washing and setting of empty grape bins, may produce noise levels that reach 70 to 80 dBA L_{max} or L_{02} at 50 feet from the center of operations.

TABLE 7 Crushing Related L_{50} Noise Levels

	L_{50}			
	(Noise Level Exceeded 30 Minutes in any Hour)			
	Daytime			
Receptor	R1 350 feet	R2 450 feet	R3 575 feet	R4 750 feet
Unadjusted Table NE-2 Limit	50	50	50	50
Ambient Noise Levels	47	45	52	54
Crushing Noise Level ¹	42	40	33	36
NE-2 Adjustment ²	0	0	+2	+4
Adjusted Table NE-2 Limit	50	50	52	54
Operations Exceed NE-2?	No	No	No	No

¹ Assumes 5 to 10 dBA noise reduction due to acoustical shielding by Barrel Storage Building structure.

² Limit is adjusted to account for ambient conditions.

TABLE 8 Crushing Related Operations L_{02} Noise Levels

	L_{02}			
	(Noise Level Exceeded 1 Minutes in any Hour)			
	Daytime			
Receptor	R1 350 feet	R2 450 feet	R3 575 feet	R4 750 feet
Unadjusted Table NE-2 Limit	65	65	65	65
Ambient Noise Levels	59	57	64	66
Crushing Noise Level ¹	53	51	44	47
NE-2 Adjustments ²	0	0	0	+1
Adjusted Table NE-2 Limit	65	65	65	66
Operations Exceed NE-2?	No	No	No	No

¹ Assumes 5 to 10 dBA noise reduction due to acoustical shielding by Barrel Storage Building structure.

² Limit is adjusted to account for ambient conditions.

As shown in Table 7, crush activities would be anticipated to generate L_{50} noise levels about 42 dBA L_{50} at R1, 40 dBA L_{50} at R2, 33 dBA L_{50} at R3, and 36 dBA L_{50} at R4, taking into account the shielding provided by the Barrel Storage Building. Maximum noise levels from crush activities would generate L_{02} noise levels of about 53 dBA L_{02} at R1, 51 dBA L_{02} at R2, 44 dBA L_{02} at R3, and 47 dBA L_{02} at R4 (see Table 8). Crush noise levels would be in compliance with daytime L_{50} and L_{02} noise limits at all nearby receptors.

Seasonal Bottling

An increase in bottling activities would occur with the increase in production from 5,000 to 10,000 cases of wine per year. Bottling activities would occur over a few weeks per year within daytime hours. Bottling related activities are expected to occur in the Covered Crush Area, located between the Barrel Storage and Fermentation Buildings. The Covered Crush Area would be open to the east and west.

Bottling would be constant on an hourly basis. Based on sound level measurements of bottling lines at other wineries, we would expect bottling operations to produce L_{50} sound levels of 67 dBA at 50 feet in an open air, non-acoustically shielded environment.

Bottling activities could occur as close as 275 feet from R1, 375 feet from R2, 450 feet from R3, and 700 feet from R4. Table 9 summarizes the assessment of bottling related noise. The Barrel Storage Building would be anticipated to provide 5 to 10 dBA of noise reduction to nearby receptors.

TABLE 9 Bottling Related L_{50} Noise Levels

	L_{50} (Noise Level Exceeded 30 Minutes in any Hour)			
	Daytime			
	R1 275 feet	R2 375 feet	R3 450 feet	R4 700 feet
Receptor				
Unadjusted Table NE-2 Limit	50	50	50	50
Ambient Noise Levels	47	45	52	54
Bottling Noise Level ¹	45	42	36	39
NE-2 Adjustment ²	0	0	+2	+4
Adjusted Table NE-2 Limit	50	50	52	54
Operations Exceed NE-2?	No	No	No	No

¹ Assumes 5 to 10 dBA noise reduction due to acoustical shielding by Barrel Storage Building structure.

² Limit is adjusted to account for ambient conditions.

As shown in Table 9, bottling would result in noise levels of 36 to 45 dBA L_{50} at nearby residential areas and would comply with daytime noise limits of 50 dBA L_{50} at all sensitive receptors.

Construction Noise

Noise impacts resulting from construction depend on the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, the distance between construction noise sources and noise-sensitive receptors, any shielding provided by intervening structures or terrain, and ambient noise levels. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (early morning, evening, or nighttime hours), when construction occurs in areas immediately adjoining noise-

sensitive land uses, or when construction durations last over extended periods of time.

Each construction phase would include a different mix of equipment operating. The highest noise levels are typically generated when impact tools are used (e.g., jackhammers, hoe rams). Site grading and excavation activities would also generate high noise levels as these phases often require the simultaneous use of multiple pieces of heavy equipment, such as dozers, excavators, scrapers, and loaders. Lower noise levels result from construction activities when less heavy equipment is required to complete the tasks. Impact pile driving is not anticipated for project construction.

Typical construction noise levels at a distance of 50 feet are shown in Tables 10 and 11. Table 10 illustrates the average noise level range by typical construction phase type and Table 11 shows the maximum noise level range for different construction equipment. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of the distance between the source and receptor.

TABLE 10 Typical Ranges of Noise Levels at 50 Feet from Construction Sites (dBA L_{eq})

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

I - All pertinent equipment present at site.

II - Minimum required equipment present at site.

Source: United States Environmental Protection Agency, 1973, Legal Compilation on Noise, Vol. 1, p. 2-104.

TABLE 11 Construction Equipment Noise Emission Levels (at 50 feet)

Equipment Category	L _{max} Level (dBA) ^{1,2}	Impact/Continuous*
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor ³	70	Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous
Notes: *Impact activities impact the ground or construction surface, such as pile driving, while continuous activities emit more constant noise, such as construction vehicles. ¹Measured at 50 feet from the construction equipment, with a “slow” (1 sec.) time constant. ²Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation. ³Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi. Source: FHWA		

FHWA's Roadway Construction Noise Model (RCNM) was used to calculate the maximum and average noise levels anticipated during each phase of construction, based on the project specific construction equipment list. Vehicles and equipment anticipated during each phase of construction were input into RCNM to calculate noise levels at distances representative of the nearest noise sensitive uses. Levels calculated in RCNM represent an upper bound of possible construction noise. Construction noise levels would typically range 5 to 10 dBA below these upper bound levels. Table 12 presents the construction noise levels calculated for each major construction phase of the project using RCNM and Table 13 presents construction noise levels anticipated during vibratory pile driving activities.

TABLE 12 Noise Levels by Construction Phase at Representative Distances

Construction Phase	Maximum Noise Level (L_{max} , dBA)				Hourly Average Noise Level ($L_{eq[h]}$, dBA)			
	R1 50 ft	R2 250 ft	R3 125 ft	R4 450 ft	R1 50 ft	R2 250 ft	R3 125 ft	R4 450 ft
Rough Grading	82	68	74	63	81	67	73	62
Site Work	82	68	74	63	81	67	73	62
Foundation/Framing	79	65	71	60	80	66	72	61
Landscaping	81	67	73	62	80	66	72	61
Paving	80	66	72	61	78	64	70	59

TABLE 13 Noise Levels During Vibratory Pile Driving at Representative Distances

Construction Phase	Maximum Noise Level (L_{max} , dBA)				Hourly Average Noise Level (L_{eq} , dBA)			
	R1 280 ft	R2 350 ft	R3 500 ft	R4 750 ft	R1 250 ft	R2 350 ft	R3 500 ft	R4 750 ft
Vibratory Pile Driving	86	84	81	77	80	77	74	70

Residences are located as close as about 50 feet to the northeast (R1), 250 feet to the east (R2), 340 feet to the north (R3), and 550 feet to the northwest (R4) of proposed heavy construction of the Tasting Pavilion. Construction of the driveway and Barrel Storage Buildings would be further from residences. Vibratory pile driving, associated with construction of the Barrel Storage Building, would occur as close as 280 feet from R1, 350 from R2, 500 feet from R3, and 750 feet from R4.

Vibratory pile driving would result in maximum noise levels 77 to 85 dBA L_{max} and hourly average noise levels in the range of 70 to 80 dBA L_{eq} at the nearest residences. Other heavy construction activities would result in maximum instantaneous noise levels of 61 to 82 dBA L_{max} and hourly average noise levels of 59 to 81 dBA L_{eq} at the nearest residences.

Construction would be conducted over a period of about eight to ten months within the allowable hours of 8:00 am and 5:00 pm. Standard best management practices would be implemented to limit construction hours to daytime periods only, reduce construction noise levels emanating from the site, and minimize disruption and annoyance at adjacent noise sensitive uses:

- Limit construction to between the hours of 8:00 am to 5:00 pm.
- Limit work to non-motorized equipment on Sundays and holidays.
- Locate construction staging areas as far as practical from nearby sensitive receptors.
- Locate stationary noise-generating equipment, such as air compressors or portable power generators, as far as practical from nearby sensitive receptors.
- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment. Air compressors and pneumatic equipment should be equipped with mufflers, and impact tools should be equipped with shrouds or shields.
- Prohibit all unnecessary idling of internal combustion engines.

Cumulative Noise Environment

There are no known projects in the vicinity to which construction or operational activities from the Croix Estate Winery project would contribute. As a result, cumulative noise impacts would be identical to the project impacts described above.

CEQA Initial Study Checklist Questions

The California Environmental Quality Act (CEQA) includes qualitative guidelines for determining the significance of environmental noise impacts. The CEQA Initial Study checklist questions are listed below:

- (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;

*Project generated traffic is not anticipated to result in a substantial increase in traffic noise along the roadway network. Parking lot activities, mechanical equipment, seasonal bottling and crush activities, and general maintenance would be in compliance with the Sonoma County limits. The project does not propose any changes to events or the number of visitors. **Less-than-Significant Impact.***

*Construction would be conducted within allowable hours and would occur over a period of less than one-year. With implementation of standard best management practices this would be a **Less-than-Significant Impact**.*

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

*The nearest structures would be located 50 feet from heavy construction and 270 feet from vibratory pile driving. At a distance of 50 feet, groundborne vibration from construction is anticipated to generate vibration levels in the range of 0.001 to 0.0098 in/sec PPV. These vibration levels would range from barely to strongly perceptible, but would be well below the conservative 0.3 in/sec PPV vibration limit recommended by the California Department of Transportation (Caltrans) for buildings that are found to be structurally sound but where structural damage is a major concern (see Table A3). Vibratory pile driving would be anticipated to generate levels in the range of 0.012 to 0.054 in/sec PPV. These vibration levels would range from barely to distinctly perceptible, but would again be well below the conservative 0.3 in/sec PPV Caltrans vibration limit. **Less-than-Significant Impact**.*

- (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.

*The project is not located in the vicinity of a private airstrip or an airport land use plan and would not expose persons in the project area to excessive airport-related noise. **No Impact**.*

RECOMMENDED MITIGATION

The project would be in compliance with the Sonoma County noise standards and no mitigation is recommended. Standard best management practices are recommended to reduce construction noise levels.

SUMMARY/CONCLUSIONS

Based on the above findings, noise associated with project operations and construction at Croix Estate Winery is not expected to exceed Sonoma County noise standards at any residential property in the site vicinity. No mitigation is recommended.

Appendix A – Noise and Vibration Fundamentals

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 A1.

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 A2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq} . The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

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

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level (CNEL)* is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level (L_{dn})* 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 to 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 to 62 dBA L_{dn} with open windows and 65 to 70 dBA L_{dn} with standard construction if the windows are closed.

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 to 30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60 to 70 dBA. Between a L_{dn} of 70 to 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 to 35 percent of the population is believed to be highly annoyed.

TABLE A1 Definition of Acoustical Terms Used in this Report

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

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

TABLE A2 Typical Noise Levels in the Environment

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

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

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table A3 displays the reactions of people and the effects on buildings that continuous vibration levels produce. The guidelines in Table A3 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 induce structural 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 A3 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 A3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

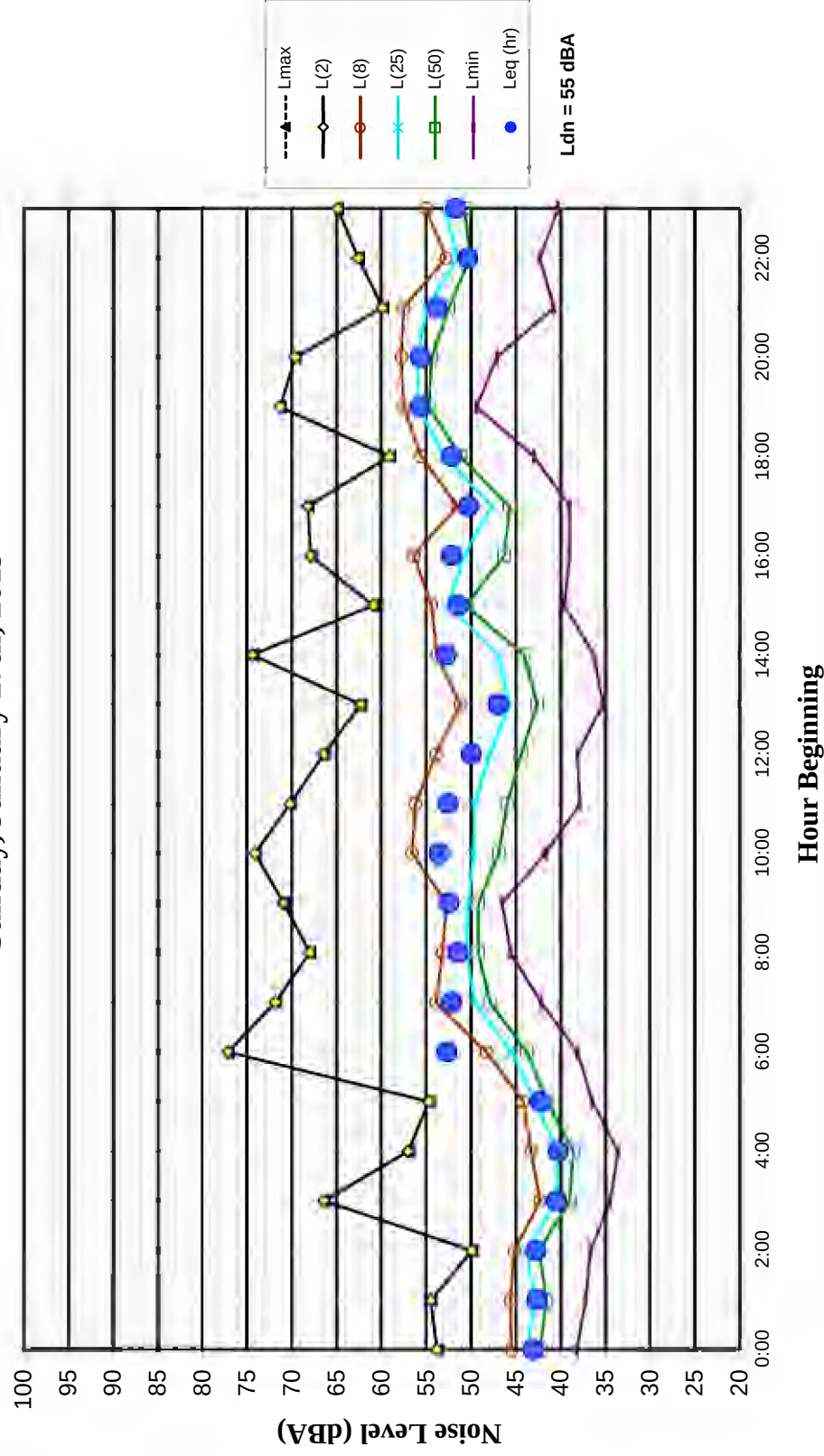
TABLE A3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

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

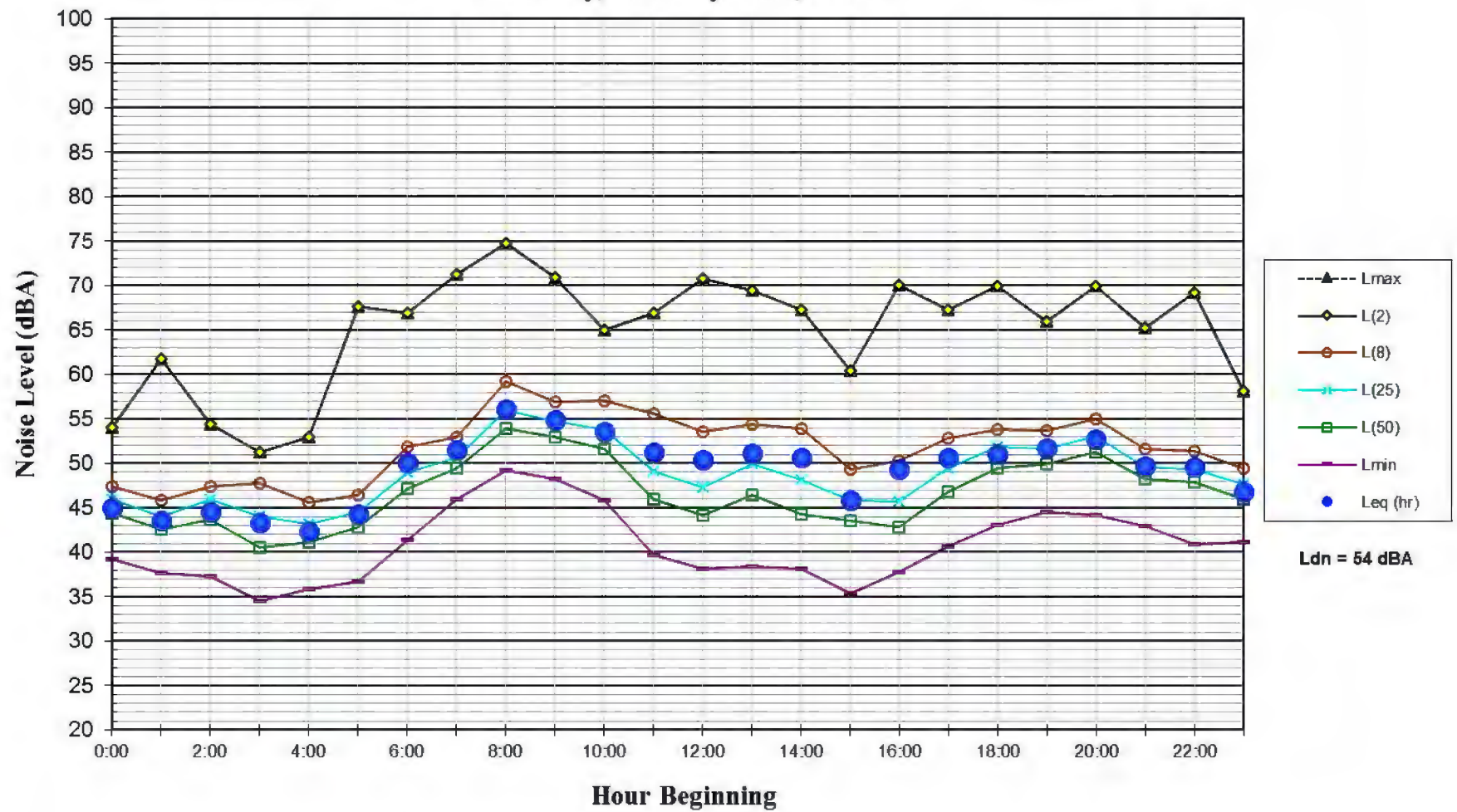
Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

Appendix B – Long-Term Noise Data

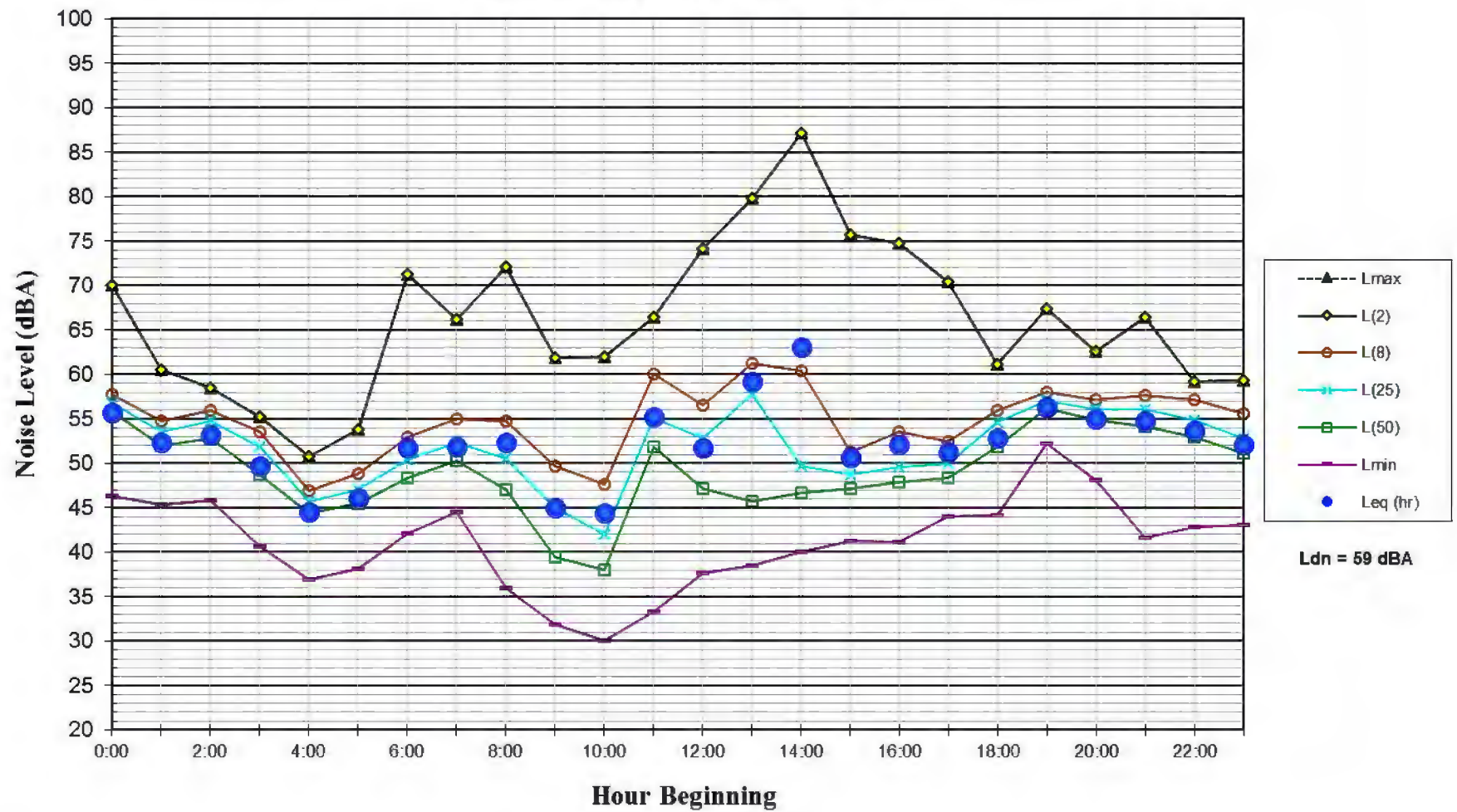
Noise Levels at Noise Measurement Site LT-1 Eastern edge of project site, 195 feet from Wood Road Sunday, January 27th, 2019



Noise Levels at Noise Measurement Site LT-1
Eastern edge of project site, 195 feet from Wood Road
Saturday, January 26th, 2019



Noise Levels at Noise Measurement Site LT-1
Eastern edge of project site, 195 feet from Wood Road
Tuesday, January 29th, 2019



Noise Levels at Noise Measurement Site LT-1
Eastern edge of project site, 195 feet from Wood Road
Monday, January 28th, 2019

