Environmental Noise & Vibration Assessment

Clayton Community Church

City of Clayton, California

BAC Job # 2020-099

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CEQA Checklist

NOISE AND VIBRATION – **Would the Project Result in:**	**NA – Not Applicable**	**Potentially Significant Impact**	**Less than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
a) Generation of 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?			**X**		
b) Generation of excessive groundborne vibration or groundborne noise levels?				**X**	
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, would the project expose people residing or working in the project area to excessive noise levels?					**X**

Introduction

The proposed Clayton Community Church (project) is located 1027 Pine Hollow Court in Clayton, California. The project proposes the development of a community church and associated parking areas, as well as for the rehabilitation of an existing on-site structure (residence). Existing land uses in the project vicinity include an elementary school to the north (Mt. Diablo Elementary), commercial to the east, and residential to the south and west. The project area and site plan are shown on Figures 1 and 2, respectively.

The purposes of this assessment are to quantify the existing noise and vibration environments, identify potential noise and vibration impacts resulting from the project, identify appropriate mitigation measures, and provide a quantitative and qualitative analysis of impacts associated with the project. Specifically, impacts are identified if project-related activities would cause a substantial increase in ambient noise levels at existing sensitive uses in the project vicinity, or if traffic or project generated noise or vibration levels would exceed applicable federal, state, or City of Clayton standards at existing noise-sensitive uses in the project vicinity.

Noise and Vibration Fundamentals

Noise

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 are designated as sound. The number of pressure variations per second is called the frequency of sound and is expressed as cycles per second, or Hertz (Hz). Definitions of acoustical terminology are provided in Appendix A.

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 uses the hearing threshold (20 micropascals of pressure) as a point of reference, defined as 0 dB. Other sound pressures are then compared to the reference pressure, and the logarithm is taken to keep the numbers in a practical range. 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 decibel levels correspond closely to human perception of relative loudness. Noise levels associated with common noise sources are provided in Figure 3.

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 filtering the frequency response of a sound level meter by means of the standardized A-weighting 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.

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}). The L_{eq} is the foundation of the day-night average noise descriptor, DNL (or L_{dn}), and shows very good correlation with community response to noise.

The day-night average sound level (DNL) is based on the average noise level over a 24-hour day, with a +10-decibel weighting applied to noise occurring during nighttime (10:00 PM to 7:00 AM) hours. The nighttime penalty is based on 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.

Vibration

Vibration is like noise in that it involves a source, a transmission path, and a receiver. While vibration is related to noise, it differs in that noise is generally considered to be pressure waves transmitted through air, while vibration is usually associated with transmission through the ground or structures. As with noise, vibration consists of an amplitude and frequency. A person's response to vibration will depend on their individual sensitivity as well as the amplitude and frequency of the source.

Vibration can be described in terms of acceleration, velocity, or displacement. A common practice is to monitor vibration in terms of velocity in inches per second peak particle velocity (IPS, PPV) or root-mean-square (VdB, RMS). Standards pertaining to perception as well as damage to structures have been developed for vibration in terms of peak particle velocity as well as RMS velocities.

As vibrations travel outward from the source, they excite the particles of rock and soil through which they pass and cause them to oscillate. Differences in subsurface geologic conditions and distance from the source of vibration will result in different vibration levels characterized by different frequencies and intensities. In all cases, vibration amplitudes will decrease with increasing distance. The maximum rate, or velocity of particle movement, is the commonly accepted descriptor of the vibration "strength".

Human response to vibration is difficult to quantify. Vibration can be felt or heard well below the levels that produce any damage to structures. The duration of the event has an effect on human response, as does frequency. Generally, as the duration and vibration frequency increase, the potential for adverse human response increases.

According to the Transportation and Construction-Induced Vibration Guidance Manual (Caltrans, June 2004), operation of construction equipment and construction techniques generate ground vibration. Traffic traveling on roadways can also be a source of such vibration. At high enough amplitudes, ground vibration has the potential to damage structures and/or cause cosmetic damage. Ground vibration can also be a source of annoyance to individuals who live or work close to vibration-generating activities. However, traffic, rarely generates vibration amplitudes high enough to cause structural or cosmetic damage.

Legend

- Project Parcel Boundaries (Approximate)
- Noise & Vibration Survey Locations

N

Scale (Feet)

0 75 150

Clayton Community Church
Clayton, California

Project Area

Figure 1

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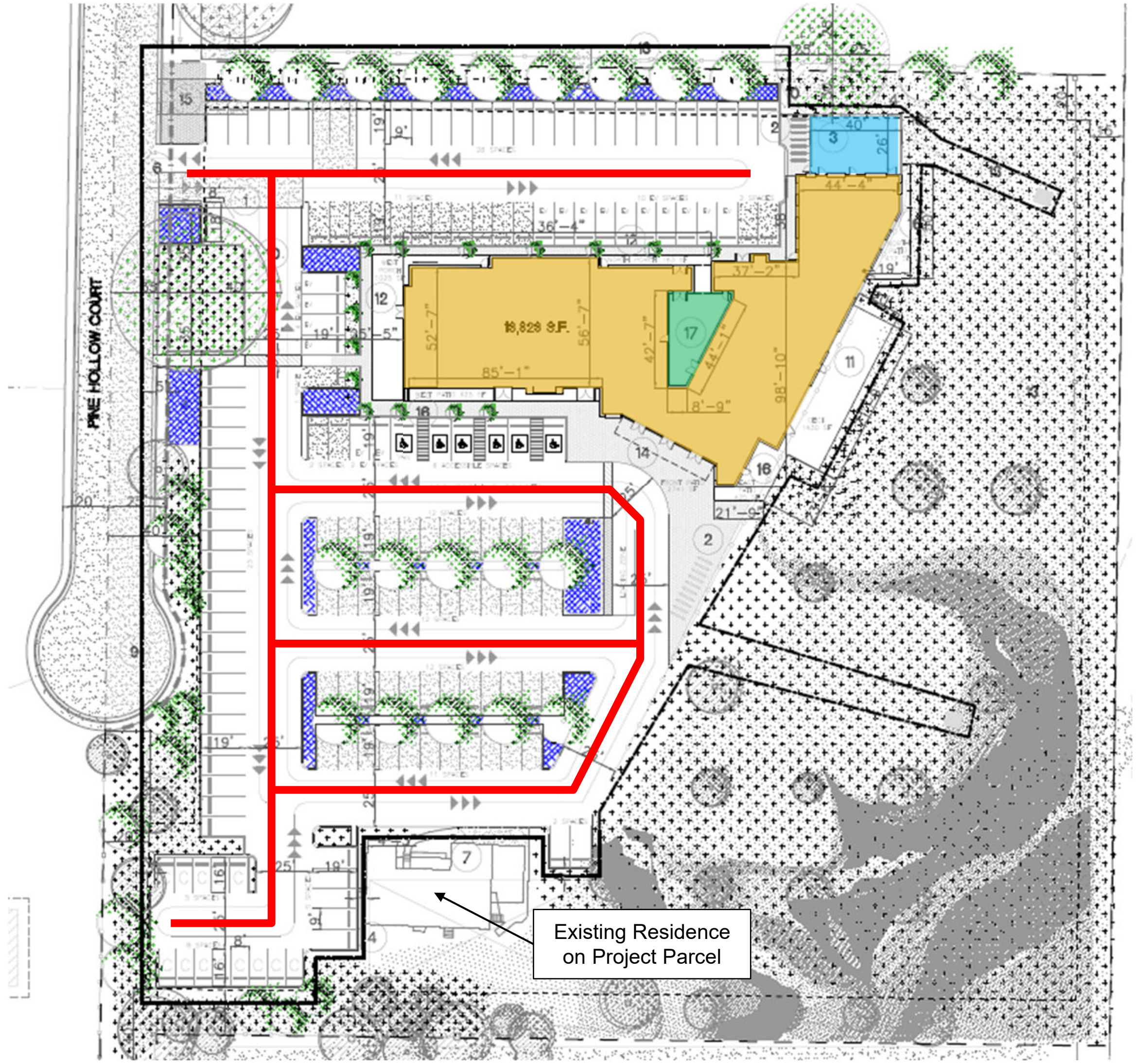

Legend

- Parking Lot Drive Aisles
- Community Church Building
- Outdoor Area – Courtyard
- Outdoor Area – Playground

N

Scale (Feet)

0 25 50

Clayton Community Church

Clayton, California

Project Site Plan

Figure 2

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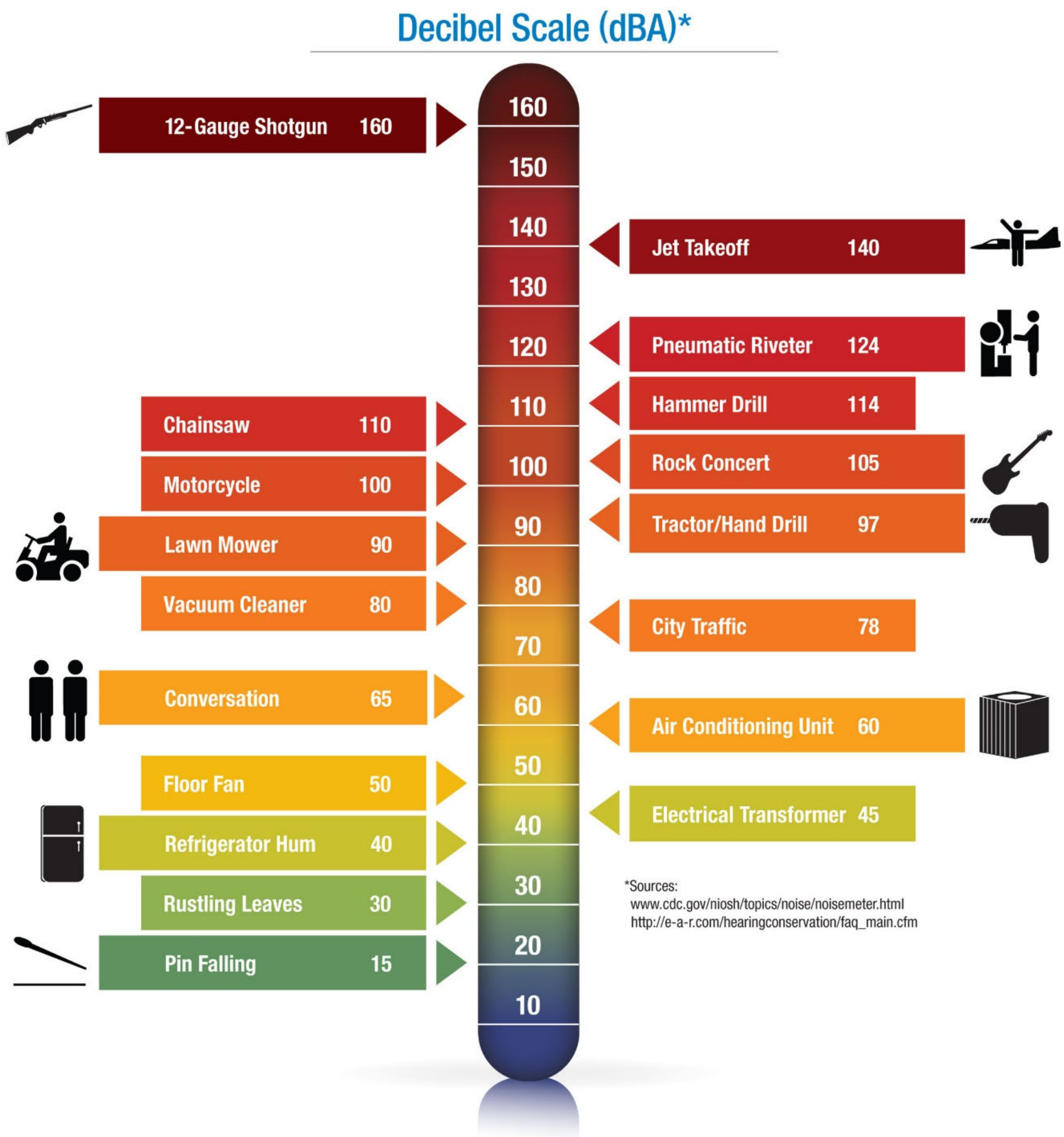
Figure 3
Noise Levels Associated with Common Noise Sources



Regulatory Setting: Criteria for Acceptable Noise and Vibration Exposure

Federal

There are no federal noise or vibration criteria which would be directly applicable to this project. However, the City of Clayton does not currently have a policy for assessing noise impacts associated with increases in ambient noise levels from project-generated noise sources. As a result, the following federal noise criteria was applied to the project.

Federal Interagency Commission on Noise (FICON)

The Federal Interagency Commission on Noise (FICON) has developed a graduated scale for use in the assessment of project-related noise level increases. The criteria shown in Table 1 was developed by FICON as a means of developing thresholds for impact identification for project-related noise level increases. The FICON standards have been used extensively in recent years by the authors of this section in the preparation of the noise sections of Environmental Impact Reports that have been certified in many California cities and counties.

The use of the FICON standards are considered conservative relative to thresholds used by other agencies in the State of California. For example, the California Department of Transportation (Caltrans) requires a project-related traffic noise level increase of 12 dB for a finding of significance, and the California Energy Commission (CEC) considers project-related noise level increases between 5 to 10 dB significant, depending on local factors. Therefore, the use of the FICON standards, which set the threshold for finding of significant noise impacts as low as 1.5 dB, provides a very conservative approach to impact assessment for this project.

Table 1
Significance of Changes in Cumulative Noise Exposure

Ambient Noise Level Without Project (L_{dn} or CNEL)	Change in Ambient Noise Level Due to Project
<60 dB	+5.0 dB or more
60 to 65 dB	+3.0 dB or more
>65 dB	+1.5 dB or more
Source: Federal Interagency Committee on Noise (FICON)	

Based on the FICON research, as shown in Table 1, a 5 dB increase in noise levels due to a project is required for a finding of significant noise impact where ambient noise levels without the project are less than 60 dB. Where pre-project ambient conditions are between 60 and 65 dB, a 3 dB increase is applied as the standard of significance. Finally, in areas already exposed to higher noise levels, specifically pre-project noise levels in excess of 65 dB, a 1.5 dB increase is considered by FICON as the threshold of significance.

State of California

California Environmental Quality Act (CEQA)

The State of California has established regulatory criteria that are applicable to this assessment. Specifically, Appendix G of the State of California Environmental Quality Act (CEQA) Guidelines 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. According to Appendix G of the CEQA guidelines, the project would result in a significant noise or vibration impact if the following occur:

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 other 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, would the project expose people residing or working in the project area to excessive noise levels?

It should be noted that audibility is not a test of significance according to CEQA. If this were the case, any project which added any audible amount of noise to the environment would be considered significant according to CEQA. Because every physical process creates noise, the use of audibility alone as significance criteria would be unworkable. CEQA requires a substantial increase in noise levels before noise impacts are identified, not simply an audible change.

California Department of Transportation (Caltrans)

The City of Clayton does not currently have adopted standards for groundborne vibration. As a result, the vibration impact criteria developed by the California Department of Transportation (Caltrans) was applied to the project. The Caltrans criteria applicable to damage and annoyance from transient and continuous vibration typically associated with construction activities are presented in Tables 2 and 3. Equipment or activities typical of continuous vibration include: excavation equipment, static compaction equipment, tracked vehicles, traffic on a highway, vibratory pile drivers, pile-extraction equipment, and vibratory compaction equipment. Equipment or activities typical of single-impact (transient) or low-rate repeated impact vibration include: impact pile drivers, blasting, drop balls, “pogo stick” compactors, and crack-and-seat equipment (California Department of Transportation 2013).

Table 2
Guideline Vibration Damage Potential Threshold Criteria

Structure and Condition	Maximum PPV (inches/second)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.20	0.10
Historic and some old buildings	0.50	0.25
Older residential structures	0.50	0.30
New residential structures	1.00	0.50
Modern industrial/commercial buildings	2.00	0.50

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = Peak Particle Velocity

Source: Caltrans, Transportation and Construction Vibration Guidance Manual (2013).

Table 3
Guideline Vibration Annoyance Potential Criteria

Human Response	Maximum PPV (inches/second)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Barely perceptible	0.40	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.90	0.10
Severe	2.00	0.40

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = Peak Particle Velocity

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

Local

Clayton 2000 General Plan

Section VIII of the Clayton 2000 General Plan (Noise Element) contains criteria to ensure that City residents are not subjected to noise beyond acceptable levels. The Noise Element criteria which are applicable to the project are reproduced below.

GOAL

To maintain or improve the overall environment and the general well-being of the community by reducing annoying levels of noise for all land uses in the city. Physically harmful levels of noise

(70 L_{dn} and above) shall be mitigated to below harmful levels and to levels of minimum annoyance (below 60 L_{dn}) where feasible.

Objective 2

To establish mitigation measures for reducing exposure to traffic noise.

Policies

2A. Require sound mitigation to 45 L_{dn} for indoor noise level uses and 60 L_{dn} for outdoor noise level uses in new developments.

2B. Require setbacks, sound walls, specific orientation and other measures where new uses are exposed to noise. Such measures shall be consistent with the intent of the Community Design Element.

2D. Require developer to conduct noise studies to determine an appropriate noise reduction plan in event development is proposed in areas where roadway or fixed-point sources exceed 60 L_{dn}.

Clayton Municipal Code

The Clayton Municipal Code provides restrictions and nuisance provisions pertaining to construction activities, which have been reproduced below.

9.30.040 Prohibitions.

Except as otherwise provided in this section, it is unlawful for a person to do any of the following acts:

A. Radios, television sets, and similar devices. A person may not operate or play a radio, television set, stereo, phonograph, receiving set, tape or compact disc player, jukebox, musical instrument, or similar device in such a manner as to disturb the peace, quiet, or comfort of the neighboring inhabitants, or to do so with a louder volume than is necessary for convenient hearing for persons in the room, vehicle, or chamber in which the device is operated.

1. A prima facie violation has occurred if the noise is plainly audible at a distance of 50 feet from the nearest property line of any yard, park, or outside activity area, or any building or structure from which the noise is emanating from or vehicle from which it is located, or distance of 50 feet from the device if outside.

C. Machinery, Equipment, Fans, Air Conditioning and Power Equipment. It is unlawful to operate machinery, equipment, or a pump, fan, air-conditioner, spa or pool equipment or engine in a manner which causes excessive noise to nearby residents between the hours of 10:00 p.m. and 7:00 a.m.

15.01.101 Construction working hours.

All grading and excavation, construction, demolition, renovation, and other works of improvement within the City of Clayton and the on-site maintenance and servicing of construction equipment in the City shall occur only between the hours of 7:00 a.m. and 5:00 p.m., Monday through Friday. Any such work beyond said hours and days is strictly prohibited unless previously specifically authorized in writing by the City Engineer or designee or by project conditions of approval. This provision shall not apply to homeowner home improvements.

Environmental Setting – Existing Ambient Noise and Vibration Environment

Noise-Sensitive Land Uses in the Project Vicinity

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the primary intended use of the land. Places where people live, sleep, recreate, worship, and study are generally considered to be sensitive to noise because intrusive noise can be disruptive to these activities.

The noise-sensitive land uses which would potentially be affected by the project consist of residential uses. Specifically, single-family residential land uses are located to the south and west of the project parcel. Existing commercial and school uses are located to the east and north of the project site (respectively). However, commercial and school uses are typically not considered to be noise-sensitive, but rather noise-generating. The project parcel and surrounding land uses are shown on Figure 1.

Existing Traffic Noise Levels along Project Area Roadway Network

The FHWA Traffic Noise Model (FHWA-RD-77-108) was used to develop existing noise contours expressed in terms of DNL for major roadways within the project study area. The FHWA model predicts hourly L_{eq} values for free-flowing traffic conditions. Estimates of the hourly distribution of traffic for a typical 24-hour period were used to develop DNL values from L_{eq} values.

Traffic data in the form of Sunday AM peak hour movements for existing conditions were obtained from the project draft traffic impact study (prepared by TJKM Traffic Consultants). Sunday daily traffic volumes were conservatively estimated by applying a factor of 10 to Sunday AM peak hour conditions. Using these data and the FHWA Model, traffic noise levels were calculated. The traffic noise level at 100 feet from the roadway centerline and distances from the centerlines of selected roadways to the 60 dB, 65 dB, and 70 dB DNL contours are summarized in Table 4.

In many cases, the actual distances to noise level contours may vary from the distances predicted by the FHWA Model. Factors such as roadway curvature, roadway grade, shielding from local topography or structures, elevated roadways, or elevated receivers may affect actual sound propagation.

It is also recognized that existing sensitive land uses within the project vicinity are located varying distances from the centerlines of the local roadway network. The 100-foot reference distance is utilized in this analysis to provide a reference position at which changes in existing and future traffic noise levels resulting from the project can be evaluated. Appendix B contains the FWHA model inputs for existing conditions.

Table 4
Existing (2020) Traffic Noise Modeling Results

Seg.	Intersection	Direction	DNL 100 Feet from Roadway	Distance to Contour (feet) 70 dB DNL	65 dB DNL	60 dB DNL
1	Pine Hollow Ct / Pine Hollow Dr	North	--	--	--	--
2		South	32	0	1	1
3		East	--	--	--	--
4		West	32	0	1	1
5	Mt. Zion Dr / Pine Hollow Rd	North	37	1	1	3
6		South	39	1	2	4
7		East	32	0	1	1
8		West	39	1	2	4
9	Mt. Zion Dr / Clayton Rd	North	--	--	--	--
10		South	36	1	1	3
11		East	54	8	18	39
12		West	54	8	18	39
13	Mitchell Canyon Rd / Pine Hollow Rd	North	47	3	6	13
14		South	46	3	6	12
15		East	40	1	2	5
16		West	47	3	6	13
17	Mitchell Canyon Rd / Clayton Rd	North	40	1	2	4
18		South	48	3	7	15
19		East	58	16	33	72
20		West	58	15	33	70

Blank cell = no traffic data was provided
Source: FHWA-RD-77-108 with inputs from TJKM. Appendix B contains the FHWA model inputs.

Existing Overall Ambient Noise Environment at the Project Site

The existing ambient noise environment within the project vicinity is defined primarily by noise from traffic on nearby surface streets, and by activities at the elementary school to the north. To generally quantify existing ambient noise environment at the project site, BAC conducted long-term (48-hour) ambient noise level measurements at three (3) locations on from July 15-16, 2020. The noise survey locations are shown on Figure 1. Photographs of the noise survey locations are provided in Appendix C.

Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters were used to complete the long-term noise level measurements. The meters were calibrated immediately before and after use with an LDL Model CA200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all specifications of the American National Standards Institute requirements for Type 1 sound level meters (ANSI S1.4). The ambient noise level survey results are summarized below in Table 5. The detailed results of the ambient noise survey are contained in Appendix D in tabular format and graphically in Appendix E.

Table 5
Summary of Long-Term Noise Survey Measurement Results – July 15-16, 2020[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: North end of the project property	7/15/20	51	50	65	41	54
	7/16/20	55	53	65	47	60
Site 2: Northwest end of the project property	7/15/20	46	44	60	39	50
	7/16/20	47	47	62	38	50
Site 3: Southwest end of the project property	7/15/20	45	44	59	37	47
	7/16/20	46	46	63	36	49

[1] Detailed summaries of the noise monitoring results are provided in Appendices D and E.
[2] Long-term noise survey locations are shown 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. (2020)

The Table 5 data indicate that measured day-night average and average hourly noise levels were generally consistent at each measurement site throughout the monitoring period. The Table 5 data also indicate that measured day-night average and average hourly noise levels were highest at site 1, which was located on the north end of project property. This was likely due to the proximity of the noise survey location to the adjacent elementary school.

Existing Ambient Vibration Environment

During a site visit on July 15, 2020, vibration levels were below the threshold of perception at the project site. Nonetheless, to quantify existing vibration levels at the project site, BAC conducted short-term (10-minute) vibration measurements at the three locations identified on Figure 1. Photographs of the vibration survey equipment are provided in Appendix C.

A Larson-Davis Laboratories Model LxT precision integrating sound level meter equipped with a vibration transducer was used to complete the measurements. The results are summarized below in Table 6.

Table 6
Summary of Ambient Vibration Level Survey Results – July 15, 2020

Site Description	Time	Average Measured Vibration Level, PPV (in. sec)[1]
Site 1: North end of the project property	11:37 AM	<0.001
Site 2: Northwest end of the project property	11:18 AM	<0.001
Site 3: Southwest end of the project property	11:54 AM	<0.001

[1] PPV = Peak Particle Velocity (inches/second)
Source: Bollard Acoustical Consultants, Inc. (2020)

The Table 6 data indicate that the measured average vibration levels during the monitoring period were less than 0.001 in/sec PPV.

Impacts and Mitigation Measures

Thresholds of Significance

For the purposes of this report, a noise and vibration impact is considered significant if the project would result in:

- 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 other applicable standards of other agencies; or
- Generation of excessive groundborne vibration or groundborne noise levels; or
- 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, would the project expose people residing or working in the project area to excessive noise levels.

The project site is not within the vicinity of a private airstrip, an airport land use plan, or within two miles of a public airport. Therefore, the last threshold listed above is not discussed further.

The following criteria based on standards established by the Federal Interagency Commission on Noise (FICON), California Department of Transportation (Caltrans), Clayton General Plan and Clayton Municipal Code were used to evaluate the significance of environmental noise and vibration resulting from the project:

- A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the Clayton General Plan or Clayton Municipal Code.
- A significant impact would be identified if off-site traffic noise exposure or on-site activities generated by the project would substantially increase noise levels at existing sensitive

receptors in the vicinity. A substantial increase would be identified relative to the FICON standards provided in Table 1.

- A significant impact would be identified if project construction activities or proposed on-site operations would expose noise-sensitive receptors to excessive groundborne vibration levels. Specifically, an impact would be identified if groundborne vibration levels due to these sources would exceed the Caltrans vibration impact criteria.

Noise Impacts Associated with Project-Generated Increases in Off-Site Traffic

With development of the project, traffic volumes on the local roadway network will increase. Those increases in daily traffic volumes will result in a corresponding increase in traffic noise levels at existing uses located along those roadways. The FHWA Model was used with traffic input data from the project traffic impact analysis (prepared by TJKM Traffic Consultants) to predict project traffic noise level increases relative to existing (2020) conditions.

Impact 1: Increases in Existing Traffic Noise Levels due to the Project

Traffic data in the form of Sunday AM peak hour movements for Existing and Existing Plus Project conditions in the project area roadway network were obtained from the project transportation impact analysis completed by TJKM Traffic Consultants. Sunday daily traffic volumes were conservatively estimated by applying a factor of 10 to Sunday AM peak hour conditions.

Existing versus Existing Plus Project traffic noise levels on the local roadway network are shown in Table 7. The following section includes an assessment of predicted traffic noise levels relative to the FICON increase significance noise criteria identified in Table 1. The Table 7 data are provided in terms of DNL at a standard distance of 100 feet from the centerlines of the project-area roadways. Appendix B contains the FWHA model inputs.

It should be noted that the FHWA Model predictions presented in Table 7 are based on inputs that include Sunday daily traffic volumes, day/night and truck type percentages (e.g., medium and heavy trucks), vehicle speed, and distance from roadway centerlines. The FHWA Model does not account for non-traffic ambient noise sources such as nearby wildlife (e.g., birds chipping) or other anthropogenic noise sources within an area (e.g., distant traffic from other roadways, recreational activities, commercial or industrial operations, etc.).

Table 7
Traffic Noise Modeling Results and Project-Related Traffic Noise Increases
Existing vs. Existing Plus Project Comprehensive Conditions

Seg.	Intersection	Direction	Average Measured DNL at Project Area[1]	Predicted Traffic Noise Level at 100 feet, DNL[2]			Substantial Increase Relative to FICON?
				E	E+P	Increase	
1	Pine Hollow Ct / Pine Hollow Rd	North	47	--	--	--	--
2		South		31.9	45.9	14.0	Yes
3		East		--	--	--	--
4		West		31.9	45.9	14.0	Yes

Table 7
Traffic Noise Modeling Results and Project-Related Traffic Noise Increases
Existing vs. Existing Plus Project Comprehensive Conditions

Seg.	Intersection	Direction	Average Measured DNL at Project Area[1]	Predicted Traffic Noise Level at 100 feet, DNL[2]			Substantial Increase Relative to FICON?
				E	E+P	Increase	
5	Mt. Zion Dr / Pine Hollow Rd	North	47	37.4	40.9	3.5	No
6		South		38.8	38.8	0.0	No
7		East		31.9	45.8	13.9	Yes
8		West		39.5	46.0	6.5	Yes
9	Mt. Zion Dr / Clayton Rd	North	47	--	--	--	--
10		South		36.2	40.4	4.2	No
11		East		53.9	54.2	0.3	No
12		West		53.9	54.0	0.1	No
13	Mitchell Canyon Rd / Pine Hollow Rd	North	47	46.9	48.8	1.9	No
14		South		46.1	46.3	0.2	No
15		East		39.9	46.1	6.2	Yes
16		West		46.5	46.7	0.2	No
17	Mitchell Canyon Rd / Clayton Rd	North	47	39.7	40.5	0.8	No
18		South		47.7	49.3	1.6	No
19		East		57.9	58.0	0.1	No
20		West		57.7	58.1	0.4	No

[1] Average measured DNL at BAC measurement site adjacent to Pine Hollow Court (site 2).
[2] Blank cell = no traffic data was provided
Source: FHWA-RD-77-108 with inputs from TJKM. Appendix B contains the FHWA Model inputs.

As stated previously, the FHWA Model does not account for non-traffic ambient noise sources such as nearby wildlife or other anthropogenic noise sources within an area. Consideration of such sources typically results in higher ambient noise levels (i.e., existing no project) than those predicted by the FHWA Model alone, especially in locations where ambient noise environments are quieter (i.e., rural areas or areas removed from busy roadways).

The data in Table 7 indicate that the proposed project's contribution to traffic noise level increases is predicted to exceed the FICON cumulative noise increase significance criteria along five roadway segments evaluated in the existing conditions analysis (segments 2, 4, 7, 8 and 15). Specifically, the traffic noise level increases at those segments are calculated to range from 6.2 to 14.0 dB DNL. Upon analysis of the project roadway network, residences were identified along all five of those roadway segments. However, baseline ambient conditions are considerably higher than baseline traffic noise levels alone. When project traffic noise generation is compared to measured ambient day-night average (DNL) levels within the project area (calculated average of 47 dB DNL at site 2), no project-related traffic noise level increases are calculated to occur along the five identified roadway segments. Rather, project-generated traffic noise levels along those five roadway segments are calculated be less than the measured ambient noise level of 47 dB DNL at site 2. This is a more accurate representation of actual project-related noise level increases than the "traffic-only" noise increases shown in Table 7. Thus, project-related increases in traffic noise levels would not substantially exceed measured ambient noise conditions in the project area relative to the applicable FICON criteria. Further, it should be noted that the predicted Existing Plus Project traffic noise levels of approximately 46 dB DNL at a distance of 100 feet along those five roadway segments is well below the Clayton General Plan exterior noise level standard of 60 dB DNL applicable to traffic noise affecting noise-sensitive uses.

It should be noted that the utilization of measured day-night average noise levels at the project site (47 dB DNL, site 2) is believed to be a conservative approach in the comparison of project-related increases in ambient noise levels relative to existing no project conditions given the location of the measurement site (i.e., removed from busy roadways). It is expected that existing ambient conditions along roadway segments located farther from the project site would be higher than those measured within the project area, which would subsequently result in lower project-related traffic noise level increases.

Based on the analysis presented above, including consideration of measured ambient noise conditions within the project area, off-site traffic noise impacts related to increases in traffic resulting from the implementation of the project (Existing vs. Existing Plus Project conditions) are identified as being ***less than significant***.

Off-Site Noise Impacts Associated with On-Site Operations

The primary noise sources associated with the project have been identified as church-related on-site traffic circulation, parking lot activities (vehicles arriving and departing, doors opening and closing, etc.), and playground activities. The locations of the on-site noise sources included in this assessment are shown on Figure 2.

The nearest existing off-site sensitive receptors have been identified as residential uses located west of Pine Hollow Court and south of the project parcel. The locations of the existing residences are shown on Figure 1. An assessment of each project-related noise source at the nearest existing off-site residential uses follows.

Impact 2: On-Site Traffic Circulation Noise at Existing Off-Site Sensitive Uses

The FHWA Model was utilized with daily trip generation data provided in the project traffic impact study to quantify on-site traffic circulation noise generated by the interior roadways of the project site (parking area drive aisles) at adjacent existing off-site residential uses.

According to the project traffic impact study, worst-case project trip generation is expected to occur on Sundays. Specifically, the project is expected to generate 401 total Sunday trips, including 145 peak hour trips. Based on the trip information above, and assuming an on-site vehicle speed of less than 25 mph (through the parking areas), project worst-case on-site traffic circulation noise exposure at the nearest existing off-site residential uses was calculated. The results of those calculations are presented in Table 8.

In order to calculate project on-site traffic circulation noise generation relative to the Clayton General Plan day-night average (DNL) noise level criteria, the hours in which church services would be offered on a given Sunday must be known. According to the weekly operational plan indicated in the project description, the project proposes events Monday through Thursday and

Sundays beginning as early as 9:00 a.m. and ending as late as 9:00 p.m. However, the weekly operational plan indicates that the highest attendance for project events on any given day would occur on Sundays. Specifically, the proposed events on Sundays consist of worships services from 9:00 a.m. to 12:00 p.m. and AA meetings from 7:00 p.m. to 8:00 p.m. Day-night average noise level exposure associated with project on-site traffic circulation was calculated based on proposed events on Sundays, or worst-case on-site traffic activity expected to occur within a day.

Table 8
Predicted Worst Case On-Site Traffic Noise at Nearest Existing Off-Site Sensitive Uses

Nearest Sensitive Use[1]	Distance from Nearest Drive Aisle (ft)[2]		Predicted Exterior Noise Levels, DNL (dB)[3]	
	Yard	Building Facade	Yard	Building Facade
Residential – South	150	80	40	44
Residential – West	180	125	39	41

[1] Existing land use locations are identified on Figure 1.
[2] Distances scaled from center of nearest parking area drive aisle to residential uses using provided site plan.
[3] Calculated DNL based on data contained in the project traffic impact study and proposed event operations cited in the project description.
Source: Bollard Acoustical Consultants, Inc. (2020)

As indicated in Table 8, noise levels generated by project on-site traffic circulation are predicted to satisfy the Clayton General Plan 60 dB DNL exterior noise level standard at the outdoor areas (yards) of the nearest existing off-site residential uses. The Table 8 data also indicate that on-site traffic circulation noise levels at the building facades of the nearest existing off-site residences are predicted to range from 41 to 44 dB DNL. With windows in the open configuration, standard residential building construction is estimated to provide an exterior to interior noise level reduction of approximately 15 dB. The resulting project on-site traffic circulation noise levels of 26 to 29 dB DNL within the interior areas of the nearest existing off-site residences would satisfy the Clayton General Plan 45 dB DNL interior noise level standard. Finally, the predicted exterior day-night average noise levels shown in Table 8 are below measured ambient day-night average noise levels within the vicinity of the nearest existing residential uses to the south and west (Table 5, BAC noise survey sites 2 and 3).

Because project on-site traffic circulation noise level exposure is predicted to satisfy the applicable Clayton General Plan exterior and interior day-night average noise level limits at the nearest existing off-site sensitive uses, and because on-site traffic circulation noise levels are not predicted to significantly increase ambient noise levels at those sensitive uses, this impact is identified as being ***less than significant.***

Impact 3: Parking Lot Activity Noise at Existing Off-Site Sensitive Uses

As a means of determining potential noise exposure due to project parking lot activities, Bollard Acoustical Consultants, Inc. (BAC) utilized specific parking lot noise level measurements conducted by BAC. Specifically, a series of individual noise measurements were conducted of multiple vehicle types arriving and departing a parking area, including engines starting and stopping, car doors opening and closing, and persons conversing as they entered and exited the vehicles. The results of those measurements revealed that individual parking lot movements generated mean noise levels of approximately 70 dB SEL at a reference distance of 50 feet. The maximum noise level associated with parking lot activity typically did not exceed 65 dB L_{max} at the same reference distance.

To compute hourly average (L_{eq}) noise levels generated by parking lot activities, the approximate number of hourly operations in any given area and distance to the effective noise center of those activities is required. According to the project site plan, the project proposes at total of 156 parking spaces. It was conservatively assumed for the purposes of this analysis that all of the 156 parking stalls could fill or empty during a given Sunday AM peak hour (worst-case). The hourly average noise level generated by parking lot movements is computed using the following formula:

$$Peak\ Hour\ L_{eq} = 70+10*\log(N) - 35.6$$

Where 70 is the mean Sound Exposure Level (SEL) for an automobile parking lot arrival or departure, N is the number of parking lot operations in a given hour, and 35.6 is 10 times the logarithm of the number of seconds in an hour. Using the information provided above, and assuming standard spherical spreading loss (-6 dB per doubling of distance), worst-case project parking activity noise exposure at the nearest off-site residential uses was calculated and the results of those calculations are presented in Table 9.

In order to calculate project parking activity noise generation relative to the Clayton General Plan day-night average (DNL) noise level criteria, the hours in which church services would be offered on a given Sunday must be known. According to the weekly operational plan indicated in the project description, the project proposes events Monday through Thursday and Sundays beginning as early as 9:00 a.m. and ending as late as 9:00 p.m. However, the weekly operational plan indicates that the highest attendance for project events on any given day would occur on Sundays. Specifically, the proposed events on Sundays consist of worships services from 9:00 a.m. to 12:00 p.m. and AA meetings from 7:00 p.m. to 8:00 p.m. Day-night average noise level exposure associated with project parking activity was calculated based on proposed events on Sundays, or worst-case on-site parking activity expected to occur within a day.

Table 9
Predicted Worst-Case Parking Activity Noise Levels at Nearest Existing Off-Site Sensitive Uses

Nearest Sensitive Use[1]	Distance from Parking Area (ft)[2]		Predicted Exterior Noise Levels, DNL (dB)[3]	
	Yard	Building Facade	Yard	Building Facade
Residential – South	300	240	37	39
Residential – West	250	200	38	40

[1] Existing land use locations are identified on Figure 1.
[2] Distances scaled from effective noise center of parking area to residential uses using provided site plan.
[3] Calculated DNL based on BAC file data and proposed event operations cited in the project description.
Source: Bollard Acoustical Consultants, Inc. (2020)

The Table 9 data indicates that noise levels generated by worst-case project parking activities are predicted to satisfy the Clayton General Plan 60 dB DNL exterior noise level standard at the outdoor areas (yards) of the nearest existing off-site residential uses. In addition, project parking area noise levels at the building facades of the nearest existing off-site residences are predicted to range from 39 to 40 dB DNL. With windows in the open configuration, standard residential building construction is estimated to provide an exterior to interior noise level reduction of approximately 15 dB. The resulting worst-case parking area noise levels of 24 to 25 dB DNL within the interior areas of the nearest existing off-site residences would satisfy the Clayton General Plan 45 dB DNL interior noise level standard. Finally, the predicted exterior day-night average noise levels shown in Table 9 are below measured ambient day-night average noise levels within the vicinity of the nearest existing residential uses to the south and west (Table 5, BAC noise survey sites 2 and 3).

Because project worst-case parking activity noise level exposure is predicted to satisfy the applicable Clayton General Plan exterior and interior day-night average noise level limits at the nearest existing off-site sensitive uses, and because parking area noise levels are not predicted to significantly increase ambient noise levels at those sensitive uses, this impact is identified as being ***less than significant.***

Impact 4: Playground Noise at Existing Off-Site Noise-Sensitive Uses

According to the project site plan, the project proposes a playground near the northeast end of the project property. The location of the proposed playground is shown on Figure 2.

For the assessment of playground noise impacts, noise level data collected by BAC staff at various outdoor play areas in recent years was utilized. The primary noise source associated with play area use is shouting children. BAC file data indicate that average noise levels of similar sized outdoor play areas is approximately 55 dB L_{eq} at a distance of 50 feet from the focal point of the play area during school recess. Based on the reference noise level presented above, and assuming standard spherical spreading loss (-6 dB per doubling of distance), playground noise exposure at the nearest off-site residential uses was calculated and the results of those calculations are presented in Table 10.

In order to calculate project playground noise generation relative to the Clayton General Plan day-night average (DNL) noise level criteria, the hours in which church services would be offered on a given Sunday must be known. According to the weekly operational plan indicated in the project description, the project proposes events Monday through Thursday and Sundays beginning as early as 9:00 a.m. and ending as late as 9:00 p.m. However, the weekly operational plan indicates that the highest attendance for project events on any given day would occur on Sundays. Specifically, the proposed events on Sundays consist of worships services from 9:00 a.m. to 12:00 p.m. and AA meetings from 7:00 p.m. to 8:00 p.m. Day-night average noise level exposure associated with project playground activities was calculated based on proposed events on Sundays, or worst-case playground activity expected to occur within a day.

Table 10
Predicted Worst-Case Playground Noise Levels at Nearest Existing Off-Site Sensitive Uses

Nearest Sensitive Use[1]	Distance from Playground Area (ft)[2]		Predicted Exterior Noise Levels, DNL (dB)[3]	
	Yard	Building Facade	Yard	Building Facade
Residential – South	500	440	31	32
Residential – West	420	400	33	33

[1] Existing land use locations are identified on Figure 1.
[2] Distances scaled from playground to nearest residential uses using provided site plan.
[3] Calculated DNL based on BAC file data and proposed event operations cited in the project description.
Source: Bollard Acoustical Consultants, Inc. (2020)

As indicated in Table 10, noise levels generated by project playground activities are predicted to satisfy the Clayton General Plan 60 dB DNL exterior noise level standard at the outdoor areas (yards) of the nearest existing off-site residential uses. The Table 10 data also indicate that playground noise levels at the building facades of the nearest existing off-site residences are predicted to range from 32 to 33 dB DNL. With windows in the open configuration, standard residential building construction is estimated to provide an exterior to interior noise level reduction of approximately 15 dB. The resulting playground noise levels of 17 to 18 dB DNL within the interior areas of the nearest existing off-site residences would satisfy the Clayton General Plan 45 dB DNL interior noise level standard. Finally, the predicted exterior day-night average noise levels shown in Table 10 are below measured ambient day-night average noise levels within the vicinity of the nearest existing residential uses to the south and west (Table 5, BAC noise survey sites 2 and 3).

Because project playground noise level exposure is predicted to satisfy the applicable Clayton General Plan exterior and interior day-night average noise level limits at the nearest existing off-site sensitive uses, and because playground noise levels are not predicted to significantly increase ambient noise levels at those sensitive uses, this impact is identified as being ***less than significant.***

Impact 5: Other On-Site Operations Noise Sources at Existing Off-Site Sensitive Uses

It is possible that the proposed church could have amplified music (instruments or choir) or speech emanating from within the church building (sanctuary). In addition, the proposed church building would likely have mechanical equipment (HVAC) for the regulation of indoor environments.

Due to the variability of sound system configurations, it is difficult to quantify amplified music or speech that could occur from within the church building. However, Section 9.30.040(A)(1) of the Clayton Municipal Code prohibits noise from electronic devices and musical instruments from being plainly audible at a distance of 50 feet from any building or structure from which the noise is emanating from, or a distance of 50 feet from the device if outside. Based on the interior to exterior noise level reduction provided by standard building construction (approximately 25 dB with the windows in the closed position and 15 dB with windows in the open position), it is expected that noise associated with amplified music or speech emanating from within the church building sanctuary would not exceed the noise criteria identified in Section 9.30.040(A)(1).

The heating, ventilating, and air-conditioning (HVAC) requirements for the church building will likely be met using packaged roof-mounted equipment. It is the experience of BAC that such roof-top mounted equipment is typically screened from view at nearby ground locations by building parapets, which would provide a degree of noise level attenuation. Section 9.30.040(C) requires that noise levels associated with mechanical equipment (HVAC) not result in excessive noise at residential uses during the hours of 10:00 p.m. and 7:00 a.m. (nighttime hours). According to the weekly operational plan indicated in the project description, the project does not propose events during nighttime hours. Based on this information, it is reasonably assumed that HVAC equipment associated with the church building would not be in operation during nighttime hours. In addition, based on the large setbacks from the proposed church building to nearby existing residential uses, it is expected that noise associated with daytime operation of the church building HVAC equipment would easily satisfy the Clayton General Plan exterior and interior day-night average (DNL) noise level criteria at the nearest residential uses.

Based on the information above, and because the code sections identified above are enforced under Section 9.30.070 of the Clayton Municipal Code, this impact is identified as being ***less than significant.***

Impact 6: Cumulative (Combined) Noise Levels from On-Site Operations at Existing Off-Site Sensitive Uses

The calculated cumulative (combined) noise levels of project on-site operations at the nearest existing off-site sensitive uses to the south and west are presented in Tables 11 and 12, respectively. It should be noted that due to the logarithmic nature of the decibel scale, the sum of two noise values which differ by 10 dB equates to an overall increase in noise levels of 0.4 dB. When the noise sources are equivalent, the sum would result in an overall increase in noise levels of 3 dB.

Table 11
Predicted Cumulative Project Noise Levels at Nearest Existing Off-Site Sensitive Use to South

Location	Predicted Project Operations Exterior Noise Levels, DNL (dB)[1]			
	On-Site Traffic	Parking	Playground	Cumulative
Yard	40	37	31	42
Building facade	44	39	32	45

[1] Calculated cumulative noise levels based on predicted noise levels presented in Impacts 2-4.
Source: Bollard Acoustical Consultants, Inc. (2020)

Table 12
Predicted Cumulative Project Noise Levels at Nearest Existing Off-Site Sensitive Use to West

Location	Predicted Project Operations Exterior Noise Levels, DNL (dB)[1]			
	On-Site Traffic	Parking	Playground	Cumulative
Yard	39	38	33	42
Building facade	41	40	33	44

[1] Calculated cumulative noise levels based on predicted noise levels presented in Impacts 2-4.
Source: Bollard Acoustical Consultants, Inc. (2020)

As indicated in Tables 11 and 12, cumulative on-site operations noise levels are predicted to satisfy the Clayton General Plan 60 dB DNL exterior noise level standard at the outdoor areas (yards) of the nearest existing off-site residential uses to the south and west of the project parcel. In addition, cumulative on-site operations noise levels at the building facades of the nearest existing off-site residences are predicted to range from 44 to 45 dB DNL. With windows in the open configuration, standard residential building construction is estimated to provide an exterior to interior noise level reduction of approximately 15 dB. The resulting cumulative on-site operations noise levels of 29 to 30 dB DNL within the interior areas of the nearest existing off-site residences would satisfy the Clayton General Plan 45 dB DNL interior noise level standard. Finally, the predicted cumulative exterior day-night average noise levels shown in Tables 11 and 12 are below measured ambient day-night average noise levels within the vicinity of the nearest existing residential uses to the south and west (Table 5, BAC noise survey sites 2 and 3).

Because project cumulative on-site operations noise level exposure is predicted to satisfy the applicable Clayton General Plan exterior and interior day-night average noise level limits at the nearest existing off-site sensitive uses, and because cumulative noise levels are not predicted to significantly increase ambient noise levels at those sensitive uses, this impact is identified as being ***less than significant.***

Noise Impacts Associated with Project Construction and Rehabilitation Activities

Impact 7: Project Construction Noise Levels at Existing Off-Site Sensitive Receptors

During project construction, heavy equipment would be used for grading excavation, paving, and building construction / structure rehabilitation, which would increase ambient noise levels when in use. Noise levels would vary depending on the type of equipment used, how it is operated, and how well it is maintained. Noise exposure at any single point outside the project work area would also vary depending upon the proximity of equipment activities to that point. The nearest existing off-site noise-sensitive use has been identified as a residence located approximately 50 feet away from where construction activities would occur on the project parcel.

Table 13 includes the range of maximum noise levels for equipment commonly used in general construction projects at full-power operation at a distance of 50 feet. Not all of these construction activities would be required of this project.

Table 13
Construction Equipment Reference Noise Levels at 50 Feet

Equipment Description	Maximum Noise Level at 50 Feet, dBA
Air compressor	80
Backhoe	80
Ballast equalizer	82
Ballast tamper	83
Compactor	82
Concrete mixer	85
Concrete pump	82
Concrete vibrator	76
Crane, mobile	83
Dozer	85
Generator	82
Grader	85
Impact wrench	85
Jack hammer	88
Loader	80
Paver	85
Pneumatic tool	85
Pump	77
Rail saw	90
Saw	76
Scarifier	83
Scraper	85
Shovel	82
Spike driver	77
Tie cutter	84
Tie handler	80
Tie inserter	85
Truck	84
Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, Table 7-1 (2018)	

Based on the equipment noise levels in Table 13, worst-case on-site project construction equipment noise levels at the nearest off-site existing noise-sensitive use located 50 feet away are expected to range from approximately 76 to 85 dB. Thus, it is possible that a portion of the project construction equipment could result in substantial short-term increases over ambient maximum noise levels at the nearest off-site existing sensitive receptors. As a result, noise impacts associated with construction activities are identified as being ***potentially significant***.

<u>Mitigation Impact 7:</u> Construction Noise Control Measures

MM 7: To the maximum extent practical, the following measures should be incorporated into the project construction operations:

- Pursuant to Section 15.01.101 of the Clayton Municipal Code, all grading and excavation, construction, demolition, renovation, and other works of improvement shall occur only between the hours of 7:00 a.m. and 5:00 p.m., Monday through Friday.

- The project shall utilize temporary construction noise control measures including the use of temporary noise barriers, or other appropriate measures as mitigation for noise generated during construction of projects.
- All noise-producing project equipment and vehicles using internal-combustion engines shall be equipped with manufacturers-recommended mufflers and be maintained in good working condition.
- All mobile or fixed noise-producing equipment used on the project site that are regulated for noise output by a federal, state, or local agency shall comply with such regulations while in the course of project activity.
- Electrically powered equipment shall be used instead of pneumatic or internal-combustion-powered equipment, where feasible.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors.
- Project area and site access road speed limits shall be established and enforced during the construction period.
- Nearby residences shall be notified of construction schedules so that arrangements can be made, if desired, to limit their exposure to short-term increases in ambient noise levels.

Significance of Impact 7 after Mitigation: *Less than Significant*

Vibration Impacts Associated with Project Activities

Impact 8: Project Construction and On-Site Operations Vibration Levels at Existing Off-Site Sensitive Receptors

During project construction, heavy equipment would be used for grading, excavation, paving, and building construction, which would generate localized vibration in the immediate vicinity of the construction. The nearest existing off-site sensitive use is a residential structure located approximately 50 feet from construction activities which would occur within the project parcel.

Table 14 includes the range of vibration levels for equipment commonly used in general construction projects at a distance of 25 feet. The Table 14 data also include predicted equipment vibration levels at the nearest existing off-site residence to the project site located approximately 50 feet away.

Table 14
Vibration Source Levels for Construction Equipment and Predicted Levels at 50 Feet

Equipment	Maximum PPV (inches/second)[1]	
	Maximum PPV at 25 Feet[2]	Predicted PPV at 50 Feet
Hoe ram	0.089	0.032
Large bulldozer	0.089	0.032
Caisson drilling	0.089	0.032
Loaded trucks	0.076	0.027
Jackhammer	0.035	0.012
Small bulldozer	0.003	0.011

1 PPV = Peak Particle Velocity
2 Reference vibration level obtained from the Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment Manual (2018).

As indicated in Table 14, vibration levels generated from on-site construction activities at the nearest existing residences are predicted to be well below the strictest Caltrans thresholds for damage to residential structures of 0.30 in/sec PPV shown in Table 2. Further, the predicted vibration levels are also below the Caltrans thresholds for annoyance presented in Table 3. Therefore, on-site construction within the project parcel would not result in excessive groundborne vibration levels at nearby existing off-site residential uses.

Results from the ambient vibration level monitoring at the project site (Table 6) indicate that measured average vibration levels were well below the strictest Caltrans thresholds for damage to structures and thresholds for annoyance. Therefore, it is expected that the project would not result in the exposure of persons to excessive groundborne vibration levels at proposed uses of the project.

The project proposes the development of a church with associated parking areas, as well as for the rehabilitation of a residential use. It is the experience of BAC these uses do not typically have equipment that generates appreciable vibration. Further, it is our understanding that the project does not propose equipment that will produce appreciable vibration.

Because vibration levels due to the proposed project will satisfy the applicable Caltrans groundborne impact vibration criteria at the nearest existing sensitive uses, this impact is identified as being ***less than significant***.

Noise Impacts Upon the Development

The California Supreme Court issued an opinion in *California Building Industry Association v. Bay Area Air Quality Management District (2015)* holding that CEQA is primarily concerned with the impacts of a project on the environment and generally does not require agencies to analyze the impact of existing conditions on a project's future users or residents. Nevertheless, the City of Clayton has policies that address existing/future conditions affecting the proposed project, which are discussed in the following section.

On-Site Traffic Noise Impacts

The project proposes the construction of a church building and rehabilitation of a residential structure on the project parcel. The following impact analyses address future traffic noise exposure at the exterior and interior areas of the future rehabilitated residential and new church uses of the project parcel.

Impact 9: Future Exterior Traffic Noise Levels at Project Residential and Church Uses

The FHWA Model was used with future traffic data to predict future Pine Hollow Court traffic noise levels at the residential and church uses of the project parcel. The future (Existing Plus Project) Sunday daily traffic (ADT) volume for the roadway was calculated using data provided in the project transportation impact analysis completed by TJKM Traffic Consultants. Specifically, the future Pine Hollow Court Sunday daily traffic volume was conservatively estimated by applying a factor of 10 to Sunday AM peak hour conditions. Based on the nature of the project, worst-case traffic noise exposure at the project site would occur during Sunday mornings for church services.

The predicted future Pine Hollow Court traffic noise levels at the project site are summarized in Table 15. Detailed FHWA Model inputs and results are provided in Appendix F.

Table 15
Predicted Future Exterior Pine Hollow Court Traffic Noise Levels at Project Site[1]

Project Site Use	Description	Distance from Roadway Centerline (feet)[2]	Future Exterior DNL (dB)[3]
Residential	Outdoor area – pool	300	39
	Building facade	260	44
Church	Outdoor area – courtyard	260	37
	Outdoor area – playground	330	43
	Building facade	130	47

[1] A complete listing of FHWA Model inputs and results are provided in Appendix F.
[2] Distances scaled using provided site plans.
[3] Predicted future traffic noise levels at the residential pool area and church courtyard include consideration of screening that would be provided by proposed and existing structures.
Source: Bollard Acoustical Consultants, Inc. (2020)

As indicated in Table 15, predicted future Pine Hollow Court traffic noise level exposure at the outdoor areas of the residential and church uses on the project parcel would satisfy the applicable Clayton General Plan exterior noise level standard of 60 dB DNL. As a result, this impact is identified as being ***less than significant***.

Impact 10: Future Interior Traffic Noise Levels at Project Residential and Church Uses

As indicated in Table 15, future worst-case exterior Pine Hollow Court traffic noise levels at the building facades of project residential and church uses are predicted to range from 44 to 47 dB DNL. To satisfy the Clayton General Plan 45 dB DNL interior noise level standard, a minimum building facade noise level reduction of 2 dB would be required.

Standard building construction (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. Therefore, standard construction would be adequate to ensure compliance with the Clayton General Plan 45 dB DNL interior noise level standard within the interior areas of project residential and church uses. However, mechanical ventilation (air conditioning) should be provided for project residential and church buildings to allow the occupants to close doors and windows as desired for additional acoustical isolation. Based on the information above, this impact is identified as being ***less than significant***.

This concludes BAC's noise and vibration assessment of the Clayton Community Church project in Clayton, California. Please contact BAC at (916) 663-0500 or dariog@bacnoise.com if you have any comments or questions regarding this report.

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.

Appendix B-1
FHWA Highway Traffic Noise Prediction Model Data Inputs
Clayton Community Church
File Name: 2020-099 01 Existing (V3)
Model Run Date: 1/28/2021

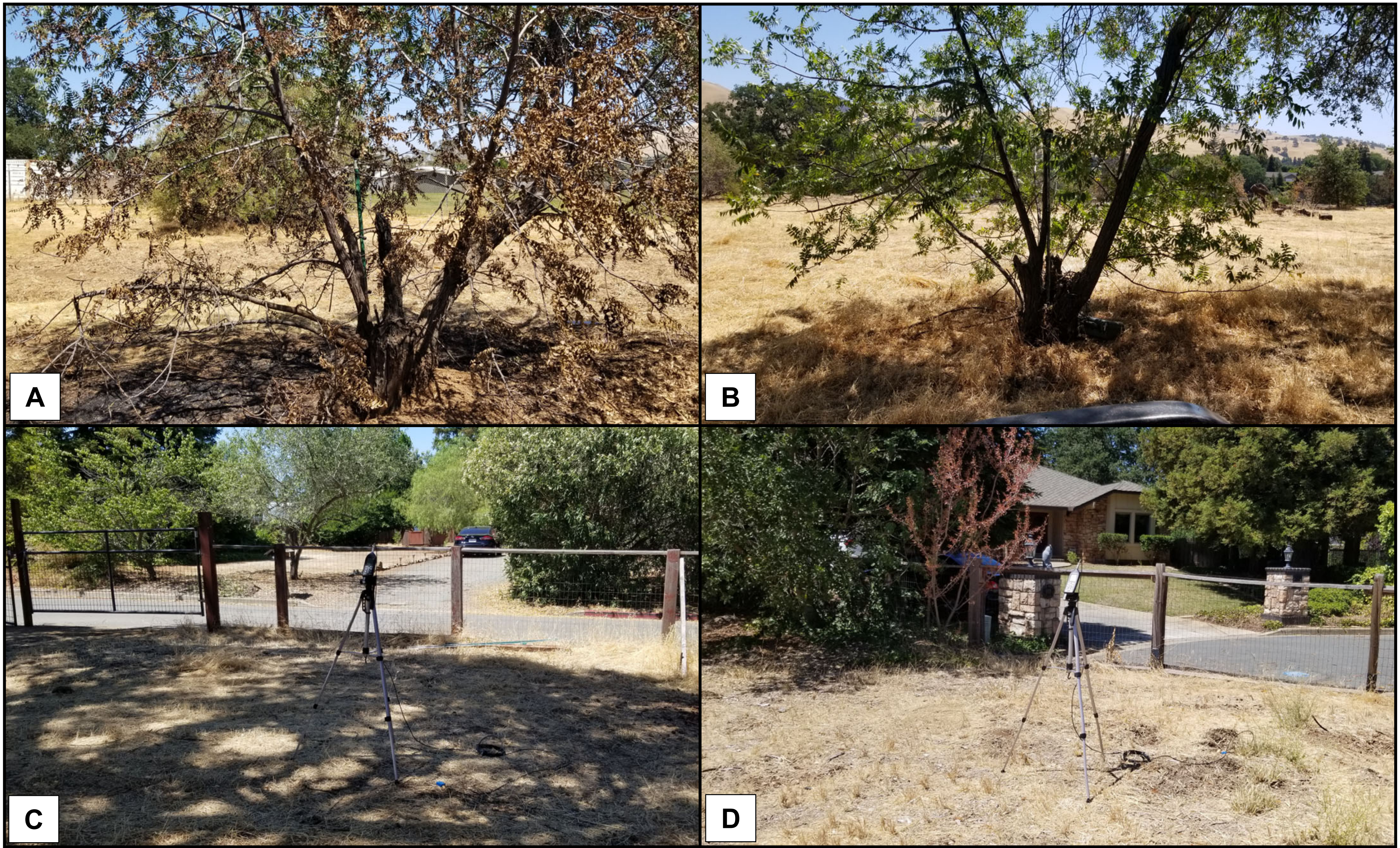
Segment	Intersection	Direction	Sunday Daily Trips	Day %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance
1	Pine Hollow Ct / Pine Hollow Rd	North							
2		South	60	99	1	2	1	25	100
3		East							
4		West	60	99	1	2	1	25	100
5	Mt. Zion Dr / Pine Hollow Rd	North	210	99	1	2	1	25	100
6		South	290	99	1	2	1	25	100
7		East	60	99	1	2	1	25	100
8		West	340	99	1	2	1	25	100
9	Mt. Zion Dr / Clayton Rd	North							
10		South	160	99	1	2	1	25	100
11		East	9,510	99	1	2	1	25	100
12		West	9,350	99	1	2	1	25	100
13	Mitchell Canyon Rd / Pine Hollow Rd	North	1,890	99	1	2	1	25	100
14		South	1,580	99	1	2	1	25	100
15		East	380	99	1	2	1	25	100
16		West	1,730	99	1	2	1	25	100
17	Mitchell Canyon Rd / Clayton Rd	North	360	99	1	2	1	25	100
18		South	2,240	99	1	2	1	25	100
19		East	9,360	99	1	2	1	40	100
20		West	9,060	99	1	2	1	40	100

Note: Blank cells represent roadways for which no traffic data was provided.

Appendix B-2
FHWA Highway Traffic Noise Prediction Model Data Inputs
Clayton Community Church
File Name: 2020-099 02 Existing+Project (V3)
Model Run Date: 1/28/2021

Segment	Intersection	Direction	Sunday Daily Trips	Day %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance
1	Pine Hollow Ct / Pine Hollow Rd	North							
2		South	1,510	99	1	2	1	25	100
3		East							
4		West	1,510	99	1	2	1	25	100
5	Mt. Zion Dr / Pine Hollow Rd	North	470	99	1	2	1	25	100
6		South	290	99	1	2	1	25	100
7		East	1,450	99	1	2	1	25	100
8		West	1,530	99	1	2	1	25	100
9	Mt. Zion Dr / Clayton Rd	North							
10		South	420	99	1	2	1	25	100
11		East	10,020	99	1	2	1	25	100
12		West	9,600	99	1	2	1	25	100
13	Mitchell Canyon Rd / Pine Hollow Rd	North	2,930	99	1	2	1	25	100
14		South	1,650	99	1	2	1	25	100
15		East	1,570	99	1	2	1	25	100
16		West	1,810	99	1	2	1	25	100
17	Mitchell Canyon Rd / Clayton Rd	North	430	99	1	2	1	25	100
18		South	3,280	99	1	2	1	25	100
19		East	9,610	99	1	2	1	40	100
20		West	9,780	99	1	2	1	40	100

Note: Blank cells represent roadways for which no traffic data was provided.



Legend

A: Site 1: Noise meter, facing north towards elementary school
B: Site 2: Noise meter, facing east towards project parcel
C: Site 2: Vibration meter, facing west towards Pine Hollow Court
D: Site 3 :Vibration meter, facing residence at end of Pine Hollow Court

Clayton Community Church
Clayton, California

Photographs of Survey Locations

Appendix C

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Appendix D-1
Ambient Noise Monitoring Results - Site 1
Clayton Community Church - Clayton, California
Wednesday, July 15, 2020

Hour	Leq	Lmax	L50	L90
12:00 AM	35	51	32	30
1:00 AM	32	46	32	30
2:00 AM	31	42	30	28
3:00 AM	34	53	31	28
4:00 AM	38	54	36	33
5:00 AM	42	56	41	35
6:00 AM	45	62	43	41
7:00 AM	47	71	43	40
8:00 AM	50	64	47	43
9:00 AM	51	68	48	44
10:00 AM	50	61	48	44
11:00 AM	51	67	49	44
12:00 PM	50	61	47	42
1:00 PM	49	62	46	42
2:00 PM	48	61	45	40
3:00 PM	51	73	46	41
4:00 PM	51	63	48	43
5:00 PM	52	64	49	43
6:00 PM	53	67	51	44
7:00 PM	52	66	49	43
8:00 PM	49	62	46	41
9:00 PM	45	60	42	38
10:00 PM	45	61	40	36
11:00 PM	43	59	38	33

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	53	45	50	45	31	41
Lmax (Maximum)	73	60	65	62	42	54
L50 (Median)	51	42	47	43	30	36
L90 (Background)	44	38	42	41	28	33

Computed DNL, dB	51
% Daytime Energy	93%
% Nighttime Energy	7%

GPS Coordinates	37°56'25.91"N 121°56'16.84"W

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Appendix D-2
Ambient Noise Monitoring Results - Site 1
Clayton Community Church - Clayton, California
Thursday, July 16, 2020

Hour	Leq	Lmax	L50	L90
12:00 AM	48	60	44	34
1:00 AM	46	58	40	32
2:00 AM	50	62	46	35
3:00 AM	49	61	45	34
4:00 AM	46	61	41	35
5:00 AM	45	59	42	37
6:00 AM	46	58	45	41
7:00 AM	49	60	46	43
8:00 AM	50	63	48	43
9:00 AM	51	65	49	44
10:00 AM	58	71	53	48
11:00 AM	53	64	51	45
12:00 PM	52	63	50	43
1:00 PM	54	71	52	45
2:00 PM	53	64	50	44
3:00 PM	54	65	52	45
4:00 PM	54	66	51	45
5:00 PM	54	66	51	44
6:00 PM	51	65	47	42
7:00 PM	52	64	49	43
8:00 PM	50	64	47	42
9:00 PM	52	62	49	43
10:00 PM	49	61	46	40
11:00 PM	43	59	38	33

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	58	49	53	50	43	47
Lmax (Maximum)	71	60	65	62	58	60
L50 (Median)	53	46	50	46	38	43
L90 (Background)	48	42	44	41	32	36

Computed DNL, dB	55
% Daytime Energy	86%
% Nighttime Energy	14%

GPS Coordinates	37°56'25.91"N 121°56'16.84"W

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Appendix D-3
Ambient Noise Monitoring Results - Site 2
Clayton Community Church - Clayton, California
Wednesday, July 15, 2020

Hour	Leq	Lmax	L50	L90
12:00 AM	33	51	30	28
1:00 AM	30	41	29	28
2:00 AM	29	43	28	27
3:00 AM	31	44	29	27
4:00 AM	35	50	32	29
5:00 AM	39	49	38	32
6:00 AM	46	64	41	37
7:00 AM	46	62	41	39
8:00 AM	43	65	42	40
9:00 AM	46	61	42	40
10:00 AM	44	62	42	40
11:00 AM	46	66	42	40
12:00 PM	42	57	41	39
1:00 PM	43	61	40	38
2:00 PM	44	58	41	38
3:00 PM	44	68	41	38
4:00 PM	43	54	43	40
5:00 PM	43	53	43	40
6:00 PM	43	61	42	40
7:00 PM	42	55	42	40
8:00 PM	42	56	41	38
9:00 PM	40	60	38	37
10:00 PM	40	61	37	35
11:00 PM	35	43	34	31

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	46	40	44	46	29	39
Lmax (Maximum)	68	53	60	64	41	50
L50 (Median)	43	38	41	41	28	33
L90 (Background)	40	37	39	37	27	31

Computed DNL, dB	46
% Daytime Energy	84%
% Nighttime Energy	16%

GPS Coordinates	37°56'25.49"N 121°56'19.32"W

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Appendix D-4
Ambient Noise Monitoring Results - Site 2
Clayton Community Church - Clayton, California
Thursday, July 16, 2020

Hour	Leq	Lmax	L50	L90
12:00 AM	36	48	34	31
1:00 AM	33	48	31	29
2:00 AM	37	52	35	32
3:00 AM	35	47	33	31
4:00 AM	35	47	34	31
5:00 AM	38	49	38	34
6:00 AM	43	55	42	38
7:00 AM	54	75	43	40
8:00 AM	43	58	42	40
9:00 AM	45	65	43	40
10:00 AM	50	63	46	43
11:00 AM	45	59	44	41
12:00 PM	44	59	42	40
1:00 PM	44	59	43	41
2:00 PM	44	62	42	40
3:00 PM	45	56	44	41
4:00 PM	47	74	44	42
5:00 PM	44	56	43	41
6:00 PM	43	62	41	39
7:00 PM	45	58	43	40
8:00 PM	45	68	43	40
9:00 PM	43	57	42	39
10:00 PM	40	56	39	36
11:00 PM	36	48	34	31

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	54	43	47	43	33	38
Lmax (Maximum)	75	56	62	56	47	50
L50 (Median)	46	41	43	42	31	35
L90 (Background)	43	39	41	38	29	33

Computed DNL, dB	47
% Daytime Energy	93%
% Nighttime Energy	7%

GPS Coordinates	37°56'25.49"N 121°56'19.32"W

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Appendix D-5
Ambient Noise Monitoring Results - Site 3
Clayton Community Church - Clayton, California
Wednesday, July 15, 2020

Hour	Leq	Lmax	L50	L90
12:00 AM	35	46	34	29
1:00 AM	27	38	26	25
2:00 AM	27	40	26	25
3:00 AM	29	41	27	25
4:00 AM	33	47	30	27
5:00 AM	36	50	35	30
6:00 AM	45	61	41	37
7:00 AM	43	63	40	37
8:00 AM	48	77	40	37
9:00 AM	44	62	39	37
10:00 AM	50	65	39	37
11:00 AM	44	65	39	37
12:00 PM	40	50	38	36
1:00 PM	40	57	38	36
2:00 PM	41	57	39	36
3:00 PM	40	51	39	37
4:00 PM	41	52	40	38
5:00 PM	42	64	41	40
6:00 PM	44	61	42	40
7:00 PM	43	56	41	39
8:00 PM	39	53	38	36
9:00 PM	39	58	36	34
10:00 PM	38	57	34	33
11:00 PM	32	40	31	29

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	50	39	44	45	27	37
Lmax (Maximum)	77	50	59	61	38	47
L50 (Median)	42	36	39	41	26	32
L90 (Background)	40	34	37	37	25	29

Computed DNL, dB	45
% Daytime Energy	88%
% Nighttime Energy	12%

GPS Coordinates	37°56'22.90"N 121°56'19.70"W

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Appendix D-6
Ambient Noise Monitoring Results - Site 3
Clayton Community Church - Clayton, California
Thursday, July 16, 2020

Hour	Leq	Lmax	L50	L90
12:00 AM	32	48	31	29
1:00 AM	31	44	29	27
2:00 AM	35	48	33	30
3:00 AM	32	42	31	29
4:00 AM	33	42	32	30
5:00 AM	37	57	34	31
6:00 AM	41	61	40	37
7:00 AM	51	76	41	39
8:00 AM	44	69	40	38
9:00 AM	50	75	40	38
10:00 AM	49	65	42	39
11:00 AM	44	74	41	39
12:00 PM	41	57	39	37
1:00 PM	43	57	41	39
2:00 PM	43	59	41	39
3:00 PM	42	57	42	39
4:00 PM	43	55	42	39
5:00 PM	45	66	43	40
6:00 PM	41	55	40	36
7:00 PM	44	63	41	39
8:00 PM	45	58	41	37
9:00 PM	40	54	39	37
10:00 PM	37	56	36	34
11:00 PM	33	46	31	29

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51	40	46	41	31	36
Lmax (Maximum)	76	54	63	61	42	49
L50 (Median)	43	39	41	40	29	33
L90 (Background)	40	36	38	37	27	31

Computed DNL, dB	46
% Daytime Energy	94%
% Nighttime Energy	6%

GPS Coordinates	37°56'22.90"N 121°56'19.70"W

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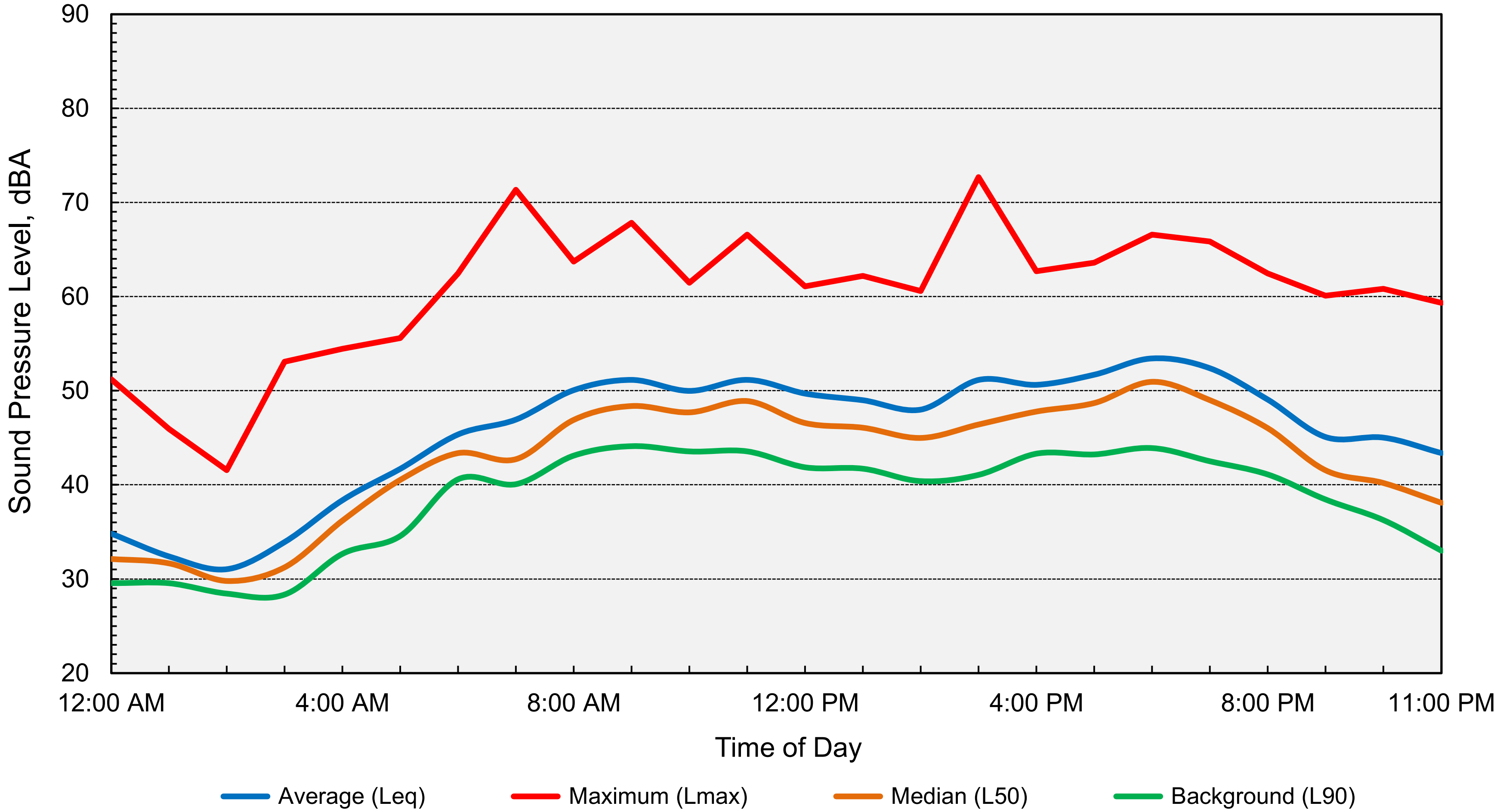
Appendix E-1
Ambient Noise Monitoring Results - Site 1
Clayton Community Church - Clayton, California
Wednesday, July 15, 2020



Computed DNL = 51 dB

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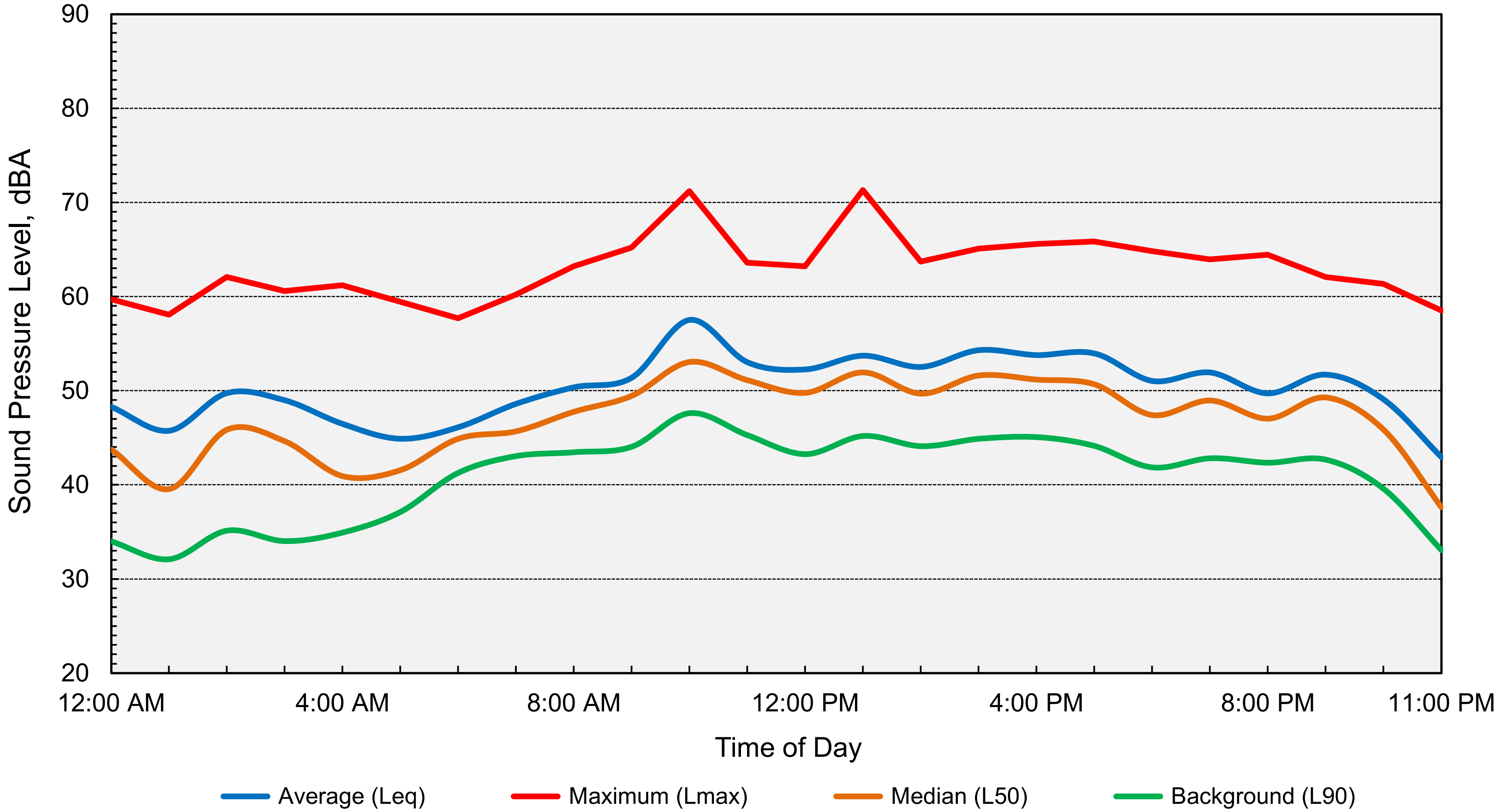
Appendix E-2
Ambient Noise Monitoring Results - Site 1
Clayton Community Church - Clayton, California
Thursday, July 16, 2020



Computed DNL = 55 dB

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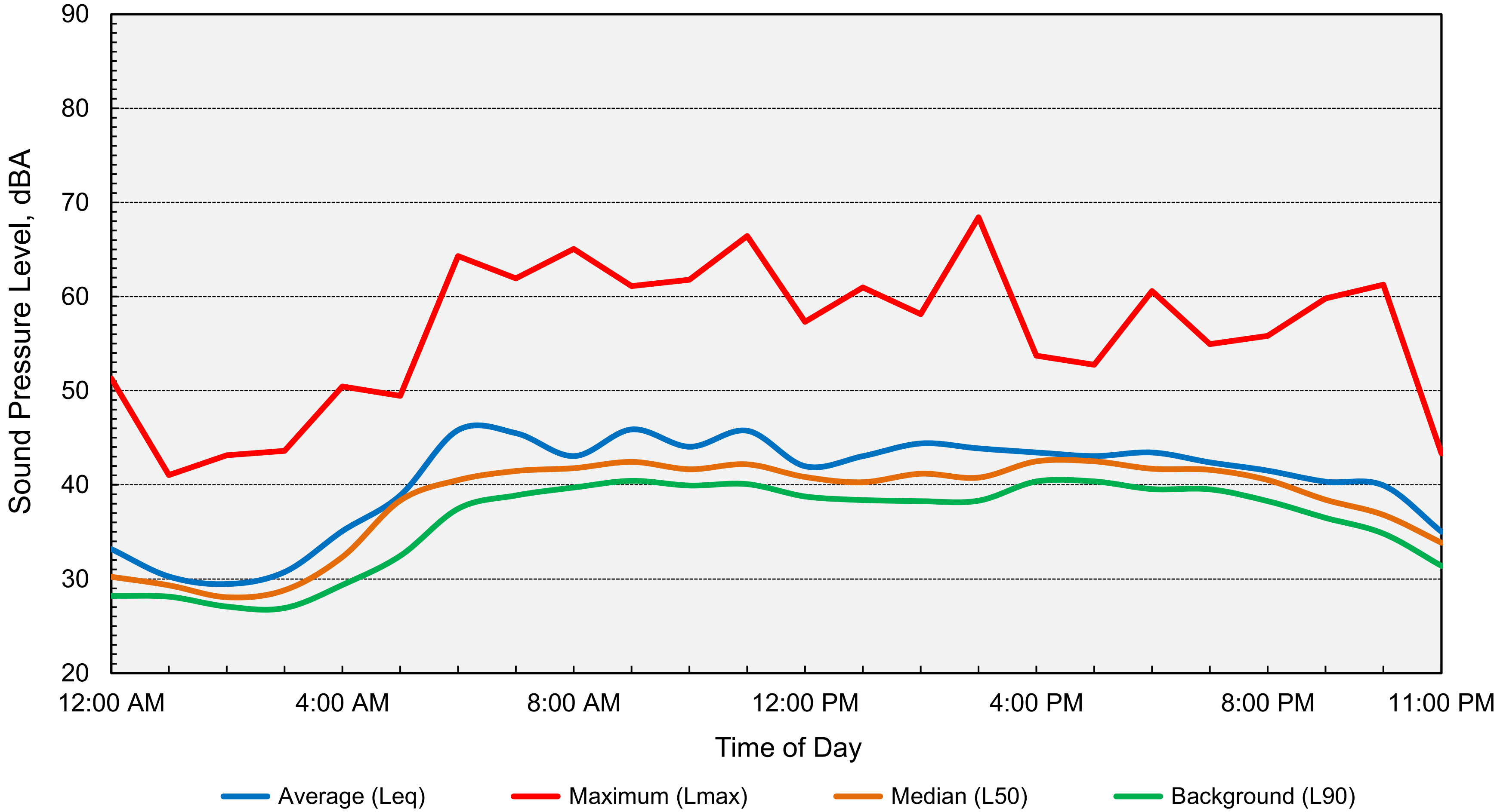
Appendix E-3
Ambient Noise Monitoring Results - Site 2
Clayton Community Church - Clayton, California
Wednesday, July 15, 2020



Computed DNL = 46 dB

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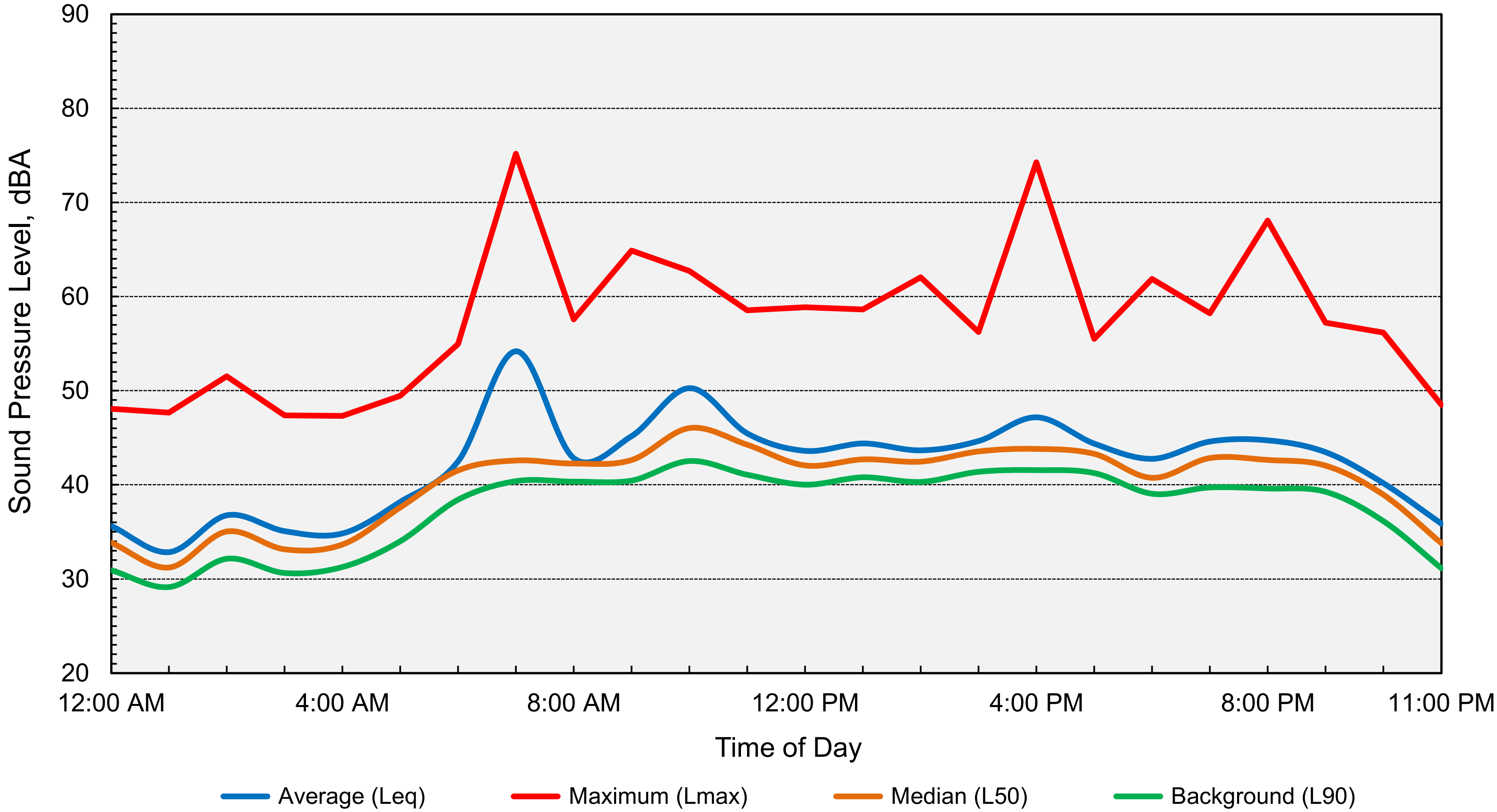
Appendix E-4
Ambient Noise Monitoring Results - Site 2
Clayton Community Church - Clayton, California
Thursday, July 16, 2020



Computed DNL = 47 dB

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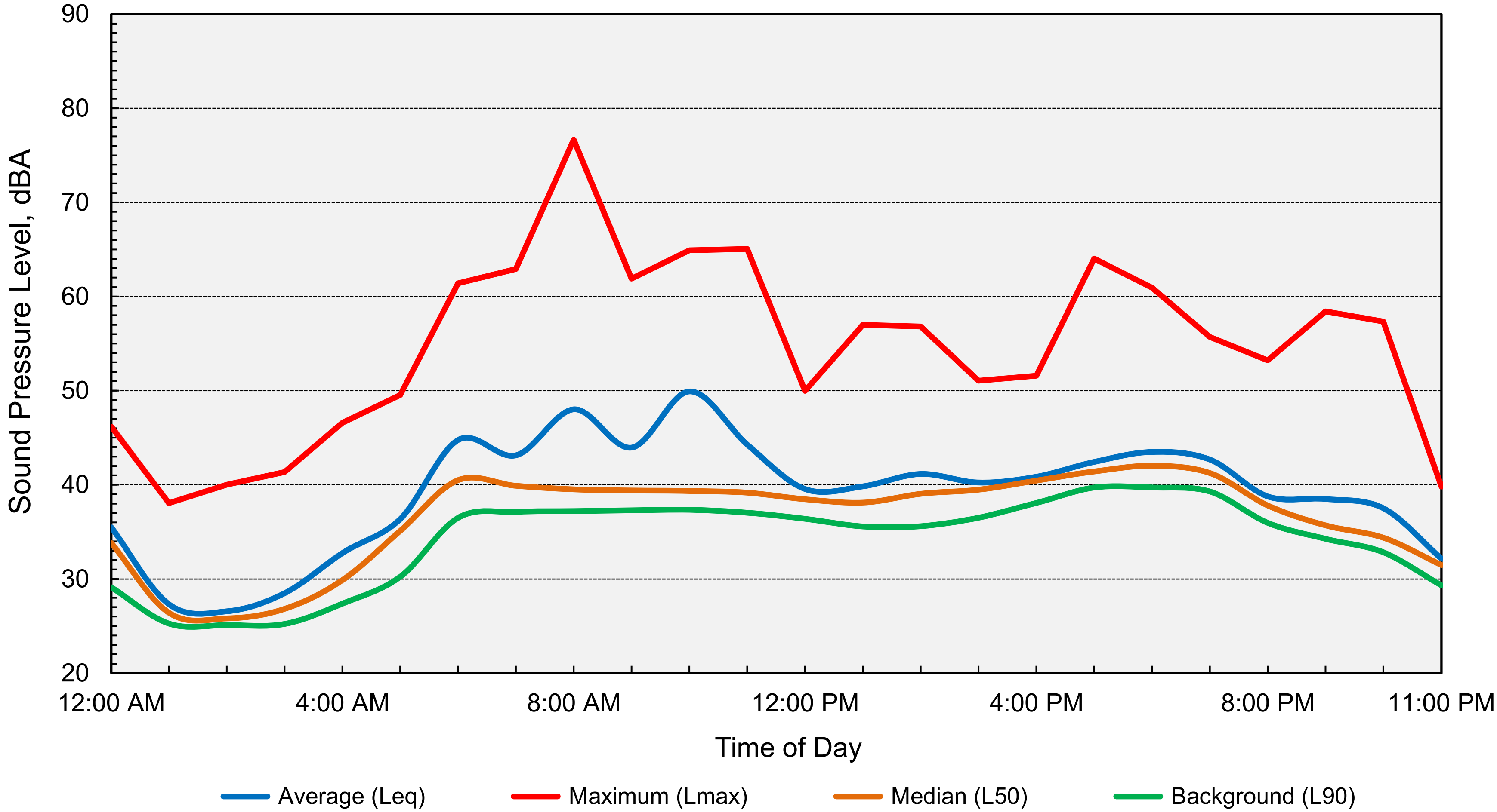
Appendix E-5
Ambient Noise Monitoring Results - Site 3
Clayton Community Church - Clayton, California
Wednesday, July 15, 2020



Computed DNL = 45 dB

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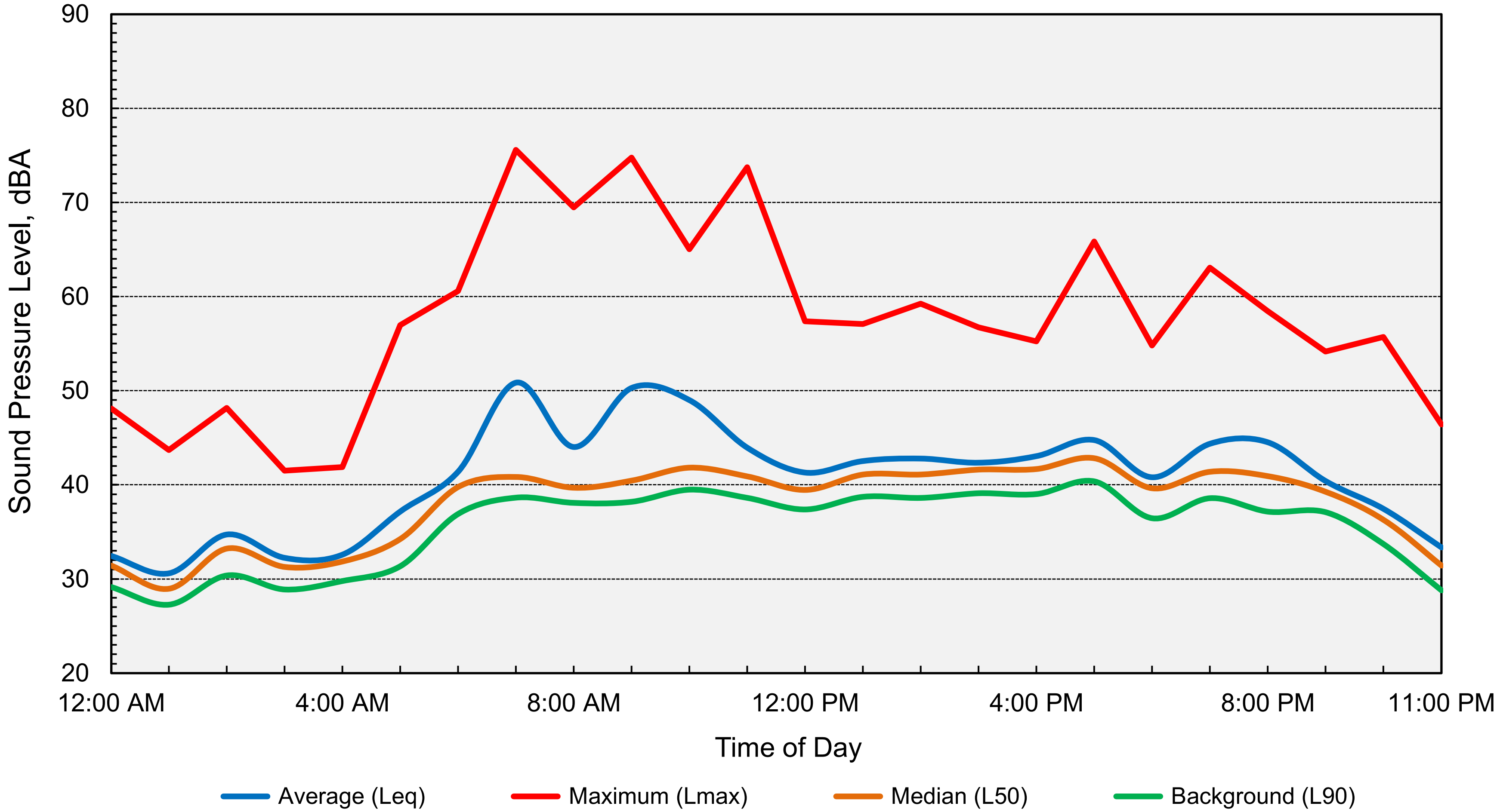
Appendix E-6
Ambient Noise Monitoring Results - Site 3
Clayton Community Church - Clayton, California
Thursday, July 16, 2020



Computed DNL = 46 dB

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Appendix F
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2020-099
Project Name: Clayton Community Church
Roadway Name: Pine Hollow Court

Traffic Data:

Year: Future
Sunday Daily Traffic Volume: 1,510
Percent Daytime Traffic: 99
Percent Nighttime Traffic: 1
Percent Medium Trucks (2 axle): 1
Percent Heavy Trucks (3+ axle): 1
Assumed Vehicle Speed (mph): 25
Intervening Ground Type (hard/soft): **Hard**

Traffic Noise Levels:

				---------------- DNL, dB	------------------		
Use	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
Residential	Outdoor area - pool	300	-5	36	27	35	39
	Building facade	260		41	33	41	44
Church	Outdoor area - courtyard	260	-7	34	26	34	37
	Outdoor area - playground	330		40	32	39	43
	Building facade	130		44	36	44	47

Traffic Noise Contours (No Calibration Offset):

DNL Contour, dB	Distance from Centerline, (ft)
75	0
70	1
65	2
60	7

Notes:

1. Future Sunday daily traffic volume (Existing Plus Project) for Pine Hollow Court was calculated by using peak hour traffic volume data obtained from the project traffic impact analysis prepared by TJKM. Future Sunday daily traffic volume was conservatively estimated by applying a factor of 10 to sum of Sunday AM peak hour conditions.
2. Negative offsets were applied at the residential pool area and church courtyard to account for screening of the roadway that would be provided by proposed and existing structures.