BASELINE
ENVIRONMENTAL CONSULTING

MEMORANDUM

Date: 3 December, 2020

To: Geoff Reilly, Senior Associate Environmental Planner, WRA, Inc.

From: Lisa Luo, Environmental Engineer II, Baseline Environmental Consulting

Subject: Noise and Vibration Technical Study, Petaluma Station, Petaluma, California.

This noise and vibration technical study evaluates the noise and vibration impacts associated with implementation of the Petaluma Station Project (proposed project) located at 315 East D Street in Petaluma, California. This study will be used to support environmental review of the proposed project under the California Environmental Quality Act (CEQA). The project sponsor proposes to construct 402 multifamily residential units and approximately 5,129 square feet of retail space in two buildings, with parking spaces located in two garage structures located in the interior portion of each building. The proposed project also includes the upsizing of the outfall from Weller Street to the Turning Basin of the Petaluma River. This technical memorandum first identifies the existing noise setting for the project and then provides the noise and vibration analysis for the construction and operation of the project.

EXISTING SETTING

Regulatory Criteria

Building Code

The 2019 California Building Standards Code specifies interior noise levels for both residential and nonresidential uses during operation. Specifically, it specifies that interior noise levels attributable to exterior sources shall not exceed 45 dBA L_{dn} in any habitable room (e.g., residential homes for living, sleeping, eating, or cooking).[1] The noise metric used (either L_{dn} or CNEL) shall be consistent with the noise element of the local general plan.[2] The 2019 California Building Standards Code also specifies that buildings containing non-residential uses (e.g., retail spaces and offices) that are exposed to exterior noise levels at or above 65 dBA L_{eq} or CNEL shall maintain interior noise level below 50 dBA L_{eq} in occupied areas during any hour of operation.[3] The buildings are required to comply with this interior sound level by either a prescriptive or performance method. A prescriptive method requires the use of building assemblies and components with appropriate Sound Transmission Class (STC) values and Outdoor-Indoor

[1] Habitable space is a space in a building for living, sleeping, eating or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces and similar areas are not considered habitable spaces.

[2] California Code of Regulations (CCR), Title 24, Part 2, Vol. 1, Section 1206.4.

[3] California Code of Regulations (CCR), Title 24, Part 11, Section 5.507.

Sound Transmissions Class (OITC) values. A performance method requires an acoustical analysis documenting compliance with this interior sound level to be prepared by personnel approved by the architect or engineer of record before construction of the building.

City of Petaluma General Plan 2025

The Health and Safety Element of the City of Petaluma General Plan 2025 contains the following policies and programs that are applicable to the proposed project:

10-P-3 Protect public health and welfare by eliminating or minimizing the effects of existing noise problems, and by minimizing the increase of noise levels in the future.

A. (…)

B. Discourage location of new noise-sensitive uses, primarily homes, in areas with projected noise levels greater than 65 dB CNEL. Where such uses are permitted, require incorporation of mitigation measures to ensure that interior noise levels do not exceed 45 dB CNEL.

C. Ensure that the City's Noise Ordinance and other regulations:

- Require that applicants for new noise-sensitive development in areas subject to noise levels greater than 65 dB CNEL obtain the services of a professional acoustical engineer to provide a technical analysis and design of mitigation measures.

- Require placement of fixed equipment, such as air conditioning units and condensers, inside or in the walls of new buildings or on roof-tops of central units in order to reduce noise impacts on any nearby sensitive receptors.

- (…)

D. Continue to require control of noise or mitigation measures for any noise-emitting construction equipment or activity.

   The City's Noise Ordinance establishes controls on construction-related noise.

E. As part of development review, use Figure 10-2: Land Use Compatibility Standards to determine acceptable uses and installation requirements in noise-impacted areas.

F. (…)

G. In making a determination of impact under the California Environmental Quality Act (CEQA), consider an increase of four or more dBA to be "significant" if the resulting noise level would exceed that described as normally acceptable for the affected land use in Figure 10-2: Land Use Compatibility Standards.

Figure 10-2 in the Petaluma General Plan, Land Use Compatibility Standards, establishes compatibility standards that are used to determine land use compatibility with the City's noise environment for proposed projects. The guidelines for multifamily residential are summarized in Table 1 below.

Table 1: Community Noise Exposure (Ldn or CNEL, dB) Levels

Compatibility	Residential – Low Density Single Family	Residential-Multifamily	Playgrounds, Neighborhood Parks
Normally acceptable	<60	<65	<70
Conditionally acceptable	55-70	60-70	67.5-75
Normally unacceptable	70-75	70-75	NA
Clearly unacceptable	>75	>75	>72.5

Note:
NA-Not available.
"Normally acceptable" = Specified land use is satisfactory, based upon the assumption that any building involved is of normal conventional construction, without any special noise insulation requirements.
"Conditionally Acceptable" = New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.
"Normally unacceptable" = New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
"Clearly unacceptable" = New construction or development should generally not be undertaken.
Source: Petaluma, 2008. City of Petaluma General Plan 2025. Adopted May 2008. Revised January 11, 2012.

City of Petaluma Noise Ordinance

The City of Petaluma has established regulations in Chapter 21 Performance Standards of the Zoning Code. Section 21.040 prohibits construction, demolition, excavation, erection, alteration or repair activity before 7:00 a.m. or after 10:00 p.m. daily (except Saturday, Sunday and State, Federal or Local Holidays, when the prohibited time shall be before 9:00 a.m. and after 10:00 p.m.).

Section 21.040 also establishes maximum exterior noise exposure levels as summarized in Table 2 below.

Table 2: Maximum Exterior Noise Exposure (Leq, dBA)

Compatibility	Time: 10 p.m. to 7 a.m. M-F; 10 p.m. to 8 a.m. Sat, Sun, and Holidays	Time: 7 a.m. to 10 p.m. M-F; 8 a.m. to 10 p.m. Sat, Sun, and Holidays
General Plan Ambient	60	60
Cumulative period of 15 minutes or more in one hour	65	70
Cumulative period of 5 minutes or more in one hour	70	75
Cumulative period of 1 minute or more in one hour	75	80

Notes:
1. If the measured ambient level is greater than 60dB, the Maximum Noise Exposure standard shall be adjusted in 5dB increments for each time period as appropriate to encompass or reflect the measured ambient noise level. In no case shall the maximum allowed threshold exceed 75dB after adjustments are made.
2. In the event the measured ambient noise level is 70dB or greater, the maximum allowable noise level shall be increased to reflect the maximum ambient noise level. In this case, adjustments for loudness and time as contained in Table 2 shall not be permitted.
3. No person shall cause or allow to cause, any source of sound at any location within the incorporated City or allow the creation of any noise on property owned, leased, occupied or otherwise controlled by such person, which when measured on the property where the noise disturbance is being experienced within public or private open/outdoor spaces, exceeds the noise level of Table 2.
Source: City of Petaluma Zoning Code. Chapter 21 Performance Standards. Section 21.040. Dangerous and Objectionable Elements.

Exemptions from the maximum exterior noise exposure level standards are:

a. Aerial warning devices which are required by law to protect the health, safety and welfare of the community shall be exempt from the provisions of this chapter.

b. Emergency vehicle responses and all necessary equipment utilized for the purpose of responding to a declared state of emergency are exempt from this chapter.

c. Airport, river operations that significantly contribute to commercial and industrial tonnage figures on the Petaluma River, and railroad operations.

d. The operation of garbage collection and other municipal or utility vehicles.

e. Uses established through the discretionary review process containing specific noise conditions of approval and/or mitigation measures.

In addition, the Noise Control Officer is authorized to grant exceptions from any provision of Chapter 21, subject to limitations of proximity to noise sensitive uses, noise levels, time limits and other terms and conditions as the Noise Control Officer determines are appropriate to protect the public health, safety and welfare from the noise emanating therefrom.

Section 21.040 prohibits vibrations in excess of approximately 80 VdB and single impulse periodic vibrations with an average interval greater than 5 minutes of approximately 87 VdB.[4]

Ambient Noise Environment

The primary sources of noise in the vicinity of the project site are traffic on major roadways and operation of the Sonoma-Marin Area Rail Transit (SMART). Roadway noise sources are: 1) traffic on Lakeville Street, which runs southeast to northwest located 170 feet northeast of the project site and 2) traffic on E Washington Street, which runs southwest to northeast adjacent to the northwestern border of the project site. Based on the 2025 roadway contours in the Petaluma General Plan 2025 Draft Environmental Impact Report, traffic on major roadways generate noise levels of approximately 60 to 65 dBA CNEL at the project site.[5] According to an environmental assessment for the SMART trains, operation of the trains without horns could generate noise levels of 52 to 57 dBA Ldn at the project site, while operation of the trains with horns could generate noise levels of 72 to 77 dBA Ldn at the project site.[6] The combination of roadway noise and operation of the SMART could result in ambient noise levels of 60 to 77 dBA CNEL at the project site.

Sensitive Receptors

Some land uses are considered more sensitive to ambient noise levels than others because of the amount of noise exposure (in terms of both exposure duration and insulation from noise) and the types of activities typically involved for those uses. City of Petaluma General Plan 2025 defines noise-sensitive uses as residences, schools, churches, and hospitals.[7]

There are potential sensitive receptors located both on-site and off-site. According to the zoning map, the closest off-site noise-sensitive uses are low density residential homes located about 435 feet to the northeast of the project site.[8] As the construction of the proposed project would occur in two phases, there would be on-site receptors on the project site during

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[4] Section 21.040 of the Zoning Code prohibits vibrations in excess of 0.002 g at 50 cycles per second and single impulse periodic vibrations with an average interval greater than 5 minutes of 0.01g at 50 cycles per second. Based on the Petaluma General Plan 2025 Draft Environmental Impact Report, 0.002 g at 50 cycles per second is about 80 VdB and 0.01 g at 50 cycles per second is about 87 VdB.

[5] City of Petaluma, 2006. Petaluma General Plan 2025 Draft Environmental Impact Report. September.

[6] SMART, 2014. Downtown San Rafael to Larkspur Extension Environmental Assessment. December. Operation of the trains without horns could generate noise levels of 61.8 dBA Ldn at 50 feet from track centerline, while operation of the trains with horns could generate noise levels of 82 dBA Ldn at 50 feet from track centerline. The northeastern boundary of the project site is about 150 feet from the track centerline while the southwestern boundary of the project site is about 450 feet from the track centerline.

[7] City of Petaluma, 2008. City of Petaluma General Plan 2025. May. Revised January 11, 2012.

[8] City of Petaluma, 2020. Zoning. Website: https://xara1-4.cityofpetaluma.net/jsviewers/zoning/. Accessed: July 2.

construction of the later phase of the proposed project. Consistent with the Air Quality and Greenhouse Gas Technical Study, it is assumed that the South Building would be constructed during the first phase and the North Building would be constructed during the second phase. On-site noise-sensitive receptors are future occupants of multifamily residential units in the South Building during construction of the North Building. The project assumes that construction will last a total of 33 months and tenants will begin moving into the South Building in the 26th month of construction. The two proposed buildings are located about 80 feet from each other.

According to the Federal Transit Administration (FTA), residences are considered vibration-sensitive receptors. In addition, extreme vibration could also cause minor cosmetic or substantial building damage. Historic buildings could be more susceptible to vibration depending on the condition of the building. The train depot is a historic building that is located about 65 feet to the northeast of the project site. The River House building at 222 Weller Street is also a historic building that is located about 400 feet from the project site. Additionally, two buildings, an office building at 226 Weller Street and the River House, are located about 35 feet from where the upsizing of the outfall from Weller Street to the Turning Basin of the Petaluma River would occur.

TECHNICAL ANALYSIS

Significance Criteria

Construction Noise Criteria

Consistent with Petaluma General Plan 2025 Draft Environmental Impact Report, a significant impact would occur if construction activities have the potential to result in noise levels above 60 dBA for low density single family residential land use or 65 dBA for multifamily residential land use (the Normally Acceptable Limit identified in Table 1).

Construction Vibration Criteria

Section 21.040 of the Zoning Code prohibits vibrations in excess of approximately 80 VdB and single impulse periodic vibrations with an average interval greater than 5 minutes of approximately 87 VdB.[9]

Table 3 summarizes the vibration criteria to prevent disturbance of residences adjacent to the project site. In this analysis, the “infrequent events” criterion (80 VdB) is applied for construction equipment, which is consistent with the Zoning Code. Table 4 summarizes the

[9] Section 21.040 of the Zoning Code prohibits vibrations in excess of 0.002 g at 50 cycles per second and single impulse periodic vibrations with an average interval greater than 5 minutes of 0.01g at 50 cycles per second. Based on the Petaluma General Plan 2025 Draft Environmental Impact Report, 0.002 g at 50 cycles per second is about 80 VdB and 0.01 g at 50 cycles per second is about 87 VdB.

vibration criteria to prevent damage to structures. The vibration criterion of 0.12 in/sec for buildings extremely susceptible to vibration damage is selected to represent the historic buildings adjacent to and near the project site, including the train depot and the River House. The vibration criterion of 0.3 in/sec for buildings with engineered concrete and masonry (no plaster) is selected to represent other buildings adjacent to and near the project site.

Table 3: Vibration Criteria to Prevent Disturbance – RMS (VdB)

Land Use Category	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Residences and buildings where people normally sleep	72	75	80

a More than 70 vibration events of the same kind per day or vibration generated by a long freight train.
b Between 30 and 70 vibration events of the same kind per day.
c Fewer than 30 vibration events of the same kind per day.
Source: Federal Transit Administration, 2018. Transit Noise and Vibration Impact Assessment Manual. FTA Report No.0123. September.

Table 4: Vibration Criteria to Prevent Damage to Structures

Building Category	PPV (in/sec)	RMS (VdB)
Reinforced-concrete, steel or timber (no plaster)	0.5	102
Engineered concrete and masonry (no plaster)	0.3	98
Non-engineered timber and masonry buildings	0.2	94
Buildings extremely susceptible to vibration damage	0.12	90

Source: Federal Transit Administration, 2018. Transit Noise and Vibration Impact Assessment Manual. FTA Report No.0123. September.

Operational Noise Criteria

A significant impact would occur if the proposed project would permanently increase ambient noise levels 4 dBA or more beyond acceptable standards for noise-sensitive land uses (i.e. residences, schools, churches, and hospitals).

Land Use Compatibility Criteria

A significant impact would occur if the proposed project would expose new residential uses to exterior noise levels greater than 65 dB CNEL and interior noise levels greater than 45 dB CNEL; or if the proposed project would expose new non-residential uses (e.g., retail spaces and offices) to exterior noise levels above 65 dBA CNEL and interior noise levels greater than 50 dBA Leq in occupied areas during any hour of operation.

A significant impact would also occur if the proposed project would expose the potential public park in between the two proposed buildings to exterior noise levels greater than 75 dB CNEL (the Conditionally Acceptable Limit identified in Table 1).

Analysis

Construction Noise

Noise from Construction Equipment

The primary noise impacts from construction of the proposed project would occur from noise generated by the operation of construction equipment on the project site.

Construction activities would temporarily increase noise levels in the vicinity of the project site. Construction noise levels would vary from day-to-day, depending on the number and condition of the equipment being used, the types and duration of activity being performed, the distance between the noise source and the receptor, and the presence or absence of barriers, if any, between the noise source and receptor. Piles would be installed with drilled methods (e.g. stone pile installations or torque down piles), which would generate noise levels similar to an auger drill.[10]

The assumptions regarding the types of construction equipment that would be used on the project site are based on the California Emissions Estimator Model (CalEEMod) equipment list (see Appendix A of the Air Quality Technical Study). Table 5 shows typical noise levels associated with various types of construction equipment that may be used at the project site. To evaluate potential construction noise impacts associated with the proposed project, this analysis quantified the noise levels that would result from the simultaneous operation of the two noisiest pieces of equipment expected to be used during each construction phase (this is a standard analytical approach used in acoustical analysis to estimate construction noise levels).[11] Table 5 also presents the estimated construction noise at the closest on-site noise-sensitive receptors (future occupants of multifamily residential units in the South Building) located about 80 feet from the North Building, and the closest off-site noise-sensitive receptors (single family homes) located about 435 feet to the northeast of the project site.

[10] Heinrich Michael, Principal, AO Architects, E-mail correspondence with Yilin Tian, Baseline Environmental Consulting, November 20, 2020.

[11] Federal Transit Administration (FTA), 2018. Transit Noise and Vibration Impact Assessment Manual, FTA Report No.0123, September.

Table 5: Reference Noise Levels and Calculated Noise Levels, dBA

Construction Phase	Equipment	Reference Noise Levels at 50 Feet	Noise Levels from the Two Noisiest Pieces of Equipment	Calculated Noise Levels at the Nearest On-site Residences[1]	Calculated Noise Levels at the Nearest Off-site Residences[1]
Site Preparation	Auger Drill Rig	85	88	84	69
Site Preparation	Rubber Tired Dozers	85			
Site Preparation	Tractors/Loaders/Backhoes	84			
Grading	Excavators	85	88	84	69
Grading	Graders	85			
Grading	Rubber Tired Dozers	85			
Grading	Tractors/Loaders/Backhoes	84			
Grading	Cranes	85			
Building Construction	Cranes	85	88	84	69
Building Construction	Forklifts	NA			
Building Construction	Generator Sets	82			
Building Construction	Tractors/Loaders/Backhoes	84			
Building Construction	Welders	73			
Paving	Cement and Mortar Mixers	85	88	84	69
Paving	Pavers	85			
Paving	Paving Equipment	85			
Paving	Rollers	85			
Paving	Tractors/Loaders/Backhoes	84			
Architectural Coating	Air Compressors	80	80	76	61

Notes: NA- Not Available. Forklifts are relatively small construction equipment that does not generate high noise levels and therefore their noise levels are not available. It is assumed that site preparation, which may include the use of an auger drill rig, would be completed before the construction of the two proposed buildings.

1. Noise levels are calculated based on the following equations:

   Dba2=dba1+10*log10(D1/D2)^2
   Where:
   Dba1 is the reference noise level at a specified distance
   Dba2 is the calculated noise level
   D1 is the reference distance, 50 feet
   D2 is the distance from the equipment to the receiver, 435 feet

Source: Federal Transit Administration, 2018. Transit Noise and Vibration Impact Assessment Manual. FTA Report No.0123. September.

As shown in Table 5, construction activities have the potential to result in noise levels above the 60-dBA standard for low density single family residential land use and the 65-dBA standard for multifamily residential land use. However, construction activities would be required to comply with Section 21.040 of the Zoning Code, which restricts the hours of operation to between 7:00 a.m. and 10:00 p.m. Monday through Friday and between 9:00 a.m. and 10:00 p.m. on Saturdays, Sundays, and holidays. This requirement would prevent the disturbance of sleep for the neighboring and on-site residences.

Noise from Increased Traffic Flow

During construction, secondary sources of noise would include increased traffic flow from the transport of workers, equipment, and materials to the project site. As a worst-case assumption, construction of the project could generate up to 593 truck trips during grading. These truck trips could generate noise levels of up to approximately 52.9 dBA Leq during grading.[12] Therefore, noise from increased traffic flow would not have the potential to result in noise levels above the 60-dBA standard for low density single family residential land use.

Construction Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Several different methods are used to quantify vibration. Typically, groundborne vibration generated by human activities attenuates rapidly with distance from the source of the vibration. Sensitive receptors to vibration include structures (especially older masonry structures), people (especially residents, the elderly, and sick), and vibration-sensitive equipment. Vibration amplitudes are usually expressed as either Peak Particle Velocity (PPV) or as Root Mean Square (RMS) velocity. PPV is appropriate for evaluating potential damage to buildings, but it is not suitable for evaluating human response to vibration because it takes the human body time to respond to vibration signals. The response of the human body to vibration is dependent on the average amplitude of a vibration event. Thus, RMS is more appropriate for evaluating human response to vibration. PPV is normally described in units of inches per second (in/sec), and RMS is often described in vibration decibel (VdB).

Construction activities can result in varying degrees of ground vibration, depending on the equipment, activity, and soil conditions. The reference vibration levels at 25 feet away from the construction equipment that could be used at the project site are summarized in Table 6. Although the table provides one vibration level for each piece of equipment, it should be noted that there is considerable variation in reported ground vibration levels from construction

[12] Numbers of truck trips and duration are based on the California Emissions Model (CalEEMod) (see Appendix A of the Air Quality Technical Study). Traffic noise model outputs are included in Appendix A. FHWA TNM Version 2.5 model was used for these results.

activities, primarily due to variation in soil characteristics. Table 6 also shows the buffer distance that would be required to reduce vibration levels to below the Federal Transit Administration (FTA) thresholds for disturbance and building damage.

Table 6: Reference Source Levels for Construction Equipment and the Associated Buffer Distances Required to Prevent Exceedance of FTA Thresholds

Equipment	At 25 Feet		Required Buffer Distance from Source		
	PPV (in/sec)	RMS (VdB)	Building Damage Threshold 0.12 PPV (Feet)	Building Damage Threshold 0.3 PPV (Feet)	Human Annoyance Threshold 80 VdB (Residences) (Feet)
Vibratory Roller	0.21	94	36	20	73
Caisson Drilling	0.089	87	20	11	43
Large Bulldozer	0.089	87	20	11	43
Loaded Trucks	0.076	86	18	10	40
Small Bulldozer	0.003	58	2	1	5

Notes: It is assumed that site preparation, which may include the use of an auger drill rig, would be completed before the construction of the two proposed buildings. The vibration level from an auger drill rig is similar to caisson drilling. Based on vibration levels at 25 feet, the following propagation adjustment was applied to estimate buffer distance required to reduce vibration levels at a receptor to 0.12 in/sec PPV and 0.3 in/sec PPV:

PPV2 = PPV1 x (D1/D2)^1.5

Where: PPV1 is the reference vibration level at a specified distance.
PPV2 is the calculated vibration level.
D1 is the reference distance (in this case 25 feet).
D2 is the distance from the equipment to the receiver.

Based on vibration levels at 25 feet, the following propagation adjustment (FTA, 2018) was applied to estimate buffer distance required to reduce RMS vibration levels at a receptor to 80 VdB (residential receptor).

RMS2 = RMS1 – 30 Log10 (D2/D1)

Where: RMS1is the reference vibration level at a specified distance.
RMS2 is the calculated vibration level.
D1 is the reference distance (in this case 25 feet).
D2 is the distance from the equipment to the receiver.

Source: PPV and RMS vibration levels at 25 feet from the FTA (2018) Transit Noise and Vibration Impact Assessment.

According to Table 6, the construction equipment that would generate the highest vibration levels is a vibratory roller. As discussed above, the closest off-site residences are located approximately 435 feet to the northeast of the project site boundary. The on-site receptors are future occupants of multifamily residential units in the South Building, which is about 80 feet from the North Building where construction could occur. The closest off-site residences and on-site receptors would be located outside of the 73-foot buffer distance where a vibratory roller could exceed the 80-VdB threshold. Therefore, construction activities would not generate vibration with the potential to disturb adjacent and on-site residences.

A large bulldozer could generate the highest vibration level for upsizing the outfall from Weller Street to the Turning Basin of the Petaluma River.[13] The River House at 222 Weller Street would be located outside of the 20-foot buffer where a large bulldozer could exceed the 0.12 in/sec PPV threshold. The office building at 226 Weller Street would be located outside the 11-foot buffer where a large bulldozer could exceed the 0.3 in/sec PPV threshold. A vibratory roller could generate the highest vibration level for construction on the project site. The train depot would be located outside of the 36-foot buffer where a vibratory roller could exceed the 0.12 in/sec PPV threshold and all of the structures surrounding the project site would be located outside of the 20-foot buffer where a vibratory roller could exceed the 0.3 in/sec PPV threshold. Therefore, construction activities would not generate vibration with the potential to damage adjacent buildings.

Operational Noise

Heating, Ventilation, and Air Conditioning (HVAC) Systems

The proposed project could involve the installation of heating, ventilation, and air conditioning (HVAC) systems. Information regarding the noise-generating characteristics and locations of the equipment was not available at the time this analysis was conducted. Noise from typical commercial-scale HVAC system units can range from approximately 65 dBA to 75 dBA at 50 feet. Because noise levels at a known distance from point sources (e.g., HVAC systems) are reduced by 6 dBA for every doubling of that distance over hard surfaces,[14] a typical commercial-scale HVAC system unit could generate noise of about 47 dBA to 57 dBA at the closest off-site noise-sensitive uses, located about 435 feet to the northeast of the project site. Therefore, noise from a typical commercial-scale HVAC system unit is anticipated to comply with the operational standards set forth in the Zoning Code in Table 2.

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[13] Equipment that could be used for upsizing the outfall include: dozers, excavators, graders, pipelayers, and loaders. Because an excavator is an earth moving machinery, the vibration level is estimated to be similar to a large bulldozer. The vibration levels created by the normal movement of vehicle, including graders and loaders are of the same order-of-magnitude as the ground-borne vibration created by heavy vehicles traveling on streets and highways. Therefore, vibration levels from these equipment are estimated to be similar to loaded trucks. There is no established vibration level for a pipelayer. This analysis assumes that a pipelayer would not generate a vibration level exceeding a large bulldozer.

[14] Caltrans, 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol. September.

In addition, General Plan Policy 10-P-3.C requires placement of fixed equipment, such as air conditioning units and condensers, inside or in the walls of new buildings or on roof-tops of central units in order to reduce noise impacts on any nearby sensitive receptors. Controls that would typically be incorporated to attain this outcome include locating equipment in less noise-sensitive areas, when feasible; selecting quiet equipment; and providing sound attenuators on fans, acoustical screen walls, and equipment enclosures. Compliance with the Zoning Code and General Plan Policy 10-P-3.C, which is required by law and will be enforced by the City, would ensure that appropriate noise controls on HVAC equipment are applied and would ensure the compliance with the operational standards set forth in the Zoning Code in Table 2.

Traffic-Generated Noise

The proposed project could increase vehicle-trip generation during operation. In this analysis, a significant noise impact would be identified if the proposed project would increase traffic noise levels by more than 4 dBA.

The assessment of the AM and PM peak hour traffic volumes at 12 intersections in the vicinity of the project site indicates that traffic volumes increase would range from approximately 0 to 33 percent. The highest traffic volume increase of 33 percent would occur along East D Street between Copeland Street and Lakeville Street during the AM peak hour. The predicted existing and existing plus project traffic noise levels for this roadway segment are summarized in Table 7 below. Traffic noise is expected to increase by about 1.2 dB along this roadway segment. As this segment would have the greatest predicted increase in traffic, traffic noise increase along other roadway segments affected by the proposed project would be less than 1.2 dB. This is below the 4-dBA significance threshold for project-generated traffic noise. Consequently, the implementation of the proposed project would not result in a significant increase in traffic noise along local area roadways.

Under a cumulative scenario, which considers traffic generated by past, present, and probable future projects, including the proposed project, the assessment of AM and PM peak hour traffic volumes at 12 intersections in the vicinity of the project site indicates that the most impacted locations (those with the highest traffic noise increase that exceed 4 dB) would occur along:

- Caulfield Lane between Lakeville Street and Hopper Street during AM peak hour
- Caulfield Lane between Lakeville Street and Hopper Street during PM peak hour

Table 7: Existing and Existing Plus Project Peak-Hour Traffic Noise Levels For The Roadway Segment With Highest Increase, Dba Leq At 50 Feet

Roadway Segment	Existing Traffic Noise Levels[a]	Existing Plus Project Traffic Noise Levels[a]	Estimated Increase in Noise[b]
East D Street between Copeland Street and Lakeville Street (AM peak hour)	56.0	57.2	1.2

Notes:
a. Noise levels were determined using FHWA TNM Version 2.5 model. Traffic noise model outputs are included in Appendix A. Road center to receptor distance is approximately 50 feet. The analysis assumed 100 percent automobile under the existing condition and the existing project condition for this roadway segment. Traffic speeds were set at 30 mph.
b. Considered significant if the incremental increase in noise from traffic is greater than the existing noise level by 4 dBA Leq.
Source: Fehr & Peers, 2020.

As cumulative noise increase of more than 4 dB is anticipated to occur along each of these roadway segments above, a significant cumulative noise increase is anticipated to occur along each of these roadway segments. As indicated in Table 8, the contribution from the proposed project to the significant cumulative noise increase is below the 4-dBA Leq cumulative contribution significant threshold for each of the roadway segments. Consequently, the contribution of the proposed project to the significant cumulative traffic noise increase is less than cumulatively considerable.

Exterior Noise Levels Exposure

The combination of roadway noise and operation of the SMART could result in ambient noise levels of 60 to 77 dBA CNEL at the project site. Therefore, a significant impact could occur because the proposed project could expose new noise-sensitive uses to exterior noise levels greater than 65 dB CNEL.

General Plan Policy 10-P-3.B requires incorporation of mitigation measures to ensure that interior noise levels do not exceed 45 dB CNEL in areas with projected noise levels greater than 65 dB CNEL. Policy 10-P-3.C also requires a professional acoustical engineer to be obtained to provide a technical analysis and design of mitigation measures if new noise-sensitive development in areas subject to noise levels greater than 65 dB CNEL.

Table 8: Modeled Peak Hour Traffic Noise Levels For The Most Impacted Locations Under Cumulative Scenario, Dba Leq At 50 Feet

Roadway Segment	(A) Existing Traffic Noise Levels[a]	(B) Cumulative Traffic Noise Levels[a]	(C) Cumulative Plus Project Traffic Noise Levels[a]	(C-A) Difference Between Cumulative Plus Project and Existing[b]	(C-B) Difference Between Cumulative Plus Project and Cumulative[c]
Caulfield Lane between Lakeville Street and Hopper Street (AM peak hour)	52.8	64.3	64.3	11.5	<0.1
Caulfield Lane between Lakeville Street and Hopper Street (PM peak hour)	55.2	65.1	65.1	9.9	<0.1

Notes:
a. Noise levels were determined using FHWA TNM Version 2.5 model. Traffic noise model outputs are included in Appendix A. Road center to receptor distance is approximately 50 feet. The analysis assumed 100 percent automobile under the existing condition, the cumulative condition, and the cumulative project condition for these roadway segments. Traffic speeds were set at 30 mph.
b. Considered significant if the incremental increase in noise from traffic is greater than the existing noise level by 4 dBA Leq.
c. Considered significant if the contribution from the proposed project of the incremental increase in noise is more than 4 dBA Leq.
Source: Fehr & Peers, 2020.

In addition, the proposed retail space could be exposed to exterior noise levels above 65 dB CNEL. According to the 2019 California Building Standards Code, buildings containing non-residential uses (e.g., retail spaces and offices) that are exposed to exterior noise levels at or above 65 dBA L_{eq} or CNEL shall maintain interior noise level below 50 dBA Leq in occupied areas during any hour of operation.

A potential public park would be located in the middle of the project site between the two proposed buildings. The proposed buildings would break the line of sight of the park from traffic on E Washington Street and E D Street, and the buildings could provide about a 5-dBA attenuation of traffic noise. At a known distance from line sources (e.g., roads, highways, and railroads), noise levels are also reduced by 3 dBA for every doubling of the distance over hard surfaces.[15] Therefore, ambient noise levels at the potential public park would be further reduced because of its distance from major roadways and SMART trains. Based on the ambient noise levels of 60 to 77 dBA CNEL at the project site, it is anticipated that ambient noise levels

[15] Caltrans, 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol. September.

at the potential public park, after construction of the proposed buildings, would meet the land use compatibility standards of 75 dB CNEL.

Noise and Vibration Control Measures

Construction activities could generate noise that exceeds the 60-dBA standard for low density single family residential land use and the 65-dBA standard for multifamily residential land use. Construction activities could also generate vibration with the potential to damage the train depot. In addition, the proposed project could expose noise-sensitive uses and retail spaces to exterior noise above 65 dB CNEL, which could result in interior noise levels exceeding 45 dB CNEL for residential uses and exceeding 50 dBA Leq for non-residential uses. Therefore, the proposed project should incorporate noise and vibration control measures during construction and during the design of the buildings.

Construction Noise Control Measures

Notification

Two weeks prior to the commencement of construction, notification must be provided to surrounding land uses disclosing the construction schedule, including the various types of activities that would be occurring throughout the duration of the construction period.

Noise Complaint Tracking

Prior to the issuance of construction-related permit, the applicant shall submit to the City for review and approval a set of procedures for responding to and tracking complaints pertaining to construction noise. These measures shall include: (1) a sign posted on-site describing noise complaint procedures and a complaint hotline number; (2) designation of an on-site construction compliance and enforcement manager for the project; (3) protocols of receiving, responding to, and tracking received complaints; and (4) maintenance of a complaint log that records received complaints and how complaints were addressed, which shall be submitted to the City for review upon the City's request.

Best Management Practices

Noise reduction measures shall be implemented to reduce noise impacts related to construction. Noise reduction measures include, but are not limited to, the following:

1. Equipment and trucks used for project construction shall use the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically-attenuating shields or shrouds), wherever feasible.

2. Except as provided herein, impact tools (e.g., jack hammers and pavement breakers) used for project construction shall be hydraulically or electrically powered to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where

use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used, if such jackets are commercially available; this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever such procedures are available and consistent with required construction procedures.

3. Stationary noise sources shall be located as far from nearby receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures to provide equivalent noise reduction.

Noise Reduction Plan Measure

A Noise Reduction Plan that includes specific noise reduction measures cannot be developed at the time this evaluation was prepared, because precise design level details for the proposed project have yet to be identified. However, once project design is completed and prior to beginning construction, a qualified acoustical engineer shall be retained for the proposed project to prepare a Noise Reduction Plan for City review and approval. The Plan shall contain noise reduction measures (e.g., sound-rated window, wall, and door assemblies) to achieve an acceptable interior noise level of 45 dB CNEL for the multifamily residential units and 50 dBA L_{eq} for the retail space. A Sound Transmission Class (STC) rating roughly equals the decibel reduction in noise volume that a wall, window, or door can provide.[16] Given that the ambient noise environment at the project site currently ranges from about 60 to 77 dBA L_{dn}, the use of sound-rated windows, exterior doors, and exterior walls with STC ratings ranging from about STC 15 to about STC 32 would be required to reduce interior noise levels from exterior sources to about 45 dBA L_{dn} for residential units. The use of sound-rated windows, exterior doors, and exterior walls with STC ratings ranging from about STC 10 to about STC 27 would be required to reduce interior noise levels from exterior sources to about 50 dBA L_{eq} for the retail space.

CONCLUSIONS

No control measures are required for construction vibration because construction vibration would not result in significant impacts to sensitive receptors or buildings near or on the project site.

No control measures are required for operational noise because operational noise would not result in significant impacts to sensitive receptors.

[16] United States Department of Housing and Urban Development, undated. Noise Notebook, Chapter 4 Supplement, Sound Transmission Class Guidance.

Control measures are required for construction noise to reduce impacts to sensitive receptors during construction to a less-than-significant level. Noise reduction measures are also required to achieve an acceptable interior noise level of 45 dB CNEL for the multifamily residential units and 50 dBA L_{eq} for the retail space and reduce noise impacts to a less-than-significant level.

APPENDIX A

Traffic Noise Model Outputs

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Hauling trips during grading

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	0.0
Average automobile speed (mph):	0.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	5.0
Average heavy truck speed (mph):	30.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft): 50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA): 52.9

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

East D Street between Copeland Street and Lakeville Street AM E

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	250.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	56.0

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Street between Copeland Street and Lakeville Street AM E+P

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	333.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	57.2

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Caulfield Lane south of Lakeville Street AM C

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1712.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft): 50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA): 64.3

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Caulfield Lane south of Lakeville Street AM E

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	120.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	52.8

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Caulfield Lane south of Lakeville Street AM C+P

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	1728.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	64.3

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Caulfield Lane south of Lakeville Street PM E

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	210.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	55.2

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Caulfield Lane south of Lakeville Street PM C

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2036.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	65.1

* * * * CASE INFORMATION * * * *

* * * * Results calculated with TNM Version 2.5 * * * *

Caulfield Lane south of Lakeville Street PM C+P

* * * * TRAFFIC VOLUME/SPEED INFORMATION * * * *

Automobile volume (v/h):	2048.0
Average automobile speed (mph):	30.0
Medium truck volume (v/h):	0.0
Average medium truck speed (mph):	0.0
Heavy truck volume (v/h):	0.0
Average heavy truck speed (mph):	0.0
Bus volume (v/h):	0.0
Average bus speed (mph):	0.0
Motorcycle volume (v/h):	0.0
Average Motorcycle speed (mph):	0.0

* * * * TERRAIN SURFACE INFORMATION * * * *

Terrain surface: hard

* * * * RECEIVER INFORMATION * * * *

DESCRIPTION OF RECEIVER # 1

person

Distance from center of 12-ft wide, single lane roadway (ft):	50.0
A-weighted Hourly Equivalent Sound Level without Barrier (dBA):	65.1