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December 1, 2021
Project No. 53-054

Ms. Mison Cooper
ABC Construction, LLC
4100 Moorpark Avenue
San Jose, CA 95117

Subject: Noise Assessment Study for the Planned Multi-Family Development, 150 Felker Street, Santa Cruz

Dear Ms. Cooper:

This report presents the results of a noise assessment study for the planned supportive housing development at 150 Felker Street in Santa Cruz, as shown on the Site Plan, Ref. (a). The noise exposures at the site were evaluated against the standards of the City of Santa Cruz Noise Element, Ref. (b), and the State of California Code of Regulations, Title 24, Ref. (c), which applies to all new multi-family housing in California. Project-generated noise from roof-top mechanical equipment was evaluated against the standards of the City of Santa Cruz Noise Ordinance, Ref. (e). Also included in this study is an analysis of the impacts due to demolition and construction noise and vibration to the nearby residences. The analysis of the on-site sound level measurements indicates that the existing noise environment is due primarily to vehicular traffic sources on Highway 1. The results of the study indicate that the exterior noise exposures are in compliance with the standards for the rear yard areas. However, the interior noise exposures will exceed the City of Santa Cruz Noise Element and Title 24 standards. Noise from the roof-top mechanical equipment will be in compliance with the standards of the Noise Ordinance at the nearest common property line.

Sections I and II of this report contains a summary of our findings and recommendations, respectively. Subsequent sections contain the site, traffic and project descriptions, analyses, evaluations, a construction noise and vibration analysis and controls. Attached hereto are Appendices A, B and C, which include the list of references, descriptions of the applicable standards, definitions of the terminology, descriptions of the acoustical instrumentation used for the field survey, ventilation requirements, general building shell controls, the on-site noise measurement data and calculation tables.

I. Summary of Findings

City of Santa Cruz Noise Element of the General Plan

The noise assessment results presented in the findings were evaluated against the standards of the City of Santa Cruz Noise Element, which utilize the Day-Night Level (DNL) descriptor. The Noise Element standards specify an exterior limit of 65 decibels (dB) DNL for multi-family exterior spaces. The noise standards are typically not applied to small, limited use areas such as balconies. Interior noise exposures are limited to 45 dB DNL.

State of California Code of Regulations, Title 24

The Title 24 standards also use the DNL descriptor and are applicable to all new multi-family developments. Title 24 specifies an interior noise exposure limit of 45 dB DNL from exterior noise sources.

The Title 24 standards also specify minimum noise insulation ratings for common partitions separating different dwelling units and dwelling units from interior common spaces. The standards specify that common walls and floor/ceiling assemblies must have a design Sound Transmission Class (STC) rating of 50 or higher. In addition, common floor/ceiling assemblies must have a design Impact Insulation Class (IIC) rating of 50 or higher. As design details for the interior partitions of the project were not available at the time of this study, an evaluation of the interior partitions has not been made.

City of Santa Cruz Noise Ordinance

Section 24.14.260 of the City of Santa Cruz Noise Ordinance states that no person shall produce, suffer or allow to be produced by any machine, animal or device, or any combination of the same, on residential property, a noise level more than five dBA above the local ambient. The local ambient shall establish the maximum noise limit. More stringent noise limits may be established for specific uses through the conditions of a use permit. Statistically, over a one-hour period the ambient noise level is quantified using the L_{90} noise descriptor. The L_{90} value is the level of noise exceeded for 90% of the time period.

By definition in Section 24.22.488, the local ambient shall be no lower than 40 dBA.

The lowest ambient noise level at the site was measured to be 39 dBA. Thus, 40 dBA is considered the lowest ambient noise level at the property line and neighboring building setbacks. Therefore, the noise limit for the project mechanical equipment is 45 dBA.

The noise exposures shown below are without the application of mitigation measures and represent the noise environment for existing and project site conditions.

A. <u>Exterior Noise Exposures</u>

- The existing exterior noise exposure in the most impacted ground level rear yards along the north side of the building is 58 dB DNL. Under future traffic conditions, the noise exposure is expected to remain at 58 dB DNL. Thus, the noise exposures are within the 65 dB DNL limit of the City of Santa Cruz Noise Element standard.

- The exterior noise exposure at the most impacted planned building setback from Highway 1, 137 ft. from the centerline of the road, is 67 dB DNL. Under future traffic conditions, the noise exposure is expected to remain at 67 dB DNL.

B. Interior Noise Exposures

- The interior noise exposures in the most impacted living spaces closest to Highway 1 will be up 52 dB DNL under existing and future traffic conditions. Thus, the noise exposures will be up to 7 dB in excess of the City of Santa Cruz Noise Element and Title 24 standards.

C. Project-Generated Noise from Mechanical Equipment

Precise mechanical equipment has not been specified. Therefore, an assumed typical roof-top mechanical equipment scenario was developed. This study assumes that 32 air-conditioning condensers or heat pumps will be located on the roof in a line directly above the fourth floor central corridor. The AC units will be either 1.5 ton or 2-ton units as the dwelling unit floor areas range from 612 to 737 sq. ft. A typical Carrier 1.5 or 2 ton condensing unit will generate an A-weighted sound power level (Lwa) of 76 dB.

Table I on page 5 provides the analysis for 32 roof-top air-conditioners. Note that the distance from the source to the receiver is the angled distance from the roof-top to the ground level elevation of 5 ft. The Sound Level @ 5 ft. represents the AC unit at a distance of 5 ft. which is the conversion of sound power to sound pressure. The total sound level of all mechanical units in operation is shown in the black cell at the bottom of the chart.

TABLE I								
Mechanical Equpment Analysis, dBA Leq								
Limit = 45 dBA								
Single-Family		Distance	Dist	Dist	Sound Level	Sound Level	Barrier	Final
to East	Lwa	AC to Parapet	Parapet to Rec.	AC to PL (5')	@ 5 ft.	@ Receiver	Reduction	Sound Level
1	76	5	27	51	65	45	10	35
2	76	9	27	54	65	44	11	33
3	76	13	27	57	65	44	13	31
4	76	17	27	59	65	43	13	30
5	76	21	27	62	65	43	14	29
6	76	25	27	66	65	43	14	28
7	76	29	27	69	65	42	15	28
8	76	33	27	72	65	42	15	27
9	76	37	27	75	65	41	15	26
10	76	41	27	79	65	41	16	26
11	76	45	27	82	65	41	16	25
12	76	49	27	86	65	40	16	24
13	76	53	27	89	65	40	16	24
14	76	57	27	93	65	40	16	23
15	76	61	27	97	65	39	16	23
16	76	65	27	100	65	39	16	23
17	76	69	27	104	65	39	17	22
18	76	73	27	108	65	38	17	22
19	76	77	27	111	65	38	17	21
20	76	81	27	115	65	38	17	21
21	76	85	27	119	65	37	17	21
22	76	89	27	123	65	37	17	20
23	76	93	27	126	65	37	17	20
24	76	97	27	130	65	37	17	20
25	76	101	27	134	65	36	17	19
26	76	105	27	138	65	36	17	19
27	76	109	27	142	65	36	17	19
28	76	113	27	146	65	36	17	19
29	76	117	27	149	65	35	17	18
30	76	121	27	153	65	35	17	18
31	76	125	27	157	65	35	17	18
32	76	129	27	161	65	35	17	18
							TOTAL	41

As shown above, the exterior noise exposures will be within the limits of the standards as significant acoustical shielding occurs from the shoulder of the slope from the elevated roadway. Noise mitigation measures for the exterior areas will not be required. However, the interior noise exposures will exceed the limits of the standards. Noise mitigation measures will be required for the noise impacted living spaces. The recommended measures are described in Section II, below. The mechanical equipment noise levels will be within the 45 dBA limit of the City of Santa Cruz Noise Ordinance standards. Noise mitigation measures for the mechanical equipment will not be required.

II. Recommendations

A. Interior Noise Controls

To achieve compliance with the 45 dB DNL standards of the City of Santa Cruz Noise Element and Title 24, the following noise control measures will be required. In addition, general construction measures affecting the building shell are also recommended, as described in Appendix B.

- Maintain closed at all times all windows and glass doors of living spaces of the project with a direct or side view of Highway 1, i.e., facing west, north or east. Install windows and glass doors rated minimum Sound Transmission Class (STC) 32 at these units.

- Provide some type of mechanical ventilation for all living spaces with a closed window condition.

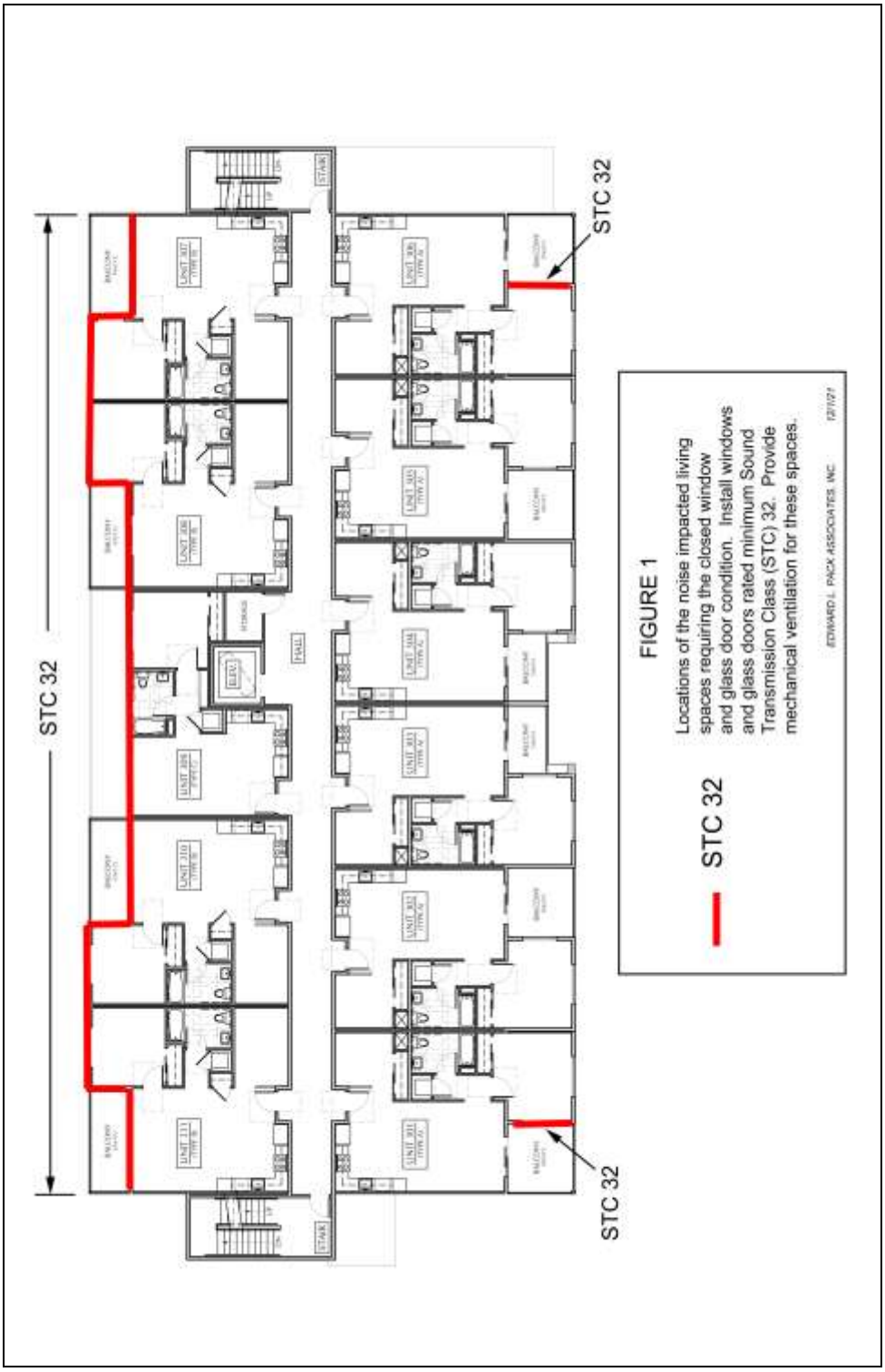
Please see Figure 1 for the locations and STC ratings of the noise impacted windows.

When windows and glass doors are maintained closed for noise control, some type of mechanical ventilation to assure a habitable environment must be provided. The windows specified to be maintained closed are to be operable, as the requirement does not imply a "fixed" condition. All other windows and glass doors of the project and all bathroom windows may have any type of glazing and may be kept opened as desired unless the bathroom is an integral part of a living space without a closeable door.

The windows and doors shall be installed in an acoustically-effective manner. To achieve an acoustically-effective window construction, the sliding window panels must form an air-tight seal when in the closed position and the window frames must be caulked to the wall opening around their entire perimeter with a non-hardening caulking compound to prevent sound infiltration. Exterior doors must seal air-tight around the full perimeter when in the closed position.

Please be aware that many dual-pane window assemblies have inherent noise reduction problems in the traffic noise frequency spectrum due to resonance that occurs within the air space between the window lites, and the noise reduction capabilities vary from manufacturer to manufacturer. Therefore, the acoustical test report of all sound rated windows and doors should be reviewed be a qualified acoustician to ensure that the chosen windows and doors will adequately reduce traffic noise to acceptable levels.

The implementation of the above recommended measures will reduce excess noise exposures to achieve compliance with the 45 dB DNL interior standards of the City of Santa Cruz Noise Element and Title 24.


STC 32
STC 32
STC 32
FIGURE 1
STC 32
Locations of the noise impacted living spaces requiring the closed window and glass door condition. Install windows and glass doors rated minimum Sound Transmission Class (STC) 32. Provide mechanical ventilation for these spaces.
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III. Site, Traffic and Project Descriptions

The planned development site is located at 150 Felker Street along the south side of Highway 1 in Santa Cruz. The site currently contains a single-story office building. The site slopes up slightly from west to east and is at-grade with Felker Street and the surrounding land uses. Highway 1 slopes up from west to east and ranges from 14 ft. to 21 ft. above the site. Surrounding land uses include a vacant parcel adjacent to the west, Highway 1 adjacent to the north, and single-family residential adjacent to the east and across Felker Street to the south.

The on-site noise environment is controlled primarily by vehicle traffic sources on Highway 1, which carries an existing traffic volume of 49,500 vehicles ADT, Ref. (d).

The planned project includes the construction of 4-story building with 32 apartment units on the 2nd, 3rd and 4th floors. Parking and building services will be located on the 1st floor. A narrow rear yard area will be located at the ground level along the north side of the building. Ingress and egress to the project will be by way of project driveways off of Felker Street. The Site Plan is shown on Figure 2 on the following page.

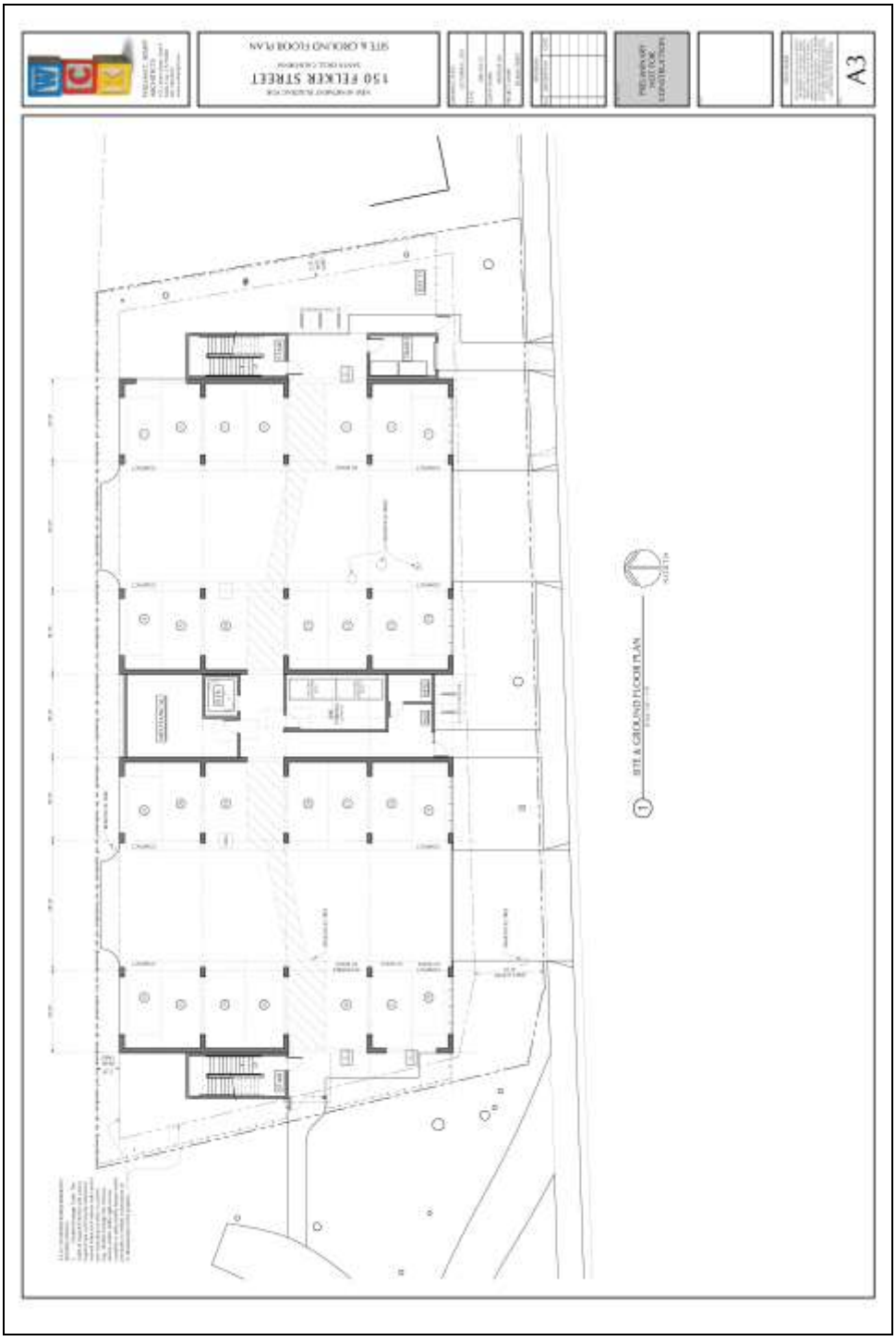


FIGURE 2 – Site Plan

IV. Analysis of the Noise Levels

A. Existing Noise Levels

To determine the existing noise environment at the site, continuous recordings of the sound levels were made on November May 20-21, 2020 on the roof of the existing building on the site. The roof elevation is 14 ft. above sea level. The sound meter was placed on a mast 8 ft. above the roof elevation at 22 ft. above sea level and along the northerly edge of the roof. The measurement location was 143 ft. from the centerline of Highway 1. The measurement location is shown on Figure 3, below.

FIGURE 3 – Noise Measurement Locations

The sound levels were recorded and processed using a Larson-Davis Model 812 Precision Integrating Sound Level Meter. The meter yields, by direct readout, a series of descriptors of the sound levels versus time, as described in Appendix B. The measured descriptors include the L_1, L_{10}, L_{50}, and L_{90}, i.e., those levels exceeded for 1%, 10%, 50%, and 90% of the time. Also measured were the maximum and minimum levels and the continuous equivalent-energy levels (L_{eq}), which are used to calculate the DNL. The measurements were made for a continuous period of 24 hours and included representative hours of the daytime and nighttime periods of the DNL index. The results of the measurements are shown in the data tables in Appendix C.

As shown in the data tables, the L_{eq}'s at the measurement location 143 ft. from the centerline of Highway 1 and with a direct view of the road ranged from 62.6 to 66.7 dBA during the daytime and from 51.8 to 63.5 dBA at night.

Vehicular traffic noise dissipate at the rate of 3 to 6 dB for each doubling of distance from the source and contains a wide spectrum of frequency components (from 100 to 10,000 Hz), which are associated with engine, tire, drive-train, exhaust and other sources. These frequency components are centered primarily in the 250 and 500 Hz octave bands and were used in determining the noise control measures for this project.

B. Future Noise Levels

Future traffic volume projections for Highway 1 were not available from CalTrans. To make an estimate of future volume, reference was made to the reported 1997 volume of 59,000 vehicles ADT, Ref. (e). The 2020 volume was reported to be 49,500 vehicles ADT. Even though the traffic volumes have decreased over the past 23 years, we estimate that the future traffic volume will be similar to current levels over a 20 year horizon resulting in no substantial change in the traffic noise environment at the site.

IV. Evaluations of the Noise Exposures

A. Exterior Noise Exposures

To evaluate the on-site noise exposures against the City of Santa Cruz standards, the DNL for the survey location was calculated by decibel averaging of the L_{eq}'s as they apply to the daily time periods of the DNL index. The DNL is a 24-hour noise descriptor that uses the measured L_{eq} values to calculate a 24-hour time-weighted average noise exposure with a 10 decibel factor added to nighttime noise to account for the increased human sensitivity to noise at night. Adjustments were also made to the measured noise levels to account for differences in distance between the measurement location and the building setback and receiver locations using methods established by the Highway Research Board, Ref. (f). The formula used to calculate the DNL is described in Appendix B.

The results of the calculations indicate that the exterior noise exposure at the measurement location 100 ft. from the centerline of Highway 1 and with a direct view of the road is 67 dB DNL. Under future traffic conditions, the noise exposure is expected to remain at 67 dB DNL.

At the planned minimum building setback of 137 ft. from the centerline of Highway 1 the noise exposures will also be 67 dB DNL under existing and future traffic conditions.

At the ground floor exterior rear yard area along the north side of the building, the noise exposures were calculated to be 58 dB DNL under existing and future traffic conditions. This includes a 13 dB noise reduction due to the shoulder of the slope of the elevated roadway. Thus, the noise exposures in the rear yards will be within the 65 dB DNL limit of the City of Santa Cruz Noise Element standards.

B. Interior Noise Exposures

To evaluate the interior noise exposures in project living spaces against the standards of City of Santa Cruz Noise Element and Title 24, a 15 dB reduction factor was applied to the exterior noise exposures at the building setbacks to represent the attenuation provided by the building shell under an *annual-average* condition. The *annual-average* window condition assumes that windows will have standard dual-pane thermal insulating glass and are kept open up to 50% of the time for natural ventilation.

The interior noise exposures in the most impacted living spaces closest to Highway 1 will be up to 52 dB DNL under existing and future traffic conditions. Thus, the noise exposures will be up to 7 dB in excess of the City of Santa Cruz Noise Element and Title 24 standards.

As shown by the above evaluations, the exterior noise exposures within the common areas will be within the limits of the City of Santa Cruz Noise Element standards. Noise mitigation measures for these areas will not be required.

The interior noise exposures will exceed the limits of the standards. Mitigation measures for the interior living spaces will be required. The recommended measures are described in Section II of this report.

V. Construction Noise and Vibration Analysis

Short-term noise impacts may be created during clearing of the site and the construction of the project. Demolition equipment will consist primarily of hand power tools, a small crane and excavators. Construction equipment will consist of small bulldozers, loaders, backhoes, excavators, graders, cranes, forklifts, generators and air compressors. Demolition/construction equipment noise levels range from 76 to 88 dBA at a 50 ft. distance from the source, and has a potential to disturb residences adjacent to the west, north and across Delaware Street to the south. Very high noise level equipment, such as pile drivers and rock drills are not expected to be used on this project.

A table of construction equipment (mostly earthwork equipment, which is usually the noisiest, taken from the Federal Transit Administration Noise and Vibration Impact Assessment is provided on page 16. The noise levels for each item of equipment, not all of which will be used on this project, are reported for a standard distance of 50 ft. None of the construction equipment used for this project will generate noise levels higher than 90 dBA at 50 ft. No extreme noise generators, such as pile driving, will be used on this project. Noise from construction equipment dissipates at the rate of 6 dB per doubling of the distance from the source to the receiver.

Since construction is carried out in several reasonably discrete phases, each will have its own mix of equipment and consequently, its own noise characteristics. Generally, the site preparation requires the use of heavy equipment such as bulldozers, loaders, graders, concrete trucks and diesel trucks. Construction of the building includes haul trucks, cranes, forklifts, pumps, air compressors and powered and manual hand tools (saws, nail guns, sprayers). Once the shells of the buildings are completed with the windows installed, much of the construction noise will be contained inside the buildings.

Table 7-1 Construction Equipment Noise Emission Levels *

Equipment	Typical Noise Level 50 ft. from Source, dBA
Air Compressor	80
Backhoe	80
Ballast Equalizer	82
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Concrete Pump	82
Concrete Vibrator	76
Crane, Derrick	88
Crane, Mobile	83
Dozer	85
Generator	82
Grader	85
Impact Wrench	85
Jack Hammer	88
Loader	80
Paver	85
Pile-driver (Impact)	101
Pile-driver (Sonic)	95
Pneumatic Tool	85
Pump	77
Rail Saw	90
Rock Drill	95
Roller	85
Saw	76
Scarifier	83
Scraper	85
Shovel	82
Spike Driver	77
Tie Cutter	84
Tie Handler	80
Tie Inserter	85
Truck	84

**This Table is copied from the FTA Transit Noise and Vibration Impact Assessment Manual, pg. 176.

Construction activities can produce varying amounts of ground-borne vibration, which depend on the type of equipment used and various methods. Vibration is produced by the equipment operation and the vibrational waves travel through the ground/soil that diminish over distance. It is rare that construction vibration is intense enough to cause damage to existing structures. However, due to the close proximity of the light framed building to the west and the masonry building to the north, a qualitative analysis of vibration is warranted.

Ground-borne vibration is typically reported in terms of "peak particle velocity" or PPV, and sometimes reported in terms of decibels of vibration, notated as VdB, which is a level of vibration (L_v). The use of PPV is more common for construction equipment and methods. Table II, below, provides building damage criteria from construction vibration established by the Federal Transit Administration, Ref. (h).

TABLE II		
Construction Vibration Damage Criteria		
Building Category	PPV (in/sec)	Approx. L_v (VdB)
I. Reinforced-concrete, steel or timber (no plaster)	0.50	102
II. Engineered concrete and masonry (no plaster)	0.30	98
III. Non-engineered timber and masonry buildings	0.20	94
IV. Buildings extremely susceptible to vibration damage	0.12	90
** RMS velocity in decibels (VdB) re: 1 micro-inch/second		

The adjacent residential building to the easts is a standard wood-framed, wood-sided structure. The type of foundation is unknown, but is likely concrete. This structure falls into Building Category III where the vibration limit is 0.20 in/sec PPV.

The contractors used for the demolition of the site and construction of the project have not yet been selected, nor has a construction schedule and list of equipment been developed. Table III, below, provides a list of typical construction equipment, their vibration levels at 25 ft. reference distances, the vibration levels at the building setbacks of the very near residential buildings to the west and north. Also shown are the distances each item of equipment must stay away from the respective adjacent structures to limit the vibration levels to no more than 0.20 in/sec PPV at the residential building to the east. As shown in Table III, nearly all of the equipment will generate ground-borne vibration levels in excess of the 0.20 in/sec. residential criterion due to the very close proximities of this building to the construction site. Due to the small size of the site, most of the vibration inducing equipment will be on the smaller size.

TABLE III

Construction Equipment Vibration Levels, in/sec PPV

Dist. to Res. To East, ft.	5		
EQUIPMENT d =	Reference Vibration at d, ft. 25	Vibration Level @ Res. To East	Dist for 0.2 PPV limit
Excavator	0.089	**1.0**	15
Vibratory Roller	0.210	**2.3**	26
Hoe Ram	0.089	**1.0**	15
Large Bulldozer	0.089	**1.0**	15
Loaded Trucks	0.076	**0.8**	13
Jackhammer	0.035	**0.4**	8
Small Bulldozer	0.003	0.0	2
Backhoe	0.088	**1.0**	14
Compactor	0.240	**2.7**	28
concrete Mixer	0.080	**0.9**	14
Concrete Pump	0.080	**0.9**	14
Crane	0.008	0.1	3
Dump Truck	0.080	**0.9**	14
Front End Loader	0.088	**1.0**	14
Grader	0.088	**1.0**	14
Hydra Break Ram*	0.040	**0.4**	9
Soil Sampling Rig	0.088	**1.0**	14
Paver	0.080	**0.9**	14
Pickup Truck	0.080	**0.9**	14
Slurry Trenching	0.016	0.2	5
Tractor	0.080	**0.9**	14
Vibratory Roller (lge)	0.477	**5.3**	45
Vibratory Roller (sm)	0.176	**2.0**	23
Clam Shovel*	0.208	**2.3**	26
Rock Drill	0.088	**1.0**	14
* Transient vibration levels			

VI. Construction Noise and Vibration Reduction

Mitigation of the demolition/construction phase noise at the site can be accomplished by using quiet or "new technology" equipment. The greatest potential for noise abatement of current equipment should be the quieting of exhaust noises by use of improved mufflers. It is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer. In addition, all equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engine, drive-train and other components. Demolition and construction noise can also be mitigated by the following measures.

As additional noise reduction benefits can be achieved by appropriate selection of equipment utilized for various operations, subject to equipment availability and cost considerations, the following recommendations for minimizing impacts on the surrounding area are offered:

OPERATIONAL AND SITUATIONAL CONTROLS

- No material deliveries are allowed on Sundays or Federal Holidays.
- Minimize material movement along the east side of the site.
- Locate stockpiles adjacent to residential neighbors as much as possible to help shield residences from on-site noise generation.
- Keep mobile equipment (haul trucks, concrete trucks, etc.) off of local streets near residences as much as possible.
- Utilize temporary power service from the utility company in lieu of generators wherever possible.

- Keep vehicle paths graded smooth as rough roads and paths can cause significant noise and vibration from trucks (particularly empty trucks) rolling over rough surfaces. Loud bangs and ground-borne vibration can occur.

- All work within 10 ft. of the property lines common with residential uses or noise sensitive uses should be performed by hand.

INTERIOR WORK

- For interior work, the windows of the interior spaces facing neighboring residences where work is being performed shall be kept closed while work is proceeding.

- Noise generating equipment indoors should be located within the building to utilize building elements as noise screens.

EQUIPMENT

- Use the lowest vibration inducing equipment when within the distance limits shown in Table III. Small grading and earth moving equipment, such as "Bobcat" size equipment should be used.

- Place long-term stationary equipment as far away from the residential area as possible.

- Circular saws, miter or chop saws and radial arm saws shall be used no closer than 50 ft. from any residential property line unless the saw is screened from view by any and all residences using an air-tight screen material of at least 2.0 lbs./sq. ft. surface weight, such as ¾" plywood.

- Music shall not be audible off site.

- Earth Removal: Use scrapers as much as possible for earth removal, rather than the noisier loaders and hauling trucks.

- Building Construction: Power saws should be shielded or enclosed where practical to decrease noise emissions. Nail guns should be used where possible as they are less noisy than manual hammering.

- Generators and Compressors: Use generators and compressor that are housed in acoustical enclosures rather than weather enclosures or none at all.

- Backfilling: Use a backhoe for backfilling, as it is less costly and quieter than either dozers or loaders.

- Ground Preparation: Use a motor grader rather than a bulldozer for final grading. Wheeled heavy equipment is less noisy than track equipment. Utilize wheeled equipment rather than steel track equipment whenever possible, with the exception of work within the vibration distances shown in Table III. The soil conditions at the site indicate that wheeled equipment may generate higher levels of ground vibration than tracked equipment. Small, rubber tracked equipment, such as skid steers, would produce the lowest levels of noise and vibration.

- Use electrically powered tools rather than pneumatic tools whenever possible.

- The greatest potential for noise abatement of current equipment should be the quieting of exhaust noises by use of improved mufflers.

- It is recommended that all internal combustion engines used at the project site be equipped with a type of muffler recommended by the vehicle manufacturer.

- All equipment should be in good mechanical condition so as to minimize noise created by faulty or poorly maintained engines, drive-trains and other components. Worn, loose or unbalanced parts or components shall be maintained or replaced to minimize noise and vibration.

NOISE COMPLAINT MANAGEMENT

- Designate a noise complaint officer. The officer shall be available at all times during construction hours via both telephone and email. Signs shall be posted at site entries. A sample is shown below.

NOISE COMPLAINTS

FOR CONCERNS REGARDING CONSTRUCTION NOISE PLEASE CONTACT:

John Doe
JohnDoe@ConstructionCo.com
OPERATIONS MANAGEMENT ENGINEER
CALL CENTER: (111) 111-1111

- Notify, in writing, all residents within 300 ft. of the project perimeter and adjacent commercial uses of construction. The notification shall contain the name, phone number and email address of the noise complaint officer. A flyer may be placed at the doors of the residences.

- A log of all complaints shall be maintained. The logs shall contain the name and address of the complainant, the date and time of the complaint, the nature/description of the noise source, a description of the remediation attempt or the reason remediation could not be attempted.

This report presents the results of a noise assessment study for the planned multi-family development at 150 Felker Street in Santa Cruz. The study findings for current conditions are based on field measurements and other data and are correct to the best of our knowledge. Future noise level predictions and the recommendations were based on information provided by CalTrans and estimates made by Edward L. Pack Associates, Inc. However, significant changes in the future traffic volumes, speed limits, motor vehicle technology, noise regulations, or other changes beyond our control may produce long range noise results different from our estimates. If you have any questions or would like an elaboration on this report, please call me.

Sincerely,

EDWARD L. PACK ASSOC., INC.

Jeffrey K. Pack
President

Attachment: Appendices A, B and C

APPENDIX A

References

(a) Site Plan, New Apartment Building for 150 Felker Street, by William C. Kempf Architects, October 6, 2021

(b) City of Santa General Plan 2030, Chapter 8, "Hazards, Safety and Noise", Adopted, June 26, 2012

(c) California Code of Regulations, Title 24, Volume 1, , Part 2 Section 1206 "Sound Transmission", Subsection 1206.4 (Allowable Interior Noise Levels), Revised 2019

(d) City of Santa Cruz Municipal Code, Zoning Ordinance, Part 2 – Performance Standards, Section 24.14.260 Noise, 24.22.488 Local Ambient, 1985

(e) State of California Department of Transportation, Division of Traffic Operations, http://www.dot.ca.gov/trafficops/census, 2020-AADT.xlsx

(f) 1997 Traffic Volumes on California State Highways, State of California Department of Transportation, Division of Traffic Operations, June 1998

(g) Highway Research Board, "Highway Noise-A Design Guide for Highway Engineers", Report 117, 197

(h) Federal Transit Administration, "Transit Noise and Vibration Impact Assessment Manual, FTA Report No. 0123 Prepared by John A. Volpe National Transportation Systems Center, September 2018

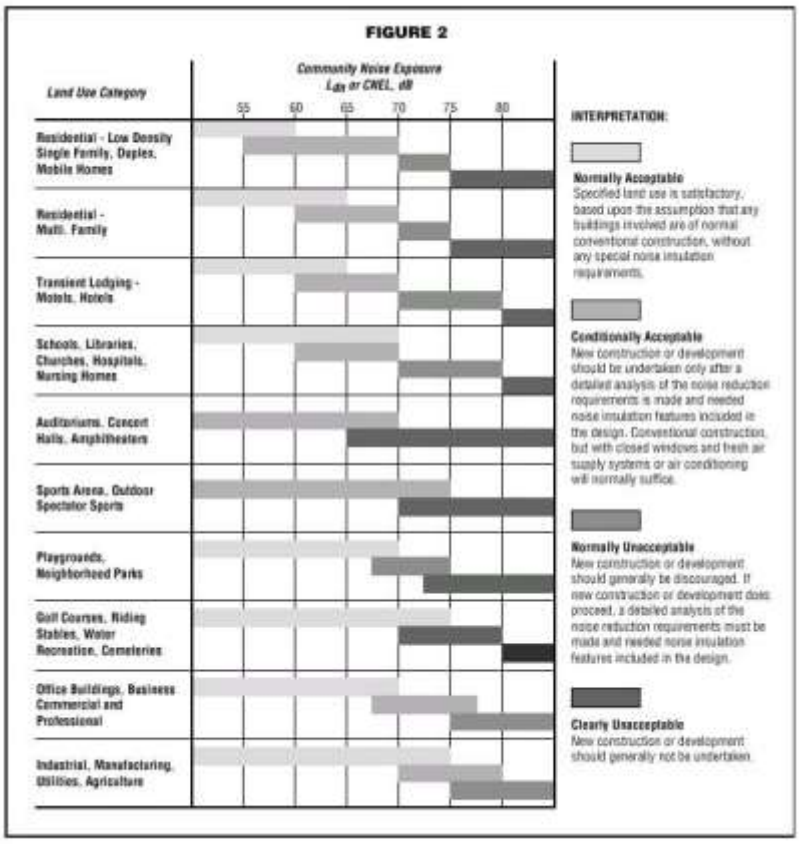
APPENDIX B

Noise Standards, Terminology, Instrumentation, Ventilation Requirements and Building Shell Controls

1. Noise Standards

A. City of Santa Cruz Noise Element Standards

The City of Santa Cruz General Plan 2030, adopted June 26, 2012, references the Land Use Compatibility chart of the State of California General Plan Guidelines. The Noise Element provides a series of noise goals for various occupancies and uses. The noise exposures are in terms of dB Day-Night Level (DNL or L_{dn}).



Goal HZ3 Noise levels compatible with occupancy and use

HZ3.1 Maintain or reduce existing noise levels and control excessive noise.

HZ3.1.1 Require land uses to operate at noise levels that do not significantly increase surrounding ambient noise.

HZ3.1.2 Use site planning and design approaches to minimize noise impacts from new development on surrounding land uses.

HZ3.1.3 Ensure that construction activities are managed to minimize overall noise impacts on surrounding land uses.

HZ3.1.4 Minimize the impacts of intermittent urban noise on residents.

HZ3.1.5 Develop a system to monitor construction noise impacts on surrounding land uses.

HZ3.1.6 Require evaluation of noise mitigation measures for projects that would substantially increase noise.

HZ3.1.7 Protect residential areas from excessive noise from traffic and from road projects.

HZ3.1.8 Require environmental review and mitigation of roadway projects that may significantly increase the average day/night noise levels.

HZ3.1.9 Limit truck traffic in residential and commercial areas to designated truck routes.

HZ3.1.10 Where noise reduction would be beneficial, consider installing quiet pavement surfaces as part of repaving projects.

HZ3.1.11 Require soundwalls, earth berms, setbacks, and other noise reduction techniques for new development when appropriate and necessary as conditions of approval.

HZ3.2 Ensure that noise standards are met in the siting of noise-sensitive uses.

HZ3.2.1 Apply noise and land use compatibility table and standards to all new residential, commercial, and mixed-use proposals, including condominium conversions, in accordance with standards set forth in the Land Use-Noise Compatibility Standards Figure 2.

HZ3.2.2 Establish DNL noise level targets of 65 dB for outdoor activity areas in new multifamily residential developments.

HZ3.2.3 Require that interior noise in all new multifamily housing not exceed a DNL of 45 dB with the windows and doors closed (State of California Noise Insulation Standards) and extend the requirement to single-family homes.

B. Title 24 Noise Standards

2019 California Building Code, Volume 1, Part 2
SECTION 1206 – SOUND TRANSMISSION

1206.1 Scope. This section shall apply to common interior walls, partitions and floor/ceiling assemblies between adjacent dwelling units and sleeping units or between dwelling units and sleeping units and adjacent public areas such as halls, corridors, stairways or service areas.

1206.2 Air-borne sound. Walls, partitions and floor/ceiling assemblies separating dwelling units and sleeping units from each other or from public or service areas shall have a sound transmission class of not less than 50, or not less than 45 if field tested, for air-borne noise when tested in accordance to ASTM E-90. Alternatively, the sound transmission class of walls, partitions and floor-ceiling assemblies shall be established by engineering analysis based on a comparison of walls, partitions and floor-ceiling assemblies having sound transmission class ratings as determined by the test procedures in ASTM E90. Penetrations or openings in construction assemblies for piping; electrical devices; recessed cabinets; bathtubs; soffits; or heating, ventilating or exhaust ducts shall be sealed lined, insulated or otherwise treated to maintain the required ratings. The requirement shall not apply to entrance doors; however, such doors shall be tight fitting to the frame and sill.

1206.3 Structure-borne sound. Floor/ceiling assemblies between dwelling units and sleeping units or between a dwelling unit or sleeping unit and a public or service area with the structure shall have an impact insulation class rating of not less than 50, or not less than 45 if field tested, when tested in accordance with ASTM E-492. Alternatively, the impact insulation class of floor-ceiling assemblies shall be established by engineering analysis based on a comparison of floor-ceiling assemblies having impact insulation class ratings as determined by the test procedures in ASTM E492.

Exception: *Impact sound insulation is not required for floor/ceiling assemblies over non-habitable rooms or spaces not designed to be occupied, such as garages, mechanical rooms or storage areas.*

1206.4 Allowable interior noise levels. *Interior noise levels attributable to exterior sources shall not exceed 45 dB in any habitable room. The noise metric shall be either the day-night average sound level (Ldn) or the community noise equivalent level (CNEL), consistent with the noise element of the local general plan.*

1206.5 Acoustical control. [BSC-CG] *See California Green Building Standards code, Chapter 5, Division 5.5 for additional sound transmission requirements.*

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the sound measuring instruments. Some of the statistical levels used to describe community noise are defined as follows:

L_1 - A noise level exceeded for 1% of the time.

L_{10} - A noise level exceeded for 10% of the time, considered to be an "intrusive" level.

L_{50} - The noise level exceeded 50% of the time representing an "average" sound level.

L_{90} - The noise level exceeded 90 % of the time, designated as a "background" noise level.

L_{eq} - The continuous equivalent-energy level is that level of a steady noise having the same sound energy as a given time-varying noise. The L_{eq} represents the decibel level of the time-averaged value of sound energy or sound pressure squared and is the descriptor used to calculate the DNL and CNEL.

B. Day-Night Level (DNL)

Noise levels utilized in the standards are described in terms of the Day-Night Level (DNL). The DNL rating is determined by the cumulative noise exposures occurring over a 24-hour day in terms of A-Weighted sound energy. The 24-hour day is divided into two subperiods for the DNL index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m. and the nighttime period from 10:00 p.m. to 7:00 a.m. A weighting factor of 10 dBA is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The DNL is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$DNL = \left[[(10\log_{10}(10^{\Sigma Leq(7\text{-}10)})) \times 15] + [((10\log_{10}(10^{\Sigma Leq(10\text{-}7))})+10) \times 9]\right]/24$$

C. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighted network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of one of the instruments specified below, which provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the instrument was provided by a microphone extended to a height of 5 ft. above the ground on using a tripod or mast. The "A" weighting network and the "Fast" response setting of the instruments were used in conformance with the applicable standards. The instruments conform to American National Standards Institute (ANSI) standard S1.4 for Type I instruments, and all instrumentation was acoustically calibrated before and after field tests to assure accuracy.

Instruments used for field surveys:
Larson-Davis Model 812 Integrating Sound Level Meter
Larson-Davis 2900 Real Time Analyzer
Bruel & Kjaer Model 2231 Precision Sound Level Meter
Larson-Davis Model 831 Integrating Sound Level Meter

4. Mechanical Ventilation Requirements

California Mechanical Code Chapter 4- Ventilation Air

402.3 Mechanical Ventilation

Where natural ventilation is not permitted by this section or the building code, mechanical ventilation systems shall be designed, constructed, and installed to provide a method of supply air and exhaust air. Mechanical ventilation systems shall include controls, manual or automatic, that enable the fan system to operate wherever the spaces served are occupied. The system shall be designed to maintain minimum outdoor airflow as required by Section 403.0 under any load conditions.

5. Building Shell Controls

The following additional precautionary measures are required to assure the greatest potential for exterior-to-interior noise attenuation by the recommended mitigation measures. These measures apply at those units where closed windows are required:

- Unshielded entry doors having a direct or side orientation toward the primary noise source must be 1-5/8" or 1-3/4" thick, insulated metal or solid-core wood construction with effective weather seals around the full perimeter. Mail slots should not be used in these doors or in the wall of a living space, as a significant noise leakage can occur through them.

- If any penetrations in the building shell are required for vents, piping, conduit, etc., sound leakage around these penetrations can be controlled by sealing all cracks and clearance spaces with a non-hardening caulking compound.

- Ventilation openings shall not compromise the acoustical integrity of the building shell.

- Spray-in or expandable foams are not acceptable acoustical sealants. However, they may be used to fill a large void between a rough frame and a window or door frame provided that an appropriate caulking bead is inserted over the foam filler to provide an air-tight seal.

APPENDIX C

On-Site Noise Measurement Data and Calculation Tables

DNL CALCULATIONS

CLIENT: ABC CONSTRUCTION, LLC
FILE: 53-054
PROJECT: 150 FELKER ST.
DATE: 11/17-18/2021
SOURCE: HIGHWAY 1

LOCATION 1	Highway 1			
Dist. To Source	143 ft.			
TIME	Leq	10^Leq/10		
7:00 AM	65.1	3235936.6		
8:00 AM	65.0	3162277.7		
9:00 AM	64.5	2818382.9		
10:00 AM	65.3	3388441.6		
11:00 AM	64.8	3019951.7		
12:00 PM	65.7	3715352.3		
1:00 PM	65.2	3311311.2		
2:00 PM	65.2	3311311.2		
3:00 PM	65.8	3801894.0		
4:00 PM	66.7	4677351.4		
5:00 PM	65.1	3235936.6		
6:00 PM	65.0	3162277.7		
7:00 PM	63.9	2454708.9		
8:00 PM	63.8	2398832.9		
9:00 PM	62.6	1819700.9	SUM=	47513667
10:00 PM	60.0	1000000.0	Ld=	76.8
11:00 PM	57.3	537031.8		
12:00 AM	54.7	295120.9		
1:00 AM	54.1	257039.6		
2:00 AM	51.8	151356.1		
3:00 AM	54.8	301995.2		
4:00 AM	57.1	512861.4		
5:00 AM	60.3	1071519.3		
6:00 AM	63.5	2238721.1	SUM=	6365645
		1.0	Ln=	68.0
	Daytime Level=	76.8		
	Nighttime Level=	78.0		
	DNL=	**67**		
	24-Hour Leq=	63.5		