CHRISTOPHER JEAN & ASSOCIATES, INC.
ACOUSTICAL CONSULTING SERVICES

January 20, 2021

ACOUSTICAL ANALYSIS

PALMDALE TERRACE APARTMENTS

CITY OF PALMDALE

Prepared by:

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Prepared for:

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CHRISTOPHER JEAN & ASSOCIATES, INC.
ACOUSTICAL CONSULTING SERVICES

SUMMARY

This analysis has been completed to determine the exterior and interior noise exposure and the necessary mitigation measures for the proposed Palmdale Terrace Apartments project located at Avenue Q-12 and 25th Street East in the City of Palmdale. A list of requirements and recommendations is given in the following summary. Details are discussed in the body of the report.

A. EXTERIOR NOISE CONTROL

Sound walls at least six feet (6') high must be constructed around the perimeters of all first floor patios with any view to 25th Street East and within 200 feet of the centerline of 25th Street East. Sound walls at least five and a half feet (5.5') high must be constructed around the perimeters of all second floor balconies with any view to 25th Street East and within 200 feet of the centerline of 25th Street East. Sound walls at least five feet (5') high must be constructed around the perimeters of all third floor balconies with any view to 25th Street East and within 200 feet of the centerline of 25th Street East.

B. NOISE CONTROL BARRIER CONSTRUCTION MATERIALS

The required noise control barriers may be constructed using any of the following materials:

(1) Masonry block

(2) Stucco on wood frame

(3) 3/4" plywood

(4) 1/4" tempered glass or 1/2" Lexan

(5) Earthen berm

(6) Any combination of the above materials or any material with a surface weight of at least 3.5 pounds per square foot.

Each completed noise control barrier must present a solid face from top-to-bottom and end-to-end. Cutouts are not permitted except for drain holes.

C. INTERIOR NOISE CONTROL

The buildings shall be constructed, as a minimum, in accordance with the outline of Table 6 found in the body of the report. This will be adequate for all units with the following exceptions:

(1) Add STC 34 glazing to all Living Rooms with any view to 25th Street East and within 200 feet of the centerline of 25th Street East,

(2) Add STC 32 glazing to all bedrooms with any view to 25th Street East and within 200 feet of the centerline of 25th Street East,

(3) Add STC 28 glazing to all remaining rooms facing Avenue Q-12.

D. VENTILATION

This analysis assumed that all windows and doors are kept closed. If the allowable interior noise levels are met by requiring that windows and doors be kept closed, then the design of the structure must also specify a ventilation or air conditioning system to provide a habitable interior environment. The ventilation system must not compromise the dwelling or guest room noise reduction.

E. UNIT-TO-UNIT NOISE CONTROL

Common floor/ceiling assemblies between units are subject to Title 24 Sound Transmission Class (STC) and Impact Insulation Class (IIC) requirements. The plan set provided for this analysis did not include common floor/ceiling assembly details. It is highly recommended that one of the following widely used common floor/ceiling assemblies, all of which rate at least STC 50, be incorporated into the building plans:

(1) 8" concrete slab (Riverbank Acoustical Labs, TL 76-77, 1977, 16f, for Pre-stressed Concrete Institute, STC 58 – IIC 71 with carpet, IIC 34 for bare floor)

(2) 1 1/2" lightweight concrete, plywood sub-floor, 3 1/2" thick fiberglass insulation, resilient channels, drywall ceiling (Geiger and Hamme CCA-14MT, CCA-15MT, 1972, 16f, for Cellular Concrete Association, STC 60 – IIC 73 with carpet, IIC 47 with vinyl tile)

(3) 1 3/8" Gyp-Crete, plywood sub-floor, 2" by 10" wood joists, 3 1/2" thick fiberglass insulation, resilient channels, 1/2" drywall ceiling (Riverbank Acoustical Labs TL 81-16, for Gyp-Crete Corporation, 1981, STC 60 – Riverbank Acoustical Labs IN 81-14, for Gyp-Crete Corporation, 1981, IIC 51 with sheet vinyl)

As can be seen by the above list, some of the recommended assemblies cannot meet the IIC 50 minimum requirement without carpet. Uncarpeted areas above other living units will require some form of proprietary isolation product included in the assembly to achieve the required rating. Such products include Enkasonic, Acousti-Mat, Regupol and others. Such products are designed to be installed atop the bare sub-floor and topped with either lightweight concrete/Gyp-Crete pour or additional layers of plywood. Each product has its own specific installation requirements. These products can produce both design and field IIC compliance with sheet vinyl or wood flooring. While various lab tests have shown these same products to produce design IIC compliance when used with ceramic tile, field testing experience has proven that actual ceramic tile installations are marginal. The use of ceramic tile or marble is not recommended, regardless of the installation method.

The plan set provided for this analysis did not include common wall assembly details. It is highly recommended that one of the following widely used common wall assemblies, all of which rate at least STC 50, be incorporated into the building plans:

(1) Two layers of 1/2" direct nailed drywall, 2" by 6" plate, 2" by 4" staggered studs, 3 1/2" thick fiberglass insulation, two layers 1/2" direct nailed drywall (Owens/Corning Fiberglas, OCF W-55-69, 1969, 16f, for Owens/Corning Fiberglas, STC 54)

(2) Two layers of 5/8" direct nailed drywall, 2" by 6" plate, 2" by 4" staggered studs, 3 1/2' thick fiberglass insulation, two layers 5/8" direct nailed drywall (National Gypsum Company NGC 2376, 1970, 16f, STC 53)

(3) 5/8" direct nailed drywall, 2" by 4" plate with 2" by 4" studs, 3 1/2" thick fiberglass insulation, 1" clear air space at plate, 2" by 4" plate with 2" by 4" studs, 5/8" direct nailed drywall (Owens/Corning Fiberglas OCF 448, 1967, 16f, STC 56)

(4) Same as #3 but with two layers of 3 1/2" thick fiberglass insulation (Riverbank Acoustical Labs TL 75-83, 1975, 16f, for U. S. Department of Agriculture, STC 57)

(5) Two layers 5/8" direct nailed drywall, 2" by 4" plate with 2" by 4" studs, 3 1/2" thick fiberglass insulation, 1" clear air space at plate, 2" by 4" plate with 2" by 4" studs, two layers 5/8" direct nailed drywall (National Gypsum Company, NGC 3056, 1970, 16f, for Gypsum Association, STC 58)

(6) Same as #5 but with two layers of 3 1/2" thick fiberglass insulation (Riverbank Acoustical Labs TL 75-82, 1975, 16f, for U. S. Department of Agriculture, STC 63)

All wall assemblies between any common space and a living unit must be an STC 50 minimum rated assembly. All plumbing, mechanical and electrical installations shall be installed per the instructions and details contained in Appendix 5. Add all appropriate details to the project plans.

F. PROJECT DISCLOSURE

The acoustical code requirements represent minimal acceptable standards. Compliance with the Building Department acoustical criteria does not require, guarantee or even imply that local sound sources will be mitigated to inaudibility. Compliance with an exterior noise limit of 65 dBA CNEL means that exterior noise will remain clearly audible within the mitigated exterior space. Compliance with an interior noise limit of 45 dBA CNEL means that exterior noise sources will remain audible on the interior of a building.

Due to quality control and other field related problems, the code minimum laboratory ratings of STC/IIC 50 for common assemblies does not guarantee that all common assemblies will pass a field test. In fact, there is a 50 percent chance that half of all common assemblies rated at the STC/IIC minimum could fail field tests. An STC 50 rated assembly will produce around 45 dBA of voice reduction in the field. This means that normal conversation in adjoining units will be audible a certain percentage of the time.

Do not misrepresent the degree of exterior to interior or unit-to-unit acoustical isolation as anything more than meeting code during any phase of this project. Never, ever, use any form of the term "Soundproof" to describe any portion of this project.

1.0 INTRODUCTION

This report presents the results of a noise impact and design study of the proposed Palmdale Terrace Apartments project located at Avenue Q-12 and 25th Street East in the City of Palmdale. This report includes a discussion of the expected exterior community noise environment and the recommendations for control of noise in the exterior and interior living spaces.

A vicinity map showing the general location of the project site is presented in Exhibit 1 – Site Location Map. An aerial photograph of the existing project site and its surroundings is shown on Exhibit 2. The project site plan is shown on Exhibit 3. The project consists of multi-family apartment housing.

2.0 APPLICABLE NOISE CRITERIA

The City of Palmdale and the California Green Building Standards (CalGreen) require all residential projects to conform to the requirements of Table 1.

TABLE 1

APPLICABLE NOISE CRITERIA (1)

Exterior	65 dBA CNEL
Interior	45 dBA CNEL*
Unit-to-Unit	STC 50/IIC 50

(1) Please see Noise Rating Methods (Appendix 1) for an explanation of the commonly applicable acoustical terminology. *Non-residential portions of this project must conform to an interior noise limit of 50 dBA Leq(1 hour). It should be noted that compliance with the more strict limit of 45 dBA CNEL will automatically produce compliance with the 50 dBA Leq(1hour) limit.

3.0 DESIGN NOISE LEVELS

3.1 ROADWAYS

The expected future roadway noise impact was projected using the Federal Highway Administration's Highway Noise Prediction Model (FHWA RD-77-108) together with several roadway and site parameters that determine the projected impact of vehicular traffic noise. These include the roadway cross-section (e.g. number of lanes), the roadway active width, the average daily traffic (ADT), the vehicle travel speed, the percentage of auto and truck traffic, the roadway grade, the angle of view, the site conditions ("hard" or "soft" site), and the percentage of average daily traffic that flows each hour throughout a 24 hour period.

The forecast traffic volume for 25th Street East was obtained from the Palmdale Circulation Element. Since future traffic volumes for 27th Street East and Avenue Q-12 are not given in the Circulation Element, these streets are assumed to be local collector streets with volumes of no more than 10,000 ADT. The percentage of truck traffic was taken from a standard arterial mix. The same source was used to project the distribution by time of day. The input data is listed in Table 2.

TABLE 2

TRAFFIC INPUT DATA

	% DAY	% EVENING	% NIGHT	% VOLUME
Autos	75.51	12.57	9.34	100.0
Medium Trucks	1.56	0.09	0.19	100.0
Heavy Trucks	0.64	0.02	0.08	100.0

Volume = 29,000 ADT on 25th Street East

Speed = 50 MPH (posted)

The calculations are contained in Appendix 2. The calculations yield a design noise level of 71 dBA CNEL at 100 feet from the centerline of 25th Street East.

3.2 RAILROAD

There are no railroad operations in the vicinity of the project site. Railroad noise will not impact the site.

3.3 AIRCRAFT

The City's General Plan Airport Noise Contours are shown on Exhibit 4. Exhibit 4 shows the site to lie well outside the 60 dBA CNEL noise contour. Aircraft noise, though audible, will not impact the site as defined by City and CalGreen standards.

4.0 MITIGATION MEASURES

4.1 EXTERIOR

The mitigation of exterior noise would require individual sound barriers for all private patios and balconies along 25th Street East. For purposes of analysis, the barrier height calculations assume that the barriers are only intended to reduce exterior noise to 65 dBA CNEL using a "seated" receiver height. The assumptions for the barrier height calculations are listed in Table 3 on the following page.

TABLE 3

BARRIER ANALYSIS GENERAL ASSUMPTIONS
FOR RECEIVER AND SOURCE GEOMETRY

RECEIVER ASSUMPTIONS

HORIZONTAL GEOMETRY	VERTICAL GEOMETRY
Distance behind top-of-roadways barrier: 5'	Height above pad for ground level receivers: 3'
Distance behind individual patio and balcony barriers: 5'	Height above pad for second level receivers: 13'

SOURCE ASSUMPTIONS

HORIZONTAL GEOMETRY *	VERTICAL GEOMETRY	
For roadways with grades no greater than 2%, all vehicles were located at the single lane equivalent acoustic center of the full roadway. For roadways with over 2% grade, vehicle count was divided in half and located at the single lane equivalent acoustic center for each side of the roadway.	Automobiles:	0' above center of road grade
	Medium Trucks:	2.3' above center of road grade
	Heavy Trucks:	8' above center of road grade

* = Single Lane Equivalent (SLE) location.

The barrier calculations are contained in Appendix 3. These calculations show that sound walls at least six feet (6') high must be constructed around the perimeters of all first floor patios with any view to 25th Street East and within 200 feet of the centerline of 25th Street East. Sound walls at least five and a half feet (5.5') high must be constructed around the perimeters of all second floor balconies with any view to 25th Street East and within 200 feet of the centerline of 25th Street East. Sound walls at least five feet (5') high must be constructed around the perimeters of all third floor balconies with any view to 25th Street East and within 200 feet of the centerline of 25th Street East.

The required noise control barriers may be constructed using any of the following materials:

(1) Masonry block

(2) Stucco on wood frame

(3) 3/4" plywood

(4) 1/4" tempered glass or 1/2" Lexan

(5) Earthen berm

(6) Any combination of the above materials or any material with a surface weight of at least 3.5 pounds per square foot.

Each completed noise control barrier must present a solid face from top-to-bottom. Cutouts and/or openings are not permitted except for drain holes.

4.2 INTERIOR

The City's exposure criteria for new residential construction require that the interior noise environment, attributable to outside noise sources, be limited to 45 dBA CNEL. Analysis and recommendations for control of outdoor-to-indoor noise intrusion are presented in this section.

The exterior-to-interior noise reduction expected for the planned construction was based on a detailed analysis of sample rooms and units planned for the development. Calculations of the expected typical noise reduction performance were performed for sample rooms. The analysis was based on the typical spectra expected for the primary sources of community noise impact, the typical octave-band transmission loss for each element in the planned building shell, the relative square footage of each element of the planned building shell, the expected typical interior surface treatment, and the acoustical absorption coefficient for each interior surface treatment. Corrections for the "A" Weighted room absorption factors are also included.

Each component of the building shell (e.g. exterior wall, windows, doors, etc.) provides a different amount of transmission loss for each "A" Weighted octave- band of community noise. With the knowledge of the building shell components and their individual octave band transmission loss values for the noise sources, calculations of the composite building shell transmission loss can be made for each room.

The characteristics of the basic building shell are listed in Table 4 on the following page.

TABLE 4

BASIC BUILDING SHELL CHARACTERISTICS

PANEL	CONSTRUCTION
Exterior Wall	Siding or stucco, 2" X 4" studs, R-13 fiberglass insulation, 1/2" drywall
Windows	Double pane
Sliding Glass Door	Double pane
Roof	Shingle over 1/2" plywood, fiberglass insulation, 5/8" drywall, vented
Floor	Carpeted except kitchen and baths

Table 4 construction minimums will provide around 20 dBA of interior noise reduction. However, exterior noise levels as high as 72 dBA will occur outside the units nearest to 25th Street East meaning that interior noise reduction levels as high as 27 dBA will be required. Since Table 4 construction will yield only around 20 dBA, specific room calculations were carried out to determine whether additional mitigation is needed.

The calculations are contained in Appendix 4, and the results are given in Table 5.

TABLE 5

ROOM NOISE REDUCTION VALUES

		NOISE REDUCTION VS. GLAZING STC					
PLAN	ROOM	24	26	28	30	32	34
All	Living Room	20	21	23	25	26	27
	Bedroom	21	23	25	26	27	28

The results of Table 5 show that Table 4 construction should be adequate for all units with the following exceptions:

(1) Add STC 34 glazing to all Living Rooms with any view to 25th Street East and within 200 feet of the centerline of 25th Street East,

(2) Add STC 32 glazing to all bedrooms with any view to 25th Street East and within 200 feet of the centerline of 25th Street East,

(3) Add STC 28 glazing to all remaining rooms facing Avenue Q-12.

4.3 VENTILATION

If interior allowable noise levels are met by requiring that windows be unopenable or remain closed, then the design of the structure must also specify a ventilation or air conditioning system to provide a habitable interior environment. The ventilation system must not compromise the dwelling unit or guest room noise reduction.

4.4 UNIT-TO-UNIT NOISE CONTROL

Common floor/ceiling assemblies between units are subject to Title 24 Sound Transmission Class(STC) and Impact Insulation Class (IIC) requirements. The plan set provided for this analysis did not include common floor/ceiling assembly details. It is highly recommended that one of the following widely used common floor/ceiling assemblies, all of which rate at least STC 50, be incorporated into the building plans:

(1) 8" concrete slab (Riverbank Acoustical Labs, TL 76-77, 1977, 16f, Pre-stressed Concrete Institute, STC 58 -- IIC 71 with carpet, IIC 34 for bare floor)

(2) 1 1/2" lightweight concrete, sub-floor, R-11 insulation, resilient channel, drywall ceiling (Geiger and Hamme CCA-14MT, CCA-15MT, 1972, 16f, Cellular Concrete Associates, STC 60 --IIC 73 with carpet, IIC 47 with vinyl tile)

(3) 1 3/8" Gyp-Crete, sub-floor, 2" by 10" joists, R-11 insulation, resilient channel, 1/2" drywall ceiling (Riverbank Acoustical Labs TL 81-16, Gyp-Crete Corp., 1981, STC 60 -- Riverbank Acoustical Labs IN 81-14, Gyp-Crete Corp., 1981, IIC 51 with sheet vinyl)

As can be seen by the above list, some of the recommended assemblies cannot meet the IIC 50 minimum requirement without carpet. Uncarpeted areas above other living units will require some form of proprietary isolation product under the floor to achieve the required rating. Such products include Enkasonic, Acousti-Mat, Monsanto SC50, and others. Such products are designed to be installed atop the bare sub-floor and topped with either a LWC/Gyp-Crete pour or additional layers of plywood. Each product has its own specific installation requirements. These products can produce both design and field IIC compliance with sheet vinyl or wood flooring. While various lab tests have shown these same products to produce design IIC compliance when used with ceramic tile, field testing experience has proven that actual ceramic tile installations are marginal. The use of ceramic tile or marble flooring is not recommended, regardless of the installation method.

The plan set provided for this analysis did not include common wall assembly details. It is highly recommended that one of the following widely used common wall assemblies, all of which rate at least STC 50, be incorporated into the building plans:

(1) Two layers 1/2" direct nailed drywall, 2" by 6" plate, 2" by 4" staggered studs, fiberglass insulation, two layers 1/2" direct nailed drywall (Owens/Corning Fiberglas, OCF W-55-69, 1969, 16f, Owens/Corning Fiberglas, STC 54)

(2) Two layers 5/8" direct nailed drywall, 2" by 6" plate, 2" by 4" staggered studs, R-11 insulation, two layers 5/8" direct nailed drywall (National Gypsum Co. NGC 2376, 1970, 16f, STC 53)

(3) 5/8" direct nailed drywall, 2" by 4" plate with 2" by 4" studs, R-11 insulation, 1" airspace at plate, 2" by 4" plate with 2" by 4" studs, 5/8" direct nailed drywall (Owens/Corning Fiberglas OCF 448, 1967, 16f, STC 56)

(4) Same as #3 with two layers of R-11 insulation (Riverbank Acoustical Labs TL75-83, 1975, 16f, U.S. Department of Agriculture, STC 57)

(5) Two layers 5/8" drywall direct nailed, 2" by 4" plate with 2" x 4" studs, 1" air space, 2" by 4" plate with 2" by 4" studs, R-11 insulation, two layers 5/8" drywall (National Gypsum Co. NGC 3056, 1970, 16f, Gypsum Association, STC 58)

(6) Same as #5 with two layers of R-11 insulation (Riverbank Acoustical Labs TL 75-82, 1975, 16f, U.S. Department of Agriculture, STC 63)

All wall assemblies between any common space and a living unit must be an STC 50 minimum rated assembly. All Plumbing and electrical installations shall be installed per the instructions contained in Appendix 5. Put all details onto Plans.

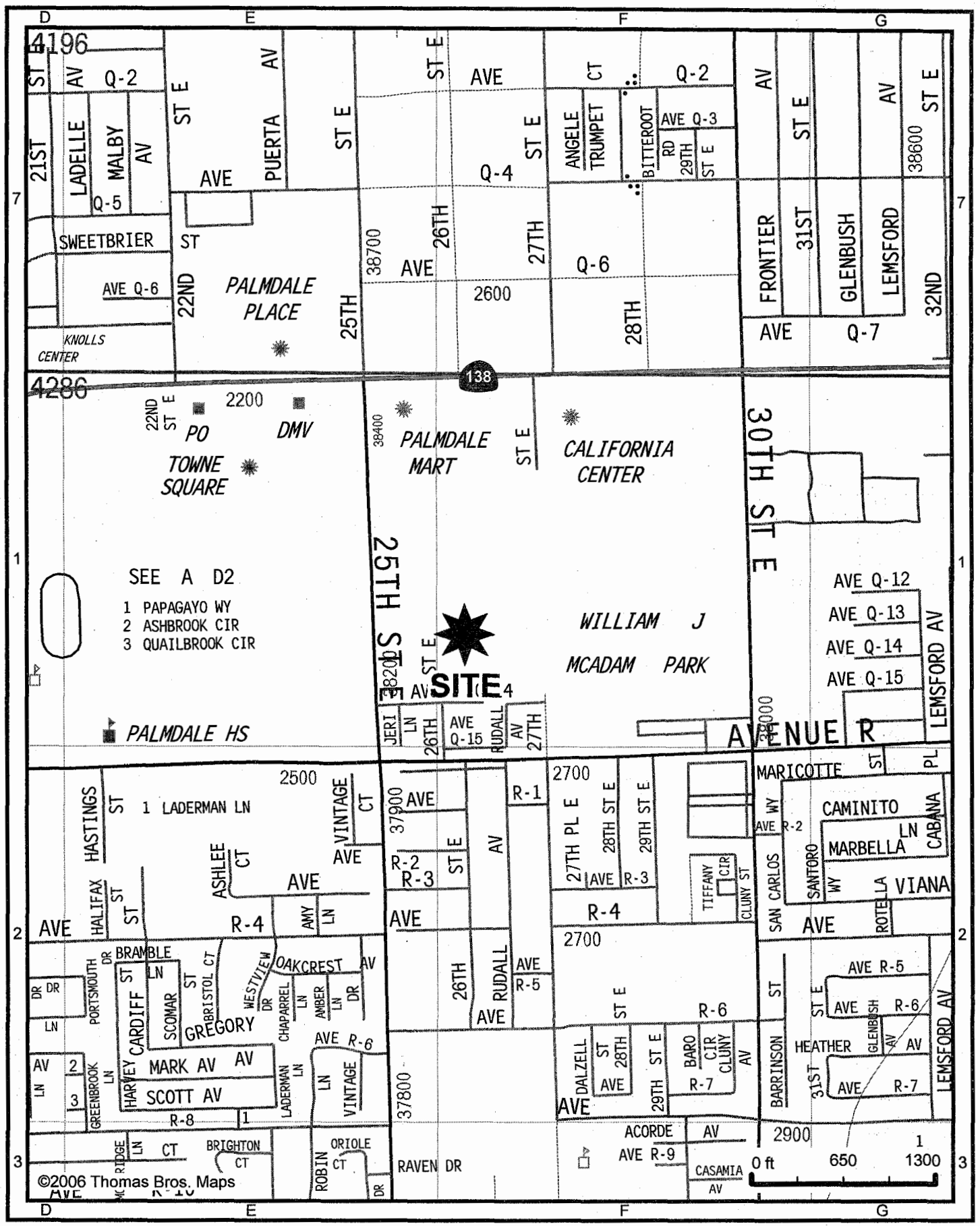
5.5 PROJECT DISCLOSURE

The acoustical code requirements are minimal acceptable standards. Compliance with Building Department acoustical criteria does not require, guarantee or even imply that local sound sources will be mitigated to inaudibility. Compliance with an exterior noise limit of 65 dBA CNEL means that exterior noise will remain clearly audible within the mitigated exterior space. Compliance with an interior noise limit of 45 dBA CNEL means that exterior noise sources will remain audible on the interior of a structure.

Due to quality control and other field related problems, the code minimum laboratory rating of STC/IIC 50 for common assemblies does not guarantee that all common assemblies will pass a field test. In fact, there is a 50% chance that half of all laboratory rated STC/IIC 50 common assemblies could fail field tests. An STC 50 rated assembly will produce around 45 dBA of voice reduction in the field. This means that normal conversation in adjoining units will be audible a certain percentage of the time.

Do not misrepresent the degree of exterior to interior or unit to unit acoustical isolation as anything more than meeting code during any phase of this project. Never, ever, use any form of the term "Soundproof" to describe any portion of this project.

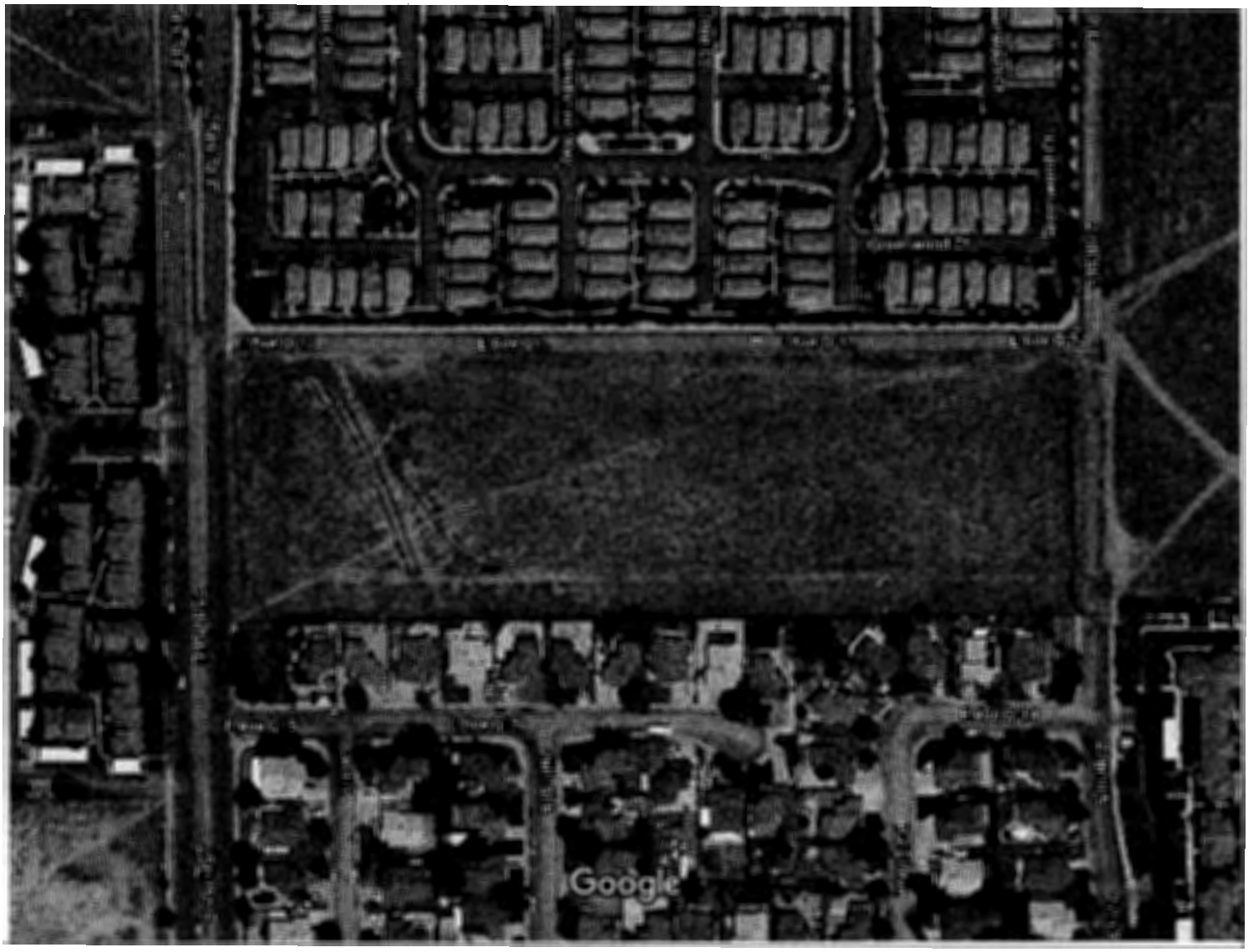
EXHIBIT 1



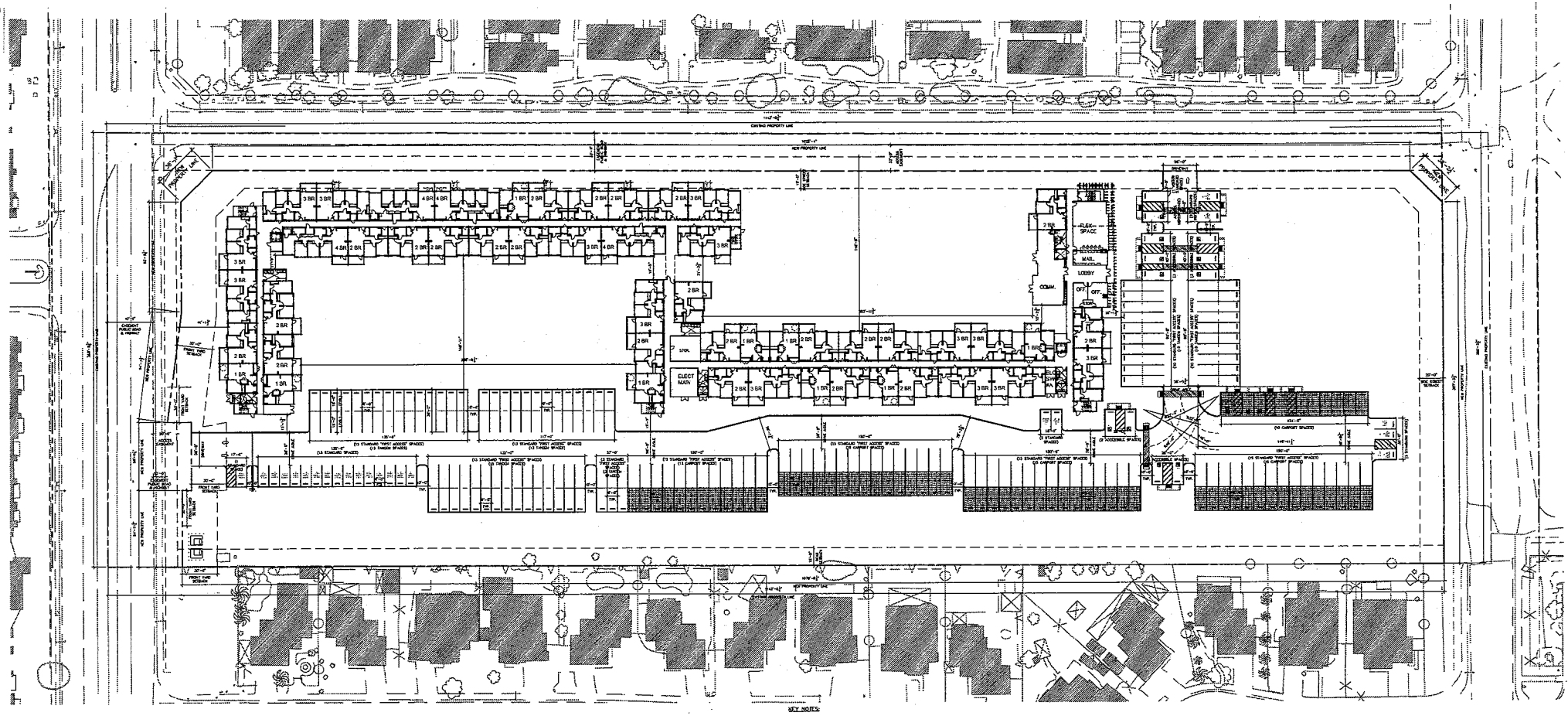
SITE: 1999 Avenue Q-12, Palmdale,CA 93550, 4286 - F1

EXHIBIT 2
AERIAL PHOTO

Google Maps Palmdale



Imagery ©2020 CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2020 100 ft



KEY NOTES:

1. 6'-0" HIGH AUTOMATIC TELESCOPIC VEHICULAR ACCESS SLIDING GATE.
2. 6'-0" TUBE STEEL SECURITY FENCE AND CMU BLOCK PILLASTERS ALL EXPOSED STEEL TO BE PRIMED AND PAINTED
3. FIRE DEPARTMENT & PEDESTRIAN SECURITY ACCESS GATE
4. (E) CMU PROPERTY WALL HEIGHT: TBD
5. 6'-0"x 8'-0" TRANSFORMER PAD WITH LANDSCAPE SCREEN SEE LANDSCAPE DRAWINGS
6. BOLLARD PER SCE REQUIREMENTS WITH ARCHITECTURAL DECORATIVE COVER COLOR: URBAN BRONZE
7. TRANSFORMER SCREENING ENCLOSURE
8. BUILDING ENTRANCE
9. INTERNATIONAL SYMBOL OF ACCESSIBILITY
10. CLEAN-AIR/VANPOOL/EV PARKING SIGNAGE
11. CONCRETE WALKWAY, 5'-0" WIDE MINIMUM, UNLESS NOTED
12. TOT LOT - RUBBER SAFETY SURFACE SEE LANDSCAPE DRAWING
13. FIRE LANE, CURB TO BE PAINTED RED
14. POST MOUNTED INTERCOM SYSTEM
15. SOLAR CARPORT WITH PHOTOVOLTAIC PANELS - DEFERRED SUBMITTAL.
16. BBQ ISLAND, BBQ TO COMPLY WITH CBC 1113-804
17.
18.

EXHIBIT 3
SITE PLAN

Y&M Architects
724 S. Spring Street #304
Los Angeles, CA 90014
Tel. 213 623 2107 Fax. 213 623 2108
www.ymarch.com

Palmdale Terrace Apartments
Project. Palmdale, CA

Meta Housing Corporation
Developer. 11150 W. Olympic Blvd. Suite #620, Los Angeles, CA 90064

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Date

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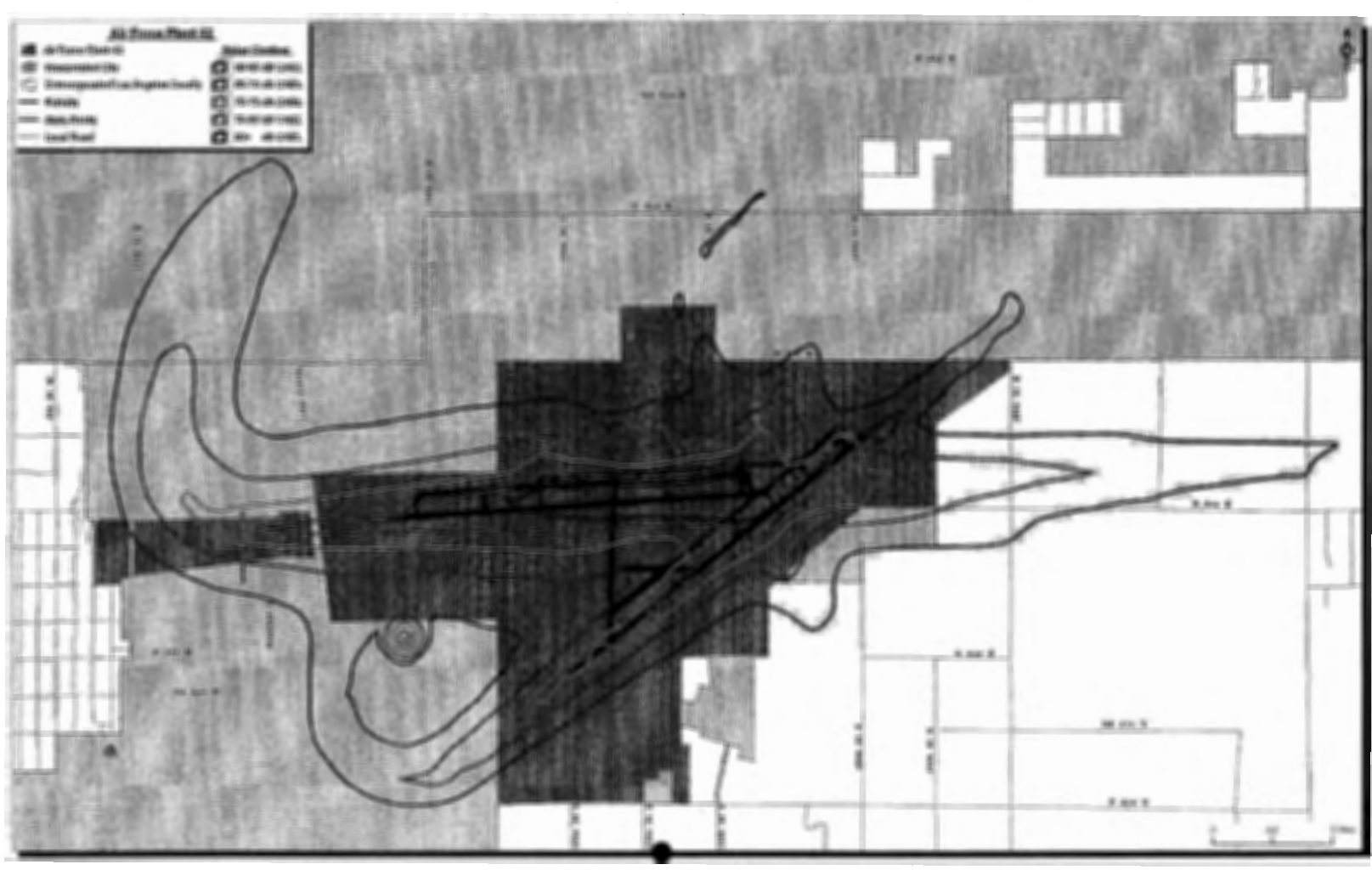

Figure 3-3. Air Force Plant 42 – Community Noise Equivalent Level (CNEL)

EXHIBIT 4

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APPENDIX 1

NOISE RATING METHODOLOGY

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NOISE RATING METHODOLOGY

The A-weighted decibel (dBA) or "A" scale on a sound level meter is typically used for environmental noise measurements because the weighting characteristics of the "A" scale approximate the subjective response of the human ear to a broad frequency band noise source by discriminating against the very low and very high frequencies of the audible sound spectrum.

Since community noise is seldom constant, varying from moment to moment and throughout the day, the "A" weighted noise level needs to be further described to provide meaningful data. The Environmental Protection Agency, the Federal Department of Transportation, several foreign countries and many private consultants are now using three time-exceeded percentile figures to describe noise, which are:

(1) L_{90} is the noise level that is exceeded 90 percent of any sample measurement period (such as 24 hours) and is often used to describe the background or ambient noise level.

(2) L_{50} is the noise level that is exceeded 50 percent of any sample measurement period. It is generally considered to represent the median noise level.

(3) L_{10} is the noise level that is exceeded 10 percent of any sample measurement period. It is a good descriptor of fluctuating noise sources such as vehicular traffic. It indicates the near-maximum noise levels that occur for groups of single noise events. Being related to the subjective annoyance to community noise, the L_{10} is a good design tool in the planning of acoustical barriers.

More recent noise assessment methods are based on the equivalent energy concept where Leq(x) represents the average energy content of a fluctuating noise source over a sample measurement period. The subscript (x) represents the period over which the energy is computed and/or measured. Current practice references the time quantity to either one (1) hour, eight (8) hours, or twenty-four (24) hours. When referenced to one (1) hour, Leq is also called the HNL (Hourly Noise Level).

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Since Leq is the summation of the functional products of noise level and duration, many different combinations of noise levels, duration times and time histories can produce similar Leq values. Thus a value of Leq(24) equals 50 means only that the average noise level is 50 dB. During that 24-hour period, there can be times when the noise level is higher than 50 dB and times when it is lower than 50 dB.

If the period of the measurement is only a single event, the energy content is not averaged. The energy expression for a single event is simply the sum of the functional product of the noise level and duration time of the event. This term is called the Le or SENEL (Single Event Noise Exposure Level). The summation of Le values averaged over one hour is Leq(1), over eight hours is Leq(8), over 24 hours is Leq(24), etc.

Leq is further refined into Ldn (Level Day-Night) and CNEL (Community Noise Equivalent Level), where noise that occurs during certain hours of the day are weighted (or penalized) in an attempt to compensate for the general perception that such noise is more annoying during these time periods (typically evening and nighttime hours).

(1) Ldn is the sound level in dBA that corresponds to the average energy content of the noise being measured over a 24-hour period but includes a ten (10) dBA weighting penalty for noise that occurs during the nighttime hours between 10:00 PM and 7:00 AM. The Ldn is a noise rating method recommended by the Environmental Protection Agency because it takes into account those subjectively more annoying noise events that occur during normal sleeping hours.

(2) CNEL is the sound level in dBA that corresponds to the average energy content of the noise being measured over a 24-hour period but includes a five (5) dBA penalty for noise that occurs during the evening hours between 7:00 PM and 10:00 PM, and a ten (10) dBA penalty for noise that occurs during the nighttime hours between 10:00 PM and 7:00 AM. For typical highway vehicular traffic situations, computer analysis has shown that the Ldn and CNEL values correlate within 0.5 dBA.

The percentile figures L_{10}, L_{50} and L_{90} can be directly scaled from a graphical recording of the measured noise sample over a particular time period. These figures can also be measured directly using modern automatic noise measuring equipment. Measurement of the parameters Le, Leq, Ldn and CNEL requires even more sophisticated and correspondingly expensive noise measuring equipment. As a result, engineers have devised ways of estimating Leq (and hence, Ldn) using standard instrumentation and methods.

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APPENDIX 2

FUTURE TRAFFIC NOISE CALCULATIONS

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FHWA RD-77-108 HIGHWAY NOISE PREDICTION MODEL

PROJECT NAME :PALMDALE TERRACE APTS
SITE LOCATION :PALMDALE
DESCRIPTION :25TH STREET EAST
SITE TYPE :HARD

INPUT DATA	AUTO	MEDIUM TRUCK	HEAVY TRUCK
SPEED	50	50	50
% DAY	75.51	1.56	.64
% EVENING	12.57	0.09	0.02
% NIGHT	9.34	.19	.08
% VOLUME	100	100	100

VOLUME 29000

----AVERAGE HOURLY NOISE LEVELS AT 50 FEET----

	DAY	EVENING	NIGHT	24 HOUR	CNEL
AUTO	71.59	69.82	63.76	69.68	72.95
MEDIUM TRK.	64.77	58.40	56.88	62.48	65.55
HEAVY TRK.	65.14	56.11	57.36	62.76	65.83
TOTAL	73.15	70.29	65.33	71.12	74.33

NOISE LEVEL AT SPECIFIED DISTANCES

DISTANCE	CNEL
50	74.33
75	72.57
100	71.32
125	70.36
150	69.56
175	68.89
200	68.31
225	67.80
250	67.34
275	66.93
300	66.55
325	66.21
350	65.88
375	65.58
400	65.30
450	64.79
500	64.33
550	63.92
600	63.54
650	63.19
700	62.87

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APPENDIX 3

SOUND BARRIER HEIGHT CALCULATIONS

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BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....PALMDALE TERRACE APARTMENTS
DESCRIPTION..THIRD FLOOR BALCONY WALLS -- SEATED RECEIVER
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 20
BARRIER ELEVATION..... 20
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 95
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 72.95
M.TRK NOISE LEVEL..... 65.55
H.TRK NOISE LEVEL..... 65.83
SOURCE NOISE LEVEL..... 74.34

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
0.00	74.34	0.00
0.50	74.34	0.00
1.00	74.34	0.00
1.50	74.34	0.00
2.00	70.48	3.86
2.50	68.94	5.40
3.00	68.22	6.12
3.50	67.50	6.84
4.00	66.56	7.78
4.50	65.54	8.80
5.00	64.54	9.79
5.50	63.62	10.72
6.00	62.78	11.56
6.50	62.02	12.31
7.00	61.35	12.99
7.50	60.74	13.60
8.00	60.19	14.15

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....PALMDALE TERRACE APARTMENTS
DESCRIPTION..SECOND FLOOR BALCONY WALLS -- SEATED RECEIVER
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 10
BARRIER ELEVATION..... 10
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 95
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 72.95
M.TRK NOISE LEVEL..... 65.55
H.TRK NOISE LEVEL..... 65.83
SOURCE NOISE LEVEL..... 74.34

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
0.00	74.34	0.00
0.50	74.34	0.00
1.00	74.34	0.00
1.50	74.34	0.00
2.00	74.34	0.00
2.50	70.48	3.86
3.00	68.92	5.41
3.50	68.20	6.13
4.00	67.47	6.86
4.50	66.54	7.80
5.00	65.53	8.80
5.50	64.56	9.77
6.00	63.66	10.67
6.50	62.85	

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....PALMDALE TERRACE APARTMENTS
DESCRIPTION..FIRST FLOOR PATIO WALLS -- SEATED RECEIVER
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 0
BARRIER ELEVATION..... 0
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 95
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 72.95
M.TRK NOISE LEVEL..... 65.55
H.TRK NOISE LEVEL..... 65.83
SOURCE NOISE LEVEL..... 74.34

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
0.00	74.34	0.00
0.50	74.34	0.00
1.00	74.34	0.00
1.50	74.34	0.00
2.00	74.34	0.00
2.50	74.34	0.00
3.00	70.48	3.86
3.50	68.92	5.42
4.00	68.20	6.13
4.50	67.48	6.85
5.00	66.57	7.76
5.50	65.60	8.73
6.00	64.66	9.67
6.50	63.79	10.55
7.00	63.00	11.34
7.50	62.29	12.05
8.00	61.65	12.69

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APPENDIX 4

INTERIOR NOISE REDUCTION CALCULATIONS

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WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL LIVING ROOM + STC = 24

FLOOR AREA 155

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			329	
WINDOW 1	22	.05	50	0.31548
WINDOW 2	25	.05	0	0.00000
WINDOW 3	32	.05	0	0.00000
SGD	22	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	155	0.01550
FLOOR		.6	155	
ET*S				0.33828
-10LOG(ET*S)				4.7
10LOGA				20.7
NOISE REDUCTION				19.5

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL LIVING ROOM + STC = 26

FLOOR AREA 155

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			329	
WINDOW 1	24	.05	50	0.19905
WINDOW 2	27	.05	0	0.00000
WINDOW 3	34	.05	0	0.00000
SGD	24	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	155	0.01550
FLOOR		.6	155	
ET*S				0.22185
-10LOG(ET*S)				6.5
10LOGA				20.7
NOISE REDUCTION				21.3

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL LIVING ROOM + STC = 28

FLOOR AREA 155

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			329	
WINDOW 1	26	.05	50	0.12559
WINDOW 2	29	.05	0	0.00000
WINDOW 3	36	.05	0	0.00000
SGD	26	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	155	0.01550
FLOOR		.6	155	

ET*S	0.14839
-10LOG(ET*S)	8.3
10LOGA	20.7
NOISE REDUCTION	23.0

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL LIVING ROOM + STC = 30

FLOOR AREA 155

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			329	
WINDOW 1	28	.05	50	0.07924
WINDOW 2	31	.05	0	0.00000
WINDOW 3	38	.05	0	0.00000
SGD	28	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	155	0.01550
FLOOR		.6	155	
ET*S				0.10204
-10LOG(ET*S)				9.9
10LOGA				20.7
NOISE REDUCTION				24.7

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL LIVING ROOM + STC = 32

FLOOR AREA 155

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			329	
WINDOW 1	30	.05	50	0.05000
WINDOW 2	33	.05	0	0.00000
WINDOW 3	40	.05	0	0.00000
SGD	30	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	155	0.01550
FLOOR		.6	155	

ET*S	0.07280
-10LOG(ET*S)	11.4
10LOGA	20.7
NOISE REDUCTION	26.1

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL LIVING ROOM + STC = 34

FLOOR AREA 155

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			329	
WINDOW 1	32	.05	50	0.03155
WINDOW 2	35	.05	0	0.00000
WINDOW 3	42	.05	0	0.00000
SGD	32	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	155	0.01550
FLOOR		.6	155	
ET*S				0.05435
-10LOG(ET*S)				12.6
10LOGA				20.7
NOISE REDUCTION				27.4

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL BEDROOM + STC = 24

FLOOR AREA 114

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		18	0.00090
EXT.WALL 3	50		0	0.00000
INT.WALL			278	
WINDOW 1	22	.05	24	0.15143
WINDOW 2	25	.05	0	0.00000
WINDOW 3	32	.05	0	0.00000
SGD	22	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	114	0.01140
FLOOR		.6	114	
ET*S				0.17103
-10LOG(ET*S)				7.7
10LOGA				19.5
NOISE REDUCTION				21.2

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL BEDROOM + STC = 26

FLOOR AREA 114

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		18	0.00090
EXT.WALL 3	50		0	0.00000
INT.WALL			278	
WINDOW 1	24	.05	24	0.09555
WINDOW 2	27	.05	0	0.00000
WINDOW 3	34	.05	0	0.00000
SGD	24	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	114	0.01140
FLOOR		.6	114	

ET*S	0.11515
-10LOG(ET*S)	9.4
10LOGA	19.5
NOISE REDUCTION	22.9

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL BEDROOM + STC = 28

FLOOR AREA 114

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		18	0.00090
EXT.WALL 3	50		0	0.00000
INT.WALL			278	
WINDOW 1	26	.05	24	0.06029
WINDOW 2	29	.05	0	0.00000
WINDOW 3	36	.05	0	0.00000
SGD	26	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	114	0.01140
FLOOR		.6	114	
ET*S				0.07989
-10LOG(ET*S)				11.0
10LOGA				19.5
NOISE REDUCTION				24.5

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL BEDROOM + STC = 30

FLOOR AREA 114

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		18	0.00090
EXT.WALL 3	50		0	0.00000
INT.WALL			278	
WINDOW 1	28	.05	24	0.03804
WINDOW 2	31	.05	0	0.00000
WINDOW 3	38	.05	0	0.00000
SGD	28	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	114	0.01140
FLOOR		.6	114	

ET*S	0.05764
-10LOG(ET*S)	12.4
10LOGA	19.5
NOISE REDUCTION	25.9

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL BEDROOM + STC = 32

FLOOR AREA 114

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		18	0.00090
EXT.WALL 3	50		0	0.00000
INT.WALL			278	
WINDOW 1	30	.05	24	0.02400
WINDOW 2	33	.05	0	0.00000
WINDOW 3	40	.05	0	0.00000
SGD	30	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	114	0.01140
FLOOR		.6	114	
ET*S				0.04360
-10LOG(ET*S)				13.6
10LOGA				19.5
NOISE REDUCTION				27.1

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME TYPICAL BEDROOM + STC = 34

FLOOR AREA 114

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		73	0.00730
EXT.WALL 2	43		18	0.00090
EXT.WALL 3	50		0	0.00000
INT.WALL			278	
WINDOW 1	32	.05	24	0.01514
WINDOW 2	35	.05	0	0.00000
WINDOW 3	42	.05	0	0.00000
SGD	32	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	114	0.01140
FLOOR		.6	114	

ET*S	0.03475
-10LOG(ET*S)	14.6
10LOGA	19.5
NOISE REDUCTION	28.1

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APPENDIX 5

PLUMBING AND ELECTRICAL INSTALLATIONS

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CHRISTOPHER JEAN & ASSOCIATES, INC.
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PLUMBING NOISE REDUCTION REQUIREMENTS FOR COMPLIANCE WITH THE CALIFORNIA CODE OF REGULATIONS TITLE 24, PART 2, APPENDIX CHAPTER 35

REQUIRED PLUMBING DESIGN FEATURE IN COMON WALL AND FLOOR/CEILING ASSEMBLIES

The plumbing system, by its nature, can degrade the acoustical integrity of a common wall or floor/ceiling assembly. This is primarily due to the fact that the plumbing system, a sound carrier and a sound source, is generally attached to the studs, plates, joists and drywall of a building's walls and floors. In order to alleviate the problem of plumbing system noise, one hundred percent of the plumbing system must be isolated from the building structure (not just at the common assemblies). Special installation requirements are necessary in order to:

(1) reduce the level of noise from the plumbing system, and

(2) isolate the total plumbing system from the building structure.

These special isolation procedures may be accomplished by using an approved commercial isolation system. Hard plastic "isolators" are **NOT** acceptable. Examples of approved commercial isolation systems in order of preference are:

(1) "Acousto-Plumb" ™ system by Specialty Products, Inc. (www.ispproducts.com),

(2) Holdrite Silencer System by Holdrite, Inc. (www.holdrite.com), and

(3) the felt lined series of isolators, clamps and hangers from Tolco, Inc.

Only when appropriate commercial isolation products are not available for unusual applications or extra large pipe sizes, will it be acceptable to use high density, 1/4" thick, 2" wide, adhesive backed felt wrap and/or 1/2" thick pre-formed, self-adhesive foam rubber pipe insulation such as Armaflex or Rubatex. If the felt wrap or pre-formed pipe insulation is used,

great care must be taken not to compress the insulation material when strapping or anchoring the attachment points. Use of expanding foam products as plumbing isolation is **strictly prohibited**.

SUPPLY LINES

- All hot and cold water pipes, fittings and valves shall NEVER come in direct contact with either the building structure framing or drywall. Supply lines are to be isolated using Acousto-Plumb, Holdrite Silencer System, Tolco I.S.P. felt lined isolator products, 1/4" high density felt wrap or 1/2" pre-formed pipe insulation. Acousto-Plumb products and installation details can be found at www.lspproducts.com. Holdrite Silencer System products and installation details can be found at www.holdrite.com. Tolco I.S.P. products can be found at www. cooperindustries.com. Installation details for use of felt wrap or pre-formed pipe insulation are available upon request and approval. If felt wrap or pre-formed pipe insulation are used (and only with prior written approval by the acoustical consultant when appropriate commercial isolation products cannot be located), these installation details must be followed to the letter. No deviations from these details will be allowed.

- All sink and shower faucets, spouts and risers shall be isolated with resilient gaskets that are positioned between the faucet, spout or riser and its mounting surface.

- Water supply stub-outs shall be temporarily isolated from the drywall using the Acousto-Sleeve ™ during drywall installation, and then permanently isolated using the Acousto-Scutcheon ™ or resilient caulking and a standard plumbing escutcheon.

- Water pressure shall not exceed 65 psi.

- Shower head flow restrictors shall be used to limit water flow to less than three (3) gallons per minute.

- The pipe stubs commonly installed to combat water hammer are not effective. A commercially produced water hammer device consisting of a bellows, similar to that made by Plumbing Products, Inc., is recommended.

- Sections of the plumbing supply system employing PEX (cross linked polyethylene tubing) do not require acoustical isolation except where it transitions to or from conventional copper lines.

WASTE LINES

- The cavity under plastic or fiberglass tubs and showers shall be packed with fiberglass or spray-on insulation materials and/or lightweight concrete pours. The bottoms of such tubs shall be blocked or supported by lightweight concrete to reduce drumming.

- All waste lines above the slab and at the penetrations of any floor/ceiling assemblies and any walls (including non-common walls) shall be cast iron. The use of ABS waste lines is not recommended. If ABS is used, the entire framing cavity surrounding the ABS pipe shall be completely packed with fiberglass, mineral wool or spray–on adhesive cellulose insulation materials. All elbows below toilet and tub waste outlets shall be isolated from all positioning blocks using carpet padding or high-density 1/4" felt material. The entire framing cavity surrounding these elbows shall be completely packed with fiberglass, mineral wool or spray-on adhesive cellulose insulation materials.

- Waste lines of a diameter greater than two and a half inches (2.5") shall never be installed in a wall framed with less than 2" by 6" studs. Walls framed with 2" by 4" studs simply don't allow sufficient clearance to properly insulate and isolate waste lines and/or avoid pipe contact with the drywall.

Failure to COMPLETELY isolate the plumbing system from the building structure will result in a significant transfer of plumbing noise into the building. Therefore, it is important that all of the above measures and techniques are employed. Collectively, these measures and techniques act as parts of a complete system, each designed to perform a particular function of the total effort. Any circumvention of the function of any one component, whether intentional or not, will ultimately lessen the effectiveness of the entire system. **QUALITY CONTROL IS CRITICAL TO PROPER PLUMBING SYSTEM ISOLATION.**