APPENDIX E:

NOISE STUDY

Christopher Jean & Associates, Inc.,
Acoustical Analysis, Juniper Grove Apartments, City of Palmdale,
November 15, 2018.

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CHRISTOPHER JEAN & ASSOCIATES, INC.
ACOUSTICAL CONSULTING SERVICES

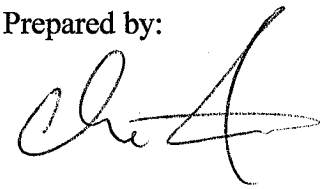
November 15, 2018

ACOUSTICAL ANALYSIS

JUNIPER GROVE APARTMENTS

CITY OF PALMDALE

Prepared by:



Christopher Jean, INCE

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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 Juniper Grove Apartments project located at Avenue R and Division Street 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 four feet (4') high must be erected around all first floor patios facing Avenue R or Division Street. Barriers at least three and a half feet (3.5') high must be erected around all second floor balconies facing Avenue R or Division Street. Barriers at least three feet (3') high must be erected around all third floor balconies facing Avenue R or Division Street.

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 26 glazing to all rooms with any view toward Avenue R and/or Division Street.

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 Juniper Grove Apartments project located at Avenue R and Division Street 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 as well as between living units.

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 requires 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.

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 Avenue R and Division Street year 2028 forecast traffic volumes were obtained by applying a growth rate of two percent per year to the existing traffic volumes published on the City of Palmdale Traffic Volume Map. 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
AVENUE R AND DIVISION STREET

	% 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 = 12,100 ADT on Avenue R
= 6,600 ADT on Division Street

Speed = 50 MPH on Avenue R/45 MPH on Division Street (as posted)

The SR 14 Freeway forecast traffic volume was obtained from CALTRANS data. CALTRANS data was also used for the percentage of truck traffic and to project the distribution by time of day. The input data is listed in Table 3 on the following page.

TABLE 3

TRAFFIC INPUT DATA – SR 14 FREEWAY

	% DAY	% EVENING	% NIGHT	% VOLUME
Autos	73.00	8.60	18.40	94.8
Medium Trucks	73.00	8.60	18.40	2.4
Heavy Trucks	69.10	6.70	24.20	2.8
Volume =	101,000 ADT			
Speed =	65 MPH			

The calculations are contained in Appendix 2. The calculations yield design noise levels of 71 dBA CNEL at 50 feet from the centerline of Avenue R, 67 dBA CNEL at 50 feet from the centerline of Division Street, and 64 dBA CNEL at 1,300 feet from the centerline of the SR 14 Freeway.

3.2 RAILROAD

A line of the Metrolink and Union Pacific railroads parallels Sierra Highway approximately 3,600 feet from the project site. Though train horns will sometimes be audible, distance plus terrain and building shielding means that train operations will not impact the project site as defined by City standards.

3.3 AIRCRAFT

The Palmdale Airport/Plant 42 Noise Contours are shown on Exhibit 4. Exhibit 4 shows that the 60 dBA CNEL contour does not extend south of Avenue P. Though aircraft operations will frequently be audible, aircraft noise will not impact the project site as defined by City standards.

4.0 MITIGATION MEASURES

4.1 EXTERIOR

The mitigation of exterior noise would require sound barriers for all private patios and balconies facing the roadways. For purposes of analysis, the barrier height calculations assume that the barrier is located at the top of any slope between the roadway and building pads, and is only intended to reduce exterior noise to 65 dBA CNEL at each patio and balcony. The assumptions for the barrier height calculations are listed in Table 4.

TABLE 4

BARRIER ANALYSIS GENERAL ASSUMPTIONS
FOR RECEIVER AND SOURCE GEOMETRY

RECEIVER ASSUMPTIONS	
HORIZONTAL GEOMETRY	VERTICAL GEOMETRY
Distance behind top-of-roadways barrier: 5' to 10'	Height above pad for ground level receivers: 3' (seated receiver)
Distance behind individual patio and balcony barriers: 3' to 5'	Height above pad for second level receivers: 12'

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 barriers at least four feet (4') high must be erected around all first floor patios facing Avenue R or Division Street. Barriers at least three and a half feet (3.5') high must be erected around all second floor balconies facing Avenue R or Division Street. Barriers at

least four feet (3') high must be erected around all third floor balconies facing Avenue R or Division Street. Sound barriers made of transparent materials will cause the least impact on the architectural look of the project, and will not impact occupant views.

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 5.

TABLE 5

BASIC BUILDING SHELL CHARACTERISTICS

PANEL	CONSTRUCTION
Exterior Wall	Siding or stucco, 2" X 4" studs, R-13 fiberglass insulation, 5/8" 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 5 construction minimums will provide around 20 dBA of interior noise reduction. This will be adequate for all units exposed to exterior noise levels as high as 65 dBA CNEL. However, units with a view of Avenue R will be exposed to exterior noise levels as high as 68 dBA CNEL. These units will require interior noise reduction levels as high as 23 dBA. Since this may be beyond the normal yield of Table 5 construction, specific room calculations were performed to determine the level of interior noise mitigation necessary to achieve compliance with the 45 dBA CNEL interior standard.

The calculations are contained in Appendix 4, and the results are given in Table 6.

TABLE 6

ROOM NOISE REDUCTION VALUES

	NOISE REDUCTION VS. GLAZING STC								
ROOM	24	26	28	30	32	34	36	38	40
Bedroom	22	24	25	27	28	28	29	30	30
Living Room	21	23	25	26	27	28	29	30	30

The results of Table 9 show that Table 7 construction should be adequate for all units with the following exceptions:

(1) Add STC 26 glazing to all rooms with any view of Avenue R and/or Division Street.

5.3 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.

5.4 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)

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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:

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(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.

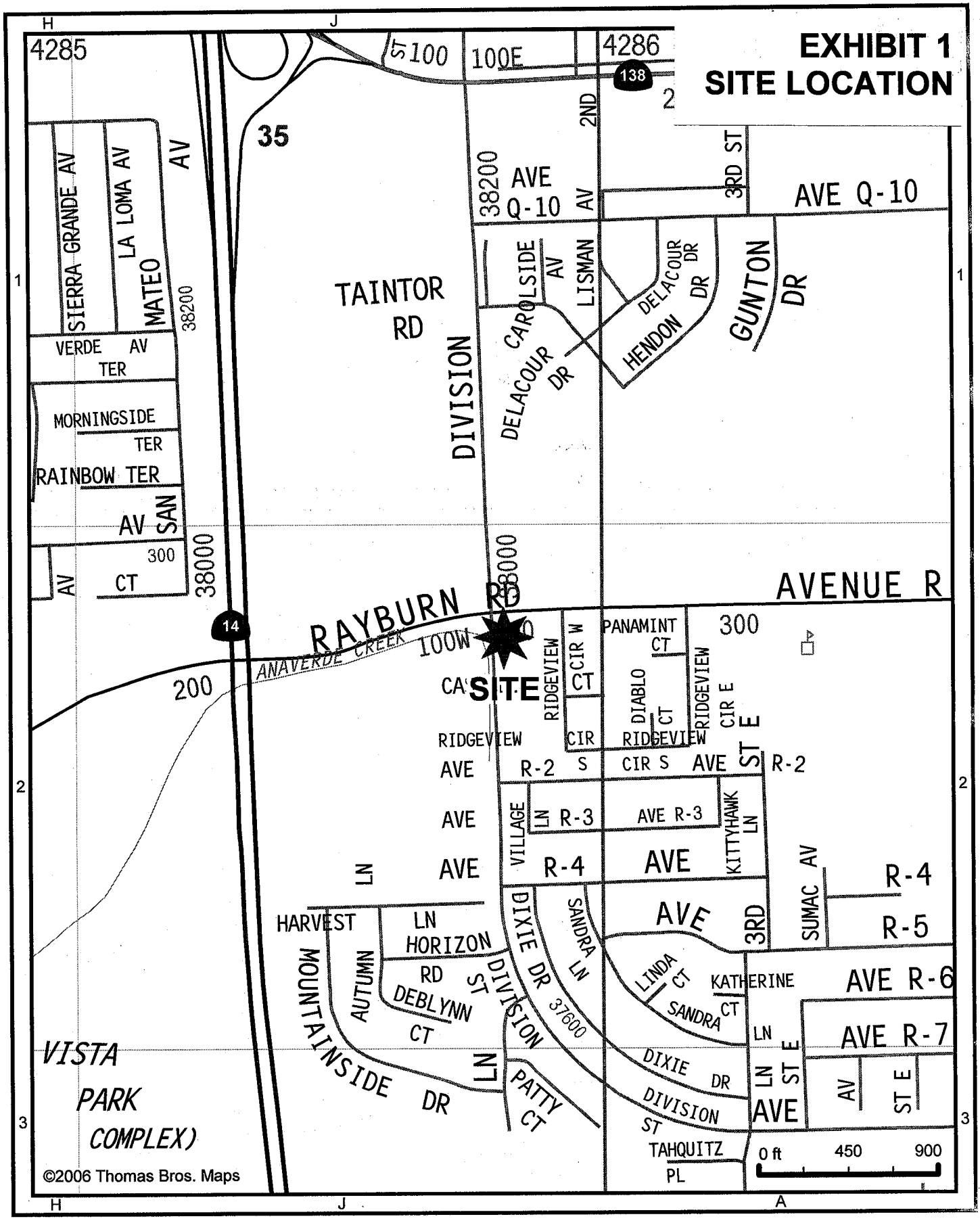
5.5 PROJECT DISCLOSURE

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 LOCATION



SITE: 100 Avenue R, Palmdale,CA 93550, 4285 - J2

EXHIBIT 2
AERIAL PHOTO

Google Maps Juniper Grove Apartments

Imagery ©2018 DigitalGlobe, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2018 Google 100 ft

EXHIBIT 3
SITE PLAN

NOTES:

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED) KEYNOTES:

1. SECURITY CAMERA
BUILDING SHALL BE PRE-WIRED FOR CLOSED-CIRCUIT SURVEILLANCE CAMERAS IN PARKING AREAS, MAIN ENTRANCES, EXTERIOR EXIT DOORS AND COMMON AREAS NOT DIRECTLY ADJACENT TO REGULARLY OCCUPIED ROOMS

2. SITE LIGHTING:
A) WALL MOUNTED EXTERIOR LIGHT FIXTURE AROUND PERIMETER OF BUILDING (LIGHT SHALL SHINE DOWNWARD)
B) PARKING AREA AND OVERALL SITE SHALL HAVE ADEQUATE AND UNIFORMLY DISTRIBUTED LIGHTING.

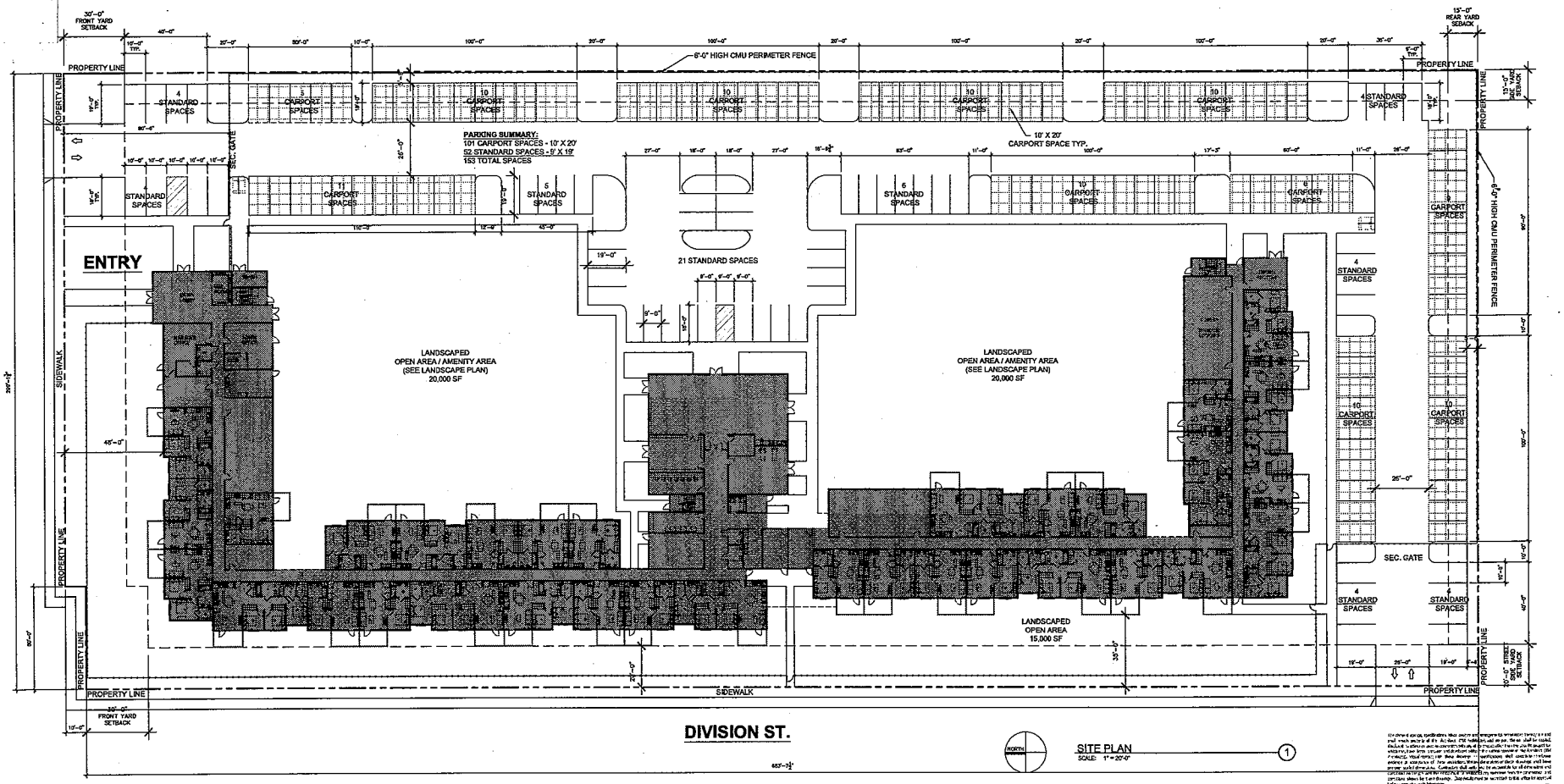
REQUIRED SUSTAINABLE BUILDING METHODS:

01. BCSC MULTI-FAMILY BUILDING RATED EXTERIOR ENHANCED: ALL NEW CONSTRUCTION PROJECTS MUST MEET MINIMUM CONSTRUCTION STANDARDS DEFINED BY TCAC REGULATIONS SECTION 10325(f)(7)(A).

02. OUTDOOR WATER CONSERVATION MEASURES:
ALL PROJECTS MUST INCORPORATE OUTDOOR WATER CONSERVATION MEASURES THAT INCLUDE (NOT APPLICABLE FOR PROJECTS WITH GRAYWATER IRRIGATION SYSTEMS):
A) USE NATIVE OR DROUGHT-TOLERANT PLANTS FOR A MINIMUM OF 75% OF LANDSCAPED AREA; SELECT PLANTS FROM LOS ANGELES COUNTY'S DROUGHT-TOLERANT PLANT LIST FOUND AT HTTP://PLANNING.LACOUNTY.GOV/TODER, OR THE LOCAL JURISDICTION'S DROUGHT-TOLERANT PLANT LIST, IF REQUIRED TO DO SO BY THE LOCAL JURISDICTION.
B) LIMIT CONVENTIONAL GRASS/TURF TO 25% OF LANDSCAPED AREA.
C) GROUP PLANTS WITH SIMILAR WATERING NEEDS (HYDROZONES).
D) INSTALL HIGH EFFICIENCY IRRIGATION SYSTEM WITH SMART IRRIGATION CONTROLS FOR ALL LANDSCAPING.

03. RECYCLING:
ALL PROJECTS, AT MINIMUM, SHALL RECYCLE AND/OR SALVAGE 75% OF NON-HAZARDOUS CONSTRUCTION AND DEMOLITION DEBRIS.

04. RECYCLING AREA:
ALL PROJECTS SHALL PROVIDE AN EASILY-ACCESSIBLE RECYCLING AREA FOR TENANT USE THAT SERVES THE ENTIRE BUILDING.



SITE PLAN
SCALE: 1" = 20'-0" ①

Y&M Architects

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Los Angeles, CA 90014
Tel. 213 623 2107 Fax. 213 623 2108
www.ymarch.com

JUNIPER GROVE - PALMDALE
Project. AVENUE R AND DIVISION STREET

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

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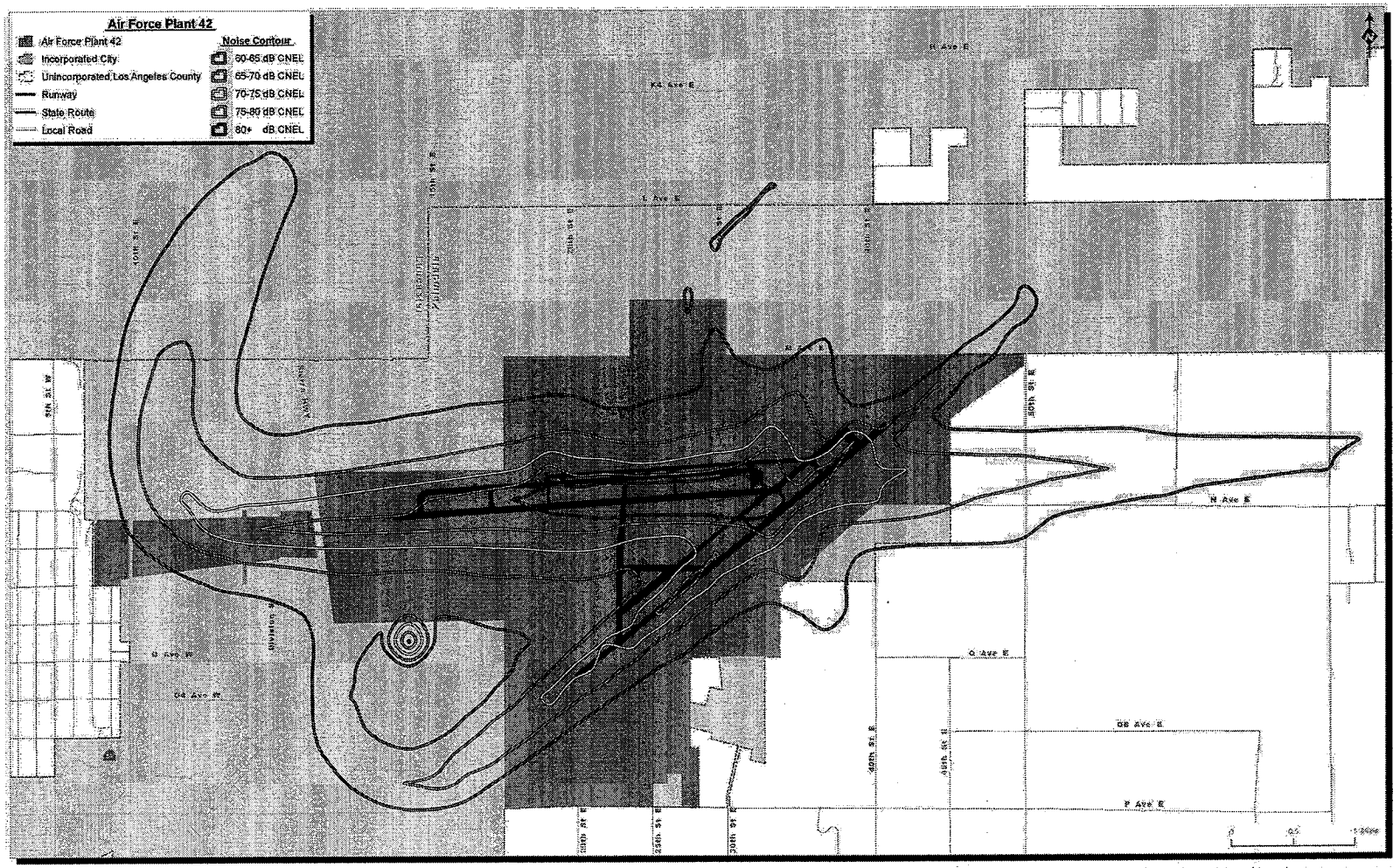

Figure 3-3. Air Force Plant 42 – Community Noise Equivalent Level (CNEL)

EXHIBIT 4
AIRCRAFT NOISE

CHRISTOPHER JEAN & ASSOCIATES, INC.
ACOUSTICAL CONSULTING SERVICES

APPENDIX 1

NOISE RATING METHODOLOGY

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ACOUSTICAL CONSULTING SERVICES

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 ROADWAY NOISE CALCULATIONS

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PHONE: 714-805-0115

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..FIRST FLOOR PATIOS FACING AVENUE R
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 0
BARRIER ELEVATION..... 0
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 97
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 69.51
M.TRK NOISE LEVEL..... 62.19
H.TRK NOISE LEVEL..... 63.03
SOURCE NOISE LEVEL..... 71.00

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	67.28	3.73
3.50	65.60	5.41
4.00	64.88	6.12
4.50	64.17	6.84
5.00	63.26	7.74
5.50	62.29	8.71
6.00	61.35	9.65

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..SECOND FLOOR BALCONIES FACING AVENUE R
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 10
BARRIER ELEVATION..... 10
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 97
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 69.51
M.TRK NOISE LEVEL..... 62.19
H.TRK NOISE LEVEL..... 63.03
SOURCE NOISE LEVEL..... 71.00

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	65.61	5.39
3.50	64.89	6.11
4.00	64.17	6.83
4.50	63.24	7.76
5.00	62.24	8.76
5.50	61.27	9.73
6.00	60.37	10.63

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..THIRD FLOOR BALCONIES FACING AVENUE R
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 20
BARRIER ELEVATION..... 20
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 97
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 69.51
M.TRK NOISE LEVEL..... 62.19
H.TRK NOISE LEVEL..... 63.03
SOURCE NOISE LEVEL..... 71.00

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	64.92	6.09
3.50	64.21	6.79
4.00	63.28	7.72
4.50	62.26	8.74
5.00	61.27	9.74
5.50	60.34	10.66
6.00	59.50	11.51

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUINPER GROVE APARTMENTS
DESCRIPTION..FIRST FLOOR PATIOS FACING DIVISION STREET
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 0
BARRIER ELEVATION..... 0
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 77
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 66.76
M.TRK NOISE LEVEL..... 59.8
H.TRK NOISE LEVEL..... 62.2
SOURCE NOISE LEVEL..... 68.67

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	65.38	3.29
3.50	63.26	5.41
4.00	62.58	6.09
4.50	61.83	6.83
5.00	60.93	7.73
5.50	59.96	8.70
6.00	59.02	9.65

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..FIRST FLOOR PATIOS FACING FREEWAY
SOURCE ELEVATION..... 20
RECEIVER ELEVATION..... 0
BARRIER ELEVATION..... 0
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 1300
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 61.48
M.TRK NOISE LEVEL..... 55.07
H.TRK NOISE LEVEL..... 59.6
SOURCE NOISE LEVEL..... 64.22

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	64.22	0.00
3.50	59.01	5.21
4.00	58.29	5.92
4.50	57.68	6.54
5.00	56.85	7.36
5.50	55.92	8.29
6.00	55.00	9.22

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..SECOND FLOOR BALCONIES FACING DIVISION STREET
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 10
BARRIER ELEVATION..... 10
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 77
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 66.76
M.TRK NOISE LEVEL..... 59.8
H.TRK NOISE LEVEL..... 62.2
SOURCE NOISE LEVEL..... 68.67

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	63.12	5.55
3.50	62.43	6.24
4.00	61.64	7.03
4.50	60.68	7.99
5.00	59.67	9.00
5.50	58.70	9.97
6.00	57.81	10.86

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APATMENTS
DESCRIPTION..SECOND FLOOR BALCONIES FACING FREEWAY
SOURCE ELEVATION..... 20
RECEIVER ELEVATION..... 10
BARRIER ELEVATION..... 10
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 1300
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 61.48
M.TRK NOISE LEVEL..... 55.07
H.TRK NOISE LEVEL..... 59.6
SOURCE NOISE LEVEL..... 64.22

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	64.22	0.00
3.50	58.97	5.25
4.00	58.22	6.00
4.50	57.62	6.60
5.00	56.78	7.44
5.50	55.84	8.37
6.00	54.92	9.30

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..THIRD FLOOR BALCONIES FACING DIVISION STREET
SOURCE ELEVATION..... 0
RECEIVER ELEVATION..... 20
BARRIER ELEVATION..... 20
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 77
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 66.76
M.TRK NOISE LEVEL..... 59.8
H.TRK NOISE LEVEL..... 62.2
SOURCE NOISE LEVEL..... 68.67

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.00	62.30	6.37
3.50	61.49	7.18
4.00	60.50	8.17
4.50	59.47	9.19
5.00	58.49	10.18
5.50	57.59	11.08
6.00	56.77	11.90

BARRIER NOISE REDUCTION ANALYSIS

PROJECT.....JUNIPER GROVE APARTMENTS
DESCRIPTION..THIRD FLOOR BALCONIES FACING FREEWAY
SOURCE ELEVATION..... 20
RECEIVER ELEVATION..... 20
BARRIER ELEVATION..... 20
RECEIVER HEIGHT..... 3
DISTANCE TO SOURCE..... 1300
DISTANCE TO RECEIVER... 5
AUTO NOISE LEVEL..... 61.48
M.TRK NOISE LEVEL..... 55.07
H.TRK NOISE LEVEL..... 59.6
SOURCE NOISE LEVEL..... 64.22

ANGULAR CORRECTION(DB) - 0

WALL HEIGHT	NOISE LEVEL	INSERTION LOSS
3.10	59.20	5.01
3.50	58.93	5.29
4.00	58.15	6.07
4.50	57.56	6.66
5.00	56.70	7.51
5.50	55.76	8.45
6.00	54.84	9.38

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APPENDIX 4

INTERIOR NOISE REDUCTION CALCULATIONS

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PHONE: 714-805-0115

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 24

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	22	.05	16	0.10095
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	100	0.01000
FLOOR		.6	100	
ET*S				0.11876
-10LOG(ET*S)				9.3
10LOGA				18.9
NOISE REDUCTION				22.1

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 26

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	24	.05	16	0.06370
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	100	0.01000
FLOOR		.6	100	
ET*S				0.08150
-10LOG(ET*S)				10.9
10LOGA				18.9
NOISE REDUCTION				23.8

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 28

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	26	.05	16	0.04019
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	100	0.01000
FLOOR		.6	100	
ET*S				0.05799
-10LOG(ET*S)				12.4
10LOGA				18.9
NOISE REDUCTION				25.2

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 30

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	28	.05	16	0.02536
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	100	0.01000
FLOOR		.6	100	
ET*S				0.04316
-10LOG(ET*S)				13.6
10LOGA				18.9
NOISE REDUCTION				26.5

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 32

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	30	.05	16	0.01600
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	100	0.01000
FLOOR		.6	100	
ET*S				0.03380
-10LOG(ET*S)				14.7
10LOGA				18.9
NOISE REDUCTION				27.6

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 34

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	32	.05	16	0.01010
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	100	0.01000
FLOOR		.6	100	
ET*S				0.02790
-10LOG(ET*S)				15.5
10LOGA				18.9
NOISE REDUCTION				28.4

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 36

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	34	.05	16	0.00637
WINDOW 2	37	.05	0	0.00000
WINDOW 3	44	.05	0	0.00000
SGD	34	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	100	0.01000
FLOOR		.6	100	
ET*S				0.02417
-10LOG(ET*S)				16.2
10LOGA				18.9
NOISE REDUCTION				29.0

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 38

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	36	.05	16	0.00402
WINDOW 2	39	.05	0	0.00000
WINDOW 3	46	.05	0	0.00000
SGD	36	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	100	0.01000
FLOOR		.6	100	
ET*S				0.02182
-10LOG(ET*S)				16.6
10LOGA				18.9
NOISE REDUCTION				29.5

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME BEDROOM + STC = 40

FLOOR AREA 100

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		68	0.00680
EXT.WALL 2	43		20	0.00100
EXT.WALL 3	50		0	0.00000
INT.WALL			220	
WINDOW 1	38	.05	16	0.00254
WINDOW 2	41	.05	0	0.00000
WINDOW 3	48	.05	0	0.00000
SGD	38	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	100	0.01000
FLOOR		.6	100	
ET*S				0.02034
-10LOG(ET*S)				16.9
10LOGA				18.9
NOISE REDUCTION				29.8

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 24

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	22	.05	36	0.22714
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	173	0.01730
FLOOR		.6	173	
ET*S				0.25244
-10LOG(ET*S)				6.0
10LOGA				21.1
NOISE REDUCTION				21.1

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 26

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	24	.05	36	0.14332
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	173	0.01730
FLOOR		.6	173	
ET*S				0.16862
-10LOG(ET*S)				7.7
10LOGA				21.1
NOISE REDUCTION				22.8

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 28

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	26	.05	36	0.09043
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	173	0.01730
FLOOR		.6	173	
ET*S				0.11573
-10LOG(ET*S)				9.4
10LOGA				21.1
NOISE REDUCTION				24.5

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 30

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	28	.05	36	0.05706
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	173	0.01730
FLOOR		.6	173	
ET*S				0.08236
-10LOG(ET*S)				10.8
10LOGA				21.1
NOISE REDUCTION				26.0

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 32

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	30	.05	36	0.03600
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	173	0.01730
FLOOR		.6	173	
ET*S				0.06130
-10LOG(ET*S)				12.1
10LOGA				21.1
NOISE REDUCTION				27.2

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 34

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	32	.05	36	0.02271
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	173	0.01730
FLOOR		.6	173	
ET*S				0.04801
-10LOG(ET*S)				13.2
10LOGA				21.1
NOISE REDUCTION				28.3

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 36

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	34	.05	36	0.01433
WINDOW 2	37	.05	0	0.00000
WINDOW 3	44	.05	0	0.00000
SGD	34	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	173	0.01730
FLOOR		.6	173	
ET*S				0.03963
-10LOG(ET*S)				14.0
10LOGA				21.1
NOISE REDUCTION				29.1

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 38

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	36	.05	36	0.00904
WINDOW 2	39	.05	0	0.00000
WINDOW 3	46	.05	0	0.00000
SGD	36	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	173	0.01730
FLOOR		.6	173	
ET*S				0.03434
-10LOG(ET*S)				14.6
10LOGA				21.1
NOISE REDUCTION				29.8

WORK SHEET FOR CALCULATING ROOM NOISE REDUCTION VALUE

ROOM NAME LIVING ROOM + STC = 40

FLOOR AREA 173

SURFACES	TL	@	AREA	T*S
EXT.WALL 1	40		80	0.00800
EXT.WALL 2	43		0	0.00000
EXT.WALL 3	50		0	0.00000
INT.WALL			309	
WINDOW 1	38	.05	36	0.00571
WINDOW 2	41	.05	0	0.00000
WINDOW 3	48	.05	0	0.00000
SGD	38	.05	0	0.00000
DOORS	0	.04	0	0.00000
ROOF	40	.04	173	0.01730
FLOOR		.6	173	
ET*S				0.03101
-10LOG(ET*S)				15.1
10LOGA				21.1
NOISE REDUCTION				30.2

CHRISTOPHER JEAN & ASSOCIATES, INC.
ACOUSTICAL CONSULTING SERVICES

APPENDIX 5

PLUMBING AND ELECTRICAL INSTALLATIONS

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PHONE: 714-805-0115

CHRISTOPHER JEAN & ASSOCIATES, INC.
ACOUSTICAL CONSULTING SERVICES

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.**

CHRISTOPHER JEAN & ASSOCIATES, INC.
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ELECTRICAL SYSTEM INSTALLATION NOTES

The following items shall be incorporated into the building plans:

COMMON WALLS

- Electrical outlets, switches, phone jacks, television antennae boxes and computer outlet boxes installed in opposite sides of a common wall shall be offset a minimum of 24" to comply with the fire code. This offset is not needed for acoustical reasons if insulation is used in the framing cavities and Lowry's #10 putty pads or 3M fire pads are applied around the backs and sides of all outlets, switches, phone jacks, etc.
- All electrical outlets, switches, phone jacks, television antennae boxes and computer outlet boxes installed in common walls shall be backed by and Lowry's #10 putty pads, 3M fire pads or equivalent. Pads shall be stapled to the studs to insure that they remain in place indefinitely (the adhesive backing of the pads deteriorates over time).
- Wiring shall avoid crossing over the air gap of common walls. Where unavoidable, wiring crossovers between common wall studs shall include a loop where the depth is equal to its width.
- Electrical panel boxes, fixture boxes or outlet boxes greater than 25 square inches shall be set in raised boxes that do not touch the opposite side of the common wall.

COMMON FLOOR/CEILINGS

- Recessed lighting shall be set in recessed and airtight boxes made of plywood or drywall.
- All other precautions applicable to common wall installations shall also apply to common floor/ceiling installations.

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