Park Delmas

San Jose, California

Environmental Noise and Vibration Feasibility Study

16 April 2014

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CSA Project Number: 14-0077

PROJECT DESCRIPTION

This report provides an environmental noise and vibration study for the proposed residential development at Park Delmas in San Jose, California. The purpose of the study is to determine the noise and vibration environments at the site, compare the measured data with the applicable project criteria, and propose mitigation measures as necessary. This report summarizes the results of our study.

The project site is located in the City of San Jose, on the southwest corner of the intersection of Park Avenue and Delmas Avenue. The proposed project will consist of 106 condominiums and ground floor retail space. There are commercial properties to the west and south of the site, residential properties to the north, and a dog park to the west of the site. A Valley Transit Authority (VTA) light rail corridor is located to the east of the site. The major noise sources affecting the project site are vehicular traffic along the nearby roadways, aircraft flyovers, and light rail traffic on the VTA line.

In summary, interior noise levels would be reduced to meet City standards by incorporating sound-rated assemblies at exterior building facades. Vibration levels are below the applicable FTA criteria. Appendix A and Figure A1 contain more information about the fundamental concepts of environmental noise.

PROJECT CRITERIA

State of California – California Building Code (CBC)

The 2013 California Building Code does not currently include an exterior noise intrusion criterion. However, the CBC has historically required that the indoor noise level in residential units of multi-family dwellings not exceed L_{dn}[1] 45 dB where the exterior noise level is greater than L_{dn} 60 dB. This is our recommended criterion.

City of San Jose, California – Envision San Jose 2040 General Plan

The City of San Jose General Plan contains several goals outlining noise and vibration standards for new residential development. The following policies apply to this site:

EC-1.1 Locate new development in areas where noise levels are appropriate for the proposed uses. Consider federal, state, and City noise standards and guidelines as part of a new development review. Applicable standards and guidelines for land uses in San Jose include:

> Interior Noise Levels – The City's standard for interior noise levels in residences, hotels, motels, residential care facilities, and hospitals is 45 dBA DNL. Include appropriate site and building design, building construction and noise attenuation techniques in new development to meet this standard. For sites with exterior noise levels of 60 dBA DNL or more, an acoustical analysis following protocols in the City-adopted California Building Code is required to demonstrate that development projects can meet this standard. The acoustical analysis shall base required noise attenuation techniques on expected Envision General Plan traffic volumes to ensure land use compatibility and General Plan consistency over the life of this plan.

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[1] Day-Night Average Sound Level (DNL or L_{dn}) – A descriptor established by the U.S. Environmental Protection Agency to represent a 24-hour average noise level with a 10 dB penalty applied to noise occurring during the nighttime hours (10 pm to 7 am) to account for the increased sensitivity of people during sleeping hours.

Exterior Noise Levels – The City's acceptable exterior noise level objective is 60 dBA DNL or less for residential and most institutional land uses (Table 1). The acceptable exterior noise level objective is established for the City, except in the environs of the San Jose International Airport and the Downtown, as described below:

- For new multi-family residential projects and for the residential component of mixed-use development, use a standard of 60 dBA DNL in usable outdoor activity areas, excluding balconies and residential stoops and porches facing existing roadways. Some common use areas that meet the 60 dBA DNL exterior standard will be available to all residents. Use noise attenuation techniques such as shielding by buildings and structures for outdoor common use areas. On sites subject to aircraft overflights or adjacent to elevated roadways, use noise attenuation techniques to achieve the 60 dBA DNL standard for noise from sources other than aircraft and elevated roadway segments[2].

- For single family residential uses, use a standard of 60 dBA DNL for exterior noise in private usable outdoor activity areas, such as backyards.

TABLE 1: LAND USE COMPATIBILITY FOR RESIDENTIAL COMMUNITY EXTERIOR NOISE ENVIRONMENTS

Less than 60 dB	**Normally Acceptable**: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
Between 60 dB and 75 dB	**Conditionally Acceptable**: Specified land-use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.
Greater than 75 dB	**Unacceptable**: New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies.

EC-1.9 Require noise studies for land use proposals where known or suspected loud intermittent noise sources occur which may impact adjacent existing or planned land uses. For new residential development affected by noise from heavy rail, light rail, BART or other single-event noise sources, implement mitigation so that recurring maximum instantaneous noise levels do not exceed 50 dBA L_{max} in bedrooms and 55 dBA L_{max} in other rooms.

EC-2.1 Near light and heavy rail lines or other sources of ground-bourne vibration, minimize vibration impacts on people, residences, and buildings through the use of setbacks and/or structural design features that reduce vibration levels at or below the guidelines of the Federal Transit Administration. Require new development within 100 feet of the rail lines to demonstrate prior to project approval the vibration experienced by residents and vibration sensitive uses would not exceed these guidelines.

[2] Our understanding is that the noise contribution from aircraft flyovers and elevated roadways should be excluded when calculating exterior noise levels per EC-1.1. Furthermore, there does not appear to be any specific alternate criteria that must be met for these noise sources.

Federal Transit Administration – Transit Noise and Vibration Impact Assessment

The Federal Transit Administration (FTA)[3] lists ground borne vibration (GBV) discusses methods for evaluating vibration levels with respect to various land-uses. This document outlines two methods, a "general assessment" based on frequency of events, and a "detailed assessment", which takes into account the frequency characteristics of each vibration event and compares it to a daytime and nighttime criterion. Since the City of San Jose Noise Element does not indicate which method to use, we have included analysis for both.

General Assessment Criteria

Table 2, below, includes the FTA criteria for ground-borne vibration when using the general assessment.

Table 2: FTA Criteria – General Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch/sec)		
	Frequent Events	Occasional Events	Infrequent Events
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB

Frequent events are defined as more than 70 vibration events of the same source per day. Occasional events are defined as between 30 and 70 vibration events of the same source per day and infrequent events are fewer than 30 vibration events of the same source per day. It should also be noted that the levels above the criteria are in terms of overall linear-weighted vibration levels.

Detailed Assessment Criteria

The daytime and nighttime detailed assessment vibration criteria for residential uses are shown below in Table 3.

Table 3: FTA Criteria – Detailed Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch/sec)	
	Daytime	Nighttime
Residential	78 VdB	72 VdB

The above criterion applies to each third octave-band frequency between 8 and 80 Hz.

[3] Federal Transit Administration, "Transit Noise and Vibration Impact Assessment", May 2006.

County of Santa Clara Airport Land Use Commission Report

The project site is located within the San Jose International Airport (SJC) airport influence area. Per the 26 February 2014 report to the Airport Land Use Commission, the following policy applies:

The SJC noise contours use CNEL for depicting noise disruption from aviation activity due to the penalty added during nighttime activities where aviation noise disruption could affect people the most. The SJC Comprehensive Land Use Plan (CLUP) uses 65, 70, and 75 decibel CNEL noise contours and includes different noise mitigation based on the type of use exposed to aviation noise

The project site is located between the 60 and 65 dBA CNEL contours. The report goes on to state:

> Because the site is located outside of the 65 dBA CNEL noise contour, none of the noise policies contained in the CLUP apply to the subject property.
>
> However, the subject site is located very near the final approach path of runway 30R from the south. Therefore, it should be noted that outdoor activities associated with hotel uses, such as pools and outdoor open space areas, may experience temporary noise disruption from single-event aviation activities, due to the close proximity to the airport. But these disruptions will be short and non-harmful to adjacent noise receptors.

As stated above, the airport noise policies in the CLUP do not apply to this site.

CALGreen Criteria – 2012 California Green Building Standards Code

The 2012 CALGreen Code (Section 5.507.4.3, Acoustical Control) lists environmental noise requirements for non-residential buildings, which would include the commercial spaces at this project. In locations where the exterior noise levels regularly exceed 65 dB, CALGreen requires that the interior noise environment not exceed $L_{eq}(h)$[4] of 50 dB in occupied areas during the hours of operation. We assumed that the hours of operation would be 7 a.m. to 10 p.m.

NOISE ENVIRONMENT

To quantify the existing noise environment at the project site, we conducted noise measurements at the site between 7 February and 18 February 2014. We placed noise monitors at four long-term continuous locations (M1 to M4). A summary of the long-term acoustical measurement locations and measured noise levels are shown below in Tables 4 and 5, and in the attached Figure 1.

We also conducted noise measurements at this site in 2006. The measured L_{dn} across the site were consistent with our previously measured noise levels.

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[4] $L_{eq}(h)$ – The equivalent steady-state A-weighted sound level that, in an hour, would contain the same acoustic energy as the time-varying sound level during the same hour.

Table 4: On-Site Measured Data		
Monitor	**Location**	**Measured L_{dn}**
M1	Approximately 20-feet south of Park Avenue and approximately 180-feet west of Delmas Avenue, 12-feet above grade	72 dB
M2	Approximately 25-feet west of Delmas Avenue and approximately 210-feet south of Park Avenue, 12-feet above grade	72 dB
M3	Approximately 40-feet north of San Carlos Street and approximately 290-feet west of Delmas Avenue, 12-feet above grade	74 dB
M4	Approximately 15-feet east of Sonoma Street and approximately 215-feet south of Park Avenue, 12-feet above grade	68 dB

Table 5 summarizes the single-event recurring maximum noise levels for the site. Our previous noise study noted that typical recurring maximum single-event noise levels from vehicles ranged from 87 to 92 dBA. These measurements were conducted over a 3 to 4 day period, whereas, the recent measurements were conducted over a ten day period. The 2014 measurements capture a larger sample size that more accurately represents typical noise levels surrounding the site.

Table 5: On-Site Measured Data		
Monitor	**Location**	**Recurring Maximum Instantaneous Noise Level (L_{max})[5]**
M1	Approximately 20-feet south of Park Avenue and approximately 180-feet west of Delmas Avenue, 12-feet above grade	88 dB
M2	Approximately 25-feet west of Delmas Avenue and approximately 210-feet south of Park Avenue, 12-feet above grade	89 dB
M3	Approximately 40-feet north of San Carlos Street and approximately 290-feet west of Delmas Avenue, 12-feet above grade	88 dB
M4	Approximately 15-feet east of Sonoma Street and approximately 215-feet south of Park Avenue, 12-feet above grade	89 dB

In addition to looking at the recurring maximum noise levels due to all noise sources, we analyzed our measurements looking specifically at aircraft overflights. Maximum noise levels from the aircraft were typically between 80 and 84 dB. Our previous measurements also indicate that maximum noise levels from aircraft overflights were approximately 81 dBA.

[5] To calculate the recurring maximum instantaneous noise level, we have used the logarithmic average of the top 30 percent of single-event noise levels. We have considered all pass-bys (e.g., cars, sirens, planes, light rail) above 80 dB.

A traffic study has not been provided for this project. For our calculations, we have added 1 decibel to the expected L_{dn} to account for future traffic increases on the nearby roadways[6]. We have assumed no change in the number of daily light rail operations.

ASSESSMENT OF NOISE LEVELS

Exterior Noise Levels

The City General Plan states that exterior noise levels should not exceed an L_{dn} of 60 dB at common outdoor recreation areas in multi-family projects, excluding aircraft flyovers per EC-1.1 of the General Plan. At the central recreation area, noise levels are expected to be below L_{dn} 60 dB. Therefore, no mitigation is needed. As noted above, the site is between the L_{dn} 60 and 65 dB contour lines of the San Jose Airport.

Interior Noise Levels – Residential

To allow the project to meet the City's interior noise requirement of an L_{dn} not exceeding 45 dB(A) in habitable rooms, sound rated assemblies will be required at all exterior building facades. In addition, the City states typical maximum instantaneous noise levels should not exceed 50 dBA in bedrooms and 55 dBA in other habitable rooms. Figures 2 to 5 show the STC ratings necessary to meet the project criteria. For our analysis, we have used the site plan received on 21 February 2014.

STC ratings for selected assemblies should be based on laboratory testing performed in accordance with ASTM E-90 and comprise the entire window or door assembly, including the frame. Acoustical reports are to be submitted for exterior windows and doors indicating they meet the required STC ratings. For reference purposes, a typical construction-grade one-inch insulated, dual-pane window achieves an STC rating of approximately 28 to 30. A qualified acoustical engineer must review the design as it is developed to refine the specific STC ratings once the building design and site layout has been refined.

This mitigation design (i.e. STC ratings and exterior wall construction) predicates the City's policy that "recurring maximum instantaneous" interior noise levels (i.e. truck pass-bys, aircraft flyovers, etc.) should be reduced to 50 dBA in bedrooms and 55 dBA in other habitable rooms. Our design is based on laboratory STC ratings and calculations to allow the design to meet the intent of the City's interior noise standards. It should be noted that the STC ratings shown in Figures 2 to 5 will also reduce interior noise levels to meet the City requirement of an L_{dn} not exceeding 45 dB.

Every unit on the project will need closed windows to meet the project criterion of L_{dn} 45 dB. We understand that all of the units will have split-system heat pumps to provide mechanical ventilation. Any requirements for fresh-air intake should be discussed with the mechanical engineer, if applicable.

Interior Noise Levels – Commercial

We measured maximum hourly L_{eq} noise levels of 73 dB along both Park and Delmas Avenues. Based on these noise levels, and the anticipated 1 decibel increase due to future traffic levels, the commercial space at the corner of Park Avenue and Delmas Avenue should have windows rated at STC 32. This is shown in Figure 2.

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[6] Caltrans assumes a traffic volume increase of three-percent per year, which corresponds to a 1 dB increase over ten years. In the absence of City data, we have used this same formula for the local roads.

ASSESSMENT OF NOISE LEVELS – ALTERNATIVE BUILDING DESIGN

We understand that the project is currently considering an alternative design which would eliminate the connector between the two buildings. This would create an open pathway for noise into the central courtyard and pool area. With the connector removed, L_{dn} at courtyard residences would increase. However, the controlling factor for the window STC ratings is due to the aircraft maximum noise levels, which would not increase. The final window STC ratings at these locations will depend on the unit layout and glazing. We will provide updated recommendations as the design progresses.

At the central courtyard and pool area, noise levels would range from L_{dn} 61 to 68 dB, depending on the proximity to Delmas Avenue. To reduce vehicle noise to meet the City's exterior noise goal of 60 dB L_{dn} or less, an eight-foot barrier would be needed at the courtyard entrance from Delmas Avenue. The barrier must be continuous from grade to top, have no cracks or gaps, and have a minimum surface density of three pounds per square foot (e.g., 1/2-inch laminated glass, one-inch thick marine-grade plywood, CMU). As noted above, the project is between the 60 and 65 dB L_{dn} contour of San Jose Airport.

ASSESSMENT OF GROUNDBORNE VIBRATION

On 7 February and 4 March we conducted vibration measurements at two distances setback from the railroad centerline. Location V1 was located approximately 75 feet from the centerline of the tracks and Location V2 was located approximately 150 feet from the centerline of the tracks (see Figure 6). Vibration levels were measured on 7 February during the morning rush hour, and on 4 March during an evening rush hour during a San Jose Sharks game night. The vibration levels of the light rail pass-bys are shown below in Table 6.

Table 6: On-Site Measured Vibration Data

Location	Measured Linear Vibration Levels (VdB re 1 micro-inch/sec)	Peak Vibration Frequency (Hz)
V1, 75' from rail centerline	55 – 62	10, 16, 20
V2, 150' from rail centerline	48 – 60	10

General Assessment

The schedule for the Winchester – Mountain View VTA line shows that the light rail passes the site more than 70 times during the day, meaning that it is subject to the FTA frequent event criterion of 72 VdB. All of the measured noise levels were below the criterion.

Detailed Assessment

All of the measured vibration levels are below the residential daytime and nighttime maximum vibration criteria of 78 and 72 VdB.

Vibration Measurement Discussion

Vibration levels in this report were measured at-grade. The FTA document also identifies that vibration will change as it enters the building. The effect of the building on vibration is dependant on the structural design. While vibration levels will vary, we expect that they will remain below the FTA criterion. Still, future residents should also be made aware of the proximity of light rail tracks and potential for vibration through disclosure documents.

* * *

This concludes our environmental noise and vibration feasibility study for the Park Delmas project. Should you have any questions, please give us a call.

APPENDIX A

FUNDAMENTAL CONCEPTS OF ENVIRONMENTAL NOISE

This section provides background information to aid in understanding the technical aspects of this report.

Three dimensions of environmental noise are important in determining subjective response. These are:

- The intensity or level of the sound
- The frequency spectrum of the sound
- The time-varying character of the sound

Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in decibels (dB), with 0 dB corresponding roughly to the threshold of hearing.

The "frequency" of a sound refers to the number of complete pressure fluctuations per second in the sound. The unit of measurement is the cycle per second (cps) or hertz (Hz). Most of the sounds, which we hear in the environment, do not consist of a single frequency, but of a broad band of frequencies, differing in level. The name of the frequency and level content of a sound is its sound spectrum. A sound spectrum for engineering purposes is typically described in terms of octave bands, which separate the audible frequency range (for human beings, from about 20 to 20,000 Hz) into ten segments.

Many rating methods have been devised to permit comparisons of sounds having quite different spectra. Surprisingly, the simplest method correlates with human response practically as well as the more complex methods. This method consists of evaluating all of the frequencies of a sound in accordance with a weighting that progressively de-emphasizes the importance of frequency components below 1000 Hz and above 5000 Hz. This frequency weighting reflects the fact that human hearing is less sensitive at low frequencies and at extreme high frequencies relative to the mid-range.

The weighting system described above is called "A"-weighting, and the level so measured is called the "A-weighted sound level" or "A-weighted noise level." The unit of A-weighted sound level is sometimes abbreviated "dBA." In practice, the sound level is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting characteristic. All U.S. and international standard sound level meters include such a filter. Typical sound levels found in the environment and in industry are shown in Figure A-1.

Although a single sound level value may adequately describe environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise is a conglomeration of distant noise sources, which results in a relatively steady background noise having no identifiable source. These distant sources may include traffic, wind in trees, industrial activities, etc. and are relatively constant from moment to moment. As natural forces change or as human activity follows its daily cycle, the sound level may vary slowly from hour to hour. Superimposed on this slowly varying background is a succession of identifiable noisy events of brief duration. These may include nearby activities such as single vehicle pass-bys, aircraft flyovers, etc. which cause the environmental noise level to vary from instant to instant.

To describe the time-varying character of environmental noise, statistical noise descriptors were developed. "L10" is the A-weighted sound level equaled or exceeded during 10 percent of a stated time

period. The L10 is considered a good measure of the maximum sound levels caused by discrete noise events. "L50" is the A-weighted sound level that is equaled or exceeded 50 percent of a stated time period; it represents the median sound level. The "L90" is the A-weighted sound level equaled or exceeded during 90 percent of a stated time period and is used to describe the background noise.

As it is often cumbersome to quantify the noise environment with a set of statistical descriptors, a single number called the average sound level or "Leq" is now widely used. The term "Leq" originated from the concept of a so-called equivalent sound level which contains the same acoustical energy as a varying sound level during the same time period. In simple but accurate technical language, the Leq is the average A-weighted sound level in a stated time period. The Leq is particularly useful in describing the subjective change in an environment where the source of noise remains the same but there is change in the level of activity. Widening roads and/or increasing traffic are examples of this kind of situation.

In determining the daily measure of environmental noise, it is important to account for the different response of people to daytime and nighttime noise. During the nighttime, exterior background noise levels are generally lower than in the daytime; however, most household noise also decreases at night, thus exterior noise intrusions again become noticeable. Further, most people trying to sleep at night are more sensitive to noise. To account for human sensitivity to nighttime noise levels, a special descriptor was developed. The descriptor is called the Ldn (Day/Night Average Sound Level), which represents the 24-hour average sound level with a penalty for noise occurring at night. The Ldn computation divides the 24-hour day into two periods: daytime (7:00 am to 10:00 pm); and nighttime (10:00 pm to 7:00 am). The nighttime sound levels are assigned a 10 dB penalty prior to averaging with daytime hourly sound levels.

For highway noise environments, the average noise level during the peak hour traffic volume is approximately equal to the Ldn.

The effects of noise on people can be listed in three general categories:

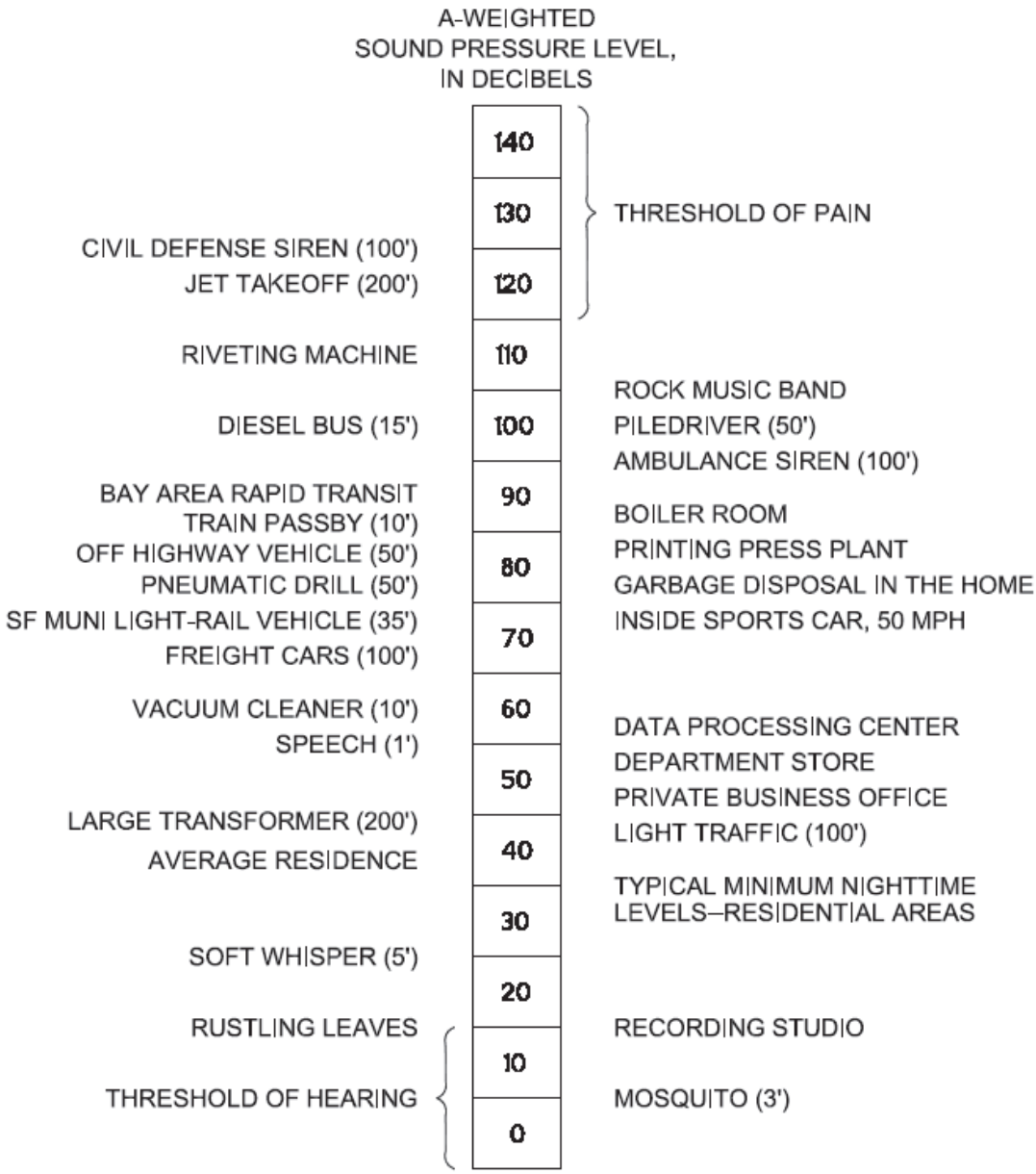
- Subjective effects of annoyance, nuisance, dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as startle, hearing loss

The sound levels associated with environmental noise usually produce effects only in the first two categories. Unfortunately, there has never been a completely predictable measure for the subjective effects of noise nor of the corresponding reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance and habituation to noise over time.

Thus, an important factor in assessing a person's subjective reaction is to compare the new noise environment to the existing noise environment. In general, the more a new noise exceeds the existing, the less acceptable the new noise will be judged.

With regard to increases in noise level, knowledge of the following relationships will be helpful in understanding the quantitative sections of this report:

Except in carefully controlled laboratory experiments, a change of only 1 dB in sound level cannot be perceived. Outside of the laboratory, a 3 dB change is considered a just-noticeable difference. A change in level of at least 5 dB is required before any noticeable change in community response would be expected. A 10 dB change is subjectively heard as approximately a doubling in loudness, and would almost certainly cause an adverse community response.



(100') = DISTANCE IN FEET BETWEEN SOURCE AND LISTENER

TYPICAL SOUND LEVELS MEASURED IN THE ENVIRONMENT AND INDUSTRY

FIGURE A1

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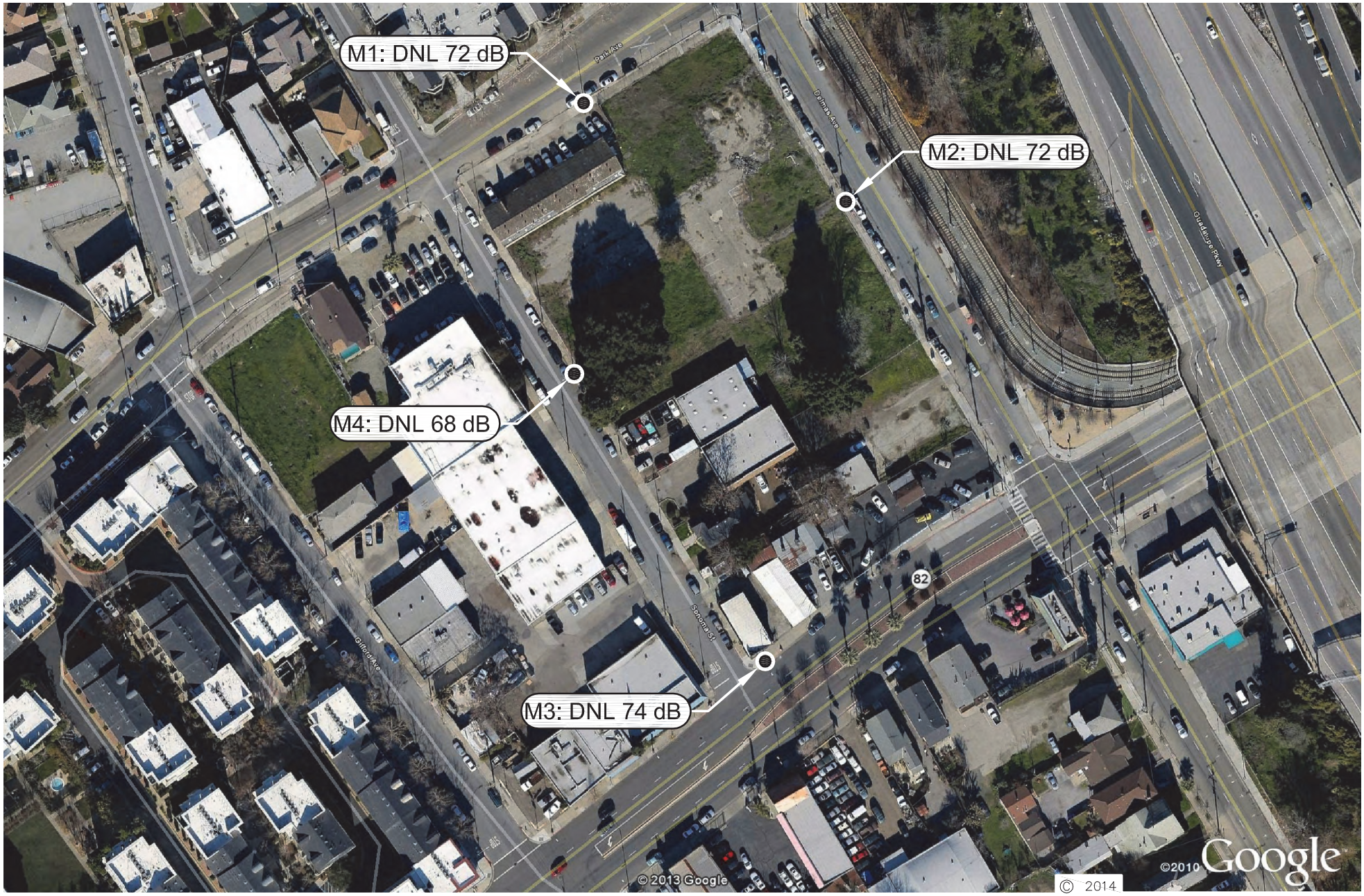

PARK DELMAS
NOISE MEASUREMENT LOCATIONS

FIGURE 1

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VS/AKS 04.16.14

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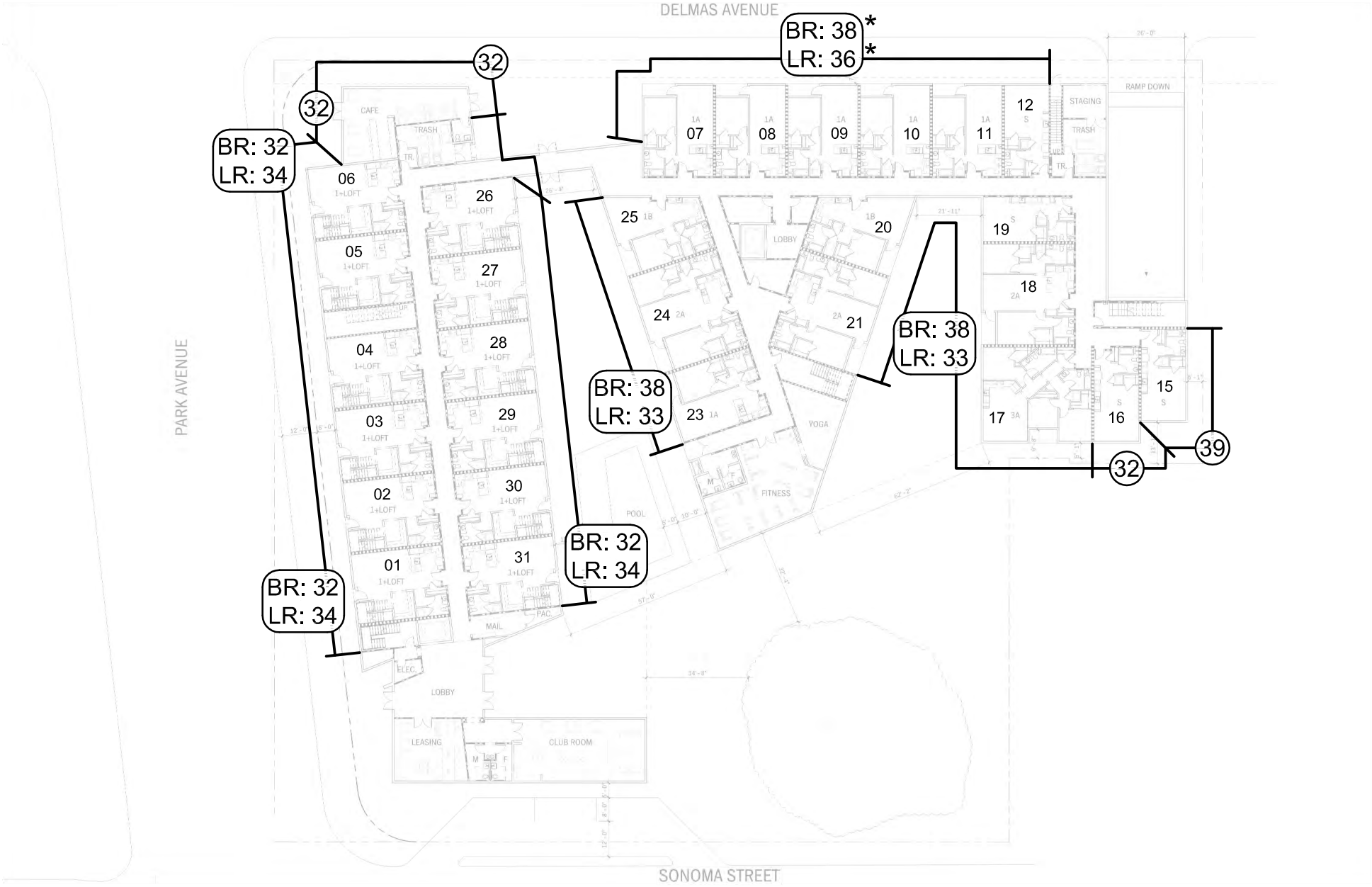

* RESILIENT CHANNELS AND TWO LAYERS OF GYPSUM BOARD ON THE EXTERIOR WALL. OUTLET BOXES SHOULD BE SEALED WITH PUTTY PADS AND ACOUSTICAL SEALANT

PARK DELMAS
MINIMUM RECOMMENDED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOOR 1)

FIGURE 2

CSA # 14–0077

VS/AKS 04.16.14

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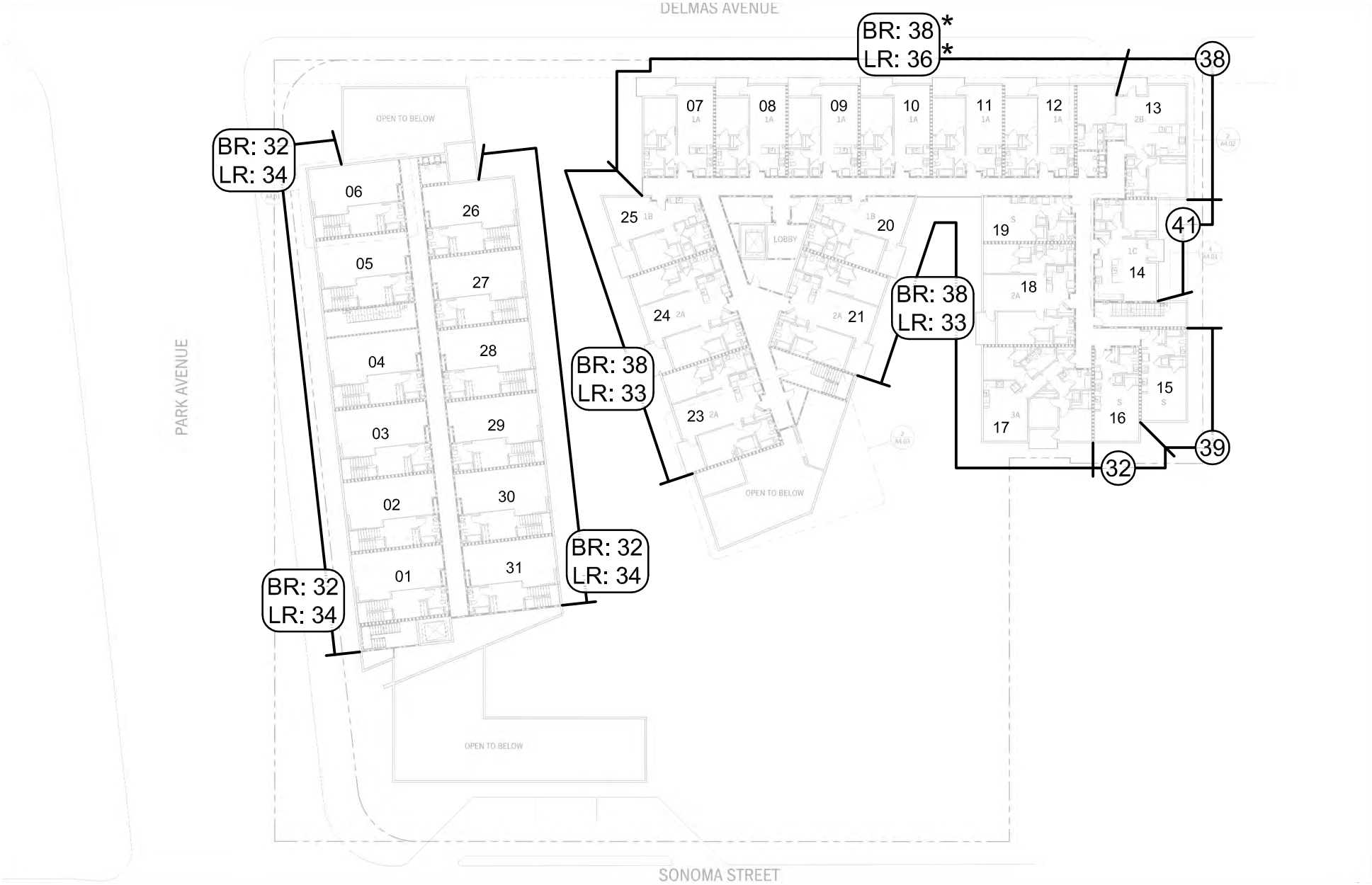

* RESILIENT CHANNELS AND TWO LAYERS OF GYPSUM BOARD ON THE EXTERIOR WALL. OUTLET BOXES SHOULD BE SEALED WITH PUTTY PADS AND ACOUSTICAL SEALANT

PARK DELMAS
MINIMUM RECOMMENDED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOOR 2)

FIGURE 3

CSA # 14–0077

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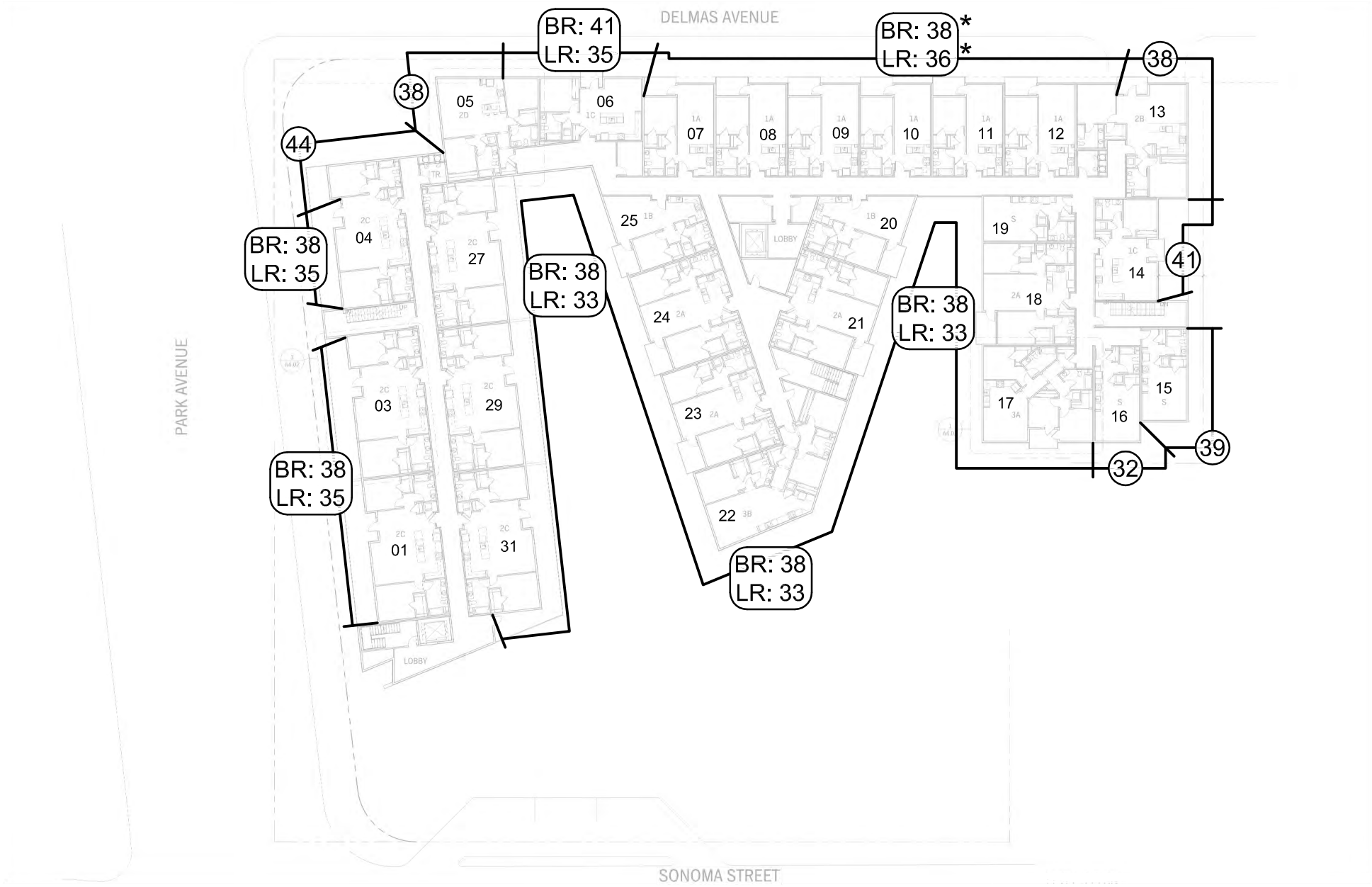

* RESILIENT CHANNELS AND TWO LAYERS OF GYPSUM BOARD ON THE EXTERIOR WALL. OUTLET BOXES SHOULD BE SEALED WITH PUTTY PADS AND ACOUSTICAL SEALANT

PARK DELMAS
MINIMUM RECOMMENDED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOORS 3 & 4)

FIGURE 4

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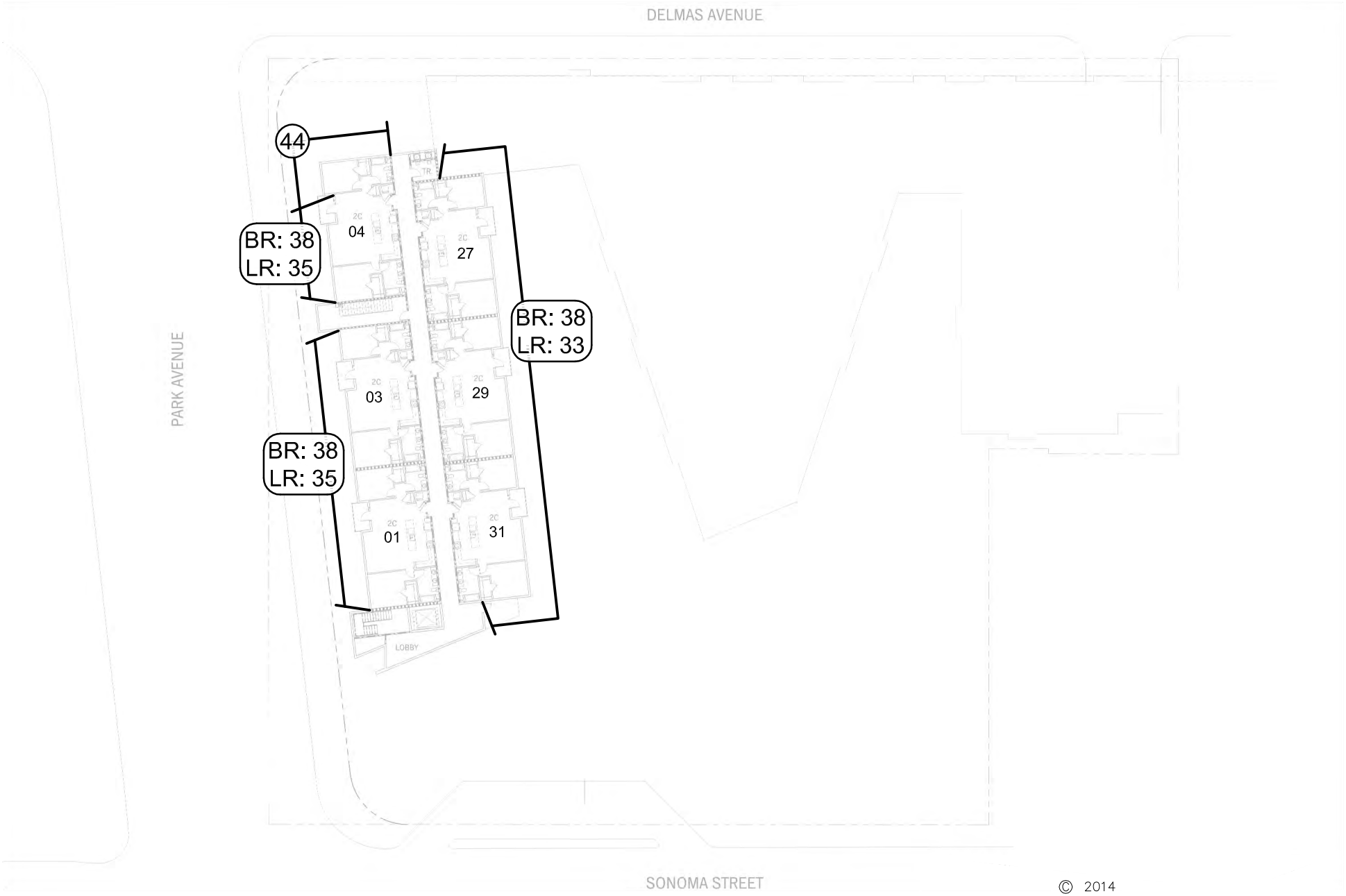

PARK DELMAS
MINIMUM RECOMMENDED STC RATINGS FOR WINDOWS AND EXTERIOR DOORS (FLOOR 5)

FIGURE 5

CSA # 14-0077

VS/AKS 04.16.14

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PARK DELMAS
VIBRATION MEASUREMENT LOCATIONS

FIGURE 6

CSA # 14-0077

VS/AKS 04.16.14