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INTRODUCTION

The proposed Monarch Senior Assisted Living Facility residential project is located adjacent to Sunrise Boulevard in the City of Citrus Heights, California. The project consists of the construction of a 95-unit Senior Living Facility. Traffic on Sunrise Boulevard is considered to be a potentially significant noise source which may affect the project design. As a result, the City of Citrus Heights has requested an analysis of potential noise impacts associated with traffic at the proposed project site (Figure 1 shows the project tentative site plan).

CRITERIA FOR ACCEPTABLE NOISE EXPOSURE

The City of Citrus Heights General Plan Noise Element establishes a 60 dB L_{dn} ¹ exterior noise level criterion as being acceptable for new residential uses affected by traffic noise sources. The exterior noise level standard is applied at the outdoor activity areas of the residences. Where the City determines that providing a L_{dn} of 60 dB or lower is not feasible, the noise level in outdoor activity areas shall be reduced to as close to the standard as feasible through project design.

The City also establishes an interior noise level standard of 45 dB L_{dn} in new residential housing. The General Plan also states that residential development exposed to an exterior L_{dn} of 60 dBA or greater shall be limited to a maximum instantaneous noise level (e.g., trucks on busy streets) in bedrooms of 50 dBA. Maximum instantaneous noise levels in all other habitable rooms shall not exceed 55 dBA.

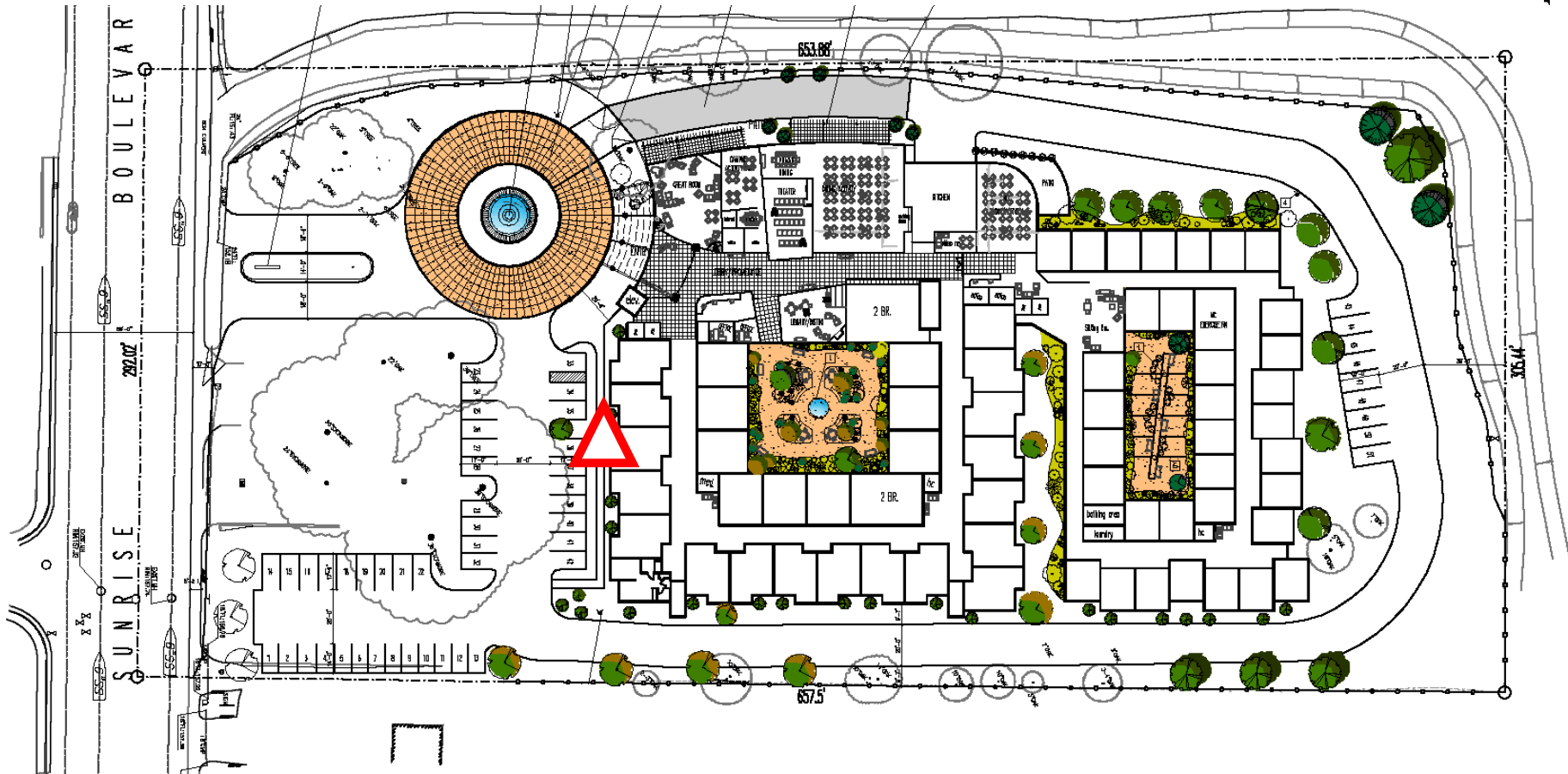
EVALUATION OF FUTURE TRAFFIC NOISE LEVELS AT THE PROJECT SITE


Traffic Noise Prediction Methodology

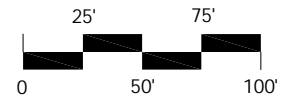
Bollard Acoustical Consultants, Inc. employs the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA RD-77-108) for the prediction of traffic noise levels. The model is based upon the CALVENO noise emission factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site.

¹ Please refer to Appendix "A" for definitions of acoustic terminology.

Figure 1
 Monarch Senior Assisted Living Facility – Citrus Heights, California
 Proposed Site Plan and Noise Measurement Location



 : Short-Term Noise Measurement Site



Traffic Noise Prediction Model Calibration

On March 28, 2008, Bollard Acoustical Consultants, Inc. conducted noise level measurements and concurrent counts of Sunrise Blvd. traffic on the project site. The purpose of the short-term traffic noise level measurements was to determine the accuracy of the FHWA model in describing the existing noise environment on the project site, accounting for shielding from existing intervening structures, actual travel speeds, and roadway grade. Noise measurement results were compared to the FHWA model results by entering the observed traffic volume, speed and distance as inputs to the FHWA model. See Figure 1 for noise measurement locations.

Instrumentation used for the measurement was a Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meter which was calibrated in the field before use with an LDL CA-200 acoustical calibrator. The noise measurement site was selected to represent the nearest proposed building facades to Sunrise Boulevard. The calibration results, which are shown in Appendix B, indicate that the FHWA Model was found to reasonably predict traffic noise levels on the project site adjacent to Sunrise Blvd. Therefore, no corrections or offsets to the model were applied for the calculation of future traffic noise levels at the project site.

Predicted Future (2025) Exterior Traffic Noise Levels

In order to determine future traffic noise levels from Sunrise Blvd. on the project site, Bollard Acoustical Consultants, Inc. once again employed the FHWA model. The future traffic volume for Sunrise Blvd. was provided by the City of Citrus Heights. Table 1 shows the results of the traffic noise modeling at both the nearest facades and nearest outdoor recreation area. It should be noted that the outdoor area will be completely shielded from view of Sunrise Boulevard by the project structures. As a result, a -10 dB offset was applied to the model for the prediction of future traffic noise levels at the nearest outdoor area of the project site. The detailed FHWA Model inputs and results are shown in Appendix C.

Table 1
Predicted Future Sunrise Blvd. Traffic Noise Levels
Monarch Senior Assisted Living Facility - Citrus Heights, CA

Location	Distance to C/L	Predicted Noise Level, L_{dn}
Nearest Building Facades	225	65 dB
Nearest Outdoor Activity Area	300	53 dB

*Predicted distances to noise level contours are from the roadway centerline.

Note: A complete listing of FHWA Model inputs and results is provided in Appendix C.

Analysis of Compliance with Citrus Heights Noise Standards

Exterior Areas:

The Table 1 data indicate that future Sunrise Boulevard traffic noise levels will be approximately 53 dB L_{dn} at the nearest proposed outdoor activity areas of this development. Because this level is in compliance with the City of Citrus Heights 60 dB L_{dn} exterior noise level criterion, no additional noise mitigation measures would be warranted for the outdoor areas of this development.

Interior Areas:

Worst case exterior traffic noise levels at the residences proposed nearest to Sunrise Blvd. are predicted to be 65 dB L_{dn} at first floor facades. Second floor facades are typically exposed to traffic noise levels approximately 2-3 dB higher than first floor facades due to the loss of excess ground attenuation. Therefore, the second floor facades of residences adjacent to Sunrise Blvd. would be exposed to future traffic noise levels of approximately 68 dB L_{dn}. Building facade noise level reductions of 20 to 23 dB will be required to reduce interior traffic noise levels to a state of compliance with the City of Citrus Heights 45 dB L_{dn} interior noise level standard at first and second floor building facades, respectively.

Standard residential construction (wood siding or one-coat stucco siding, STC-26 windows, door weatherstripping, exterior wall insulation, composition plywood roof, etc.), results in an exterior to interior noise reduction of about 25 dB with windows closed, and approximately 15 dB with windows open.

Based upon a 25 dB building facade noise reduction provided by standard residential construction, interior traffic noise levels at first and second floor receivers are predicted to satisfy the City of Citrus Heights interior noise level standard of 45 dB L_{dn} at the worst-case locations nearest Sunrise Boulevard. Provided air conditioning is provided to allow occupants to close windows as desired for acoustical isolation, no additional noise mitigation measures would be required for the interior spaces of this development.

The City also requires that interior noise levels shall be limited to a maximum instantaneous noise level (e.g., trucks on busy streets) in bedrooms of 50 dBA. Maximum instantaneous noise levels in all other habitable rooms shall not exceed 55 dBA. Based upon noise level measurements on the project site, maximum noise levels due to truck passbys were approximately 67 dB at the location of the nearest proposed building facades. Therefore, first and second floor building facades adjacent to Sunrise Blvd. are predicted to be exposed to maximum noise levels of 67 to 70 dB L_{max}, respectively.

Building facade noise level reductions of 20 dB or less will be required to reduce interior traffic noise levels to a state of compliance with the City of Citrus Heights 50 dB maximum interior noise level standard. As noted previously, standard construction would be sufficient to provide this level of noise reduction provided mechanical ventilation is provided to allow occupants to close windows as desired.

CONCLUSIONS

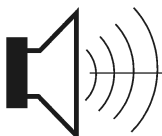
The proposed Monarch Senior Assisted Living Facility project will comply with the City of Citrus Heights General Plan Noise Element criteria provided that:

1. Mechanical ventilation is provided to allow occupants to close windows and doors in order to achieve the desired acoustical isolation.

These conclusions are based on the project site plan shown in Figure 1, on the traffic assumptions contained in Appendix C, and on noise reduction data for standard residential dwellings. Bollard Acoustical Consultants, Inc. is not responsible for degradation in acoustic performance of the residential construction due to changes in site plans, poor construction practices, failure to comply with applicable building code requirements, or for failure to adhere to the minimum building practices cited in this report.

Appendix A Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
L_{dn}	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
L_{max}	The highest root-mean-square (RMS) sound level measured over a given period of time.
Loudness	A subjective term for the sensation of the magnitude of sound.
Masking	The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT₆₀	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.
SEL	A rating, in decibels, of a discrete event, such as an aircraft flyover or train passby, that compresses the total sound energy of the event into a 1-s time period.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.



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Appendix B
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Calibration Worksheet

Project Information:

Job Number: 2008-030
Project Name: Monarch Senior ALF
Roadway Tested: Sunrise Boulevard
Test Location: 1
Test Date: March 28, 2008

Weather Conditions:

Temperature (Fahrenheit): 50
Relative Humidity: Low
Wind Speed and Direction: Calm
Cloud Cover: Moderate

Sound Level Meter:

Sound Level Meter: LDL Model 820
Calibrator: LDL Model CA200
Meter Calibrated: Immediately before
Meter Settings: A-weighted, slow response

Microphone:

Microphone Location: On Project Site
Distance to Centerline (feet): 225
Microphone Height: 5 feet above ground
Intervening Ground (Hard or Soft): **Soft**
Elevation Relative to Road (feet): 5

Roadway Condition:

Pavement Type Asphalt
Pavement Condition: Good
Number of Lanes: 4
Posted Maximum Speed (mph): 40

Test Parameters:

Test Time: 10:45 AM
Test Duration (minutes): 15
Observed Number Automobiles: 501
Observed Number Medium Trucks: 12
Observed Number Heavy Trucks: 11
Observed Average Speed (mph): 40

Model Calibration:

Measured Average Level (L_{eq}): 58.8
Level Predicted by FHWA Model: 60.3

Difference: 1.5 dB

Conclusions:

Appendix C
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2008-030
 Project Name: Monarch Senior ALF
 Roadway Name: Sunrise Boulevard

Traffic Data:

Year: 2025
 Average Daily Traffic Volume: 54,000
 Percent Daytime Traffic: 83
 Percent Nighttime Traffic: 17
 Percent Medium Trucks (2 axle): 2
 Percent Heavy Trucks (3+ axle): 2
 Assumed Vehicle Speed (mph): 40
 Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

Location:	Description	Distance	Offset (dB)	-----L _{dn} , dB-----			Total
				Autos	Medium Trucks	Heavy Trucks	
1	Nearest Building Façade	225	0	62	54	59	65
2	Nearest Outdoor Area	300	-10	50	43	47	53

Traffic Noise Contours (No Calibration Offset):

L _{dn} Contour, dB	Distance from Centerline, (ft)
75	45
70	97
65	209
60	450

Notes: