F: Noise Impact Analysis

NOISE IMPACT ANALYSIS

SERRANO SUMMIT

LSA

December 2009

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SERRANO SUMMIT

LAKE FOREST, CALIFORNIA

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SERRANO SUMMIT

INTRODUCTION

This noise impact analysis has been prepared to evaluate the potential noise impacts and mitigation measures associated with the Serrano Summit mixed-use development in the City of Lake Forest (City), California. This report is intended to satisfy the City's requirement for a project-specific noise impact analysis by examining the impacts of the proposed noise-sensitive uses on the project site and evaluating the mitigation measures required as part of the project design. Modeled noise levels are based upon vehicle data included in a traffic study prepared for the proposed project (Austin-Foust Associates, Inc., June 16, 2009).

Project Description

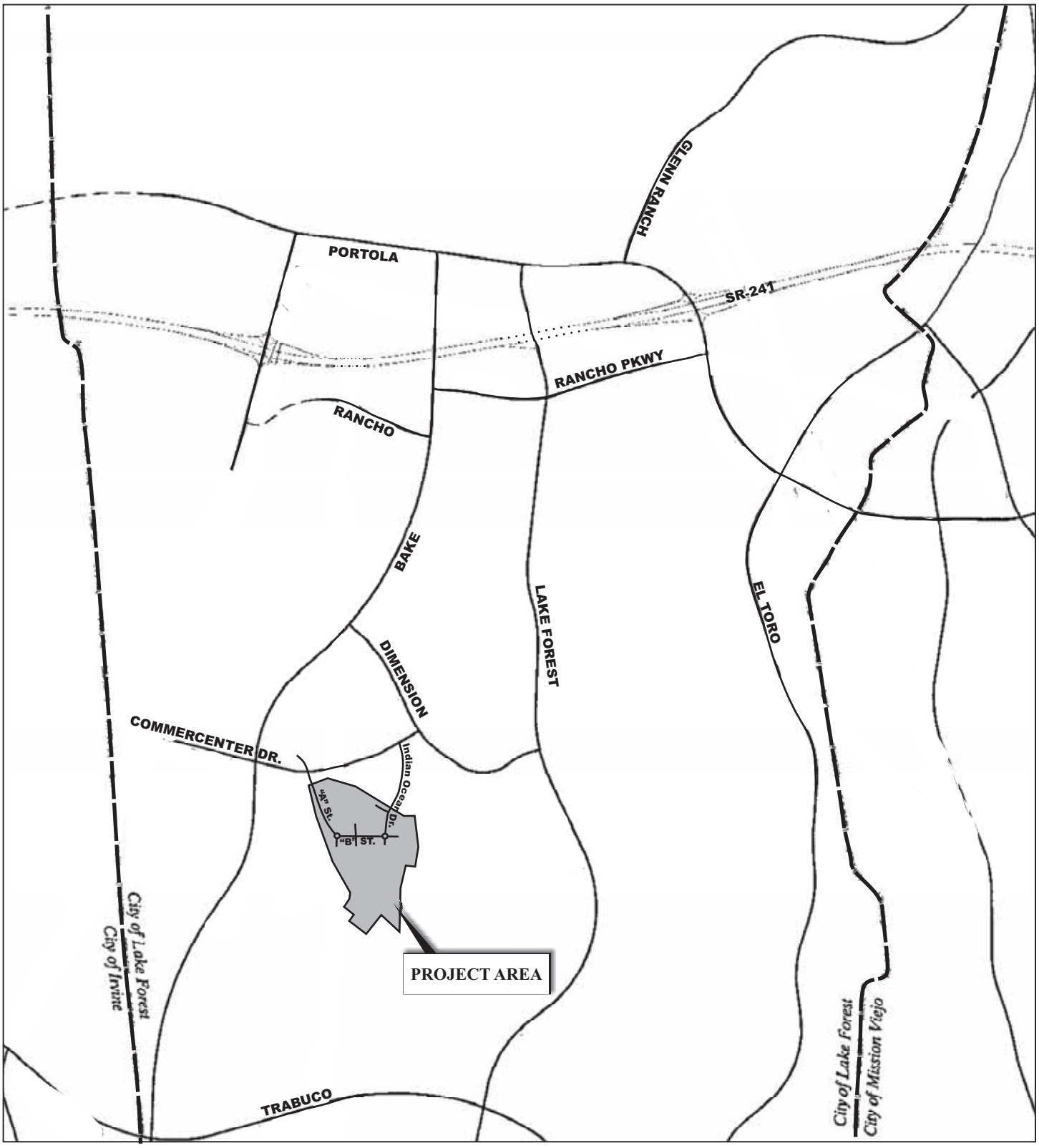
The proposed project site is located in the City between Lake Forest Drive and Bake Parkway, near Commercentre Drive, as shown on Figure 1. Direct access to the project site is provided along Commercentre Drive at Biscayne Bay Drive and Indian Ocean Drive.

The proposed project includes residential uses and public facilities (i.e., a Civic Center). The proposed residential project consists of 150 single-family detached homes and 458 for-sale attached homes, for a total of 608 dwelling units on approximately 43.6 acres (ac). The Civic Center includes 114,000 square feet (sf) of public facilities (a 44,000 sf city hall, a 20,000 sf community center, and 50,000 sf police center) on approximately 11.9 ac. Public facilities will occupy approximately 8.1 ac. There will be 2.9 ac of land for on-site park use and 3.8 ac of land for off-site passive park use. In addition, there will be 19.9 ac of land dedicated to open space. The project's Master Land Use Plan is shown on Figure 2.

Methodology Related to Noise Impact Assessment

Evaluation of noise impacts associated with a proposed residential project typically includes the following:

- Determine the short-term construction noise impacts on off-site noise-sensitive uses
- Determine the long-term off-site mobile- and stationary-source noise impacts on on-site noise-sensitive uses
- Determine the required mitigation measures to reduce long-term on-site noise impacts



LSA

FIGURE 1

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Not To Scale

SOURCE: Austin-Foust Associates, Inc.

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Serrano Summit

Project Location

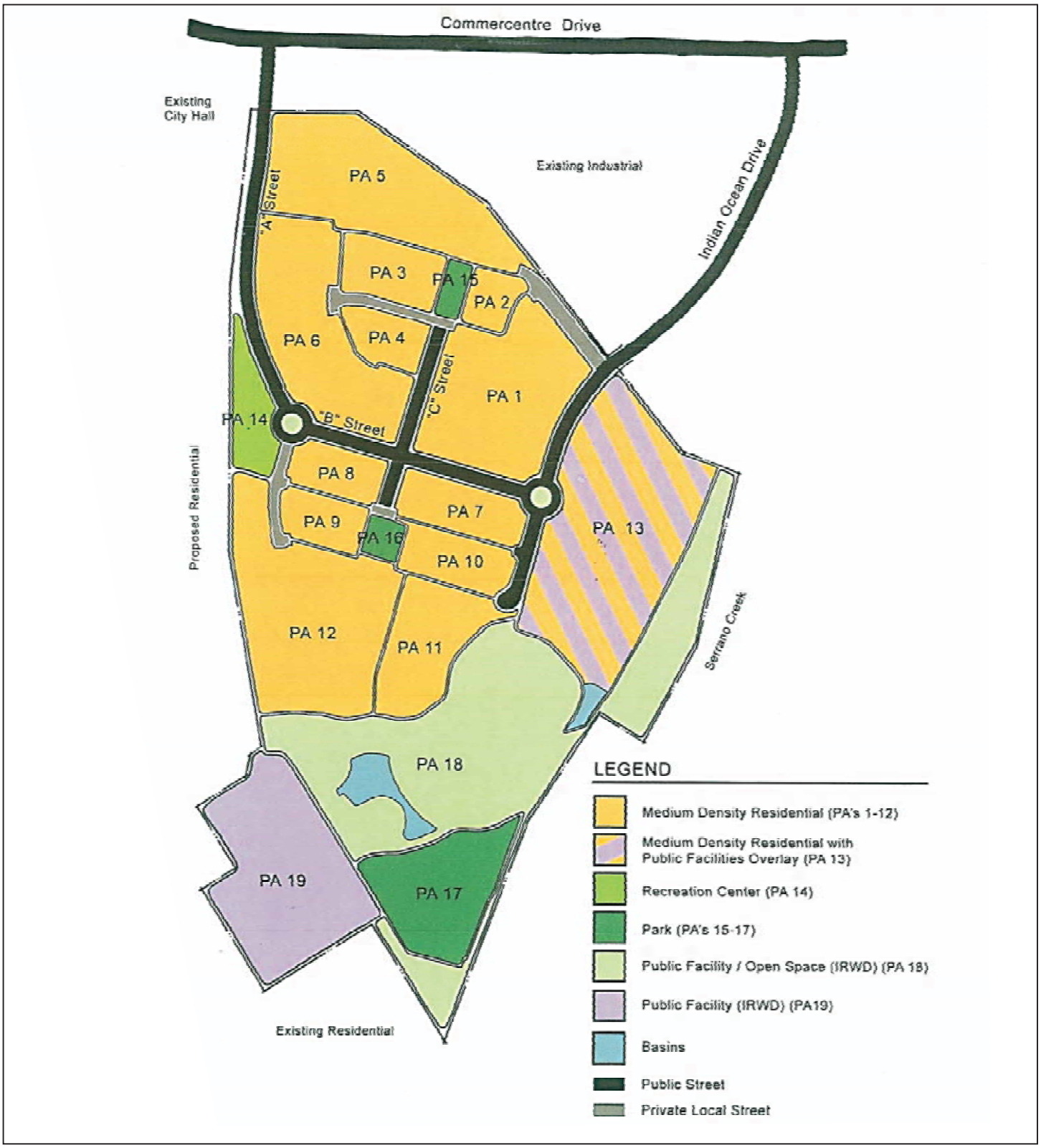

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FIGURE 2

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Serrano Summit

Master Land Use Plan

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Characteristics of Sound

Sound is increasing to such disagreeable levels in our environment that it can threaten our quality of life. Noise is usually defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep. To the human ear, sound has two significant characteristics: pitch and loudness. Pitch is generally an annoyance, while loudness can affect our ability to hear. Pitch is the number of complete vibrations, or cycles per second, of a wave resulting in the tone's range from high to low. Loudness is the strength of a sound that describes a noisy or quiet environment and is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves, combined with the reception characteristics of the human ear. Sound intensity refers to how hard the sound wave strikes an object, which in turn produces the sound's effect. This characteristic of sound can be precisely measured with instruments. The analysis of a project defines the noise environment of the project area in terms of sound intensity and its effect on adjacent sensitive land uses.

Measurement of Sound

Sound intensity is measured through the A-weighted scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound similar to the human ear's de-emphasis of these frequencies. Unlike linear units, such as inches or pounds, decibels are measured on a logarithmic scale representing points on a sharply rising curve.

For example, 10 decibels (dB) are 10 times more intense than 1 decibel, 20 decibels are 100 times more intense, and 30 decibels are 1,000 times more intense. Thirty decibels represent 1,000 times as much acoustic energy as one decibel. The decibel scale increases as the square of the change, representing the sound pressure energy. A sound as soft as human breathing is about 10 times greater than zero decibels. The decibel system of measuring sound gives a rough connection between the physical intensity of sound and its perceived loudness to the human ear. A 10 decibel increase in sound level is perceived by the human ear as only a doubling of the loudness of the sound. Ambient sounds generally range from 30 dBA (very quiet) to 100 dBA (very loud).

Sound levels are generated from a source, and their decibel level decreases as the distance from that source increases. Sound dissipates exponentially with distance from the noise source. For a single point source, sound levels decrease approximately 6 dBA for each doubling of distance from the source. This drop-off rate is appropriate for noise generated by stationary equipment. If noise is produced by a line source, such as highway traffic or railroad operations, the sound decreases 3 dBA for each doubling of distance in a hard site environment. Line source, noise in a relatively flat environment with absorptive vegetation, decreases 4.5 dBA for each doubling of distance.

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. Equivalent continuous sound level (L_{eq}) is the total sound energy of time varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the L_{eq} and community noise equivalent level (CNEL) or the day-night average level (L_{dn}) based on A-weighted decibels (dBA). CNEL is the time varying noise over a 24-hour period, with a five dBA weighting factor applied to the hourly L_{eq} for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and a

10 dBA weighting factor applied to noise occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). L_{dn} is similar to the CNEL scale, but without the adjustment for events occurring during the evening hours. CNEL and L_{dn} are within one dBA of each other and are normally exchangeable. The City of Lake Forest uses the CNEL noise scale for long-term noise impact assessment.
Other noise rating scales of importance when assessing the annoyance factor include the maximum noise level (L_{max}), which is the highest exponential time averaged sound level that occurs during a stated time period. The noise environments discussed in this analysis for short-term noise impacts are specified in terms of maximum levels denoted by L_{max}, which reflects peak operating conditions and addresses the annoying aspects of intermittent noise. It is often used together with another noise scale, or noise standards in terms of percentile noise levels, in noise ordinances for enforcement purposes. For example, the L_{10} noise level represents the noise level exceeded 10 percent of the time during a stated period. The L_{50} noise level represents the median noise level. Half the time the noise level exceeds this level, and half the time it is less than this level. The L_{90} noise level represents the noise level exceeded 90 percent of the time and is considered the background noise level during a monitoring period. For a relatively constant noise source, the L_{eq} and L_{50} are approximately the same.

Noise impacts can be described in three categories. The first is audible impacts that refer to increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3.0 dB or greater since this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1.0 and 3.0 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category is changes in noise level of less than 1.0 dB, which are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects our entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. In comparison, extended periods of noise exposure above 90 dBA would result in permanent cell damage. When the noise level reaches 120 decibels, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling. As the sound reaches 140 decibels, the tickling sensation is replaced by the feeling of pain in the ear. This is called the threshold of pain. A sound level of 160 to 165 decibels will result in dizziness or loss of equilibrium. The ambient or background noise problem is widespread and generally more concentrated in urban areas than in outlying less developed areas.

Table A lists “Definitions of Acoustical Terms,” and Table B shows “Common Sound Levels and Their Noise Sources.”

EXISTING CONDITIONS

Sensitive Land Uses in the Project Vicinity

There are existing residences adjacent to the project site to the east, west, and south of the project site. Construction on site would result in potential noise impacts to these off-site sensitive uses.

Table A: Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of level that denotes the ratio between two quantities proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
Frequency, Hz	Of a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted, unless reported otherwise.
L_{01}, L_{10}, L_{50}, L_{90}	The fast A-weighted noise levels equaled or exceeded by a fluctuating sound level for 1 percent, 10 percent, 50 percent, and 90 percent of a stated time period.
Equivalent Continuous Noise Level, L_{eq}	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time varying sound.
Community Noise Equivalent Level, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of five decibels to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 decibels to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
Day/Night Noise Level, L_{dn}	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 decibels to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
L_{max}, L_{min}	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging.
Ambient Noise Level	The all encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources at many directions, near and far; no particular sound is dominant.
Intrusive	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, 1991.

Table B: Common Sound Levels and Their Noise Sources

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Evaluations
Near Jet Engine	140	Deafening	128 times as loud
Civil Defense Siren	130	Threshold of Pain	64 times as loud
Hard Rock Band	120	Threshold of Feeling	32 times as loud
Accelerating Motorcycle at a few feet away	110	Very Loud	16 times as loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very Loud	8 times as loud
Ambulance Siren; Food Blender	95	Very Loud	
Garbage Disposal	90	Very Loud	4 times as loud
Freight Cars; Living Room Music	85	Loud	
Pneumatic Drill; Vacuum Cleaner	80	Loud	2 times as loud
Busy Restaurant	75	Moderately Loud	
Near Freeway Auto Traffic	70	Moderately Loud	Reference Level
Average Office	60	Quiet	½ as loud
Suburban Street	55	Quiet	
Light Traffic; Soft Radio Music in Apartment	50	Quiet	¼ as loud
Large Transformer	45	Quiet	
Average Residence Without Stereo Playing	40	Faint	⅛ as loud
Soft Whisper	30	Faint	
Rustling Leaves	20	Very Faint	
Human Breathing	10	Very Faint	Threshold of Hearing
	0	Very Faint	

Source: Compiled by LSA Associates, Inc. 2003.

Overview of the Existing Noise Environment

The primary existing noise sources in the project area are commercial/industrial uses and transportation facilities. Traffic on Biscayne Bay Drive, Indian Ocean Drive, and other local streets is the main source contributing to the background noise. Vehicles and operations associated with adjacent commercial/warehouse uses also contribute to the ambient noise in the project vicinity. Occasional aircraft overflight generates noise higher than the other more steady background noise sources.

A field survey conducted by LSA Associates, Inc. (LSA) on November 30, 2009, showed that the ambient noise levels vary from 42 to 50 dBA in the residential neighborhoods to the east and south and from 43 to 52 dBA in the commercial/warehousing areas to the north. However, at the rear parking lot near Advanced Surfaces, Inc., located at 25722 Commercentre Drive, noise from dust collector and wood sawing associated with the countertop manufacturing process registered in the range of 62 to 64 dBA at a distance of 20 feet (ft) from the door. An air compressor at the next-door DVP Exhaust and Automotive Repair shop also produced noise levels ranging from 60 to 64 dBA intermittently. These doors are approximately 50 ft from the project boundary. The project site is generally lower in elevation compared to the commercial/industrial area in this area. Further to the southeast, there are 11 dock doors at the 25800 Commercentre Drive building (approximately 200 ft from the project boundary) and 38 dock doors associated with two industrial buildings adjacent to Indian Ocean Drive, but no truck loading/unloading activity occurred during the field survey. The industrial facility on the east side of Indian Ocean Drive has no loading docks near the project boundary.

Applicable City Noise Standards

A project will normally have a significant effect on the environment related to noise if it will substantially increase the ambient noise levels for adjoining areas or conflict with adopted environmental plans and goals of the community in which it is located. The applicable noise standards governing the project site are the City's noise criteria.

Noise Element of the General Plan. Applicable policies and standards governing environmental noise in the City of Lake Forest are set forth in the Noise Element of the General Plan. The Noise Element was compiled under the mandate of Section 653021(g) of the California Government Code and guidelines prepared by the California Department of Health Services (DHS). The Noise Element quantifies the community noise environment in terms of noise exposure contours for both near- and long-term levels of growth and traffic activity.

Table C lists State compatibility guidelines for various land uses. For example, a residential use is acceptable in areas with up to 60 dBA CNEL. Residential uses in a 60-70 dBA CNEL zone would be appropriate only with certain mitigation. For commercial or business office buildings, noise levels up to 70 dBA CNEL are conditionally acceptable with noise insulation. In areas with noise levels from 70 to 75 dBA CNEL, construction of commercial/business office buildings would require acoustic analysis to determine the insulation needed.

Table C: Noise/Land Use Compatibility Matrix

Land Use Category	50 dBA	55 dBA	60 dBA	65 dBA	70 dBA	75 dBA	80 dBA
Residential – Single-Family, Multifamily, Duplex	A	A	B	B	C	C	D
Residential – Mobile Homes	A	A	A	B	C	C	D
Transient Lodging – Motels, Hotels	A	A	A	B	B	C	D
Schools, Libraries, Churches, Hospitals, Nursing/Convalescent Homes, Preschools, Day Care Centers (1)[2]	A	A	A	B	C	C	D
Auditoriums, Concert Halls, Amphitheaters, Meeting Halls	B	B	B	C	D	D	D
Sports Areas, Outdoor Spectator Sports, Amusement Parks	A	A	A	A	B	B	D
Playgrounds, Neighborhood Parks	A	A	A	A	B	C	D
Golf Courses, Riding Stables, Cemeteries	A	A	A	A	A	B	C
Office and Professional Buildings	A	A	A	A	B	B	C
Commercial Retail, Banks, Restaurants, Theaters	A	A	A	A	A	B	B
Industrial, Manufacturing, Utilities, Wholesale, Service Stations	A	A	A	A	A	B	B
Agriculture	A	A	A	A	A	A	A

Source: City of Lake Forest General Plan, Safety and Noise Element, June 21, 1994.
KEY:
Zone A. Normally Acceptable—Specified land use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction without any special noise insulation requirements.
Zone B. Conditionally Acceptable—New construction or development should be undertaken only after detailed analysis of noise reduction requirement is made and needed noise insulation features in the design are determined. Conventional construction, with closed windows and fresh air supply systems or air-conditioning, will normally suffice.
Zone C. Normally Unacceptable—New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of noise reduction requirements must be made and needed noise insulation features included in the design.
Zone D. Clearly Unacceptable—New construction should generally not be undertaken.
dBA = A-weighted decibels

Table D presents the City of Lake Forest's interior and exterior noise standards for assessing the compatibility of land uses with the noise environment. This matrix may be used to determine whether a certain type of land use is appropriate in a particular CNEL zone. The City requires that all outdoor living areas associated with new residential uses be attenuated to less than 65 dBA CNEL. All new residential units and noise-sensitive land uses shall have an interior noise level in living areas no greater than 45 dBA CNEL.

The City also enforces building sound transmission loss and indoor fresh-air ventilation requirements specified in Chapter 35 of the Uniform Building Code.

Noise Control Ordinance. The City's Municipal Code, Chapter 11.16, Noise Control, specifies that construction activities are generally prohibited between 8:00 p.m. and 7:00 a.m. the following day from Monday through Saturday, and no construction is permitted on Sundays and federal holidays. Construction noise during the allowed construction time periods is exempt from the noise level provisions in the noise control ordinance.

The Noise Control Ordinance identifies that maximum permissible exterior ambient noise level for residential uses shall be no greater than 55 dBA between 7:00 a.m. and 10:00 p.m. and no greater than 50 dBA between 10:00 p.m. and 7:00 a.m. Maximum permissible interior ambient noise level for residential uses shall be no greater than 55 dBA between 7:00 a.m. and 10:00 p.m. and no greater than 45 dBA between 10:00 p.m. and 7:00 a.m.

The permitted exterior ambient noise level shall not be exceeded for more than 30 minutes in any hour. The exterior ambient noise level plus 5 dBA shall not be exceeded for a cumulative period of more than 15 minutes in any hour; or the exterior ambient noise level plus 10 dBA shall not be exceeded for a cumulative period of more than 5 minutes in any hour; or the exterior ambient noise level plus 15 dBA shall not be exceeded for more than 1 minute in any hour; or the exterior ambient noise level plus 20 dBA shall not be exceeded for any period of time (i.e., 75 and 70 dBA L_{max} during daytime and nighttime, respectively). If the ambient noise level exceeds any of the first four noise limit categories above, the cumulative period applicable to such category shall be increased to reflect such ambient noise level. If the ambient noise level exceeds the fifth noise limit category, the maximum allowable noise level under such category shall be increased to reflect the maximum ambient noise level.

The permitted interior ambient noise level shall not be exceeded for more than five minutes in any hour; or the interior ambient noise level plus 5 dBA shall not be exceeded for a cumulative period of more than one minute in any hour; or the interior ambient noise level plus 10 dBA shall not be exceeded for any period of time (i.e., 65 and 55 dBA L_{max} during daytime and nighttime, respectively). If the ambient noise level exceeds either of the first two noise limit categories above, the cumulative period applicable to such category shall be increased to reflect such ambient noise level. If the ambient noise level exceeds the third noise limit category, the maximum allowable noise level under such category shall be increased to reflect the maximum ambient noise level.

Table D: Interior and Exterior Noise Standards

Land Use	Noise Standards	
	Interior[1]	Exterior
Residential: Single-Family, Multifamily, Duplex, Mobile Home	45 dBA CNEL	65 dBA CNEL[2]
Residential: Transient Lodging, Hotels, Motels, Nursing Homes, Hospitals	45 dBA CNEL	65 dBA CNEL
Private Offices, Church Sanctuaries, Libraries, Board Rooms, Conference Rooms, Theaters, Auditoriums, Concert Halls, Meeting Halls, etc.	45 dBA $L_{eq}(12)$[3]	—
Schools	45 dBA $L_{eq}(12)$	67 dBA $L_{eq}(12)$[4]
General Offices, Reception, Clerical, etc.	50 dBA $L_{eq}(12)$	—
Bank Lobby, Retail Store, Restaurant, Typing Pool, etc.	55 dBA $L_{eq}(12)$	—
Manufacturing, Kitchen, Warehousing, etc.	65 dBA $L_{eq}(12)$	—
Park, Playgrounds	—	65 dBA CNEL
Golf Courses, Outdoor Spectator Sports, Amusement Parks	—	70 dBA CNEL

Source: City of Lake Forest, July 11, 1995.

$L_{eq}(12)$: The A-weighted equivalent sound level averaged over a 12-hour period (usually the hours of operation).

1 Noise standard with windows closed. Mechanical ventilation shall be provided per Uniform Building Code requirements to provide a habitable environment. Indoor environment excludes bathrooms, toilets, closets, and corridors.

2 Outdoor environment limited to rear yard of single-family homes, multifamily patios and balconies (with a depth of 6 feet or more), and common recreation areas.

3 Religious institutions (churches, temples, and other places of worship) of a small size (occupancy of 100 persons or less) may occupy existing buildings within areas of exterior noise levels. ranging from 65 to 75 dBA CNEL without providing additional noise insulation for the building.

4 Outdoor environment limited to playground areas, picnic areas, and other areas of frequent human use.

CNEL = Community Noise Equivalent Level.

dBA = A-weighted decibels.

Thresholds of Significance

Traffic Noise. A proposed project would normally have a significant off-site traffic noise impact if both of the following criteria are met:

- Project traffic will cause a noise level increase of 3 dBA or more on a roadway segment adjacent to a noise-sensitive land use. Noise-sensitive land uses include the following: residential (single-family, multifamily, duplex, mobile home); transient lodging (e.g., hotels, motels); nursing homes; hospitals; parks, playgrounds, and recreation areas; and schools.
- The resulting "future with project" noise level exceeds the noise standard for sensitive land uses as identified in the City of Lake Forest General Plan (refer to Table D above, Interior and Exterior Noise Standards).

Stationary Noise. The Noise Ordinance for the City of Lake Forest set limits on the level and duration of time a stationary noise source may impact a residential area. The determination that a project has the potential to exceed the City's established noise limits is typically based on a noise technical report prepared by a qualified acoustical consultant. The project would normally have a significant noise impact if it would:

- Exceed the stationary-source noise criteria for the City of Lake Forest as described in the City of Lake Forest Noise Ordinance.

IMPACTS AND MITIGATION MEASURES

Short-Term Construction-Related Impacts

Construction-related noise impacts from the proposed project would not be considered adverse; in addition, compliance with the City's construction hours requirement would reduce the impact to a less than significant level.

Short-term noise impacts would be associated with excavation, grading, and erecting of buildings on site during construction of the proposed project. Construction-related short-term noise levels would be higher than existing ambient noise levels in the project area today, but would no longer occur once construction of the project is completed.

Two types of short-term noise impacts could occur during the construction of the proposed project. First, construction crew commutes and the transport of construction equipment and materials to the site for the proposed project would incrementally increase noise levels on access roads leading to the site. Although there would be a relatively high single-event noise exposure potential causing intermittent noise nuisance (passing trucks at 50 ft would generate up to a maximum of 87 dBA), the effect on longer term (hourly or daily) ambient noise levels would be small. Therefore, short-term construction-related impacts associated with worker commute and equipment transport to the project site would be less than significant.

The second type of short-term noise impact is related to noise generated during excavation, grading, and building erection on the project site. Construction is completed in discrete steps, each of which has its own mix of equipment, and consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on the site, and therefore, the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase. Table E lists typical construction equipment noise levels recommended for noise impact assessments, based on a distance of 50 ft between the equipment and a noise receptor.

Typical noise levels range up to 91 dBA L_{max} at 50 ft during the noisiest construction phases. The site preparation phase, which includes excavation and grading of the site, tends to generate the highest noise levels because the noisiest construction equipment is earthmoving equipment. Earthmoving equipment includes excavating machinery such as backfillers, bulldozers, draglines, and front loaders. Earthmoving and compacting equipment includes compactors, scrapers, and graders. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full-power operation followed by three or four minutes at lower power settings.

Construction of the proposed project is expected to require the use of earthmovers, bulldozers, and water and pickup trucks. This equipment would be used on the project site. Based on the information in Table E, the maximum noise level generated by each scraper on the proposed project site is assumed to be 87 dBA L_{max} at 50 ft from the scraper. Each bulldozer would also generate 85 dBA L_{max} at 50 ft. The maximum noise level generated by water and pickup trucks is approximately 86 dBA L_{max} at 50 ft from these vehicles. Each doubling of the sound sources with equal strength increases the noise level by 3 dBA. Assuming that each piece of construction equipment operates at some distance from the other equipment, the worst-case combined noise level during this phase of construction would be 91 dBA L_{max} at a distance of 50 ft from the active construction area.

There are existing residences approximately 100 ft to the southwest of the project site with six dwelling units in two buildings. These closest residences may be exposed to construction noise up to 85 dBA L_{max} intermittently during project construction. Existing residences to the south of the project site are near the proposed onsite Passive Park that is not proposed to be graded and, therefore, would not be exposed to high construction noise. Compliance with the construction hours specified in the City's Noise Ordinance would reduce the construction noise impacts to less than significant levels.

Long-Term Traffic Noise Impacts

Project-related long-term vehicular trip increases are anticipated to be small when distributed to adjacent street segments. In addition, the proposed on-site residential uses are not directly adjacent to any major arterial, would not be exposed to traffic noise levels exceeding the exterior noise standard of 65 dBA CNEL, and would not exceed the interior noise standard of 45 dBA CNEL from exterior noise sources. Further, the proposed on-site Civic Center facilities would not be exposed to traffic noise exceeding the 50 dBA $L_{eq}(12)$ exterior noise standard for office use. No mitigation measures would be required.

Table E: Typical Construction Equipment Noise Levels

Type of Equipment	Range of Maximum Sound Levels Measured (dBA at 50 feet)	Suggested Maximum Sound Levels for Analysis (dBA at 50 feet)
Pile Drivers, 12,000 to 18,000 ft-lb/blow	81 to 96	93
Rock Drills	83 to 99	96
Jack Hammers	75 to 85	82
Pneumatic Tools	78 to 88	85
Pumps	74 to 84	80
Scrapers	83 to 91	87
Haul Trucks	83 to 94	88
Cranes	79 to 86	82
Portable Generators	71 to 87	80
Rollers	75 to 82	80
Dozers	77 to 90	85
Tractors	77 to 82	80
Front-End Loaders	77 to 90	86
Hydraulic Backhoe	81 to 90	86
Hydraulic Excavators	81 to 90	86
Graders	79 to 89	86
Air Compressors	76 to 89	86
Trucks	81 to 87	86

Source: Noise Control for Buildings and Manufacturing Plants, Bolt, Beranek & Newman, 1987.
dBA = A-weighted decibels
ft-lb/blow = foot-pound per blow

Table F: Traffic Noise Levels along Roadways with Project

Roadway Segment	ADT	Center-line to 70 CNEL (feet)	Center-line to 65 CNEL (feet)	Center-line to 60 CNEL (feet)	CNEL (dBA) 50 Feet from Centerline of Outermost Lane
Private Street south of Biscayne Bay Drive/B St. roundabout	1,200	< 50	< 50	< 50	57.7
B St. between Biscayne Bay Dr. and C St.	1,300	< 50	< 50	< 50	58.0
B Street between C St. and Indian Ocean Dr.	900	< 50	< 50	< 50	56.4
Indian Ocean Dr. north of B St.	3,800	< 50	< 50	84	62.7
Indian Ocean Dr. south of B St.	900	< 50	< 50	< 50	56.4
C St. north of B St.	600	< 50	< 50	< 50	54.7
C St. south of B St.	200	< 50	< 50	< 50	49.9

Source: LSA Associates, Inc., November 2009.
ADT = Average Daily Traffic
CNEL = community noise equivalent level
dBA = A-weighted decibels

A doubling of the traffic volume is needed for a 3 dB increase in traffic noise. Table F shows the traffic noise levels for the future with project scenario. Because no noise-sensitive land uses in the project vicinity would be exposed to traffic noise levels exceeding the City's noise standards, as shown in Table D, no significant off-site traffic noise impacts would occur. In addition, Table F shows that none of the roadway segments that would be directly adjacent to the project site would have the 65 dBA CNEL noise contour extending to beyond the roadway right-of-way. Therefore, the proposed residential uses would be outside the 65 dBA CNEL noise contour from all roadway segments in the project area. Similarly, with the 24 dBA exterior-to-interior noise attenuation provided by the building shell when windows are closed (Protective Noise Levels, EPA 550/9-79-100, November 1978), neither the proposed residential uses nor the on-site Civic Center facilities would be exposed to traffic noise exceeding the 50 dBA $L_{eq}(12)$ interior noise standard. The extension of existing street segments onto the project site would result in residential traffic within the project site. Therefore, no significant traffic noise impacts are anticipated and no mitigation measures are required.

Long-Term Off-Site Stationary-Source Impacts

The potential long-term stationary-source noise impacts would be associated primarily with stationary sources from the adjacent office/warehouse facilities. The existing office/warehouse facilities adjacent to the project site would generate noise from vehicle and truck movement, loading/unloading activities, and manufacturing operations. These activities are potential point sources of noise that could affect noise sensitive receptors proposed on site. Potentially significant noise impacts would occur from these off-site commercial/warehouse operations if on-site noise sensitive uses are proposed within the impact zones of these off-site noise-generating activities.

As noise spreads from a source it loses energy, so that the farther away the noise receiver is from the noise source, the lower the perceived noise level would be. Geometric spreading causes the sound level to attenuate or be reduced, resulting in a 6 dBA reduction in the noise level for each doubling of distance from a single point source of noise, such as an idling truck, to the noise-sensitive receptor of concern.

The proposed on-site residential uses would be potentially exposed to noise from truck delivery, loading/unloading, and manufacturing activities, as well as other activities at the parking lot associated with existing commercial/warehouse uses to the north and the office use to the west of the project site. These activities are potential point sources of noise that could affect noise-sensitive receptors adjacent to the loading areas such as proposed residential uses on the project site. Mitigation measures may be required to comply with the City's noise standards.

The existing commercial uses to the north have loading/unloading areas located approximately 50–100 ft from the project boundary. Noise associated with loading/unloading activities at these commercial/warehouse uses would potentially affect on-site residences if they are located near the project boundary. Other off-site, noise-producing activities may include outdoor air-conditioning units, parking, traffic, and pedestrian activity within the parking lot of the commercial/warehousing uses. Most of the events are intermittent in nature and usually of a very short duration, lasting a few seconds. The combination of the intermittent activities, even over the course of a day, does not amount to a significant amount of time.

The ambient noise survey conducted by LSA showed that, at the rear parking lot near Advanced Surfaces Inc., located at 25722 Commercentre Drive, noise from dust collector and wood sawing associated with the countertop manufacturing process registered in the range of 62 to 64 dBA at a distance of 20 ft from the door. The air compressor at the next-door DVP Exhaust and Automotive Repair shop also produced noise levels ranging from 60 to 62 dBA intermittently. These doors are approximately 50 ft from the project boundary. The project site is generally lower in elevation compared to the commercial/industrial area in this area. Further to the southeast, there are 11 dock doors at the 25800 Commercentre Drive building (approximately 200 ft from the project boundary) and 38 dock doors associated with two industrial buildings adjacent to Indian Ocean Drive. The industrial facility on the east side of Indian Ocean Drive has no loading docks near the project boundary on the proposed Civic Center site.

The project site is generally higher in elevation at the northern end. The project would be graded so that it is approximately 12 feet higher than the adjacent industrial uses near Biscayne Bay Drive in the northwest corner. However, the adjacent industrial use site would rise in elevation to approximately five feet above the project site, then gradually descends to be level with the project site near Indian Ocean Drive. There would be a 6-foot-high wall consisting of concrete masonry units (CMU) along the project's northern boundary between Biscayne Bay Drive and Indian Ocean Drive.

Truck Delivery and Loading/Unloading. Delivery trucks (including Federal Express, United Parcel Service, and other trucks) and loading/unloading (including forklift) operations for the existing commercial/warehousing uses would result in maximum noise readings similar to loading and unloading activities for other projects, which generate a noise level of 75 dBA L_{max} at 50 ft and are

used in this analysis. Based on the above discussion, loading/unloading noise would be reduced by the combination of distance divergence, elevation difference, and the 6-foot-high CMU wall throughout the project's northern boundary adjacent to the industrial use area to below 55 dBA L_{max} at ground level of the nearest on-site location for residential uses. This range of maximum noise levels is lower than the exterior noise standards of 75 dBA L_{max} during the day (7:00 a.m.–10:00 p.m.) and the 65 dBA L_{max} standard during the night (10:00 p.m.–7:00 a.m.). Although typical truck unloading processes take an average of 15–20 minutes, this maximum noise level occurs in a much shorter period of time (i.e., just a few minutes). However, due to the multiple dock doors associated with these buildings, it is possible that loading/unloading activities would be continuous for more than 30 minutes in an hour. Because the City's noise standard of 55 dBA that should not be exceeded for more than 30 minutes in any hour during the daytime hours would not be violated, no mitigation measures would be required. There would be no nighttime delivery at these commercial/industrial uses to the west or north of the project site.

Manufacturing Activities. Manufacturing operations and goods movement inside the existing warehouse to the north would result in a maximum noise reading of 78 dBA L_{max} at 50 ft. This noise is further reduced by the building itself, depending on the receptor location. As shown in the ambient noise field survey, a range of noise levels (62 to 64 dBA) were measured at a location 20 ft from the countertop manufacturing facility to the north of the project site, from dust collector and wood sawing activities inside the building. At a distance of 50 ft from this facility near the project boundary, the noise would be reduced to 58 dBA or lower. Based on the above discussion, noise associated with these operations would be reduced by distance divergence, elevation difference, and the proposed 6-foot-high CMU wall along the project's northern boundary to below 55 dBA L_{max} at the ground level of the nearest residences proposed on site. This range of maximum noise levels is lower than the exterior noise standards of 75 dBA L_{max} during the day and the 65 dBA L_{max} standard during the night. Based on the conversation between LSA noise survey staff and the owner of the countertop manufacturing facility, it is possible that operations associated with this manufacturing facility to the north would last more than 30 minutes in an hour, making it necessary to meet the most stringent noise standards applicable to the proposed on-site residences. However, noise associated with manufacturing activities inside the existing industrial buildings to the north would not result in noise levels exceeding the City's exterior noise standard of 55 dBA L_{50} during daytime hours at the nearest residences. No additional noise mitigation measures would be required.

Parking Lot Activity. Representative parking activities, such as employees conversing and doors slamming, would generate approximately 60 dBA L_{max} at 50 ft. This level of noise is much lower than that of the truck delivery and loading/unloading activities. With the noise attenuation effect from the distance divergence, noise in the parking lot would be attenuated to below 54 dBA L_{max} and is not anticipated to be a significant noise issue with respect to residences to the southwest of the project site.

Outdoor Air-Conditioning Units. There is an outdoor air-conditioning unit generating approximately 65 dBA L_{max} at 80 ft. At 100 ft, the noise level reduces to 63 dBA L_{max}. This level of noise is lower than that of the truck delivery and loading/unloading activities. With the noise attenuation effect from the elevation difference and the proposed 6-foot-high CMU wall, noise from

the outdoor air-conditioning unit would be attenuated to below 50 dBA L_{max} and is not anticipated to be a significant noise issue with respect to residences on the project site.

Interior Noise Standard. The typical maximum allowable interior noise levels for residential uses are 45 dBA between 10:00 p.m. and 7:00 a.m. and 50 dBA between 7:00 a.m. and 10:00 p.m. Typical sound level reduction of buildings in a warm climate such as Southern California is 12 dBA with windows opened and 24 dBA with windows closed (Protective Noise Levels, EPA 550/9-79-100, November 1978). Interior noise levels at the residences nearest the commercial/warehousing uses, attributable to loading/unloading activities from the off-site loading areas, would be reduced to 43 dBA L_{max} with windows opened and to 31 dBA L_{max} with windows closed. Standard building construction for residential structures would be sufficient to meet the interior noise standard.

Civic Center/Public Facilities. The proposed Civic Center is located in the eastern portion of the project site, separated with the proposed onsite residences by the Indian Ocean Drive. The proposed public facilities are located in the southwest corner of the project site, separated from the on-site residential uses by an open space. With proper site planning and building orientation, noise associated with typical Civic Center operations would be attenuated by distance divergence and shielded by buildings/structures proposed as part of the Civic Center facilities. Similarly, it is not anticipated that there would be any significant noise sources associated with the proposed onsite public facilities. No additional mitigation measures are required.

Mitigation Measures

Construction Impacts. Construction of the proposed project would potentially result in relatively high noise levels and annoyance at the closest residences. The following measures would reduce short-term construction-related noise impacts resulting from the proposed project:

- During all project site excavation and grading on site, the project contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers consistent with manufacturers' standards.
- The project contractor shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site.
- The construction contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.
- The construction contractor shall obtain the City's approval for its haul plan, with the planned haul truck routes avoiding residential areas to the extent feasible.
- The construction contractor shall change the timing and/or sequence of the noisiest construction operations to avoid sensitive times of the day.
- Construction activities are generally prohibited between 8:00 p.m. and 7:00 a.m. the following day from Monday through Saturday, and no construction is permitted on Sundays and federal

holidays. Construction noise during the allowed construction time periods is exempt from the noise level provisions in the noise control ordinance.

Traffic Noise Impacts. No mitigation measures are required.

- **Stationary-Source Noise Impacts.** With the proposed 6-foot-high CMU wall along the project's northern boundary between Biscayne Bay Drive and Indian Ocean Drive, no additional noise mitigation measures are required for stationary noise sources.

Level of Significance after Mitigation

With implementation of the identified mitigation measures, potential long-term noise impacts would be reduced to below a level of significance.

REFERENCES

Austin-Foust Associates, Inc. 2009. City of Lake Forest IRWD Project Site On-Site Analysis ("B" Street). June.

Bolt, Beranek & Newman. 1987. Noise Control for Buildings and Manufacturing Plants.

City of Lake Forest. Noise Element and Municipal Code Noise Ordinances.

Environmental Protection Agency. 1978. Protective Noise Levels, EPA 550/9-79-100. November.

Federal Highway Administration. 1977. Highway Traffic Noise Prediction Model, FHWA RD-77-108.

APPENDIX A

FHWA HIGHWAY TRAFFIC NOISE PREDICTION MODEL OUTPUT

SERRANO SUMMIT

FHWA ROADWAY NOISE LEVEL ANALYSIS

CONTOUR6 MODEL PRINTOUTS

BUILDOUT YEAR WITH PROJECT SCENARIO

TABLE With Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: Biscayne Bay south of B St.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 1200 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 57.68

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL			
70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	84.2

TABLE With Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: B St. between Biscayne Bay and C St.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 1300 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 58.02

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL

70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	88.7

TABLE With Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: B Street between C St. and Indian Ocean Dr.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 900 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 56.43

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL			
70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	69.6

TABLE With Project-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: Indian Ocean Dr. north of B St.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 3800 SPEED (MPH): 45 GRADE: .5

	TRAFFIC DISTRIBUTION PERCENTAGES DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.68

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL 70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	84.2	181.1

TABLE With Project-05
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: Indian Ocean Dr. south of B St.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 900 SPEED (MPH): 45 GRADE: .5

	TRAFFIC DISTRIBUTION PERCENTAGES DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 56.43

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL 70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	69.6

TABLE With Project-06
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: C St. north of B St.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 600 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 54.67

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL			
70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	53.2

TABLE With Project-07
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 11/23/2009
ROADWAY SEGMENT: C St. south of B St.
NOTES: Serrano Summit - With Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 200 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

CNEL AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 49.89

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO CNEL			
70 CNEL	65 CNEL	60 CNEL	55 CNEL
0.0	0.0	0.0	0.0
