APPENDIX C

NOISE AND VIBRATION STUDY

Medlin & Associates, Inc.
Acoustical Consultants

RSCI Upper Reach
Noise and Vibration Study

Prepared for:

Los Angeles Department of Water and Power

and

Aspen Environmental Group

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Contents

Summary

Significant impacts to noise-sensitive receivers due to the Upper Reach project are summarized in answering the relevant questions from the CEQA Guidelines, as follows:

Would the project result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Significant and unavoidable. Both the Los Angeles and Burbank ordinances focus on restricted operating hours as a means of regulating construction hours. Construction of the project is planned to occur during daytime, swing and nighttime hours. Section 112.05 of the Los Angeles code further restricts noise emissions from construction equipment to a level of 75 dBA at a distance of 50 feet from any construction equipment, if technically feasible. Provided that all equipment used on this project is fitted with appropriate mufflers, shields, or other available noise-attenuating devices, the technical-feasibility requirement is presumed to be met. Only machinery which inherently creates loud noise (e.g. pavement breakers) would be considered exempt from the technical-feasibility requirement.

Would the project result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

Significant and unmitigatable impact. Sensitive receivers lying within a distance of 150 feet (residential or similar) or 170 feet (film/recording studio) of a tunnel alignment may be subject to ground-vibration or groundborne-noise in excess of the criteria recommended by the Federal Transit Administration. These receivers lie along the northern portion of the project (Phase 1) and along Whitnall Highway in Burbank (Phase 3). Although certain mitigation measures may be applied (discussed below), it is unlikely that impacts can be confidently reduced to below the recommended thresholds due to the nature of ground vibration. All impacts, however, will be temporary and only occur during daytime hours as currently planned.

Would the project result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Significant but mitigatable impact. Airborne noise from construction equipment will exceed the significant thresholds defined above for many receivers along the alignment. Of primary concern is exceedance of the 75 dBA threshold. Mitigation of airborne noise to acceptable levels is feasible, however, using a combination of noise barriers and other techniques discussed below.

1 Introduction

The Los Angeles Department of Water and Power proposes to install approximately six miles of pipeline from the Headworks Spreading Grounds to the North Hollywood pump station. This pipeline, referred to as Upper Reach, is part of the larger River Supply Conduit Improvement program. The potential exists that construction of this pipeline could produce unacceptably high levels of noise and vibration at residential and other sensitive locations along the project route.

Medlin & Associates, Inc. was tasked to study the potential noise and vibration impacts from construction of the project, identify significant impacts, and recommend notional mitigation measures. This report documents the findings of that study. This study focused solely on potential impacts due to construction; it did not address operational noise.

2 Project Description

2.1 Project Location

The proposed Upper Reach pipeline would involve the construction of approximately 31,600 linear feet of underground pipeline and appurtenant structures, stretching through portions of the City of Los Angeles and the City of Burbank, as shown in Figure 1 below. The project would be located in the streets, utility corridors, and parks of both cities, with the majority surrounded by urban development including both residential and commercial zones, as well as the existing Whitnall Highway utility corridor. Construction would occur within existing street rights-of-way, existing easements such as Whitnall Highway and Headworks spreading grounds, new easements, and recreation areas.

The project will be divided into three phases, as color-coded in Figure 1. The first phase, shown in orange, begins near the North Hollywood pump station and consists entirely of tunneling. Phase two, shown in blue, is mainly open-trenching with jacking used in certain critical areas. Phase three, shown in green, carries the project to its termination at the Headworks spreading grounds. The stretch across Burbank consists almost entirely of tunneling, with trenching and jacking used on the south side of the Los Angeles River.

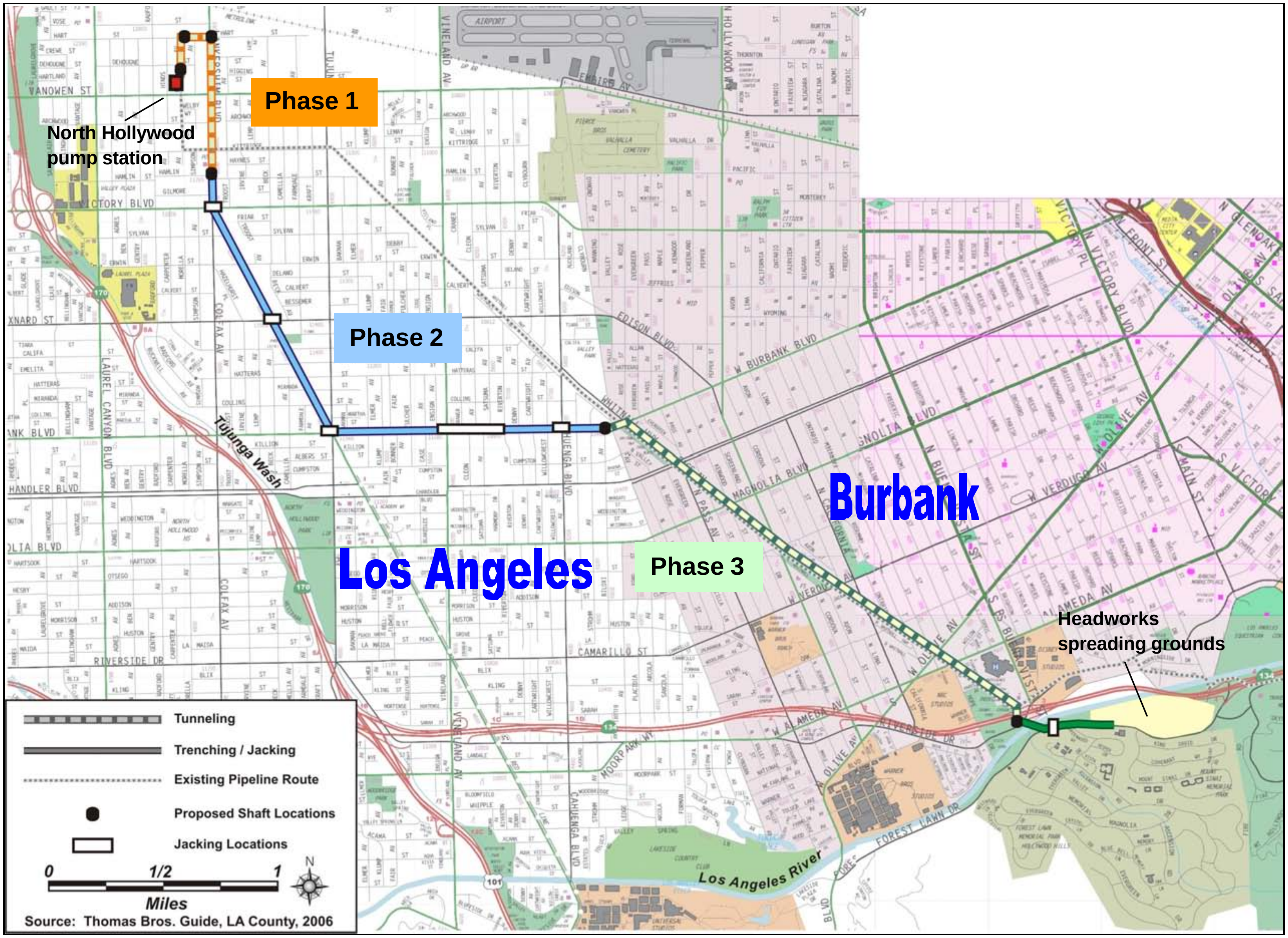

Figure 1: Project map

2.2 Construction Overview

Installation of the pipeline will be accomplished by a combination of open-trench excavations, jacking, and traditional tunneling. Tunneling will occur along those portions shown in Figure 1, with shaft locations noted as black dots. The remainder of the project will comprise open-trenching, with jacking used at certain critical areas. Jacking will likely occur across seven street intersections, including Lankershim Blvd./Burbank Blvd. and Burbank Blvd./Clybourn Ave., under the Los Angeles River from north of Riverside Drive (and south of Highway 134) to Forest Lawn Drive, and beneath existing storm drain on Forest Lawn Drive northeast of Memorial Drive. Other jacking locations may be added during the design phase. Similar to tunneling, pits will be located at both ends of a jacking area. The maximum pit sizes for jacking or tunneling will be about 18 feet wide by 60 feet long.

Potential staging areas identified for the proposed project include the Headworks Spreading Grounds, Buena Vista Park north of Riverside Drive, open right-of way within the Whitnall Highway, or local LADWP facilities, including the North Hollywood Pump Station. Staging area activities may include refueling and maintenance of equipment as well as storage.

Equipment, materials, and waste would be truck-hauled to and from the construction sites over existing roads. Excavated soil may also have to be hauled away from open-trench portions of the project during pipelaying operations.

2.3 Construction Methods

2.3.1 General

The general process for construction consists of site preparation, excavation, pipe (and/or appurtenant structure) installation and backfilling, and site restoration (where applicable). For tunneling and jacking operations, a pit will be located at the entrance and exit of each tunneled or jacked segment. All construction methods will require off-site staging area(s) to temporarily store supplies and materials.

2.3.2 *Open Trench Excavation*

Open trench excavation is a construction method typically utilized to install pipelines and appurtenant structures including maintenance holes, flow meters, valves, and vaults. In general, the process consists of trench excavation, pipe installation, trench backfilling, and site restoration. The existing pavement along the pipeline alignment is cut or broken and removed. A trench is excavated along the pipeline alignment, with the excavated soil either temporarily stored adjacent to the trenches or hauled off-site. The pipe is laid into the trench and welded together, and then the trench is backfilled and the surface restored and repaved.

Equipment used for the above activities comprises common heavy machinery used in construction. A summary of typical equipment is as follows:

- concrete saws and/or pavement breakers to demolish existing pavement, and loaders/backhoes and dump trucks to remove it;
- excavators, loaders, backhoes, and dump trucks to excavate the trench and remove soil;
- excavators and/or cranes to lower pipe into the trench;
- welding trucks to join pipe sections;
- equipment similar to that for excavation to backfill the trench;
- concrete mixers, dump trucks, graders, rollers, and pavers to restore the trench site and replace the pavement;
- ancillary service equipment such as water trucks, pickup trucks, electric generators, air compressors, etc.;
- delivery trucks (tractor-trailers) to bring supplies to the trenching site and remove waste.

For the Upper Reach project, the maximum length of open-trench at any one time would be about 500 feet, with a total construction zone extending about 1,400 feet. Trench widths will be approximately 11 feet, with an overall work-area width of about 30 to 35 feet. This process is expected to move at a rate of 80 feet per day for this project.

2.3.3 Jacking

Pipe-jacking is utilized where open-trenching would cause unreasonable disruption of busy intersections or to avoid other facilities such as flood control channels (e.g., Los Angeles River). Pipe-jacking is an operation in which the soil ahead of the steel casing is excavated and brought out through the steel casing barrel while the casing is pushed forward by a horizontal, hydraulic jack which is placed at the rear of the casing. The jacking equipment utilized for this operation is placed in the jacking pit. Once the casing is placed, the pipe is installed inside the casing. A receiving pit is located on the opposite end of the operation from the jacking pit.

Equipment and operations for pipe-jacking are similar to those for open-trenching, except that operations are essentially stationary from the view of the surface and continue for a much longer duration. The distance between the pits typically ranges from 250 to 500 feet, but may be longer or shorter depending on site conditions. For this project, the size of the jacking and receiving pits would be approximately 20-60 feet long and 12 feet wide.

2.3.4 Tunneling

Traditional tunneling involves the placement of the pipeline in an underground tunnel which is excavated between two or more shafts. As such, it shares characteristics similar to those of pipe-jacking, however the distance between tunnel shafts is typically far greater than those between jacking pits. A tunnel-boring machine (TBM), a device using a large disk mounted with cutters, is typically used to excavate the tunnels.

2.3.5 Dewatering

Excavation in areas with high groundwater may require the use of dewatering pumps. Such pumps may run continuously (including at night) even in the absence of other construction activities, and must therefore be considered separately from the above equipment.

2.4 Project Schedule

Overall project construction is expected to commence in August 2008 and finish in October 2012, for a total of 51 months. Table 1 shows the proposed start and completion dates for the individual phases.

Table 1: Proposed construction schedule

Phase	Start Date	Completion Date	Estimated Duration
1	August 2008	January 2011	630 days
2	December 2010	October 2012	468 days
3	November 2008	September 2011	748 days

As a worst-case scenario, up to three open trench and three jacking operations, in addition to tunnel operations, are anticipated to occur simultaneously over three pipeline phases during peak construction activity.

Construction would generally occur between 7:00 a.m. and 6:00 p.m. Monday through Friday (10-hour work day) and 8:00 a.m. to 5:00 p.m. on Saturdays (8-hour work day). No nighttime construction activities are proposed within public rights-of-way. However, dewatering equipment may remain in 24-hour operation throughout the duration of activities conducted below the groundwater surface. Also, as the schedule dictates, tunneling production may require night shift work.

3 Fundamentals of Noise

Rapid variations in ambient air pressure are perceived as sound by the human ear when they occur within certain limits. Specifically, the ear is sensitive to variations which occur at the rate of twenty times per second (20 Hertz) to twenty-thousand times per second, and at pressure differentials of at least twenty millionths of a Pascal (20 micropascals).

These are extreme limits for healthy ears. Most human hearing takes place in the frequency range of 100 Hz to 10,000 Hz, with the highest sensitivity at about 4,000 Hz. The human voice contains most of its energy in the frequency range between 125 Hertz and 8,000 Hertz.

The pressure variation of 20 micropascals is the lower limit of perceptibility. Human hearing extends from this limit up to the threshold of discomfort where pressure variations approach 20 pascals—a range of one million to one. Because of this large range of values, sound pressure is usually measured in terms of “decibels”:

$$L = 20\log(\frac{P}{P_o})$$

L is the value of sound pressure *level* in decibels, **P** is the mean pressure variation, and $\mathbf{P_o}$ is the lower limit described above. Sound pressure levels are referenced to the lower limit of hearing, meaning a level of zero decibels corresponds to that limit whereas a level of one-hundred decibels represents a pressure variation one-hundred thousand times greater than that limit. The logarithmic conversion provides a compression effect. Thus, sound pressure level is a method of expressing the wide range of human hearing in a manageable range of numerical values.

Because of the logarithmic conversion, decibel arithmetic works differently than ordinary arithmetic. Doubling the sound power in a measured environment results in only a three decibel addition to the measured values, not a doubling of the number of decibels; a ten-fold increase in the sound power results in an addition of ten decibels to the measured value. Similarly, averaging sound levels involves taking the anti-logarithms of measured sound levels. A simple arithmetic average of sound levels produces meaningless results, particularly if the two levels are widely divergent. (Note, however, that local ordinances often use a simple arithmetic average of sound levels when setting statutory thresholds on property-line limits involving two different zoning areas.)

Conveniently, human perception of “loudness” is also approximately logarithmic. A three decibel change in sound level is just noticeable to most people. A five decibel change

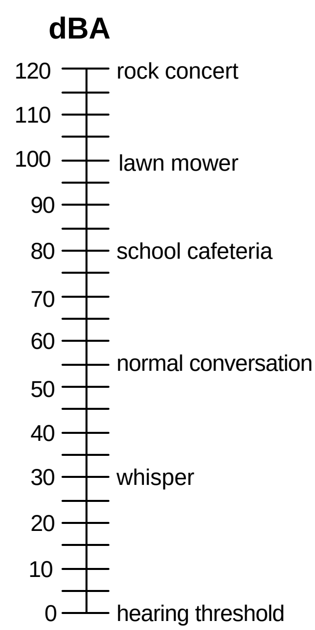

Figure 2

is readily noticeable, whereas a change of ten decibels is usually perceived as a doubling of the "volume".

Because human hearing is not equally sensitive at all frequencies, various weighting schemes have been developed to account for these variations. The most commonly used is the “A” weighting. It heavily discounts measured levels at lower frequencies, while providing slight emphasis around 2500 Hertz. The abbreviation for decibels is “dB”. When levels have been A-weighted, they are expressed as “dBA” or “dB(A)”. Figure 2 depicts several representative noise sources and the A-weighted sound levels they produce at a typical receiver location.

Objects in the environment rarely produce steady levels of noise. Fluctuating levels produce fluctuating measurements, thus requiring a method of describing the noise environment in a meaningful way. The common method in use is the equivalent-continuous sound level, abbreviated L_{eq}, which expresses the energy-average noise level over a specified interval of time (typically one hour). It is important to note that, like other averaging methods, L_{eq} does not indicate the range of noise level measurements. Two identical values of L_{eq} may represent two widely different ranges of actual noise measurements. Because of the logarithmic nature of expressing sound level, however, very loud sounds of any significant duration will tend to “swamp” quieter sounds of longer duration, thus biasing measurements in favor of the louder sounds.

Because quieter conditions are normally preferred during sleeping hours, various measures have been developed which account for additional annoyance produced by noises occurring at night. In California, the Community Noise Equivalent Level (CNEL) is standard in most statutes and requirements. CNEL is a twenty-four hour "equivalent" noise level. It accounts for the additional annoyance above by adding a 5 decibel penalty to noises measured between 7 p.m. and 10 p.m., and a 10 decibel penalty to noises between 10 p.m. and 7 a.m. . An alternative measure, the Day-Night Level (DNL or L_{dn}) is similar to CNEL but does not assess a penalty from 7 p.m. to 10 p.m.

DNL and CNEL are average values only. Because a noise source produces a DNL or CNEL value below a specified threshold does not mean that the noise will be inaudible. Rather, DNL and CNEL thresholds are normally set so that the occurrence of a disturbing noise is not so frequent that it causes substantial annoyance to people or other receivers in the affected area.

4 Applicable Regulations

4.1 General

The project will extend through portions of both Los Angeles and Burbank, and therefore be subject to noise ordinances of both of these cities. Thresholds of significant environmental impact are established by the California CEQA Guidelines and the Los Angeles Environmental Quality Act Guidelines, the latter of which incorporates the former by reference. The California CEQA Guidelines refer to levels set by local code or general plan in establishing significance thresholds. Thresholds regarding acceptable vibration levels have been established by the Federal Transit Administration (FTA) and others; those of the FTA are used herein.

4.2 California CEQA Guidelines

The California CEQA Guidelines establish the following criteria for determining a significant impact due to project noise:

> Would the project result in:
>
> a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?
>
> b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?
>
> c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?
>
> d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?
>
> e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?
>
> f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

All of the above criteria will be addressed in the EIR for this project, however, only paragraphs (a), (b), and (d) are considered in this study.[1]

Paragraph (a) refers to noise limits set by local regulations or general plans. For this project, the ordinances, noise elements, and other documents of Los Angeles (city) and Burbank would apply, and are addressed below. A definition of "excessive" groundborne

[1] This project will not create any permanent operational noise, as addressed by criterion (c), and will not introduce any noise-sensitive receivers in the vicinity of Burbank Airport, as addressed by criteria (e) and (f).

vibration, as discussed in paragraph (b), is developed below and based indirectly on criteria set forth by the Federal Transit Administration for rail vibration. Similarly, a "substantial" increase in ambient noise, as discussed in paragraph (d), is defined below.

4.3 Los Angeles Municipal Code

Chapter 11 of the Los Angeles municipal code regulates noise within the city. Section 112.03, however, defers regulation of construction noise to section 41.40 under chapter 4 (Public Welfare):

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SEC. 112.03.  CONSTRUCTION NOISE.
Noise due to construction or repair work shall be regulated as
provided by Section 41.40 of this Code.
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Section 41.40 does not set permissible noise level limits, but instead regulates the hours during which construction may be carried out. Specifically, it prohibits between the hours of 9 p.m. and 7 a.m. the use of machinery which "makes loud noises to the disturbance of persons occupying sleeping quarters in any dwelling hotel or apartment or other place of residence." It further prohibits, during these hours, "the operation, repair or servicing of construction equipment and the job-site delivering of construction materials" in such residential zones. These restrictions do not apply in any manufacturing or industrial zoned areas, or if written permission is obtained from the Board of Police Commissioners.

Section 41.40 further restricts construction activities occurring with 500 feet of a residential property (including maintenance and materials delivery) to the hours of 8 a.m. and 6 p.m. on Saturdays and national holidays, and prohibits activities entirely on Sundays. Again, the Board of Police Commissioners has the authority to grant a waiver to these restrictions.

Despite the above deferral of construction noise regulation to section 41.40, section 112.05 of the code clearly limits the permissible noise emissions from construction machinery. Specifically, this section requires that noise levels not exceed 75 dBA as measured at a distance of fifty feet from any "construction, industrial, [or] agricultural" machine. These include "crawler-tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, motor graders, paving machines, off-highway trucks, ditchers, trenchers, compactors, scrapers, wagons, pavement breakers, compressors and pneumatic or other powered equipment." This requirement does not apply, however, "where compliance therewith is technically infeasible", meaning that "noise limitations cannot be complied with despite the use of mufflers, shields, sound barriers and/or other noise reduction device or techniques during the operation of the equipment".

4.4 Los Angeles Noise Element

The noise element of the Los Angeles general plan does not prescribe any specific noise levels in regard to construction. Its most relevant statement is Objective 2 which states:

> Reduce or eliminate nonairport related intrusive noise, especially relative to noise sensitive uses.

The conjunctive Policy 2.2 states:

> Enforce and/or implement applicable city, state and federal regulations intended to mitigate proposed noise producing activities, reduce intrusive noise and alleviate noise that is deemed a public nuisance.

4.5 Los Angeles Environmental Quality Act Guidelines

The City of Los Angeles has replaced its previous CEQA Guidelines with a document that incorporates the California CEQA guidelines by reference, and adds a list of exclusions. It does not set specific thresholds for acceptable noise levels or noise level increases due to a project. The following excerpt from the new document provides the essence of its contents:

> **CITY OF LOS ANGELES**
> **ENVIRONMENTAL QUALITY ACT GUIDELINES**
> **Adopted** : July 31, 2002 - **CF# :** 02-1507
> **Section 1.** Articles II, IV through VI, and VIII through X of the 1981 City CEQA Guidelines are hereby repealed.
> **Section 2.** Article I of the City CEQA Guidelines is hereby amended to read as follows:
>
> > **"Article I. INCORPORATION OF STATE CEQA GUIDELINES**
> > The City hereby adopts as its own City CEQA Guidelines all of the State CEQA Guidelines, contained in title 15, California Code of Regulations, sections 15000 et seq, and incorporates all future amendments and additions to those guidelines as may from time to time be adopted by the State."
>
> **Section 3.** Article III of the City CEQA Guidelines is hereby renumbered as Article II and is amended to read as follows:
>
> > **"ARTICLE II: EXEMPTIONS..."** [a list of exempted activities follows]
>
> **Section 4.** Article VII of the City CEQA Guidelines is hereby renumbered as Article III and reads as follows:
>
> > **"ARTICLE III: CATEGORICAL EXEMPTIONS..."** [a list of categorically-exempted activities follows]

4.6 Burbank Municipal Code

Chapter 21 Article 2 (Environmental Protection - Noise Control) of the Burbank municipal code regulates the emission of noise within the city. Section 21-209 appears to exempt construction noise from any numerical noise-level limit, however, controlling instead the permissible hours of activity. It reads as follows:

> **Sec. 21-209. Construction in Residential Areas; Exception.**
> (a) HOURS DURING WHICH CONSTRUCTION IS PROHIBITED.
> It is unlawful for any person performing a Construction activity that requires a building permit in any zone other than R-1, R-1-H, and R-1-E, within a radius of five hundred feet measured from the nearest property line of any residentially zoned property, to operate Construction Equipment or perform any outside Construction on buildings, structures or projects (as those capitalized terms are defined in Section 31-203) within the city other than during the following hours:

Sites 500 Feet or Less from a Residential Zone *	
Monday – Friday	7:00 a.m. to 7:00 p.m.
Saturday	8:00 a.m. to 5:00 p.m.
Sunday and Holidays	None

The section further requires that a sign(s) be posted on the construction site stating the times and days during which construction is permitted. The Community Development Department, the Planning Board, or the City Council may grant exceptions to the above restrictions.

4.7 Burbank Noise Element

The noise element of the Burbank general plan lists areas where noise is a problem within the city, and provides guidelines for its abatement. It does not prescribe any specific noise levels in regard to construction.

4.8 Federal Transit Administration Vibration Impact Criteria

A search of the Los Angeles and Burbank municipal codes yielded no applicable regulation over permissible levels of groundborne vibration and consequent groundborne noise. Lacking any specific vibration limits in local regulations, a determination of significance for this study was based on other available and relevant criteria.

The Federal Transit Administration has set forth a number of criteria to determine whether groundborne vibration is likely to cause annoyance or interfere with activities within a building. These criteria are provided in tables 8-1 and 8-2 of the FTA document *Transit Noise and Vibration Impact Assessment* (May 2006), and are reproduced here. While they carry no statutory authority for this project, they provide a reasonable baseline to determine significant impacts. Though these criteria were developed specifically to assess vibration impacts from trains, they should also serve well for construction activities.

Table 2 below states criteria for three general categories of building use, with Category 1 having the most stringent criteria. Briefly, Category 1 refers to buildings with vibration-sensitive operations, such as medical or manufacturing equipment whose function maybe affected by even imperceptible vibrations. Category 2 refers to buildings where sleep-disturbance may occur, such as residences, hotels, and hospitals. Category 3 refers to buildings such as schools and churches where vibration may interfere with activities but not operation of sensitive equipment.

Within a category, criteria may vary depending upon the frequency of occurrence of a vibration-inducing event.[2] Infrequent events are considered those which occur less than 30 times per day, occasional events are those which occur between 30 and 70 times per day, while frequent events occur more than 70 times per day. Construction activity is considered to fall within the latter class, and therefore has the most stringent criteria within each category.

Levels in the table are stated as decibels referenced to one micro-inch per second, also called "velocity-decibels". They are computed using the root-mean-square (rms) of the ground velocity (not acceleration), and represent the logarithmic sum across the spectrum without any weighting.

Table 2: Groundborne vibration criteria - general assessment (Vdb re 1 m-inch/sec)

Land Use Category	Frequent Events	Occasional Events	Infrequent Events
Category 1: buildings where vibration would interfere with interior operations	65 VdB	65 VdB	65 VdB
Category 2: residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB
Category 3: institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB

Levels provided in Table 2 are broad-scope criteria for general use in many different types of land-use. Certain buildings, however, have specific functions which do not adequately fit into any of the three categories. Specifically, these include concert halls, television and recording studios, auditoria, and theaters. As a result, levels in Table 3 below were developed to address these "special-use" buildings.

Vibration criteria set forth above were all developed with regard to annoyance, not structural damage. Vibration levels well above these are typically required to cause even minor cosmetic damage to a building, and separate criteria are employed to determine potential structural impact.

[2] The premise is that infrequent events are less likely to disturb than frequent events of the same level.

Table 3: Groundborne vibration criteria - special-use buildings (Vdb re 1 m-inch/sec)

Land Use Category	Frequent Events	Occasional or Infrequent Events
Concert halls	65 VdB	65 VdB
TV studios	65 VdB	65 VdB
Recording studios	65 VdB	65 VdB
Auditoriums	72 VdB	80 VdB
Theaters	72 VdB	80 VdB

5 Setting

5.1 Existing Land Uses

5.1.1 General

With the exception of that portion south of the Los Angeles River, the project will pass entirely through existing urban and suburban developments, with varying levels of residential and commercial use as shown in Figure 3. In broad terms, the Phase 1 area of the project is mixed residential and commercial, the Phase 2 area is primarily commercial, while Phase 3 is residential and parks. Each of these phases is discussed in further detail below.

Note that the potential exists that sensitive historic buildings or other fragile structures exist close to the project route which may be subject to cosmetic damage from vibration due to tunneling. Such damage would be limited to minor cracking of plaster and similar effects resulting from the age or condition of the building. No attempt was made to identify such structures for this study, and it would be incumbent upon the contractor to determine which, if any, buildings along the tunnel routes fall under this category.

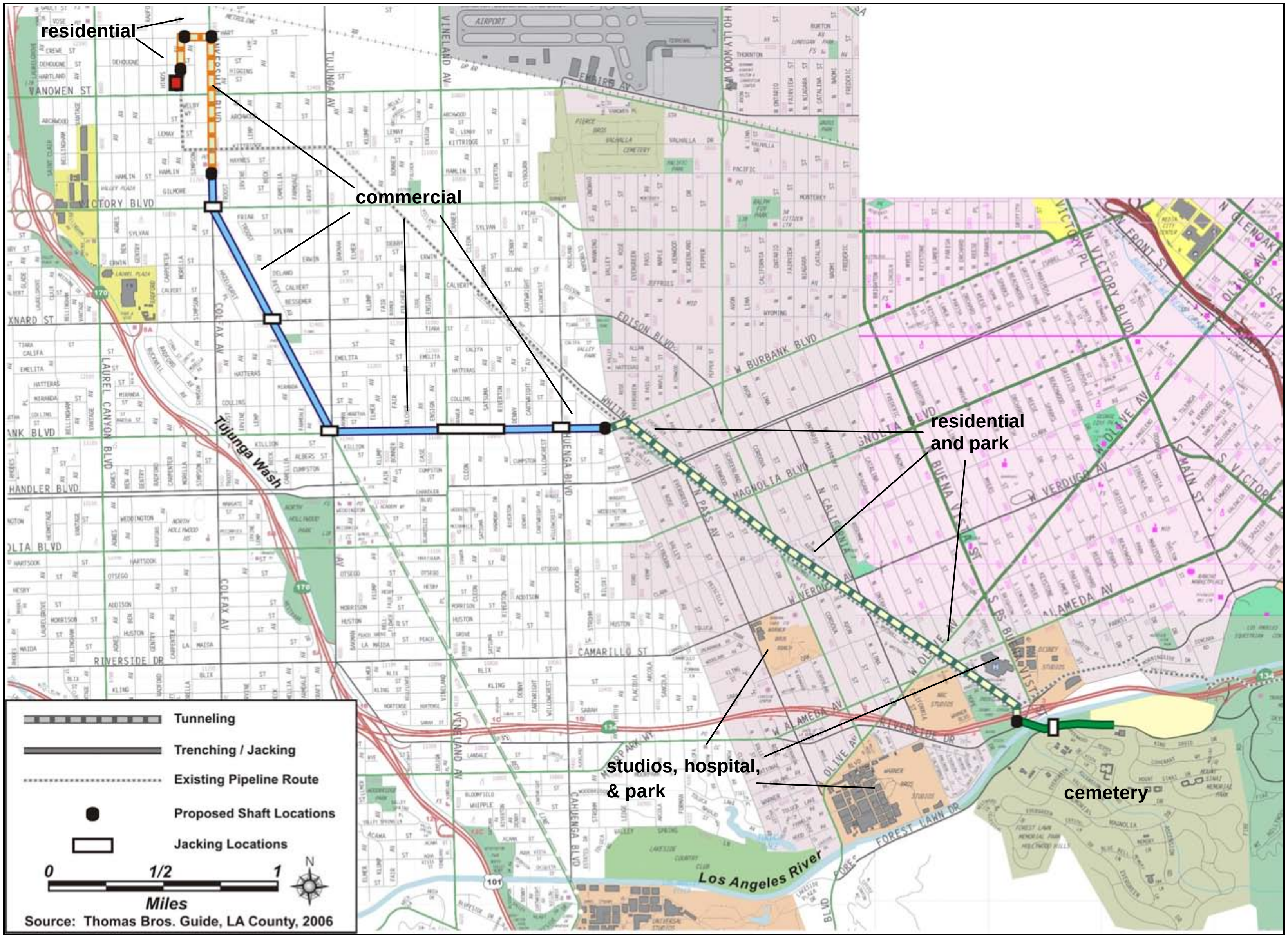

Figure 3: Notional land-use map

5.1.2 Phase 1

The Phase 1 area comprises the tunneling portion from the North Hollywood pump station to the intersection of Lankershim Boulevard and Victory Boulevard. Areas off of Lankershim Boulevard are primarily single and multi-family residences, such as shown in Figure 4. Other noise-sensitive uses include the Sagrado Corazon De Jesus Church and the Iglesia Pentecostes Church.

Along Lankershim Boulevard, land uses are primarily dense urban commercial, as shown in Figure 5, with few sensitive uses such as the Kiddie Academy shown in Figure 6. A medical clinic lies about a block east of Lankershim Boulevard near Archwood Street. The Phase 1 area is also subject to frequent noise from aircraft servicing Burbank Airport, as shown in Figure 7.

Figure 8 and Figure 9 provide an overview of the locations of noise-sensitive receivers with respect to the project alignment. Those receivers of concern, due to their proximity to the project, include:

- residences along Morella Avenue and Hart Street (Figure 8)
- Sagrado Corazon De Jesus church on Lankershim Boulevard (Figure 8)
- Inglesia Pentecostal Unida church on Lankershim Boulevard (Figure 8)
- Kiddie Academy on Lankershim Boulevard (Figure 9).

Figure 4: Residences on Hart Street & Morella Avenue

Figure 5: Lankershim Blvd. & Kittridge Street

Figure 6: Kiddie Academy on Lankershim Blvd.

Figure 7: Aircraft approaching Burbank Airport in the Phase 1 area

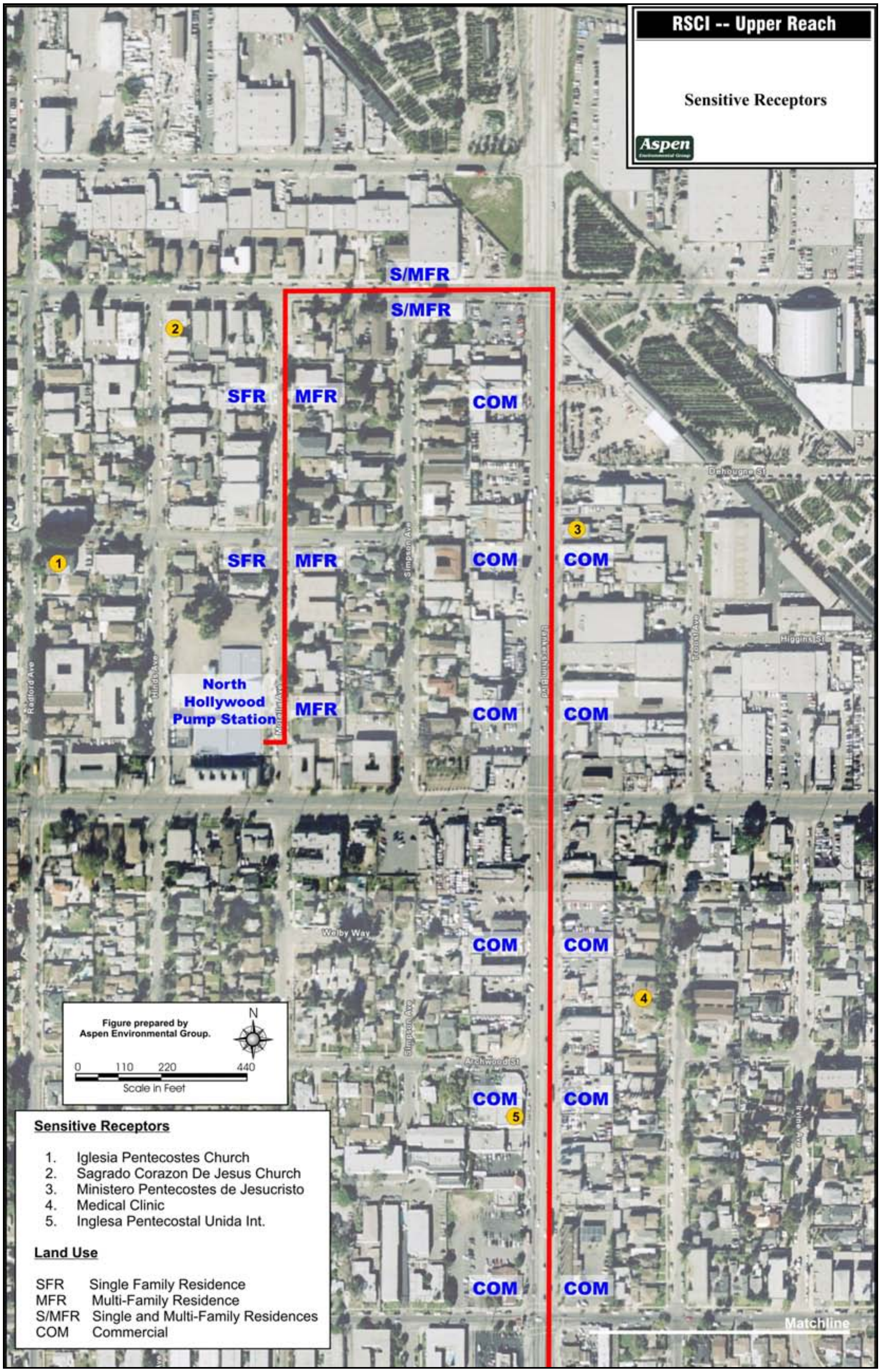

Figure 8: Sensitive receivers - Phase 1 (1 of 2)

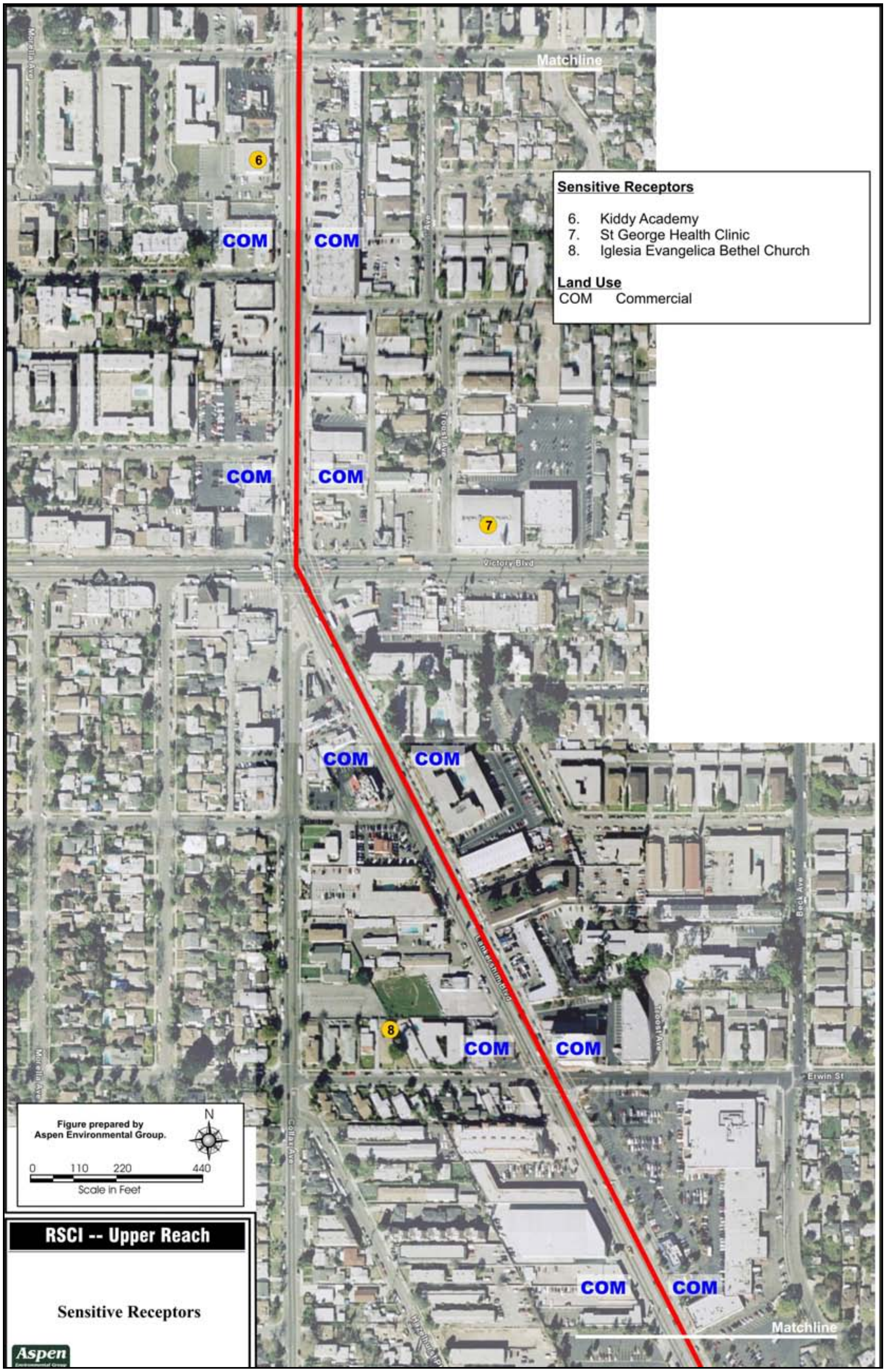

Figure 9: Sensitive receivers - Phase 1 (2 of 2)

5.1.3 Phase 2

The Phase 2 area comprises the open-trenching and jacking portion of the project extending approximately from the intersection of Lankershim Boulevard and Victory Boulevard to the intersection of Burbank Boulevard and Biloxi Avenue near the Burbank border. This portion of the project is largely high-density urban commercial, with some sensitive receivers interspersed. Figure 10 is representative of the land uses along Burbank Boulevard, this view being from the intersection of Satsuma Avenue. The Maurice Sendak Elementary School on Lankershim Boulevard (Figure 11) constitutes a noise-sensitive use, however, the actual school buildings are set back from Lankershim Boulevard by several hundred feet. The playgrounds of this school are still of concern.

A number of other noise-sensitive uses lie along this phase, as indicated in Figure 12 through Figure 14. Those receivers of concern, due to their proximity to the project, are:

- Lankershim Medical Clinic (Figure 12)
- Inglesia Pentecostes Fuente de Luz (Figure 12)
- Maurice Sendak Elementary School (Figure 12)
- Family Hope Medical Clinic (Figure 12)
- Multi-congregational church (Figure 12)
- The Center @ North Hollywood Church (Figure 13)
- Inglesia Pentecostes (Figure 13)
- L.A. Urgent Care Clinic
- West Coast Seminary (Figure 13)
- Triune Science of Being School (Figure 14)
- Lonny Chapman Group Repertory Theatre (Figure 14)
- Medical Career College (Figure 14)
- Jehovah's Witnesses Congregation (Figure 14)
- Ministerio Palabra Verdad Y Vida (Figure 14)
- Cahuenga Potters Studio (Figure 14)[3]
- Iglesia De Dios (Figure 14)
- Screenland Studios (Figure 14)

[3] The Cahuenga Potters Studio would not normally be considered a sensitive receiver, however, filming was observed at this location in October 2007.

Figure 10: Burbank Blvd. & Satsuma Avenue

Figure 11: Maurice Sendak Elementary School

Figure 12: Sensitive receivers - Phase 2 (1 of 3)

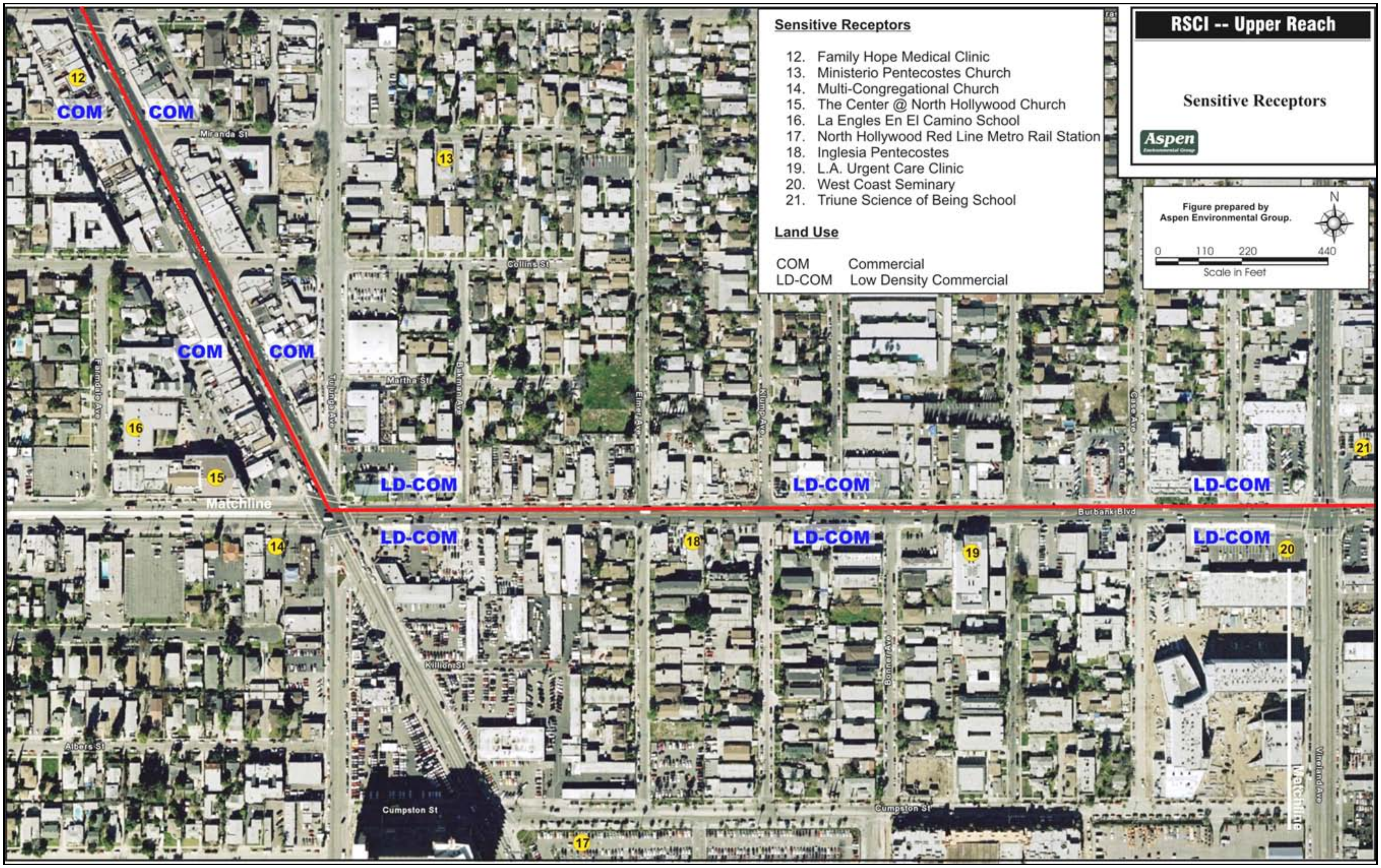

Figure 13: Sensitive receivers - Phase 2 (2 of 3)

Figure 14: Sensitive receivers - Phase 2 (3 of 3)

5.1.4 Phase 3

The Phase 3 area comprises the entirely-tunnel portion under Burbank and the short trenching section in Los Angeles on the south side of the river.

The stretch through Burbank is primarily residential along Whitnall Highway from the north end of this section to around Olive Avenue. Figure 15 shows residences near the Chandler Boulevard intersection, which are subject to heavy air-traffic noise from Burbank Airport. Figure 16 shows residences further south near Verdugo Avenue. In addition to residences, this stretch of Whitnall Highway also includes abundant park land and a number of schools, as shown in Figure 18 through Figure 20.

Land uses along the project alignment below Olive Avenue become more commercial, and include the NBC and Disney studios, and Providence Saint Joseph Medical Center (Figure 21). The Burbank section of the project terminates in the Johnny Carson Park. These areas are affected by noise from Ventura Freeway as well as heavily traveled local roads such as Alameda Avenue.

Cemeteries constitute the only sensitive land use south of the Los Angeles river until the project terminates at the Headworks Spreading Grounds, as shown in Figure 17, Figure 22, and Figure 23. This area is dominated by noise from both Ventura Freeway and Forest Lawn Drive.

Those receivers of concern, due to their proximity to the project, include:

- Universal Adult Day Care (Figure 18)
- Fred Wolfe Films (Figure 18)
- Whitnall Highway Park North (Figure 18 and Figure 19)
- Media Center Montessori Pre-school (Figure 19)
- American Lutheran Church and School (Figure 19)
- Robert Louis Stevenson Elementary School (Figure 20)
- CCI Digital (Figure 21)
- NBC TV, D Lot and NBC Studios (Figure 21)
- Providence Saint Joseph Medical Center (Figure 21)
- Burbank Medical Plaza and Emergency Medical Group (Figure 21)
- Johnny Carson/Buena Vista Park (Figure 21)
- Providence High School (Figure 21)
- Lod Cook Center/Junior Achievement Foundation (Figure 22)
- Forest Lawn Mortuary and Memorial Park (Figure 22)
- Mt. Sinai Mortuary and Memorial Park (Figure 22).

Figure 15: Residences along Whitnall Highway near Chandler Blvd.

Figure 16: Whitnall Highway near Verdugo Avenue

Figure 17: Forest Lawn Drive with cemeteries in background

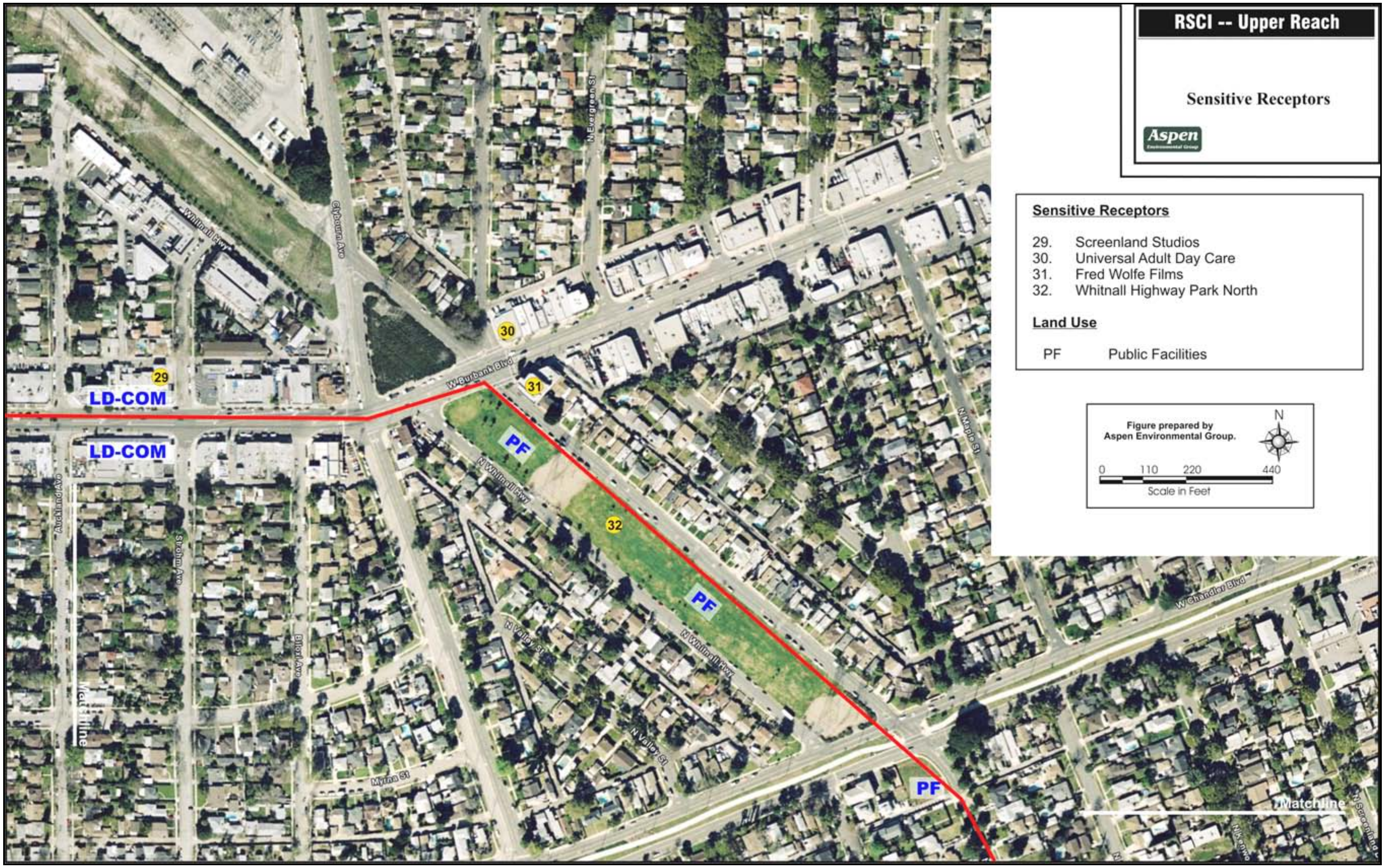

Figure 18: Sensitive receivers - Phase 3 (1 of 6)

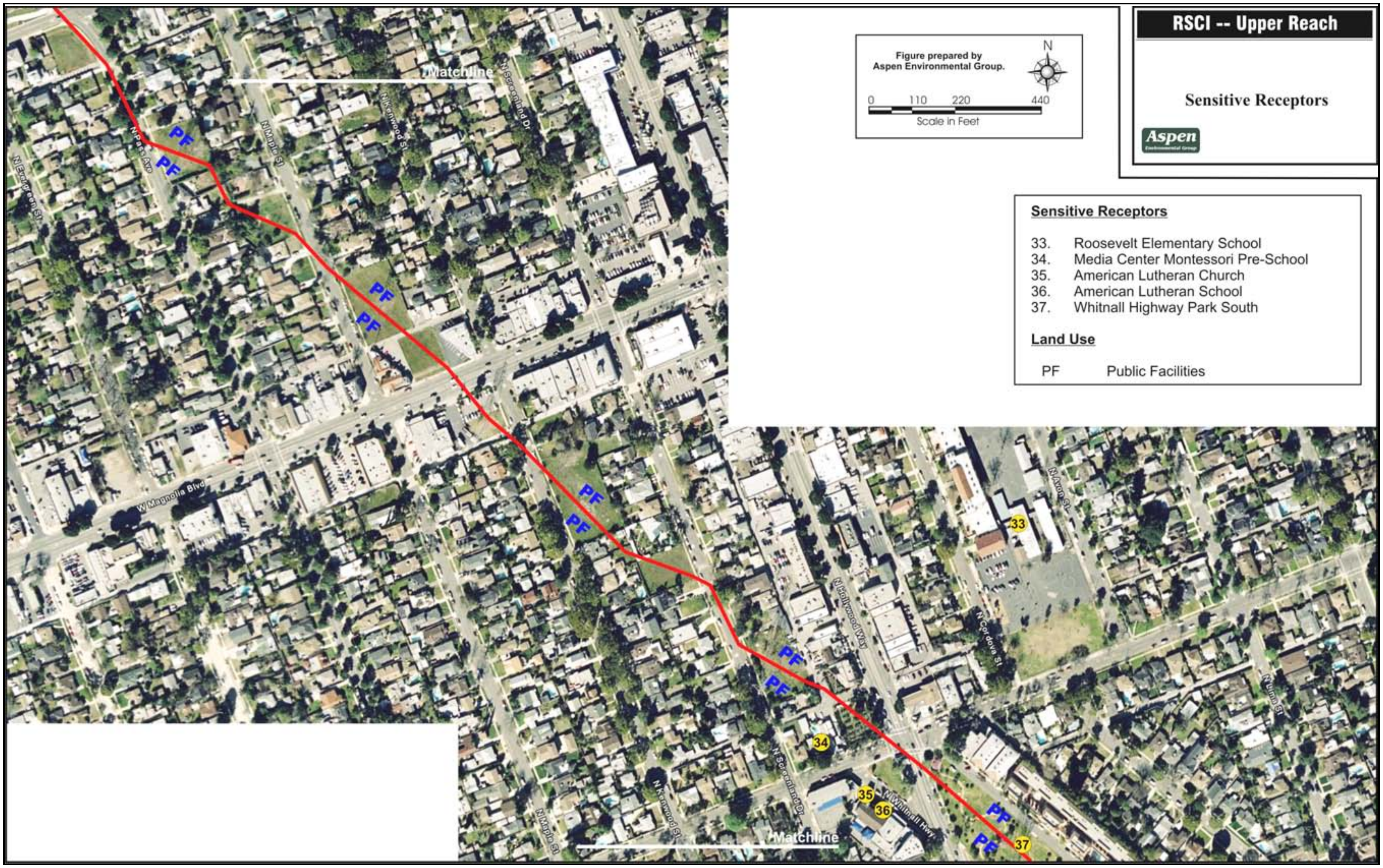

Figure 19: Sensitive receivers - Phase 3 (2 of 6)

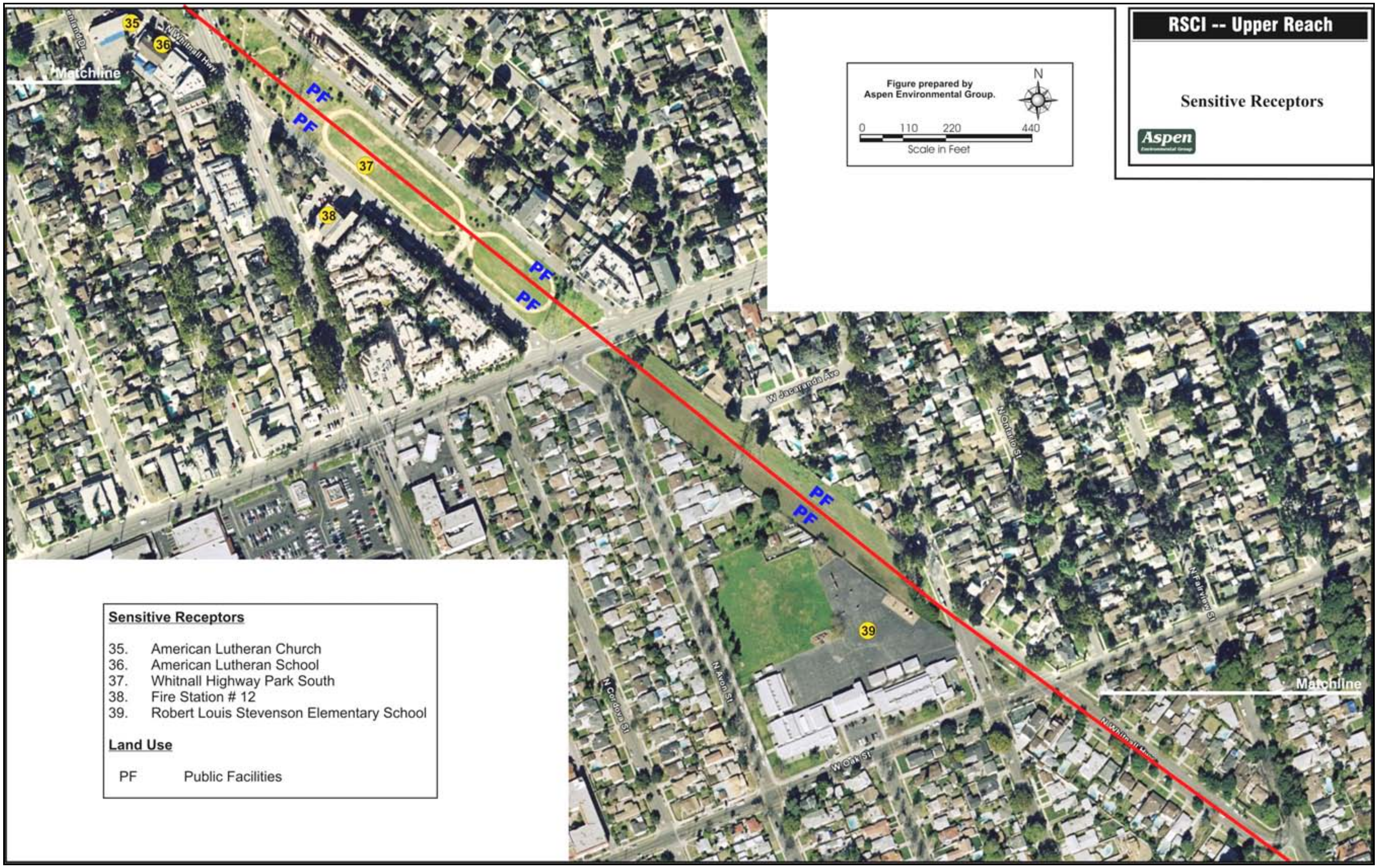

Figure 20: Sensitive receivers - Phase 3 (3 of 6)

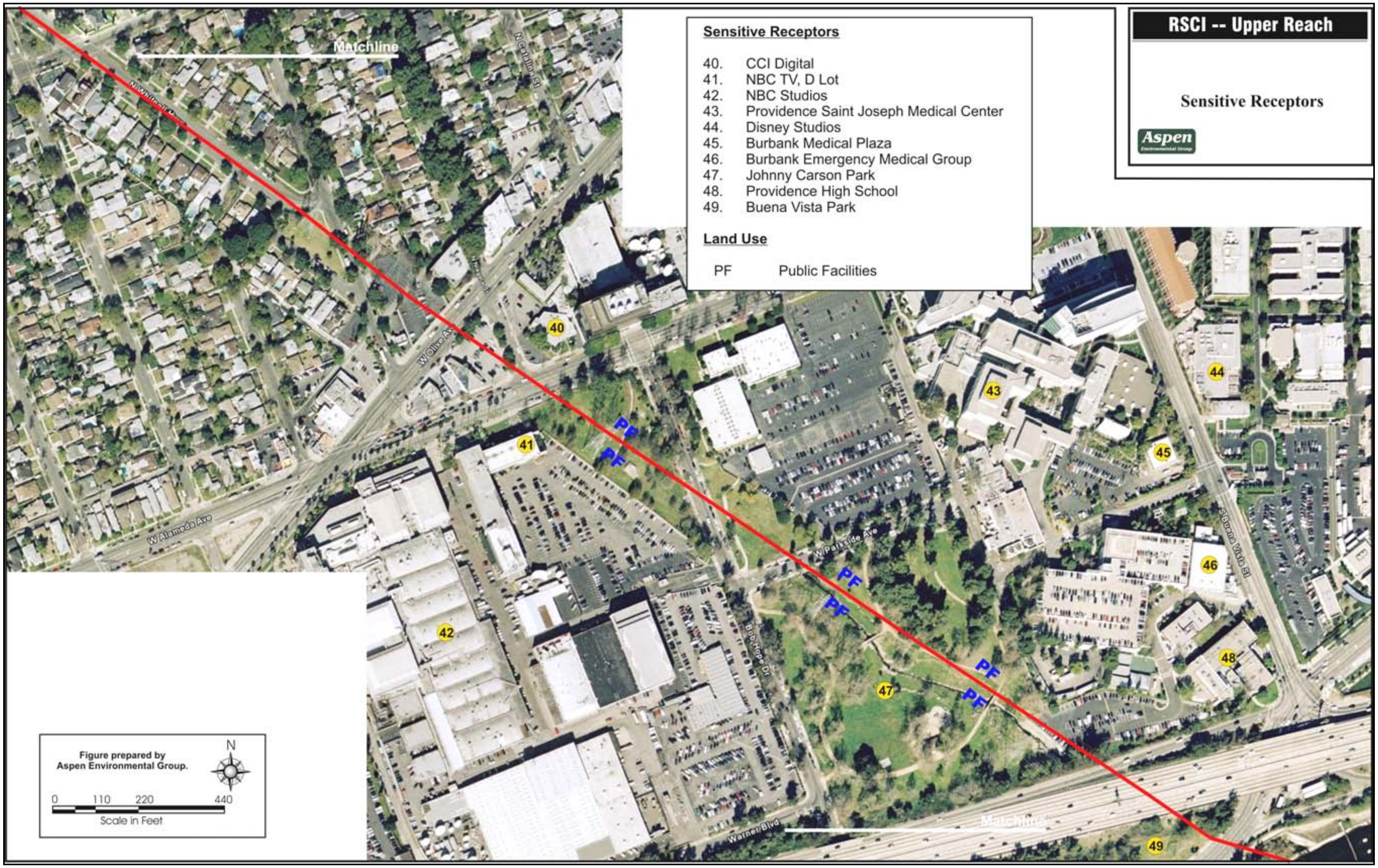

Figure 21: Sensitive receivers - Phase 3 (4 of 6)

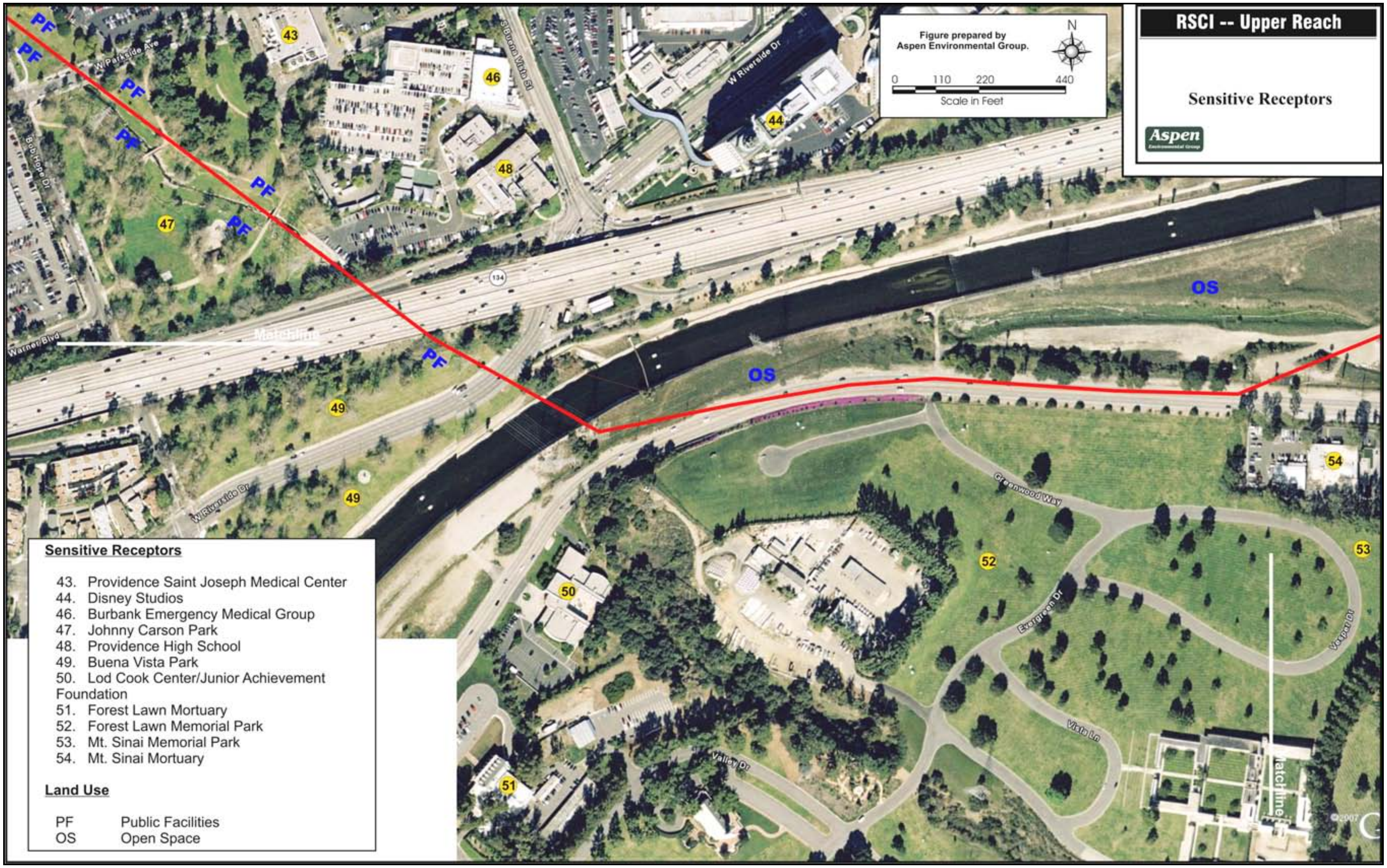

Figure 22: Sensitive receivers - Phase 3 (5 of 6)

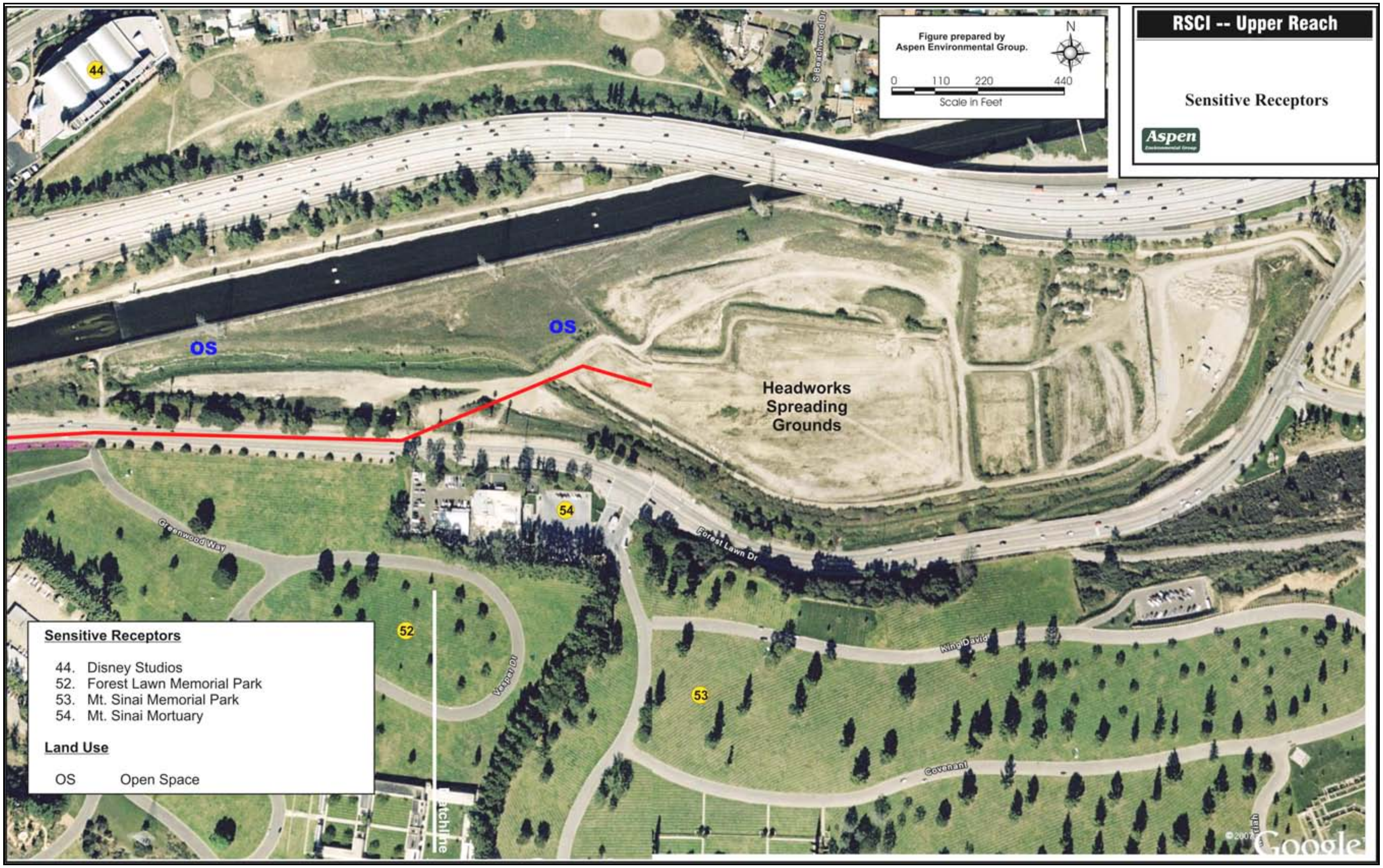

Figure 23: Sensitive receivers - Phase 3 (6 of 6)

5.2 Existing Ambient Noise Levels

In order to document existing noise levels along the project alignment, fourteen ambient noise measurements were conducted around midday on 30 March and 1 April 2007.[4] Measurement results are summarized in Table 4 below, with approximate measurement locations shown in Figure 24. Measurements were nominally fifteen minutes in duration each. Levels shown in the table and figure reflect the A-weighted average noise level over each measurement duration (dBA-Leq).

As expected, ambient noise levels in residential areas such as those along Whitnall Highway are generally lower than those in the commercial district along Lankershim and Burbank Boulevards. Frequent aircraft activity over residential areas both west and south of Burbank Airport, however, raises the ambient noise levels above what would normally be measured at these locations.

Measurements were conducted as follows:

- Three measurements ("a", "b", "c") conducted near the north part of Phase 1 ranged between 60 to 66 dBA. These were all in the residential area near the North Hollywood Pump Station, and were chosen to represent the tunnel-shaft work locations. These measurements included aircraft noise and varying degrees of traffic noise from Lankershim Boulevard.

- A measurement ("d") at the intersection of Kittridge Street and Lankershim Boulevard produced an average noise level of about 67 dBA, due primarily to street traffic, though it also included some low-level construction nearby. This is primarily a commercial district with residences behind, however the Kiddie Academy of Figure 6 above is situated next to this intersection. This location was measured to baseline conditions at the Kiddie Academy and the nearby tunnel-shaft access and jacking areas.

- A measurement ("e") was conducted further down Lankershim Boulevard near the Oxnard Street jacking area and the North Hollywood New Elementary School of Figure 11 above. This district is also primarily commercial along Lankershim Boulevard, with residences behind. The average noise level measured was 62 dBA, which was due primarily to street traffic though it also included some aircraft.

- A measurement ("f") in front of the central jacking area on Burbank Boulevard (by the intersection of Satsuma Avenue) produced an average noise level of about 71 dBA (approximately 68 dBA if the effects of an ambulance siren are removed). This area is also heavily commercial along Burbank Boulevard, with residences to the

[4] Measurements conducted with a Larson Davis 824 Type 1 sound level meter and spectral analyzer, fitted with windscreen and calibration-checked before and after measurements; microphone height was five feet above ground for all measurements; weather 30 March 73 degrees, 42% relative humidity, winds less than 5 mph; weather 1 April 71 degrees, 64% relative humidity, winds calm.

north beyond. Noise levels here are driven primarily by traffic on Burbank Boulevard, with some aircraft effects present.

- Four measurements ("g" through "j") were conducted along the primarily residential Whitnall Highway corridor in Burbank, including the tunnel access shaft on the north end of Phase 3. These locations have less road traffic noise than do the commercial districts, however, they experience frequent high-level noise peaks due to passing aircraft. Consequently, ambient noise levels measured along this corridor ranged from 58 to 69 dBA, depending upon the level of aircraft activity present.

- Further down Whitnall Highway, another measurement ("k") was conducted near the intersection of Alameda Avenue and Bob Hope Drive, in the vicinity of the studios and Providence Saint Joseph Medical Center. The measurement produced an ambient noise level of 67 dBA, driven primarily by traffic on Alameda Avenue, but also in part by traffic on Ventura Freeway (134).

- A measurement ("l") in Johnny Carson park also resulted in an ambient noise level of 67 dBA, driven primarily by traffic on Ventura Freeway and also Riverside Drive. This location represents the park as a sensitive receiver, and covers construction activity at the shaft location on the south end of Phase 3 as well as a potential staging area in this park.

- A companion measurement ("m") to the one above was conducted at the nearest residences, on the corner of Bob Hope Drive and Riverside Drive. Noise levels here are driven by the same traffic, though the ambient level is somewhat less at around 59 dBA.

- A final measurement ("n") was conducted on the south side of the Los Angeles River, north of Forest Lawn Drive, in the vicinity of the jacking area on south end of Phase 3. This measurement produced a high ambient noise level of 70 dBA, driven by traffic on Forest Lawn Drive and Ventura Freeway.

Table 4: Ambient noise measurements

#	Level (dBA)	Duration (minutes)	Time	Date	Major Use	Location & Description
a	60.2	15	12:15	30-Mar	residential	Morella across from pump station - shaft
b	62.4	15	12:33	30-Mar	residential	Morella & Hart - shaft
c	66.4	15	12:52	30-Mar	residential	Hart & Lankershim - shaft
d	66.7	15	13:21	30-Mar	commercial	Kittridge & Lankershim - Kiddie Academy
e	62.0	19	13:50	30-Mar	commercial	Lankershim & Oxnard - school, jacking
f	70.5	31	14:11	30-Mar	commercial	Satsuma & Burbank
g	61.6	11	11:23	30-Mar	residential/comrcl	Clybourn & Burbank
h	68.8	15	11:00	30-Mar	residential/park	Chandler & Whitnall - grassy area
i	56.3	15	9:56	30-Mar	residential/comrcl	Magnolia & Kenwood
j	58.2	16	10:30	30-Mar	residential/park	Whitnall & Verdugo - grassy area
k	67.0	15	11:06	1-Apr	commercial	Alameda & Bob Hope - studios, medical
l	67.2	15	10:45	1-Apr	park	Johnny Carson Park - shaft and staging
m	59.4	16	10:23	1-Apr	residential	Bob Hope & Riverside
n	70.2	15	12:44	1-Apr	--	Headworks/Forest Lawn

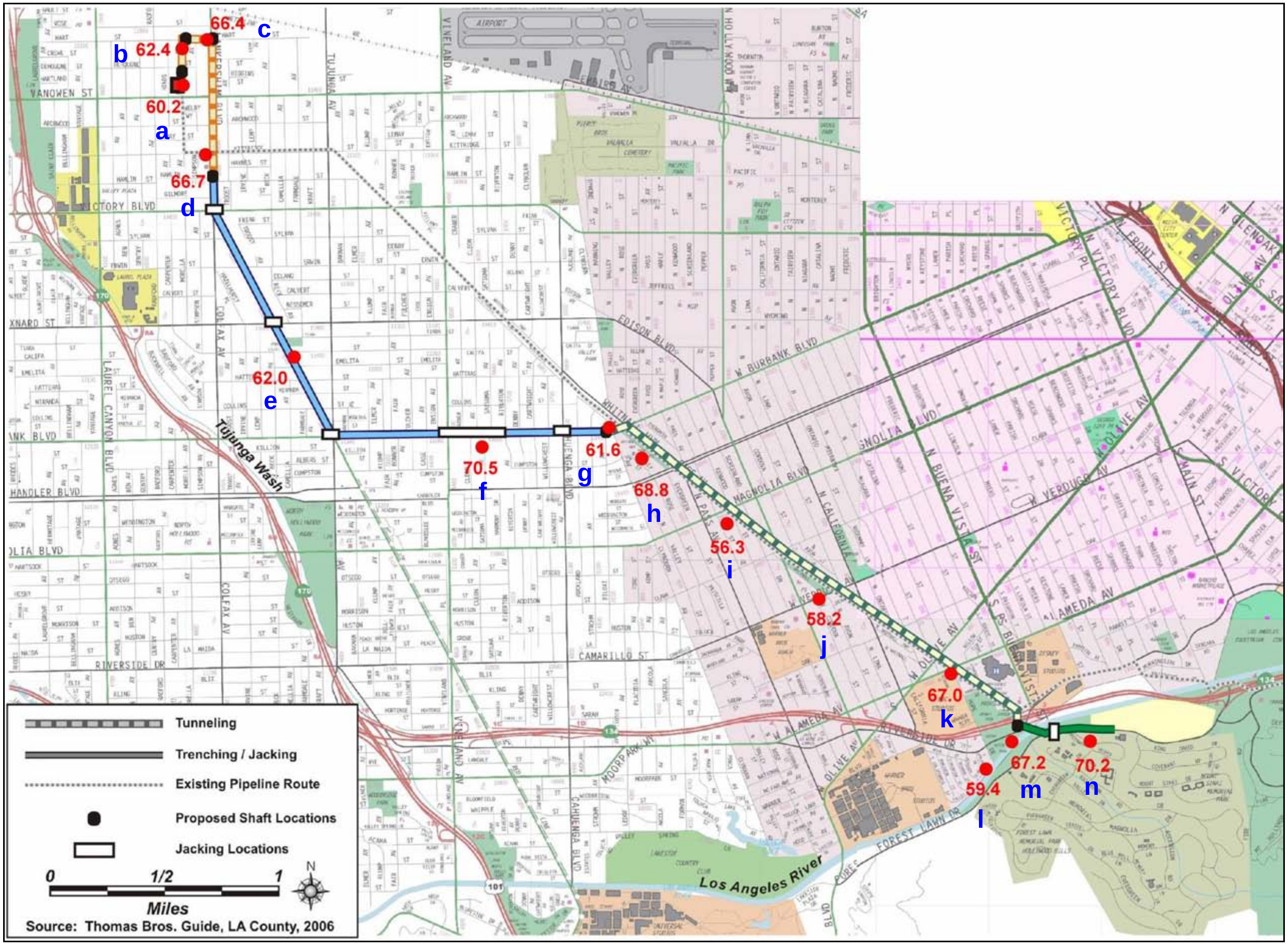

Figure 24: Ambient noise measurements (dBA-Leq)

6 Impacts Assessment

6.1 General

6.1.1 Summary of Potential Impacts

Construction of the project will produce appreciable levels of airborne noise which, due to its long-duration of 51 months, will result in significant temporary environmental noise impacts.[5] Significant levels of ground vibration and accompanying groundborne noise are also anticipated at sensitive receivers close to the tunnel alignments.

Airborne noise will result from operation of heavy machinery along the trenching route (Phase 2) and at jacking pits and tunnel shafts (all phases). The primary areas of concern are around the shafts and pits, with secondary concern given to points along the trenching route (due to their relatively brief exposure).

Ground vibration and accompanying groundborne noise may occur along the tunneled portions of the project (Phases 1 and 3), resulting from operation of the tunnel-boring machine (TBM) and movement of muck trains within the tunnel. Areas of concern are limited to receivers within "impact distances" determined below. Because of the continuous operation of muck trains along the length of the alignments, tunneling operations will produce long-duration impacts.

Trucks hauling materials, dirt, and waste will also produce airborne noise. Unlike that for construction machinery, however, trucking noise will be extended along the delivery routes and consist only of addition to existing traffic noise.

6.1.2 Airborne Noise

Airborne noise will result from operation of heavy machinery along the trenching route and at jacking pits and tunnel shafts. It will consist primarily of engine exhaust noise, with conjunctive other noises produced by these machines such as track squeal, hydraulic pump whine, and banging of dump truck bays. Ancillary on-site equipment may also contribute significant noise to the surrounding environment--examples include portable generators, air-compressors, and concrete-mixers. Certain activities, such as pavement cracking and sawing, may produce intense noise levels for short durations.

Airborne noise from construction equipment will occur at all points along the project except along the tunnel alignments.[6] The primary areas of concern are around the tunnel shafts and jacking pits. While airborne noise levels around the trenched areas will be substantially above ambient, the relatively high rate of trench progression (approximately 80 feet per day) will limit the duration to which any one receiver along the trench route is

[5] Operational noise is expected to be insignificant, and is not addressed in this study.
[6] As tunneling machinery will be underground, it will produce no significant airborne noise.

exposed. Construction activities around tunnel shafts and jacking pits, however, will continue for considerably longer durations (three to six months), thus creating greater impacts on nearby sensitive receivers.

Specifics details regarding construction activities are provided in Section 2 ("Project Description") above. Essentially, however, open-trenching will require equipment to open and close the trench, haul dirt, install the pipe, and deliver materials and waste to and from the site. Approximately 500 feet of trench could be open at one time, with a work area extending up to 1400 feet. Tunnel shafts and jacking pits will require sufficient equipment to excavate the shafts/pits, haul dirt, deliver materials and waste to and from the site, and handle them within the shaft or pit. Activities around tunnel shafts and jacking pits will be essentially stationary, and will continue for as long as necessary to complete the task at hand.

Table 5 below shows the expected types and quantities of machines required for the above two operations.

Table 5: Equipment used by operation

Activity	Equipment	
	Quantity	Type
Open Trench	5	Pickups
	1	Service truck
	1	Backhoe
	6	Dump trucks
	1	Welding trucks
	1	Pitman
	1	Crane
	1	Wheel loader
	1	Compactor
	1	Fork lift
	1	Water truck
	1	Excavator
Jacking & Tunneling	2	Pickups
	1	Dump trucks
	1	Excavator
	1	Crane

A 1971 EPA document is commonly cited as a reference for noise-emission levels of construction equipment. A more recent document put out by the Federal Highway Administration, however, has compiled actual construction equipment noise emission levels from the on-going Central Artery/Tunnel project in Boston.[7] In addition to providing more recent data, the FHWA compilation also lists a "usage factor" for each type of equipment, which allows more accurate prediction of an average noise level. The usage factor indicates the amount of time a particular piece of equipment is likely to run at high noise output (Lmax) during a particular operation. Data from the FHWA document are reproduced in Appendix 1.

[7] *FHWA-HEP-05-054 Final Report,* January 2006

In order to estimate airborne noise levels around the Upper Reach project, the FHWA noise data were applied to the list of project equipment in Table 5 above and adjusted for the usage factor and quantity of each type of machine (where an exact match was not found, a similar machine was substituted). Table 6 below shows the adjusted noise levels for equipment to be used on the open-trench portion of the project. The "Lmax" column shows the highest typical noise output for each machine when it is fully engaged in an operation. This level is adjusted down by the usage factor to estimate levels in the " Leq" column, which represent the hourly-average noise level each machine would produce when measured at 50 feet. Table 7 shows similar data for equipment to be used around tunnel shafts and jacking pits.

Detailed impacts on nearby receivers are provided in noise-contour figures below, however, a rough estimate of the noise level near an operation can be obtained by accounting for the quantity of each type of equipment and then summing all of their noise emissions together. This value is shown in the lower right corner of each table below. For open-trench operations, the estimated hourly-average (Leq) noise level is approximately 87 dBA at 50 feet, whereas for tunnel shafts and jacking pits it is 81 dBA. These are rough estimates only, which assume that all of the equipment is clustered together (not valid for trenching operations).

Table 6: Open-trench equipment noise emissions

Project Equipment	Quantity	Modeled Equivalent	Usage Factor	Lmax @ 50 ft	Leq @ 50 ft	Quantity Adjusted
Backhoe	1	Backhoe	40 %	78 dBA	74 dBA	74 dBA
Compactor	1	Compactor	20 %	83 dBA	76 dBA	76 dBA
Crane	1	Crane	16 %	81 dBA	73 dBA	73 dBA
Dump Truck	6	Dump Truck	40 %	76 dBA	72 dBA	80 dBA
Excavator	1	Excavator	40 %	81 dBA	77 dBA	77 dBA
Fork Lift	1	Front-end Loader	40 %	79 dBA	75 dBA	75 dBA
Pickup Truck	5	Pickup Truck	40 %	75 dBA	71 dBA	78 dBA
Pitman	1	Man Lift	20 %	75 dBA	68 dBA	68 dBA
Service Truck	1	Dump Truck	40 %	76 dBA	72 dBA	72 dBA
Water Truck	1	Dump Truck	40 %	76 dBA	72 dBA	72 dBA
Welding Truck	1	Generator	50%	81 dBA	78 dBA	78 dBA
Wheel Loader	1	Front-end Loader	40 %	79 dBA	75 dBA	75 dBA
SUM	--	--	--	**90 dBA**	**85 dBA**	**87 dBA**

Table 7: Tunnel-shaft and jacking-pit equipment noise emissions

Project Equipment	Quantity	Modeled Equivalent	Usage Factor	Lmax @ 50 ft	Leq @ 50 ft	Quantity Adjusted
Crane	1	Crane	16 %	81 dBA	73 dBA	73 dBA
Dump Truck	1	Dump Truck	40 %	76 dBA	72 dBA	72 dBA
Excavator	1	Excavator	40 %	81 dBA	77 dBA	77 dBA
Pickup Truck	2	Pickup Truck	40 %	75 dBA	71 dBA	74 dBA
SUM	--	--	--	**85 dBA**	**80 dBA**	**80 dBA**

Other potential sources of airborne noise will also exist. Prior to trench excavation, existing pavement will be removed using either a concrete saw or pavement breaker, both of which produce high noise levels (greater than 90 dBA at 50 feet). Their use in any one location will be relatively brief, however. Dewatering pumps may be used near the Los Angles River and other locations as necessary. These pumps would likely run at night, and therefore must be shielded or otherwise configured to avoid noise impacts on any nearby sensitive receivers.

6.1.3 Ground Vibration & Groundborne Noise

Ground vibration and associated groundborne noise may occur along the tunneled portions of the project (Phases 1 and 3), resulting from operation of the tunnel-boring machine (TBM) and movement of muck trains within the tunnel. Tunnel boring machines (TBMs) have a rotating cutting wheel in the front and a rear systems of conveyors for soil removal (muck). The cutting wheels of a TBM rotate slowly, between 1-10 rpm. The muck is carted back to the access shaft with the use of muck trains, where it is then removed vertically to the street level. Because of the continuous operation of muck trains along the length of the alignments, tunneling operations will produce long-duration impacts, even after the TBM has passed a given location.

Ground vibration is felt, rather than heard, and may produce other effects such as interference with operation of sensitive equipment. In extreme cases, it may produce cosmetic or even structural damage of buildings, however, such levels of vibration are not anticipated on this project. Groundborne noise is a secondary effect of ground vibration, and results from vibration of interior walls, dishes, picture frames, etc. It is confined to those areas where ground vibration is present, and is usually only of concern in quiet environments (i.e. groundborne noise would likely not be noticeable near a tunnel shaft, as it would be dominated by airborne noise from machinery operating around the shaft).

Ground vibration impacts are substantially more difficult to predict than airborne noise impacts, as propagation characteristics vary widely with soil conditions. Furthermore, only limited data are available regarding ground-vibration levels produced by TBMs and muck trains, thus limiting the ability to predict their impacts. Therefore, estimation of impacts for this study was made using data from two previous projects in Los Angeles.

Regression analyses of two other projects in Los Angeles which employed tunnel boring machines produced the following conclusions:[8]

- TBM operations would create:
  - no significant impact at general receivers (including residential), either from ground vibration or groundborne noise
  - significant impact due to vibration at TV and recording studios lying within a distance of about 110 feet from the tunnel alignment.

- Muck train operations would create:
  - significant impact due to groundborne noise at residential receivers lying within 150 feet of the tunnel alignment;
  - significant impact due to vibration at TV and recording studios lying within a distance of about 170 feet from the tunnel alignment.

In summary, impacts related to ground-vibration are anticipated for this project due to muck-train operation, and are projected to extend to either 150 feet or 170 feet from the tunnel alignment depending upon whether the affected receiver is a residence or a TV/recording studio. Impacts to other types of receivers are not anticipated.

These results were based on application of the FTA criteria shown in Table 2 and Table 3 above, classifying TBM operation as "infrequent" due to its brief duration in any one area, and muck train operation as "frequent" due to its continuous nature. Thus, the vibration impact thresholds were set as shown in Table 8 below. Results were calculated as follows.

Table 8: Ground vibration impact thresholds

Receiver	Operation	Event Frequency	Threshold
Residence	TBM	infrequent	80 VdB
Residence	muck train	frequent	72 VdB
TV/recording studio	TBM	infrequent	65 VdB
TV/recording studio	muck train	frequent	65 VdB

For TBM operations, a regression curve through actual data was calculated as approximately:

$$L = -0.1D + 76 \text{ (VdB)}$$

[8] Regression analyses performed on the North Outfall Replacement Sewer and Metro Red Line projects in the Northeast Interceptor Sewer and Eagle Rock Interceptor Sewer EIR (City of Los Angeles Dept of Public Works).

where "L" is the vibration level in velocity decibels (VdB), "D" is the distance between the TBM and a receiver, and a crest-factor of four is assumed for TBM vibrations.[9] Based on this curve, TBM vibrations would never exceed the 80 VdB threshold for residences, and would not exceed the 65 VdB threshold for TV and recording studios beyond a distance of 110 feet from the tunnel alignment. Likewise, the 83 VdB threshold for institutional uses primarily used during the daytime would also never be breached. No significant groundborne noise from TBMs is anticipated, due to their low rotational speeds; any resulting groundborne noise would be of frequencies below human audibility.

These results do not guarantee that no complaints will be received regarding TBM ground-vibration, since levels as low as 65 VdB are perceptible to humans. However, the above results indicate that no significant impact to residences are anticipated.

In contrast to TBMs, muck trains will continue to operate along the entire tunnel alignment even after the TBM has passed, meaning that their impact must be classified as "frequent", with a correspondingly lower impact threshold. Muck trains are also likely to produce higher-frequency ground vibrations than TBMs, and therefore produce potentially audible levels of groundborne noise in addition to ground-vibration.

Analysis of two previous projects in Los Angeles indicates that ground vibration levels due to muck trains may exceed the 72 VdB threshold for frequent events at residential receivers at distances up to 100 feet from the tunnel alignment, while levels exceeding the 65 VdB for TV and recording studios may occur up to 170 feet from the alignment. These levels are based on a crest factor of five for muck train vibrations. 72 VdB was about the highest level measured on the two previous projects. It is not anticipated that muck-train vibrations will exceed the 75 VdB threshold for institutional uses primarily used during the daytime, therefore no impact is expected to these receivers.

As described in Section 6.2.3 below, an appropriate threshold for groundborne noise impacts inside a residence is 45 dBA (1 hour average). Groundborne noise inside a typical residence is estimated by A-weighting the ground-vibration levels (when stated as VdB referenced to one micro-inch per second).[10] As the highest frequency of muck-train vibration would be on the order of 60 Hertz, groundborne noise levels would be approximately 20-25 dB less than the corresponding ground vibration level. Muck-train vibration on the two previous projects fell to a level of about 66 Vdb at a distance of 150 from the tunnel alignment, corresponding to a groundborne vibration level of 41-46 dBA inside a typical residence. Therefore, residences lying at a distance of up to 150 feet from the tunnel alignment may be considered to be impacted by muck-train operations. Structures other than residences are not considered impacted by groundborne noise.

Combining the above results, it becomes clear that muck-train operations are likely to create the furthest-reaching impacts during tunnel construction, with the outer limits

[9] Ground-vibration is typically measured in terms of peak values, whereas the criteria are specified as average (RMS) values; the crest factor relates the two for comparison.

[10] For an explanation of ground-vibration to groundborne noise conversions, see the FTA document *Transit Noise and Vibration Impact Assessment,* May 2006.

being 150 feet from the tunnel alignment for residences (as a result of groundborne noise), and 170 feet for TV/recordings studios or any other industrial facility which employs vibration-sensitive equipment.

No structural or cosmetic damage is anticipated from any TBM or muck car operation on the Upper Reach project. Figure 25 below shows the recommended vibration limits (due to blasting) published by the former U.S. Bureau of Mines.[11] These curves express maximum allowable vibration limits as a function of frequency. In all cases, the recommended limits are far above levels anticipated from either TBM or muck-train operations on this project. The only exceptions to this conclusion might be any fragile or historic buildings lying close to the tunnel alignments. Such buildings may contain weakened old plaster or other construction which may be overly sensitive to vibration. It will be incumbent upon the tunneling contractor to identify any such buildings, if they exist, and take necessary measures to prevent or repair any damage.

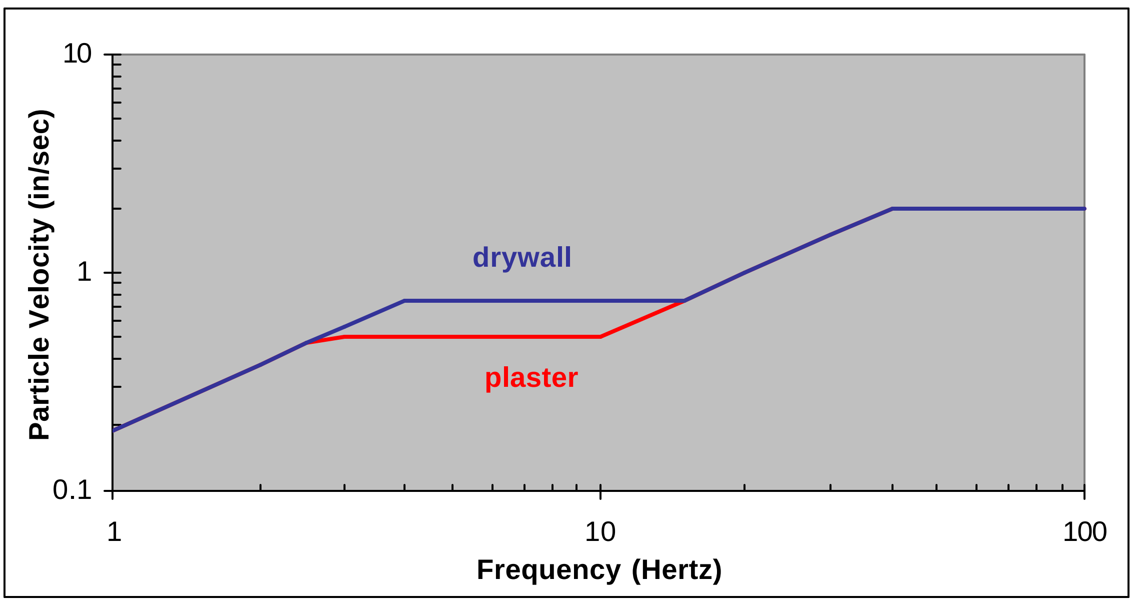

Figure 25: U.S. Bureau of Mines recommended blasting criteria

[11] USBM RI 8507, 1980

6.1.4 Trucking Noise

Trucks hauling materials, dirt, and waste will produce airborne noise along the delivery routes chosen by the contractors. Trucking noise will only contribute to existing traffic noise, and is therefore considered separately from airborne construction-equipment noise above.

Figure 26 below shows the noise levels produced by heavy trucks as measured at a distance of 25 feet from the centerline of travel (the approximate distance of a building from the lanes). These curves are based on results from the Federal Highway Administration's *Traffic Noise Model 2.5* software. They show the hourly-average noise level which would be measured as a function of the number of truck-trips per hour. Two curves are shown, one representing trucks traveling at 30 miles per hour, and the other representing trucks moving at 45 miles per hour. For example, 25 trucks per hour moving at 45 miles per hour would produce an average noise level of 65 dBA at a point 25 feet from the lane centerline.

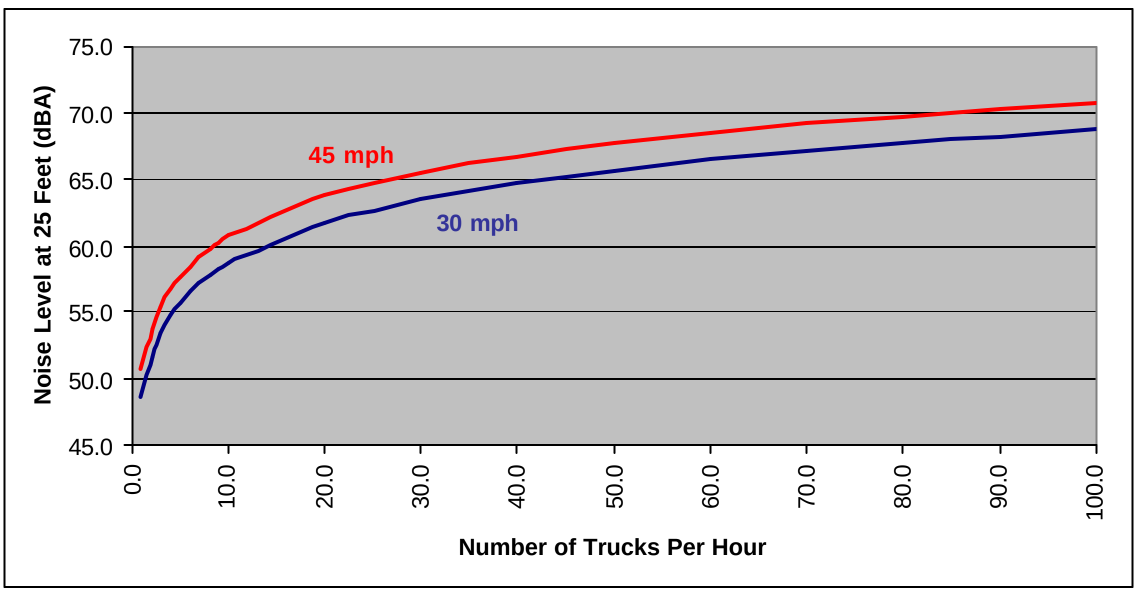

Figure 26: Heavy-truck noise emission at 25 feet; one-hour average (dBA)

Whether trucking would cause a significant impact on any particular delivery route depends upon intended number of truck-trips per hour as well the volume of traffic already using that route (or more specifically the ambient traffic noise level).

Delivery routes will be specified by the project contractors, and have not yet been determined. For this study, it was assumed that trucks servicing the project will use the major thoroughfares through the commercial districts, and not the smaller streets in the residential areas. This assumption may not be valid in certain specific areas.

6.2 Criteria for Determination of Significant Impacts

6.2.1 Sensitive Receivers

The criteria below were used in this study to determine whether significant impacts will occur at noise-sensitive receivers along the Upper Reach project due to construction activities. "Noise-sensitive receivers" comprise any of the following:

- residences - including hotels, dormitories, shelters, etc.
- schools - including day-care facilities, colleges, etc.
- places of worship
- medical facilities actually engaged in treatment of patients (not offices)
- theaters, auditoria, recording studios, etc.
- parks, cemeteries, etc.

Sensitive receivers also include any confined outdoor recreational area, such as school yards or apartment playgrounds, where users do not have the option of moving away from construction noise.

Sensitive receivers do not include any industrial or commercial facility unless it conducts activities which can be specifically shown to be noise or vibration sensitive (e.g. microchip manufacturing).

6.2.2 Airborne Noise

In the absence of statutory limits, airborne-noise impact criteria were determined for this project based on other relevant standards, laws, and industry-accepted criteria. An airborne-noise impact is defined as any of the following when occurring at any noise-sensitive receiver:

- **An hourly-average noise level greater than 75 dBA:** This criterion is intended to provide a substantial margin in avoiding any hazardous noise condition, and is consistent with statutory requirements on HUD-supported development (24CFR51B).
- **An hourly-average noise level which is ten decibels (10 dB) above the existing ambient level:** This criterion is based on the fact that the human ear interprets a ten-decibel increase as a doubling of the "volume" of sound. Whereas the ear interprets a five-decibel increase as a significant increase in noise, such a stringent criterion would be inappropriate for construction noise, which is of limited duration.
- **Any activity which violates statutory limits in the Los Angeles or Burbank municipal codes:** This criterion specifically refers to permitted hours of construction, as stated in section 4 ("Applicable Regulations") above.

6.2.3 Ground Vibration and Groundborne Noise

In the absence of any statutory limits, ground vibration impact criteria were based on the guidance provided by the Federal Transit Administration and summarized in Table 2 and Table 3 above.

A significant impact due to groundborne-noise is assumed to occur if levels exceed 45 dBA at any residence or similar sensitive-receiver. This level is consistent with the interior-noise requirement of the California Building Code (Title 24) and other codes and general-plan requirements in California. No significant impact from groundborne noise is assumed for any commercial facility, including those which house vibration-sensitive equipment.

Combining these criteria with the analyses of section 6.1.3 above, significant impacts are assumed to exist for any of the following conditions:

- **a TV studio, recording studio, or other building which houses vibration-sensitive equipment and lies within 170 feet of the tunnel alignment (muck-train vibration);**
- **a residence or similar sensitive receiver lying within 150 feet of the tunnel alignment (muck-train groundborne noise).**

6.3 Los Angeles Impacts Assessment

6.3.1 General

As shown in Figure 1, pipeline-laying in the City of Los Angeles will comprise tunneling in the Phase 1 area (northern end of the project), with open-trenching and jacking being employed in all other locations. Consequently, vibration concerns associated with tunneling are confined to the Phase 1 area. All other areas will be impacted only by airborne noise due to trenching and activities around the jacking pits and tunnel-access shafts.

6.3.2 Airborne Noise

Airborne noise will occur along the entire length of the open-trench portions of the alignment (Phase 2) and around jacking pits and tunnel shafts (all phases). Because activity around the pits and shafts will be of extended duration and occur within residential zones, it is of higher concern than trenching operations.

6.3.2.1 Jacking Pits and Tunnel Shafts

Projected noise levels surrounding tunnel shafts and jacking pits were modeled using the equipment scenario of Table 7, substituting a single loader for two pickup trucks. This same scenario was applied to each jacking pit and tunnel shaft, with the resulting noise contours shown in Figure 27 through Figure 42 below. These contours represent the hourly-average noise produced by this complement of machinery operating under typical conditions. Modeling incorporated the usage factors shown in Table 7 to obtain average, rather than instantaneous, noise levels. Modeling assumed no attenuation due to shielding or ground absorption; the contours therefore represent a simplified but conservative estimate of expected construction noise levels.

Figure 27 shows projected hourly-average noise contours around the tunnel shaft in front of the North Hollywood pump station. Red contours represent noise levels which exceed the 75 dBA criterion above; yellow contours represent a cautionary range between 70 – 75 dBA; all other noise levels are depicted in blue. As is seen in the figure, the proximity of nearby residences (as close as 30 feet) potentially exposes them to noise levels in excess of 80 dBA, which constitutes a clear noise impact at this location. A similar situation exists farther up Morella Avenue, at the intersection of Hart Street, as shown in Figure 28. These projected noise levels are also well above the existing ambient level of 62 dBA for this location.

Figure 29 shows the scenario at the intersection of Hart Street and Lankershim Boulevard. As this location is the transition from residential to commercial zones, most of the surrounding land uses are not considered noise-sensitive receivers. The 70 dBA contour does approach one of the nearby residential structures, however, projected noise levels exceed the existing ambient level of 66 dBA by only a few decibels. Therefore, no airborne-noise impacts are projected for this location.

Commercial uses also surround the tunnel-shaft/jacking-pit on Lankershim Boulevard north of Victory Boulevard, as shown in Figure 30. St. George Health Clinic on Victory Boulevard is the nearest identified sensitive receiver, however, it lies well outside the range of concern. Because there are no sensitive receivers nearby, there will be no noise impacts from operations around this pit.[12] This point does, however, mark the beginning of Phase 2 trenching operations, which will create potential airborne-noise impacts discussed below.

The jacking pit south of Victory Boulevard (Figure 31) has no nearby sensitive receivers, and therefore will create no airborne noise impacts.

Figure 32 represents the jacking pit north of Oxnard Street. This pit lies directly in front of Inglesia Pentecostes Fuente de Luz, and is expected to create noise levels approaching 80 dBA impinging on this receiver, resulting in a clear impact. The Lankershim Medical Clinic (not shown) lies to the north of this pit, but far enough away that noise levels should fall to the point where they are within a few decibels of existing ambient levels. No impact is therefore projected for this clinic.

The jacking pit to the south of Oxnard Street is shown in Figure 33. No sensitive receivers have been identified near this pit. Similarly, no sensitive receivers lie within the vicinity of the jacking pit north of Hatteras Street, shown in Figure 34.

The jacking pit south of Hatteras Street lies directly in front of the Family Hope Medical Clinic, as shown in Figure 35. Projected noise levels impinging on this facility approach 80 dBA, indicating a clear impact.

Figure 36 shows combined noise contours from operations around the jacking pits straddling the intersection of Lankershim Boulevard and Burbank Boulevard. The only noise-sensitive receivers in the vicinity of this intersection are the Multi-Congregational Church and The Center @ North Hollywood Church. While projected construction noise levels are rather high at these locations, they do not exceed either threshold of 75 dBA or 10 dB above ambient. Therefore, no impact is projected for either receiver.

The jacking pit near the intersection of Burbank Boulevard and Vineland Avenue is shown in Figure 37. Though not visible in the figure, three sensitive receivers lie near this intersection: the West Coast Seminary on the southwest corner, the Triune Science of Being School on the northeast corner, and the Lonny Chapman Theater on the southeast corner. As shown in the figure, however, project noise emissions from pit operations do not exceed 70 dBA at any of these locations. The 70 dBA contour falls short of the West Coast Seminary building, and does not cross to the east side of Vineland Avenue. As the

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[12] Residential receivers may lie behind this and other commercial facilities along the project route; because they are shielded by the commercial structures, however, noise impacts upon them are considered less than significant.

existing ambient noise level along this section of Burbank Boulevard is on the order of 71 dBA, and pit noise emissions do not exceed the 75 dBA threshold, no impact is projected for any receiver at this location.

A Jehovah's Witnesses Congregation is the only sensitive receiver near the jacking pit at the intersection of Burbank Boulevard and Cartwright Avenue (Figure 38). Though projected noise levels from pit operations exceed the existing ambient level of 71 dBA, the 75 dBA contour is still constrained to the east side of Cartwright Avenue, and does not impinge on the congregation building. As such, no impact is projected for this location.

Figure 39 shows the jacking pits which straddle the intersection of Burbank Boulevard and Cahuenga Boulevard. The Iglesia De Dios, on the northeast corner of the intersection, lies less than 60 feet away from the east pit and will be subject to construction noise levels in excess of the 75 dBA threshold, resulting in an impact at this location. The Ministerio Palabra Verdad Y Vida on the southwest corner (not shown) lies near the 70 dBA contour, which is less than ten decibels above ambient noise; consequently, there will be no significant impact for this receiver. The Cahuenga Potters Studio--a nominally sensitive receiver--also lies near this intersection, but outside the 75 dBA contour. Noise levels at this location are further not expected to exceed ambient levels by ten decibels, therefore, no impact is projected for this receiver.

Figure 40 shows the location of the tunnel shaft at the beginning of Phase 3. This shaft lies between Strohm Avenue and Biloxi Avenue, where the project approaches Whitnall Highway and transitions into a residential area. Because the shaft is receded from the transition, there is no construction noise impact on these residences. The only other nearby sensitive receiver is Screenland Studios, on the west side of Strohm Avenue. Construction noise associated with this pit are projected to diminish to insignificant levels prior to reaching this receiver, however, creating no significant impact.

Ambient noise along Forest Lawn Drive exceeds 70 dBA. However, projected noise emissions exceeding 75 dBA from shaft operations will impinge on the Lod Cook Center/Junior Achievement Foundation building, as shown in Figure 42. Therefore a noise impact will exist at this location.

Table 9 below summarizes those noise-sensitive receivers described above which will be impacted by airborne noise from jacking-pit or tunnel-shaft operations. The impacts of greatest concern are those occurring at the residences near the North Hollywood pump station in Phase 1. Without mitigation, these residences will be subject to long-term noise levels in excess of 80 dBA, posing a potentially hazardous noise condition.

A significant noise impact will technically exist at small segment of Forest Lawn Memorial Parks, however, most of this cemetery will be remain unaffected by jacking-pit operations on Forest Lawn Drive.

Table 9: Airborne noise impacts from jacking-pit & tunnel-shaft operations

Sensitive Receiver	Figure	Land Use
multiple residences	Figure 27	residential
multiple residences	Figure 28	residential
Inglesia Pentecostes Fuente de Luz	Figure 32	worship
Family Hope Medical Clinic	Figure 35	medical
Iglesia De Dios	Figure 39	worship
Johnny Carson Park see section 6.4.2	Figure 41	park
Lod Cook Center/Junior Achievement Foundation	Figure 42	school

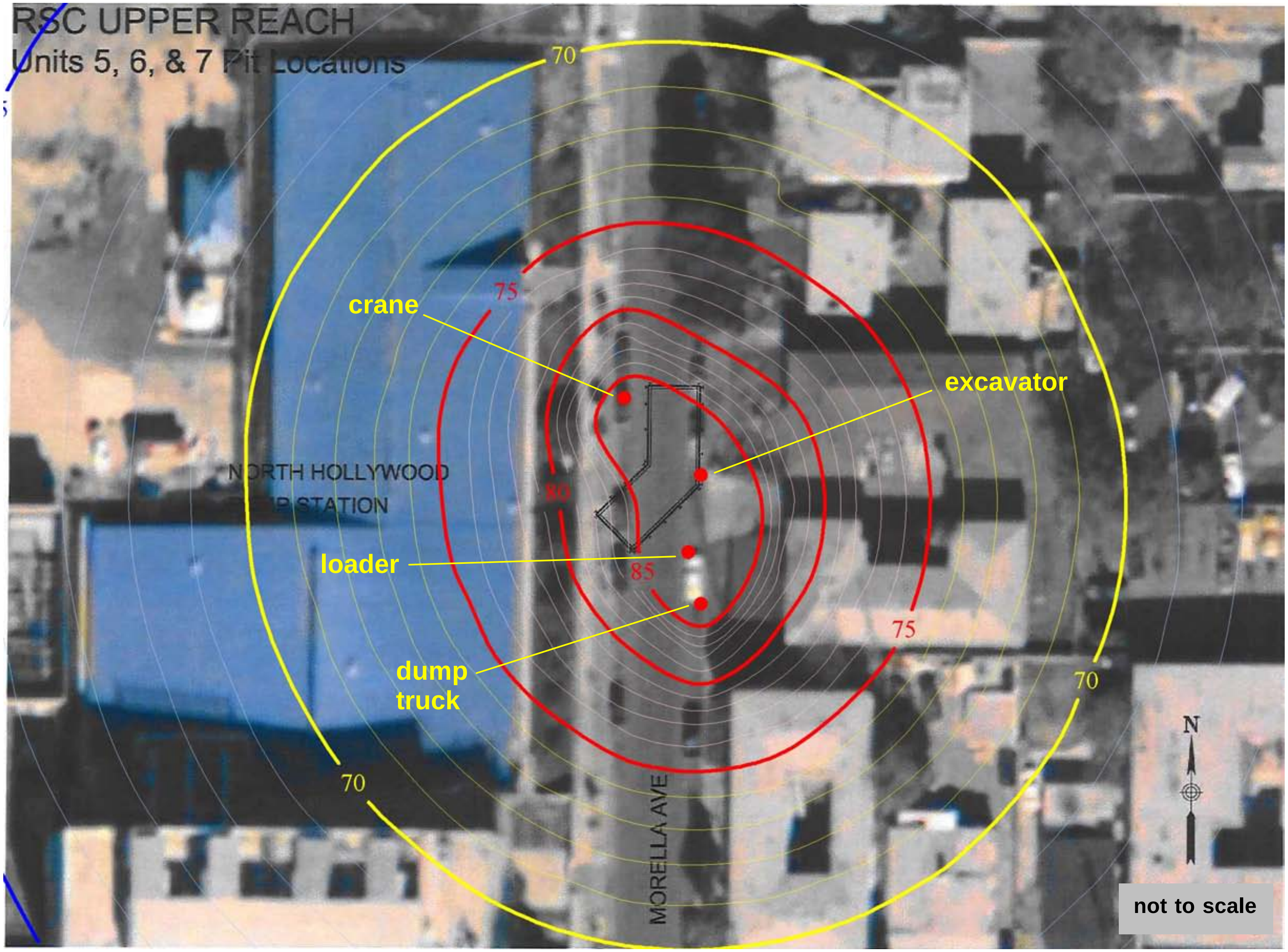

Figure 27: Tunnel shaft near North Hollywood pump station on Morella Ave. (1-hr Leq)

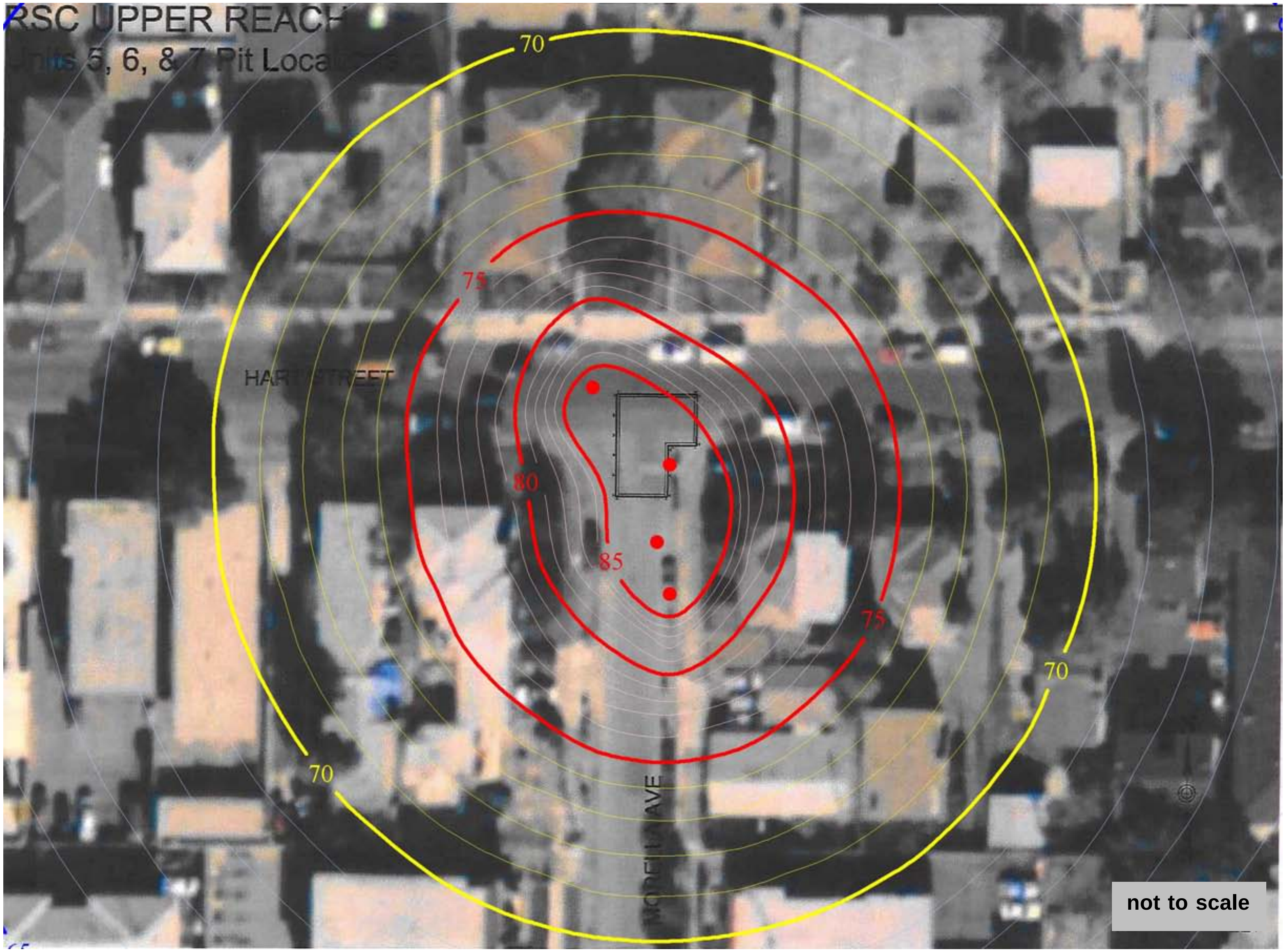

Figure 28: Tunnel shaft at intersection of Morella Ave. and Hart St. (1-hr Leq)

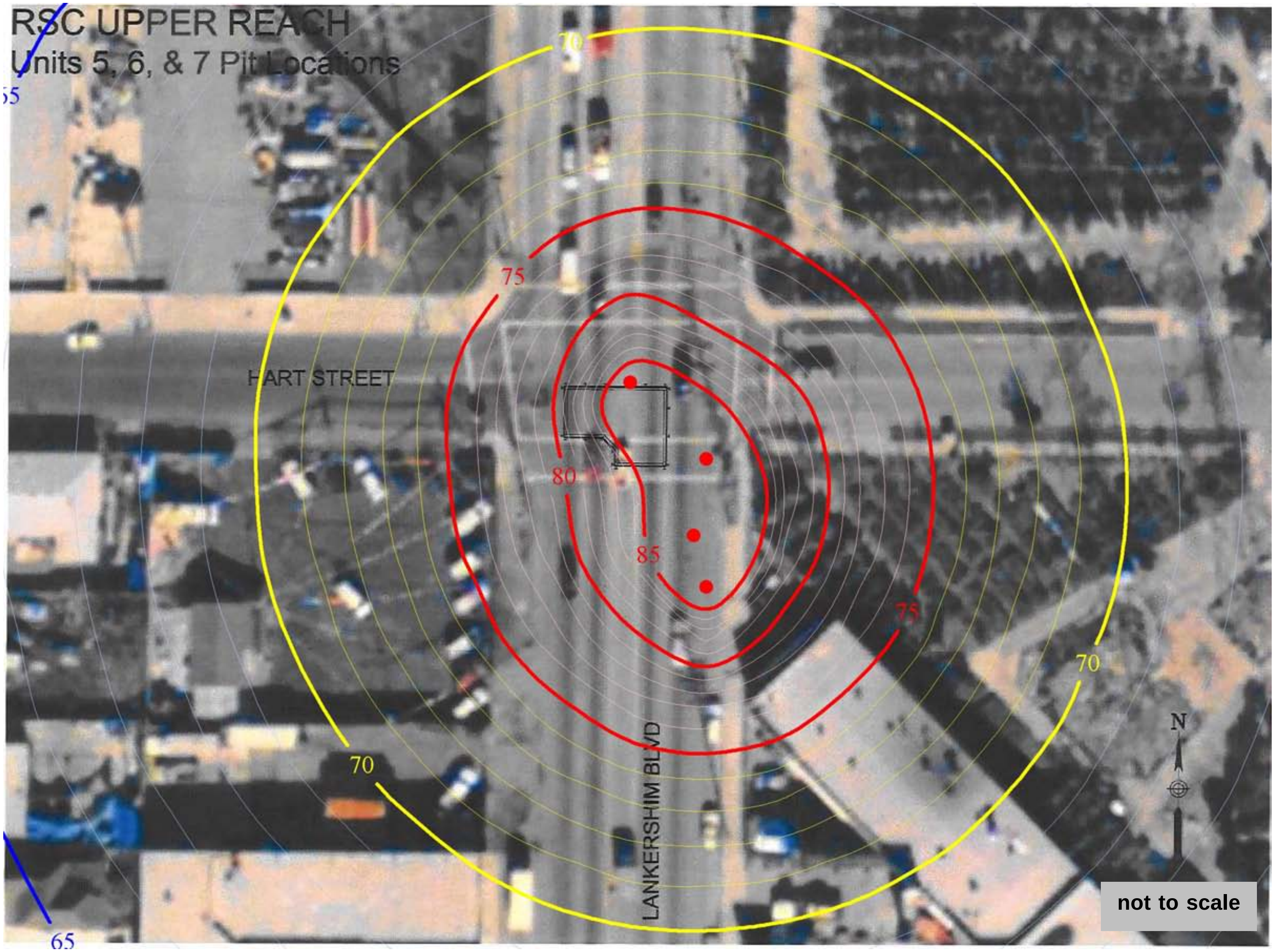

Figure 29: Tunnel shaft at intersection of Hart St. and Lankershim Blvd. (1-hr Leq)

Figure 30: Tunnel shaft/jacking pit on Lankershim Blvd. north of Victory Blvd. (1-hr Leq)

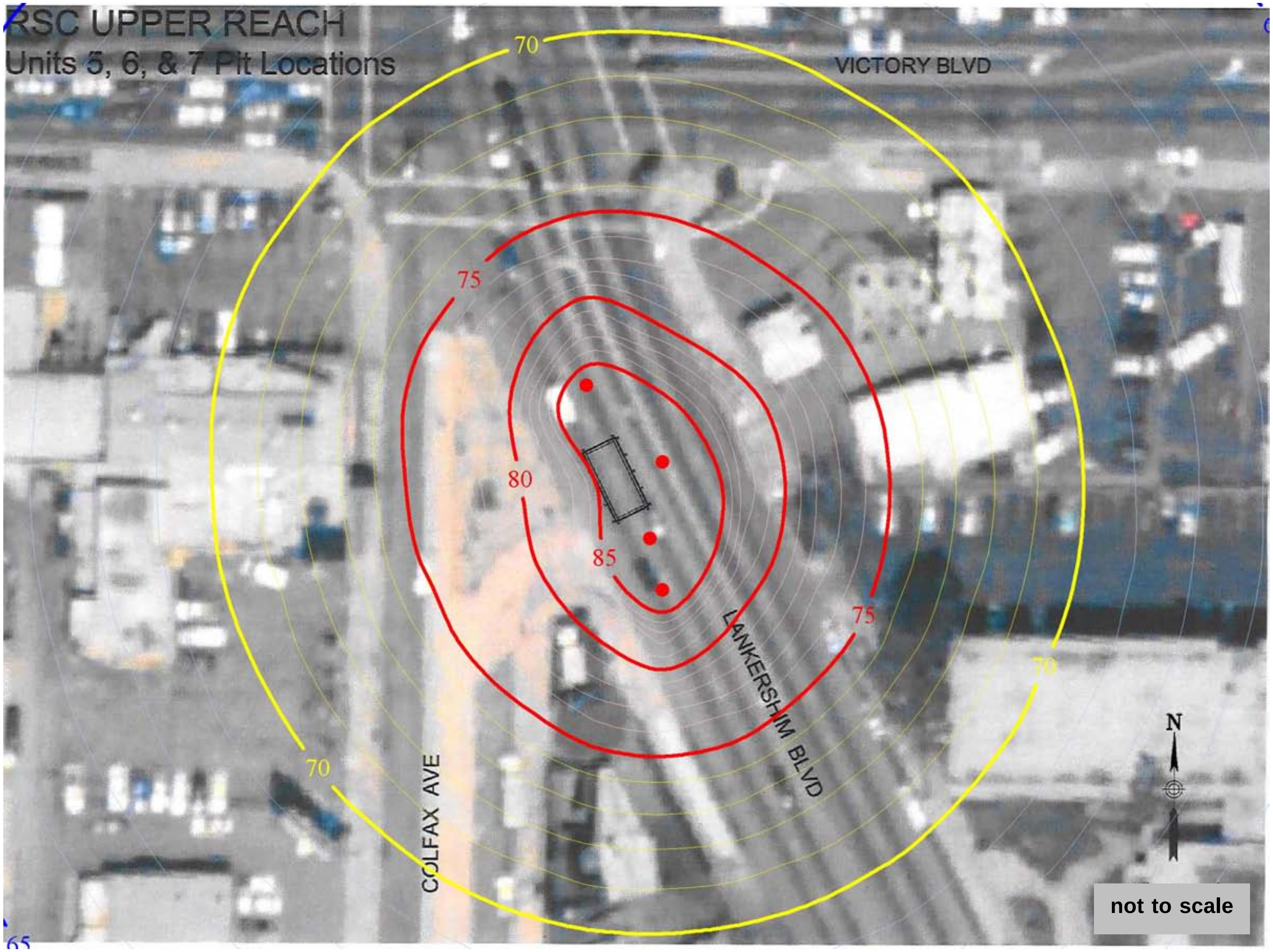

Figure 31: Jacking pit on Lankershim Blvd. south of Victory Blvd. (1-hr Leq)

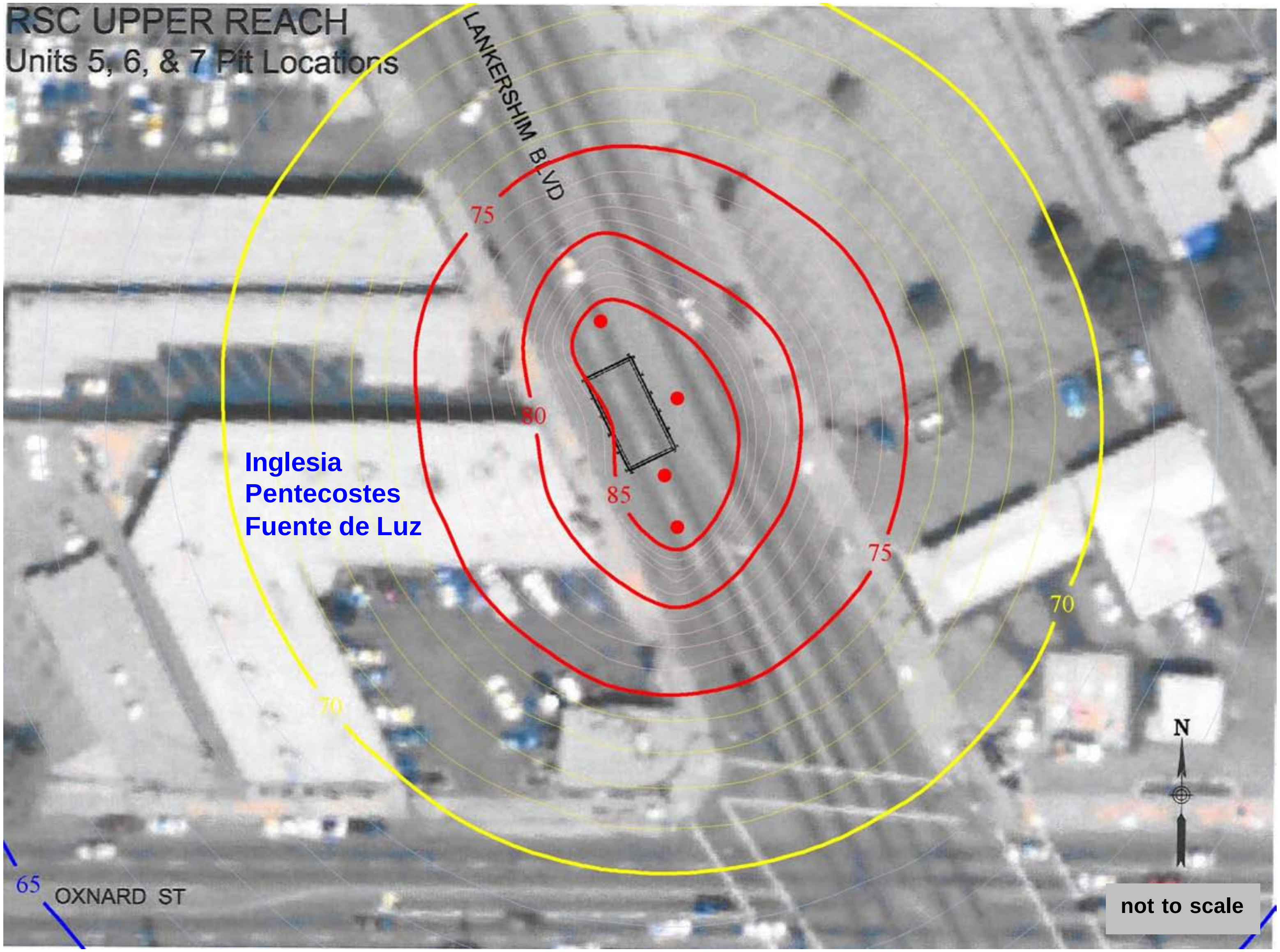

Figure 32: Jacking pit on Lankershim Blvd. north of Oxnard St. (1-hr Leq)

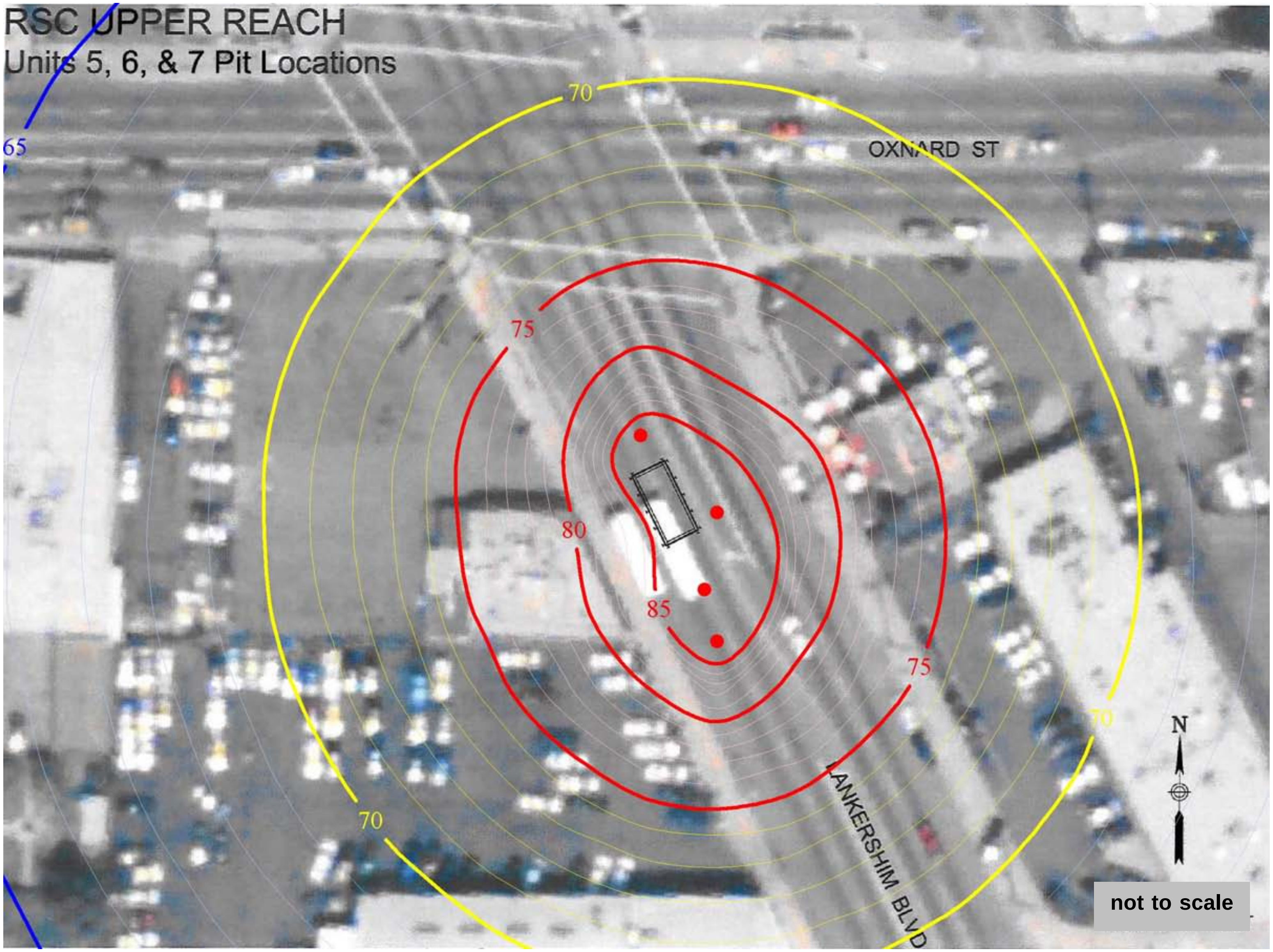

Figure 33: Jacking pit on Lankershim Blvd. south of Oxnard St. (1-hr Leq)

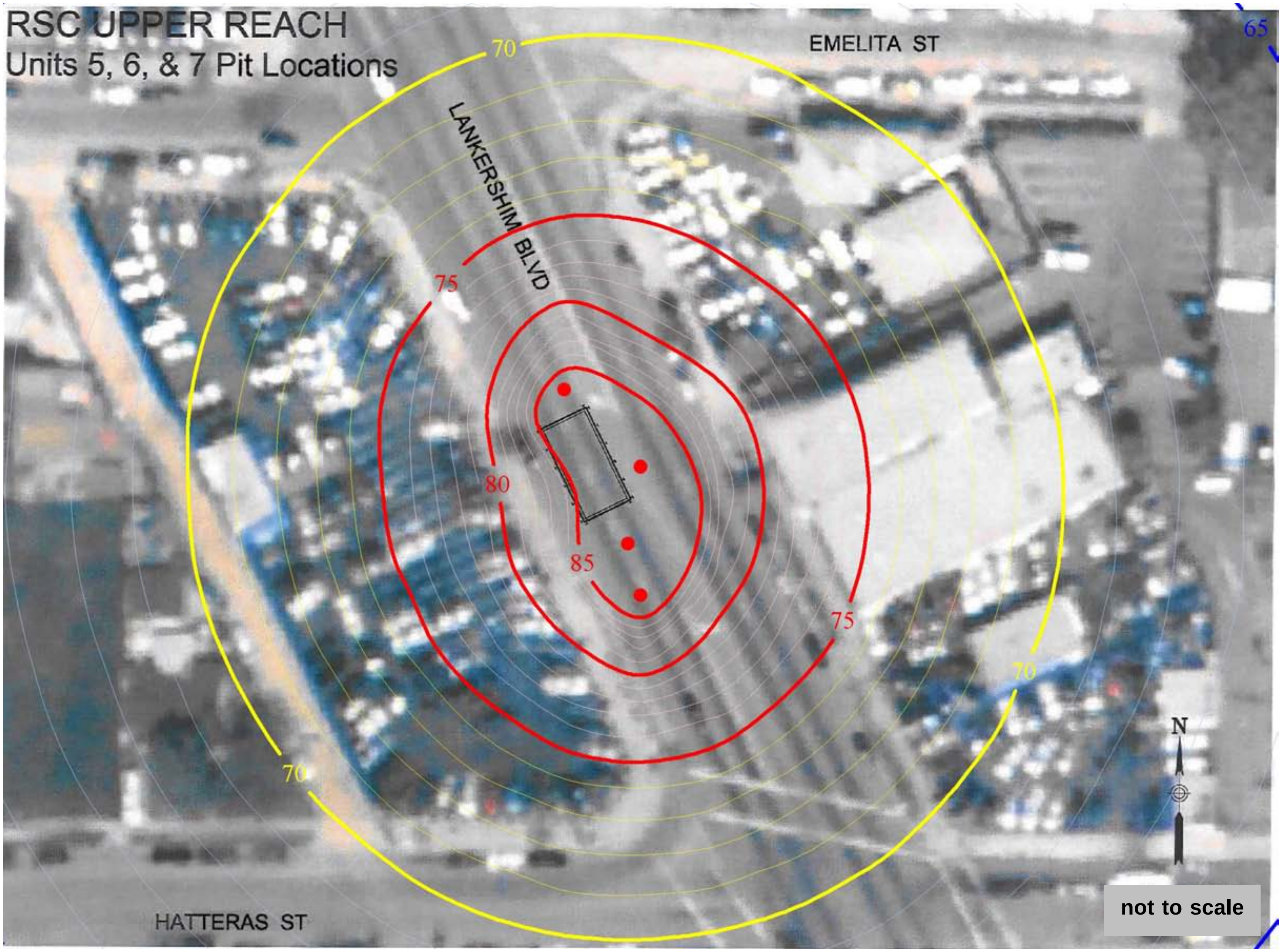

Figure 34: Jacking pit on Lankershim Blvd. north of Hatteras St. (1-hr Leq)

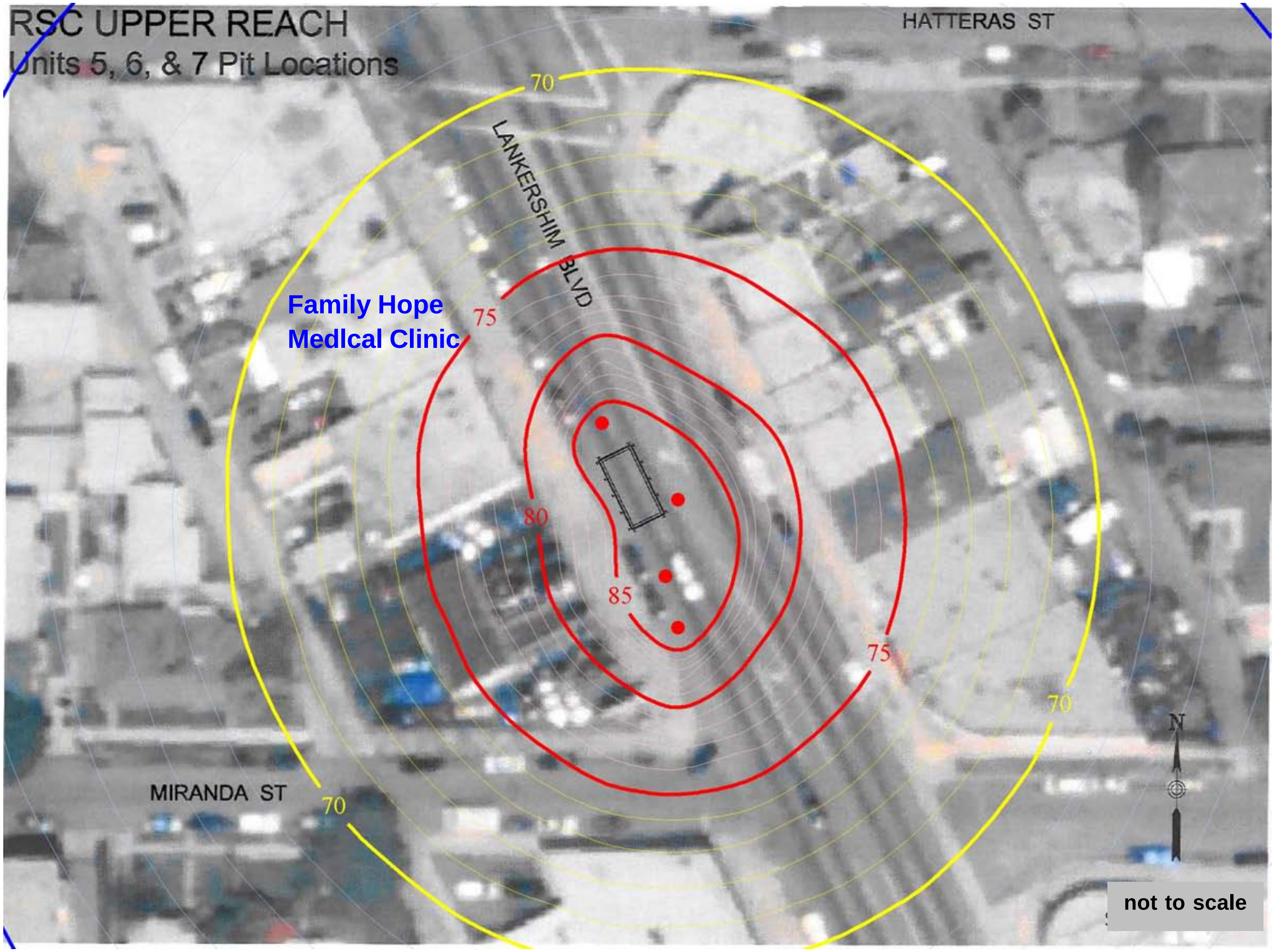

Figure 35: Jacking pit on Lankershim Blvd. south of Hatteras St. (1-hr Leq)

Figure 36: Jacking pits at intersection of Lankershim Blvd. and Burbank Blvd. (1-hr Leq)

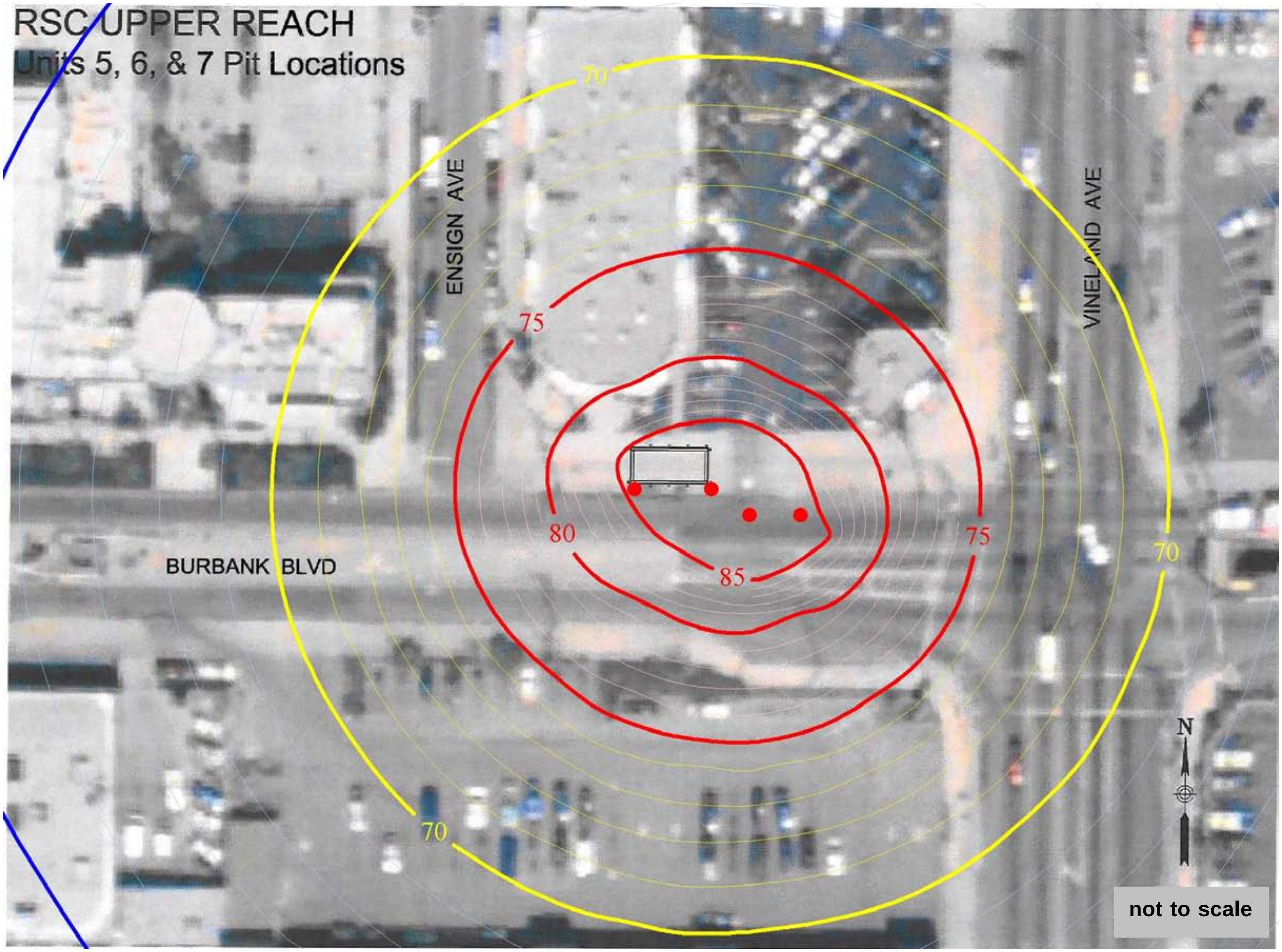

Figure 37: Jacking pit on Burbank Blvd. west of Vineland Ave. (1-hr Leq)

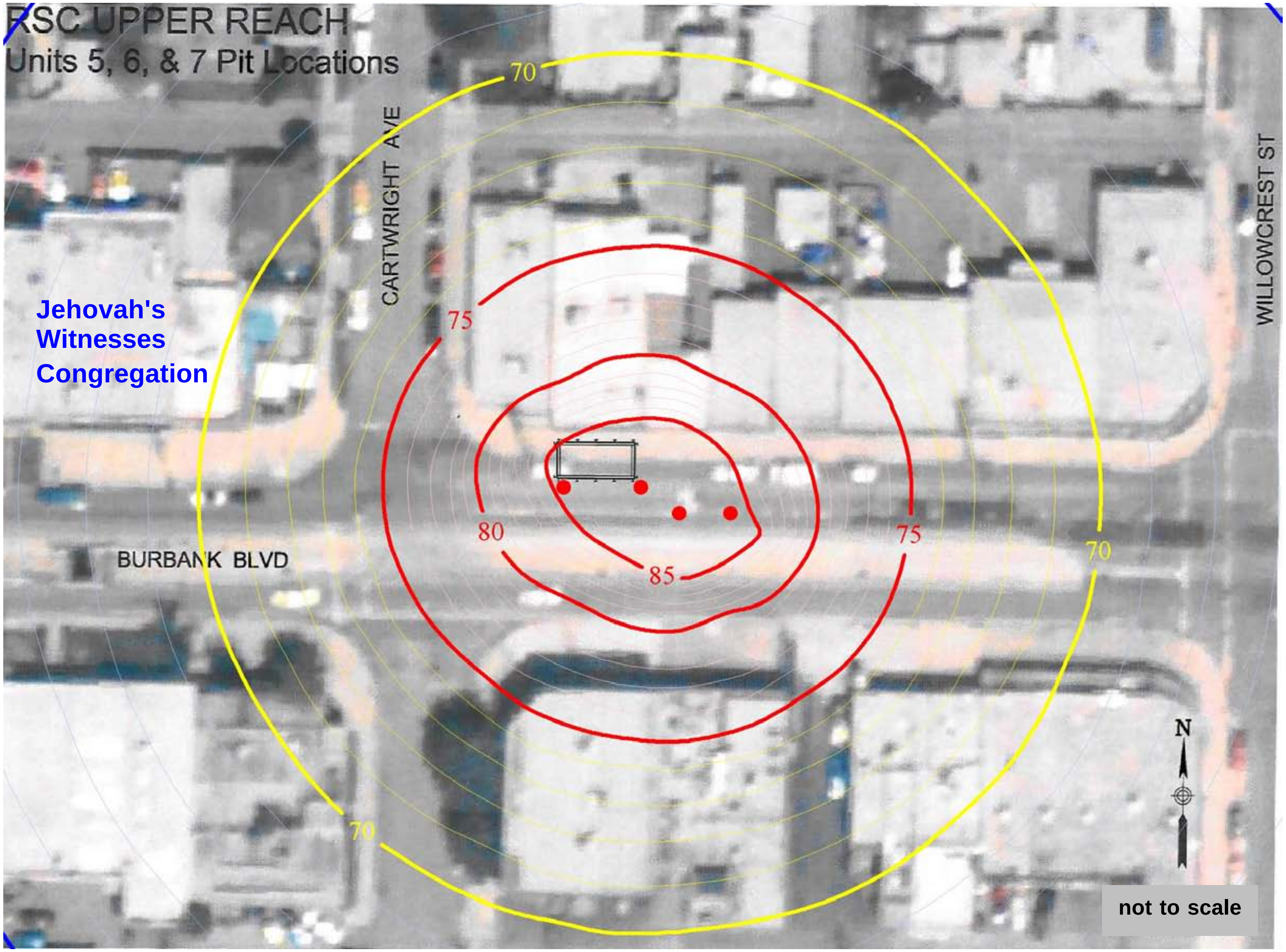

Figure 38: Jacking pit on Burbank Blvd. east of Cartwright Ave. (1-hr Leq)

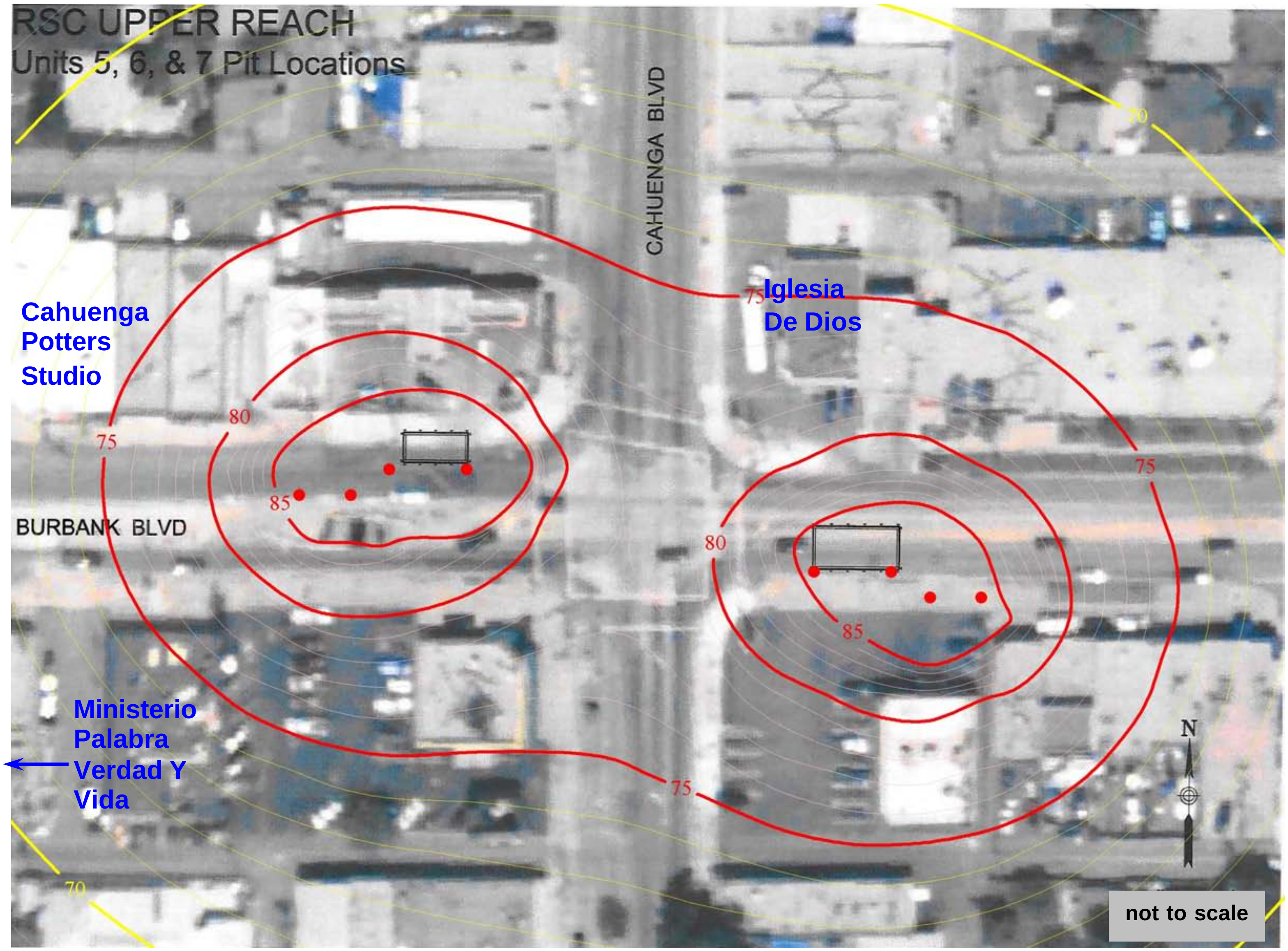

Figure 39: Jacking pit on Burbank Blvd. east of Cahuenga Blvd. (1-hr Leq)

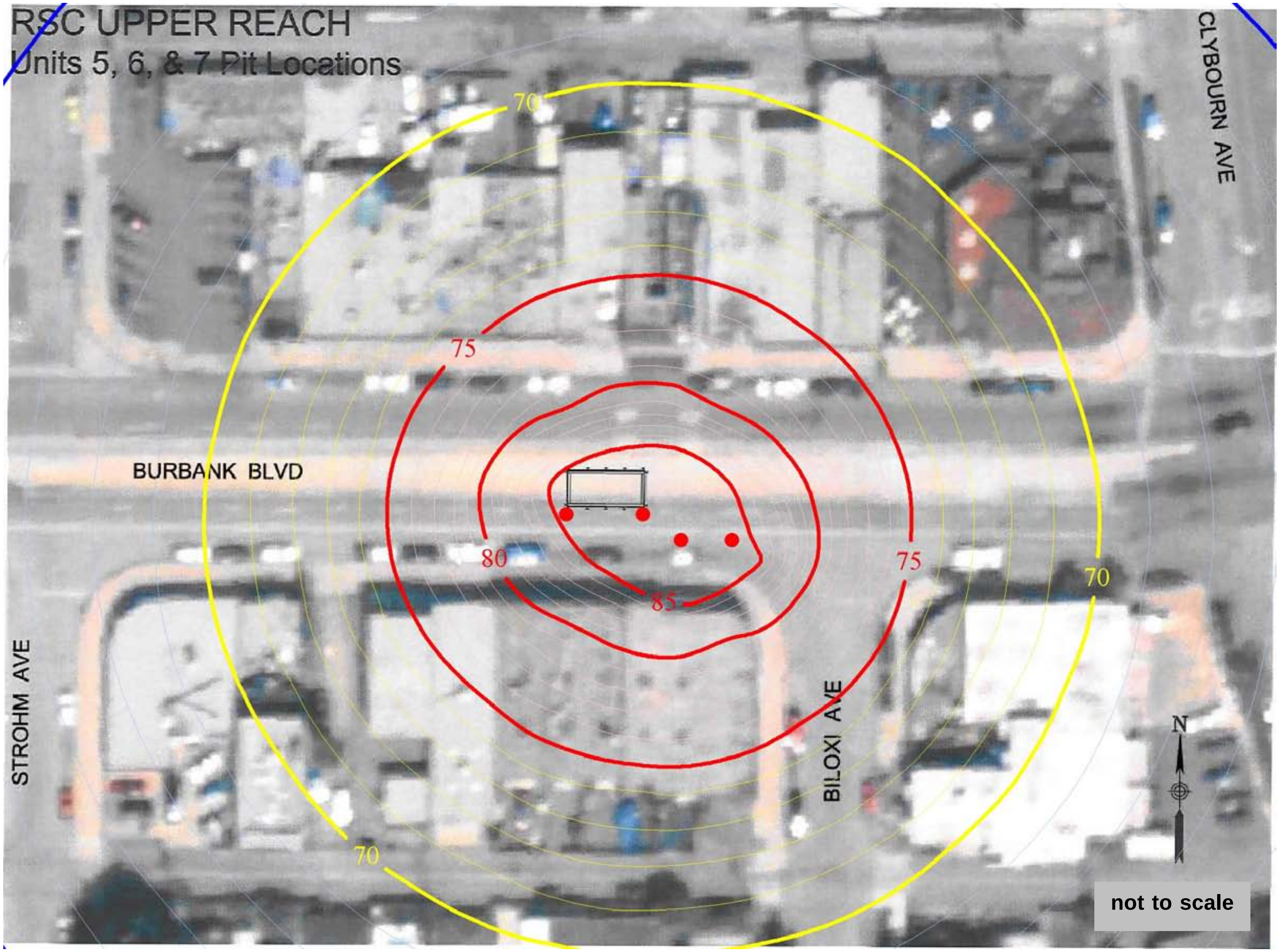

Figure 40: Tunnel shaft on Burbank Blvd. near Whitnall Hwy. (1-hr Leq)

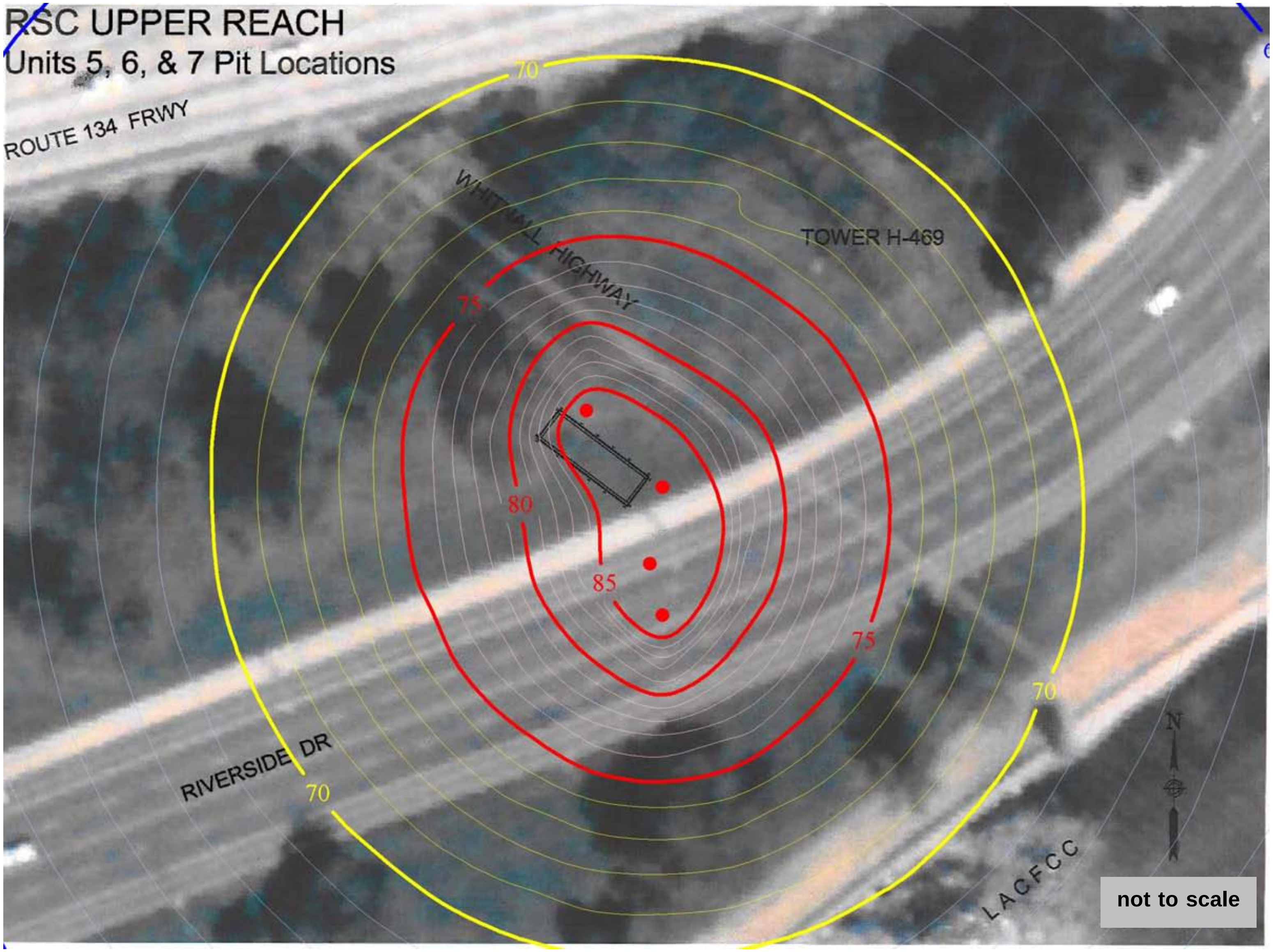

Figure 41: Tunnel shaft in Johnny Carson Park (1-hr Leq)

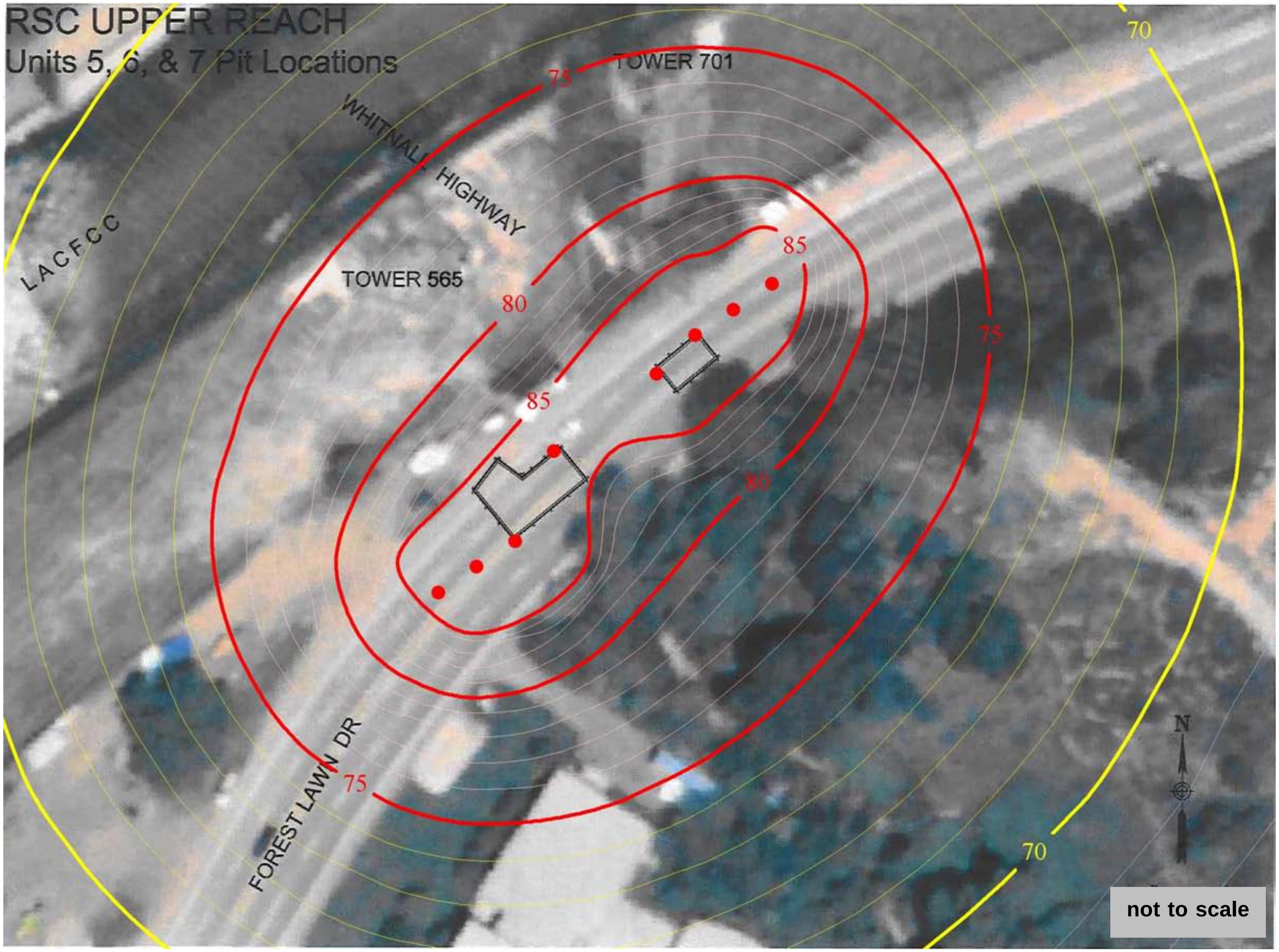

Figure 42: Jacking pits on Forest Lawn Dr. (1-hr Leq)

6.3.2.2 Open-trenching

Projected noise levels along open-trenching portions of the alignment were modeled using the equipment of Table 6. As depicted in Figure 43, the modeled scenario represents a chain of operations extended over a one-thousand foot work area, with an excavator and a line of dump trucks at the head excavating the trench, and a compactor following in the rear repaving the street. The intermediate tasks of placing and attaching the pipe are represented by the crane and welding truck. Various other trucks and machinery are spaced randomly around the operation as they might be found on an actual job site. Not shown are pavement cutting/breaking operations, and ancillary functions such as concrete mixing.

The contours represent the combined hourly-average noise levels of all of the equipment operating simultaneously under typical conditions, stated as average A-weighted decibels. As is seen in the figure, the loudest contours are centered around the area of most intense operation--excavation and pipelaying. The color scheme is the same as above, with red contours representing levels which exceed the 75 dBA criterion. Because open-trenching will occur away from residential areas, the number of potentially impacted sensitive receivers is minimal. Many of those sensitive receivers identified along the trenching route are already exposed to noise impacts from shaft and pit operations, which will dominate those produced by trenching. Below is an assessment of impacts on those individual receivers identified in Section 5.1 above.

The only sensitive receivers along the trenching route north of Oxnard Street are the Lankershim Medical Clinic and the Inglesia Pentecostes Fuente de Luz, as shown in Figure 43. Lacking any mitigation, construction noise levels are projected to exceed 80 dBA at the Lankershim Medical Clinic, clearly indicating a significant impact here. Trenching noise levels will also exceed the 75 dBA threshold at the Inglesia Pentecostes Fuente de Luz, which is also subject to noise impacts due to pit operations. Both of these receivers are therefore subject to significant noise impacts without mitigation.

Likewise, the Maurice Sendak Elementary School is the only sensitive receiver between Oxnard Street and Hatteras Street, shown in Figure 44. As indicated, the 75 dBA contour is projected to cross over onto this school's property. It is difficult to determine whether a significant impact will occur here, however, as the school building itself lies much farther to the east. The portions of school property which lie adjacent to Lankershim Boulevard appear to be playgrounds, though to what extent they are used is unknown. Lacking definitive information, it will be assumed that a significant noise impact exists at this location.

The Family Hope Medical Clinic, shown in Figure 45, is the only sensitive receiver lying between Hatteras Street and Burbank Boulevard. It will likely be exposed to trenching noise exceeding the 75 dBA threshold, in addition to that from jacking pit operations. Without mitigation, a significant impact will occur at this location.

Figure 46 shows the construction scenario on the first open-trench section along Burbank Boulevard, from Lankershim Boulevard to Vineland Avenue. Seen in the figure are the Inglesia Pentecostes and the L.A. Urgent Care Clinic, both of which will be subject to trenching noise in excess of the 75 dBA threshold. Not shown is the West Coast Seminary, which will also likely be subject to noise in excess of the 75 dBA threshold. Without mitigation, significant impacts are expected at all three of these receivers.

Jacking beneath Burbank Boulevard will occur between Vineland Avenue and Cartwright Avenue, eliminating any airborne noise impacts to receivers along this portion of the alignment.

A short stretch of open-trenching will occur between Cartwright Avenue and Cahuenga Boulevard, as shown in Figure 47. Because this stretch is too short to contain the entire trenching operation, only the excavation portion is shown. The two sensitive receivers here, Ministerio Palabra Verdad Y Vida and Cahuenga Potters Studio, will both be subject to noise levels in excess of the 75 dBA threshold. Without mitigation, significant impacts will therefore exist for both receivers.

Trenching will continue east of Cahuenga Boulevard until terminating near Biloxi Avenue. Figure 48 shows the two sensitive receivers along this final stretch, Iglesia De Dios and Screenland Studios. Both receivers will be subject to noise exceeding the 75 dBA threshold, resulting in significant unmitigated impacts at both.

South of the river, trenching will continue along Forest Lawn Drive until the project terminates at the Headworks Spreading Grounds. Figure 49 shows noise contours from trenching operations near the Lod Cook Center/Junior Achievement Foundation building. Trenching noise levels at this building are projected to approach 70 dBA, however, this is comparable to existing noise levels from traffic on Forest Lawn Drive, and no significant impact is therefore expected for this receiver.[13]

Similarly, the Mount Sinai Mortuary is not expected to be subject to trenching noise levels significantly higher than those existing due to traffic, as shown in Figure 50. All other sensitive receivers south of the river lie beyond the range of any significant impact.

Impacts due to open-trenching operations in the City of Los Angeles are summarized in Table 10 below.

[13] This building is impacted by pit/shaft noise, as described above.

Table 10: Airborne noise impacts due to open-trenching operations

Sensitive Receiver	Figure	Land Use
Lankershim Medical Clinic	Figure 43	medical
Inglesia Pentecostes Fuente de Luz	Figure 43	worship
Maurice Sendak Elementary School	Figure 44	school
Family Hope Medical Clinic	Figure 45	medical
Inglesia Pentecostes	Figure 46	worship
L.A. Urgent Care Clinic	Figure 46	medical
West Coast Seminary	--	worship/school
Ministerio Palabra Verdad Y Vida	Figure 47	worship
Cahuenga Potters Studio	Figure 47	film/recording
Iglesia De Dios	Figure 48	worship
Screenland Studios	Figure 48	film/recording

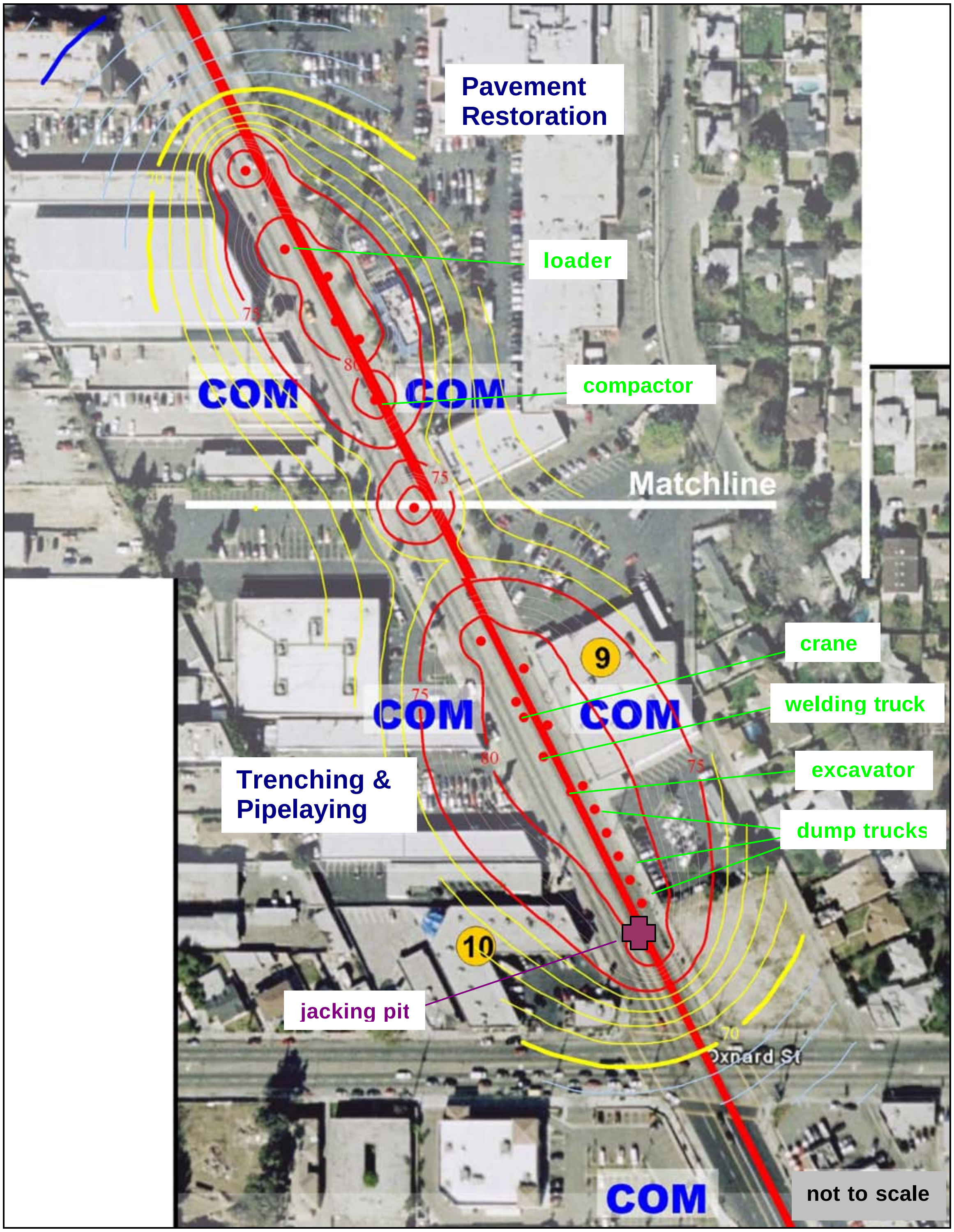

Figure 43: Open-trenching noise contours – north of Oxnard St. (1-hr Leq)

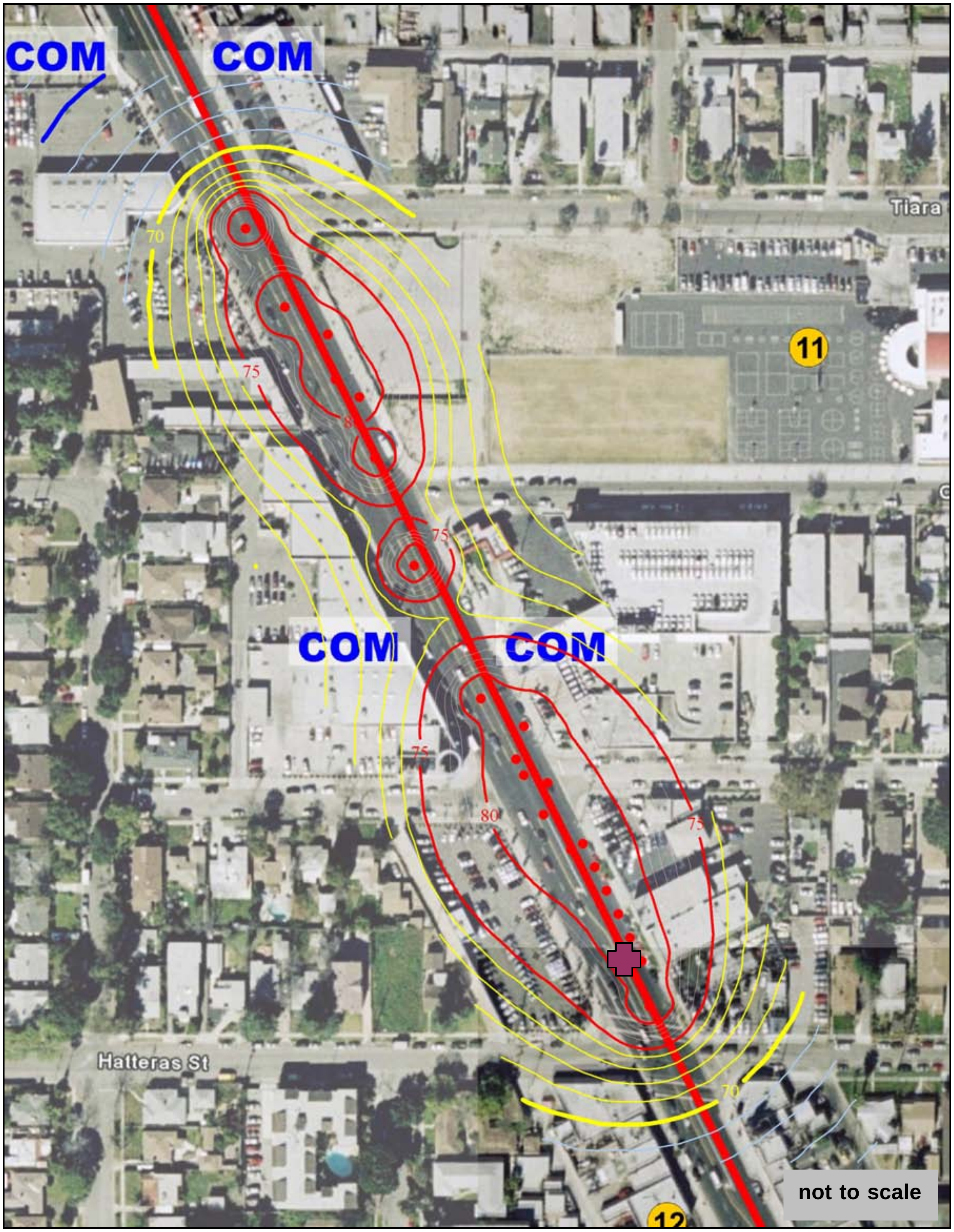

Figure 44: Open-trenching noise contours – Oxnard St. to Hatteras St. (1-hr Leq)

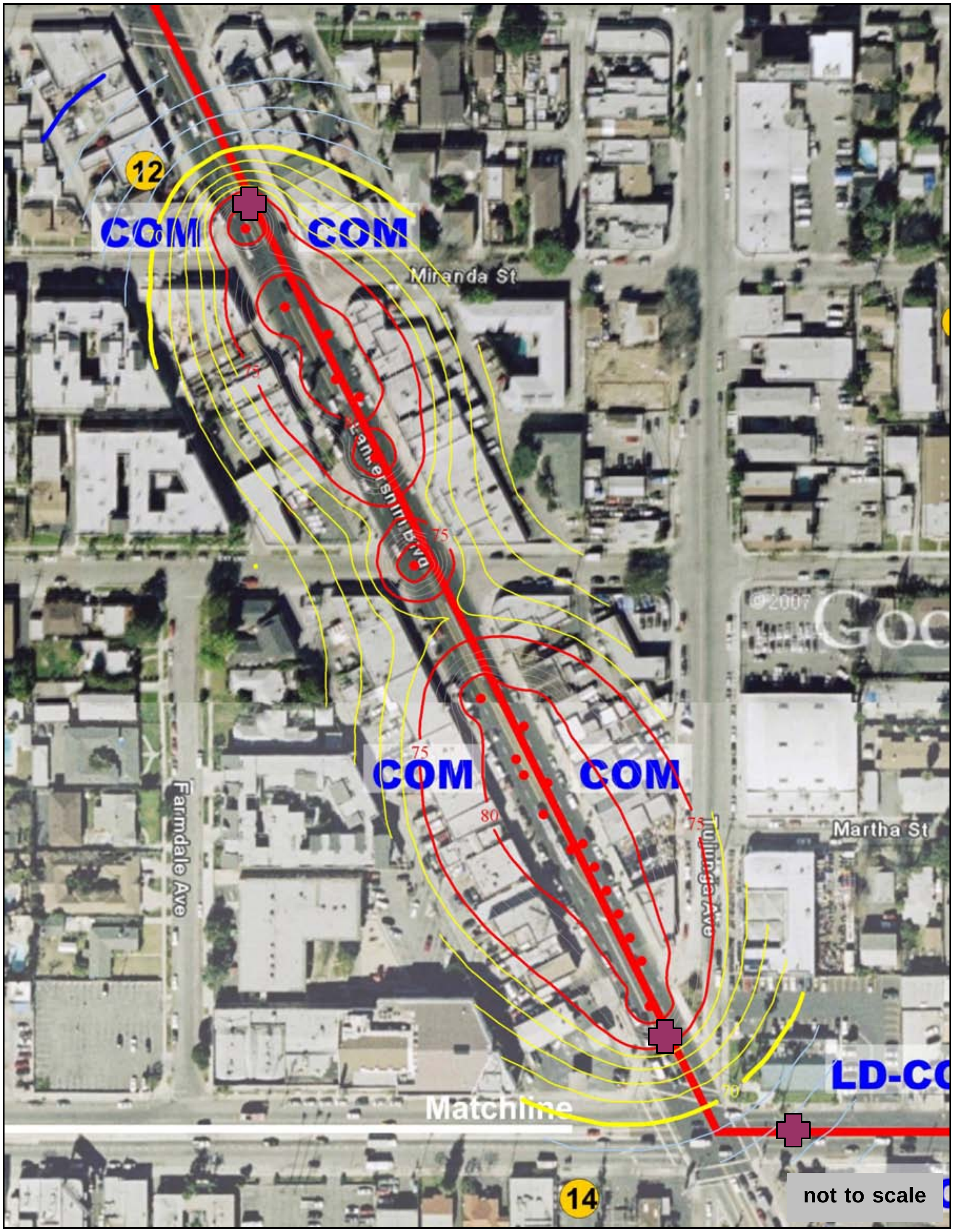

Figure 45: Open-trenching noise contours – Hatteras St. to Burbank Blvd. (1-hr Leq)

Figure 46: Open-trenching noise contours – Lankershim Blvd. to Vineland Ave. (1-hr Leq)

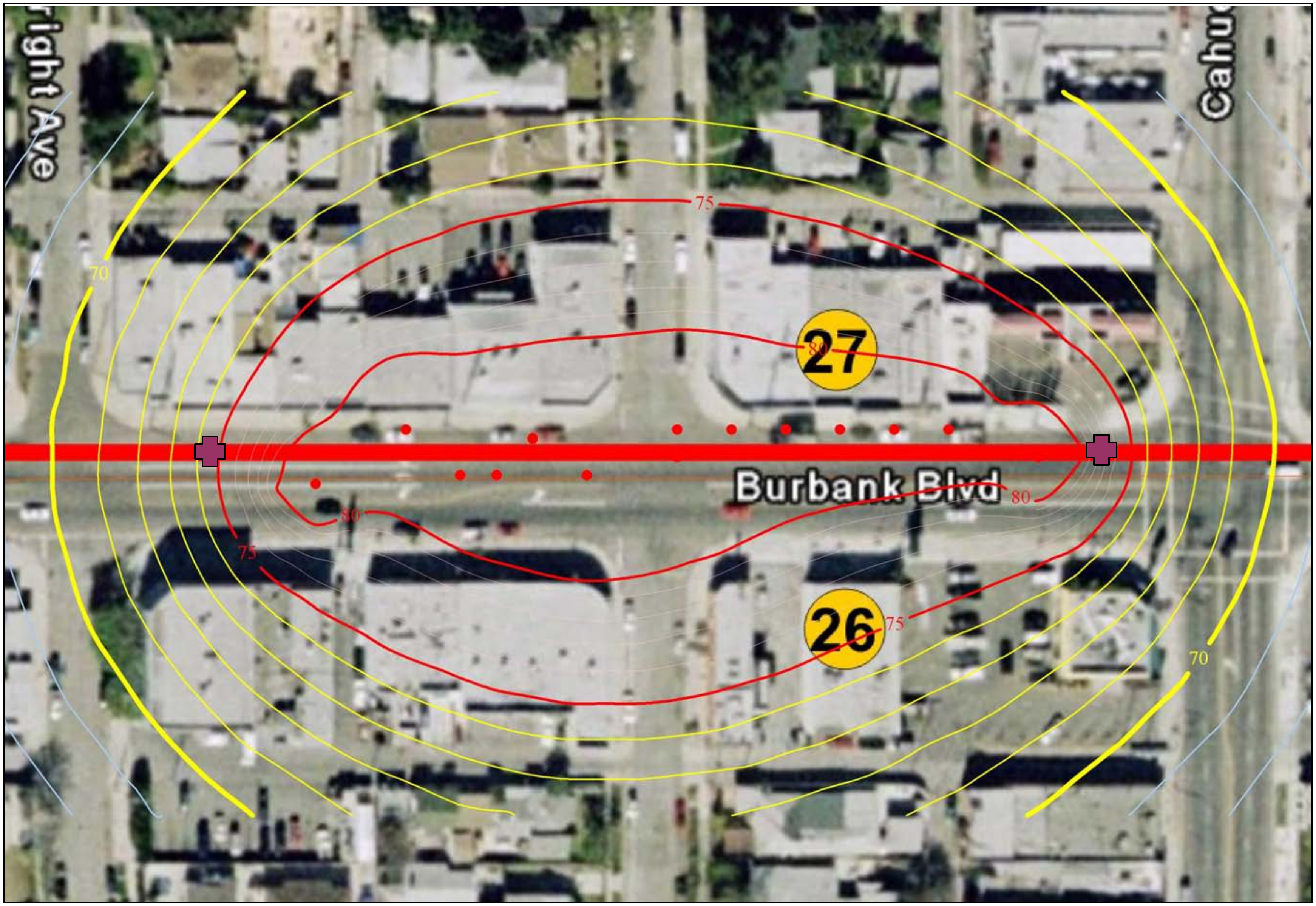

Figure 47: Open-trenching noise contours – Cartwright Ave. to Cahuenga Blvd. (1-hr Leq)

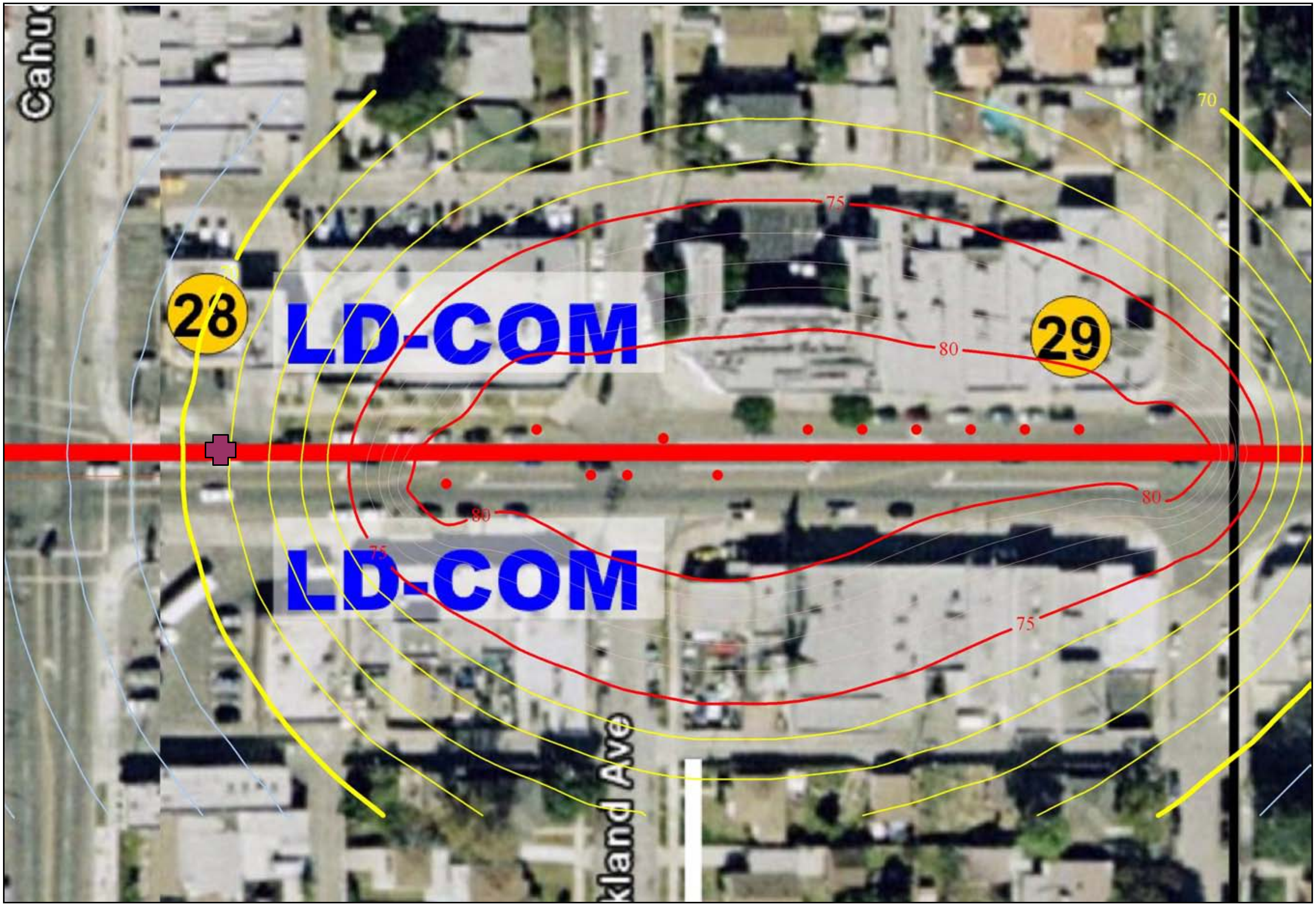

Figure 48: Open-trenching noise contours – Cahuenga Blvd. to Biloxi Ave. (1-hr Leq)

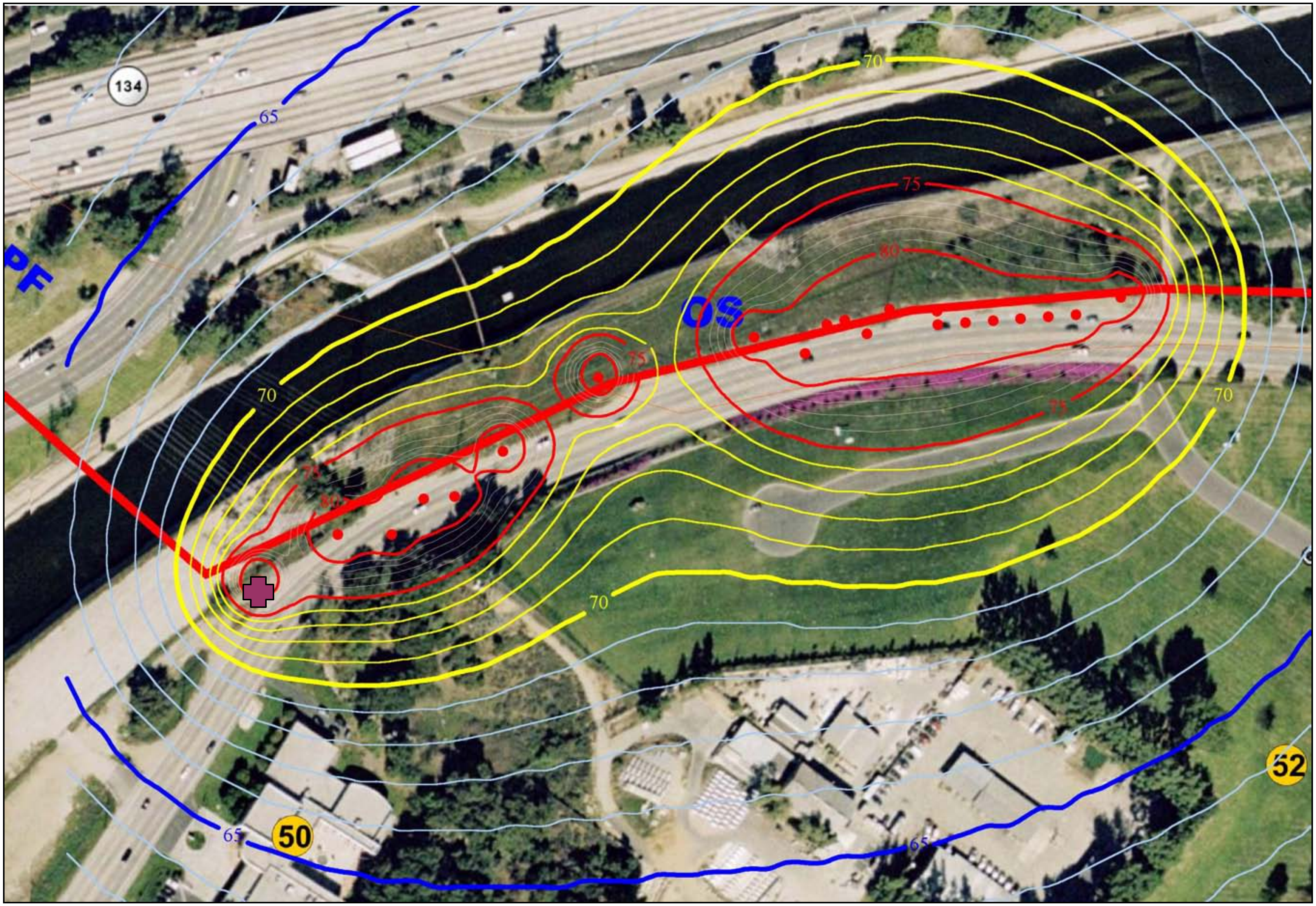

Figure 49: Open-trenching noise contours – Forest Lawn Drive near Lod Cook/Junior Achievement (1-hr Leq)

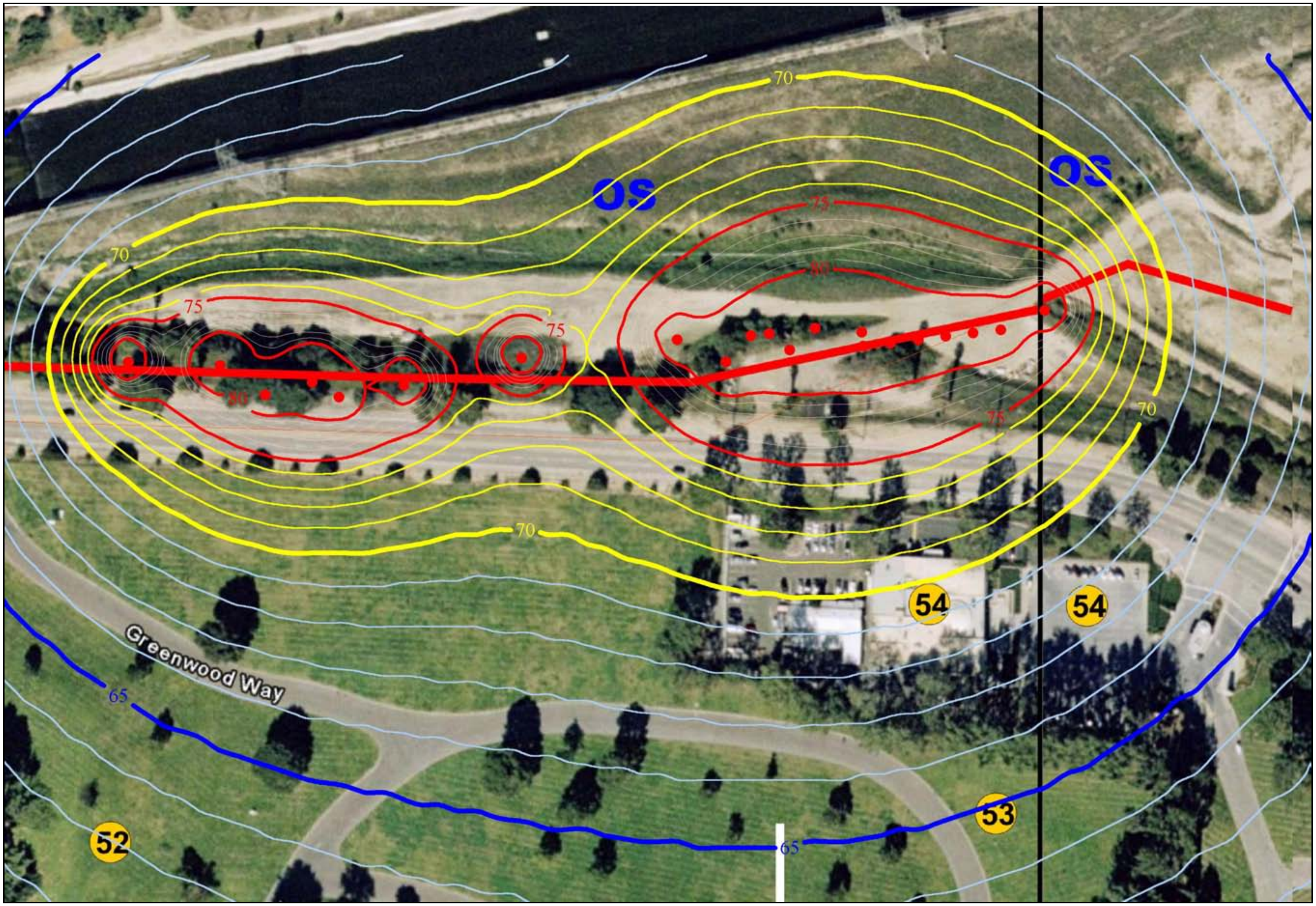

Figure 50: Open-trenching noise contours – Forest Lawn Drive near Mt. Sinai Mortuary (1-hr Leq)

6.3.3 Ground Vibration and Groundborne Noise

In Los Angeles, ground vibration and associated groundborne noise impacts will be limited to the northern portion of the project where tunneling occurs in Phase 1. The 150-foot and 170-foot impact zones, described in Section 6.2.3 above, are shown in Figure 51 and Figure 52 below. In this area, however, only the 150-foot impact zone for residential and similar receivers is likely to apply, as there are no known industrial receivers with vibration-sensitive equipment located here.

As is seen in Figure 51, the 150-foot groundborne-noise zone encompasses all first-tier residences lying adjacent to the project alignment on Hart Street and Morella Avenue, resulting in an impact at these receivers. Though exterior ambient noise levels in this area exceed 60 dBA, an allowance must be made for reduction of noise levels inside these residences due to architectural attenuation. A rule of thumb is that a twenty decibel difference will exist between exterior and interior noise levels with doors and windows closed, when using standard residential construction. Therefore, it is reasonable to assume that muck-train operations which cause groundborne noise levels to exceed 45 dBA inside any of these residences will result in interior noise levels higher than existing ambient levels. It should be noted, however, that residences in the vicinity of tunnel shafts will likely be impacted greater by airborne-noise due to operations around the shaft than groundborne noise due to muck-train activity.

Other sensitive receivers which may be affected by groundborne-noise similar to a residence include Ministero Pentecostes de Jesucristo and Inglesa Pentecostal Unida in Figure 51, and the Kiddie Academy in Figure 52. Commercial receivers along Lankershim Boulevard are not considered impacted for the reason stated above.

Table 11 below summarizes the vibration-related impacts in Los Angeles.

Table 11: Vibration-related impacts

Sensitive Receiver	Figure	Land Use
multiple residences	Figure 51	residential
Ministero Pentecostes de Jesucristo	Figure 51	worship
Inglesa Pentecostal Unida	Figure 51	worship
Kiddie Academy	Figure 52	school

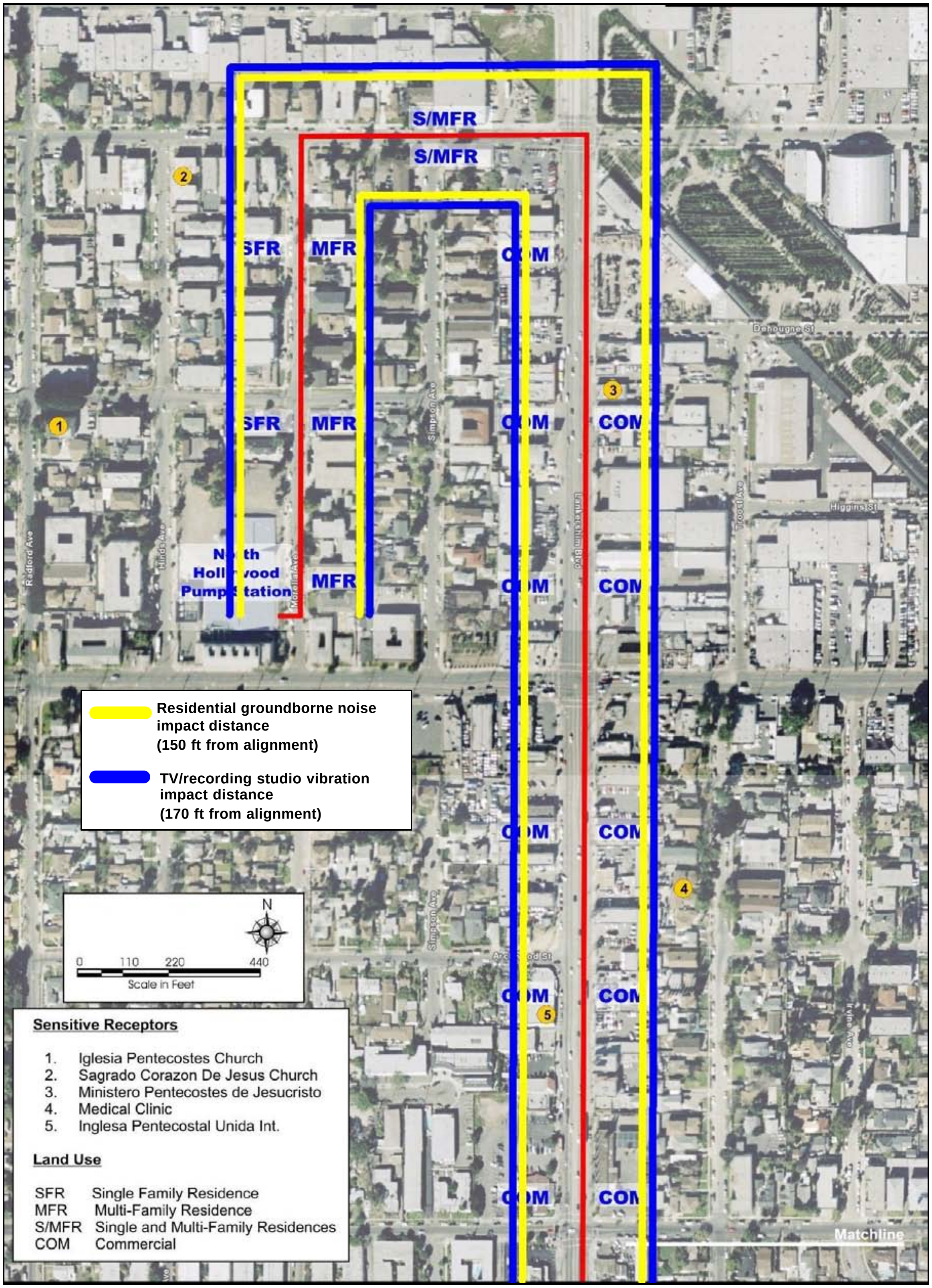

Figure 51: Tunneling impact zones - Phase 1 (1 of 2)

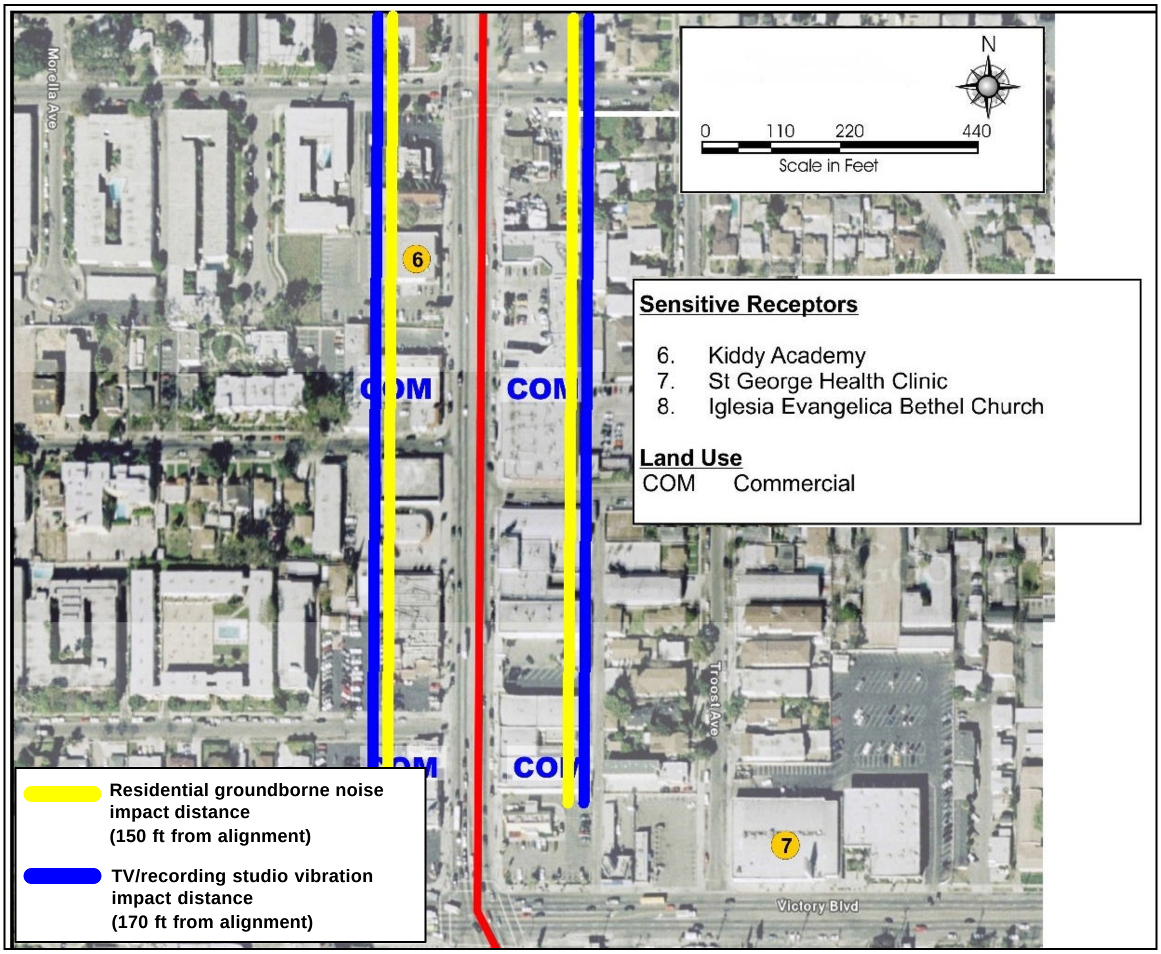

Figure 52: Tunneling impact zones - Phase 1 (2 of 2)

6.3.4 Trucking Noise

No determination has yet been made regarding the routes or number of trucks required to haul soil, materials, and waste to and from the construction zones. It is presumed, however, that trucking will be confined to the major roads such as Lankershim Boulevard and Burbank Boulevard, and will avoid residential side streets.

Figure 26 above shows the average noise emissions produced by heavy trucking as a function of trips per hour. The levels shown by this graph are those which would be experienced by a close-in receiver (25 feet from the centerline of travel). As shown in the graph, thirty truck-trips per hour would result in average noise levels of around 65 dBA, which is comparable to the existing ambient noise levels along Lankershim Boulevard and Burbank Boulevard. Unless project requirements dictate trucking activity at a rate substantially higher than one trip every two minutes, no impact from trucking noise is anticipated.

In the event that trucking is required on residential side streets, a noise impact is likely, and must be handled on a case-by-case basis.

6.3.5 Miscellaneous Noise

No staging areas have yet been identified for this project, therefore no detailed assessment of potential noise impacts can be made. The contractor(s) would be responsible for scouting and securing suitable local lots for staging areas. However, possible staging areas identified for the proposed project include the Headworks Spreading Grounds, Johnny Carson Park north of Riverside Drive, open right-of way within the Whitnall Highway, or local LADWP facilities, including the North Hollywood Pump Station. Potential impacts from staging areas must be addressed as locations are selected.

The possibility exists that the use of dewatering pumps may be required, especially around the river. These pumps would run continuously and at night, and would therefore create potential noise impacts on nearby sensitive receivers. As no details regarding their use are yet available, no specific impacts can be identified. Mitigation of dewatering pump noise, however, should be readily achievable where necessary, and should be handled on a case-by-case basis.

6.4 Burbank Impacts Assessment

6.4.1 General
As shown in Figure 1, pipeline-laying in the City of Burbank will consist entirely of tunneling. Airborne construction noise and ground-vibration are impacts of concern.

6.4.2 Airborne Noise
Noise contours around the tunnel shaft in Johnny Carson Park are depicted in Figure 41. This section of the park is sandwiched between Ventura Freeway and Riverside Drive, where measured ambient noise levels here exceeded 67 dBA. Nevertheless, this shaft lies within a sensitive receiver, as defined above, and noise levels will exceed 75 dBA within a confined area.

Though a significant noise impact will technically exist at Johnny Carson Park (based on the above-defined criteria), it will occur in a rather isolated section of the park which is straddled by two busy roads. The majority of the park will remain unaffected by operations around this tunnel shaft.

It is likely, however, that a portion of Johnny Carson Park between the freeway and Riverside Drive will be set aside for staging construction equipment. In addition to the park itself, nearby residences also constitute noise-sensitive receivers for this location. Assuming the staging area is removed a sufficient distance from these residences, they would be subject primarily to truck traffic accessing the staging area via Bob Hope Drive. As indicated in Figure 26 above, however, it is unlikely that sufficient truck traffic will exist to drive noise levels substantially above the existing ambient level of approximately 60 dBA.

6.4.3 Ground Vibration and Groundborne Noise
Ground vibration and associated groundborne noise are anticipated along the entire length of the tunnel alignment in Burbank. As shown in Figure 53 through Figure 56, most first-tier residences and some second-tier residences along Whitnall highway lie within the 150-foot impact zone for muck-train groundborne-noise impacts (yellow lines). As existing ambient noise levels along this corridor are relatively low, it is expected that groundborne noise will be noticeable inside these residences and may result in some complaints.

In addition to these residences, significant vibration-related impacts are also expected at the sensitive receivers shown in Table 12 below. Three of these are film/recording type facilities and will therefore be impacted by ground vibrations (blue lines in the figures). The remainder will be impacted by groundborne-noise.

Most of the studios and other receivers in Figure 56, which may be vibration-sensitive, lay well outside of the estimated impact zones. Therefore, the expected impact on these receivers from either ground-vibration or groundborne-noise is less than significant. Note that two of the buildings in Figure 56 have been demolished, as annotated; therefore, no impact exists here. Finally, exterior areas are not considered impacted by ground vibration regardless of their distance to the tunnel alignment; therefore, no impact exists for any park land along Whitnall Highway.

Table 12: Vibration-related impacts

Sensitive Receiver	Figure	Land Use
multiple residences	Figure 53 - Figure 56	residential
Universal Adult Day Care	Figure 53	residential
Fred Wolfe Films	Figure 53	film/recording
Media Center Montessori Pre-School	Figure 54	school
American Lutheran Church	Figure 54	worship
American Lutheran School	Figure 54	school
Robert Louis Stevenson Elementary School	Figure 55	school
CCI Digital	Figure 56	film/recording
NBC TV, D Lot	Figure 56	film/recording

6.4.4 Trucking Noise

Because construction will be carried out completely underground, no trucking noise in connection with this project is anticipated in the City of Burbank.

6.4.5 Miscellaneous Noise

No staging areas have yet been identified for this project, therefore no detailed assessment of potential noise impacts can be made. The likelihood that a portion of Johnny Carson Park between the freeway and Riverside Drive will be set aside for staging construction equipment is addressed above. The contractor(s) would be responsible for scouting and securing suitable local lots for staging areas. However, possible staging areas identified for the proposed project include the Headworks Spreading Grounds, Johnny Carson Park north of Riverside Drive, open right-of way within the Whitnall Highway, or local LADWP facilities, including the North Hollywood Pump Station. Potential impacts from project staging areas must be addressed as locations are selected.

The possibility exists that the use of dewatering pumps may be required, especially around the river. These pumps would run continuously and at night, and would therefore create potential noise impacts on nearby sensitive receivers. As no details regarding their use are yet available, no specific impacts can be identified. Mitigation of dewatering pump noise, however, should be readily achievable where necessary, and should be handled on a case-by-case basis.

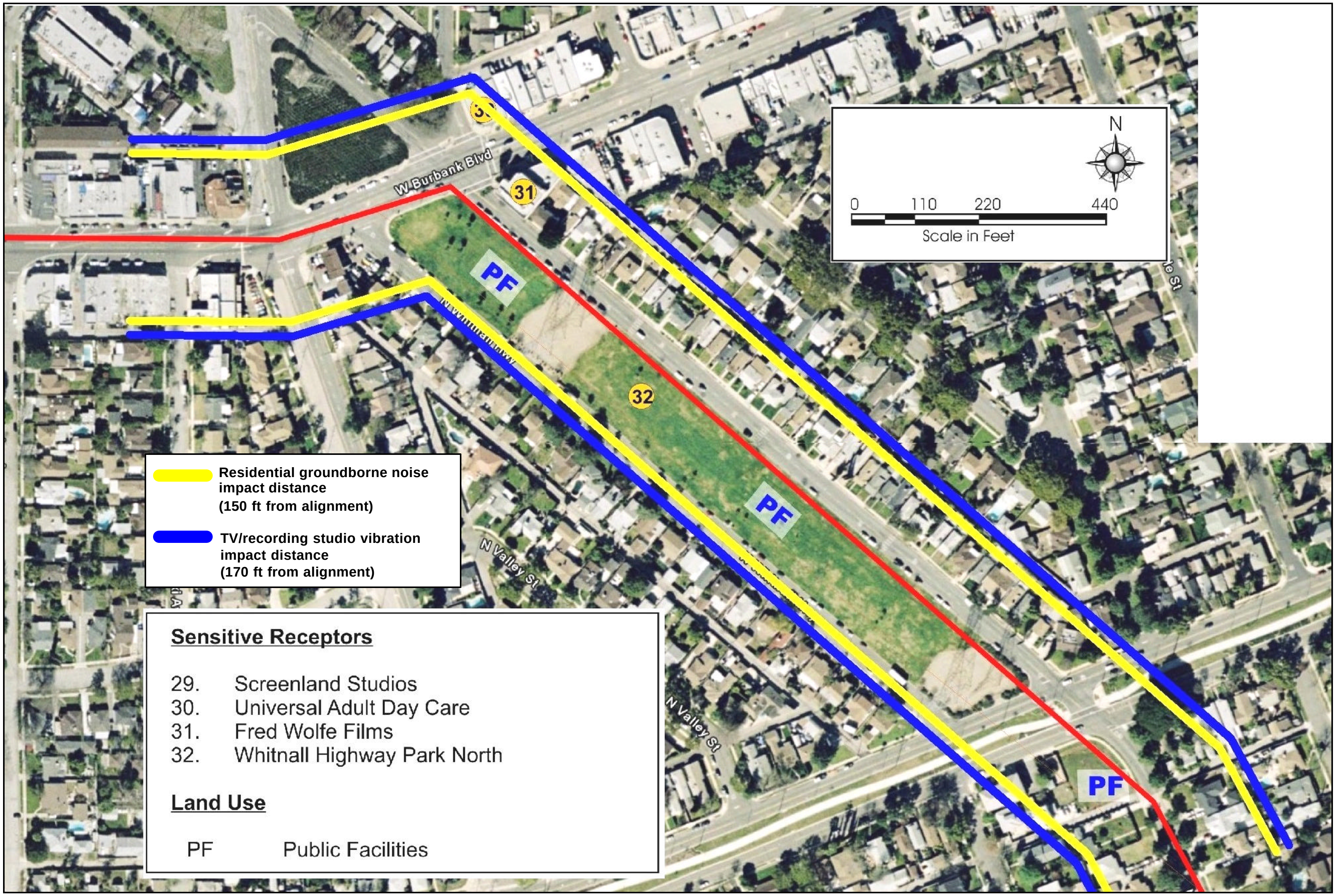

Figure 53: Tunneling impact zones - Phase 3 (1 of 4)

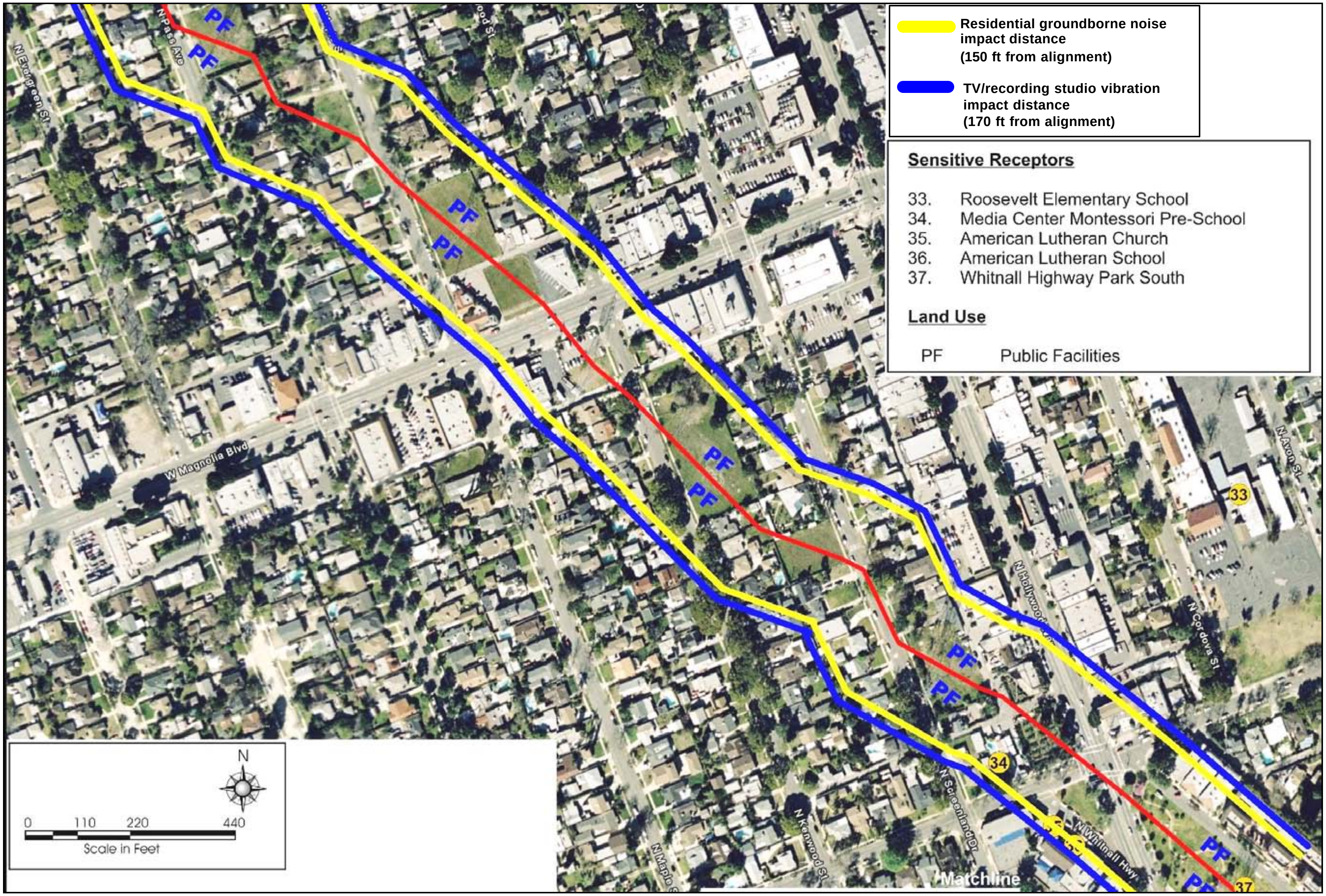

Figure 54: Tunneling impact zones - Phase 3 (2 of 4)

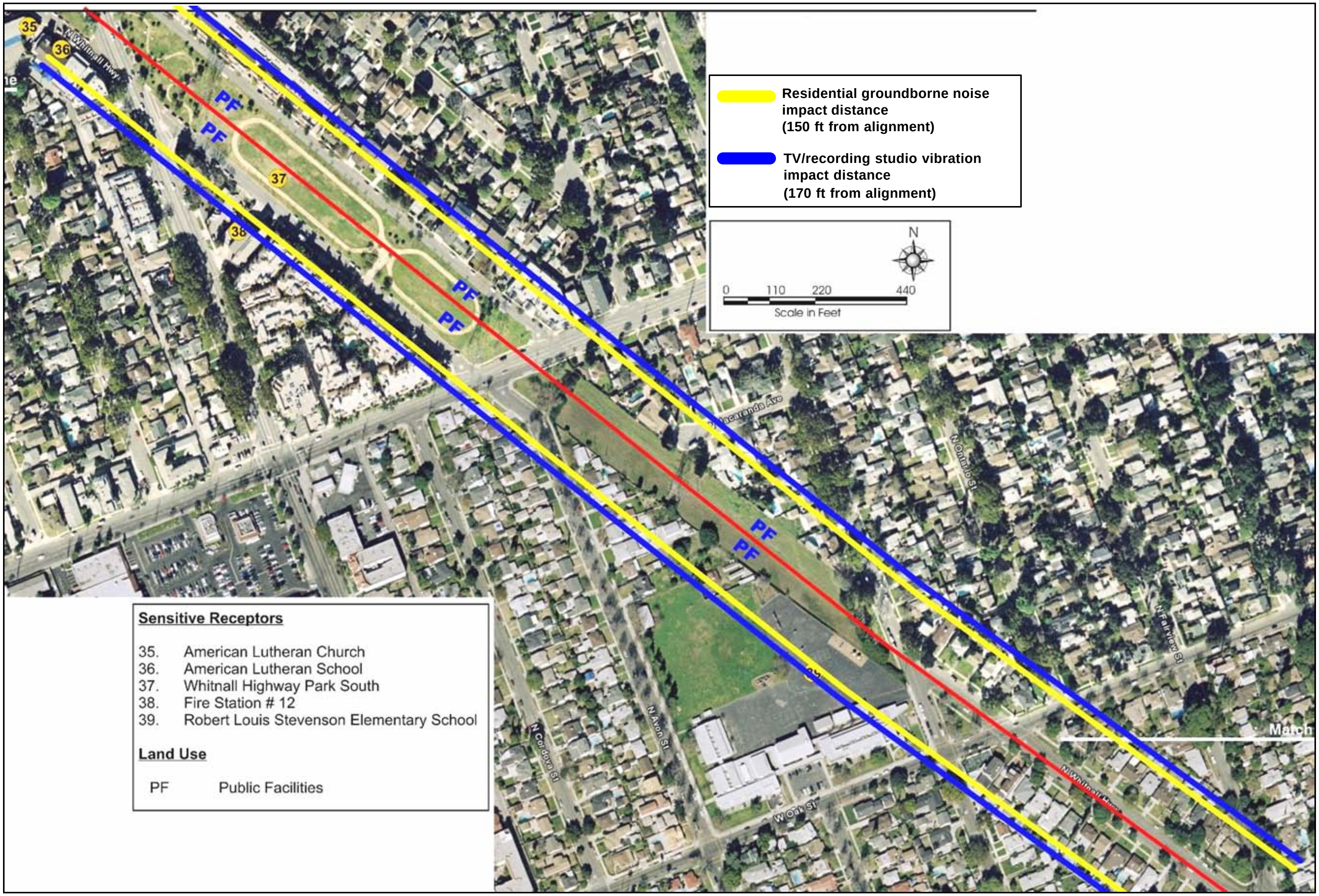

Figure 55: Tunneling impact zones - Phase 3 (3 of 4)

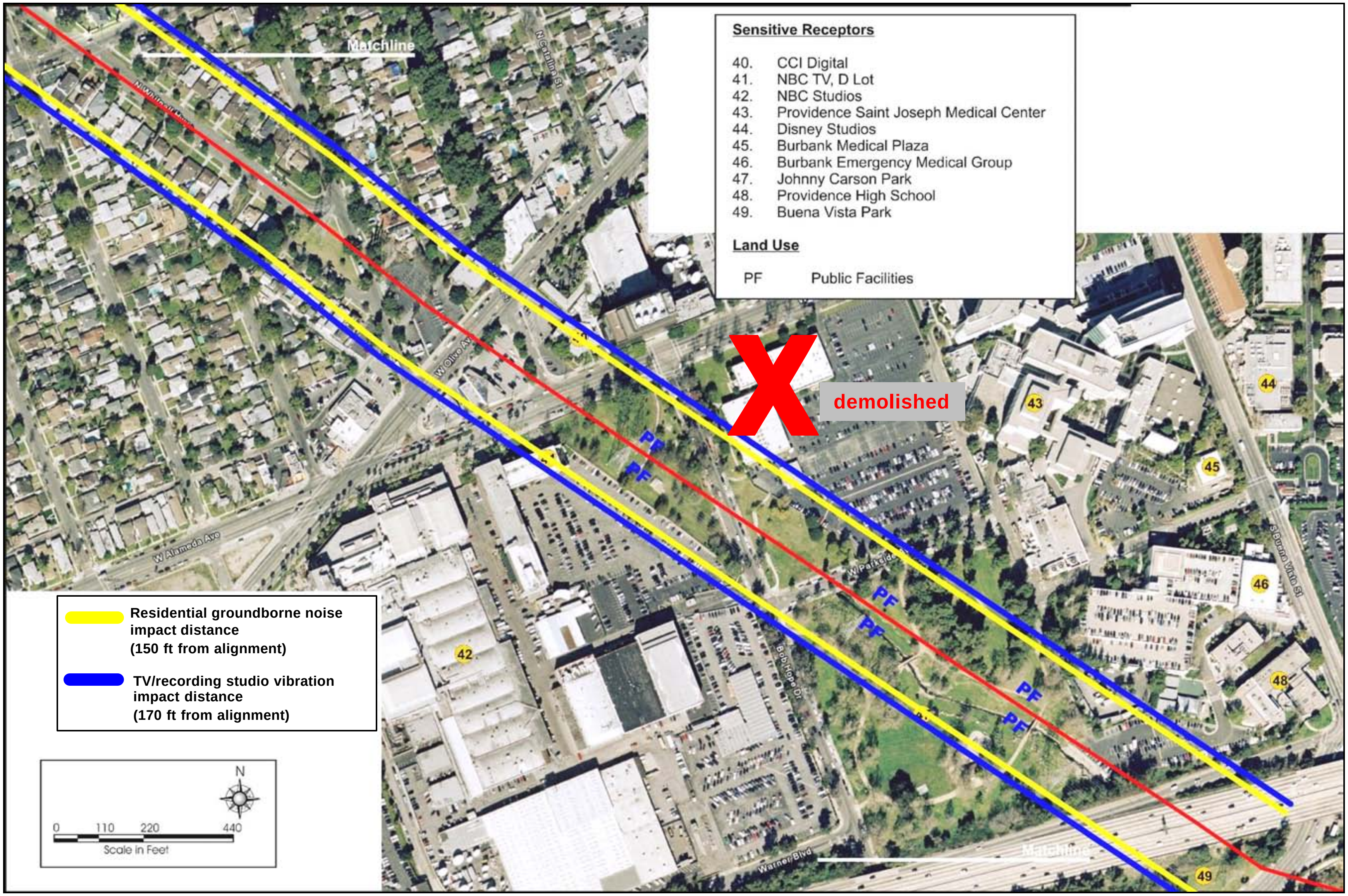

Figure 56: Tunneling impact zones - Phase 3 (4 of 4)

6.5 Summary of Impacts

Significant impacts to noise-sensitive receivers due to the Upper Reach project are summarized in answering the relevant questions from the CEQA Guidelines, as follows:

Would the project result in exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Significant and unavoidable. Both the Los Angeles and Burbank ordinances focus on restricted operating hours as a means of regulating construction hours. Construction of the project is planned to occur during daytime, swing and nighttime hours. Section 112.05 of the Los Angeles code further restricts noise emissions from construction equipment to a level of 75 dBA at a distance of 50 feet from any construction equipment, if technically feasible. Provided that all equipment used on this project is fitted with appropriate mufflers, shields, or other available noise-attenuating devices, the technical-feasibility requirement is presumed to be met. Only machinery which inherently creates loud noise (e.g. pavement breakers) would be considered exempt from the technical-feasibility requirement.

Would the project result in exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

Significant and unmitigatable impact. Sensitive receivers lying within a distance of 150 feet (residential or similar) or 170 feet (film/recording studio) of a tunnel alignment may be subject to ground-vibration or groundborne-noise in excess of the criteria recommended by the Federal Transit Administration. These receivers lie along the northern portion of the project (Phase 1) and along Whitnall Highway in Burbank (Phase 3). Although certain mitigation measures may be applied (discussed below), it is unlikely that impacts can be confidently reduced to below the recommended thresholds due to the nature of ground vibration. All impacts, however, will be temporary and only occur during daytime hours as currently planned.

Would the project result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Significant but mitigatable impact. Airborne noise from construction equipment will exceed the significant thresholds defined above for many receivers along the alignment. Of primary concern is exceedance of the 75 dBA threshold. Mitigation of airborne noise to acceptable levels is feasible, however, using a combination of noise barriers and other techniques discussed below.

Table 13 below summarizes all of those noise impacts specifically identified above, whether due to above-ground or tunneling operations. Receivers are listed in approximately the order they are found, starting from the north end of the project alignment. Excluded from the table are possible, but unidentified, impacts due to staging-area operations, dewatering, and other activities associated with the project.

Table 13: Summary of identified impacts

Sensitive Receiver	Figure	Land Use	Impact	Source
multiple residences	Figure 27 & Figure 51	residential	airborne & vibration	pit/shaft & tunneling
multiple residences	Figure 28 & Figure 51	residential	airborne & vibration	pit/shaft & tunneling
Ministero Pentecostes de Jesucristo	Figure 51	worship	vibration	tunneling
Inglesa Pentecostal Unida	Figure 51	worship	vibration	tunneling
Kiddie Academy	Figure 52	school	vibration	tunneling
Lankershim Medical Clinic	Figure 43	medical	airborne	trenching
Inglesia Pentecostes Fuente de Luz	Figure 32 & Figure 43	worship	airborne	pit/shaft & trenching
Maurice Sendak Elementary School	Figure 44	school	airborne	trenching
Family Hope Medical Clinic	Figure 35 & Figure 45	medical	airborne	pit/shaft & trenching
Inglesia Pentecostes	Figure 46	worship	airborne	trenching
L.A. Urgent Care Clinic	Figure 46	medical	airborne	trenching
West Coast Seminary	--	worship/school	airborne	trenching
Ministerio Palabra Verdad Y Vida	Figure 47	worship	airborne	trenching
Cahuenga Potters Studio	Figure 47	film/recording	airborne	trenching
Iglesia De Dios	Figure 39 & Figure 48	worship	airborne	pit/shaft & trenching
Screenland Studios	Figure 48	film/recording	airborne	trenching
multiple residences	Figure 53 - Figure 56	residential	vibration	tunneling
Universal Adult Day Care	Figure 53	residential	vibration	tunneling
Fred Wolfe Films	Figure 53	film/recording	vibration	tunneling
Media Center Montessori Pre-School	Figure 54	school	vibration	tunneling
American Lutheran Church	Figure 54	worship	vibration	tunneling
American Lutheran School	Figure 54	school	vibration	tunneling
Robert Louis Stevenson Elementary School	Figure 55	school	vibration	tunneling
CCI Digital	Figure 56	film/recording	vibration	tunneling
NBC TV, D Lot	Figure 56	film/recording	vibration	tunneling
Johnny Carson Park	Figure 41	park	airborne	pit/shaft
Lod Cook Center/Junior Achievement Foundation	Figure 42	school	airborne	pit/shaft

7 Mitigation Options

7.1 General

Mitigation of the above-identified impacts will be readily achievable in some cases, but impractical in others. The discussion that follows addresses general methods of abating each impact and notionally quantifies results where applicable. Because each location and activity will impose its own constraints on mitigation treatments, no attempt is made to definitively determine the effects of treatments.

7.2 Jacking-pit/Tunnel-shaft Noise

Airborne construction noise is usually controlled by use of temporary sound barriers. Typical barriers are solid (e.g. plywood) walls fabricated on site, or commercially-available noise curtains which are hung from scaffolding or some other framework. Rigid temporary sound walls are also commercially available. Solid walls tend to offer greater resistance to sound-penetration than curtains, however, the latter can generally be raised to greater heights given stability and wind-loading considerations.

A curtain, if used, must be massive (heavy) enough to significantly attenuate low-frequency exhaust noise from construction machinery; lightweight curtains will prove unsatisfactory. A minimum rating of STC-28 is recommended, though higher values are preferred.[14] A curtain material that provides reasonably adequate performance is reinforced mass-loaded vinyl. Such curtains can provide attenuation up to ratings of STC-33, with the heavier, thicker sheets performing best. Composite materials are also available which combine an absorptive material with the mass-loaded vinyl, providing additional noise containment.

Solid sound walls should be also be constructed to provide a massive barrier to noise transmission. They are typically constructed of a minimum 1-inch thick plywood or oriented-strand board (OSB). Alternately, a minimum 5/8" thick gypsum board, cement board, or similar material may be substituted for the plywood. Single-layer walls are common, though dual-layer walls are also used for extra protection. Sound walls should preferably be treated with a sound-absorptive face on the construction side, which further enhances its performance. Sound-absorption typically consists of a minimum 2-inches of encased fiberglass or equivalent. Solid sound walls must be constructed so that they contain no gaps or holes which would allow noise penetration, including along the seams. They must also be adequately braced to prevent collapse due to wind-loading, seismic events, and other causes.

Earth berms present a third alternative for noise control, particularly along the trenching portion of the alignment where excavated soil can be laid alongside the trench as a noise

[14] STC: Sound transmission class—a rating of a barrier's ability to attenuate noise; higher values are better.

barrier rather than trucking it off-site. Numerous constraints limit the feasibility of this approach, however, including the locations and heights of receivers, and available ground space. Where conditions are favorable, however, earth berms can provide excellent noise abatement.

Assuming it is sufficiently solid, the height of a sound wall will largely determine its performance. Sound walls shall be constructed as high as practical, but at a minimum should be eight feet tall. Greater heights are preferable in order to block the line-of-sight between receivers and machinery exhaust stacks. Furthermore, second-story receivers require taller barriers to adequately mitigate noise impacts, possibly mandating the use of curtains in lieu of solid walls. It will be incumbent upon the contractor to determine the best approach to mitigation given specific constraints of the project site.

7.3 Open-trenching Noise

Noise from open-trenching activities would be controlled substantially the same as that around the jacking pits and tunnel shafts, namely by the use of temporary sound barriers. Because of the relatively few sensitive receivers located along the open-trenching portions of the alignment, mitigation treatments can focus on the receivers themselves rather than on the construction equipment. Specifically, barriers can be erected directly in front of sensitive receivers, remaining there until construction has moved out of the area. This is a more practical arrangement than mobile barriers which move with construction activity, given that trenching may be extended over a thousand feet.

7.4 Tunneling Vibration

Mitigating groundborne vibration and associated groundborne noise due to tunneling is more problematic than controlling airborne noise from surface machinery. There is no practical way to block the path of vibration as there is with airborne noise, thus all mitigation measures must be implemented at the source of vibration, namely the tunnel-boring machine and the muck-trains. It is not within the scope of this study to perform a detailed assessment and provide recommendations regarding source-level control of vibration, however, the following measures may be considered:

- adjust the speed of the TBM cutting wheel (it is possible that the rotational speed of the cutting wheel may coincide with natural frequencies of nearby structures, thus amplifying the induced vibration; increasing or decreasing the wheel speed would likely reduce this impact);
- use alternate TBM cutting surfaces (different cutting surfaces, if available, may induce varying levels of vibration into the soil, particularly with regard to soil composition and condition);
- minimize the undulations and roughness of muck-train tracks (a muck car which rolls smoothly over its tracks will induce less vibration into the surrounding soils);

- minimize the number of junctions in the muck-train tracks (previous experience indicates that muck-train vibration impacts are greatest near junctions in the tracks, where disjoints are likely to occur in the rails);
- minimize gaps between adjoining rails;
- mount muck-train tracks on resilient pads or springs;
- maintain roundness of muck-train wheels;
- lessen the load of the muck-trains (lightly-loaded cars will induce less vibration into surrounding soils than heavily-laden cars).

The above mitigation treatments are suggested only for consideration. Any or all of them may be infeasible due to operational constraints, and it will be incumbent upon the contractor to determine what mitigation measures are appropriate and implement them accordingly. Where excessive vibration induced in sensitive industrial uses (i.e. TV and recording studios) is unavoidable, coordination between the contractor and facility management should occur such that tunneling activities do not coincide with vibration-sensitive activities at the facility. In the area around NBC and Disney studios, it may be preferable to tunnel at night.

Otherwise, ground-vibration and associated groundborne noise must be considered a significant, but unmitigatable impact. The groundborne noise induced in residential and other sensitive buildings will almost certainly be less than would be present with open-trench construction.

7.5 Staging-area Noise

Locations for staging areas have not yet been determined, as they will be selected by the contractor. Control of staging-area noise is best obtained by locating the staging-areas and their access routes well away from any sensitive receivers. Barring this, staging area noise can be controlled by use of temporary sound barriers (see above) and restrictions on operating hours. Nighttime work and deliveries must be prohibited, including maintenance of construction machinery. The staging area should be fenced and equipped with locks to prevent unauthorized activities after hours, and signs should be prominently displayed indicating the hours of operation.

7.6 Trucking Noise

Mitigation of noise impacts due to trucking activity would be accomplished by restricting delivery routes to the major roadways, specifically Lankershim Boulevard, Burbank Boulevard, and Forest Lawn Drive. Ambient noise levels created by existing traffic on these roads is high enough to be essentially unaffected by trucking activity for this project. Any unavoidable use of residential side streets as alternate routes must be kept to the absolute minimum to meet project requirements.

7.7 Miscellaneous Treatments

Various miscellaneous treatments can be employed to further control construction noise, as described below.

Noise reductions can be obtained at the source by using quiet machinery:

1. **Muffle machinery:** all equipment used on the site should be equipped with appropriate exhaust mufflers and any available "hush kit", the latter of which may include quieter cooling fans, shrouds, etc.
2. **Maintain machinery:** all equipment should be properly maintained and lubricated to ensure it does not produce any extraneous noise due to squeal, vibration, etc.
3. **Substitute machinery models:** some types of construction equipment are available which are specifically designed for noise-control; MQ Power, for example, makes a "Whisperwatt" line of generators which are substantially quieter than comparable generators of the same output; such machines should be selected for use on this project.
4. **Substitute machinery types:** the Bobcat line of construction machines produce substantially lower noise-emissions than do larger loaders and backhoes; where feasible, they should be used in lieu of the larger and louder machines; the same approach also applies to trucks. Gasoline-powered trucks and equipment should be favored over diesel-powered units where feasible, and small pickup trucks should be used in lieu of large delivery trucks where feasible.

Stationary equipment used on-site (electric generators, air compressors, cement mixers) should be located as far as feasible from any noise-sensitive receiver. They should further be shielded or enclosed, as appropriate, to prevent unnecessary noise emissions. This requirement applies to dewatering pumps that are run in the vicinity of any noise-sensitive receiver.

Equipment that is not in use should be turned off. No machinery should be allowed to idle unnecessarily, including waiting delivery trucks. Signs should be prominently posted advising on-site personnel to limit machinery noise.

All personnel, including subcontractors, should be regularly briefed on the necessity for, and methods of, controlling noise. Briefings should occur primarily before construction enters any noise-sensitive areas.

7.8 Construction Noise Monitoring

Requiring that the contractor implement a noise-monitoring program as part of the construction contract will also help to control noise emissions associated with the project. The primary goal of a monitoring program is to raise the contractor's awareness of noise and the responsibility for controlling it to the extent practical. As part of the program, the contractor would be encouraged to:

- exclude noisier equipment from the project site - noise emissions of each piece of machinery would be tested against a set of criteria before allowing it onto the site;
- substitute low-noise equipment where possible, as described above;
- conduct noisy operations off-site where possible (e.g. rock crushing);
- diligently use noise shielding near all residences and other noise-sensitive receivers;
- impose noise-control procedures on all subcontractors;
- designate an on-site noise representative.

The monitoring program should be ongoing and goal-directed to reduce hazardous noise levels and address individual complaints before they escalate to community concerns.

8 Conclusions and Recommendations

8.1 Conclusions

Three different types of pipelaying techniques (trenching, jacking, and tunneling), will be employed on the Upper Reach project in the vicinity of many and varied receivers. Each construction technique varies in the level and type of impact it produces, and the various receivers have different impact thresholds. The impacts may be summarized as follows:

- open-trenching will generally produce significant airborne-noise impacts on all residences and other sensitive receivers immediately adjacent to the project alignment in Phase 2, requiring the use of noise barriers and other techniques to mitigate these impacts;
- jacking will produce significant (and extended) airborne-noise impacts at sensitive receivers in the vicinity of jacking pits, also requiring noise mitigation measures;
- tunneling will produce airborne noise impacts around tunnel shafts similar to those around jacking pits, and requiring the same mitigation measures; it will further produce significant ground-vibration and associated groundborne-noise impacts at nearby residences and commercial facilities using vibration-sensitive equipment.

8.2 Recommendations

Medlin & Associates, Inc. recommends that the mitigation options discussed in Section 7 above be applied, as appropriate, on the Upper Reach project. Mitigation measures shall be incorporated into the construction contract documents, and an independent monitoring program shall be implemented to verify contractor compliance and initiate corrective actions where necessary.

Medlin & Associates, Inc. further recommends that the Los Angeles Department of Water and Power establish a community liaison program for the Upper Reach project, the purpose of which would be to advise residences and sensitive establishments of the anticipated activities and their necessity, and to provide an open feedback path for complaints and consequent corrective actions.

Specific recommendations are as follows.

8.2.1 Airborne-noise Shielding

The contractor shall erect temporary noise-barriers to shield nearby residences and other sensitive receivers from direct exposure to airborne construction noise. Said barriers shall be erected wherever project construction is taking place in the vicinity of sensitive receivers, and to the extent necessary to reduce construction noise levels to 70 dBA or below if feasible. Under no conditions, however, shall one-hour average noise levels exceed 75 dBA at any sensitive receiver. Barriers shall be erected to heights necessary to protect any second-floor receivers; otherwise, they shall be constructed to a minimum height of twelve feet unless safety or other considerations constrain their heights.

Barriers shall either consist of commercially-available noise-control curtains, in-situ fabricated sound walls, or any equivalent with an overall sound-transmission class rating of STC-28 or higher. Solid barriers shall be equipped with an absorptive face on the construction side with a noise reduction coefficient of NRC-0.65 or greater. Curtains shall have an inherent absorption of NRC-0.65 or greater. Barriers shall preferably comprise solid walls unless stability or other considerations prevent their use. All barriers shall be constructed to contain no unnecessary holes or gaps. Where access through the barrier is required, overlapping sections shall be constructed to prevent noise escaping through the opening.

Sound walls shall be placed as dictated by construction activities underway. Semi-permanent barriers are preferred around jacking pits and tunnel shafts, whereas receiver-specific barriers are recommended along the open-trenching areas. Portable, hand-held barriers (e.g. a single sheet of plywood) shall be used in the immediate vicinity of certain noise-intensive activities such as concrete sawing. Stationary equipment such as air-compressors and generators shall be contained in temporary shelters or otherwise shielded from direct exposure to sensitive receivers (e.g. placing them behind larger equipment, dirt mounds, etc.). The most appropriate barrier shall be determined specific to each situation.

Noise barriers shall be erected around staging areas wherever these are established near residences or other sensitive receivers. To the maximum extent practicable, staging areas shall not be located within residential areas.

8.2.2 Machinery Silencing and Selection

All machinery to be used on-site shall be equipped with the best available exhaust mufflers and any applicable "hush kits". No machinery shall be allowed on-site which emits noise levels in excess of 75 dBA when measured at a distance of 50 feet from the machine, unless technically infeasible due to the nature of the machine or its operation. Each piece of machinery shall be measured by a qualified acoustical engineer for its noise-level emissions prior to allowing it onto the construction site. Any piece which exceeds acceptance criteria shall be prohibited from use on-site.

The contractor shall substitute quieter machinery wherever feasible.

All machinery shall be maintained in good working order and lubricated as necessary to minimize unnecessary noise emissions. No machine shall generate unusual squeals, groans, or other noises which may be eliminated due to proper maintenance and lubrication. All cabinets, panels, covers, shrouds, and similar components shall be securely fastened to ensure that they do not create excessive noise due to vibration.

The contractor shall turn off all unused machinery. Delivery and hauling trucks shall not sit with their engines idling. The contractor shall post signs advising drivers to turn off idling engines.

Contractor personnel shall park personal vehicles off-site wherever feasible.

8.2.3 Ground-vibration

The contractor shall take all reasonable measures necessary to maintain ground-vibration levels below a peak-particle velocity of 0.02 inches per second at any sensitive receiver. Such measures include those discussed in Section 7 above, or any others the contractor chooses to implement. Under no circumstances shall ground-vibration levels exceed a peak-particle velocity of 0.2 inches per second anywhere.

8.2.4 Off-site Work

The contractor shall perform noisy work off-site and away from any residential areas wherever feasible. Such off-site activities may include rock-crushing, materials pre-fabrication, and equipment maintenance.

8.2.5 Trucking

All trucking shall be constrained to major roadways (e.g. Lankershim Boulevard). The contractor shall establish designated truck routes to serve each project area. All subcontractors shall also be required to adhere to the designated truck routes.

8.2.6 Hours of Operation

The contractor shall restrict operations, including deliveries, to those hours permitted by the Los Angeles and Burbank ordinances. Staging areas in the vicinity of sensitive receivers shall be locked after hours, and shall have signs prominently displaying operating hours.

8.2.7 Contractor Personnel Training

The contractor shall instruct all personnel, including subcontractor personnel, of the necessity and procedures for controlling noise and vibration impacts on sensitive receivers.

8.2.8 Pre-construction Survey and Damage Repair

The contractor shall perform a pre-construction survey of all historic and fragile buildings along the tunneling portions of the alignment. The conditions of the buildings shall be recorded and assessed for their ability to withstand ground-vibrations. The contractor shall take any measures necessary to reinforce the structures against vibration damage, and shall correct any damage which occurs as a result of project construction.

8.2.9 Monitoring and Mitigation

A noise and vibration monitoring and mitigation program shall be implemented under the guidance of an independent qualified acoustical consultant. The program shall comprise measuring construction equipment noise emissions levels, continuous or frequent spot-checks of noise and vibration levels at sensitive receivers near the construction site, and guidance by the acoustical consultant regarding the control of excessive noise and vibration emissions.

Noise measurements of equipment prior to allowing it on-site, as discussed above, shall be a part of the noise monitoring a mitigation program.

The noise consultant or LADWP shall have the authority to cease any activity which is deemed to create a hazardous noise level at any residence until an appropriate mitigation measure is found.

8.2.10 Public Notification and Complaint Resolution

The contractor shall issues notices of start of construction to the public, residences and commercial establishments in the impacted vicinity of the project sites, 30 days in advance of the start of construction. The notices shall include hours of construction and construction schedule. The notices shall provide an overview of the types of noise and vibration which will occur, the reason for their occurrence, and measures being taken to minimize disturbance. The notices shall establish a noise-complaint hotline and include the number in the notification letter.

The contractor shall promptly respond to all complaints received at the noise-complaint hotline. The contractor shall assess the complaint to determine if the complainer is experiencing noise or vibration levels which are hazardous, significantly above expected levels, or out of line with levels experienced at other nearby similar receivers. The contractor shall further assess whether the complainer has any medical or other condition which makes the complainer especially susceptible to noise or which might create a hazardous situation. Contractor shall resolve all complaints commensurate with the findings.

Appendix 1: Construction Machinery Noise

Data in the table below are from the Federal Highway Administration Document *FHWA-HEP-05-054 Final Report*, dated January 2006. It contains a compilation of noise data from the on-going Central Artery/Tunnel project in Boston. Noise levels shown are both from the project specification as well as actual levels measured in the field. Additionally, the table also lists a "usage factor" for each type of equipment, which allows more accurate prediction of an average noise level. The usage factor indicates the amount of time a particular piece of equipment is likely to run at high noise output (L_{max}) during a particular operation.

Equipment Description	Impact Device?	Usage Factor (%)	Spec Levels Lmax @ 50 ft (dBA, slow)	Actual Measured Lmax @ 50 ft (dBA, slow)
All Other Equipment > 5 HP	No	50 %	85 dBA	N/A
Auger Drill Rig	No	20 %	85 dBA	84 dBA
Backhoe	No	40 %	80 dBA	78 dBA
Bar Bender	No	20 %	80 dBA	N/A
Blasting	Yes	N/A	94 dBA	N/A
Boring Jack Power Unit	No	50 %	80 dBA	83 dBA
Chain Saw	No	20 %	85 dBA	84 dBA
Clam Shovel (dropping)	Yes	20 %	93 dBA	87 dBA
Compactor (ground)	No	20 %	80 dBA	83 dBA
Compressor (air)	No	40 %	80 dBA	78 dBA
Concrete Batch Plant	No	15 %	83 dBA	N/A
Concrete Mixer Truck	No	40 %	85 dBA	79 dBA
Concrete Pump Truck	No	20 %	82 dBA	81 dBA
Concrete Saw	No	20 %	90 dBA	90 dBA
Crane	No	16 %	85 dBA	81 dBA
Dozer	No	40 %	85 dBA	82 dBA
Drill Rig Truck	No	20 %	84 dBA	79 dBA
Drum Mixer	No	50 %	80 dBA	80 dBA
Dump Truck	No	40 %	84 dBA	76 dBA
Excavator	No	40 %	85 dBA	81 dBA
Flat Bed Truck	No	40 %	84 dBA	74 dBA
Front End Loader	No	40 %	80 dBA	79 dBA
Generator	No	50 %	82 dBA	81 dBA
Generator (<25KVA, VMS signs)	No	50 %	70 dBA	73 dBA
Gradall	No	40 %	85 dBA	83 dBA
Grader	No	40 %	85 dBA	N/A
Grapple (on backhoe)	No	40 %	85 dBA	87 dBA
Horizontal Boring Hydr. Jack	No	25 %	80 dBA	82 dBA
Hydra Break Ram	Yes	10 %	90 dBA	N/A
Impact Pile Driver	Yes	20 %	95 dBA	101 dBA

Equipment Description	Impact Device?	Usage Factor (%)	Spec Levels Lmax @ 50 ft (dBA, slow)	Actual Measured Lmax @ 50 ft (dBA, slow)
Jackhammer	Yes	20 %	85 dBA	89 dBA
Man Lift	No	20 %	85 dBA	75 dBA
Mounted Impact Hammer (hoe ram)	Yes	20 %	90 dBA	90 dBA
Pavement Scarafier	No	20 %	85 dBA	90 dBA
Paver	No	50 %	85 dBA	77 dBA
Pickup Truck	No	40 %	55 dBA	75 dBA
Pneumatic Tools	No	50 %	85 dBA	85 dBA
Pumps	No	50 %	77 dBA	81 dBA
Refrigerator Unit	No	100 %	82 dBA	73 dBA
Rivet Buster/chipping gun	Yes	20 %	85 dBA	79 dBA
Rock Drill	No	20 %	85 dBA	81 dBA
Roller	No	20 %	85 dBA	80 dBA
Sand Blasting (Single Nozzel)	No	20 %	85 dBA	96 dBA
Scraper	No	40 %	85 dBA	84 dBA
Shears (on backhoe)	No	40 %	85 dBA	96 dBA
Slurry Plant	No	100 %	78 dBA	78 dBA
Slurry Trenching Machine	No	50 %	82 dBA	80 dBA
Soil Mix Drill Rig	No	50 %	80 dBA	N/A
Tractor	No	40 %	84 dBA	N/A
Vacuum Excavator (Vac-truck)	No	40 %	85 dBA	85 dBA
Vacuum Street Sweeper	No	10 %	80 dBA	82 dBA
Ventilation Fan	No	100 %	85 dBA	79 dBA
Vibrating Hopper	No	50 %	85 dBA	87 dBA
Vibratory Concrete Mixer	No	20 %	80 dBA	80 dBA
Vibratory Pile Driver	No	20 %	95 dBA	101 dBA
Warning Horn	No	5 %	85 dBA	83 dBA
Water Jet deleading	No	20 %	85 dBA	92 dBA
Welder / Torch	No	40 %	73 dBA	74 dBA

* Source: *FHWA-HEP-05-054 Final Report*, January 2006