NOISE ANALYSIS

INTRODUCTION

A preliminary study to assess the noise impact of proposed helicopter operations at San Francisco General Hospital (SFGH) was conducted by Charles M. Salter and Associates in January 2003. This purpose of the study was to help in determining the feasibility of locating a dedicated helipad on the medical campus of SFGH.

The helipad site study in Chapter 4 identified five possible sites. The rooftop of the Main Hospital building on Wing C is one of the proposed locations that was studied. For the purposes of this study, the noise contour results were based on locating the helipad at this site. The other sites will be covered in a more detailed environmental review at a later time.

The primary conclusion of the study is that there would be an incidental noise increase in the general area of the helipad from the proposed 1-3 daily operations. The higher noise levels will be contained on the hospital campus within the immediate vicinity of the helipad. The noise levels of individual overflights may prove to be an annoyance, but the impact will be minimal due to the relatively low number of anticipated operations.

This chapter documents the field noise study, and describes the results. The noise criteria used to assess the impact of the helipad is discussed in the first section. The following two sections describe existing sound levels at three sites in the community and their predicted sound levels due to helicopter operations. The assessment of noise impact is presented in the last section.

NOISE IMPACT CRITERIA

Noise Measurement Methods

The noise impacts of helicopter operations can be based on the cumulative noise exposure of multiple operations over daily periods. The noise method that was utilized was Day- Night Average Sound Level, or DNL, which is the sum of daily sound exposure for a given period, or the sound exposure level for a number of specific events within a time period. This noise metric was based on social survey research that was conducted over the years to quantify people's reaction to noise exposure levels in the community. It divides 24 hours into two time periods: 7 AM to 10 PM is characterized as day and 10 PM to 7 AM is identified as nighttime hours. For events that occur during the nighttime hours, a night penalty of 10 dB is added to take into account the greater sensitivity of people to sounds that occur during these time periods. The measurement unit of sound is the decibel, or dB (just as the unit to measure temperature is the degree or the unit of length is the inch or foot).

Consider a car driving on a local street. Before the sound of the car is heard there is already some sound that may be heard in the area, called background or ambient sound. This background sound may be due to distant traffic, wind in the trees, people talking, etc. As the car approaches the listener the sound due to the car can first be heard just above the background sound, and then the sound of the car increases as the car gets closer. As the car passes the listener the sound reaches its highest level; this level is called the maximum sound level. The sound level than decreases and fades into the background sound level as the car drives farther away. This maximum sound level will depend on several factors such as the type of car (some cars are louder than others), the speed of the car (higher speed causes higher maximum sound levels), and the distance between the car and the distance (the maximum sound is lowered if the listener moves farther away from the street).

In a similar manner the maximum sound level of a helicopter when it is flying overhead represents the highest sound level that will be heard during the flyover. This level will also depend on the type of helicopter, the speed and type of operation (approach, departure, or level flyover), and the distance between the helicopter and the listener. Often it is not possible to measure the noise level of the helicopter because it is below the level of the background noise. However, it is possible to identify the sound as belonging to a helicopter since it has a distinct noise signature.

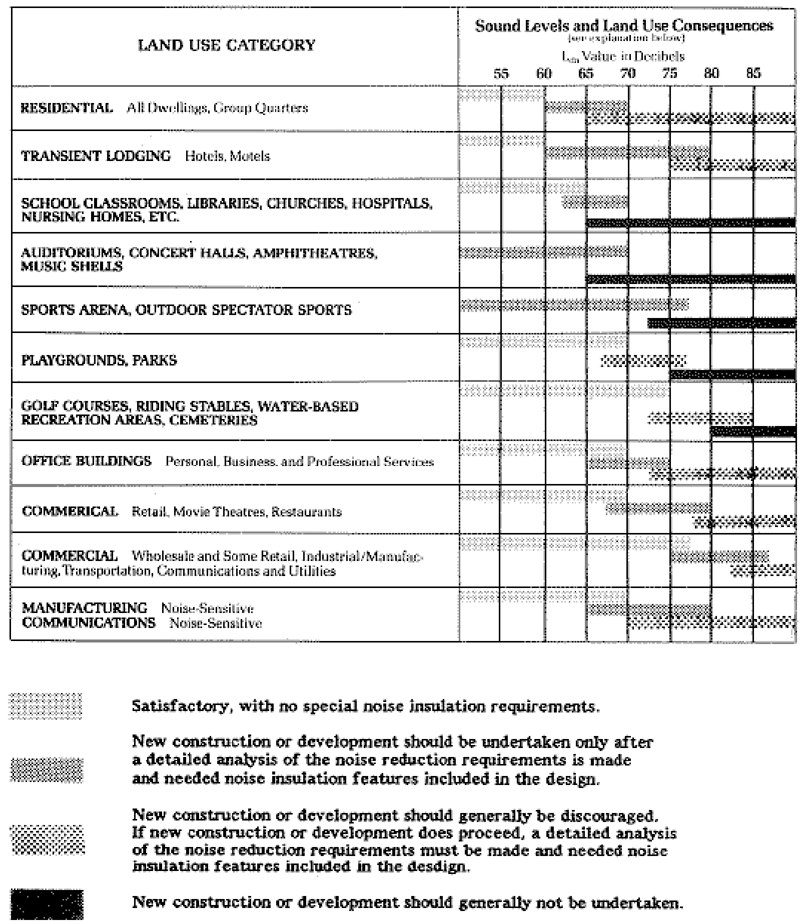
DNL as a background measure is a cumulative noise measure based on an average of all the sounds occurring during a typical 24-hour period. DNL was originally developed by the federal government as a measure of land use compatibility and is used in every state in the Union with the exception of California. The cities and counties of California typically use Community Noise Equivalent Level (CNEL), which like DNL is very useful for making land use planning decisions. Both measures are almost identical. The distinguishing feature is that CNEL divides the 24-hour period into three time periods thereby adding a weighting factor of 5 dB for events occurring in the evening hours (defined as between 7 PM to 10 PM). Both noise exposure methods contain a 10 dB correction factor applied to nighttime sounds levels to account for increase annoyance during the night hours.

The day-night sound level was introduced as a simple method for predicting the effects on a population of the average long-term exposure to environmental noise. It can be derived directly from an A-weighted sound exposure level.

DNL was chosen for this report because, the City and County of San Francisco use this noise measure in their Land Use Compatibility Chart for Community Noise found in the General Plan. The Planning Department uses this as a guideline for new development and for the assessment of land uses. Research over the years has established criteria which relate the acceptability of various noise environments in terms of the DNL level to different land uses (see Table 6-1- Land Use Compatibility Chart).

Table 6-1

LAND USE COMPATIBILITY CHART FOR COMMUNITY NOISE



The FAA uses an alternate cumulative noise measure, the 24-hour equivalent sound level, Leq. The 24-hour Leq is also an average of all the sounds occurring during a full day, but without any weighting factors for time periods. This measure was used to analyze the everyday occurring background noise in the neighborhoods adjacent to SFGH.

DNL can be measured with a special type of sound level meter called an integrated sound level meter; a measurement period of at least 24 hours is required. Alternately, DNL due to a particular sound source such as helicopter can be calculated from measurements or estimates of the sound exposure levels (SEL) of individual operations if the number and time of such operations during a 24-hour period are known.

Impact Criteria

It is useful to consider the sound levels that are routinely experienced in the community which is in the vicinity of the proposed helipad. For example, the maximum sound level from a typical passenger car about 50 ft away traveling on a local street at 35 mph is 60 to 70 dBA. Under the same conditions the maximum sound level of a bus or truck is between 78 and 90 dBA. The noise level of a leaf blower can be between 80 and 95 dBA. All of these everyday noise events and more are potential noise sources which when measured over a 24-hour period comprise the typical background noise level. It is against this tapestry of sound levels that the helicopter noise event is compared.

FIGURE 6-1
NOISE MONITORING
LOCATIONS

Land use compatibility guidelines have been established by several federal agencies and many cities and counties in California and are usually found in their General Plan Noise or Land Use Elements. These compatibility guidelines typically show that residential land use is incompatible with a CNEL/DNL higher than 65 dB. This agrees with the recommendations in the City of San Francisco's Land Use Compatibility Chart. Hospitals or nursing homes are acceptable within DNL levels of 65 dB. Commercial and office buildings can exist within DNL noise contours of 70 to 80 dB.

EXISTING SOUND LEVELS

Traffic is the dominant source of noise in the area around the proposed helipad, particularly near the Highway 101 freeway and in the vicinity of major streets such as Potrero and Vermont Avenues. The background noise was measured in 24-hour DNL and Leq at 3 different sites as noted in Figure 6-1. Site 1 was on Potrero Ave. The second site was in a residential area to the south of SFGH on San Bruno. The third site was in the Potrero Hill District where the background noise levels were dominated by Highway 101 traffic. A detailed discussion of the field noise measurement study is found in Appendix D.

San Francisco's transit agency, MUNI, operates four different bus lines in the vicinity of SFGH, with two running along Potrero Ave. (see Figure 6-2). In addition to the MUNI routes, there is moderate to heavy car and truck

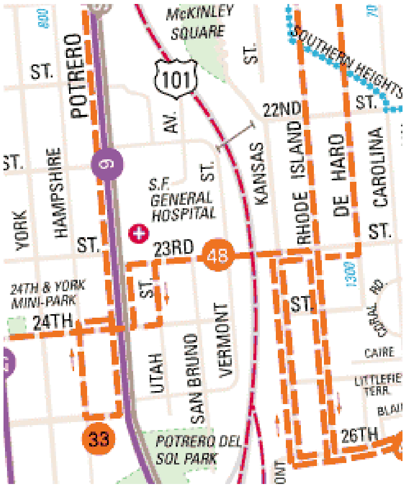


FIGURE 6-2
MUNI ROUTES

traffic along Potrero Ave. and moderate traffic on the side streets near SFGH. Highway 101 located directly to the east of the hospital and contributes to the existing noise environment.

As was noted during the field noise measurement phase of the project, the overall noise level environment is dominated by transportation noise from buses, cars and trucks. The measured noise levels for the background ambient noise are summarized in Table 6-2. The DNL noise results range from 68 dB DNL for Site 1 (Potrero Ave.); 65 dB DNL for Site 2 (San Bruno); and, 65 dB DNL for Site 3 (DeHaro at 24th St.).

Table 6-2
NOISE MONITORING AROUND
SAN FRANCISCO GENERAL HOSPITAL

Location	***Measured DNL (dB)***	***Comments***
#1 22nd St. between Potrero and Hampshire	68	The noise environment was dominated by local traffic (cars and light trucks) on 22nd Street and traffic on Potrero Avenue. In addition, pedestrians and occasional airplane and helicopter flyovers made some contribution to the overall noise environment.
#2 San Bruno Ave. at 23rd St.	65	The noise environment was dominated by traffic (cars and light trucks) on 23rd Street and San Bruno Avenue. Most of the traffic was due to the parking structure located across the street and general hospital circulation. In addition, pedestrians and occasional airplane and helicopter flyovers made some contribution to the overall noise environment.
#3 DeHaro at 24th St.	65	Background noise is controlled by US Highway 101 and punctuated with occasional local traffic and aircraft flyovers.

PROPOSED FLIGHT PATHS

Figure 6-3

FIGURE 6-4

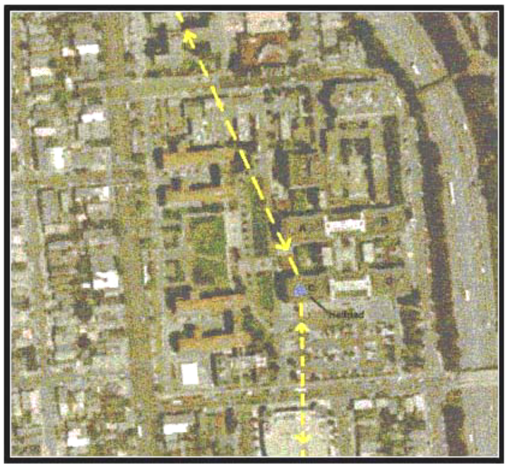


Figure 6-3 shows the recommended planned flight tracks for departure and arrival operations at the proposed rooftop helipad. There is a flight path to the north over the campus and towards the freeways and a flight path to the south over 23rd Street and the hospital parking structure. These flight paths were selected to avoid residential areas and overfly major roads as much as possible in order to minimize noise exposure. The choice of which flight path to use for this rooftop location or any helipad site depends upon: 1] the speed and direction the predominant wind is coming from; and, 2] where helicopter is coming or going from a scene accident or hospital transfer. Because the wind in this area typically comes from the west/northwest, the primary flight path, predicted to be used 85 percent of the time, will be an approach from the south with the departure in a northerly direction. When the wind is blowing out of the south/southwest, approximately 15% of the time during the year, the secondary flight path will be an approach from the north with the departure to the south.

The helicopter approach and departure angle to a rooftop helipad is usually steeper than for a ground level helipad. This is a benefit because the helicopter is at a higher altitude for a longer period of time, thereby reducing the noise exposure. The landing and takeoff profile for each helicopter depends upon the their individual performance capabilities, weather conditions, and the passenger load or weight factor, among other variables.

The twin-engine helicopter that will operate at SFGH will typically approach or depart the helipad at an angle ranging from10 to 16 degrees. This translates into a slope of 6 to 1 for a 10-degree approach to 3 to 1 for a 16 degree departure. That is, for every 6 ft traveled in a horizontal direction the slope increases by 1 ft. Thus a 3 to 1 departure glide slope is steeper than a 6 to 1 slope. All of the identified helicopters are capable of performing these noise abatement type approach/departure glide slope profiles.

HELICOPTER MODELS

The primary helicopter emergency medical services (HEMS) in the Bay Area are REACH, CALSTAR and Life Flight. The helicopters owned by these providers will be the ones that most often land at SFGH. The public helicopter providers such as the CHP, with a smaller helicopter, will land on a much less frequent basis. Each provider uses a different model aircraft that is especially configured on the inside for EMS missions. All private HEMS providers own twin-engine turbine powered helicopters. The noise contours were based upon these helicopters.

HELIPAD NOISE PREDICTIONS

Various helicopters may land at the helipad but those owned by the Bay Area providers will land most often. In order to predict the noise levels for impact evaluation purposes and to provide conservative noise predictions, a composite helicopter noise model was developed combining the sound exposure levels (SEL) of the four different helicopters weighted by their proposed usage of the SFGH helipad. Table 6-3 identifies the helicopters and contains the proposed percentage of use. The following contains a discussion of the assumptions used for the noise analysis.

TABLE 6-3 HELICOPTER USAGE

Helicopter Type	*Percentage Use*
Agusta 109A	40%
BO 105	40%
Bell 222A	10%
BK 117	10%

Helipad Noise Analysis

The helicopters in Table 6-3 were assumed for all operations. The FAA approved computer program called, Integrated Noise Model (INM), contains a fixed data base of helicopter noise levels. The sound levels in this data base are derived from helicopter noise certification data.

That is, each helicopter manufacturer must meet a certain FAA noise certification standard before they can sell a civil helicopter that is used in the United States. INM is the program that was used to generate the noise contours around the helipad. However, it does not have the ability to account for the real-life noise abatement procedures that the pilots can use to help reduce the noise levels. A helicopter noise level composite was created by weighting the sound exposure levels in INM with the percentage of time over a year that the helicopters might land at the SFGH helipad.

Since there is no helipad at SFGH, there is no flight operations history. Therefore it was decided to predict flight operations history for SFGH based upon a careful survey of the other Bay Area regional hospitals of similar size with helipads (see Appendix B).

In an effort to take a conservative look at the impact of the helicopter operations, it was decided to look at the noise exposure for two different idealized days: 1] the average day of 1 flight (takeoff and a landing); and, 2] the busy day with 3 flights (3 takeoffs and 3 landings). These scenarios will present a worse case picture of the noise exposure at the proposed rooftop site. Two noise contours were generated to depict these flight operation scenarios.

The following are the assumptions used in the INM model calculations.

1] The composite helicopter noise model is based upon the usage weighted helicopter noise exposure levels (SEL).

2] The average, normal day is 1 flight at night after 10 PM. Therefore, a 10 dB penalty is added to the composite noise level.

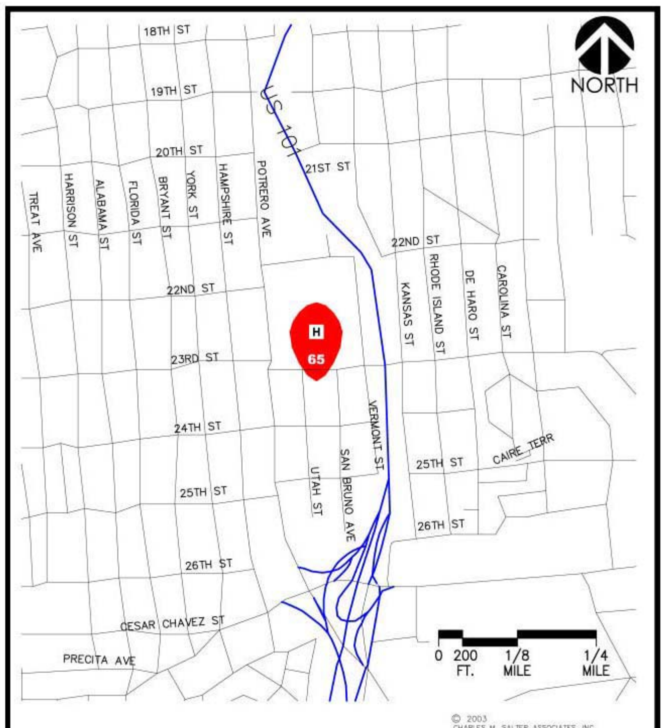
3] The busy day is 3 flights: 2 flights between 7 AM and 10 PM; 1 flight between 10 PM and 7 AM. Again, a 10 dB penalty was added to the composite noise levels for a nighttime landing.

4] The angle of the glide slope was 10 degrees or a slope of 6 to 1.

The analysis was performed using INM Version 6.0c. This program calculates contour values in terms of Day-Night Average Sound Level (DNL).

NOISE IMPACT ASSESSMENT

The contour value of 65 dB DNL was calculated for both the average and the busy day. The INM calculations were based upon the flight path depicted in Figure 6-4. As can be seen in the aerial, the approach flight path from the south would fly over the parking structure in a northerly direction.



PROPOSED ROOFTOP HELIPAD
WING C (Site 1)
AVERAGE DAY--DNL CONTOURS
HELICOPTER NIGHTTIME LANDING (1 Flight)

Figure 6-4

Figure 6-4 - shows one operation and a contour that is almost entirely on the hospital property even though this was for a nighttime operation which by definition in the DNL methodology includes a 10 dB penalty. The higher noise levels will be in closer proximity to the main hospital building. If the DNL contour was calculated for a single daytime event, the contour would be smaller and entirely within the hospital campus.

Any residential dwellings along 23rd Street are outside the 65 dB DNL contour generated by the helicopter landing profile. According to the background noise study, the ambient noise on San Bruno Street just south of 23rd Street was 65 dB DNL for a 24-hour period.

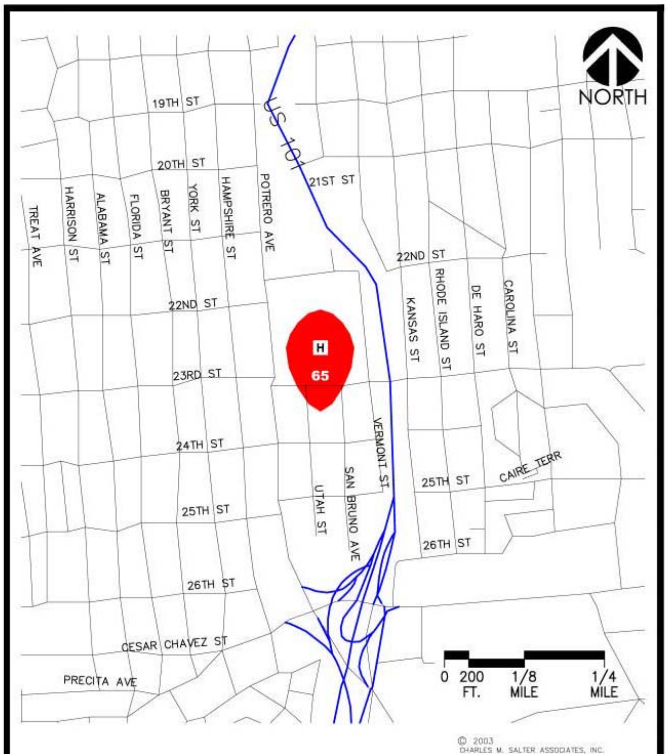
Figure 6-5, which is the Busy Day scenario - is an example of a 65 dB DNL for 3 flights on a given day. This predicts the impact for 2 daytime and 1 nighttime operation. This shows the impact for a worst case scenario should there by 3 landings within a 24-hour period. This noise exposure contour is larger because of the increase in the number of operations. The 65 dB contour extends to the south of 23rd Street. The noise impact on the business/residential buildings on 23rd Street adjacent to the hospital property will be heard for a few seconds per flight. The 65 dB DNL contour does not extend across Potrero Ave. to the Mission District nor east to the Potrero Hill area.

HELICOPTER NOISE ABATEMENT OPTIONS

The two scenarios depicted above did not include possible noise reduction procedures that pilots could employ when utilizing a “fly neighborly” approach. This is the procedure that the pilots who fly for EMS providers employ on a continuing basis when landing in urban area.

<u>On Approach</u>

The helicopter noise levels experienced on the ground can be reduced 2 to 6 dB with a “fly neighborly” approach. The basic difference between a quieter approach technique and a normal one is that the pilot begins the descent to the helipad before reducing the air speed. The rate of descent is between 600 to 800 fpm. The quieter technique uses a glide slope that is a few degrees steeper.



PROPOSED ROOFTOP HELIPAD
WING C (Site 1)
BUSY DAY--DNL CONTOURS
HELICOPTER LANDINGS (3 Flights)

Fig. 6-5

On Departure

Contrary to popular belief, takeoffs are reasonably quiet operations. The total ground area exposed to helicopter noise can be reduced by using a high rate of climb and making a smooth transition to forward flight. Given weather conditions and desired direction of departure, the pilot should avoid overflying noise sensitive areas where possible.

The noise abatement options were not utilized in the calculations of the noise contours because a more conservative result was desired. However, the pilots would be expected to use them as a noise abatement mitigation measure during actual operations.

CONCLUSION

This preliminary study, based upon helicopter noise certification sound levels and computer generated noise contours, is a first attempt to characterize the noise impact that might be experienced in the community due to helicopter operations. As a result, the two conservative scenarios that were developed showed minimal impact on the surrounding community when using a land use assessment criteria.

A further study is recommended in which actual helicopter flyovers are measured at various sites in the community. This would provide a more accurate assessment of the length of time for the noise event and the impact of the noise exposure. Ideally, this would be carried out as part of the project's environmental review process.