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Jane Tolmach

+ Roberta

ENVIRONMENTAL IMPACT STUDY

OF THE

CAMARILLO AIRPORT

PREPARED FOR

VENTURA COUNTY BOARD OF SUPERVISORS

OCTOBER 8, 1970

FOREWARD

The objective of the following Study was to define and make provision for the environmental impact of Intrastate Commercial Aviation Airport located at Camarillo Airport, Ventura County, California. It was recognized during the Phase II portion of the Commercial Aviation Feasibility Study being performed by Adrian Wilson Associates that there were sensitive area impacts caused by airport operation that most concerned the citizens of Ventura County. These sensitive issues were the increment of noise expected from the level of aviation operations, of ambient noise levels for the communities of Camarillo and Oxnard, the increment of air pollution assignable to aviation operations proposed for the airport, and the visual characteristics of the airport environment and its resultant planned land use within the impacted area.

It was incumbent upon AWA to select prominent practitioners who could perform objectively to the tasks assigned them by utilizing the developed data of Phases I, II, and III of the Commercial Aviation Feasibility Study

Also AWA was given the responsibility for direction and administration of this Study, so that it might be coordinated amongst the subcontractors. It was felt that each should be left wholly free to draw their own conclusions as to the environmental impact that would result from the operation of Camarillo Airport.

The performance of this Study and its results was in a great part dependent upon the capability of leadership in Ventura County in appointing representative groups to act as a multi-origin citizens' participation council. Because environmental impacts of many projects are in need of review for alternative solutions, it is a credit to the County governments and its citizenry that so much work has been done in so short a time to achieve the results contained in this Study. Certainly the very communicative channels that have been evolved through the work of this study should be fully utilized for further environmental analyses with citizen participation. Currently, for example, an Environmental Impact Study of Calleguas Creek is underway by the Chief of the Environmental Section of the Corps of Engineers. This study involves the full reach of the Creek and is expected to be completed in approximately three months. Other impact studies are also being currently conducted in Ventura County, and the control of the County's future, therefore, offers an opportunity for the citizens, governmental planning groups, the environmental coalition, and for all County government bodies to work together for the future betterment of their community.

NOISE ELEMENT
OF AN
ENVIRONMENTAL IMPACT STUDY
ON THE
PROPOSED CAMARILLO AIRPORT

Wyle Laboratories Research Staff
Consultants in Acoustics
128 Maryland Street
El Segundo, California 90245

Under Contract to
Adrian Wilson Associates

For The Ventura County Board of Supervisors

October 8, 1970

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INTRODUCTION

The question to be resolved is whether the facilities previously known as Oxnard Air Force Base should be converted to use as a civilian airport; if so, to what aeronautical uses might they be put without an unsuitable environmental impact on existing communities, and what controls should be placed upon the operation of the proposed airport and its surrounding land uses to assure future environmental compatibility.

It is not the role of the consultant to make recommendations on whether the inactive field should be utilized for commercial aeronautical use; that is a policy decision to be made by the local governments involved. It is the role of the acoustical consultant, however, to place before the client and the public the estimated noise environment which would be associated with various alternative uses of the proposed airport, our recommendations on noise limits for various land uses, and the control measures we believe should be taken to assure future compatibility of the airport with its surroundings if, in fact, it becomes an active airport.

The acoustical consultant's statement of work (Appendix E) only required that estimated noise contours be prepared for the three cases in the Adrian Wilson Phase III report (Reference 1); i.e., for specified amounts of use for combined commercial service and general aviation for the years 1975, 1980 and 1985. However, we believed it desirable also to explore certain alternative uses of the airport (such as non-jet general aviation use and use as a combined general aviation and STOL commuter facility), and to determine the effects on the noise environment of such additional factors as permitting night jet operations and admitting business jets.

The results of these studies are presented here in the form of estimated noise contours in the Community Noise Exposure Level (CNEL) scale. This is a composite scale which takes account of both the magnitude of noise from each flight and the number of flights (see Appendix B). This is the scale which is recommended for the proposed state noise standard for airports (Reference 2). It was developed for ease of application in noise monitoring systems as well as for airport siting and can be applied to land use planning decisions. In addition, we have provided an indication of the peak noise level that could be expected to occur along various CNEL contours as a result of individual flybys of the noisiest types of aircraft.

We have recommended (Appendix B) a set of guidelines for aircraft noise/land use compatibility for new developments. Since we consider the airport itself to be a new development, we also recommend that those guidelines which correspond to existing land uses around the proposed airport should be taken as criteria against which the compatibility of various levels of airport use should be judged. In particular, we recommend that the proposed airport not be operated in such a manner that its CNEL 60 contour would enclose existing residential communities, nor its CNEL 55 contour enclose existing schools. Postulated alternative uses of the proposed airport should be examined against these criteria.

Additional background information is provided in the appendices. They include a discussion of typical criteria available for the setting of noise limits (Appendix A), aircraft noise/land use compatibility guidelines (Appendix B), a discussion of new laws which may affect the future of the airport and legal powers of airport proprietors to control the noise environment generated (Appendix C), the tallied results of the noise sensitivity questionnaire survey of Camarillo (Appendix D), and a glossary of terms often encountered in the field of aircraft noise (Appendix F).

Recommendations are made on measures which should be taken, in the event the proposed airport is utilized as a jet facility, to control its noise environment.

ESTIMATED NOISE ENVIRONMENTS FOR VARIOUS POSTULATED ALTERNATIVE USES OF THE PROPOSED CAMARILLO AIRPORT

1. BASES FOR ESTIMATED NOISE CONTOURS

The estimated noise contours reported herein were produced by standard techniques involving the noise characteristics of the aircraft categories involved plus their normal takeoff and approach profiles, in conjunction with flight paths laterally located in accordance with those shown in Reference 1.

a. Flight Paths

The runway at Oxnard Air Force Base consists of a 9000-foot concrete strip running approximately east-west, augmented by a 1000-foot overrun section at each end. The noise contours shown herein are based on use of only the westernmost 7000 feet of the concrete portion; that is, brake release point for westward takeoffs and the landing threshold for westward landings are located at a point 2000 feet west of the east end of the concrete runway.

The flight paths prescribed in Reference 1 are as follows:

- All takeoffs are westward.
- During 16.5 percent of the time (under IFR conditions) landings are eastward. The remaining 83.5 percent of the landings (VFR conditions) are westward, following an easterly approach to the field for commercial aircraft, a downwind leg located 8000 feet south of the runway, and a descending turn to the runway. Altitudes for commercial aircraft utilizing this VFR approach were 2000 feet at point of crossing the departure path and 1500 feet at completion of the downwind leg.

For the general aviation aircraft cases, the same percentage allocation to IFR and VFR paths was used, but pattern altitude was taken to be 800 feet, the downwind leg was brought in to align with Pleasant Valley Road, standard pattern entry by a 45° turn to the downwind leg was used, and 50 percent of the traffic was taken to be remaining in the pattern for touch-and-go-practice.

b. Aircraft Noise Data

Aircraft noise and flight profile data were obtained, for existing aircraft types, from standard curves which have been generated over the past several years from noise measurements of aircraft where accurate acoustical and positional data were obtained during both controlled and routine aircraft operations, e.g., References 3 through 6. Noise characteristics of business jets include recent data accumulated at Orange County Airport by a noise monitoring system, References 7 and 8. Data on the noise of existing and potential STOL aircraft (up to 50 passenger capacity) were obtained from aircraft manufacturers and Reference 9. For general aviation aircraft (non-jet), the noise characteristics were obtained from Reference 10, based on a national average mix of specific general aviation aircraft, Reference 11.

Potential future reductions in noise of commercial jet aircraft include the possible entry into service of two-engine, lower capacity versions of the DC-10 and L-1011. Such aircraft would be powered by high bypass ratio turbofan engines of the same generation as those on the DC-10 and L-1011, which are somewhat quieter than low bypass ratio turbofan engines. At a later date (1985 or later), we may expect entry into service of aircraft powered by the "quiet engine," which will be significantly quieter than existing engines. Noise contours are shown which would be affected by these developments; noise characteristics used in their estimation have been based on conservative selections from References 12 through 14 and influenced by Reference 15.

c. Atmospheric and Terrain Conditions

The procedure for estimation of noise contours is based on flat terrain and standard atmospheric conditions. It does not, therefore, take account of hills or temperature inversions. Considering the location of the predicted noise contours, the direct sound is expected to dominate over any potential reflected sound. Therefore, we believe the accuracy of the estimated contours to be adequate for preliminary planning decisions. If airport operations begin, and particularly if jet aircraft are involved, the contour locations should be confirmed by measurement, especially those portions of the contours which lie near populated areas.

d. Time Mix

All contours shown are for daytime and evening operations only; no night operations are included (10:00 p.m. to 7:00 a.m.). The distribution of operations between the day and evening time periods (7:00 a.m. to 7:00 p.m. and 7:00 p.m. to 10:00 p.m., respectively) is in proportion to the number of hours in those two time periods, i.e., the ratio of daytime flights to evening flights is 4:1.

Noise contours are presented below for the various postulated uses of the proposed airport, generally in order of increasing noise impact.

2. POTENTIAL FOR OPERATION AS A FACILITY FOR GENERAL AVIATION AND STOL COMMUTERS

Figure 1 shows the estimated noise contours in the CNEL scale for three cases:

a. 306 daily operations[1] of (non-jet) general aviation aircraft. This corresponds to the number of general aviation aircraft for 1975 in Reference 1.

b. 810 daily operations of (non-jet) general aviation aircraft. This corresponds to the number of general aviation aircraft for 1985 in Reference 1.

c. The addition of 135 daily operations of STOL commuters (4-engine, 50-passenger) plus 35 of Twin Otters to the foregoing 810 general aviation operations. This case corresponds to a modification of the 1985 case (Reference 1) by replacing the jet transport aircraft with STOL commuters in sufficient quantity to move the same number of passengers (to major terminals such as LAX and Palmdale and over ranges in excess of 200 miles fully-loaded or in excess of 500 miles with lighter loads).

It may be noted that for the general aviation cases, the CNEL 60 contour is well clear of existing residential areas. For the case including STOL commuters, flight path controls at the eastern end of the contour (monitored by a ground-based noise measurement system) would be desirable.

It must be emphasized that these contours presume exclusion of all jet aircraft, including business jets. Significantly larger contours would result if business jets were admitted. Current turbojet type business jets are about 3 dB noisier than 2-engine commercial jet aircraft (737 or DC-9). Hence, each business jet admitted would be equivalent to two twin-engine commercial jet aircraft, even if both types are flown along their best (noise minimization) flight profiles.

3. POTENTIAL FOR OPERATION AS A COMMERCIAL AVIATION FACILITY

Figures 2 through 5 show the families of noise contours which would be generated by operation of the proposed airport as a commercial facility (i.e., with commercial

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(1) The word "operation" is used throughout this report to mean either a takeoff or a landing; hence 20 operations means 10 takeoffs and 10 landings, for example.

jets up to 3-engine category). For all these cases, the contours assume a thrust cutback at 1500 feet altitude for all jet aircraft, for noise abatement purposes; this will be further discussed below.

Table 1

NOISE CONTOURS IN CNEL FOR COMMERCIAL AIRPORT CASES

Figure No.	Year	Basis
2	1975	Aircraft mix from 1975 case, Reference 1.
3	1980	Aircraft mix from 1980 case, Reference 1.
4	1985	Aircraft numbers from 1985 case, Reference 1, assuming 50 percent of the jet fleet has benefitted from noise reductions in new high bypass ratio turbofan engines; and 50 percent from the "quiet engine."
5	1985+	Aircraft numbers from 1985 case, Reference 1, assuming all the jet fleet has evolved to the "quiet engine."

The noise contours in Figure 2 represent the 1975 case in Reference 1: 28 daily operations of 2-engine jet transports (DC-9 or 737), 26 of Twin Otters, and 306 of (non-jet) general aviation aircraft.

Figure 3 shows the noise contour family estimated for the 1980 case of Reference 1: 46 daily operations of 2-engine jet transports (DC-9 or 737), 31 of Twin Otters, 11 of STOL commuters (4-engine turboprop) and 540 of general aviation aircraft.

Figures 4 and 5 show the estimated contours for two different possibilities associated with the date 1985, and based on the aircraft numbers given for the 1985 case in Reference 1: 18 daily operations of 3-engine jets (of 727 class), 34 daily operations of 2-engine jets (of 737, DC-9 class), 35 of Twin Otters, 13 of STOL commuters (4-engine turboprop) and 810 of general aviation aircraft.

Noise certification requirements for all new subsonic jet air carrier aircraft recently imposed by FAA (Reference 15) will lead to quieter aircraft in the future. Both

Figures 4 and 5 are based, therefore, upon reductions in aircraft noise by the 1985 time period. We estimate that aircraft utilizing the "quiet engine" will be in service by 1985 or shortly thereafter. Further, a 15-year time period is sufficient to retire aircraft now in service. However, if new aircraft are added to the airline mix in the interim, they will have noise characteristics typified by smaller versions of the DC-10 and L-1011 with high bypass ratio turbofan engines. Figure 4, therefore, is based on the assumption that 50 percent of the jet fleet utilizing the proposed Camarillo Airport would have the noise reduction benefits of the high bypass ratio turbofan engines, while the other 50 percent would have the (greater) noise reduction benefits of the "quiet engine." This represents our best estimate of the 1985 situation.

Figure 5 is based on all jet aircraft having the "quiet engine," which probably would not occur in actual airline fleet mixes until some time after 1985. It is shown here to represent the trend one can expect, if no flight operations are added after 1985.

It will be noted that the worst case (most extensive noise contours) occurs for 1980, where the number of jet operations has increased but it is assumed that no benefit of engine noise reductions is yet available. The 1980 case, therefore, will be controlling in decisions regarding the future of the airport. It may be necessary to restrict the number of jet operations below those postulated for the 1980 case until after quieter aircraft become available. This appears to be necessary because of schools in Oxnard, and may be necessary because of the westernmost homes in the southern section of Camarillo. When a decision is made as to the future use of the airport, the level of service finally selected for the 1980 time period (that is, until quieter aircraft become available) should be compatible with existing land uses. In the meantime, Figure 3 should be used for land use planning since it represents the most extensive noise environment in the sequence of commercial uses being considered for the proposed airport.

4. EFFECTS OF OPERATIONAL VARIANTS ON NOISE CONTOURS DURING COMMERCIAL OPERATION

All of the foregoing noise contours were based on the following restrictions:

a. No night operations (10:00 p.m. to 7:00 a.m.)

b. No business jets

c. No eastward takeoffs

The effects of deleting these restrictions have also been explored, based on the most marginal case (1980) as a starting point. We studied: (1) the effects of adding business jets to the mix (for 10 daily operations and 20 daily operations of business jets) and (2) the effects of having 10 percent of the takeoffs of commercial jets occur at night. Each of these effects was studied separately.

The effect of night operations (10 percent of the total) was to move the end of the CNEL 60 contour 5000 feet farther west, to cause negligible widening of the contour at the landing end and to extend the takeoff contour laterally by approximately 500 feet.

The effect of adding 20 daily operations of business jets was approximately equivalent to the effect of having 10 percent night operations. For 10 daily operations of business jets, the CNEL 60 contour was extended approximately 2500 feet west (compared to its position without business jets, Figure 3) and widened it at takeoff end by less than 500 feet.

We also intended to investigate the effect of a small percentage of jet takeoffs occurring eastward. However, on questioning the Western Regional Office of the FAA regarding the feasibility of a noise abatement right turn after takeoff, we were given the following official FAA opinion regarding eastward takeoffs by commercial jet aircraft from the proposed Camarillo Airport (Reference 16): For flight safety reasons, (1) eastward takeoffs of commercial jets from the proposed Camarillo Airport could be approved only with 1000 (+)-foot ceiling and 2 miles (+) visibility; (2) due to the surrounding terrain, commercial jets would not be allowed either to climb straight out or to turn right or to use noise abatement thrust reduction procedures. Instead, they would be required to turn left within 2 miles of the departure threshold (east end of the runway), to continue climbing under 98 percent power to 2000 feet altitude, and then to make a 180° turn (of 3-1/2 mile radius) to achieve a 250° heading. Such a procedure, of course, would take the departing flights directly over the City of Camarillo under climb power. If 5 percent of the annual takeoffs were performed in this manner, the annual average CNEL contours are not affected. Nevertheless, we believe that a few hours or a few days per year of this kind of procedure probably would be unacceptable to the citizens of Camarillo, and we recommend against it.

5. SINGLE-EVENT NOISE CONTOURS AND EFFECTS OF POWER CUTBACK

Figure 6 is provided to illustrate two points: (a) the single-event noise contours for operations of current 2-engine turbofan aircraft (DC-9, 737) in terms of the peak sound level in dBA, and (b) the effects of power cutback.

Single-event noise contours are presented for 75, 80, 85 and 90 dBA; both with and without power cutback at 1500 feet altitude. It will be noted that the benefits of power cutback are localized to the region immediately following cutback, and that an increase in noise is incurred farther along the flight path due to the reduced ability of the aircraft to climb and thus put more distance between itself and points on the ground. This effect becomes increasingly large for the lower sound levels, since those contours extend a greater distance along the climb path. Therefore, a power cutback utilized to diminish noise for the community of Nyland (intersection of Highway 101 and Santa Clara Avenue) tends to extend the contours farther into Oxnard. It is believed that an optimum climb power schedule can be found which will minimize noise for Nyland and still prevent the CNEL 55 contour (Figure 3) from extending into Oxnard. This would consist of a temporary power cutback near Nyland, resumption of climb power, and a second power cutback initiated at the populated area of Oxnard and maintained until the shoreline is crossed. This possibility should be further studied.

RECOMMENDATIONS

The acoustical consultant does not intend to recommend whether or not Oxnard Air Force Base should be converted to commercial use. That decision rests upon a number of economic and environmental factors and value judgments which must be made by the people and their elected representatives. In addition, our study has not included environmental aspects of providing commercial air service at other sites.

However, from the estimated noise contours for various alternative uses, in conjunction with existing land use patterns, we would conclude the following:

1. Use as a (non-jet) general aviation facility, for the numbers of operations included in this study, would be compatible with existing land uses.

2. Use as a limited commercial aviation facility might be made compatible with the existing land uses, providing a number of specific conditions are imposed and adhered to.

If the decision is made to utilize Oxnard Air Force Base for any kind of future jet operations, the following precautions should be taken:

1. A commitment should be made to a limiting noise ceiling which will not be exceeded during the life of the airport. That is, a given position of the annual CNEL 60 and 55 contours should be established and drawn on a map, and a commitment made not to exceed that position. This limiting noise impact boundary should be drawn such that it is compatible with existing land uses; that is, the CNEL 60 boundary should not enclose existing residential communities; nor the CNEL 55 boundary, existing schools. This form of noise ceiling takes the form of a performance specification for the airport, allowing the maximum flexibility for admission of new aircraft types provided the noise ceiling is complied with.

2. The foregoing commitment should be made permanently binding upon the airport proprietor so that it cannot be changed by subsequent administrations. For example, it might be written in the form of a deed restriction when the property is conveyed to the County (as has already been suggested), and it should be a part of the application for any permits or funding requested from the state or federal government.

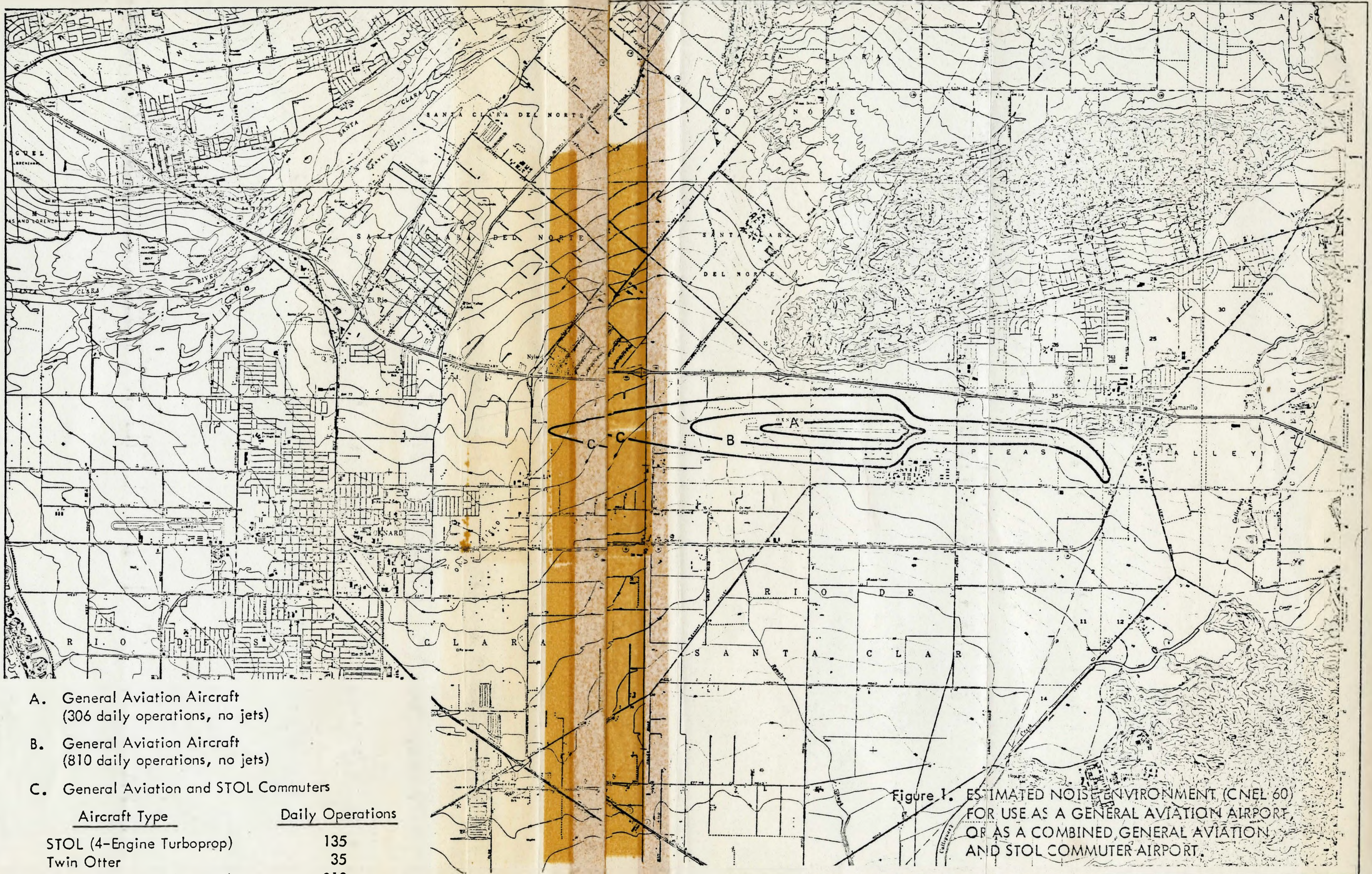
3. Land use controls should be placed into effect in the vicinity of the airport, within the above committed ceiling noise impact boundaries, in accordance with the guidelines recommended in Appendix B. This will require the cooperation of local city

and county governments concerned, probably through the mechanism of an airport land use commission.

4. Simultaneously with the admission of jet aircraft, the airport proprietor should acquire, install and continuously operate a noise monitoring system capable of measuring CNEL. In particular, this system should confirm the location of the annual CNEL 60 and 55 contours in those regions associated with inhabited areas of Oxnard and South Camarillo. The airport proprietor should also adopt single-event noise limits for his airport and utilize them (in conjunction with his noise monitoring system and his legal powers as an airport proprietor) to limit the noise environment generated by the airport and to exclude nonconforming aircraft. The data from the monitoring system should be made available to interested citizens upon request.

5. At the earliest opportunity (i.e., when jet aircraft and the monitoring system are available), measured annual CNEL contours should be compared against estimated contours for the same operating conditions. From this comparison, effects of local terrain and meteorology can be included in corrections to the estimation procedure, which the airport proprietor can then use to plan his operations so as to remain within the noise ceiling of the airport.

6. It is further recommended that night jet operations (10:00 p.m. to 7:00 a.m.), night jet engine ground runups without adequate runup suppressors, and eastward takeoffs of jet aircraft be prohibited at the proposed Camarillo Airport.



A. General Aviation Aircraft (306 daily operations, no jets)

B. General Aviation Aircraft (810 daily operations, no jets)

C. General Aviation and STOL Commuters

Aircraft Type	Daily Operations
STOL (4-Engine Turboprop)	135
Twin Otter	35
General Aviation (non-jet)	810

Figure 1. ESTIMATED NOISE ENVIRONMENT (CNEL 60) FOR USE AS A GENERAL AVIATION AIRPORT OR AS A COMBINED GENERAL AVIATION AND STOL COMMUTER AIRPORT.

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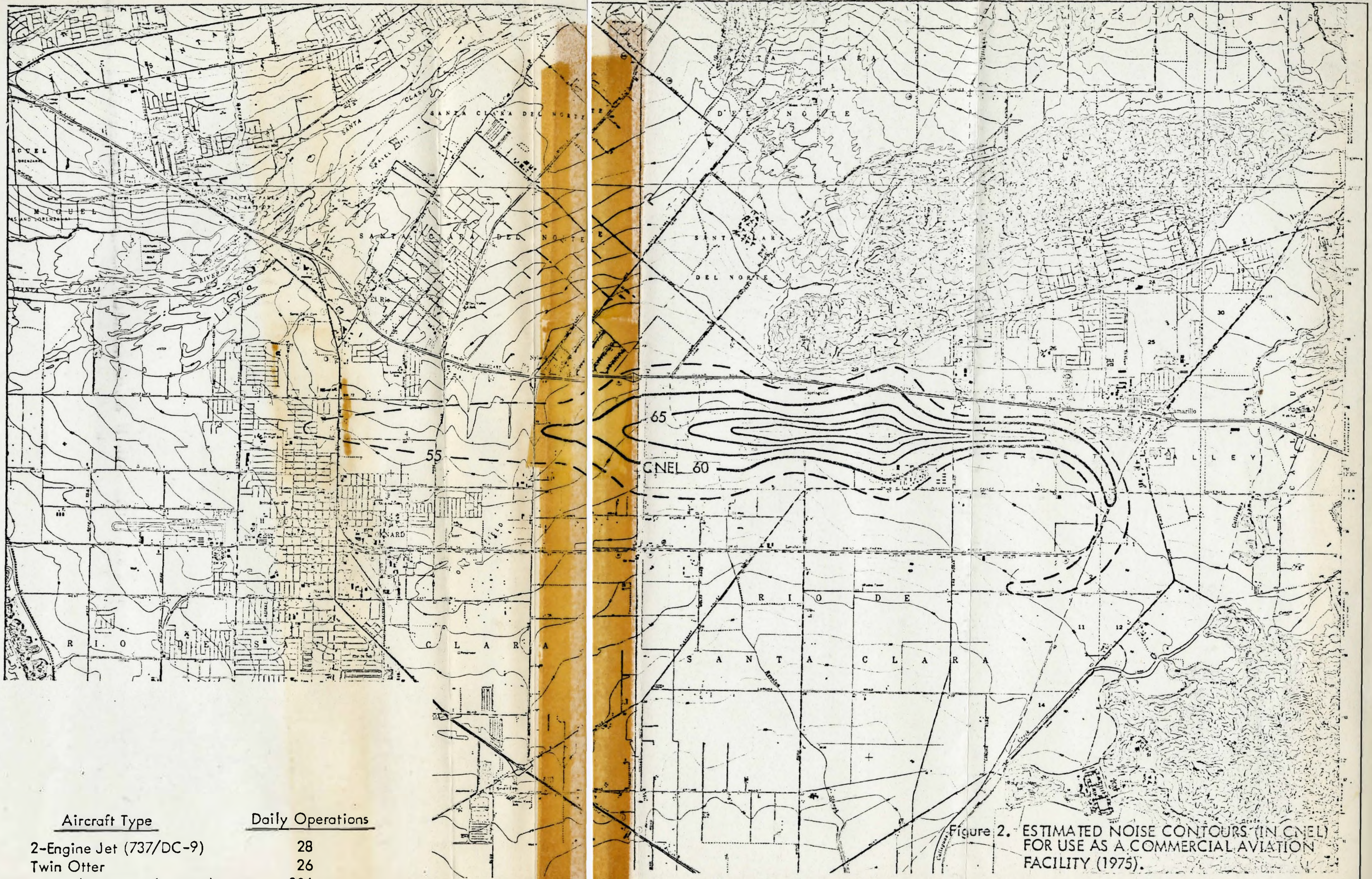

Figure 2. ESTIMATED NOISE CONTOURS (IN CNEL) FOR USE AS A COMMERCIAL AVIATION FACILITY (1975).

Aircraft Type	Daily Operations
2-Engine Jet (737/DC-9)	28
Twin Otter	26
General Aviation (non-jet)	306

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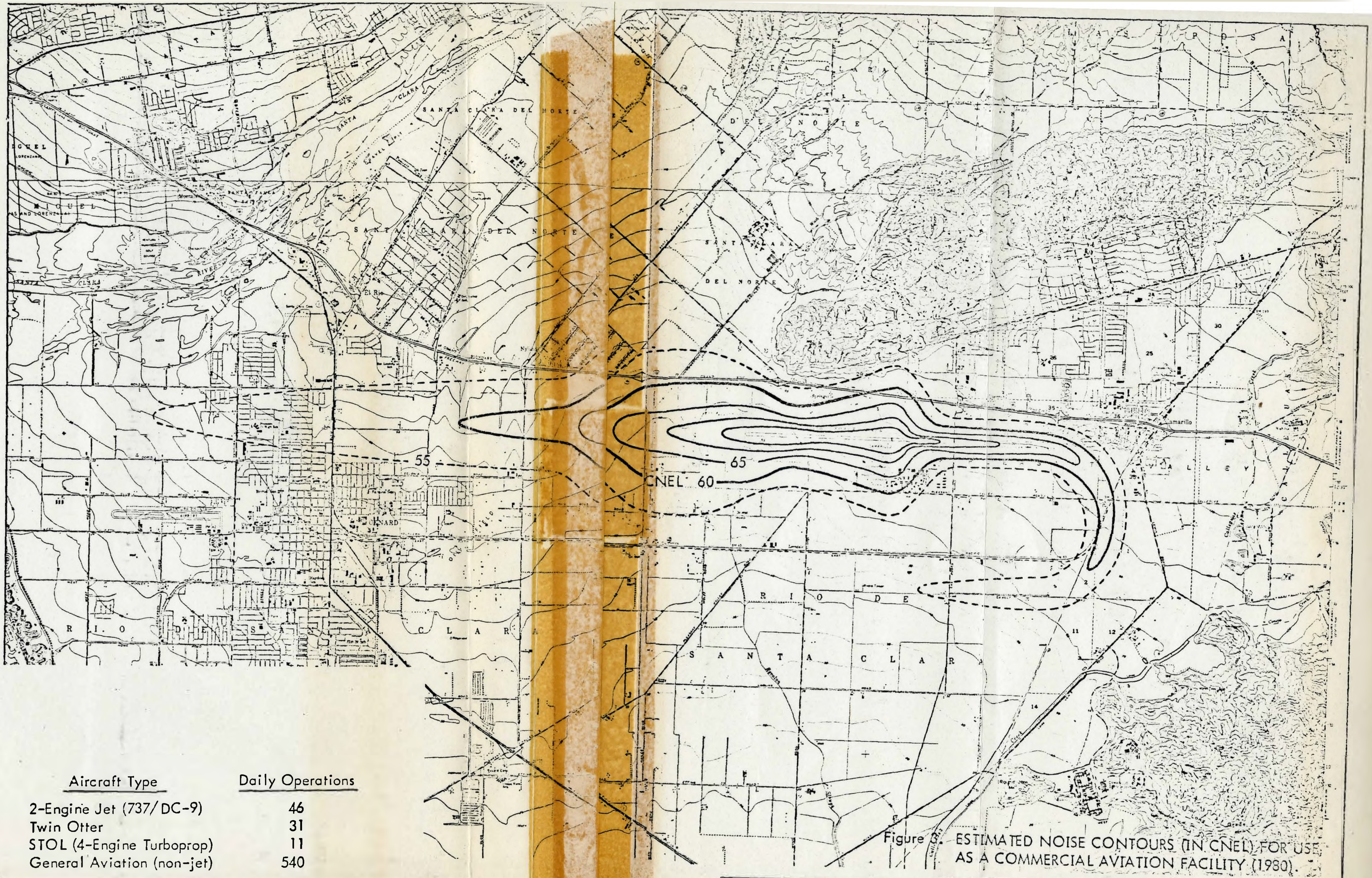

Aircraft Type	Daily Operations
2-Engine Jet (737/DC-9)	46
Twin Otter	31
STOL (4-Engine Turboprop)	11
General Aviation (non-jet)	540

Figure 3. ESTIMATED NOISE CONTOURS (IN CNEL) FOR USE AS A COMMERCIAL AVIATION FACILITY (1980).

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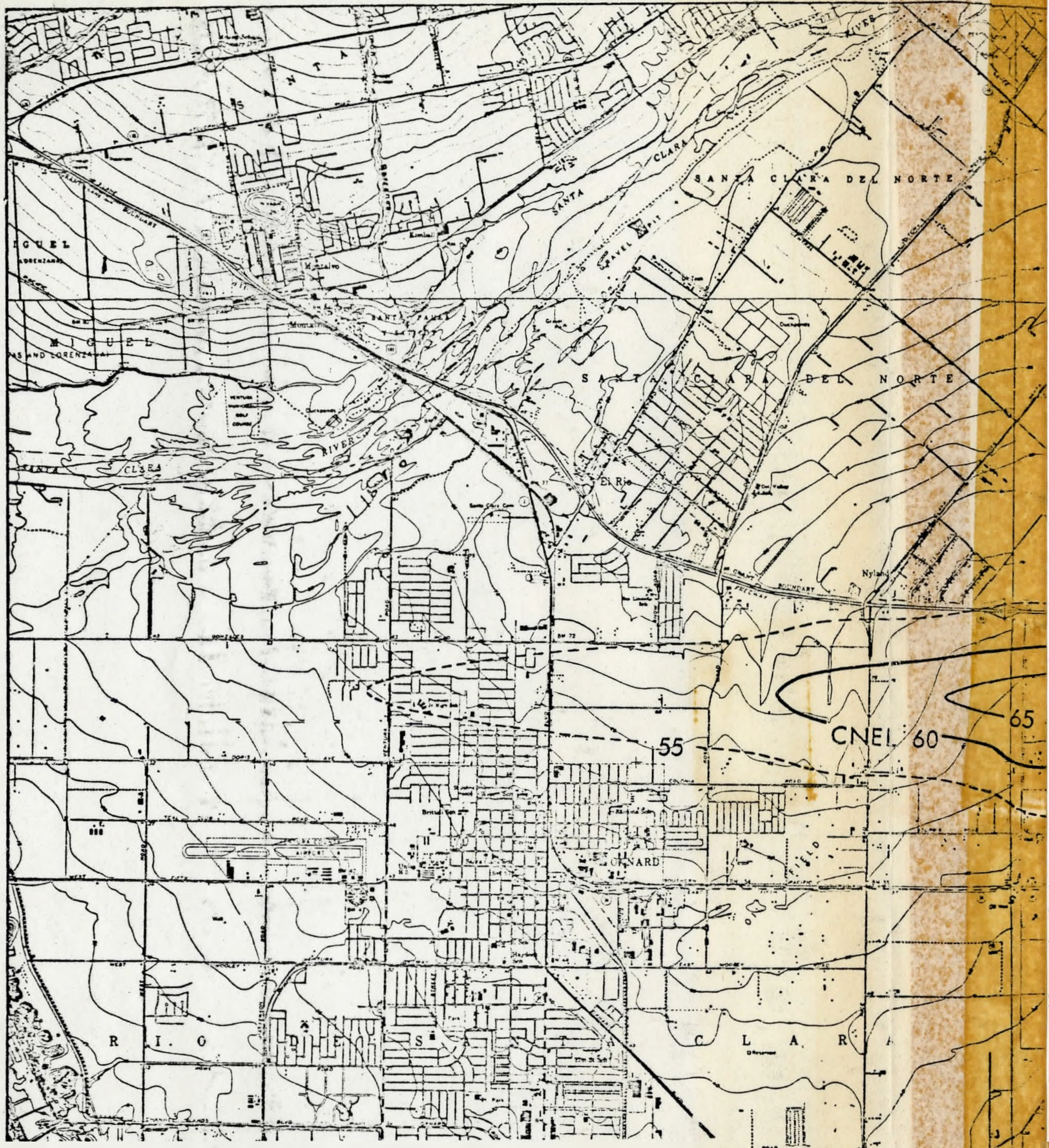

Aircraft Type	Daily Operations
2-Engine Jet (high bypass ratio)	17
2-Engine Jet (quiet engine)	17
3-Engine Jet (high bypass ratio)	9
3-Engine Jet (quiet engine)	9
Twin Otter	35
STOL (4-Engine Turboprop)	13
General Aviation (non-jet)	810

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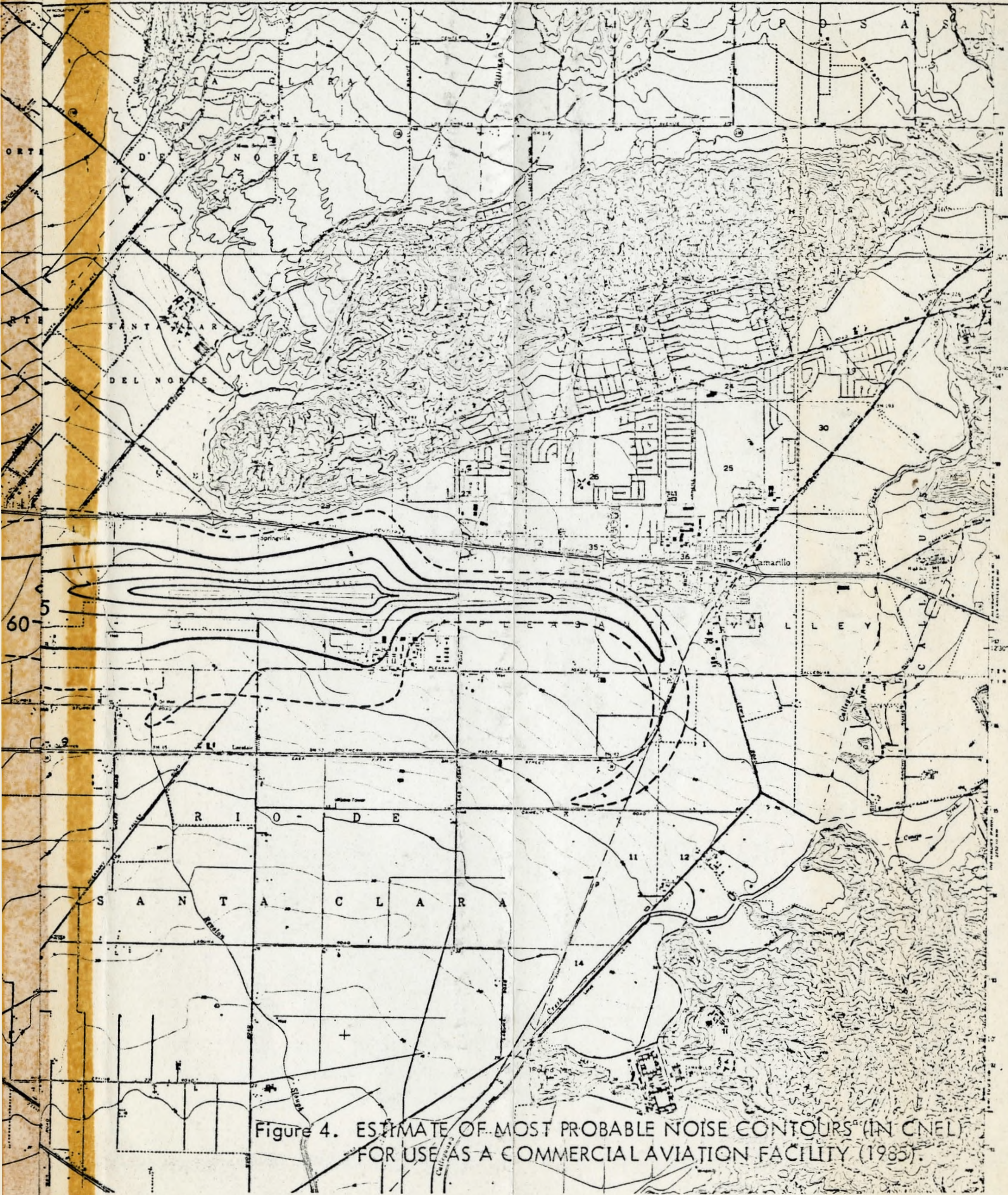

Figure 4. ESTIMATE OF MOST PROBABLE NOISE CONTOURS (IN CNEL) FOR USE AS A COMMERCIAL AVIATION FACILITY (1985).

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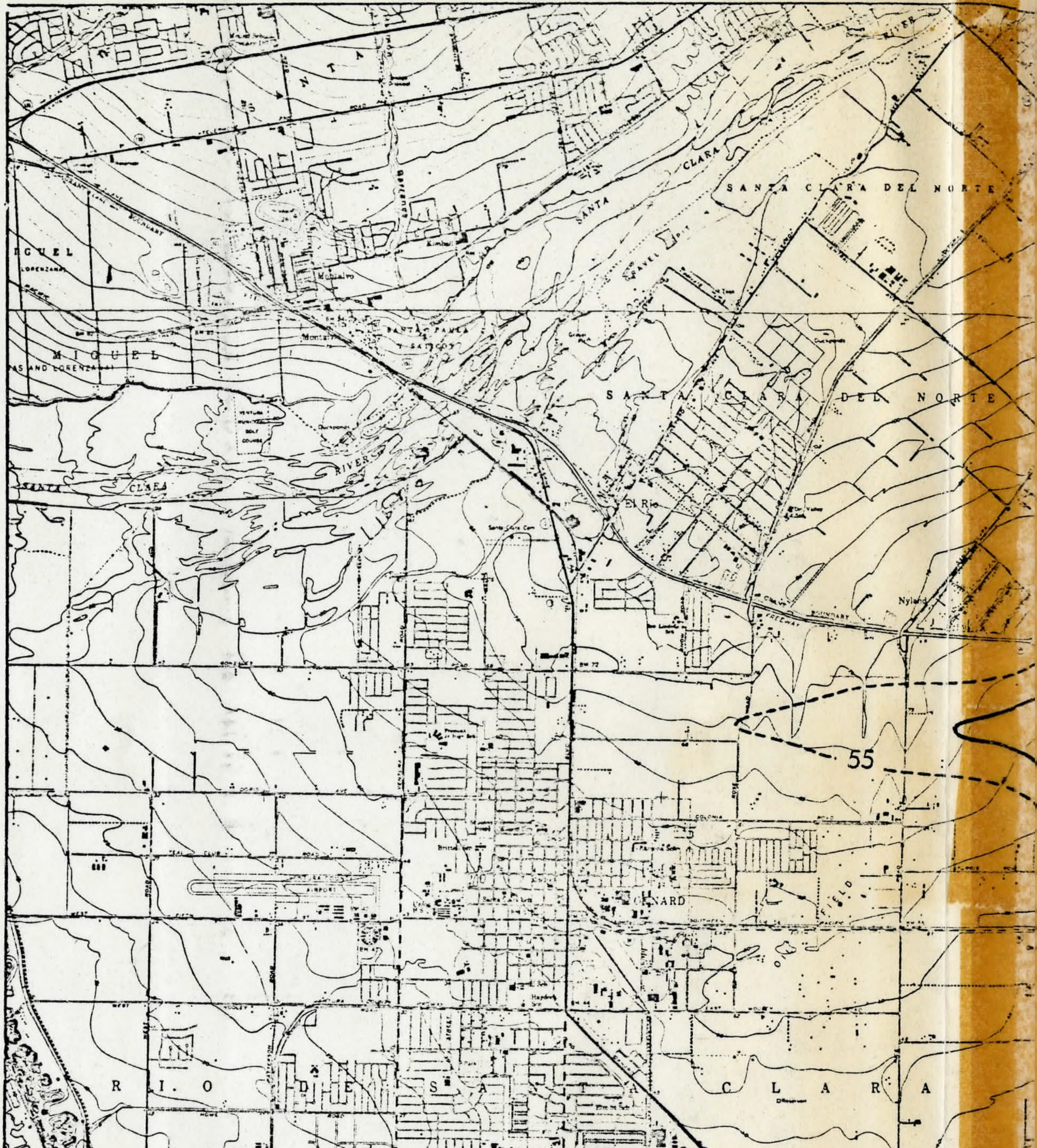

Aircraft Type	Daily Operations
2-Engine Jet (quiet engine)	34
3-Engine Jet (quiet engine)	18
Twin Otter	35
STOL (4-Engine Turboprop	13
General Aviation (non-jet)	810

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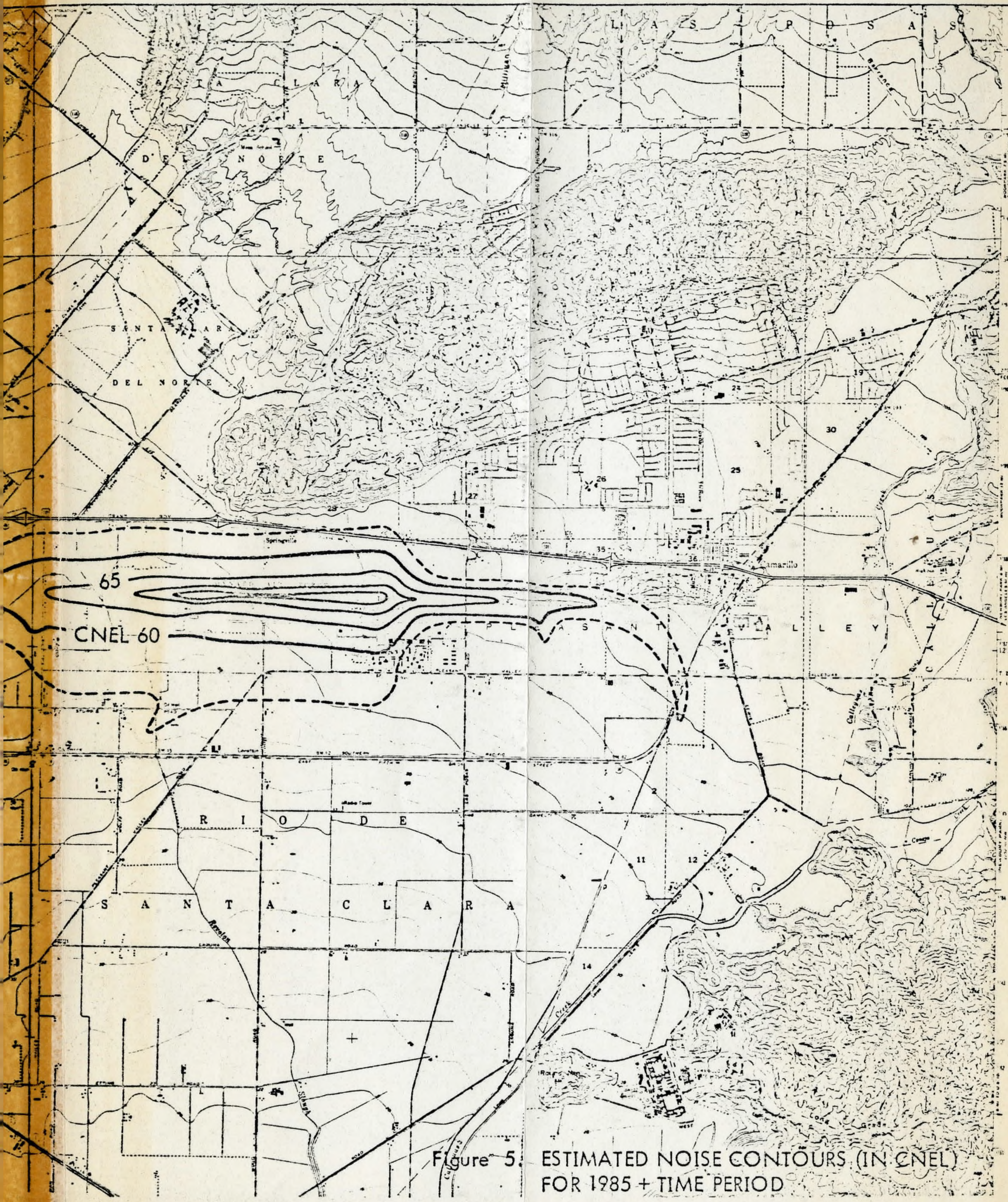

Figure 5. ESTIMATED NOISE CONTOURS (IN CNEL) FOR 1985 + TIME PERIOD

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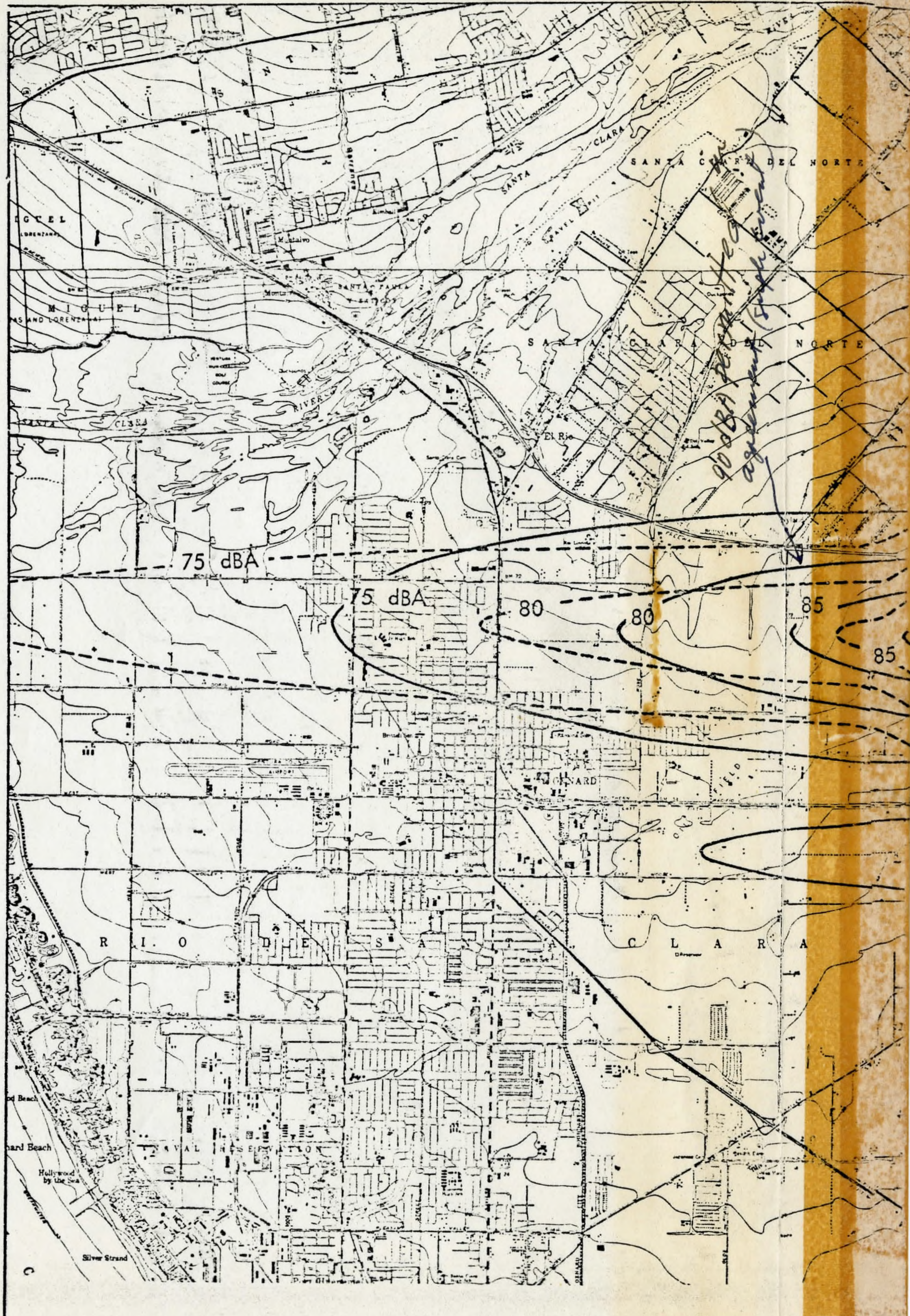

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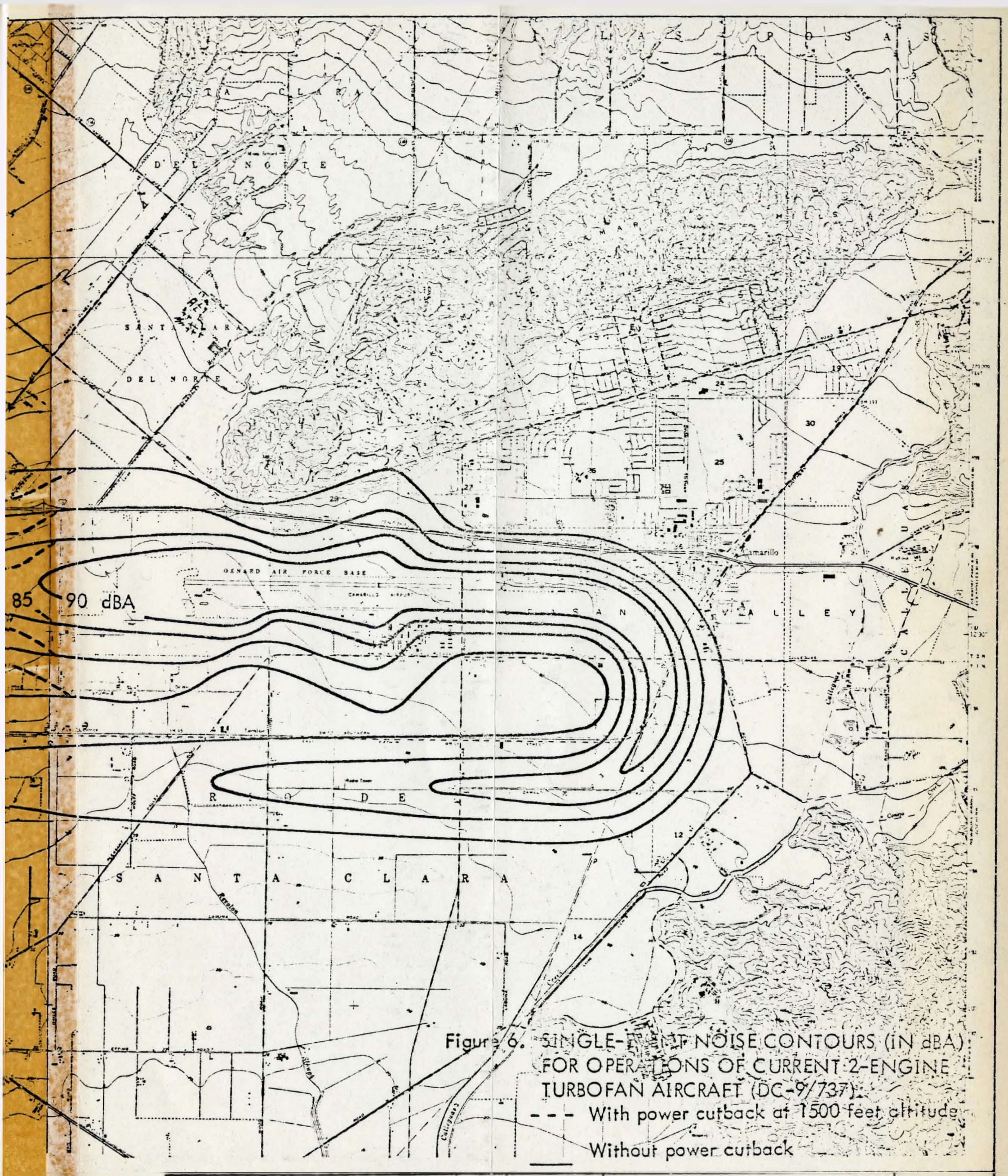

Figure 6. SINGLE-EVENT NOISE CONTOURS (IN dBA) FOR OPERATIONS OF CURRENT 2-ENGINE TURBOFAN AIRCRAFT (DC-9/737)

- - - With power cutback at 1500 feet altitude

—— Without power cutback

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Appendix A

TYPICAL CRITERIA CURRENTLY AVAILABLE AS BASES FOR SETTING NOISE LIMITS

Noise can have many effects on people's lives, particularly if the noise levels are high and the noise is present for a significant portion of the time. The most widespread direct effects of noise involve interference with activities, such as sleep, conversations, telephoning, listening to TV, radio or music, individual tasks requiring concentration, and the like. In addition, noise can be annoying in and of itself, particularly if the noise is one which could be reduced or eliminated. Field studies and observations are beginning to show secondary social effects (within the family and outside it) in areas heavily impacted by extreme noise of the kind generated by large airports and heavy vehicular traffic. The long-term effects of community noise on health are not yet fully known, but are suspected to be significant, and are beginning to be documented in a few scattered studies.

Noise which has semantic content (that is, which carries information) can constitute a loss of privacy. This loss of acoustical privacy is a major factor in most apartments and can be equally serious in sensitive office situations, such as those involving attorneys, doctors or psychologists. The direct effects of noise from other apartments can include sleep disturbance if the noise is severe enough, and the suspected indirect effects include sociological behavior patterns resulting from imposed inhibitions on family activities and from strained or non-existent relationships with one's neighbors. It is suspected that this widespread (and unnecessary) lack of privacy in apartment living may be a major contributing factor in the desire of most families for a single-family residence, and hence a contributor to urban sprawl and its associated compounding effects on the urban environment. Criteria for speech privacy exist and are often applied in the design of offices, but are not further discussed since the emphasis here is on limitation of aircraft noise exposure.

To be useful in the setting of design limits, the effects of noise on people must be quantified. There are three basic categories of quantitative information which may be utilized as input to the setting of noise limits: (1) the direct "human factors" bases, resulting from data that can be measured and hence may uncover effects of which the people themselves are unaware, (2) community annoyance data collected from interview surveys with people living in known (measured) noise environments, and (3) complaint and community reaction data and case histories. These three bases are briefly reviewed below. The evidence for these kinds of bases for noise limitation comes from laboratory research, field studies and collected case histories, and there is a vast literature on the subject. The portion referenced here is typical of the results reported in that literature and is presented to provide the reader with an introduction to the foundation upon which noise limits can be based.

1. HUMAN FACTORS BASES FOR NOISE LIMITS

The effects which have thus far been quantified to a degree sufficient for their consideration in the process of setting noise limits are: (1) sleep disturbance effects, (2) interference with speech communication, (3) physiological (measurable) stress reactions in response to noise, and (4) permanent hearing loss due to noise exposure.

a. Sleep Disturbance

Noise can disturb sleep even without completely awakening the sleeper. Noise which is not sufficient to arouse the subject may impair the quality of sleep by shifting him from a deeper stage of sleep to a shallower stage, or by depriving him of a sufficient amount of the portion of the sleep period which is connected with dreaming and which is thought to be most important for rest.

The effects of noise on sleep have been observed by studying the subject's brain wave patterns with an electroencephalogram (EEG). A number of laboratory experiments have been done using this technique, some using artificial and steady sounds as the disturbing noise, and others using transient sounds (such as aircraft flyby noise and truck noise) more typical of the sounds experienced in residential communities. Other laboratory experiments have been performed in which actual awakening of the subjects was the only means of observing sleep disturbance effects of the noise. Results of several of the better documented studies are described in References 1 through 4 and summarized in Reference 5. There are some inconsistencies (and a wide data scatter) among the results of the sleep experiments, and these are likely a result of differences in age of subjects, background noise level during the experiment or such other parameters as may have strong effect upon the results but were not always reported. More definitive research will be needed before these discrepancies can be resolved.

Further information on sleep disturbance by noise (particularly aircraft noise) comes from community annoyance surveys in which each person is asked to complete a detailed questionnaire (including questions on how frequently he is kept from going to sleep or is awakened by noise) and the noise characteristics of the environment are also measured. The results of the sociological survey are then analyzed against the known characteristics of the noise environment as determined from an acoustical measurement survey. A number of such survey results are available: (1) from studies around military air bases, some of which are reported in References 6 through 11 and which led to the development of annoyance prediction guides and land use planning guides in the late 1950's, References 12 and 13; (2) from studies in Europe on aircraft noise and traffic noise (e.g., References 14 through 18); and (3) from a small sample obtained in the course of a project in the soundproofing of homes around Los Angeles International Airport (Reference 19).

By combining the results of all the sleep-related results from the foregoing field studies and experiments, and in spite of the scatter in the data, it becomes apparent that more noise disturbs the sleep of more people in a generally increasing way. It appears that a significantfraction of the population (20 percent or more) may suffer some form of sleep disturbance if the level of intruding noises in their bedroom exceeds 45 dBA, and that restriction of noise in sleeping areas to levels even as low as 35 dBA would be a desirable goal.

While a direct connection between sleep disturbance and long-term health awaits scientific demonstration, it is logical to believe that repeated exposures to sleep-disturbing levels of noise may well lead to health effects and should be avoided. The sleep disturbance criterion, therefore, should play an important role in setting indoor limits for residential areas at night, as well as for hospitals and hotels.

b. Interference with Speech Communication

Noise can interfere with speech communication by preventing one's hearing some of the words or sentences being communicated. The subject of speech communication includes direct communication between speaker and listener (such as conversation and classroom lectures) and includes listening to television or radio and telephone communication.

The speech interference effects of noise have been thoroughly studied and well-documented; and criteria for designing good speech communication environments have been a standard tool of acousticians and architects for many years in the design of offices, classrooms, auditoria, et cetera. The criteria which have been developed are expressed in terms of the "speech interference level" (SIL) of the interfering noise. The range of frequencies most important to speech communication is comprised of the three octave bands centered at 500, 1000, and 2000 Hertz; and the magnitude of a noise can be expressed in dB (SIL): the average of the octave band sound pressure levels in those three octave bands.

The ability of a speaker and listener to continue good communication in spite of an interfering noise depends not only on the magnitude and tonal characteristics of the noise but also on the voice colume the speaker is using and on the distance between the listener and speaker. Standard curves have been published, based on the accumulation of much experimental research, which show the noise limits to be set for various speaker-listener distances. The limits corresponding to the case where the speaker is using a normal voice level (as opposed to a raised voice) have been extracted from Reference 20 and shown in Table 1. The precise conversion from dB (SIL) to dBA depends on the spectrum of the sound in question, and the numbers in Table 1 are for sounds for which the sound level in dBA is about 7 dB higher than the sound level in dB (SIL), a good approximation for many aircraft and motor vehicle sounds.

From information on typical speaker-listener distances in the rooms involved (such as living rooms, family rooms or classrooms), a noise limit can be set which provides for good, uninterrupted speech communication. In general, a typical listener-speaker distance in homes and offices does not exceed 10 feet for a normal conversation, and one would therefore tend to limit the level of any frequently-occurring interfering noise to 56 dBA or less in homes and offices. For classrooms, where the distance between a teacher and a classroom of listening students will be greater but the teacher will be using a raised voice rather than a conversational tone, the standard acoustical design limit for continuous interfering noise has been 45 dB (SIL), which corresponds roughly to 52 dBA.

TABLE 1

NOISE LEVELS THAT BARELY PERMIT RELIABLE CONVERSATION AT VARIOUS DISTANCES AND A NORMAL VOICE LEVEL

Distance Between Speaker and Listener Feet	Level of the Interfering Noise dBA
1	75
2	70
3	66
4	64
5	62
6	60
10	56
20	50

The speech interference level criterion forms a basis for the setting of limits which is extremely important in homes during the daytime, in offices and commercial buildings, and in schools, since it constitutes the most restrictive limit for daytime activities for those uses.

c. Physiological Stress Reactions to Noise

There have been a number of experiments reported on the ability of noise to produce measurable physiological stress reactions. These stress reactions derive from a widespread activation of the autonomic nervous system, resulting in changes in salivation, gastric activity, heart rate, respiration rate, blood vessel diameter, pupil size and sweat gland activity. Experiments to establish some of the kinds of stress reactions which can be induced in animals and humans by exposure to excessive noise are typified by References 21 through 27; and specifically by exposure to aircraft noise, by Reference 34.

Many of the experiments have used stimulus sounds at levels well above those which ordinarily occur in residential areas, offices or schools --- even those in communities adjacent to airports. However, the indications of the experiments at noise levels more ordinary to everyday experience do reinforce the (lower) levels required for a good speech communication environment. Jansen has tentatively concluded from his own experiments (Reference 2) that the threshold of stress response is at about 65 dBA and becomes pronounced at 80 to 85 dBA. The region of 80 to 85 dBA, incidentally, corresponds approximately to the threshold level at which temporary hearing loss can occur in some persons.

With regard to long-term health, it is not yet possible to be sure what effects such stress reactions may have, particularly in the context of the total stress-inducing environment present in urban living. The few scattered attempts to gain insight into this question, however, have produced results which would encourage conservatism in the setting of noise limits. For example, a Swedish study of traffic noise (Reference 17) has shown that symptoms such as headache, insomnia, and nervousness are associated with noise exposure to such an extent that the degree of subjective annoyance reported by the residents can be used as a reliable measure of the noise environment itself. An even more important study, in relation to the question of effects of aircraft noise on long-term health, is reported in Reference 34 and discussed in more detail in Section 4, below.

The question of psychological effects has been raised by a British study (Reference 28) which implicated noise as a possible factor in increased rates of admission to mental hospitals. In this study, such factors as age, sex, marital status, population density, and socioeconomic status were reasonably well controlled, and the study (covering two years of admissions to a psychiatric hospital) showed significantly higher rates of admission from inside an area of maximum noise near London's Heathrow Airport than outside that area.

Finally, there is reason to suspect that periods of exposure to stress (including noise as a stressor) may temporarily alter the subject's resistance to infectious disease, Reference 29.

Until such issues as these are answered definitively, conservatism is warranted in setting design noise limits for urban environments. For this reason, it is fortunate that the stress-related criteria we would expect to emerge in the future are not as restrictive as the sleep and speech communication criteria, which will therefore play an important role in the setting of design limits.

d. Noise-Induced Hearing Loss

Exposure to high-intensity sound can cause a temporary loss of hearing, with normal hearing acuity returning gradually after the noise ceases. If the conditions leading to temporary loss are repeated frequently enough over a period of years, some degree of permanent hearing loss will result. Some permanent loss of hearing can result from a single exposure to very extreme noise, of magnitudes never experienced by most people, such as from being too near a dynamite blast or explosion.

The combination of levels of noise and repetiveness which can cause permanent hearing loss commonly occur in the work environment of noisy industries and in the military service, but not normally in the residential and commercial regions of the urban environment, even where airports are involved. However, there is reason to question this conclusion in areas very close to at least one major, heavily-used airport in California (particularly in light of measurements of the hearing of children living around airports, Reference 34). It is believed the question will soon be answered by a comparative study of populations in terms of measured hearing performance, under an HEW grant.

The State of California and the federal government have recognized the necessity for protection of industrial workers against hearing loss, and the federal government has recently amended the Walsh-Healey Public Contracts Act (Reference 30) to require protection of industrial workers in companies that hold federal contracts of $10,000 or more. The federal regulation states that personal ear protectors must be worn whenever noise levels exceed those shown in Table 2, when measured on the A-scale of the sound level meter at slow response. The limit values are based on the assumption of a ten-year exposure of the worker to the noise environment, day in and day out.

TABLE 2

WALSH-HEALEY ACT AMENDMENT VALUES

Noise Exposure Limits

Duration per Day, Hours	Sound Level, dBA
8	90
4	95
2	100
1	105
1/4 or less	115

These limits are based on the most damaging case: A steady noise which lasts for the entire time period given in the table.

Intermittent noise, as typified by aircraft flybys or truck or motorcycle passbys, is much less able to produce a temporary shift in hearing threshold and hence much less able to produce permanent hearing loss than steady noise (Reference 31).

It would be desirable, of course, to set somewhat more restrictive limits than those in the Walsh-Healey Act (say, 5 dBA lower) to protect a larger (statistical) fraction of the population than the 50 percent on which the Act was based. Even with a 5 dBA reduction of the limits, it is very unlikely that combinations of exposure time and noise level which would exceed the hearing loss criterion exist in community noise situations. This is not necessarily true, however, in extreme noise situations such as in some discotheques, around some construction equipment and in some industrial situations.

It is apparent from these numbers that a discussion of hearing loss is purely academic in the context of setting limits for residential, commercial and most other urban areas, since criteria for speech communication and sleep would call for much lower noise limits.

2. COMMUNITY ANNOYANCE BASES FOR NOISE LIMITS

It is apparent to everyone that a more serious noise problem exists if the intruding noise occurs once every five minutes than if it only occurs, say, once every day.

However, most of the foregoing direct "human factors" bases do not provide any information on the relative importance of noise level and frequency of occurrence. Currently available evidence which brings in the effect of number of occurrences comes from (1) community annoyance surveys (in which the residents' opinions are collected by questionnaire and can be related to known properties of the noise environment they were experiencing at the time), and (2) case histories of spontaneous reactions of individuals and groups to specific (measured) community noise situations.

The first category of data source is represented by community questionnaire survey results as represented by Reference 14 through 18. This survey technique was tested and formalized by sociologists working with the Organization for Economic Cooperation and Development (OECD), Reference 32. When accompanied by noise measurement surveys of the same area in which the social survey is conducted, and compared against the distribution of complaints in the area, such community questionnaire surveys can be quite illuminating.

One of the most thoroughly documented surveys of this kind was the survey around Heathrow Airport (London), References 14 and 15, in which some 1730 persons were interviewed and their responses correlated against the specific aircraft noise environment where they lived. This environment was described in terms of a rating scale called Noise and Number Index (NNI), which is one of several existing types of composite scales which incorporate both the magnitude of the noise of each flyby and the number of flybys heard. The questionnaire technique involves a series of non-directive questions which will allow the respondent to initiate the subject of noise. Questions are asked about specific activities interfered with by the noise, how frequently this occurs and how annoying it is, and a number of other questions which taken as a group allow a total picture of how the person judges the noise environment. When the results are correlated against the noise environment, they show the trend of percentage of respondents affected in each way by varying amounts of noise exposure. The problem still remains, of course, that whoever is making the decisions of noise limits must make a value judgment on what percentage of the population is to be protected. This is an unavoidable result of the statistical differences in any measured characteristic of people, even such a relatively direct and non-subjective attribute as noise-induced hearing loss.

There is an additional research program under way (under contract to NASA) in communities surrounding some airports in the United States, and it is hoped the results will provide a significant advance in our understanding of the effects of aircraft noise in people's lives, insofar as the people themselves are able to report them on a subjective basis.

Experiments to determine the importance of frequency of occurrence on a human factors and long-term health basis are sorely needed; and the only study of which we are aware which does so in terms of direct physiological effects (Reference 34) only gives us information on two flight frequencies: 10 and 20 flights per hour.

3. COMMUNITY REACTION BASES

Community reaction data (such as complaints and law suits) are difficult to apply to the setting of noise limits unless one accepts only those data cases about which he knows all the surrounding circumstances and can interpret the meaning of the data wisely. A number of cases about which the circumstances were well-known were summarized and utilized in Reference 5.

The danger in indescriminate use of community reaction data lies in the fact that there are a number of factors which can affect the actual rate of complaints or law suits (for a given noise environment) which have nothing to do with the noise itself or with the genuine welfare of the people. These include such factors as:

a. Feelings about the effectiveness of citizen action in achieving results on any matter.

b. Perception of the noise as being (1) avoidable or arising from a non-essential activity, or (2) unavoidable or arising from an essential activity.

c. Status of other plans (as through new legislation or existing action programs of their governmental agencies) to diminish the noise.

d. Ability of the community to organize and act in concert.

e. Presence of external influences of a propagandistic nature, which may either stimulate or depress the activity level with respect to what would occur on a purely spontaneous basis.

It would be easy to cite cases exemplifying each of these factors, e.g., from past and recent experience in the Los Angeles basin, from tendencies of persons around military bases to inhibit their noise-related complaints especially in wartime, from results of the Heathrow study and from some special field experiments in Sweden.

The Heathrow study, for example, gave a picture of citizen apathy probably related to the first two foregoing factors, a. and b. When one percent of the people were registering complaints, 10 percent actually felt like doing so; and when 10 percent were complaining, 40 percent actually felt like doing so. This kind of disparity between the number of persons who feel distressed by aircraft noise and those who actually take any action (even a complaint) seems to be fairly typical in regions where the noise has been a problem for some time; it was certainly apparent in the project reported in Reference 19. One may easily observe factors a. and d. in action by comparing actions taken against aircraft noise from various socioeconomic neighborhoods in the Los Angeles basin.

The ultimate proof, however, that it is dangerous to base decisions on complaint data alone without specific knowledge of the situation and without cross-checking against all other available bases comes from a field experiment in Sweden, Reference 33. That experiment (carried out in secret and with the active cooperation of the press) was designed to test the theory that the attitudes of a population around an airport toward the noise emanating from that airport could be purposely manipulated. The degree of change was tested by comparing questionnaire survey results before and after the manipulation activity took place, and the theory was clearly verified.

With respect to the establishment of design limits for noise in urban areas, therefore, it would be far preferable to be able to base those limits on direct "human factors" kinds of information (including an improved knowledge of the long-term health implications of various noise exposures), reinforced by community annoyance survey results. In particular, the temptation to place credence in the lack of a large number of complaints in a given area at a given time as an indication that no noise problem exists should be assiduously avoided.

4. COMPREHENSIVE STUDIES

Thus far we know of only one study where the effects of aircraft noise on population have been studied simultaneously by several of the foregoing approaches and the results integrated to formulate conclusions on the setting of noise limits around airports. This was a study in the USSR, Reference 34, which contained the following elements:

a. Measurements were made of the noise at ground level around nine (unidentified) airports utilized by all the main types of Soviet civil aircraft, including turbojet, turboprop and piston-engine powered transport aircraft.

b. The subjective reaction of the populations surrounding the airports were studied by sociological survey (questionnaire) including over 2000 persons in 22 urban and rural settlements located within 40 kilometers (approximately 25 statute miles) of the airports.

c. The research team carried out physiological tests of 15 healthy subjects in the age range 21 – 30 years, by exposing them in a soundproofed chamber to tape-recorded noise of the TU-104 turbojet transport aircraft at 60, 70, 80 and 90 dBA for 10 and 20 flights per hour. The physiological effects of the noise were studied by direct measurement of brain waves, pulse rate and pulse wave amplitude. Aircraft noise at 60 and 70 dBA was found to have no effect, while 80 dBA produced slight effects and 90 dBA produced pronounced effects. Most of the effects which occurred at 90 dBA for 10 flights per hour became more pronounced at 20 flights per hour. The kinds of effects found were decreases in pulse wave amplitude (due to constriction of the blood vessels) and depression of the electric activity of the cerebral cortex which caused increases in the latent period of response to both light and sound.

d. Health statistics concerning the same populations were collected and analyzed, and it was found that those residents within 6 kilometers (approximately 3.7 statute miles) of an airport had higher incidence (by a factor of 2 to 4 times) of otorhinolaryngological diseases (otitis and auricular neuritis), cardiovascular diseases (hypertension and hypotension), nervous diseases (neuritis, asthenic states), and gastrointestinal diseases (gastric and duodenal ulcers, gastritis), especially among the young and middle-aged people. The brief summary report in the published literature, unfortunately, does not give the trend or distribution of these results as a function of the noise environment itself. We infer from their table of sound levels and distances, however, that the quoted distances are measured along the primary climb paths, from a point at the beginning of takeoff roll. These studies were carried out for the adult population (over 15 years of age) by analyzing 145,000 diagnostic cards, and for the school children (9 – 13 years of age) by clinical examination in settlements adjacent to airports and in a control settlement remote from airports.

From the combined results of all the foregoing studies, the Russian research team concluded that aircraft noise of 90 dBA is not permissible in populated areas. They further recommended maximum permissible levels be set at 85 dBA in the daytime and 75 dBA at night for populated areas.

Again, it seems intuitively apparent that health effects of the kind reported in the Russian study must be a function not only of the magnitude of sound but of the number of times (per 24-hour period) the populace is exposed to it. Certainly a sound intense enough to cause a stress reaction will have more effect on health if it occurs many times a day than if it occurs only once or twice a day. Until a more definitive answer is obtained regarding the importance of flight frequency, we would do well to use the Russian recommendations as a secondary check against the primary limit established in a composite scale such as CNEL.

Appendix F

GLOSSARY OF TERMS

The following Glossary of Terms is provided to assist the reader in discriminating among the various acoustical terms which occur in this report and those he may have seen in other literature.

SOUND PRESSURE

The sound pressure at a point in a sound field is a measure of the change in pressure from the static value (i.e., atmospheric pressure caused by the presence of the sound field. For most complex sources of sound, the sound pressure contains energy over a broad frequency range audible to humans.

SOUND PRESSURE LEVEL (SPL)

The range in sound pressures from the minimum audible sound waves to those existing in the vicinity of a modern jet airplane is greater than a factor of one million. A measure of the sound pressures is therefore more convenient on a reduced scale. Consequently, a logarithmic scale is used in which equal additions correspond to equal multiples of sound pressure; the reference pressure corresponds approximately to the minimum audible sound pressure. This is a convenient scale to use since the ear responds to sound waves in a similar manner. On such a scale, the measurement of sound pressure is termed sound pressure level (SPL), the units being decibels or dB. From what has been said above, it is bovious that the SPL also varies with frequency. It is usual, when measuring the sound pressure level of noise containing a wide range of frequencies, to measure the energy in fixed bands which cover the audible range. However, it is also possible to measure the overall sound pressure level (OASPL) of noise using a single broad frequency range instrument. This has the advantage of characterizing the sound by a single number.

A-WEIGHTED SOUND PRESSURE LEVEL

The ear does not respond equally to sounds of all frequencies, but is less efficient at low and high frequencies than it is at medium or speech range frequencies. Thus, to obtain a single number representing the sound pressure level of a noise containing a wide range of frequencies in a manner representative of the ear, it is necessary to reduce, or weight, the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound pressure level is said to be A-weighted, and the units are dBA. This is also called the Noise Level.

SOUND LEVEL METER

A sound level meter is an instrument that provides a direct reading of the sound pressure level at a particular location. It consists of a microphone and electronic amplifier together with a meter having a scale graded in dB. Using electrical filters, it is possible to directly measure the A-weighted sound pressure level with such an instrument. The meter is normally set to read with a "slow response" which provides a running average measure of the sound with an effective integration time comparable to that of the ear.

NOISE EXPOSURE LEVEL

Noise exposure level is the integrated average value, over a given period of time, of a number of different events of equal or different noise levels and durations. The integration may include weighting factors for reference durations, and the number of events during certain time periods for which people are more annoyed by noise. The single event noise exposure level (SENEL) is an integrated average noise level for a single aircraft flyby with a reference duration of 10 seconds. The community noise exposure level (CNEL) is the integrated average noise level over a 24-hour period with weighting factors for the number of events during evening and night time periods.

NOISE IMPACT BOUNDARY

The noise impact boundary around an airport is a particular noise contour within which the noise is deemed excessive for a given land use.

PERCEIVED NOISE LEVEL (PNL)

The perceived noise level (PNL) is a sound pressure level weighted so as to correspond to the subjective impression of the "noisiness" of a sound. The unit used is PNdB. The PNL scale, therefore, is a single-event scale in which the noisiness of an individual aircraft flyby can be expressed.

EFFECTIVE PERCEIVED NOISE LEVEL (EPNL)

The effective perceived noise level (EPNL) is similar to the perceived noise level but in addition includes correction terms that relate to the duration of an aircraft flyby and to the fact that there may be some discrete frequencies (such as the whine from a jet aircraft) present in the total noise. The EPNL scale is also a single-event scale in which the noisiness of an individual aircraft flyby can be expressed. It is also the scale used by the FAA in noise certification tests of new aircraft types.

COMPOSITE NOISE RATING

Composite noise rating (CNR) is a scale (analogous to CNEL) which takes account of the totality of all aircraft operations at an airport in quantifying the total aircraft noise environment. It was the earliest method for evaluating compatible land use around airports and is still in wide use by the Department of Defense in predicting noise environments around military airfields.

Basically, to calculate a CNR value one begins with a measure of the maximum noise magnitude from each aircraft flyby and adds weighting factors which sum the cumulative effect of all flights. The scale used to describe individual noise events is perceived noise level (in PNdB), the term accounting for number of flights is $10 \log_{10} N$ (where N is the number of flight operations), and each night operation counts as much as 10 daytime operations. Very approximately, the noise exposure level at a point expressed in the CNR scale will be numerically 35-37 dB higher than if expressed in the CNEL scale.

NOISE EXPOSURE FORECAST

Noise exposure forecast (NEF) is a scale (analogous to CNEL) which is used by the federal government in land use planning guides for use in connection with airports.

In the NEF scale, the basic measure of magnitude for individual noise events is the effective perceived noise level (EPNL), in units of EPNdB. This magnitude measure includes the effect of duration per event. The terms accounting for number of flights and for weighting by time period are the same as in the CNR scale. Very approximately, the noise exposure level at a point expressed in the NEF scale will be numerically about 33 dB lower than if expressed in the CNEL scale.

COMMUNITY NOISE EXPOSURE LEVEL

Community noise exposure level (CNEL) is a scale which takes account of the totality of all aircraft operations at an airport in quantifying the total noise environment. It is the scale being adopted by the State of California for use in the proposed noise regulations for airports and for the noise monitoring associated with those regulations.

In the CNEL scale, the basic measure of magnitude for individual events is the single-event noise exposure level (SENEL), see above. Weighting factors are added which sum the cumulative effect of all flights in terms of $10 \log_{10} N_c$, where N_c is the weighted number of flights per 24-hour time period. N_c is composed of the number of flights during the day (7:00 a.m. to 7:00 p.m.), plus 3 times the number during the evening (7:00 p.m. to 10:00 p.m.), plus 10 times the number at night (10:00 p.m. to 7:00 a.m.).

FLIGHT OPERATION

A flight operation is either a takeoff or a landing. Therefore, in ordinary airport operations, the number of daily departures will be half the number of daily operations.

COMPATIBLE LAND USE PLANNING

In an effort to achieve a coordinated approach for Land Use Planning in the immediate impacted area of Camarillo Airport, planning seminars were held with participation by the Planning Departments of the City of Oxnard, City of Camarillo, and the County of Ventura. As a result, it was by common agreement by all the planning entities, and with the approval of the Department of Harbors and Airports, that until operational limitations had been defined and approved by the Board of Supervisors concerning the recommendations of the environmental subcontractors and the GSA dispensation of Oxnard Air Force Base, it would be of no value to proceed with a coordinated land use planning effort. Thereupon, it was agreed that a composite drawing should be prepared to indicate the existing General Land Use Plans of the three government entities involved, with the areas of non-compatible land use indicated within the noise contours defined by Wyle Laboratories. Upon acceptance of limiting noise levels by the Board of Supervisors, the conflicting areas can then be resolved to ensure future compatible land use in the impacted airport area. By inspection of the projected noise curves developed in

Section II of this Study, it is easily seen that the predominant noise curves result from activities projected for 1975 and 1980. Based upon the application of these curves to the General Plans of Oxnard, Camarillo, and the County, one can recognize the areas of incompatibility, both as to existing land use and future land use as indicated in their General Plans. If the Board accepts the recommendations of Wyle Laboratories that no residential development should occur within the 60 CNEL sound curve and no schools nor hospitals should lie within the 55 CNEL curve, the following areas of non compatibility are defined.

For the aviation activity projected for 1975, utilizing 28 daily operations of twin engine jet aircraft, 26 operations twin turbo prop and the associated general aviation operations, an area in the southwest portion of Camarillo would be affected east of the existing runway. An existing convalescent home which is currently under construction falls approximately on the borderline of the 55 CNEL curve (see sheet 2 of two.)

For the 1980 projected aircraft operations, maximum daily operation of

46 twin engine jet aircraft, 31 operations of twin engine turbo prop, and 11 operations of four engine turbo prop aircraft, the areas of incompatibility are enlarged. The residential area indicated in the southwest portion of Camarillo would be enlarged, as would an area just north of the freeway in the western portion of Camarillo, along with the small area in northeastern Oxnard. The convalescent home, as mentioned earlier, would lie within the 55 CNEL curve, as would two existing schools in northern Oxnard and four proposed school locations depicted in their General Plan (see sheet 1 of two).

It should be noted here that there is a disparity in the planning time frame of the General Plans of the three planning entities. The General Plan for the City of Camarillo is for 1975, the General Plan for Oxnard is for the year 2000, and the Plan for the County of Ventura is one that was developed in 1966 and is now in the process of being revised.

It is then AWA's recommendation that if the Board accepts the conservative recommendations as proposed by Wyle Laboratories, that the impact area of the airport operations be applied to the curves depicted for 1975. As indicated by the noise curves for future years, the refinement of aircraft hardware to decrease existing noise levels will play a major part in the acceptability of these operating limitations. Further, these limitations would allow initiation of jet service into the airport when the passenger requirements would make it feasible, and there is sufficient lead time now to resolve the incompatible land use planning that is identified on the General Plans.

Further, it is our recommendations that no matter what limits of sound increments might be approved by the Board of Supervisors, that a noise monitoring system as proposed by Wyle Laboratories be initiated at the time jet operations at the airport would commence. By this physical measurement system the actual impacted area will be clearly defined physically, and it will then be possible for the County to live compatibly with the communities involved for the operation of Camarillo Airport as its Intrastate Commercial Aviation facility.