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A STUDY OF GENERAL AVIATION COMMUNITY NOISE IMPACT AND ANNOYANCE

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PREFACE

This report describes work performed under Contract Number NAS 1-15896 which was an exploratory effort relative to noise annoyance associated with general aviation airports. It was exploratory in the sense that noise annoyance was, for the most part, to be assessed from community reactions to actual changes in general aviation airport uses but supplemented by conventional research methods such as random sample interviews. We want to thank Judith Fiedler who was responsible for observing and categorizing data from the various community activities from which noise annoyance information was to be obtained and Ralph Finney of CH_2M-Hill's Seattle office who was helpful in selecting for study the various general aviation airports. Finally we very much want to thank Professor Avery M. Guest from the University of Washington for permitting us to reexamine interview data he had collected in 1979.

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A STUDY OF GENERAL AVIATION COMMUNITY NOISE IMPACT AND ANNOYANCE

1.0 INTRODUCTION

General aviation activities are increasing at a faster rate than any other aspect of flight transportation. For example, a five-year projection (from 1973 to 1978) for one large commercially dominated airport underestimated general aviation (aircraft weighing 12,500 lbs or less) utilization by one-half. Two times as many general aviation operations occurred over the number projected five years earlier. As a result of this rapid growth, there is interest in developing and locating new general aviation airports, expanding existing general aviation airports, and legal requirements to obtain avigation easements around various airports. However, in respect to implementing proposed changes such as locating a new general aviation airport or increasing the capacity of an existing airport, there is often much controversy with noise annoyance being cited as a major element by those in opposition. Thus, the aim of this study program is to examine "typical" general aviation airports as a method of assessing the influence of noise annoyance on the growth of general aviation activities.

The method involved the selection of three airports which were dominated by aircraft weighing 12,500 lbs or under and which were also undergoing a change relative to utilization. Also, there was interest in airports with different utilization levels so that effect of number of operations could be considered. In addition, there was interest in selecting airports with communities in the surrounding areas being exposed to aircraft operations noise. Noise annoyance response data was to be obtained from available sources. These sources would include environmental impact statements, interviews with airport managers, noise complaint information, community meetings concerned with projected changes in airport utilization, and social survey data. As a means of objectively assessing the noise impact due to aircraft operations, noise measurements and computer noise modeling determinations were obtained for each airport. Listening-quality

tape recordings were also obtained so that more controlled studies could be completed.

This report provides noise assessment data for each airport in the next section followed by a section on the community response type of data and a conclusions section.

2.0 NOISE ASSESSMENT

2.1 OLYMPIA AIRPORT

For all four airports, noise assessment included both noise modeling state-of-the-art methods, and noise measurements involving both energy summation methods (L_{eq} and L_{dn}) and individual flyover event measurements. At the Olympia Airport, due to a Master Planning Study which was completed in 1978 (Ref. 1.), projections of increased aircraft operations in future years were available and were used as part of this study in developing Integrated Noise Model (INM) contours. Noise measurement data were obtained at seven measurement positions. Summary information for the measurement points is provided in Table I. while Figure 1. gives the location of the points. Figures 2. & 3. show INM contours for 1976 based on the actual number of flights plus contours based on projections of airport use for future years and conditions. The types of aircraft and number of operations on which the contours of Figures 2. & 3. are based are given in Table II.

From the standpoint of community annoyance response to general aviation noise, the most significant measurement point is "G" which is located in the area represented by the "Save Our Community" group. As discussed in the next section, under the auspices of this action group, some 503 persons signed a petition against any changes to the airport which could lead to increased airport flight activity. Consequently a comprehensive measurement program was completed at measurement position "G" as a means of obtaining a basis for understanding the high concern with noise in this area. As shown in Table I., the energy average L_{dn} over an eight-day period was 56.6 and the mean peak dBA level based on all aircraft operations over a two-day period was 67.4 dBA. A more detailed description of noise exposure at measurement position "G" is provided in Figures 4., 5. and 6. Figure 4. gives a plot of L_{dn} for the eight days of measurements at position "G" and the twenty-four hourly L_{eq}'s for Thursday which was the first complete day that measurements were obtained. Total noise at position "G" was highest on Thursday and

TABLE I. SUMMARY INFORMATION FOR NOISE MEASUREMENT POINTS

Measurement Position	Location	Energy Summation Noise Measurements	Mean Peak dBA Measurements	Comments
A	8900 ft. from brake release	L_{eq} = 63	------	Noise due to road traffic is dominant.
B	195 ft. due East of A	L_{eq} = 67	------	As for position "A", noise is due to road traffic. "B" is greater than "A" due to being at an intersection.
C	300 ft. due West of D	Takeoff L_{eq} = 66	------	Preliminary measurement point. Did not continue since could not relate to community noise annoyance response.
D	5500 ft. from brake release.	Takeoff L_{eq} = 68	------	Same as position "C".
E	500 ft. due West from F	------	Takeoff 70.1	Shows that attenuation due to distance of 500 feet is approximately 2.5 dB.
F	1800 ft. from north end of runway	Approach Max L_{eq} = 63 Takeoff Max L_{eq} = 65	Approach 69.1 Takeoff 78.7	Assists in validating noise modeling curves. Some contribution from road noise but aircraft noise clearly dominated.
G	10,800 ft. from brake release	Takeoff Energy Average (8 days) L_{dn} = 56.6	Takeoff 67.4	Most significant measurement point relative to community response data. Detailed analyses of noise data given in Figures 4 through 6.

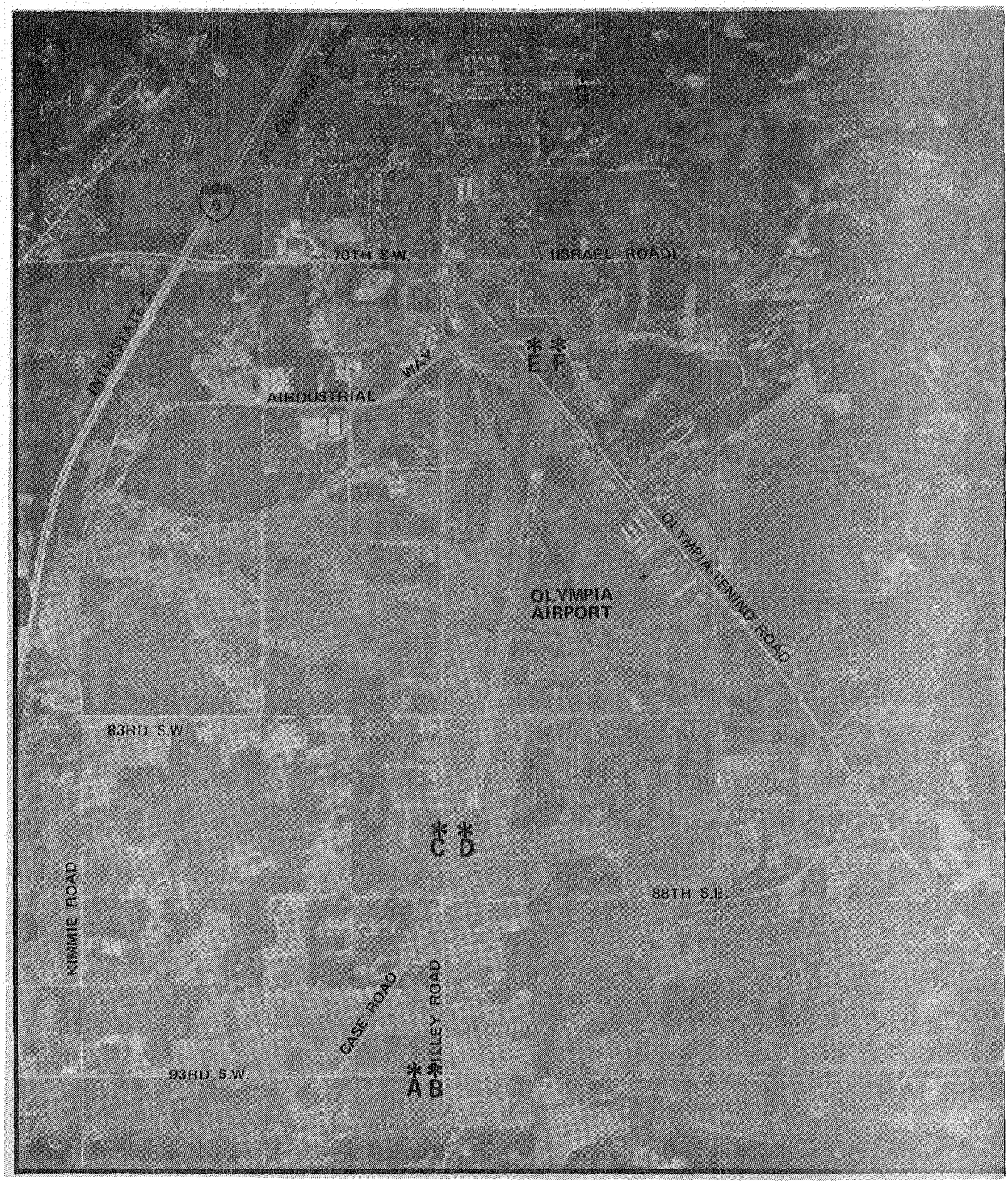


Figure 1. Location of Measurement Points at Olympia Airport

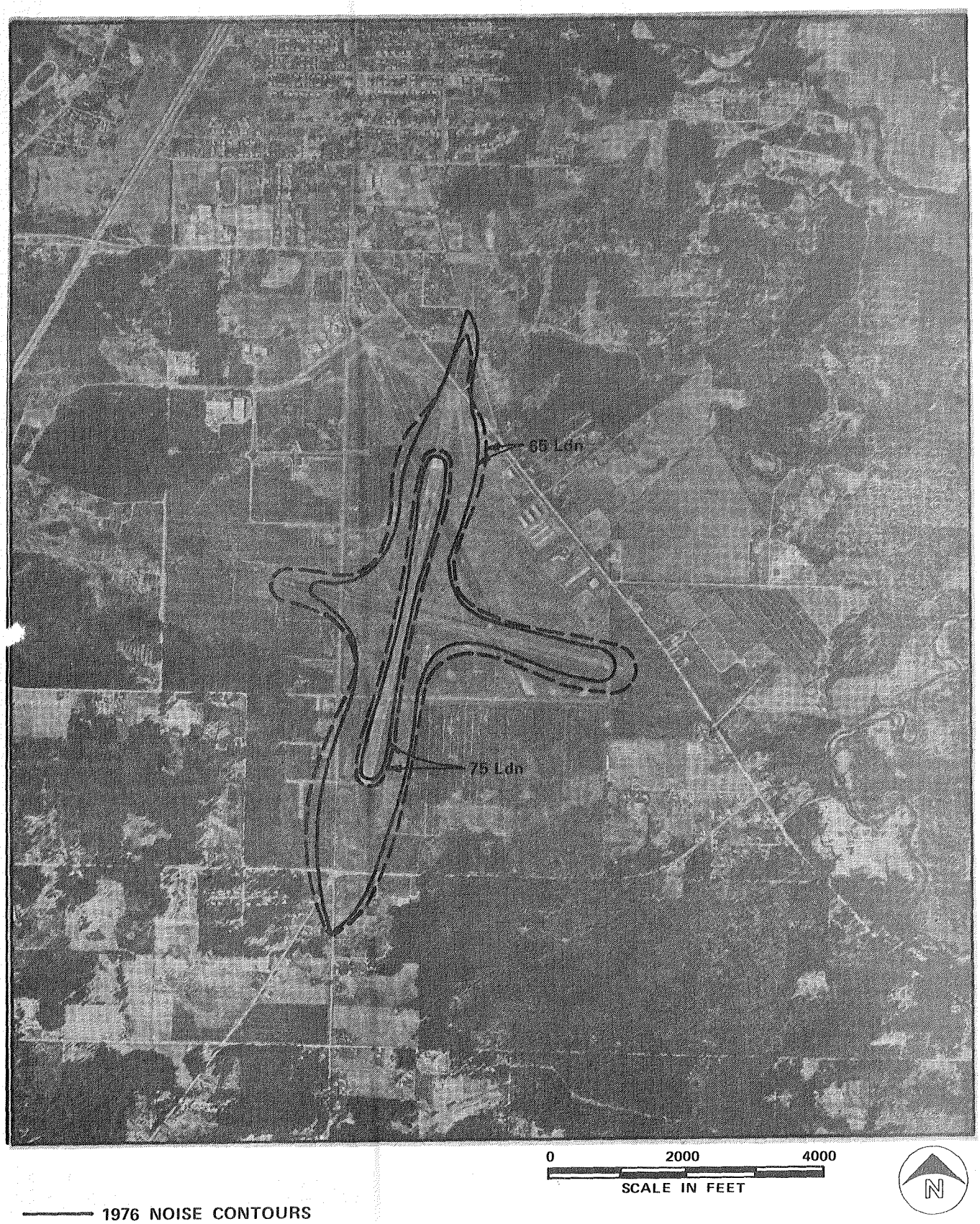


Figure 2. 1976 and 1981 (B) L_{dn} Noise Contours

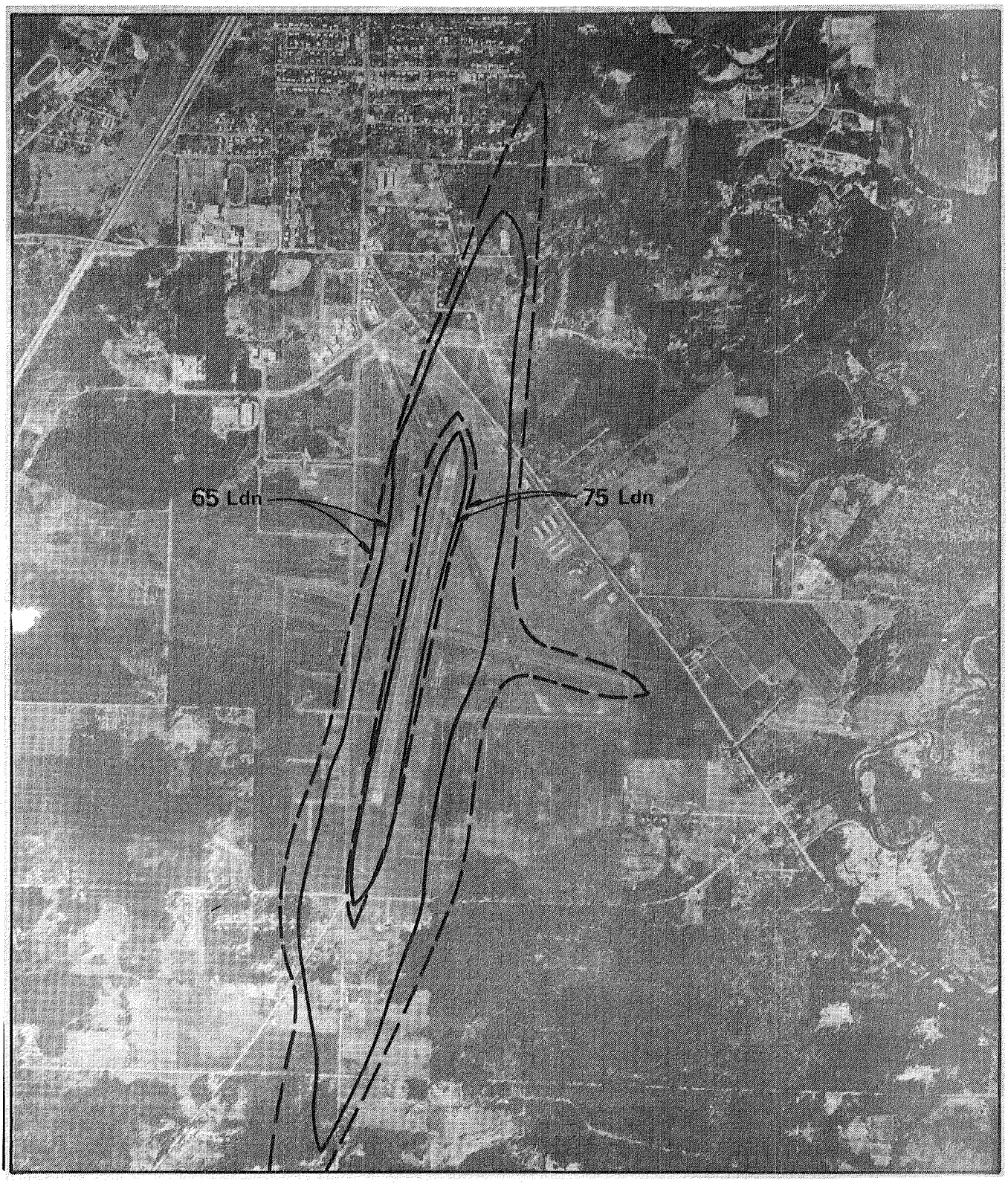
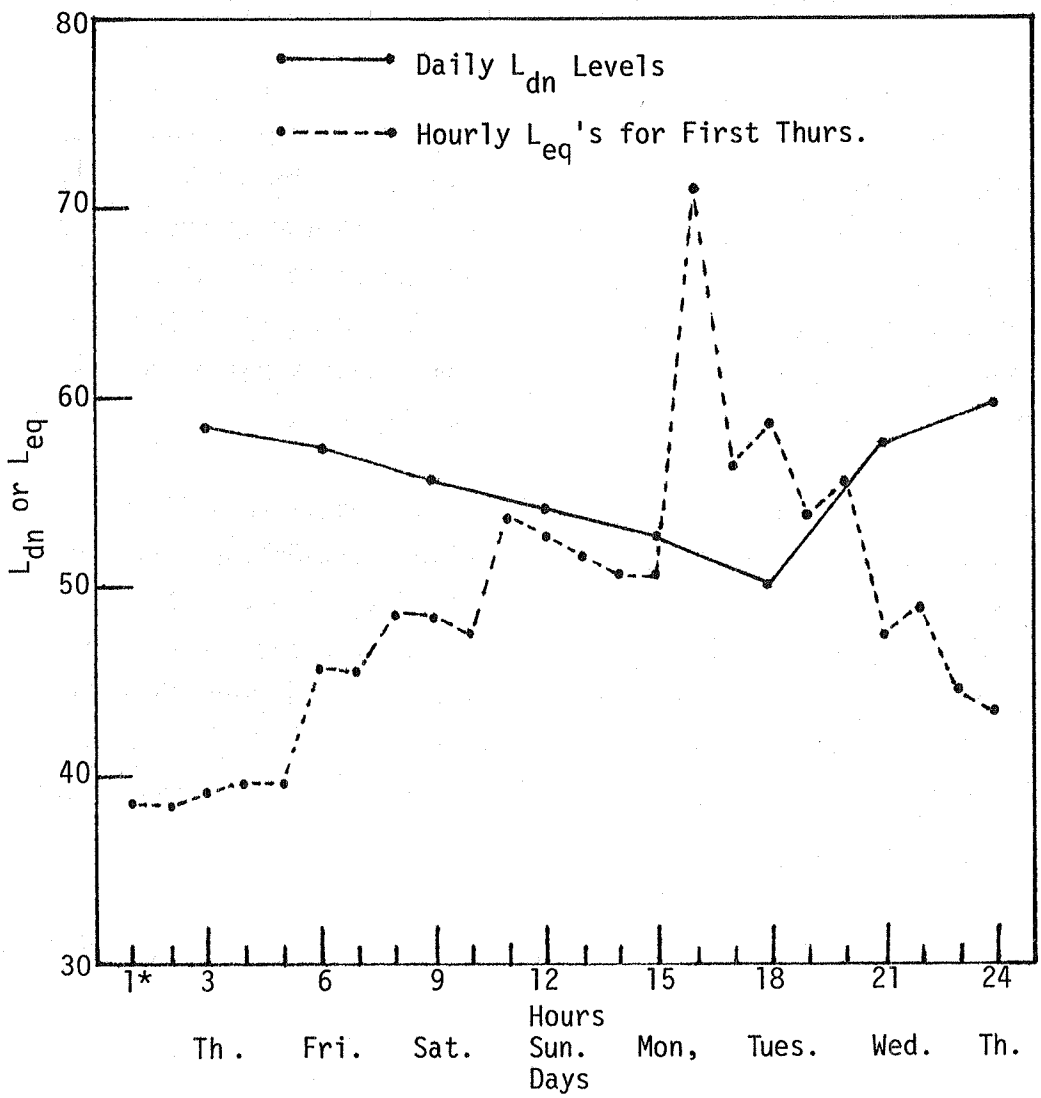


Figure 3. 1996(A) and 1996(B) L_{dn} Noise Contours

TABLE II. OLYMPIA, WASHINGTON AIRPORT SUMMARY

YEARS		1976		1981(A)		1981(B)		1996(A)		1996(B)	
TOTAL OPERATIONS/YR.		90,081		139,000		146,200		224,000		318,600	
TAKEOFFS (and APPROACHES) Per Day		123.0		190.4		200.3		306.0		435.3	
PLANE TYPES	INM Noise Curve#	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
B. DC9-15*	2	0.3	0	0	0	0	0	0.7	0.4	1.0	0.5
C. Sabre Liner**	21	12.0	0.5	14.7	0.5	15.0	0.5	29.9	1.1	42.0	1.5
D. Twin Otter	22	23.0	1.5	37.0	1.1	39.2	1.2	71.7	5.3	103.0	7.5
E. 4 Place/ 1-Engine Lgt.	25	79.0	6.5	130.0	4.2	140.0	4.3	180.0	6.7	274.0	10.0
CONTOUR AREAS (Sq.Mi.)											
65 dB		.44		.46		.49		.68		1.05	
75 dB		.06		.06		.06		.11		.14	
65 dB***		---		---		---		1.19		1.57	
75 dB***		---		---		---		.17		.23	
*For 1996(A) & (B), DC9 w/SAM Engines, N.C. #3 **For 1996(A) & (B), Cessna Citation, N.C. #29 ***For 1996(A) & (B), Sabre Liner, N.C. #21								N.C. #29 provides 43% reduction in 65 dB Contour Area		N.C. #29 provides 33% reduction in 65 dB Contour Area	

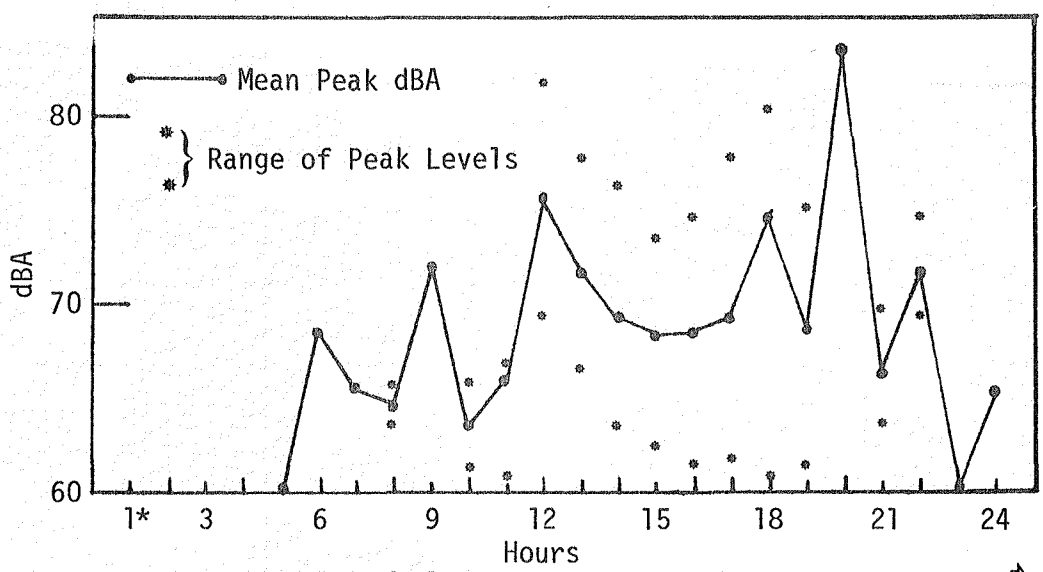


*"1" means between 12:00 and 1:00 a.m. while "17" means between 4:00 and 5:00 p.m. and so on.

Figure 4. Daily L_{dn} Values for Eight Days and Hourly L_{eq}'s for First Thursday at Measurement Position "G".

lowest on Tuesday with L_{dn}'s of 58.5 and 50.0 respectively. However, for both Thursdays part of the noise accumulated was due to the operation of a power lawn mower in the vicinity of the measurement system. The unusually high L_{eq} of 71 dBA for the 16th hour (between 3:00 and 4:00 p.m.) is due to the lawn mower noise; there were seven flyovers during this period but the L_{eq} was completely determined by non-aircraft noise which increased the L_{eq} by more than 15 dBA. Figures 5. and 6. provide mean peak dBA levels on an hourly basis along with the number of flyovers on which the means are based for the first Thursday and Sunday of the eight-day measurement period. Mean peak level for the first Thursday was 69.5 dBA based on 74 flyover events while the mean peak level on Sunday was 65.7 dBA based on 92 flyovers.

The concluding noise assessment results at the Olympia Airport involve a comparison between NEF noise modeling methodology (Ref. 1.) and L_{dn} as determined by the Integrated Noise Model (INM). The comparison is given in Figure 7. and shows that the two approaches are in no manner comparable. An L_{dn} 65 dB contour encloses more than two times the land area enclosed by the NEF 30 dB contour. As a land use planning tool, different decisions would be made as a function of which noise modeling approach was employed.

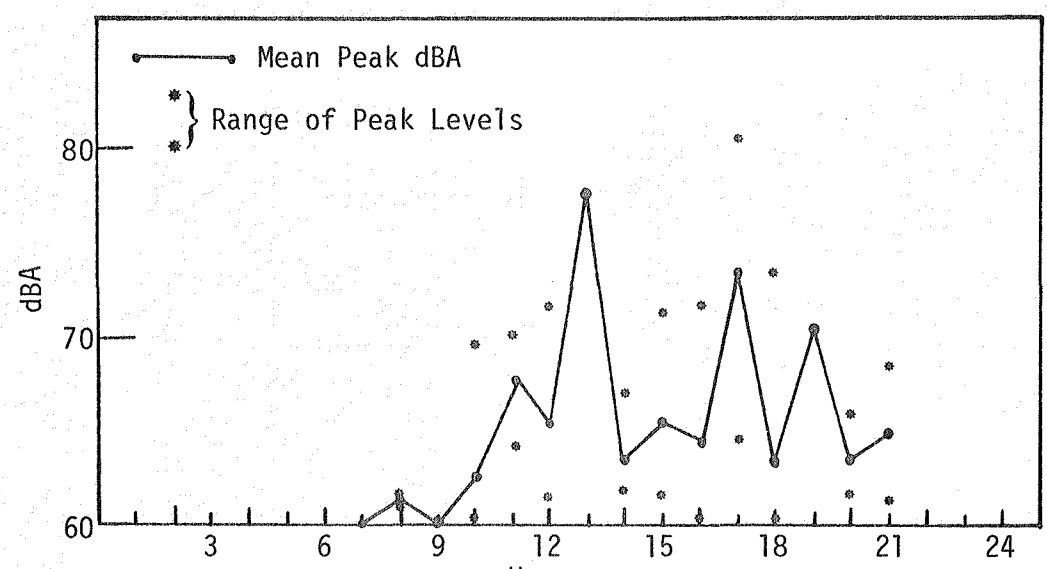


0 0 0 0 0 1 1 2 1 2 6 2 4 5 4 7 15 9 8 1 3 2 0 1 ⇨ Total for Day is 74.

Number of Flyovers Occurring Per Hour

*"1" means between 12:00 and 1:00 a.m. while "17" means between 4:00 and 5:00 p.m. and so on.

Figure 5. Mean Peak dBA Measurements by Hour for a Thursday at Measurement Position "G".



0 0 0 0 0 0 0 2 0 18 7 4 1 5 6 19 12 11 1 2 4 0 0 0 ⇨ Total for Day is 92.

Number of Flyovers Occurring Per Hour

Figure 6. Mean Peak dBA Measurements by Hour for a Sunday at Measurement Position "G"

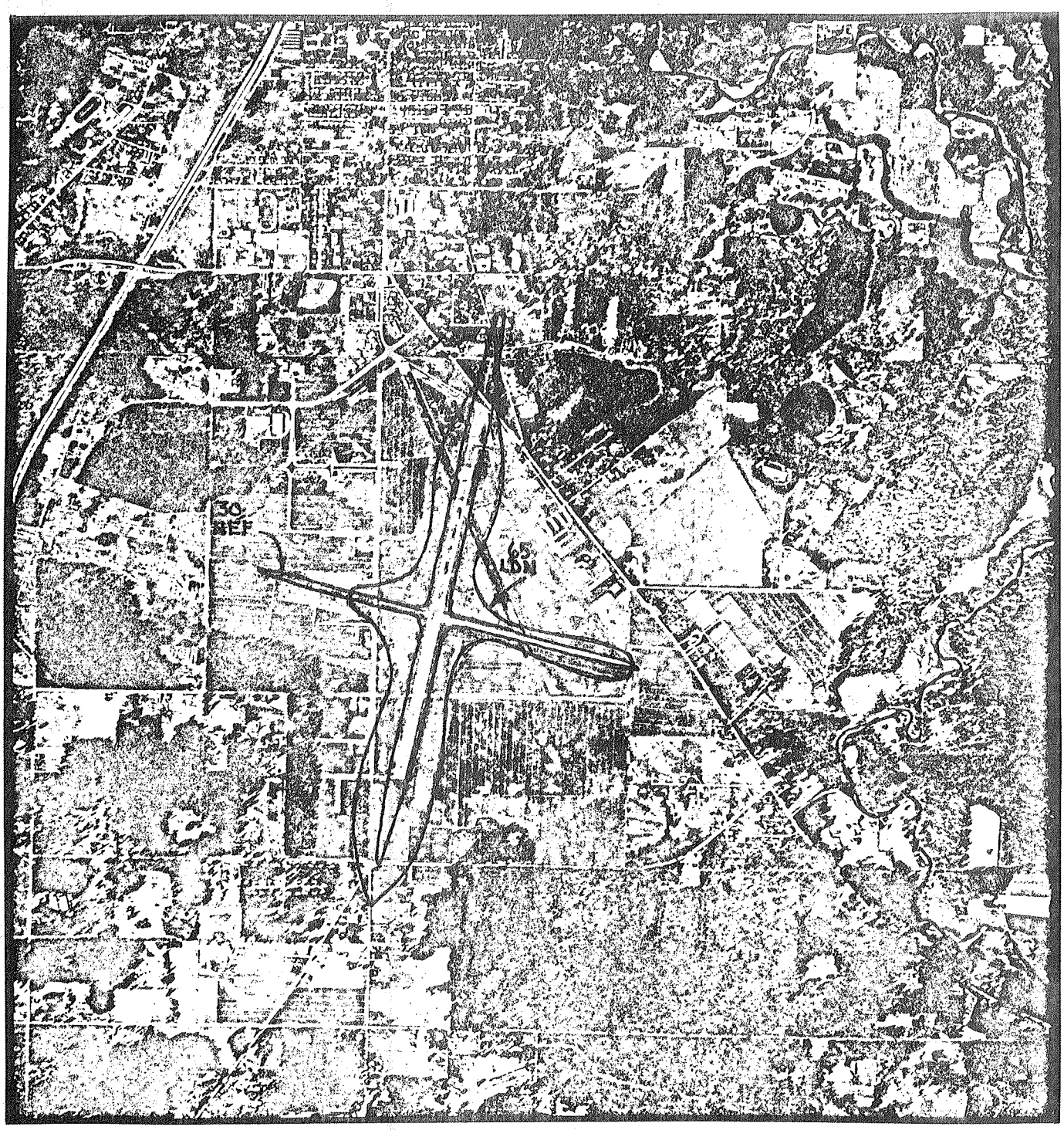


Figure 7. Comparison of L_{dn} of 65 and NEF of 30 for 1976 Operations at Olympia Airport

2.2 BELLEVUE AIRPORT

As at the Olympia Airport, both noise measurement and noise modeling determinations were utilized to assess noise impact. Five measurement positions as given in Figure 8. were used, three to the south of the airport (positions "B", "C", and "D") which were in areas from which sporadic noise complaints, including letters to government officials, had been received. Position "A", which is north and west of the runway, involved an area where previous noise assessment data (Ref. 2.) was available due to a proposal to convert the Bellevue Airport into a business park. The same situation applied for measurement position "E" which is at sideline east of the runway. Summary information for the five measurement points is given in Table III. and the points are located on the map of Figure 8. along with the 60 and 65 L_{dn} contours. In respect to the evaluations of noise assessment from aircraft flights out of this airport there are interesting contradictions from various segments of the community. There is evidence that some persons to the south of the airport rate the noise as being excessive and would prefer that the airport move to another location. There is another group making the claim that by moving the airport and replacing it with a business park, noise in the area will be reduced (particularly to the north, and east and west to sideline); this group has interest in developing the business park. Finally, there is a third group (residents around the airport to the north and at sideline) who take the position that noise from the airport has minimal or no annoyance properties for them and that they much prefer the airport over the business park. The noise assessment program of this report section and the community survey of the following section are directed to these three positions.

Measurement positions "A" and "E" provide data concerning the possibility of reducing noise impact by closing the airport and using the land for a business park. At measurement position "A", based on corrections to measured data, the estimates of L_{dn} at position "A" were 66 dBA with the airport remaining and 59 dBA if a business park were to be substituted (Ref. 2.). The authors of this report (Ref. 2.) state, "These values were obtained by comparing the measured noise levels at the test locations with data compiled

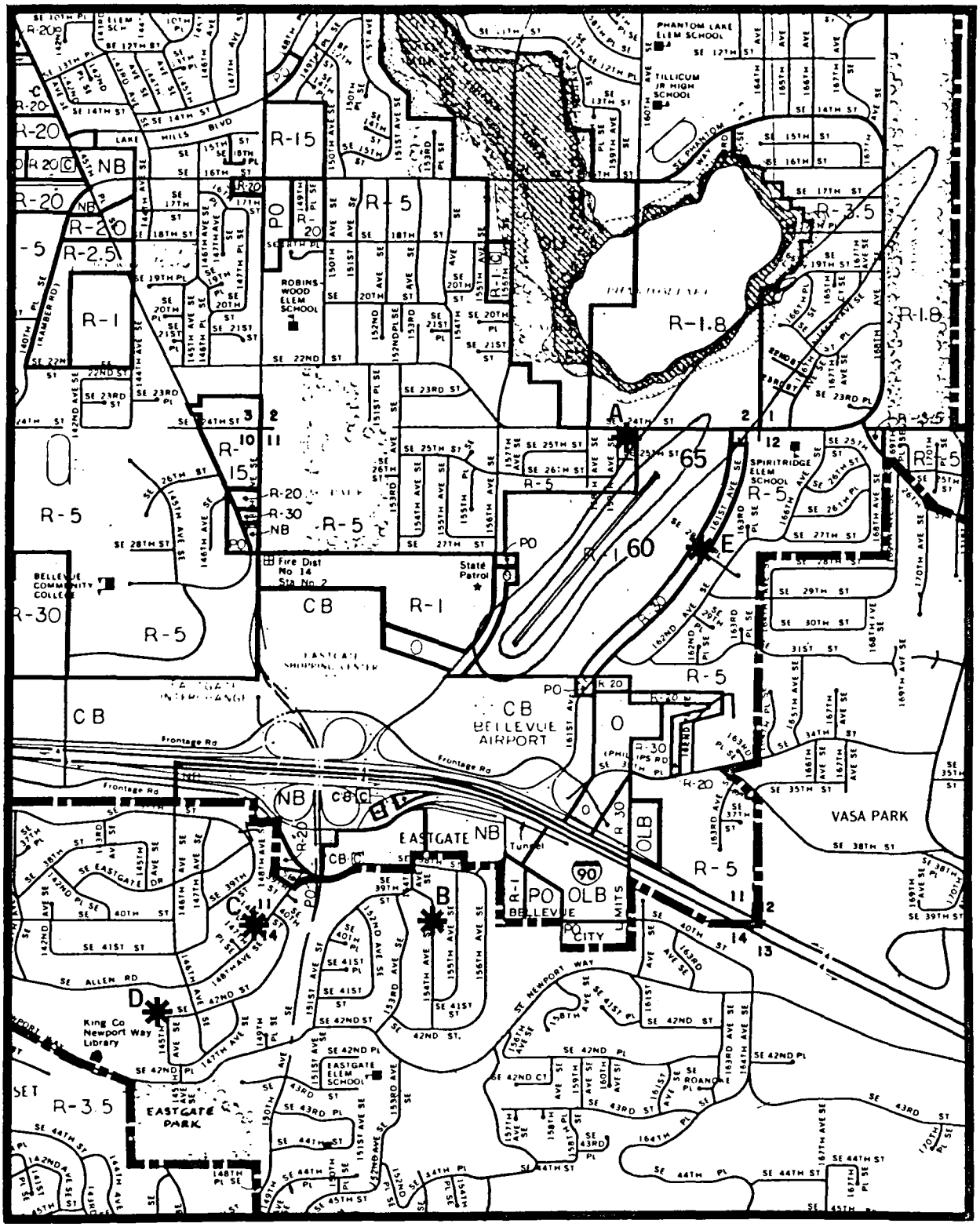


Figure 8. Location of Measurement Points at Bellevue Airport and 60 and 65 L_{dn} Contours.

TABLE III. SUMMARY INFORMATION FOR NOISE MEASUREMENT POINTS (BELLEVUE).

MEASUREMENT POSITION	*LOCATION	ENERGY SUMMATION L_{dn}	MEAN PEAK dBA MEASUREMENTS	COMMENTS
A	2490 ft 490 ft	58.3	------	Noise controversy and litigation in this area.
B	2790 ft 1590 ft	57.2	------	Some complaints from this area.
C	3390 ft 890 ft	61.0	Takeoff 76.5	Due to traffic noise, background noise ranges from 60-70 dBA.
D	6180 ft 400 ft	55.0	70.0	Quiet residential area except for aircraft.
E	2090 ft 900 ft	56.0	------	Road noise clearly dominant.

* First number of pair gives distance along centerline from the south end of the runway. Second number is distance to sideline.

by the U. S. Environmental Protection Agency for locations with similar characteristics, and applying appropriate corrections to the data." Figure 9. shows measured L_{dn} values for 21 days at measurement position "A". The L_{dn} value for any given day is considerably less than the 66 dBA estimate of Reference 2 . The measured data of Figure 9. were obtained from April 10 through May 3, 1981. The highest L_{dn} obtained was 61.4 which occurred on a Wednesday and lowest measured L_{dn} of 44.1 occurred on a Sunday when there was no flying activity due to weather. The mean measured L_{dn} for the 21 days is 58.3 dBA which is almost 8 dBA less than estimated by the firm whose employers were interested in trading the airport for a business park. Figure 10. provides a more detailed description of noise exposure at measurement position "A". Hourly L_{eq}'s are given for Thursday, Friday, Saturday, and Sunday. The L_{eq} of 68 dBA at 11:00 A.M. on Friday is primarily due to lawn mower noise. That the mean measured L_{dn} of 58.3 lies slightly outside the L_{dn} 60 dBA contour (see Figure 8.) suggests that the two methods — measurement and noise modeling based on the average operations per year — are in relatively close agreement.

Turning to noise exposure from the airport at measurement position "E", the predictions of Reference 2. were that "with aircraft", L_{dn} was 61 dBA and "without aircraft", L_{dn} was put at 59 dBA. This program did not complete an extensive measurement program at measurement point "E" as it was clear from spot peak-level measurements that airport operations were not significantly contributing to higher noise levels at this position. Traffic noise tended to mask out aircraft takeoffs and landings. Measurements were obtained using energy summation equipments from 10:00 A.M. to 2:00 P.M. when weather was clear and the airport was operating as usual. The L_{dn} from this 4-hour measurement period is 56 dBA and is due almost entirely to traffic noise. This L_{dn} of 56 is 5 dBA less than the estimate of Reference 2 . This measured L_{dn} of 56 dBA, even though it is primarily due to traffic noise, is also more consistent with the noise modeling determinations of Figure 8. than is the 61 dBA of Reference 2 . An L_{dn} of 61 dBA would be on airport property (see Figure 8.).

Measurement position "C" is not ideal as a point for assessing airport

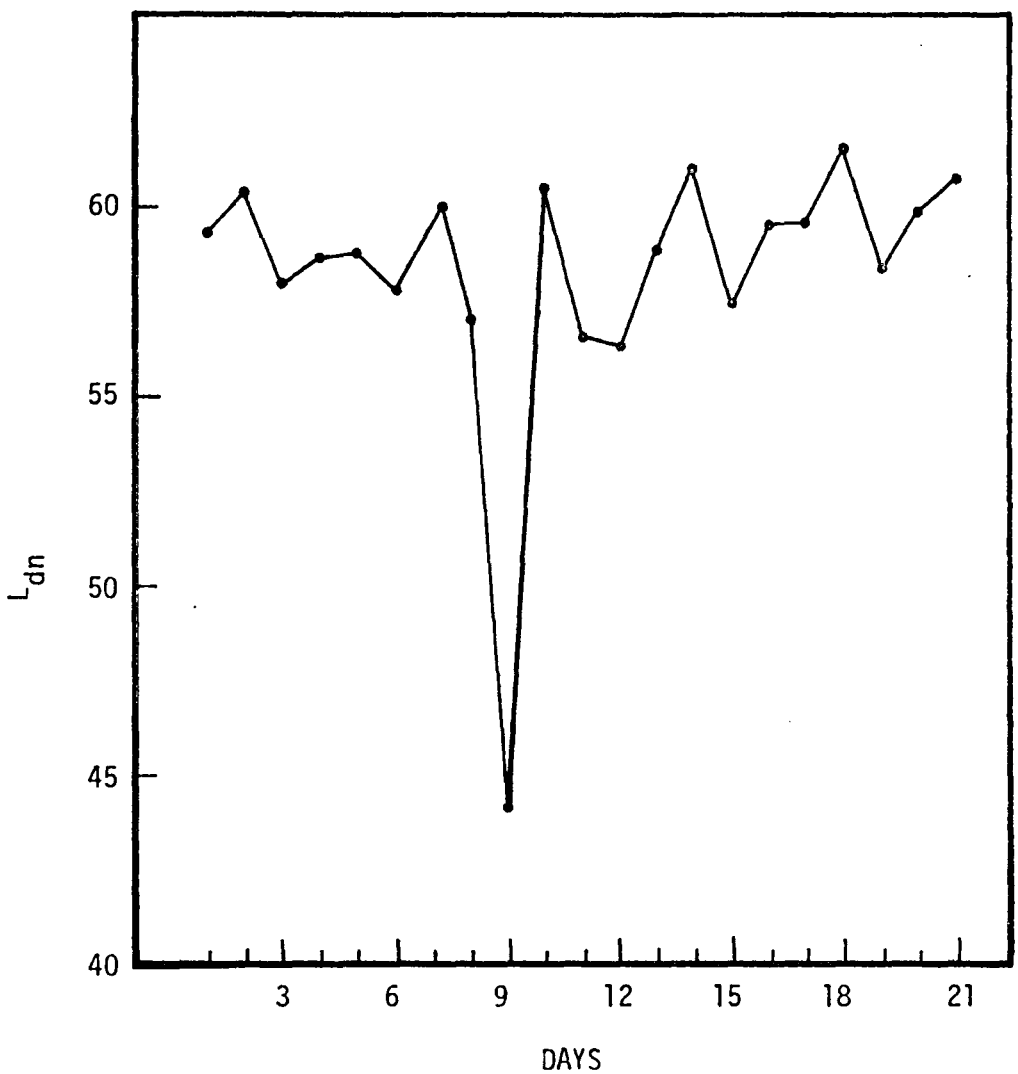


Figure 9. L_{dn} Measurements at Position "A" at the Bellevue Airport.

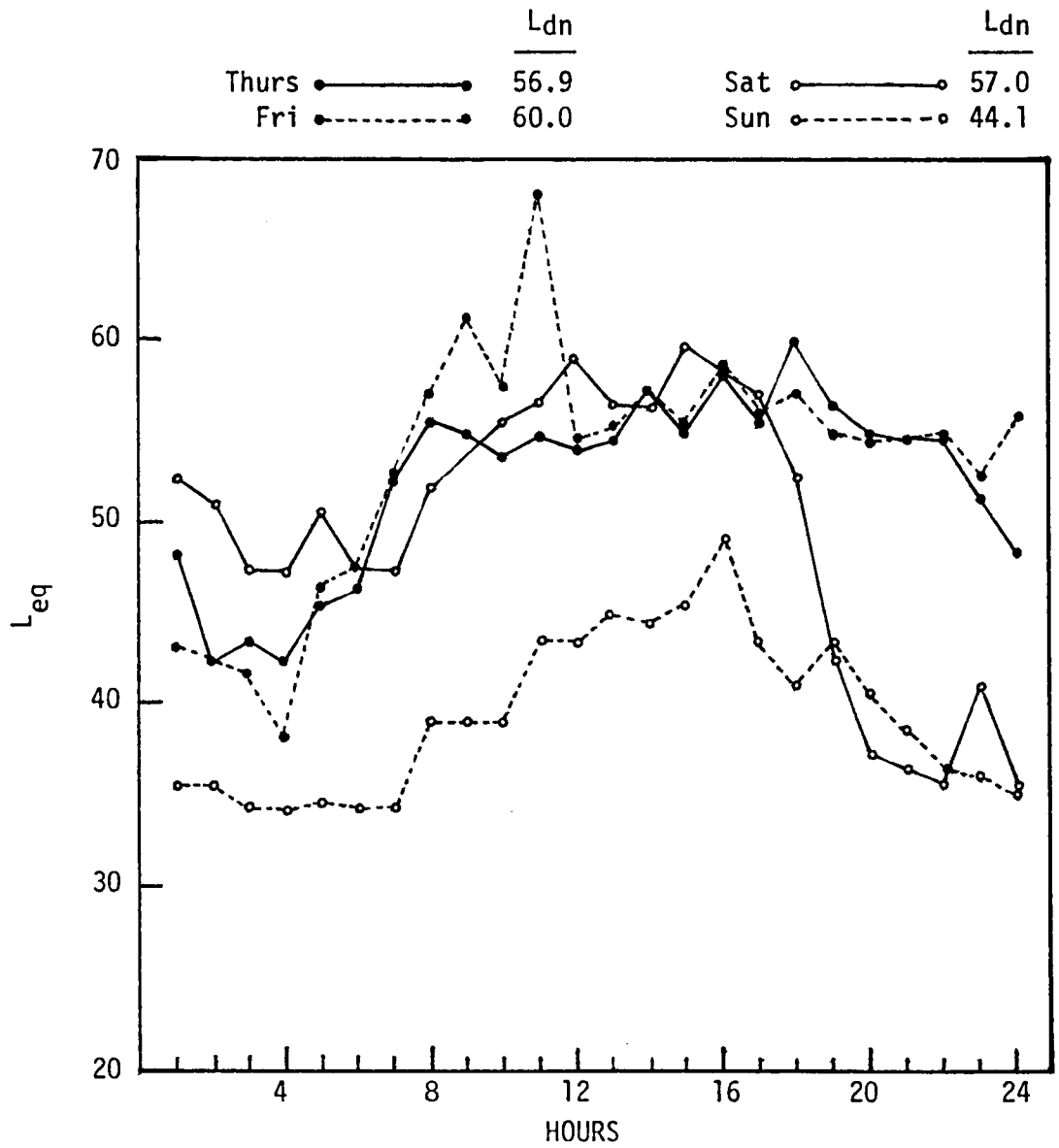


Figure 10. Hourly L_{eq} Measurements for a Four-day Period at the Bellevue Airport.

noise due to proximity to a busy 4-land interstate highway. Ambient noise during the daytime period was measured at 60-70 dBA depending on density and vehicle type on the highway. Based on two 6-hour measurement periods L_{dn} was measured at 61 dBA. Although noise from the highway contributed a major portion of this noise level, aircraft noise was also a factor as mean peak levels for takeoffs of 94 aircraft were measured at 76.5 dBA over a three-day period.

Measurement positions "D" and "B" are located in areas where sporadic complaints to airport noise had been received. Six 24-hour L_{dn}'s were obtained at position "B" over an eleven day period. A plot of these measurements is given in Figure 11. and mean L_{dn} for the six days is 57.2 dBA. However, the two highest levels for a Wednesday and a Friday are heavily influenced by lawn mower noise. If these two days are omitted, the measured average L_{dn} at position "B" is 55.5 dBA. As shown in Table III, the L_{dn} at position "D" was measured at 55 dBA based on 6 hours of energy summation measurements with average peak levels of 70 dBA based on 16 takeoffs.

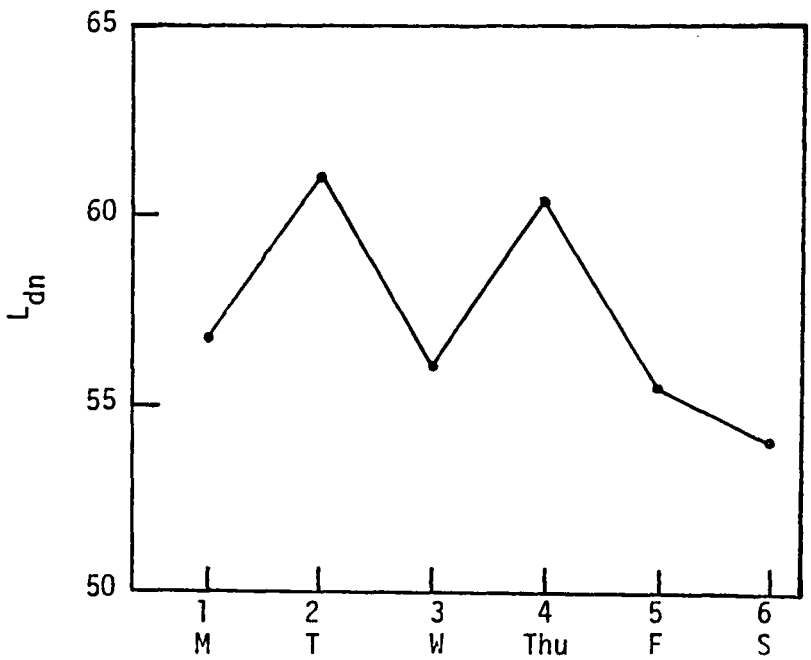


Figure 11. L_{dn} Measurements at Position "B" at the Bellevue Airport.

2.3 MARTHA LAKE AND CREST AIRPORTS

As stated above, one of the guidelines for this study program was to examine noise impact and annoyance for general aviation airports with different numbers of average daily operations. These two airports were selected as examples of "smaller" airports. Both airports are privately owned. The Martha Lake Airport is north of the Seattle Metropolitan Area and the Crest Airport is to the south. Prior to selection, managers from both airports were interviewed relative to cooperation in obtaining noise measurements on airport property and noise complaints from nearby residences. Both airport managers reported that, over the years, they had received complaints to aircraft flyover noise but that no complaint records were maintained. As a means of comparing these "smaller" airports to the Olympia and Bellevue Airports, "official" total average daily operations and square miles encompassed by L_{dn} contours ranging from 50 to 65 dB are provided in Table IV; the FAA Integrated Noise Model (INM) program was used to calculate the contour data.

TABLE IV. SQUARE MILES ENCOMPASSED BY L_{dn} LEVELS AT FOUR AIRPORTS.

AIRPORT	AVG DAILY OPERATIONS TOTAL	L_{dn} LEVEL			
		50	55	60	65
Olympia	246	----	----	2.20	0.44
Bellevue	194	3.77	0.77	0.17	0.03
Martha Lake	81	0.49	0.10	0.02	*looped
Crest	45	0.34	0.06	looped	looped

* Means that closure could not be obtained by computer program.

For all four airports, average number of daily operations, mix of aircraft, and runway utilization were based on information supplied by airport managers and/or planning studies and thus was the "official" information concerning airport utilization. Fairly long-term observation of an airport covering various seasons (summer vs. winter) and days of the week is required to accurately assess a general aviation airport's actual

activity. Such close observation was not possible for this study but a general kind of evaluation was made relative to the accuracy of the "official" information. With the exception of the Martha Lake Airport, the direct observations concerning numbers and mix of aircraft were not in marked disagreement with the "official" version. However, for the Martha Lake Airport, number of operations observed during fair weather and on weekends when peak flight activity is expected was only twenty-five percent of the 81 average daily operations claimed in the "official" version.

2.3.1 Martha Lake Airport Noise Determinations

As for the other airports, noise measurements were made in conjunction with the INM noise modeling computer program. The airport is relatively small, with a 1600 ft. runway oriented in a north-south direction. There is pasture land to the north, Martha Lake to the south, single family residential housing both east and west plus a mobile home development park some 300 ft. southwest of the runway. Since there was interest in obtaining tape recordings of individual flyover events, measurements were made 100 ft. to the north of the runway where noise from traffic would be at a minimum. Based on three 1-hour noise measurement periods, L_{eq} ranged from 55 to 62 dB with an average level of 57 dB. Using the "official" number of operations which was given at 81 per day, places this measurement point well within the 60 L_{dn} (L_{eq} since there are no night flights) contour. This means that the L_{dn} estimate based on 81 flights is at least 5 dB greater than measured. However, reducing number of average daily operations to 22 places the measurement point within a 55 dB contour and the agreement between the two approaches is higher. Measured data west of the airport in a residential area was of no value relative to assessing airport noise. Average L_{eq} obtained was also 57 dB but was primarily due to freeway noise which is predominate in this area; peak level obtained was 76 dBA which was from an overflight of a commercial jet in a landing pattern. This second measurement point is outside the 45 dB contour calculated on the basis of 22 average operations per day.

2.3.2 Crest Airport Noise Determinations

Of the four general aviation airports studied, Crest was least impacted by noise sources other than noise due to airport operations. Thus, most of the listening-quality tape recordings of individual flyover events were obtained at the Crest Airport. This airport is located in a rural area with residential housing located to sideline of the 3000 ft. north-south runway. One feature of the airport is relatively unique in that the single-family homes to sideline are much above the average for this area in cost and many of these homeowners also own general aviation aircraft. The aircraft are parked in front of the homes for easy access to the airport runway.

As indicated by the data in Table IV., the 55 L_{dn} contour falls completely within the boundaries of the airport. Using standard airport planning guidelines, an L_{dn} of 55 within airport boundaries points to a rating of "clearly acceptable" relative to noise from the airport and that no special considerations are required for planning land use activities around the airport. In conjunction with obtaining tape recordings of individual flyover events, L_{eq} determinations using noise monitoring equipments were obtained directly under the flight path at positions both north and south of the runway. For the north measurement position, which was 500 ft. from the end of the runway and based on 15.5 hours of measurement, the average L_{eq} was 63.0 dB. Since this measurement position was very much within airport boundaries, it is consistent with the L_{dn} (no night flights) calculations for this airport. Some 85 aircraft operations were observed during the 15.5 hours consisting, primarily, of one-engine take-offs. The south measurement position was located 450 ft. from the south end of the runway. Based on six hours of measurement, the average L_{eq} was 60 dB. Twenty-five aircraft operations were observed during this 6-hour period and were mainly one-engine aircraft landings. As for the measurement results at the north position, they are consistent with the noise modeling approach since the south position is encompassed by the 55 dB contour.

3.0 COMMUNITY RESPONSE AND NOISE IMPACT CONSIDERATIONS

Three different approaches were used to obtain public attitudes toward general aviation airport noise at the Olympia, Bellevue, and Martha Lake Airports. Attempts were made to organize a neighborhood meeting as a means of assessing attitudes toward noise generated by the Crest Airport but after preliminary agreement by three sponsors, final agreement was not forthcoming. The manager of the Crest Airport had reported receiving some telephone complaints (L_{dn}<50) from a housing development north of the airport so this was the area where a meeting sponsor was sought. No attempt was made to obtain a meeting sponsor from residents living along the runway of the Crest Airport. Many of these families had selected their living locations because of ready access to the airport when using their own aircraft so it was expected that, at most, their attitudes toward aviation noise would be neutral. An evaluation of attitudes toward noise impact due to the Olympia Airport involved observation of three public meetings concerned with a proposed expansion of the airport, plus petitions and letters submitted in response to the draft EIS relative to this expansion and modification. By its very nature, such a process leads to polarization with almost all involved being either very much for or very much against the proposed expansion. For the Olympia Airport, many of those against any expansion of the airport were for relocation. At the Bellevue Airport, a small random sample opinion survey was used in conjunction with a previously completed in-person survey *(1979) of four matched communities (two communities adjacent to the Bellevue Airport) which had the aim of investigating attitudes toward local issues. For Martha Lake Airport, a focused group discussion among attendees at a regularly scheduled meeting of a community club was used.

3.1 OLYMPIA

Three sources of data on public opinion about the proposed expansion or relocation of the Olympia Airport were obtained. These were presentations at a public hearing on the draft EIS, letters submitted, and petitions. In each of these three sources, input came from self-selected individuals,

* Study conducted by Prof. Avery M. Guest, Univ. of Washington

with a greater awareness of and interest in the issues than can be assumed for the community as a whole. While the residents who signed, wrote, and spoke for or against the proposal were undoubtedly expressing their own deep-felt concerns, they cannot be automatically considered as spokespersons for the entire area which would be affected by approval or disapproval of the proposal. As individuals and representatives of their interest groups, however, their opinions are of importance. Their contributions are analyzed below.

Petitions — Two petitions were presented. One, signed by 507 residents, supported the position of an ad hoc group called "Save Our Community", in opposition to the proposed development. While 507 is a large number of names, there is no information on the depth of the signers' involvement in the issue, or on what proportion of the total community they represent. Similarly, the 129 individuals who signed a petition in favor of the proposed airport modification may be either a significant or an insignificant number, depending on what portion of the population they comprise. In petitioning, mere numbers of signatures mean little, unless there is accurate information about how many people were asked to sign, how many in fact do so, and whether their signatures represent a reasoned agreement, simple good-natured compliance, or possibly only an inability to say no to a friend. Unless there is some legally-required number of names to meet some test, names on a petition are likely to say more about the length of time and number of collectors available than about the actual strength of a position.

Letters — Letters were received, presenting some point of view on the proposal. While several of the letters expressed interest in the proposal in general, or in the process of decision, the majority argued for support or defeat of the plan, or offered alternatives. Letters were received from individuals, interest groups, and governmental agencies, as well as businesses with some interest in the proposed modifications. A summary of the characteristics of the writers and content of the letters is shown in Tables V. and VI.

Presentations — Forty persons appeared at the hearing, and registered

to speak. Like the letter writers, some of these people spoke for groups as well as for themselves; they supported, opposed, or provided information about the proposal or their suggested alternative plans.

TABLE V. CHARACTERISTICS OF LETTER WRITERS AND SPEAKERS.

CHARACTERISTIC	LETTER WRITERS	SPEAKERS
Individuals	16	31
Interest Groups (Washington Pilots Assn., Save Our Community, NE Thurston Action Assn.)	2	4
Government Agencies (inc. schools)	10	3
Businesses	2	1
Organizations (Chambers of Commerce, LVW)	3	1

TABLE VI. CONTENT OF LETTERS AND PRESENTATIONS

CONTENT		LETTERS	PRESEN-TATIONS
In Support of Proposal	Utility of Airport	3	12
	Safety Factors	4	9
	Economy and Income	1	4
	Noise - pleasant or not harmful	---	7
Against Proposal	Noise	9	3
	Safety Hazzard	5	3
	Effect on Property Values	4	2
	Loss of Homes/Loss of Tax Revenue	---	5
	Expense of Modifications	3	2
	Air Pollution/Environmental	4	---
Suspicion about EIS process		4	3

For those writing letters in opposition to airport expansion, nine persons mention noise as a factor which was more than any other category. The next highest category involved the airport as a "safety hazzard" which was

given by five persons writing letters. It is quite interesting that seven of those making presentations in support of airport expansion discussed noise but in a pleasant or not harmful context.

As a means of obtaining data which could be considered more comparable among persons attending the final meeting relative to expansion of the Olympia Airport, agreement was reached with airport management to obtain responses to a short questionnaire. The questionnaire was to be anonymous but home address was to be solicited so that noise estimates could be matched with response data. Just prior to this last meeting, agreement to administer the questionnaire was withdrawn. The reasoning provided was that the questionnaire constituted a formal vote on the question before the meeting and that there was not requirement to risk a negative response to the airport expansion proposal. The proposed questionnaire is given in Appendix A.

In respect to matching any of the above attitudinal data to noise impact results for this airport, noise data in the area of those joining the "Save Our Community" group is, by far, the most clear cut. This is the noise data associated with position "G" of Section 2.1 of the NOISE ASSESSMENT section. Measurement point "G" is several city blocks north of the 65 dB L_{dn} contours for 1976 and 1981 (see Figure 2.) and measured L_{dn} over an eight-day period averaged 56.6 dB. Average peak levels from aircraft over a two-day period were measured at 67.4 dBA. Relative to guidelines for residential living around airports, these levels suggest no or mild impact. It is expected that average indoor peak levels would be approximately 45 dBA which is considerably below peak noise levels from many household activities including television listening which usually ranges between 55 and 65 dBA. Objectively, noise impact in this area would not be considered unacceptable.

3.2 BELLEVUE

Telephone interviews were conducted with 27 residents living immediately adjacent to or under the flight path of the Bellevue Airport in May, 1980. The respondents were asked the length of time they had lived in the

neighborhood, their rating of its quality, what good and bad aspects of it they recognized, and what serious problems they had encountered there. Those respondents who named problems were asked about the severity of each, the amount of annoyance caused, and whether the problem had been reported to any authority for action. Respondents who did not volunteer citations of noise as a problem were asked if they were ever bothered by noise, and all of those who mentioned noise as a problem were asked about its source and severity. One-third of the sample was asked about the frequency of the noise which bothered them, and the remainder of the respondents were asked to identify the times of day or night when the problem occurred. All of the interviewees were asked about any effects of noise on their normal life patterns, and if any changes in activities had to be made because of noise. A number of standard demographic items completed the interview. A copy of the questionnaire is given in Appendix B. The results of this survey are shown in Table VII., which includes the first eight questions asked by the interviewers. Questions 9., 10., and 11. were concerned with reporting of a "problem" to some official or authority, to whom reported, and the outcome of the reporting. Two respondents reported traffic problems to the police, and five reported crime incidents. Reports were made by telephone, and an investigation was conducted.

For question 13., eighteen persons who had not mentioned being bothered by noise to question 6. were specifically asked about this point. Four said they had been bothered, and named the airport as the source of the noise, although the problem was not considered serious. The remaining nine respondents were asked a slightly different question, "Do you hear noise from the Bellevue Airport?" When it was thus called to their attention, seven of these nine answered "Yes". They did not find the noise a severe annoyance, however. Only one respondent rated it Moderately Annoying and one Slightly Annoying, while the other seven persons found it Not Annoying. The times when the noise was most apparent was reported as during daylight hours, and on nice weekends.

None of the respondents noted any effects on their lives caused by the noise, and none reported making any changes to accommodate it. It is

TABLE VII. RESULTS OF BELLEVUE AIRPORT TELEPHONE SURVEY.

QUESTION 1. Number of years lived in the neighborhood.			
Less than 1	0	6 to 10	9
1 to 2	2	11 or more	12
3 to 5	4		
QUESTION 2. Neighborhood rating.			
Excellent	9	Fair	2
Good	16	Poor	0
QUESTION 3. Liked neighborhood characteristics.			
Friendly, social character	17*	Privacy, rural character	6
Convenient location	11	Transportation, easy access	5
QUESTION 4. Disliked neighborhood characteristics.			
Heavy traffic	9*	Park-and-Ride lot congestion	4
Isolation, unfriendliness	9	Run-down housing	4
Urbanization, density	5	Noise	1
Other	4		
QUESTION 5. Most serious problem.			
Crime, disorder	4	Urbanization, congestion	2
		Noise	1
Dogs	3	No serious problem	13
Heavy traffic	4		
QUESTION 6. Other problems recognized.			
Traffic	9	Crime	5
Noise	9	Run-down houses	3

QUESTION 7. Severity of problem (recognized by respondents).

RATING	TRAFFIC	NOISE	CRIME	HOUSES
Very severe	3	0	0	0
Moderately severe	4	5	2	3
Somewhat severe	2	5	4	0
Barely severe	9	12	11	13

TABLE VII. (cont'd) RESULTS OF BELLEVUE AIRPORT TELEPHONE SURVEY.

QUESTION 8. Level of annoyance caused by recognized problems.				
RATING	TRAFFIC	NOISE	CRIME	HOUSES
Very annoying	3	1	3	0
Moderately annoying	2	5	0	3
Somewhat annoying	2	4	2	0
Not annoying	9	8	4	1

* Multiple citations possible.

clear from responses to the above questions that no complaints were made concerning airport noise (questions 23. to 26.). The ranges of age, sex, occupation, housing type, and family constellation shown in answers to the demographic questions corresponded closely to those reported in census data and found in other studies of the same population.

The results of a 1979 Community Attachment study conducted by Prof.

Guest support these findings. In the matched communities, respondents reported similar satisfaction with their neighborhoods, and identified similar liked and disliked characteristics. In none of the neighborhoods was noise considered a primary problem, with only 6% in Eastgate and 1% in Lake Hills citing "Noise" as a disliked factor. Both Eastgate and Lake Hills are near the Bellevue Airport.

Consideration of noise data in conjunction with various community response data points to the following:

- A random sample approach supports the proposition that there is minimal concern with noise from the Bellevue Airport. The small survey conducted for this study from persons close to the airport showed no concern with aircraft noise as did a larger study which was completed in 1979.

- A suspicion concerning accuracy of EIS data expressed by seven persons who attended the final meeting relative to expansion of the Olympia Airport is partially confirmed. In a situation where higher airport noise levels could be of benefit, estimated levels were almost 8 dBA higher than those based on twenty-one days of measurement for this study.

- An averaged measured L_{dn} of 58.3 (21 days of measurement) was rated as completely acceptable by a group of persons living just to the northwest of the Bellevue Airport as opposed to a measured L_{dn} of 56.6 dBA (8 days of measurement) at the Olympia Airport. A group living in the area of L_{dn} equal 58.3 had initiated legal action to retain the Bellevue Airport and block development of a business and apartment complex on airport property.

- For those residing south of the airport where some noise complaints had been received, including letters to county

officials, measured L_{dn} was approximately 56 dB. This measurement position ("B" of Figure 8.) is a considerable distance from the L_{dn} contour of 60 dB which may underestimate noise impact south of the airport. It is likely that more flights are heading south than given by the "official" version of airport operations.

3.3 MARTHA LAKE

Between thirty and thirty-five residents of the Martha Lake area attended the meeting of the Community Club on October 6, 1980. This was a regularly scheduled event, and attendees had no special interest in the subject of the Martha Lake Airport. Rather, they were a group of individuals with a general concern about their community, with a history of activity in neighborhood affairs. Following their business meeting, their discussion was focused on questions of community quality, local problems, and, finally, airport-related noise impact.

Community members at the meeting were unanimous in praising their neighborhood, citing its rural character, convenient transportation, and social interactions. The relatively few problems which were identified tended to be linked to personal difficulties, such as uncontrolled dogs and children, loud parties, and vandalism. Problems related to physical characteristics of the community, such as poor drainage, sewer overflows, and encroaching development were of concern as well. The subject of noise was raised only in relation to animals and traffic; none of the residents considered the airport to be a factor. The major source of anxiety about the community appeared to be a perception of the probable loss of the rural, isolated, and private nature of their neighborhood. With prompting one person did respond that noise from the airport could be a problem if the airport were not already located.

4.0 SUMMARY OF CONCLUSIONS

Conclusions fall into two general categories; one involves the practical problems associated with noise modeling and measurement in conjunction with proposed changes in airport operations, while the second is directed to a noise impact criterion that would be considered acceptable for residential living.

NOISE ASSESSMENT

- Different noise modeling approaches by two different firms using the exact same airport operational data can lead to markedly different results. Data from both Olympia and Bellevue Airports supports this observation.

- There was some evidence that noise modeling and measured results were in agreement.

- Marked disagreement between measured and noise modeling results could be attributed to an absence of an accurate operational description of an airport. Due to the nature of general aviation activity, it is difficult and time-consuming to obtain an accurate description of airport operations.

- Relative to noise determinations, there was evidence that expressed concerns relative to the validity of the EIS process may have some basis in fact.

NOISE IMPACT CRITERIA

- There was evidence from one airport that an L_{dn} of approximately 55 dB is not acceptable for residential living which was contradicted by that from a second airport where the general social circumstances were entirely different. The first airport was expanding

while the second was being replaced by a business and apartment complex. Since a variety of attitudinal variables and objectives can be associated with airport noise annoyance response, it is almost impossible to isolate a noise impact level at which a wide spectrum of communities would find acceptable for residential living. So that there would be control of these extraneous conditions, a simulated living conditions experiment involving general aviation airport noise exposure, commercial airport noise exposure, and noise from surface transportation would be of considerable benefit.

REFERENCES

1. Olympia Airport Master Planning Study, CH_2M-Hill, Corvallis, OR, 1978.

2. Draft Environmental Impact Statement, Master Plan of CC&F, I-90 Bellevue Business Park, July 1979.

APPENDIX A

Questionnaire Prepared for Olympia Airport Community Meeting

1. A number of options have been suggested for the future of the Olympia Airport. Of these, please rank your preference, by marking a 1 for the choice you most prefer, a 2 for your second choice, and 3 for the option you least prefer.

Ranking	Option
_____	Move Olympia Airport to some other location
_____	Enlarge the present airport
_____	Make no changes
_____	Other (please describe) _____

2. People consider different things when they make decisions. In choosing your option for the Olympia Airport, how important were each of the following factors?

	Very Important	Moderately Important	Slightly Important	Not Important
a. Traffic associated with the airport	____	____	____	____
b. Convenience of having an airport near-by	____	____	____	____
c. Noise associated with airplanes	____	____	____	____
d. Effect of the airport on land use	____	____	____	____
e. Advantages of the airport to business and the economy	____	____	____	____
f. Issues of air and environment quality	____	____	____	____
g. Other (please describe) _____	____	____	____	____

3. What was your purpose in coming to this meeting? What did you expect would result?

_____

_____

4. Which of the following statements describe your involvement in the subjects of the meeting? (Please circle Yes or No for each statement.)

Yes	No	
Y	N	a. I came to find out what was being planned.
Y	N	b. My neighbors wanted me to come because our property would be affected.
Y	N	c. I hold strong opinions on the subjects discussed at the meeting.
Y	N	d. I belong to a group or organization which is active in these issues.
Y	N	e. I don't think that attending these meetings will have any real effect on what is done.
Y	N	f. I have often contacted a public official or office to make my opinions known.
Y	N	g. I think citizens can have a real impact on what public officials do.
Y	N	h. Protecting the environment is very important to me.
Y	N	i. Individuals don't have much chance to make their voices heard on these issues.

It is important to know where respondents live in relation to the city and to the airport. Please write in your home address below.

Thank you very much for your assistance. Please add any comments you wish to make.

APPENDIX B

Questionnaire Used for Bellevue Airport

1. First of all, how long have you lived in this neighborhood?

2. How would you rate this neighborhood as a place to live? Would you say it was Excellent, Good, Fair, or Poor?

3. What things do you like about your neighborhood?

4. What things do you dislike about living here?

5. What is the most serious problem in your neighborhood?

6. I am going to read a list of some things which might be problems in neighborhoods, and ask you if any of these things are problems in <u>your</u> neighborhood. *(Do not read items mentioned above.)*

   Traffic

   Air pollution

   Noise

   Crime or vandalism

   Run-down housing

7. *(For each problem identified either in Q. 5 or 6.)* How severe is this problem? Would you say it is Very severe, Moderately severe, Slightly severe, or Barely severe at all?

8. *(For each problem)* How much does this problem annoy you? Are you Very annoyed, Moderately annoyed, Slightly annoyed, or Scarcely annoyed by it?

9. *(For each problem)* Have you ever reported this problem or complained about it to some official or authority?

10. *(For each reported)* To whom did you report or complain?

11. *(For each reported)* Was the complaint reported by telephone, in a letter, in person, or by some other means?

12. *(For each reported)* What happened because of your complaint? What was the result?

13. *(If "Noise" not included in problems above)* Are you ever bothered by noise around here? How serious a problem is noise?

14. *(If "Noise" cited either in Q.5, 6, or 13)* What is the source of the noise that is a problem or bothers you?

15. About how often does the noise bother you?

16. Do you hear noise from the Bellevue Airport? About what times of the day or night do you hear these noises? Do you find noise from the Bellevue Airport Very annoying, Moderately annoying, Slightly annoying, or Not at all annoying?

17. Has noise around here had any effect on the way you live or carry on your usual activities?

18. *(If "YES")* What effect has the noise caused?

19. *(If effects)* Have you had to make any changes in the way you live because of noise?

20. *(If "YES")* What changes have you made?

21. Has noise around here had any effect on your health or physical condition?

22. *(If "YES")* What effects has the noise caused?

23. Have you ever reported or complained about noise to some official or authority?

24. *(If "YES")* To whom did you report or complain?

25. *(If reported)* Was the complaint reported by telephone, in a letter, in person, or by some other means?

26. *(If reported)* What happened because of your complaint? What was the result?

DEMOGRAPHICS:

Housing characteristics

Age

Occupation

Family composition

Income

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15. Supplementary Notes

Langley Technical Monitor: David A. McCurdy
Final Report

16. Abstract

The method involved the selection of three airports which were dominated by aircraft weighing 12,500 lbs or under and which were also undergoing a change relative to utilization. Also, there was interest in airports with different utilization levels so that effect of number of operations could be considered. In addition, there was a requirement to select airports with communities in the surrounding areas which were exposed to aircraft operations noise. Noise annoyance response data was obtained from available sources. These sources included environmental impact statements, interviews with airport managers, noise complaint information, community meetings concerned with projected changes in airport utilization, and social survey data. As a means of objectively assessing the noise impact due to aircraft operations, noise measurement and computer noise modeling determinations were obtained for each airport. Listening-quality tape recordings were also obtained.

17. Key Words	18. Distribution Statement
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