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INFORMATION BRIEF

POSSIBLE CONSEQUENCES

OF

FUEL ALLOCATION PROGRAM

ON

AIRCRAFT NOISE

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INTRODUCTION

Several cursory studies over the past three months have given some preliminary indication that the energy problem, as it relates in particular to the consequences of decisions resulting from the airline fuel allocation program, could result in further degradation of the environment in communities adjacent to airports due to increases in aircraft noise.

The purpose of this brief is to consolidate all of the preliminary data and provide a base reference for future consideration relative to fuel conservation and noise tradeoffs.

° Reduction in Flight Frequency

Reductions in fuel allocations to the airlines has resulted in reduced numbers of operations arising from airline capacity agreements as well as from unilateral flight cutbacks. Figure 1 indicates approximate cumulative noise reductions attainable with reductions in the number of generating sources, each having the same maximum noise level.

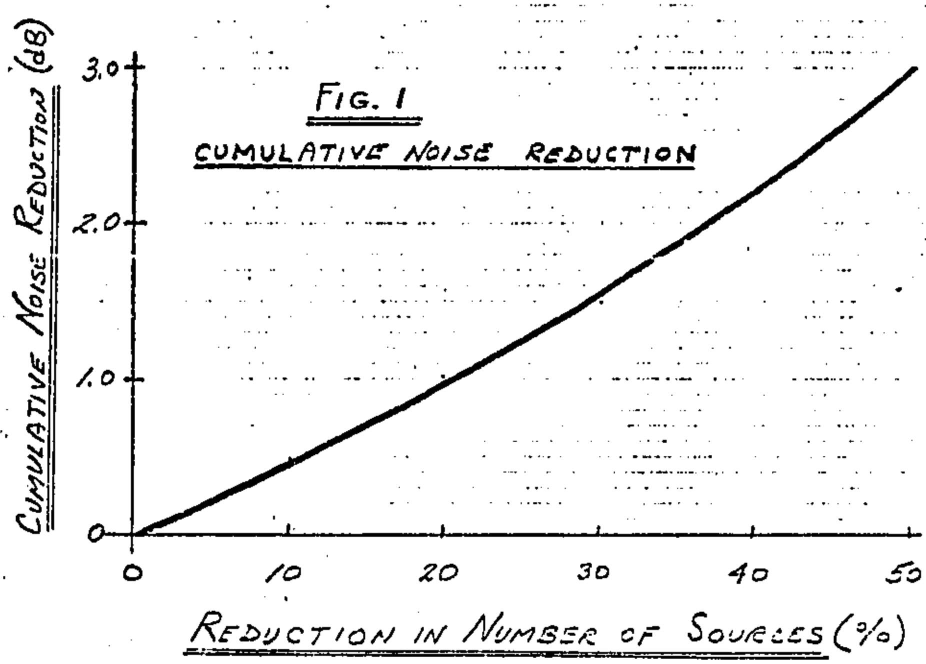


Figure 1 indicates that if 8 aircraft, each generating the same level of noise, produced a cumulative noise level of 110 EPNdB, 4 of these aircraft would then produce a cumulative noise level of approximately 107 EPNdB.

In the case of the current airline cutbacks, the reduction in number of operations is less than 20%; therefore, even if the reductions were proportionately distributed across the fleet mix, a cumulative reduction of approximately 1 dB would accrue. Even if the cutback in number of flights were concentrated at the high density, noise sensitive airports, the cumulative noise reductions would tend to be minimal. In fact, where 707's and DC-8's have replaced 747's even that slight benefit may not be realized since the 707's and DC-8's with their higher noise levels strongly dominate the noise environment.

° Fuel Efficiency Per Passenger

Whereas the new high bypass ratio fan engines powering the wide bodies (747, DC-10, L-1011) have significantly improved specific fuel consumption characteristics (#/hr./# thrust) compared with the earlier technology low bypass engines, they are also much larger (having more than twice the thrust capability). As a result, the actual fuel consumed by these engines is higher since fuel consumption in #/hr. (or gallons/hr.) is the product of the specific fuel consumption and the operating thrust level of the engine.

The ATA (Air Transport Association) has recently provided the following average fuel consumption values for several medium to long range aircraft:

707/DC-8	-	1,700 gals./hr.
DC-10/L-1011	-	2,100-2,400 gals./hr.
747	-	3,700 gals./hr.

Figure 2 illustrates the relative fuel efficiency per enplaned passenger for the long range 707/DC-8 and 747 aircraft based upon the above figures. Also plotted on the chart are operating data points for these aircraft as reported by the Civil Aeronautics Board.

This helps to explain why many airlines are grounding their 747's. It can be seen that the 707/DC-8 is more fuel efficient for any passenger demand up to its capacity limitation. Also, in some instances, use of two 707's or

DC-8's instead of one 747 could be more fuel efficient while providing additional service flexibility.

Obviously, the greater use of 707/DC-8 aircraft will tend to increase the noise impact, particularly at the already noise-sensitive airports.

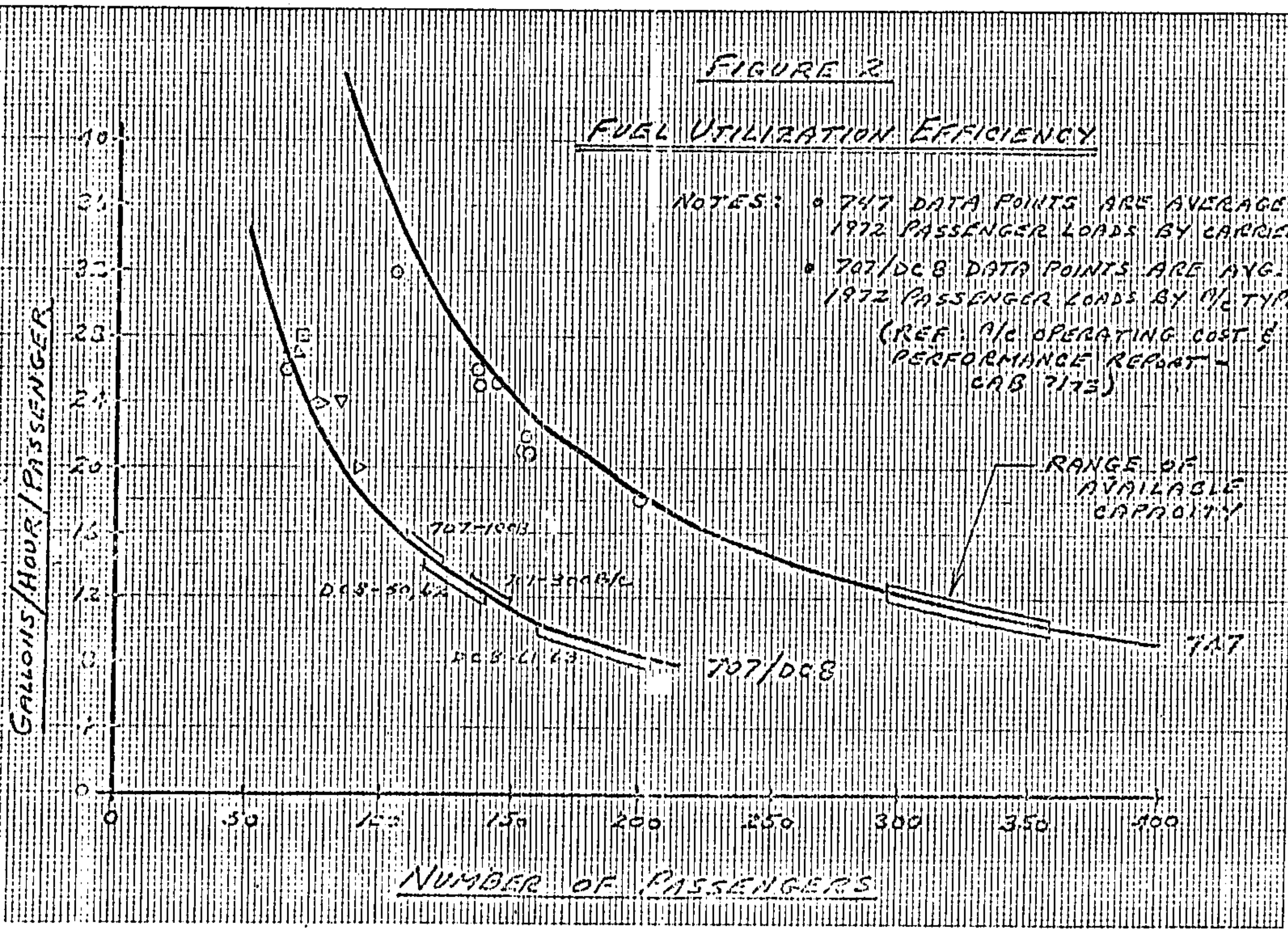


FIGURE 2
FUEL UTILIZATION EFFICIENCY
NOTES: ○ 747 DATA POINTS ARE AVERAGE 1972 PASSENGER LOADS BY CARRIER
● 707/DC8 DATA POINTS ARE AVG. 1972 PASSENGER LOADS BY A/C TYPE
(REF. A/C OPERATING COST & PERFORMANCE REPORT - CAB 7/73)
RANGE OF AVAILABLE CAPACITY
707-100B
707-300B/C
DC8-50/62
DC8-61/63
707/DC8
747
GALLONS/HOUR/PASSENGER
NUMBER OF PASSENGERS
0
50
100
150
200
250
300
350
400

° Gross Weight Effects

The grounding of aircraft as a result of the service cutbacks previously discussed, would increase the payload factor on the remaining in-service aircraft. Assuming a stable or increasing demand for service, this could be reflected in increased noise for both narrow and widebody jets, over-shadowing the possible noise benefits of reduced numbers of operations.

Figure 3 provides an illustration of this possible ramification as it relates to the Boeing 727-200 aircraft. The change in noise level, with gross weight, at FAR 36 takeoff measuring point (3.5 N.M. from brake release), was provided by the Boeing Company from unpublished data. Maximum payload and fuel capacity have been derived from aircraft characteristic data as provided in Jane's All the World's Aircraft.

1972 CAB data from Aircraft Operating Cost and Performance Report provided the following:

(1) Average available revenue payload. The range of values for 11 trunk airlines was 30,600 to 36,200 pounds. This indicates that all of the aircraft are configured near design capacity.

(2) Actual average revenue payload. The range of values is from 12,200 to 16,000 pounds for an average ton load factor of approximately 44%.

The payload capability comprises passengers plus baggage and cargo. The average passenger load factor is approximately 53%. The average cargo load factor is down around 19%. The cargo ton load capability is a function of cargo volume available. Therefore, when low density cargo is carried, the full load capability cannot be realized due to volume limitations. The cargo capability on the 727-200 varies from approximately 7 to 10,000 pounds (if the average passenger and baggage weight allocation is assumed to be 200 pounds).

It can be seen that an increase in payload to full capacity could increase the aircraft takeoff noise about 4 1/2 EPNdB.

Furthermore, assuming that the aircraft take off with full fuel load, the 1972 average takeoff gross weight would be about 150,000 pounds. Unpublished Boeing data indicates that 50% of all 727-200 flights in the United States in 1972 were below 145,000 pounds gross weight at takeoff which means that these aircraft were not fully loaded with fuel. Many of the airlines today are tending to take off with maximum fuel to avoid the possibility of unavailable refueling capability at intermediate stops due to the allocation cutbacks.

If these aircraft now take off with full payload and full fuel, the increase in noise generated could be anywhere from 3 (assuming low density cargo) to 9 EPNdB higher compared with 1972 values.

Figure 4 shows comparable data from Boeing for the 707-300 series aircraft, assuming utilization of the quiet nacelle. The estimated maximum gross weight noise level with the current nacelle is indicated as well. It is assumed that the noise/gross weight relationship holds for the current aircraft but at higher noise levels.

The 707 is less sensitive to increases in payload--approximately 3 EPNdB for full passenger and cargo capability. However, where 50% of the flights operate at below 210,000 pounds gross weight at takeoff (unpublished Boeing data) this indicates less than 50% fuel load. It is obvious from the Figure what the noise implications are for maximum gross weight takeoffs compared with 1972 operations. There have been reports that some airlines are taking off on cross country flights with maximum fuel to obviate the need for refueling at the other end.

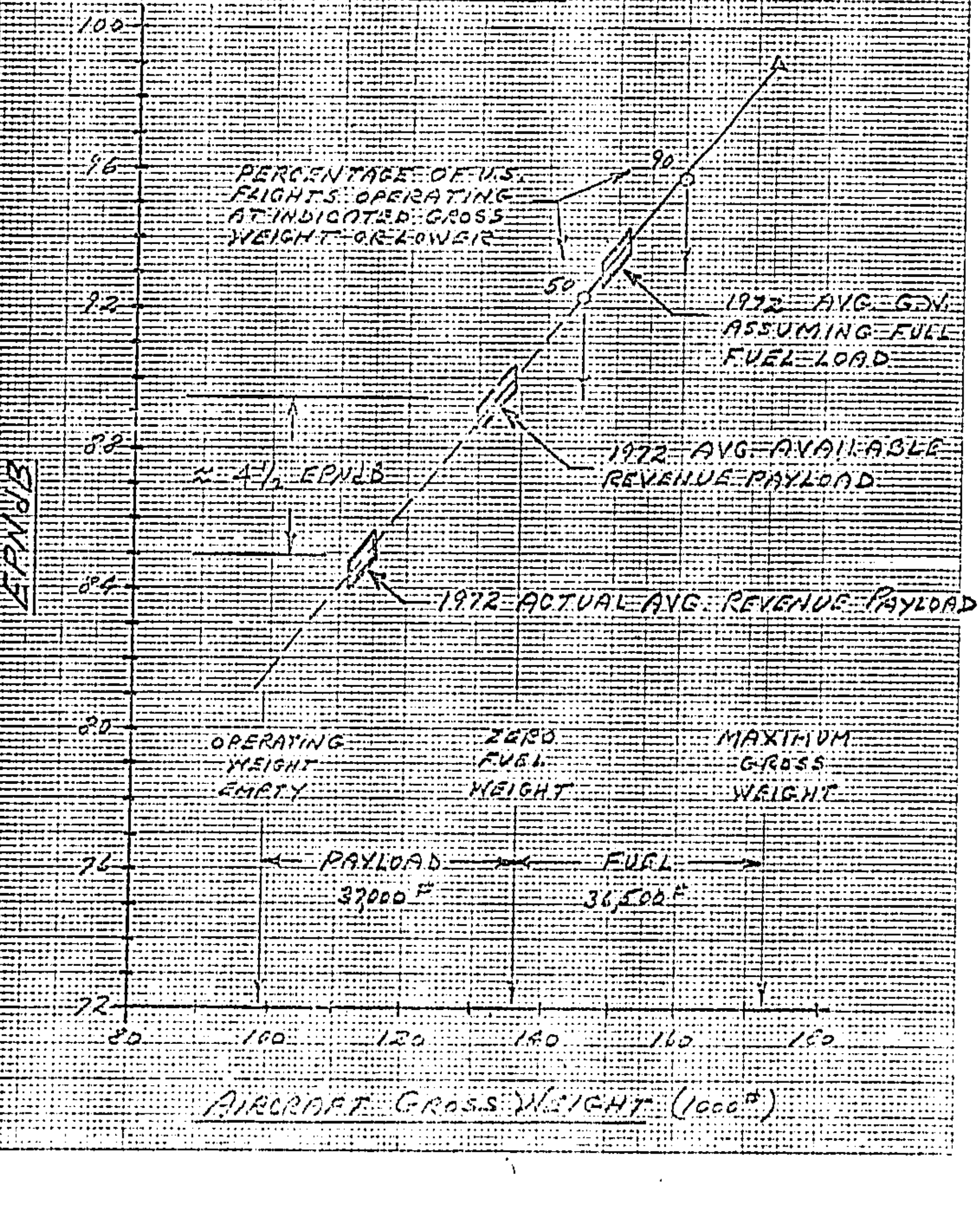
It is expected that approach noise would also be increased with gross weight since higher thrust levels would be required to maintain the same glide slope, although no data is currently available.

In addition, because of the higher gross weight operations of the remaining in-service aircraft, they will consume greater amounts of fuel than heretofore, thereby partially negating the fuel savings of reduced operations.

FIGURE 3

TAKEOFF (S/B) NOISE LEVELS

727-200



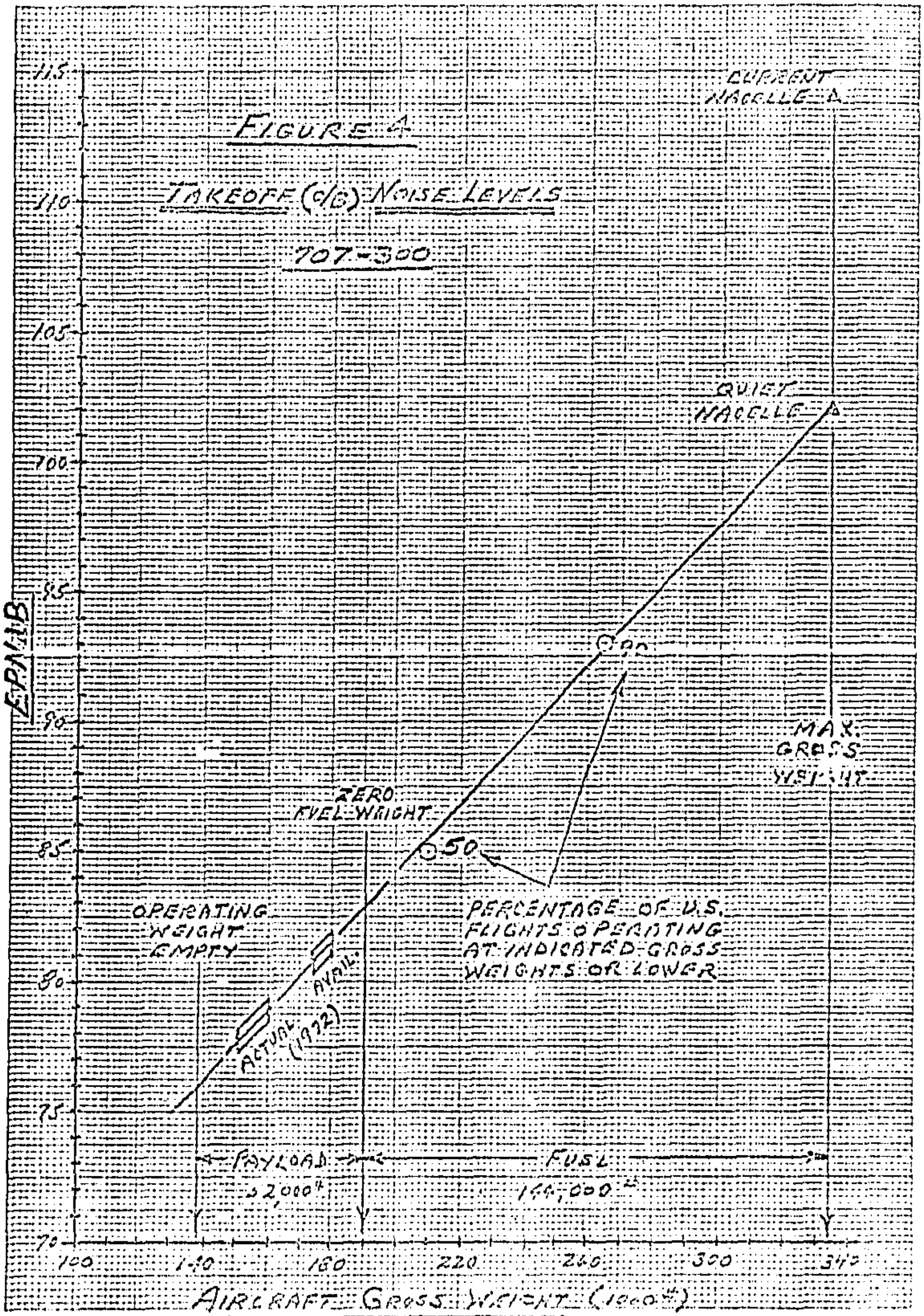


FIGURE 4

TAKEOFF (c/b) NOISE LEVELS

707-300

Summary

While it is recognized that the current energy problem requires the implementation of a fuel conservation program, there is concern that unilateral fuel allocation decisions may, in fact, have a secondary effect on another major national environmental problem--aircraft noise.

Reduction in operations could reduce noise impact in low-passenger density markets.

In high density markets (which are generally more noise sensitive), decreased operations could result in increased noise due in part to the higher load factors required to meet passenger demand. The degree of potential noise increase is dependent upon the equipment utilized.

Many aircraft are now taking off with full fuel loads even for short stage lengths to avoid the possibility of not being able to refuel at intermediate stops due to local fuel unavailability, which increases the noise impact potential.

Many airlines are grounding their widebody 747's and replacing them with noisier 707's and DC-8's in specific market segments.

In light of the current operational cutbacks, there will probably be reduced impetus for the airlines to procure or

accept delivery, on schedule, of previously ordered new, quiet aircraft as long as they are not fully utilizing their current equipment.

The noise impact will vary from airport to airport depending upon the aircraft mix and number of operations. Environmental effects should be considered in capacity agreement discussions, particularly at those airports that are currently noise sensitive as well as those which are marginally acceptable.