# Airport Planning



February 1993

Program Evaluation Division
Office of the Legislative Auditor
State of Minnesota

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February 19, 1993

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The Airport Planning Act of 1989 set in motion a complex planning process designed to determine by mid-1996 whether the Minneapolis/St.Paul International Airport needs to be significantly enlarged or replaced. The act gave major planning responsibilities to the Metropolitan Council and the Metropolitan Airports Commission (MAC). In April 1992, the Legislative Audit Commission directed us to evaluate the performance of these agencies and to assess whether the airport planning process needs modification.

We found that the study which prompted the 1989 legislation--the Metropolitan Council's 1988 airport adequacy study--used methods which led the Council to overstate the inadequacy of the current airport. While both the Council and MAC have since lowered their projections of future growth in airport activity, the Council consultants and staff have continued to use some inappropriate methods for analyzing airport adequacy.

Despite these problems, the metropolitan area continues to need a well-managed strategic airport planning process, and the Metropolitan Council should continue to have a key role. But the Council needs to take immediate steps to improve the technical support it receives from its consultants and staff, and it needs to coordinate better with MAC. Both the Council and MAC need to communicate the results of their work more clearly to policy makers and the public.

We received the full cooperation of the Metropolitan Council and the Metropolitan Airports Commission.

Our report was researched and written by Elliot Long and John Yunker.

Sincerely yours,

James Nobles
Legislative Auditor

Roger Brooks
Deputy Legislative Auditor

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# Airport Planning

## EXECUTIVE SUMMARY

In December 1988, the Metropolitan Council completed a lengthy study of the long-term adequacy of the Minneapolis-St.Paul International Airport (MSP). The study concluded that one new runway would probably be needed between 1993 and 1998 and a second new runway would probably be needed between 2003 and 2018. In addition, the Council's report said that there was a significant risk that, even with every reasonable capacity enhancement, the existing airport's capacity would be exceeded within 20 years. Finally, the report concluded that, despite the expected introduction of quieter aircraft, noise-induced stress around MSP would increase due to the growing frequency of flights.

Based on the study's findings and recommendations, the 1989 Legislature mandated a dual-track planning process which would simultaneously consider both expansion of MSP and construction of a new airport. The legislatively-mandated planning schedule will result in the Council and the Metropolitan Airports Commission (MAC) recommending a decision to the Legislature by mid-1996. The early years of this seven-year planning process have included these activities: revision of aviation forecasts, selection of a new airport search area, development of a 30-year plan for MSP, study of alternative plans for reusing MSP, and examination of alternative sites for a new airport within the search area. Much of the detailed economic, aviation, and environmental planning and analysis has not yet been done but is scheduled to be completed in time for a July 1996 recommendation to the Legislature.

Although the dual-track process is years from completion, the process has become quite controversial. This evaluation was prompted by legislative concerns about the technical adequacy of work already completed. In addition, some legislators questioned whether recent changes in the airline industry should prompt changes in the scope or timing of the dual-track process. This report examines the following general concerns about the planning process:

- **Is the process being conducted in a technically competent manner?**
- **Is the process designed to be comprehensive and complete?**
- **Is the process being conducted over an appropriate time frame?**
- **Are any changes in the dual-track strategy needed at this point?**

The report focuses mainly on aviation forecasts, noise analysis, economic analyses, and analyses of airport adequacy. The report does not examine the search area and site selection process.

# FINDINGS

Our main findings are that:

- **The Metropolitan Council's adequacy study overstated MSP's future capacity problems and inadequately analyzed future noise impacts.**

- **The need for a new runway at MSP appears to be farther off in the future than initially forecast, but recent events suggest that delaying the dual-track planning process could be risky.**

- **Some very good planning work has been done by both the Metropolitan Airports Commission and the Metropolitan Council, but the Council's consultants have used a number of questionable methods to reach key conclusions in past studies. As a result, we are concerned that the Council is not receiving adequate technical support from its consultants and staff.**

- **The technical work done by both Council and MAC consultants needs to be more clearly presented and summarized for policy makers. In addition, the two agencies need to better coordinate their efforts so that they are using similar and appropriate methods of analysis.**

- **With one major exception, plans for remaining dual-track studies seem reasonable but the test will be how well they are carried out. The important item missing from the planning process is work by the Council to ensure that the expansion options at MSP are not precluded by the future development of nearby properties.**

## Adequacy Study

**The Council's adequacy study overstated MSP's future capacity problems.**

In 1987, the Metropolitan Council recommended that the Legislature approve the undertaking of an airport adequacy study. The Council was appropriately concerned that insufficient attention was being paid to long-range airport planning in the face of strong growth in operations at MSP. However, we found that the Council's adequacy study was not carried out very well from a technical standpoint and that it overstated the probable capacity problems at MSP. In particular, we found that:

- **The forecasts of operations, particularly regional airline operations, were too high and were revised significantly downward**

**by both the Council and MAC within 10 months of the passage of the 1989 Airport Planning Act.**

- **The detailed methods used by the Council's consultant to determine airport adequacy are questionable.**
- **The estimated operational delay times, which were used by the Council consultant to estimate the benefits of the dual-track process, greatly exceeded MAC's estimates and were so high for the then current year that Council staff and consultants should not have used them without further investigation.**
- **The Council's conclusions about future airport noise annoyance were based on a technically inadequate study.**

## Timing of the Planning Process

**MSP's existing capacity may be adequate for the near term, but there are reasons to continue the planning process as scheduled.**

Based on the revised forecasts made in 1990 and on the analysis of MAC's consultants, it could be argued that only one new runway will be needed before the year 2020. MAC's revised forecast and analysis suggest that the new runway would probably be needed sometime between 2005 and 2010. This scenario also suggests that some detailed planning work could be postponed. Completion of a detailed environmental impact statement (EIS) too many years prior to the need for capacity enhancement at either MSP or a new site could result in the need to redo some EIS work. In addition, it could be argued that the current financial condition of Northwest Airlines precludes any significant construction plans for the foreseeable future.

On the other hand, there are some good reasons not to delay the detailed EIS work. First, although the revised long-run forecasts made in 1990 seem reasonable, it is possible that the growth forecast to occur over 30 years could come earlier in the 30-year period than either MAC or the Council are now forecasting. For example, despite Northwest Airlines' financial condition, operations at MSP increased substantially in 1992 as Northwest consolidated more of its operations at MSP and its Detroit hub. Also, there are some indications that Northwest and its regional airline partners may wish to significantly increase regional operations at MSP. Even if Northwest's air carrier operations do not grow much after 1993, the potential growth in regional operations could make a new runway desirable around the year 2000. Thus, there is still a reasonable chance that the current timing of the dual-track process will be appropriate.

Second, there are pressures to complete the work that has begun. Residents near MSP would probably object to any delay because of a recent increase in noise around MSP as Northwest has added flights and delayed the purchase of quieter aircraft. Residents living in or near the Dakota County search area for a new airport might object to delaying the EIS since some believe that the search area is unacceptable for environmental and other reasons and that those issues should be resolved and not delayed.

Due to the considerable uncertainty facing any forecaster and the momentum of the dual-track process, we feel that any decision regarding the timing of the dual-track process is a difficult judgment call. As a result, this report does not recommend changing the timing of the dual-track process.

## Technical Adequacy

Although we differ with MAC consultants and staff regarding some of their forecast assumptions and results, we generally found their work to be technically competent. The Council consultants and staff have appropriately attempted to provide a more comprehensive view of some issues than MAC and to summarize some of the broader implications of airport planning. This led the Council consultants during the adequacy study to attempt to make very precise statements about future airport adequacy, to examine the benefits and costs of capacity enhancement, and to look for an alternative noise measurement tool which would better capture the conflicting effects of increasing flights and quieter aircraft on noise stress.

**Council consultants and staff have made a number of technical errors.**

However, we found that:

- **The Metropolitan Council staff and consultants have used a number of methods and reached some key conclusions which are questionable.**

The serious problems we found with the technical aspects of Council studies or analyses were that:

- **The Council consultants used an inappropriate method for identifying when the airport is likely to become inadequate.**

- **The benefit/cost analyses completed by Council consultants in 1988 and 1990 were based on extremely high estimates of current and future operational delays at MSP. As a result, the analyses overstated the benefits of capacity enhancement, which were measured. However, because the analyses did not include a number of other benefits and costs, it is unclear what a corrected analysis will show.**

- **The noise analysis in the adequacy study was based on faulty statistical analysis and methods.**

- **The Council staff and consultants have provided the Council with erroneous analyses of trends in hubbing activity at MSP (the use of MSP as a connecting point for travelers).**

This does not mean that all Council airport planning work has had problems. Indeed, some very good work has also been done. However, we have serious concerns about the technical merits of some important Council analyses and

feel that the technical weaknesses of the consultants and staff should be immediately addressed by the Council.

## Presentation of Planning Work

**Studies produced by the Council and MAC are unnecessarily difficult to understand.**

A lesser, but also important, concern is that:

- **The forecasts and other technical work done by both the Council and MAC have not been clearly presented and summarized for policy makers.**

This concern is both a general and a very specific one. In general, we found that both agencies could do a better job of summarizing the assumptions and conclusions of their technical work. While the dual-track process is open to public participation and characterized by many committees and public meetings, the many technical documents produced thus far are difficult to collect, read, and understand. The documents, such as those dealing with aviation forecasts and their implications for airport adequacy, are complex and not well summarized. We feel that better summaries of assumptions, historical trends, forecasts, and conclusions should be available to policy makers and interested public participants.

Some specific concerns we had were that:

- **The Council consultant's forecasts have not been itemized by type of aircraft operation in the main forecast report going to the Legislature. For the adequacy study, we could not find a breakdown by type of aircraft for the year 2018 in any report, even though the Council was predicting that regional airline operations would exceed the operations of major air carriers such as Northwest Airlines.**

- **The MAC long-term comprehensive plan itemized $3 billion in noise mitigation costs as a cost of any MSP expansion plan even though there is general agreement that this estimate prepared by surrounding communities significantly overstates the costs of mitigation.**

In addition, we also found that the Council's consultants and staff need to do a better job of documenting their analyses. For example, we found it was difficult to determine what assumptions were used in the Council forecasts because their consultants, in contrast to MAC's consultants, did not always write down all their assumptions and put them in one document. In addition, the Council consultant had difficulty in providing us with details of important analyses done in 1988 and 1989.

## Future Planning Work

**The remaining planning work appears comprehensive but the Council needs to protect all viable options at MSP.**

Our study also included a limited review of the plans for remaining work on the dual-track planning process. Overall, we found that:

- **It appears that the Council and MAC will be addressing all of the key issues which need to be addressed during the dual-track process.**

In addition:

- **It appears that both agencies are interested in taking a strategic and flexible approach to addressing the region's future airport problems.**

However, it is difficult to fully endorse the agencies' plans since they have not yet carried out the needed studies and we have serious concerns about how the Council staff and its consultants carried out some of their previous planning work.

One important piece of planning work that had been missing from the Council's agenda, until we brought it to the attention of the chair and staff, is that:

- **The Council had not done, or planned to do, the necessary planning work to protect the North/South runway option or other runway options at MSP.**

The North/South runway is MAC's preferred option if capacity is added to MSP. That option would require acquisition of several hotels in Bloomington which are in the flight path or safety zone of the runway. We found that the Council staff assigned to the dual-track process were not aware of whether the Council had sufficient authority to prevent additional development in those areas. In addition, the Council and its staff had no plans to work with either the affected communities or the Legislature to make sure that any development would be compatible with that option or other runway options. This situation is in direct contrast with the new airport search area where the Council has direct statutory authority to limit development. Following our discussion of this concern with the Council chair and staff, the Council has begun to seek consultant and legal advice on how best to address the issue.

# RECOMMENDATIONS

We have recommendations in the following four areas: 1) improving the technical adequacy of planning work, 2) improving the presentation and documentation of planning studies, 3) revising current forecasts and monitoring MSP aviation activity, and 4) protecting the North/South runway option or other expansion options at MSP.

## Technical Adequacy

Based on our findings, we are particularly concerned that the Metropolitan Council have adequate staff and consultant support. While the Council staff assigned to the dual-track process are good general planners and facilitators of the planning process, we are concerned that the staff are not adequately equipped to evaluate the technical merits of analyses done by either the Council or MAC consultants. In addition, the Council's consultants, while providing some useful insights, have made some questionable judgments in methods and conclusions. We recommend that:

**The Council needs to strengthen its technical support.**

- **The Council should take prompt action to address these problems concerning its staff and consultant support.**

- **The Council's action could include a number of options: 1) alter or supplement its staff resources, 2) alter or supplement its consultant resources, 3) use expert panels during later stages of study not just at the initial stage before a study is begun, and 4) make sure that their consultants and staff coordinate their efforts with MAC staff and consultants to ensure that the agencies are using similar and appropriate methods.**

## Presentation and Documentation

Both agencies need to improve their written presentation of technical reports. The Council's consultants also need to improve their documentation of analyses. We recommend that:

- **The Council and MAC staff and consultants should ensure that the principal conclusions of analyses and their key assumptions are summarized better for policy makers and the public.**

- **The Council staff should ensure that their consultants provide the Council with adequate documentation of their methods, assumptions, and results.**

## Forecasts and Monitoring

While we take issue with the forecasts published in 1988, we found that the forecasting methods and results used in 1990 were generally more reasonable. Currently, the Council and MAC are once again in the process of revising the dual-track aviation forecasts. We recommend that:

- **The Council and MAC should consider revising downward their forecast of long-term enplanements because the hubbing ratio will probably not increase as forecast.**

- **The Council and MAC should consider adjusting their long-term estimate of regional operations to a level between those forecast by the two agencies in 1990. They should also consider developing a better model for forecasting long-term regional airline enplanements and operations.**

- **The Council and MAC should consider downward adjustments in the long-term forecasts of domestic air carrier operations.**

- **The Council should drop the formal use of risk analysis but continue to emphasize the fundamental uncertainty of the forecasts.**

- **As part of the annual monitoring process, Council and MAC staff should consult more closely with Northwest Airlines and its regional airline partners regarding their plans for future operations at MSP.**

**The Council and MAC should more closely monitor the plans of Northwest Airlines and its regional airline partners.**

Although we do not recommend changing the timing of the dual-track process at this time, we recommend the following:

- **As part of the current forecasting process, the Council and MAC staff and consultants should assess the short-term prospects for operations growth and assess whether there is a sufficient risk that the region may need extra capacity before the year 2005.**

- **The Council and MAC should closely monitor Northwest's financial condition and be prepared to recommend modifications in the dual-track process if warranted.**

## Protection of Development Options at MSP

The purpose of the dual-track process was to conduct a rigorous and comprehensive evaluation of options for adding airport capacity. The Council sought, and the Legislature provided, land use restrictions for new airport search areas. However, the Council staff has not researched the Council's authority to review and limit development which might jeopardize the use of a North/South runway at MSP -- MAC's preferred expansion option at MSP – or other MSP development options. In addition, until recently, the Council staff had not planned any dual-track activities to address this concern. We recommend that:

- **The Metropolitan Council should have its staff report on whether the Council needs more authority or needs to be more proactive in working with affected communities to ensure that future development does not jeopardize viable development options at MSP.**

# Introduction

At the direction of the 1987 Legislature, the Metropolitan Council undertook a study of the long-term adequacy of the Minneapolis-St. Paul International Airport (MSP) to meet the aviation needs of the Twin Cities area for the next 30 years. The Council's adequacy study examined both the physical capacity of the airport to handle future aviation demand and the airport's environmental capacity. Completed in December 1988, the study concluded that:

- **At least one new runway would probably be needed at MSP within the next 5 to 10 years.**
- **A second new runway at MSP or a new airport would probably be needed to meet the air traffic projected for the next 15 to 30 years.**
- **Even with the introduction of quieter aircraft, the projected greater frequency of flights would increase noise stress on most communities surrounding MSP and affect more households over time.**

The Council recommended, the Metropolitan Airports Commission (MAC) supported, and the 1989 Legislature adopted, a dual-track process which would simultaneously consider both the MSP expansion and new airport options at the same time. Since passage of the 1989 Airport Planning Act, the Metropolitan Council has selected a search area for a new airport and MAC is now examining alternative sites within the Dakota County search area. In addition, both the Council and MAC have revised their forecasts for aviation operations and passengers. Based on its revised forecasts, MAC developed a long-term plan for MSP which is designed to meet the aviation demand now projected for the year 2020. The Council has also prepared a draft decision document which outlines the key issues which will be addressed during the remainder of the dual-track process and will serve as the foundation for the Council's ultimate recommendations to the Legislature regarding future airport development. Finally, the Council has prepared a reuse study which examines alternative uses for MSP in the event that a new airport is built and MSP is closed.

**Much of the dual-track planning work is not scheduled to be completed for several years.**

Much of the work for the dual-track process has not yet been completed. Over the next three years, the Council and MAC will prepare an environmental im-

pact statement for various alternatives, conduct economic and community impact studies, update the MSP long-term plan, and prepare the final decision document. A recommendation to the Legislature is due by July 1996.

Although the dual-track process is intended to provide a rational and deliberate approach to airport planning, the process has become controversial. Proponents of the main options have become suspicious of the motives of one or both of the planning agencies and very critical of some of the products produced by the agencies. Our evaluation was conducted because legislators wanted an objective, independent review of the planning process and the assumptions used and analyses conducted by the Council, MAC, and their respective consultants. This study examines the following general concerns about the planning process:

- **Is the process being conducted in a technically competent manner?**
- **Is the process designed to be comprehensive and complete?**
- **Is the process being conducted over an appropriate time frame?**
- **Are any changes in the dual-track strategy needed at this point?**

Because concerns about the physical capacity of the current airport were highlighted in the adequacy study as the key reasons to initiate the dual-track process, our evaluation focused considerable attention on the aviation forecasts and analyses of airport adequacy prepared during and after the adequacy study. Furthermore, legislators were concerned about whether the agencies' aviation forecasts had been appropriately updated in response to recent changes in the airline industry. Good forecasting and analysis is essential for assessing how much additional runway and terminal capacity may be needed in the future and thus will help determine how well suited MSP or a new airport are for meeting future airport demand.

**Our study focuses on the work completed thus far.**

Our evaluation also focuses on the analyses of noise impacts conducted thus far by the Council and MAC. As part of the adequacy study, the Legislature asked the Council to examine the environmental capacity of MSP. However, conclusions about future noise problems reached by the Council and its consultants during the adequacy study differ significantly from the conclusions reached by MAC and its consultants since that study. As a result, we examined in detail the methods used by both agencies and contrasted them to methods used by national experts.

To conduct this study, we conducted interviews with the involved agencies, their consultants, outside experts, and interested participants in the process. We reviewed and critiqued the extensive studies and technical documents prepared by the planning agencies. Finally, we reviewed the relevant literature.

Chapter 1 of this report provides an overview of the 1988 airport adequacy study and the dual-track planning process which began in 1989. Chapter 2

examines in detail the aviation forecasts made by the Council and MAC. In addition, Chapter 2 reviews the conclusions each agency reached about future airport adequacy. Chapter 3 evaluates the noise analyses done by the Council and MAC. Chapter 4 discusses our general findings about the dual-track process and presents recommendations.

# Background

**CHAPTER 1**

**In 1987, the Legislature asked for a study of the physical and environmental capacity of MSP.**

In the 1970s and 1980s, the Minneapolis-St. Paul International airport (MSP), like every major airport in the nation, experienced a significant growth in operations. As we discuss in Chapter 2, growth at MSP was rapid through the mid-1980s. The growth in air traffic at MSP caused increased annoyance with airport noise and concern about the capacity of the airport to handle continued growth in the future.

Minnesota responded to the rapid growth of aviation with a unique dual-track airport planning process that required detailed analysis and design of two alternative (and mutually exclusive) sites for the Twin Cities' major airport.

The 1987 Legislature initiated the process now being carried out by the Metropolitan Council and the Metropolitan Airports Commission (MAC) when it directed the Council to conduct "an analysis of the physical and environmental capacity of the Minneapolis-St.Paul International Airport."[1] The analysis was to cover a prospective 30-year period and assess:

- the cost and benefit of various capacity enhancements;
- the effect of various capacity enhancements on the physical and environmental capacity of the airport, neighboring communities, and the airport's economic and transportation function and benefit.

The Council responded in late 1988 with the publication of the airport adequacy study.[2] This study recommended a dual-track planning process designed to prepare both for expanding MSP and development of an airport to replace MSP. The study argued that there was a substantial possibility, even a probability, that MSP as built would be inadequate before the end of the 1990s. It also argued that the MSP site, however developed, would likely

1 *Minn. Laws* (1987), Ch. 223, Section 4.

2 The adequacy study was presented in a number of separate reports. The main technical report of the study was called *Is the Airport Adequate? Report of the Minneapolis-St. Paul International Airport Adequacy Study Advisory Task Force to the Metropolitan Council* (October 1988). We refer to this and other adequacy study documents throughout this report and use the term "adequacy study" to refer to the entire adequacy study project.

prove inadequate before 30 years was up. A Council report to the Legislature[3] made these points:

- "A high probability exists that growing demand for aviation services will exceed the capacity of MSP within 10 years." (p. 3)
- "Even if every reasonable capacity enhancement is made at the existing airport, there is a significant risk that we will exceed even that capacity in the next 20 years." (p. 1)
- "Even with the steady introduction of quieter aircraft, a growing frequency of flights will increase noise stress on most surrounding communities affecting more households over time." (p. 3)
- "The Metropolitan Area risks foregoing substantial economic gains if airport capacity is not expanded in a timely fashion over the next 30 years." (p. 3)

One purpose of the study presented here is to examine, to the extent possible, whether these premises are still valid, or if the dual track planning process should be re-focused in some way. We examine these issues in Chapters 2 and 3 and present our conclusions and recommendations in Chapter 4.

# THE AIRPORT PLANNING ACT OF 1989

**The dual-track planning process was recommended by the Council in late 1988, and enacted by the Legislature in 1989.**

The recommendations of the adequacy study were substantially implemented by the 1989 Airport Planning Act.[4] The Act set out important requirements for both the Metropolitan Council and the Metropolitan Airports Commission (MAC). The key requirements for the Metropolitan Council set forth in this legislation are:

- An annual assessment, due by February 15 each year, of air transportation trends and factors that may affect major airport development in the metro area for a prospective 30 year period;
- A revised Aviation Chapter in the Metropolitan Development Guide that will include policies and alternatives applicable to the current airport and a possible replacement airport, due February 1, 1990;
- A report by the Council by February 1990 recommending methods for protecting a new airport search area from conflicting development or land speculation;
- A report by March 1990 on forecasting assumptions;

3 *Twin Cities Air Travel: A Strategy for Growth, A Report to the Minnesota Legislature* (December 1988). This is the Council's final report of the adequacy study.

4 *Minn. Laws* (1989), Ch. 279.

- A report by March 1990 analyzing long-range aviation goals;
- A report by December 1990 on the general availability of land suitable for a new airport;
- Designation of a new airport search area by January 1, 1992; and
- A report by January 1993 on policies for the reuse of the existing airport site.

The key requirements for the Metropolitan Airports Commission under the dual-track planning process are:

- A new Long-Term Comprehensive Plan for Minneapolis-St. Paul International Airport covering aviation demand, airport capacity, facilities requirements, a plan for physical development, operational issues, environmental issues and safety. This was due (as the 1989 law was amended) in January 1992.
- A conceptual design study and conceptual plan for the new airport, due by March 1990;
- Designation of a site for the new airport and a new airport comprehensive plan. Site selection is now scheduled to be completed by the end of 1993, and a new airport comprehensive plan by mid-1994. The required federal and state environmental impact statements are scheduled to be completed by the end of 1995.

**Recommendations on airport development are due by July 1996.**

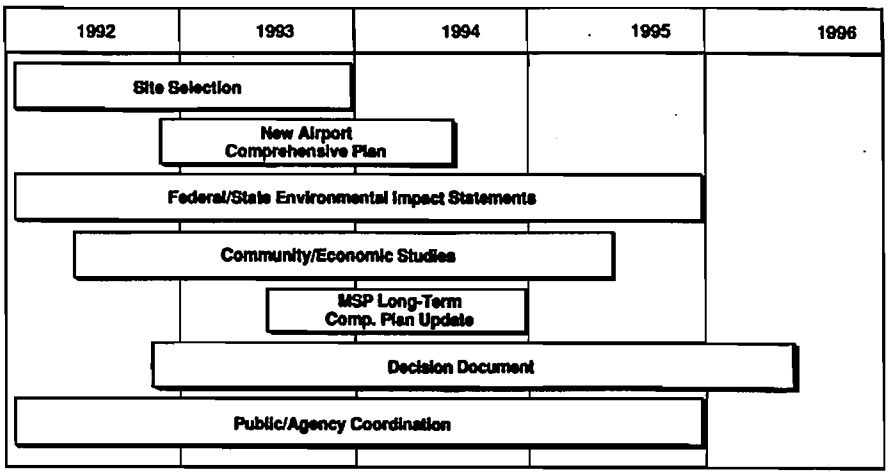
All the Metropolitan Council and MAC documents described above that are due by now have already been produced.

The final product of the dual-track planning process, due within 180 days of the completion of the comprehensive plans and required environmental documents for MSP and a new major airport, will be a report by MAC and the Council called the "Airport Decision Document." Under the terms of the 1989 law, this report is to include recommendations of the agencies on major airport development for a 30-year period, and on acquiring a site for a new major airport including recommendations on financing. The outside deadline for this report is July 1996. As late as mid-1992 there was talk of moving up the deadline for this final product by a year, but neither the Council or MAC are suggesting this is likely any longer.

# OUTLINE OF THE DUAL-TRACK PLANNING PROCESS

Figure 1.1 presents an outline of the dual-track process. By the beginning of 1992, the new MSP Long-Term plan had been written and a search area in

**Figure 1.1: Proposed Schedule for 1992-96**




Source: Metropolitan Airports Commission.

Dakota County had been chosen. As the figure shows, by the end of 1993 a site is to be chosen for the new airport, and by mid-1994 a comprehensive plan for the new airport is to be completed. A conceptual plan has already been prepared. By the end of 1994, the MSP Long-Term Comprehensive plan will be updated, and by the end of 1995 environmental impact statements will be completed for both alternatives as well as community and economic impact studies. By July 1996, the Council and MAC are scheduled to give the Legislature their recommendations.

In summary, the major products of the dual track planning process to date are:

- Annual contingency assessment reports;
- Revised aviation forecasts;
- Search area designation; and
- The MSP Long-Term Comprehensive Plan.

The major products to be produced in the future:

- Selection of a site for the new airport;
- A new airport comprehensive plan;
- Environmental impact statements for both MSP and the new airport;
- Studies of economic and regional impacts; and
- A recommendation for the Legislature on how to proceed.

# AIRPORT PLANNING COSTS

**The airport planning process is costly and complex, but future airport development will cost billions of dollars.**

This description suggests that the airport planning process is complex, time-consuming, and costly. Even advocates of the dual-track planning process acknowledge that it is more costly than airport planning as typically practiced around the country. A key point to consider, however, is that the cost of a new airport is estimated to be three to five billion dollars, and a new runway and terminal at MSP will cost about one and a half billion dollars. A few million dollars in airport planning will be well spent if it produces accurate, reliable information that will improve policymakers' ability to reach a wise decision. In addition, a substantial part of the cost of airport planning is federally financed.

## Metropolitan Council Planning Costs

As data in Table 1.1 show, the Council has spent about $2.5 million between 1987 and 1992 on airport planning connected to the dual track planning process, including the airport adequacy study. In the period, 1993 to 1996 they anticipate spending an additional $1.4 million. Of the expenditures through 1992, over $1.5 million of the $2.5 million was used to hire consultants. The Council's lead airport planning consultant is Apogee Research Inc., whose work is discussed in Chapters 2 and 3. The main components of airport planning performed by the Council are:

### Table 1.1: Summary of Metropolitan Council Expenditures for Dual-Track Planning Activities, 1987-92

| Year | Airport Adequacy Study | Contingency Assessment | Search Area Activities | MSP Reuse Study | Economic and Regional/ Community Impacts | Staff-Related Activities | Total |
|---|---|---|---|---|---|---|---|
| 1987 | $100,500[s] | -- | -- | -- | -- | -- | $100,500 |
| 1988 | 137,620[s]<br>155,000[c] | -- | -- | -- | -- | -- | 292,620 |
| 1989 | -- | $ 75,000[c] | $ 75,000[c] | -- | -- | $195,000[s] | 345,000 |
| 1990 | -- | 60,000[c] | 237,000[c] | -- | -- | 155,000[s] | 522,000 |
| 1991 | -- | 65,000[c] | 210,000[c] | $ 30,000[c] | -- | 163,000[s] | 468,000 |
| 1992 | -- | 124,000[c] | -- | 220,000[c] | $ 79,000[s]<br>160,000[c] | 196,000[s*] | 779,000 |
| Total | $393,120 | $324,000 | $592,000 | $250,000 | $239,000 | $709,000 | $2,507,120 |

Source: Metropolitan Council.

(s)-Expenditure for staff support.
(c)-Expenditure for consultant services.
(*)-Estimate (two times first six months).

- The Airport Adequacy Study in 1987-88;
- Contingency assessments each year since 1989;
- Search area selection;
- MSP Reuse Study; and
- Studies of economic and regional/community impacts.

Table 1.1 shows the approximate cost of each of these components along with unallocated staff costs. We have already described the adequacy study briefly and Chapters 2 and 3 evaluate how it handles analysis of airport activity forecasts and airport noise. As Table 1.1 shows, this component cost about $155,000 in consultant fees in 1988 and an additional $238,120 in staff costs in 1987 and 1988 ($100,500 plus $137,620).

**Most of the work of the dual-track airport planning process is done by consultants.**

The Council has staffed a contingency planning process and published annual contingency assessments in February of 1990, 1991 and 1992 as required by the 1989 Airport Planning Act. These studies update information on airport activity and examine forecasted activity levels against recent data. The consultant costs associated with contingency assessment total $324,000 between 1989 and 1992.

The Council conducted a lengthy search area process between 1989 and 1991. They first investigated the general availability of land for an airport, then identified three candidate search areas, and finally chose an area in Dakota County consisting of large parts of Marshan, Vermillion, and Empire Townships. This process cost $592,000 in consultant fees, as Table 1.1 shows.

The 1989 law called for the Council to conduct a study of the possible reuse of MSP, and this report was completed in 1992. As Table 1.1 shows this cost a total of $250,000 in consultant fees in 1991 and 1992. The Reuse Study was prompted in part by the idea that a new airport could be financed in part by revenues derived from the redevelopment of the old site, but the Reuse Study finds that this is unlikely.

Finally, in 1992 a total of $239,000 including $160,000 for consultants was spent on studies of social and economic impacts of airport development. Most of this work is being performed under contract to MAC as part of the environmental review process that is required by the Federal Aviation Administration. No major reports have been published as a result of this work yet.

## MAC Planning Costs

As noted, MAC produced the MSP Long-Term Comprehensive Plan in December 1991 and the conceptual plan for the new airport in January 1991. As Table 1.2 shows, the Long-Term Comprehensive Plan cost about $1.7 million in consultant billings, and the new airport studies cost about $1.4 million in

## Table 1.2: MAC Airport Planning Expenditures, 1989-92

| | MSP Long-Term Comprehensive Plan | New Airport Studies |
|---|---|---|
| 1989 | -- | $41,394 |
| 1990 | $6,049 | 26,677 |
| 1991 | 806,600 | 471,526 |
| 1992 | 895,194 | 861,424 |
| Total Expenditures Through 1/93[a] | $1,707,843 | $1,401,021 |
| Total Authorized by MAC[b] | $2,349,558 | $2,503,086 |

Source: Metropolitan Airports Commission.

[a]Consultant costs only.

[b]Includes amounts for 1993.

billings as of January 1993. A total of $2.5 million was authorized for new airport studies and $2.3 million for the Long-Term Comprehensive Plan.

The lead airport planning consultant for MAC is Howard Needles Tammen & Bergendoff (HNTB) whose work in activity forecasting and noise analysis is discussed extensively in later chapters. MAC estimates that about one full-time staff position is dedicated to the airport planing process, but the cost of MAC staff is not separately identified in Tables 1.2 or 1.3.

Table 1.3 shows the amounts budgeted by MAC for the airport planning process between 1992 and 1996. A million dollars or more is scheduled to be spent on site selection, environmental documentation, and coordination and public review. Altogether, about $4 million is budgeted by MAC during this period. About $3 million is budgeted for 1993 to 1996. The detailed environ-

## Table 1.3: Dual-Track Airport Planning Process, 1992-96 MAC Budget Summary

| | 1992 | 1993 | 1994 | 1995 | 1996 | Total |
|---|---|---|---|---|---|---|
| Site Selection | $442,600 | $380,840 | $205,880 | -- | -- | $1,029,320 |
| Environmental Documentation | 274,500 | 382,340 | 241,560 | $219,600 | -- | 1,118,000 |
| Regional Community Impacts[a] | 5,000 | 20,000 | 15,000 | 7,500 | $2,500 | 50,000 |
| Economic Impacts[a] | 5,000 | 20,000 | 15,000 | 7,500 | 2,500 | 50,000 |
| Ongoing MSP Analysis | 120,000 | 140,000 | 140,000 | -- | -- | 400,000 |
| Decision Document | 7,850 | 15,700 | 47,100 | 62,800 | 23,550 | 157,000 |
| Coordination/Public Review | 262,020 | 262,020 | 262,020 | 262,020 | 142,920 | 1,191,000 |
| Total | $1,116,970 | $1,220,900 | $926,560 | $559,420 | $171,470 | $3,995,320 |

Source: Metropolitan Airports Commission.

[a]Metropolitan Council also doing work in these areas under contract to MAC.

mental analysis required for site selection and environmental documentation is costly, and under the dual-track process, must be done for two alternatives. Various consulting firms in addition to HNTB, as well as the Minnesota Department of Natural Resources and (as noted) the Metropolitan Council under contract to MAC are also involved in these studies.

The planning process is multifaceted as this brief review has shown. By design, there has been an emphasis on public hearings and public participation during each study component. There have been numerous advisory committees set up as part of the planning process to provide various opportunities for the public to become involved. These include:

**Many committees and advisory groups have provided input to the planning process.**

- **The State Advisory Council.** This body was established by the Legislature to provide a forum at the state level for education, discussion and liaison to the Legislature on airport planning. The council has 23 members including legislators, agency representatives, industry representatives, representatives of the communities affected by airport planning decisions, and others.

- **Contingency Planning Group.** This group is composed of Metropolitan Council and MAC members and oversees the annual contingency planning process required by the act.

- **Interagency Committee.** A joint committee of MAC and the Council created by the Legislature, designed to oversee the dual-track planning process.

- **MSP Airport Task Force.** This committee advised MAC on policy issues during the development of the Long Term Comprehensive Plan for MSP. The committee included representatives of airport uses, the business community, MAC, the Council, various federal, state and local agencies, and the general public.

- **Site Selection Task Force.** This committee will advise MAC during the site selection study. Membership will include representatives of federal, state and local government, airport users, and the business community. After the site is selected, this group will advise MAC during the preparation of the Comprehensive Plan for the new airport.

This is not a complete list of the current or previous ad hoc committees set up to provide input or review of airport planning components. Other important committees are the MSP Interactive Planning Group formed to obtain input from the communities adjacent to MSP during the preparation of the Long Term Comprehensive Plan, and the MSP Reuse Task Force, which recently completed its study of the potential reuse of MSP. There are regular hearings of MAC and the Met Council and committees of each that deal with airport planning issues. In addition, there are regular meetings of the Metropolitan Aircraft Sound Abatement Council (MASAC). There are many venues in which airport planning is discussed and some parties interested in the debate

have said that it is difficult to keep track of when and where issues of concern will be discussed.

# Activity Forecasts

**CHAPTER 2**

The most important reason given for implementing a dual-track planning process was the imminent need to increase capacity at the existing airport. In its 1988 adequacy study, the Metropolitan Council concluded that, according to its projections, a new runway would be needed in the next 5 to 10 years even with the use of various demand-management techniques. In addition, the Council projected that a second additional runway or a new airport would be needed in the longer term -- the next 15 to 30 years.[1] In fact, the Council chair concluded that even "if every reasonable capacity enhancement is made at the existing airport, there is a significant risk that we will exceed even that capacity in the next 20 years."[2] Based on these estimates and the lack of a consensus regarding the best option, the Council recommended and the Legislature adopted the dual-track airport planning process.

This chapter reviews in detail the activity forecasts made during the adequacy study as well as the subsequent forecasts made at the outset of the dual-track planning process. In addition, we evaluate the analysis accompanying the forecasts which led planners to conclude that the existing airport would be inadequate relatively soon. In particular, we examine the following questions:

- **What activity forecasts have been made by the Metropolitan Council and the Metropolitan Airports Commission and what were the implications of these forecasts for the adequacy of the existing airport?**
- **Were the forecasts reasonable and made in a technically competent manner?**
- **Have the forecasts been used appropriately by the staffs of the two agencies?**
- **Have the important assumptions and implications of the forecasts been made clear to policymakers?**
- **Do the most recent forecasts need revision?**

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*1* Metropolitan Council, *Twin Cities Air Travel: A Strategy for Growth, A Report to the Minnesota Legislature* (December 1988), 9.

*2* *Ibid.*, 1.

- **In light of our findings, does the timing or substance of the dual-track planning process need to be reconsidered?**

# BACKGROUND

Both the Metropolitan Council and the Metropolitan Airports Commission (MAC) have made activity forecasts over the last five years. Each agency has issued two sets of forecasts. The first set of forecasts was issued in December 1988 in the Council's airport adequacy study and in MAC's MSP 2000+ Airport Development Plan. Following the 1989 Legislature's passage of the airport planning act, the agencies each issued a second set of forecasts. The second set of forecasts were released in early 1990 -- less than a year and a half after the initial set of forecasts.[3]

To prepare the forecasts and to conduct other dual-track planning work, the two agencies have utilized consultant firms experienced in aviation consulting. MAC's principal consultant has been Howard Needles Tammen & Bergendoff, while the Council's principal consultant has been Apogee Research Inc. Both agencies have also used other consulting firms to make specific forecasts or conduct certain analyses.

## Past Trends

Before examining the forecasts, it is useful to become familiar with past activity trends at the Minneapolis-St.Paul International Airport (MSP) and with the main terminology used in the forecasts. Tables 2.1 and 2.2 provide historical data on the number of operations at MSP from 1972 to 1992 and on the number of passenger enplanements at MSP over the same period. Operations, which include the number of landings and takeoffs of aircraft, are particularly important for planning runway capacity. Enplanements count the number of passengers on flights taking off at MSP. Enplanements are useful for planning the airport's ground facilities such as terminal size and parking ramps.[4]

Both operations and enplanement data are broken down into a number of categories. Operations data include domestic air carriers (such as Northwest Airlines), regional air carriers (such as Mesaba Airlines), scheduled international flights, non-scheduled (charter) domestic and international flights, and operations by cargo, general aviation, and military aircraft. Enplanement data are provided for domestic air carriers, regional carriers, international flights, and non-scheduled flights.

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*3* See Metropolitan Council, *First Annual Contingency Assessment: Major Airport Strategy,* February 1990, and Metropolitan Airports Commission, *Minneapolis-St. Paul International Airport Long-Term Comprehensive Plan, Volume 3: Activity Forecasts* (March 1990).

*4* In addition to enplanements, the total number of passengers using MSP would include deplanements -- those passengers arriving at MSP.

## Table 2.1: Operations at MSP, 1972-92

| Year | Domestic Scheduled | | Scheduled International | Non-Scheduled | Cargo | General | Military | Total[a] |
|---|---|---|---|---|---|---|---|---|
| | Air Carrier | Regional | | | | | | |
| 1972 | 115,698 | 6,478 | 20 | NA | 1,850 | 92,687 | 15,910 | 232,643 |
| 1973 | 126,712 | 6,532 | 16 | NA | 1,558 | 97,191 | 14,180 | 246,189 |
| 1974 | 124,258 | 6,888 | 6 | NA | 1,098 | 86,353 | 9,180 | 227,783 |
| 1975 | 123,826 | 8,472 | 0 | NA | 852 | 89,321 | 7,985 | 230,456 |
| 1976 | 128,296 | 9,364 | 0 | NA | 534 | 96,764 | 6,222 | 241,180 |
| 1977 | 132,370 | 9,006 | 0 | 4,090 | 1,016 | 103,239 | 6,260 | 255,981 |
| 1978 | 118,668 | 11,014 | 6 | 5,130 | 1,168 | 115,106 | 6,698 | 257,790 |
| 1979 | 143,246 | 12,306 | 0 | 4,014 | 1,412 | 116,738 | 6,080 | 283,796 |
| 1980 | 146,524 | 12,128 | 338 | 2,972 | 1,680 | 114,260 | 6,604 | 284,506 |
| 1981 | 146,338 | 9,904 | 460 | 3,666 | 1,912 | 97,278 | 5,606 | 265,164 |
| 1982 | 150,450 | 22,838 | 386 | 3,552 | 2,700 | 82,303 | 5,359 | 267,588 |
| 1983 | 170,108 | 33,924 | 366 | 4,374 | 3,304 | 83,548 | 5,100 | 300,724 |
| 1984 | 189,830 | 35,938 | 506 | 3,290 | 6,094 | 93,367 | 7,721 | 336,746 |
| 1985 | 220,190 | 31,460 | 628 | 4,356 | 5,446 | 106,715 | 14,020 | 382,815 |
| 1986 | 231,760 | 50,520 | 680 | 3,064 | 12,490 | 71,406 | 6,869 | 376,789 |
| 1987 | 213,540 | 56,410 | 614 | 3,664 | 15,622 | 70,050 | 8,676 | 368,576 |
| 1988 | 211,562 | 58,888 | 514 | 4,024 | 18,148 | 68,634 | 6,698 | 368,468 |
| 1989 | 218,339 | 59,338 | 717 | 3,334 | 16,963 | 61,048 | 4,291 | 364,030 |
| 1990 | 224,117 | 74,447 | 860 | 4,488 | 18,291 | 54,780 | 2,802 | 379,785 |
| 1991 | 225,430 | 75,778 | 1,078 | 5,046 | 20,059 | 52,145 | 2,480 | 382,016 |
| 1992[b] | 243,502 | 85,930 | NA | 5,823 | 18,691 | 58,963 | 2,993 | 415,902 |

Source: Metropolitan Airports Commission.

[a]Does not include non-scheduled operations prior to 1977.

[b]Scheduled international operations are included in domestic air carrier operations for 1992.

## Table 2.2: Passenger Enplanements at MSP, 1972-92

| Year | Domestic Scheduled | | Scheduled International | Non-Scheduled | Total[a] |
|---|---|---|---|---|---|
| | Air Carrier | Regional | | | |
| 1972 | 2,728,698 | 15,137 | 128 | NA | 2,743,963 |
| 1973 | 3,069,157 | 14,402 | 0 | NA | 3,083,559 |
| 1974 | 3,225,025 | 16,155 | 0 | NA | 3,241,180 |
| 1975 | 3,228,564 | 21,255 | 0 | NA | 3,249,819 |
| 1976 | 3,559,928 | 26,484 | 0 | NA | 3,586,412 |
| 1977 | 3,768,227 | 28,021 | 0 | 206,972 | 4,003,220 |
| 1978 | 3,856,777 | 35,226 | 372 | 241,157 | 4,133,532 |
| 1979 | 4,588,271 | 49,087 | 0 | 218,745 | 4,856,103 |
| 1980 | 4,285,217 | 42,547 | 28,662 | 153,441 | 4,509,867 |
| 1981 | 4,391,802 | 30,137 | 57,871 | 139,954 | 4,619,764 |
| 1982 | 5,071,395 | 75,774 | 50,574 | 157,264 | 5,355,007 |
| 1983 | 5,702,094 | 118,783 | 49,474 | 172,430 | 6,042,781 |
| 1984 | 5,986,288 | 130,610 | 73,014 | 245,014 | 6,434,926 |
| 1985 | 7,114,367 | 156,825 | 83,533 | 352,841 | 7,707,566 |
| 1986 | 7,845,494 | 290,700 | 81,700 | 291,656 | 8,509,550 |
| 1987 | 8,171,206 | 366,374 | 85,023 | 259,621 | 8,882,224 |
| 1988 | 8,023,121 | 397,835 | 64,708 | 348,910 | 8,834,574 |
| 1989 | 8,347,059 | 415,616 | 78,910 | 341,515 | 9,183,100 |
| 1990 | 8,609,638 | 495,327 | 102,673 | 384,718 | 9,592,356 |
| 1991 | 8,685,226 | 488,763 | 122,431 | 353,590 | 9,650,010 |
| 1992[b] | 9,731,173 | 559,673 | NA | 412,862 | 10,703,708 |

Source: Metropolitan Airports Commission.

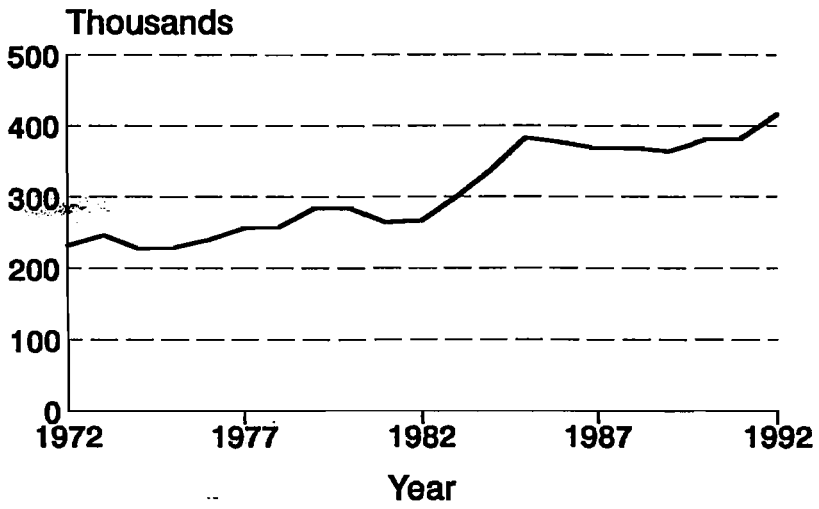
[a]Does not include non-scheduled passengers prior to 1977.

[b]Scheduled international enplanements are included in domestic air carrier enplanements for 1992.

As Figure 2.1 shows, operations grew steadily during the 1970s. Following the recession of the early 1980s, growth in operations picked up significantly until the mid-1980s. The number of operations was then relatively steady between 1985 and 1991. While the number of regional carrier operations continued to grow, domestic air carrier operations were lower in 1991 than in 1986 -- the year that Northwest and Republic airlines merged. Furthermore, on balance, other types of operations have declined due to a sizeable decrease in general aviation operations.

**Airport operations did not grow between 1985 and 1991 but increased nine percent in 1992.**

**Figure 2.1: Operations at the Minneapolis-St. Paul International Airport, 1972-92**




Source: Metropolitan Airports Commission.

However, in 1992, operations grew nine percent -- going from 382,000 to 416,000 operations. Strong growth occurred in three categories: domestic air carrier, regional airline, and general aviation operations.

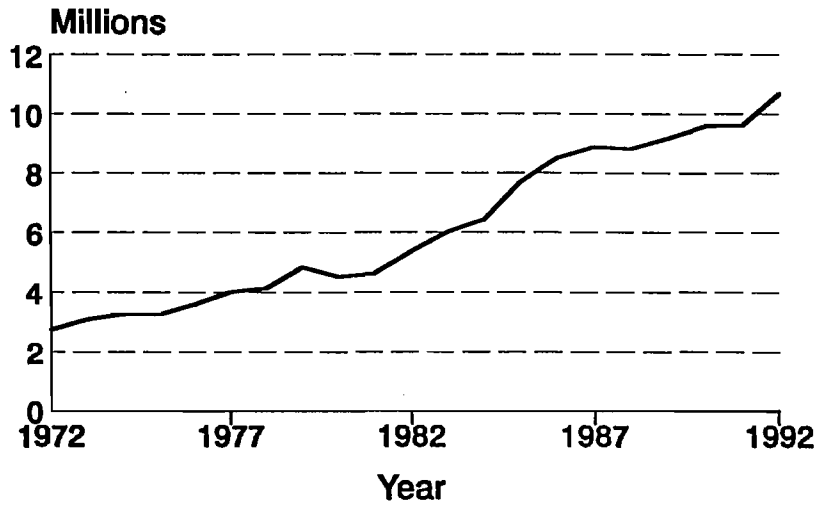
Figure 2.2 shows that enplanements have grown strongly throughout the last 20 years. This growth was particularly strong from 1981 to 1986 following federal deregulation of the airline industry. The growth slowed between 1986 and 1991, but picked up again in 1992.

## 1988 Forecasts

In December 1988, both the Council and MAC released forecasts for future airport activity. These forecasts are somewhat similar, but differ in two respects. The Council forecasts for operations and enplanements were for a prospective 30-year period (1988-2018) while the MAC forecasts were for a 20-year period (1988-2008). In addition, while the MAC forecasts included all types of airport activity, the Council forecasts did not include nonscheduled, cargo,

**The growth in passengers using MSP has been fairly steady.**

## Figure 2.2: Enplanements at Minneapolis-St. Paul International Airport, 1972-92




Source: Metropolitan Airports Commission.

general aviation, and military flights. Tables 2.3 and 2.4 provide the details of the operations forecasts made by MAC and the Council respectively. The Council's forecasts are also adjusted to facilitate a comparison. The adjusted figures include the missing categories at the levels forecast by MAC's consultants. A comparison using the adjusted figures is shown in Figure 2.3. The figure shows that that the Council's operations forecast was slightly below that of MAC through 2008. However, the Council's consultants forecast a faster overall rate of growth from 2008 through 2018 than either agency forecast for earlier periods.

## Table 2.3: 1988 MAC Forecast of Operations, 1993-2008

| | 1986 (actual) | 1993 | 1998 | 2008 |
|---|---|---|---|---|
| Scheduled Domestic Air Carrier | 231,760 | 272,184 | 282,738 | 293,054 |
| Regional | 50,520 | 132,600 | 156,200 | 240,600 |
| Subtotal: Major and Regional Carriers | 282,280 | 404,784 | 438,938 | 533,654 |
| Scheduled International | 680 | 978 | 1,344 | 2,262 |
| Non-Scheduled | 3,064 | 1,082 | 1,166 | 1,370 |
| Cargo | 12,490 | 12,518 | 12,916 | 13,756 |
| General Aviation | 71,406 | 45,581 | 42,272 | 22,115 |
| Military | 6,869 | 7,000 | 7,000 | 7,000 |
| Subtotal: Other | 94,509 | 67,159 | 64,698 | 46,503 |
| Totals | 376,789 | 471,943 | 503,636 | 580,157 |

Source: Metropolitan Airports Commission.

## Table 2.4: 1988 Metropolitan Council Forecast of Operations, 1993-2018

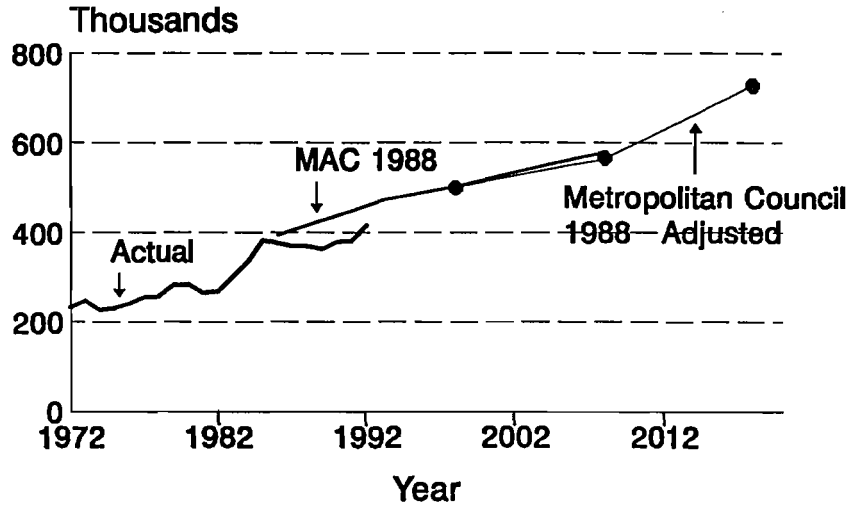
| | 1986 (actual) | 1998 | 2008 | 2018 |
|---|---|---|---|---|
| Scheduled Domestic Air Carrier | 231,760 | 279,070 | 278,069 | 308,318 |
| Regional | 50,520 | 156,080 | 240,760 | 372,000 |
| Subtotal: Major and Regional Carriers | 282,280 | 435,150 | 518,829 | 680,318 |
| Scheduled International | 680 | 1,340 | 2,260 | 3,700 |
| Non-Scheduled | 3,064 | NA | NA | NA |
| Cargo | 12,490 | NA | NA | NA |
| General Aviation | 71,406 | NA | NA | NA |
| Military | 6,869 | NA | NA | NA |
| Subtotal: Other | 94,509 | 1,340 | 2,260 | 3,700 |
| Totals | 376,789 | 436,490 | 521,089 | 684,018 |
| Modified Totals[a] | 376,789 | 499,844 | 565,330 | 728,259 |

Source: Apogee Research, Inc.

[a]Total if MAC forecasts for non-scheduled, cargo, general aviation, and military operations are added to Council estimates for the first three categories.

**In late 1988, both agencies forecast strong growth in airport operations and enplanements.**

## Figure 2.3: Total Operations, Actual Compared to 1988 Forecast, 1972-2018




Sources: Metropolitan Airports Commission and Metropolitan Council.

Tables 2.5 and 2.6 provide the enplanements forecast made by MAC and the Council respectively. Similar to the operations forecast, the Council forecast of enplanements is slightly below MAC's forecast through 2008. In addition, the Council's forecast rate of growth for 2008 through 2018 is faster than the rates of growth for previous periods.

## Table 2.5: 1988 MAC Forecast of Enplanements, 1993-2008

| | 1986 (actual) | 1993 | 1998 | 2008 |
|---|---|---|---|---|
| Scheduled Domestic Air Carrier | 7,845,494 | 10,343,000 | 11,677,100 | 13,377,900 |
| Regional | 290,700 | 1,034,600 | 1,397,700 | 2,503,100 |
| Scheduled International | 81,700 | 125,276 | 177,535 | 315,629 |
| Non-Scheduled | 291,656 | 72,020 | 83,926 | 113,370 |
| Totals | 8,509,550 | 11,574,896 | 13,336,261 | 16,309,999 |

Source: Metropolitan Airports Commission.

## Table 2.6: 1988 Metropolitan Council Forecast of Enplanements, 1993-2018

| | 1986 (actual) | 1998 | 2008 | 2018 |
|---|---|---|---|---|
| Scheduled Domestic Air Carrier | 7,845,494 | 11,500,000 | 12,700,000 | 15,500,000 |
| Regional | 290,700 | 1,400,000 | 2,500,000 | 4,500,000 |
| Scheduled International | 81,700 | 153,000 | 222,000 | 323,000 |
| Non-Scheduled | 291,656 | NA | NA | NA |
| Totals | 8,509,550 | 13,053,000 | 15,422,000 | 20,323,000 |
| Modified Totals[a] | 8,509,550 | 13,125,000 | 15,506,000 | 20,436,000 |

Source: Apogee Research, Inc.

[a]Total if MAC forecasts for non-scheduled enplanements are added to the Council forecast totals.

The Council's consultants also analyzed the implications of their activity forecasts for the adequacy of the existing airport. Table 2.7 shows that the consultants estimated that the existing airport was going to need a new runway within 10 years or sooner, had a strong chance of needing a second new runway by 2008, and a good chance of being inadequate even with these two new runways by 2018.[5] In particular, the consultants said that the existing airport, even with an extension of the crosswind runway and taxiway improvements, had only a 10 percent chance of being adequate in 1998 to meet peak-load ca-

5 Apogee Research, et. al., *Is the Airport Adequate? Part II: Study Issues and Analysis* (October 1988), 37.

## Table 2.7: Probability of Adequacy in Meeting Peak-Load Capacity Requirements (in percent)

| Option[a] | Year 1998 | 2008 | 2018 |
|---|---|---|---|
| Existing Airport | 10% | 5% | 1% |
| New North-South Runway | 67 | 18 | 9 |
| New North-South and Far Parallel Runways | 92 | 87 | 40 |

Source: Metropolitan Council

[a]All options include an extension of the crosswind runway (Runway 4-22) and taxiway improvements.

pacity requirements. In addition, they said that MSP with a new North-South runway would have only an 18 percent chance of being adequate in the year 2008. Finally, the consultants estimated that MSP with the North-South runway and a new far parallel runway would have only a 40 percent chance of being adequate in 2018. These strong conclusions about future airport adequacy caused the Council to recommend the dual-track process which the Legislature adopted during the 1989 legislative session.

# 1990 Forecasts

In early 1990, both MAC and the Council released revised forecasts of operations and enplanements for a prospective 30-year period (1990-2020). These forecasts were prepared after the 1989 Legislature adopted the dual-track process and were intended to provide a guideline for MAC in preparing a long-term plan for the existing airport through the year 2020 and for both agencies in preparing plans for a new airport. Tables 2.8 and 2.9 provide the operations forecasts made by MAC and the Council respectively. The Council's forecast

## Table 2.8: 1990 MAC Forecast of Operations, 1995-2020

| | 1988 (actual) | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| Domestic Scheduled Air Carrier | 211,562 | 256,400 | 282,000 | 293,400 | 294,000 | 304,400 | 308,200 |
| Regional | 58,888 | 73,800 | 76,800 | 79,800 | 88,200 | 97,600 | 106,000 |
| Subtotal: Major and Regional Carriers | 270,450 | 330,200 | 358,800 | 373,200 | 382,200 | 402,000 | 414,200 |
| Scheduled International | 514 | 2,288 | 5,096 | 7,280 | 10,296 | 11,752 | 15,288 |
| Non-Scheduled | 4,024 | 4,854 | 5,618 | 6,614 | 7,534 | 8,830 | 10,062 |
| Cargo | 18,148 | 23,400 | 27,000 | 29,600 | 29,400 | 31,400 | 31,400 |
| General Aviation | 68,634 | 55,500 | 49,800 | 49,800 | 49,800 | 49,800 | 49,800 |
| Military | 6,698 | 6,700 | 6,700 | 6,700 | 6,700 | 6,700 | 6,700 |
| Subtotal: Other | 98,018 | 92,742 | 94,214 | 99,994 | 103,730 | 108,482 | 113,250 |
| Totals | 368,468 | 422,942 | 453,014 | 473,194 | 485,930 | 510,482 | 527,450 |

Source: Metropolitan Airports Commission.

**In early 1990, both agencies significantly reduced their estimates of future operations growth.**

## Table 2.9: 1990 Metropolitan Council Forecast of Operations, 1995-2020

| | 1988 (actual) | 1995 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|
| Domestic Scheduled Air Carrier | 211,562 | 249,000 | 265,000 | 286,000 | 296,000 |
| Regional | 58,888 | 83,000 | 86,000 | 127,000 | 179,000 |
| Subtotal: Major and Regional Carriers | 270,450 | 332,000 | 351,000 | 413,000 | 475,000 |
| Scheduled International | 514 | 2,000 | 5,000 | 10,000 | 15,000 |
| Non-Scheduled | 4,024 | 5,000 | 5,000 | 8,000 | 10,000 |
| Cargo | 18,148 | 24,000 | 27,000 | 29,000 | 31,000 |
| General Aviation | 68,634 | 56,000 | 50,000 | 50,000 | 50,000 |
| Military | 6,698 | 7,000 | 7,000 | 7,000 | 7,000 |
| Subtotal: Other | 98,018 | 94,000 | 94,000 | 104,000 | 113,000 |
| Totals | 368,468 | 426,000 | 445,000 | 517,000 | 588,000 |

Sources: Apogee Research, Inc. and Metropolitan Council.

of operations is higher after 2000 primarily because the Council's consultant estimated much a faster rate of growth for regional airlines than MAC's consultant. By 2020, the Council forecast sees 588,000 operations compared to 527,000 for the MAC forecast.

Tables 2.10 and 2.11 show the enplanements forecasts released by the two agencies. The two forecasts are not significantly different from one another. For the year 2020, the Council's forecast for enplanements is higher for regional airlines but lower for major domestic airlines. Overall, the Council's enplanements forecast for 2020 is less than one percent higher than the MAC forecast.

Although the Council's consultants again conducted a risk analysis similar to that done during the adequacy study, the consultants apparently never completed the analysis in a form such as was published at the end of the adequacy study and is contained in Table 2.7. The Council did publish some more

## Table 2.10: 1990 MAC Forecast of Enplanements, 1995-2020

| | 1988 (actual) | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| Domestic Scheduled Air Carrier | 8,023,121 | 11,105,000 | 13,498,000 | 14,513,000 | 15,024,000 | 15,555,000 | 15,749,000 |
| Regional | 397,835 | 659,000 | 760,000 | 861,000 | 952, 000 | 1,054,000 | 1,145,000 |
| Scheduled International | 64,708 | 288,000 | 476,000 | 670,000 | 982,000 | 1,323,000 | 1,663,000 |
| Non-Scheduled | 348,910 | 450,000 | 562,000 | 684,000 | 801,000 | 939,000 | 1,070,000 |
| Totals | 8,834,574 | 12,502,000 | 15,296,000 | 16,728,000 | 17,759,000 | 18,871,000 | 19,627,000 |

Source: Metropolitan Airports Commission.

## Table 2.11: 1990 Metropolitan Council Forecast of Enplanements, 1995-2020

| | 1988 (actual) | 1995 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|
| Domestic Scheduled Air Carrier | 8,023,121 | 10,800,000 | 12,300,000 | 14,600,000 | 15,130,000 |
| Regional | 397,835 | 738,000 | 924,000 | 1,368,000 | 1,939,000 |
| Scheduled International | 64,708 | 288,000 | 476,000 | 982,000 | 1,663,000 |
| Non-Scheduled | 348,910 | 450,000 | 562,000 | 801,000 | 1,070,000 |
| Totals | 8,834,574 | 12,276,000 | 14,262,000 | 17,751,000 | 19,802,000 |

Sources: Apogee Research, Inc. and Metropolitan Council.

limited information on the implications of its revised forecast.[6] The Council's consultants concluded that, under the revised forecast, a new runway would be needed in the late 1990s as existing airfield capacity was exhausted. In addition, they concluded that, even with a new runway, capacity utilization would be at 95 percent by the year 2020, indicating MSP's "inability to offer effective, low-cost service by that time."[7] Furthermore, the Council's consultants estimated that the net economic benefits from commissioning a new airport would exceed $2 billion (in present value) even if the new airport were commissioned in the year 2009, as stated in the adequacy study.

In contrast, MAC's conclusions about airport adequacy were less alarming. MAC was required by the 1989 legislation to prepare a long-term comprehensive plan for MSP which would be adequate to meet the forecasted demand for the airport through the year 2020. MAC's plan calls for the construction of one new runway (a North-South runway) as well as a replacement terminal on the northwest side of the airport. According to MAC staff, that new runway is probably not needed until the year 2005 or 2010 if projections materialize.

## Comparison of the Forecasts

**The reduction in forecast operations was largely for regional airline operations.**

A comparison of the forecasts and their implications for airport adequacy shows the following:

- **The forecast of operations was significantly reduced by both agencies primarily due to a dramatic reduction in the forecasts for regional airline operations.**
- **The forecast of enplanements was not significantly changed.**
- **The reduction in forecast operations changed the implications for airport adequacy, but differences also remained between the conclusions drawn by the two agencies.**

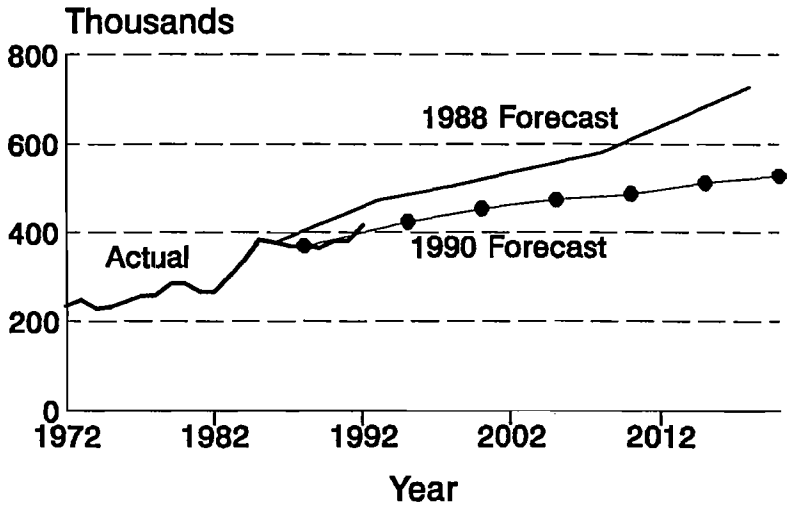
6 Metropolitan Council, *First Annual Contingency Assessment: Major Airport Strategy* (February 1990), 21-23.

7 *Ibid.*, 21.

Figure 2.4 shows the significant reduction in forecast operations between the two forecasts, while Figure 2.5 shows that the enplanement forecasts did not change much.[8] As Figure 2.6 shows, the major source of this difference is the dramatic reduction in the number of regional airline operations forecast by both agency's consultants. The Council's consultants reduced their long-run estimates of regional operations by about one-half, while MAC's consultants reduced their estimates by almost two-thirds. The Council's consultant had earlier forecast 372,000 regional airline operations for the year 2018 but revised that downward to 179,000 operations for the year 2020. MAC's consultant had earlier forecast 240,000 operations for the year 2008 and lowered that to 88,200 for the year 2010 with operations expected to grow to 106,000 by 2020.

**Actual operations have thus far closely tracked the 1990 forecast.**

**Figure 2.4: Total Operations, Actual Compared to 1988 and 1990 Forecasts, 1972-2020**




Source: Metropolitan Airports Commission and Metropolitan Council.

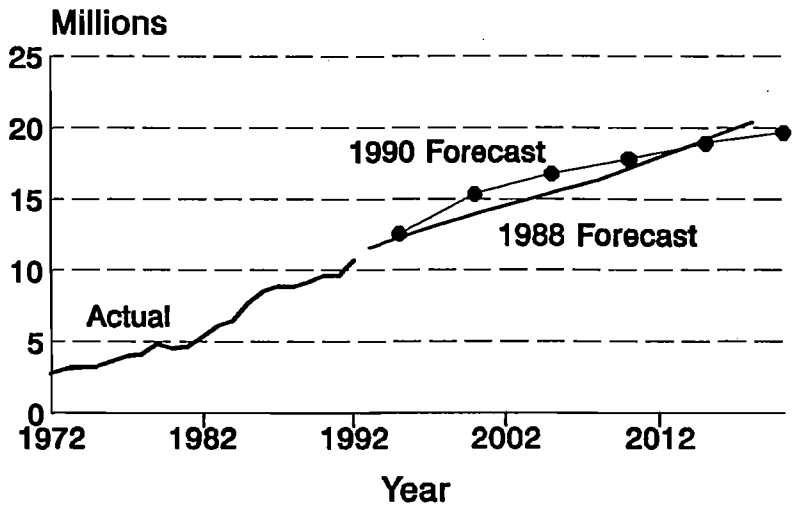
Other revisions in the operations forecast included a slight reduction in the operations forecast for major domestic air carriers and a significant increase in the long-run estimates for international, cargo, general aviation, and non-scheduled operations. The increase for these latter categories -- about 60,000 to 70,000 annual operations over previous estimates -- was not enough to offset the large reduction (between 190,000 and 270,000) in the regional airlines forecasts of the two agencies.

In addition, the stated implications of the two forecasts were somewhat different. While the Council consultant estimated in late 1988 that MSP would probably need a new runway between 1993 and 1998, the consultant revised that

*8* For these figures, the 1988 forecast is simplified to include MAC's forecast through 2008 and the Council's 2018 forecast, as adjusted to include all categories of aircraft. For the 1990 forecast, only MAC's forecast is shown.

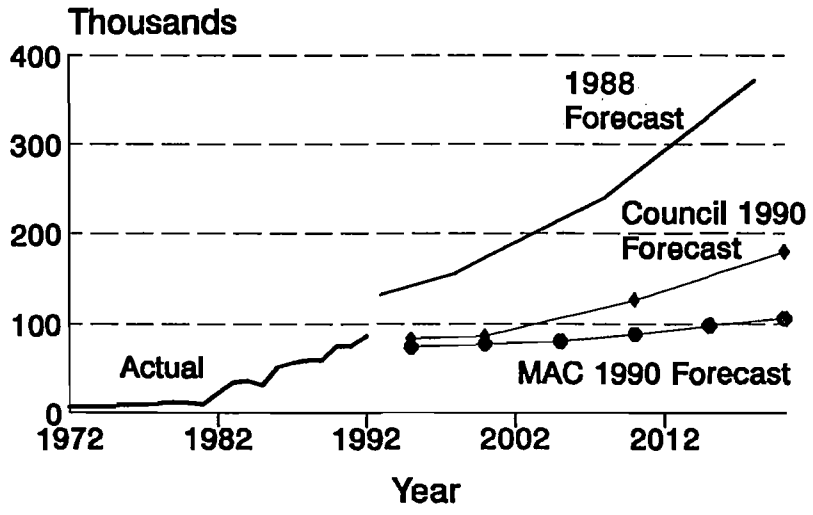
**Enplanement forecasts were not changed much.**

## Figure 2.5: Enplanements, Actual and Forecast Levels, 1972-2020




Sources: Metropolitan Airports Commission and Metropolitan Council.

## Figure 2.6: Regional Carrier Operations, Actual and Forecast Levels, 1972-2020




Sources: Metropolitan Airports Commission and Metropolitan Council.

estimate to the late 1990s. In 1988, the Council consultant also estimated that a second new runway at MSP would probably be needed between 2003 and 2018. In 1990, the consultant indicated that by 2020 MSP would have capacity problems even after adding the first new runway.

MAC's consultant concluded in early 1990 that the existing airport with only one new runway would be adequate through the year 2020. In fact, MAC's analysis estimates that MSP -- with a new North-South runway and an expected federal rule change affecting the simultaneous use of the existing runways under instrument flight rules (IFR) -- would experience average delays in the year 2020 approximately the same as those experienced in 1989 -- indicating that MSP with one additional runway would not be as stressed in 2020 as the Council's consultant estimated.[9] MSP's average delay in 1989 was 2.7 minutes per operation -- a relatively low figure for major airports.

We will see later in this chapter that the differences that remain between the Council and MAC conclusions about airport adequacy are not due to the differences in their forecasts. Instead, the difference in conclusions is largely due to some significant differences in methods and analysis.

# EVALUATION OF FORECASTS

In this section, we evaluate the forecasting methods used by the Council and MAC and their analyses of airport adequacy. Overall, we found that:

- **The Council's adequacy study overstated the crisis in airport capacity. The study's deficiencies, while very difficult for policymakers to detect, should have been apparent to those knowledgeable in aviation planning.**

- **The 1990 MAC and Metropolitan Council forecasts provide reasonable long-term estimates of overall operations, although they may both overestimate future domestic air carrier operations and the MAC forecast underestimates future regional operations. Long-term enplanement estimates may be too high due to an overestimate of the hubbing activity which is likely to occur at the major Twin Cities area airport.**

- **Despite Northwest Airlines' financial condition, operations at MSP recently increased. The 1990 forecasts may underestimate the amount of overall operations growth at MSP in the short-term even though they seem reasonable over the long run.**

---

9 According to MAC staff, the new federal rule has now been approved by the Federal Aviation Administration. In addition, the FAA has indicated that MSP will be approved for the radar system and waiver necessary for use of the runways as independent parallel approaches under IFR conditions.

- **The overall methodology used in preparing the two agencies' 1990 forecasts is adequate. Greater sophistication is not likely to improve forecast accuracy much, although a refinement of the forecast methodology for regional airline activity is desirable. The uncertainty that forecasters face is a strong reason to make sure that the airport planning process is strategic.**

- **In several key areas, the Metropolitan Council is not receiving adequate technical advice from its staff and consultants.**

- **Reports presented to policymakers, expert panel members, and others have not clearly presented the key assumptions, important historical data, and adequacy implications of forecasts.**

- **Although the 1990 forecasts suggest that the need for any additional runway capacity is farther off than previously forecast, it is unclear that policymakers can depend on that and, thus, delay certain aspects of the dual-track planning process.**

## Adequacy Study

To the credit of the Metropolitan Council, the adequacy study served to focus considerable attention on the need for future airport capacity. Enplanements and operations had been growing at a fast rate up to the mid-1980s, and it was appropriate for the Council to make sure that adequate attention would be paid to the issue of airport adequacy in a timely manner. Given the time necessary to complete an environmental impact statement on any airport expansion or new airport construction, it was very appropriate for the Council to be concerned about future airport adequacy.

**The 1988 adequacy study overstated MSP's future capacity problems.**

However, it appears that the conclusions of the adequacy study, which were largely based on the work of the Council's team of consultants, overstated the immediacy of any crisis in airport adequacy. The crisis was overstated in several ways:

- **The forecast of regional airline operations was unreasonably high and was rather quickly changed by both planning agencies without much fanfare.**

- **The Council forecast of regional airline operations for the year 2018 was in excess of major domestic airline operations but this fact was never explicitly revealed in adequacy study documents.**

- **The analysis used by the Council's consultant to estimate the probability that the airport would be inadequate in a future year provides too early an indication of the need for capacity additions.**

As we saw earlier in this chapter, the major difference between the 1988 and 1990 operation forecasts was the dramatic lowering of the estimates of

regional airline activity. The 1988 estimates were based on the following key assumptions about regional passenger growth: 1) 15 percent growth rates from 1986 to 1990 (larger than forecast by the Federal Aviation Administration (FAA); 2) use of FAA forecast growth rates through 1998; and 3) continued growth at about these same FAA growth rates through 2018.

Use of these FAA growth rates and extrapolation of these growth rates to a 20-year period beyond the FAA forecast period was not a particularly sound judgment on the part of our local planning agencies and their consultants.[10] FAA forecasts have sometimes had a tendency to provide rather optimistic outlooks for the aviation industry and, as a result, should not have been the sole basis for generating an expensive dual-track planning process. Furthermore, extrapolating the growth rates that the FAA forecast through 1998 out to 2008 and 2018 was not a particularly sound forecasting decision.

Finally, we noted that, while the MAC's detailed forecasts through 2008 were published, the Council's forecasts through 2018 were never published in a manner in which its regional forecast could be detected. The only accounting of the forecast for 2018 which was published shows the combined total operations that the Council's consultant forecast for major domestic air carriers, regional airlines, and international carriers. The Council's consultant was forecasting that regional airlines like Mesaba would have more operations in 2018 than domestic air carriers like Northwest, and that regional airline operations would grow from 13 percent to more than half of the airport's total operations by 2018. If this assumption had been highlighted or the forecast itemized by type of aircraft in the adequacy study, policymakers would have been more likely to question the forecasts and their implications.

The analysis used to estimate future airport adequacy was also faulty. The analysis compared the future airport activity which was forecast to occur during the peak hour of the average day in the peak month (August) of the year to the airport's capacity under existing conditions and expanded capacity under various options. If the estimated demand during that peak hour exceeded the capacity, then the analysis concluded that the airport would be "inadequate." The consultant was able to state this in probability terms by making assumptions about the probability distributions of key variables and then conducting a "Monte Carlo" experiment on a computer. The resulting analysis was able to provide a statement on the probability that peak hour demand in the peak month would exceed the hourly capacity of the airport. Finally, the consultant provided estimates such as the following: In the year 1998, there is only a 10 percent chance that the existing airport will be adequate. Table 2.7 provides a more complete listing of these conclusions for various years and airport expansion options.

However, this analysis prematurely signals a need to add capacity prior to the time at which it makes economic sense to add capacity. As soon as forecast activity in the peak hour of the peak month exceeds the airport's existing

*10* Only the Council's consultant extended the growth rates the full 20 years beyond 1998. MAC's forecasts only went out to the year 2008.

capacity, this analysis suggests that airport capacity is inadequate and needs to be expanded. This ignores the fact that the magnitude of the delays on an annual basis may not be large enough to justify a costly expansion of capacity. If slight delays occur during the peak hour of the peak month that does not mean that they are occurring during the remainder of the day during the peak month or during the remainder of the year. A more sophisticated analysis is needed to identify the economic costs of delay such as increased costs for the airlines or increased travel time for passengers and to compare these costs to costs of adding capacity. Such an analysis would likely provide a more conservative estimate of the need for additional capacity than was provided by the Council's consultants in the adequacy study.

## 1990 Forecasts

Although we concluded that the 1988 forecasts probably overstated future growth in operations, we find that the revised forecasts issued in early 1990 provide more reasonable estimates of future operations. In particular, we conclude that:

**Long-term total operations estimates are now reasonable, but enplanement forecasts may be too high.**

- **The basic methodology used to forecast future operations and enplanements is adequate. Some greater sophistication could be employed, but is unlikely to improve the accuracy of forecasts or reduce uncertainty.**

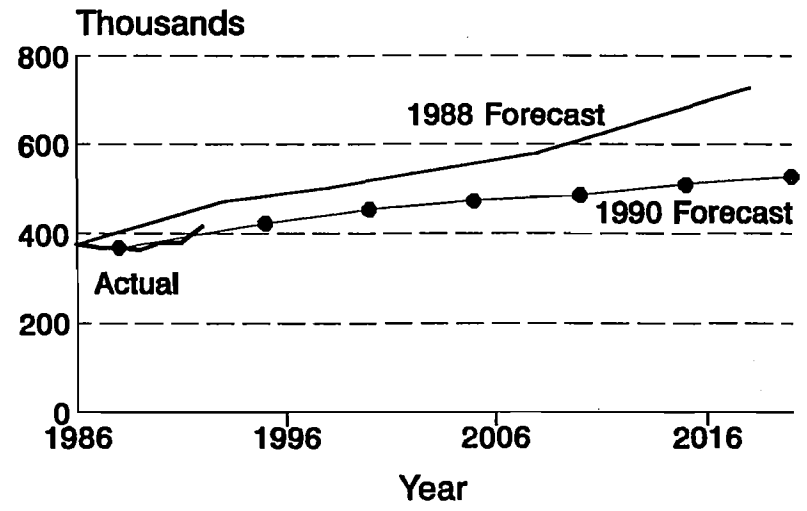
- **Overall long-term estimates of operations appear reasonable, although both agencies may have overestimated future operations by domestic air carriers and MAC probably underestimated the growth in regional carrier operations.**

- **Both agencies may be overestimating future passenger traffic because of an overly optimistic estimate of the growth in the hubbing activity at the region's major airport.**

- **However, we should guard against overreliance on any forecast since there is tremendous uncertainty involved in forecasting aviation activity over the long run. Even short-term forecasting is difficult given the financial condition and volatility of the airline industry.**

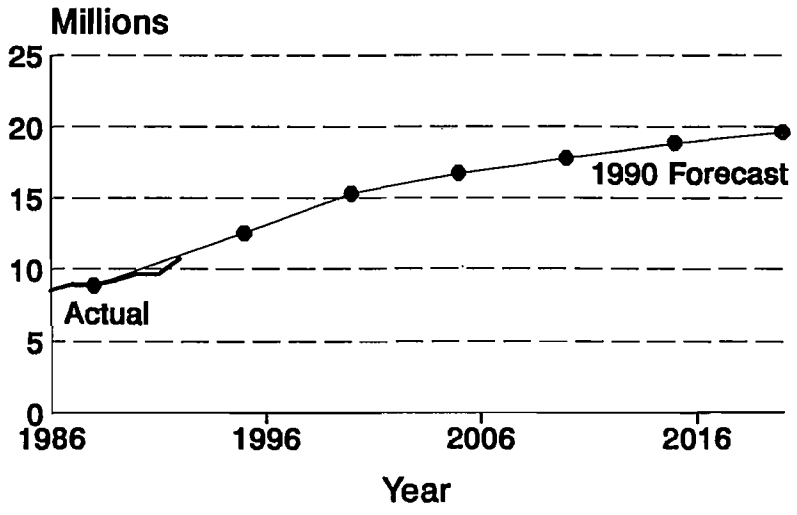
Figures 2.7 and 2.8 show how close MAC's 1990 forecasts have been to actual operations and enplanements. Figure 2.7 shows that while actual operations trailed forecast operations through 1991, MSP operations for 1992 exceeded the operations forecast. Figure 2.7 also shows that growth in operations has thus far been significantly below that forecast during the adequacy study. Figure 2.8 shows that actual enplanements have consistently lagged behind the 1990 forecast although they picked up in 1992 due to airline fare wars and now only trail the forecast by only 0.4 percent.

## Figure 2.7: Total Operations, Actual and Forecast Levels, 1986-2020




Sources: Metropolitan Airports Commission and Metropolitan Council.

## Figure 2.8: Enplanements, Actual Compared to 1990 MAC Forecast, 1986-2020




Source: Metropolitan Airports Commission.

These comparisons are useful for illustrating that actual experience has not yet deviated significantly from the 1990 MAC forecasts. However, they do not ensure that longer term experience will similarly reflect the trends forecast in 1990. To gain some insight into the longer term, we examined the methodologies used by MAC and the Council and compared the main assumptions made by forecasters with statements made by some of the major users of the airport.

**Most of the forecast growth is expected from domestic air carriers and regional airlines.**

It is useful to focus much of our attention on the long term forecasts made for major domestic air carriers and regional airlines. As Tables 2.7 and 2.8 showed, most of increase forecast for operations was in these two categories. Domestic air carriers account for almost 100,000 and regional airlines account for about 50,000 of the total increase (160,000) in operations forecast by MAC between 1988 and 2020. Similarly, the Council forecast a long-term increase of about 220,000 operations. Domestic air carriers were forecast to increase by 85,000 operations and regional carriers by about 120,000 operations. In either case, over 90 percent of the increase in operations is expected to come from these two types of aircraft. Furthermore, increases in other types of operations tend to be less significant in terms of their effect on available airport capacity since other operations are less likely to occur at the peak hours of activity at the airport.[11]

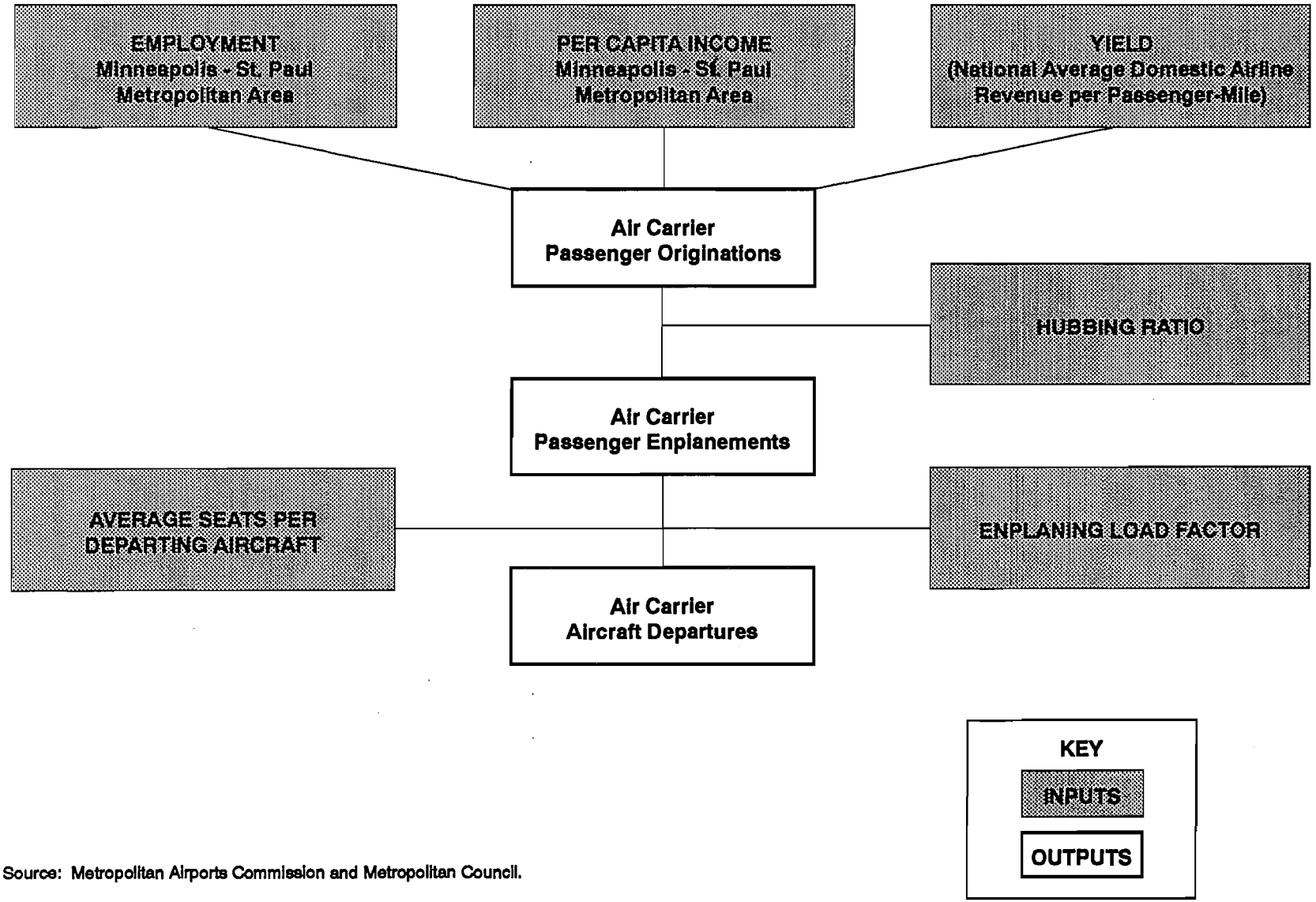
### Domestic Air Carriers

Figure 2.9 shows that there are three sets of assumptions which are important in forecasting domestic air carrier activity. The first set includes demographic and industry variables (area employment, area per capita income, and a proxy variable for airline prices) which are used in a regression analysis to predict the future level of passengers originating from the Twin Cities area. The total number of enplanements at the area's airport include both originating passengers and connecting passengers. The latter group consists of passengers who depart on flights leaving our area's airport but who got here on a connecting flight and did not originate their departure from our airport. So, a second assumption must be made about the level of connecting activity in order to forecast total enplanements. Both MAC and Council consultants make assumptions about future "hubbing ratios" in order to forecast total enplanements. The hubbing ratio is the ratio of total enplanements to originating passengers. Consequently, if there is a 50/50 split between connecting and originating passengers, the hubbing ratio is 2.

A third set of assumptions about the aircraft serving these passengers is needed to convert estimated enplanements to estimated operations. Assumptions are made about the average number of seats on departing aircraft and the enplaning load factor, or average percentage of seats which are filled. These two variables are multiplied together to obtain the estimated number of enplanements per departing aircraft. When this result is divided into estimated enplanements, one obtains the estimated number of air carrier departures. Total air carrier operations include both departures and arrivals. Total operations are

*11* About 78 percent of the forecast increase in enplanements is expected to come from domestic air carriers and regional airlines.

## Figure 2.9: Demand Forecasting Methodology for the 1990 Domestic Air Carrier Forecasts




Source: Metropolitan Airports Commission and Metropolitan Council.

derived by multiplying the number of estimated departures by two since an aircraft must arrive in order to depart.

Table 2.12 shows the assumptions used to generate the MAC forecasts for the year 2020 and the resulting forecasts for originations, enplanements, and operations for domestic air carriers. Overall, these assumptions and methods appear to be reasonable although the results are certainly subject to tremendous uncertainty since the assumptions underlying them cannot be forecast without substantial uncertainty. There is, however, one key exception to our conclusion about the reasonableness of the forecasts. In particular, we find that:

- **Both MAC and the Council used a hubbing ratio which is probably too high.**

## Table 2.12: Inputs and Outputs of 1990 Domestic Air Carrier Forecasts

| Inputs | Outputs | 1988 (Actual) | 2020 (Forecast) |
|---|---|---|---|
| Area Employment | | 1,565,290 | 1,926,100 |
| Area Per Capita Income[a] | | $7,427 | $9,609 |
| Airline Yield Per Passenger Mile[b] | | 4.64¢ | 4.27¢ |
| | Originations | 4,202,752 | 6,562,000 |
| Hubbing Ratio | | 1.88 | 2.40 |
| | Total Enplanements | 7,904,873 | 15,749,000 |
| Seats Per Aircraft | | 140 | 174 |
| Percentage of Seats Filled | | 55.1% | 58.6% |
| Seats Filled Per Aircraft | | 76.9 | 102.2 |
| | Departures | 100,854 | 154,100 |
| | Total Operations | 201,708 | 308,200 |

Source: Metropolitan Airports Commission.

[a]In 1972 dollars.

[b]In 1972 cents.

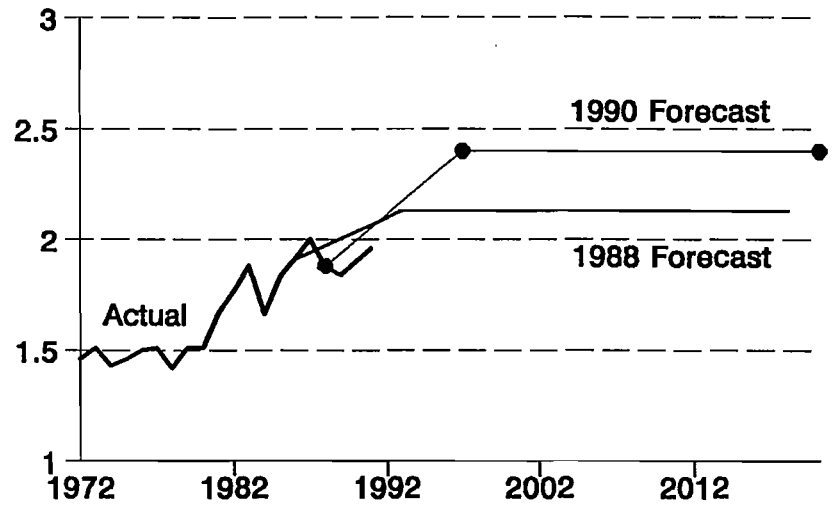
Both agencies projected that the hubbing ratio for domestic air carriers at MSP, which was 1.88 in 1988, would rise 2.8 percent per year between 1988 and 1997 and then remain constant at 2.40 through the year 2020. This projection meant that MSP would go from about 47 percent connecting passengers in 1988 to 58 percent connecting passengers by 1997. Figure 2.10 shows this 1990 forecast in comparison to historic hubbing ratios at MSP and in comparison to the 1988 forecast of a long-term ratio of 2.13.

This estimate was largely developed by MAC's consultant and then used by the Council's consultant.[12] The reasoning behind the estimate was that: 1) the growth rate in the hubbing ratio at MSP was 2.8 percent per year between 1978 and 1988; 2) the average hubbing ratio for United States airports with

12 *Long-Term Comprehensive Plan, Volume 3,* pages 2-7 to 2-12.

**Both agencies should reconsider their hubbing ratio forecasts.**

**Figure 2.10: Hubbing Ratio, Actual and Forecast Levels, 1972-2020**




Source: Metropolitan Airports Commission.

major hubs was 2.40 and hubs like MSP, which were below the average, were tending to grow toward the average; 3) there were available untapped markets to which Northwest Airlines could expand its MSP hubbing operations; 4) operational and market factors would constrain the maximum ratio at MSP to 2.25, but possible technological improvements would permit its growth to 2.40; and 5) some Northwest officials were indicating plans at that time to increase the hubbing ratio at MSP.[13]

There are several problems with the logic behind the hubbing ratio estimate. First, it does not appear reasonable to extrapolate a 2.8 percent annual growth rate from the 1978-88 period and then apply it for the next nine years. As Table 2.13 shows, most of that growth occurred in the years following the federal deregulation of the airline industry in 1978. From 1972 through 1980, little growth occurred in the hubbing ratio at MSP. From 1980 to 1983, the hubbing ratio grew significantly from 1.51 to 1.88. By 1988, the ratio was no higher than it was in 1983, thus suggesting that much of the growth had come in the early 1980s as the market adjusted to deregulation. Since 1988, as Figure 2.10 shows, there has been growth in MSP's hubbing ratio but that growth has been less than the consultants estimated in 1990.

Second, no evidence was presented to support the conclusion that major hub airports with a hubbing ratio below the national average were growing toward

*13* It was not possible for us to determine exactly what Northwest said regarding its hubbing plans in 1989 since some current Northwest employees dispute that such expansion was company policy. In addition, the Northwest employees who airport planners cite as sources are no longer with the company.

## Table 2.13: Originating and Connecting Passengers for Domestic Air Carriers at MSP, 1972-91

| Year | Total Enplanements[a] | Originations | Connecting Enplanements | Hubbing Ratio[b] |
|---|---|---|---|---|
| 1972 | 2,728,698 | 1,867,860 | 860,838 | 1.46 |
| 1973 | 3,069,157 | 2,030,540 | 1,038,617 | 1.51 |
| 1974 | 3,225,025 | 2,250,550 | 974,475 | 1.43 |
| 1975 | 3,228,564 | 2,209,110 | 1,019,454 | 1.46 |
| 1976 | 3,559,928 | 2,370,230 | 1,189,698 | 1.50 |
| 1977 | 3,768,227 | 2,502,170 | 1,266,057 | 1.51 |
| 1978 | 3,856,777 | 2,714,940 | 1,141,837 | 1.42 |
| 1979 | 4,588,271 | 3,040,040 | 1,548,231 | 1.51 |
| 1980 | 4,285,217 | 2,839,620 | 1,445,597 | 1.51 |
| 1981 | 4,391,802 | 2,623,110 | 1,768,692 | 1.67 |
| 1982 | 5,071,395 | 2,864,730 | 2,206,665 | 1.77 |
| 1983 | 5,702,094 | 3,039,930 | 2,662,164 | 1.88 |
| 1984 | 5,986,288 | 3,599,610 | 2,386,678 | 1.66 |
| 1985 | 7,114,367 | 3,888,260 | 3,226,107 | 1.83 |
| 1986 | 7,845,494 | 4,114,436 | 3,731,058 | 1.91 |
| 1987 | 8,171,206 | 4,091,830 | 4,079,376 | 2.00 |
| 1988 | 8,023,121 | 4,265,650 | 3,757,471 | 1.88 |
| 1989 | 8,347,059 | 4,525,060 | 3,821,999 | 1.84 |
| 1990 | 8,609,638 | 4,533,246 | 4,076,392 | 1.90 |
| 1991 | 8,685,226 | 4,432,920 | 4,252,306 | 1.96 |

Source: Metropolitan Airports Commission.

[a]Total enplanements include both originations and connecting enplanements.

[b]The hubbing ratio is the number of total enplanements divided by the number of originations.

the average and that such a trend would continue. The 2.40 ratio was the average of major hub airports in 1988, but no evidence was presented to suggest that all hubs will tend toward this average in the long run. It is not clear that MSP, or any other hub across the country, ought to move toward the average. Furthermore, this national average is volatile. For the 1988 forecasts, the 1986 national average of 2.13 was used as the estimate for MSP in the long run. For the 1990 forecasts, the 1988 national average was used for MSP. If the forecasts were redone today using the same logic, the estimate for MSP would be the 1990 national average of 2.24.

Finally, while it was probably not evident at the time the 1990 forecasts were made, current airline industry conditions suggest that the forecast growth in connecting traffic is not likely to occur. Northwest Airlines and other airlines are losing money on connecting traffic and are under strong market pressure to increase prices. Price increases will tend to moderate any growth in connecting traffic. Officials from Northwest Airlines told us that they consider the Midwest section of the country, including MSP, to be over-hubbed and do not consider current losses on connecting traffic to be sustainable over the long run. Northwest Airlines officials also said that a 50/50 split between originating and connecting traffic at MSP is their desired target. It is not entirely clear how to convert this target into an airport-wide hubbing ratio such as that used by the airport planning consultants. However, Northwest officials made it

clear that they do not expect their hubbing ratio to increase over the current ratio in 1992 and it may decrease if the airline is able to successfully impose fare increases on connecting traffic.

Assuming other variables change as forecast in 1990, a leveling off of the hubbing ratio would result in about 40,000 fewer domestic air carrier operations at MSP than forecast for the year 2020 and more than two million fewer enplanements. However, two other key parts of the forecast could also change. Originations from MSP were forecast using a regression equation based on area employment, area per capita income, and airline fare levels and forecasts of these variables through the year 2020. Updating this regression equation with two more years of data and more recent forecasts of the variables results in a lower forecast of originations for the year 2020. MAC's consultants forecast originations to grow from 4.2 million in 1988 to 6.56 million in 2020. A revised estimate using the additional information now available results in an estimate of 6.04 million originations in 2020. If the forecast were changed to incorporate this revision, it would result in another 20,000 fewer operations than MAC's consultants forecast for 2020 and another 1,000,000 fewer enplanements.

**Current estimates of future domestic air carrier activity are probably too high.**

A factor which may partially offset these possible overestimations of domestic air carrier operations and enplanements is more modest growth in the size of aircraft. MAC's 1990 forecast projected a substantial growth in the size of aircraft in the domestic air carrier category. The average seat size of the aircraft was expected to grow from 140 in 1988 to 174 in 2020. Recently, due to its financial condition, Northwest Airlines either postponed or cancelled orders to purchase new aircraft which would have increased the average seat size of its fleet. While these moves may be temporary in the sense of a 30-year forecast and may later be reversed, it is clear that the forecast increase in aircraft size is a key factor in limiting future operations growth at MSP. For example, even if the hubbing ratio remains constant and originations grow slower than forecast, domestic air carrier operations would grow faster than in MAC's 1990 forecast if no growth in aircraft size occurs. As Table 2.14 shows, operations in the year 2020 would be 331,000 compared to MAC's forecast of 308,200. Assuming Northwest works out its current financial troubles, some growth in aircraft size is probably to be expected in the long run. Table 2.14 shows that if the growth aircraft size were one-half as much as forecast, domestic air carrier operations in 2020 would be estimated to be between 272,000 and 295,000 depending on whether one uses a revised originations forecast.

Overall, we conclude that:

- **The 1990 forecasts by MAC and the Council probably overstate the long-run growth in operations and enplanements for domestic air carriers largely due to an overestimate of the growth in expected hubbing activity.**

## Table 2.14: Analysis of MAC's 1990 Forecasts for Domestic Air Carriers

| | Domestic Air Carrier Forecasts for the Year 2020 | | | |
|---|---|---|---|---|
| | Operations | | | |
| | With Forecast Growth In Airplane Size | With 1/2 the Forecast Growth In Airplane Size | No Growth In Airplane Size | Enplanements |
| MAC Forecast | 308,200 | NA | NA | 15,749,000 |
| No Growth in Hubbing Ratio[a] | 266,000 | 295,000 | 331,000 | 13,583,000 |
| Revised Originations Forecast and No Hubbing Ratio Growth | 245,000 | 272,000 | 305,000 | 12,500,000 |

Source: Legislative Auditor's Office.

[a]Assumes a hubbing ratio of 2.07 in 1992 and subsequent years. However, the actual hubbing ratio for 1992 will not be known for several months.

However:

- **Significant uncertainty remains about other variables, particularly the growth in aircraft size. Less than anticipated growth in aircraft size could offset some of the possible overestimation of future domestic air carrier operations at MSP.**

### Regional Airlines

In contrast to domestic air carrier operations, we found that:

**MAC's current forecast for regional airline activity is too low.**

- **MAC's 1990 projections underestimated future regional airline operations in both the short and long run.**

- **The Council's 1990 projections also underestimated the short-run growth in regional operations but their long-run estimate may still be reasonable.**

In the last three years, growth in regional airline operations at MSP has been particularly strong. Regional operations grew from about 59,000 in 1989, when the 1990 forecasts were put together, to an estimated 83,000 in 1992. In addition, Northwest Airlines officials have indicated that they anticipate continued strong growth in the near future. One official suggested that the operations of Northwest's regional carrier partners could grow to one-half the level of Northwest's MSP operations over the next five to seven years.[14] If realized, such growth could increase total regional carrier operations at MSP to 110,000 annually before the year 2000. However, some of this growth could come at

*14* Northwest Airlines has code-sharing agreements with Mesaba Airlines and Express Airlines I, the two largest regional carriers at MSP. These agreements offer a considerable price-break to passengers who travel to MSP on the regional carrier and then to their ultimate destination on Northwest. These two regional carriers account for about 85 percent of the regional operations at MSP.

the expense of existing domestic air carrier operations as Northwest shifts some flights from its carriers to its regional carrier partners.

The 1990 MAC forecasts projected regional operations to grow to 73,800 in 1995, 76,800 in the year 2000, and 106,000 by 2020. Clearly, the MAC forecasts are already too low in the short run and are likely too low in the long run. In 1990, the Council's consultants forecast regional operations to be 83,000 in 1995, 86,600 in 2000, and 179,000 in 2020. These forecasts are also low for the short run but may not be unrealistic over the long run. The Council's forecast for the year 2020 represents a more than doubling of operations from 1992's level of 83,000 to 2020's level of 179,000. This long-term growth rate cannot be rejected based on current information.

Regional enplanements could also exceed those forecast by MAC's consultants. By the year 2020, MAC forecast regional enplanements to 1.1 million from their 1988 level of about 400,000. In contrast, the Council's consultants projected that enplanements would grow to 1.9 million, a difference of 0.8 million from the MAC forecast.

It should be noted that, while MAC's 1990 forecasts underestimated the growth in regional operations, the 1988 forecasts made by both MAC and the Council still look high compared to the recent and projected short-term growth. In 1988, MAC and Council forecasts estimated that regional operations would already be 132,600 in 1993 and would grow to 156,200 by 1998 and to 240,600 by 2008. Furthermore, the Council forecast for 2018 included 372,000 regional operations. Thus, while the 1988 forecasts may have overstated the future growth in regional operations, the revised MAC forecast in 1990 appears to have underestimated future growth.

Ironically, the revised 1990 estimate from MAC's consultants was based on more sophisticated methods than used by the Council's consultants. The MAC forecast was based on a regression analysis and backed up by an elaborate market-by-market analysis, which forecast even less growth than did the regression analysis and the final MAC estimates. The Council estimate was based on splitting the difference between the MAC estimates and the FAA estimates which had been used in the 1988 forecasts.

### Conclusions

The 1990 MAC forecast projected a total of 527,000 annual operations for the year 2020. The 1990 Council forecast had an estimate of 588,000 operations. Overall, we conclude that:

- **The 1990 long-term forecasts of total operations appear to be reasonable.**

While both the MAC and Council estimates may overestimate future domestic air carrier operations, the MAC forecast probably underestimates long-run growth in regional airline operations. Thus, we believe that a forecast approxi-

mately bounded by the MAC estimate on the low end and the Council estimate on the high end appears reasonable. The lower end, or MAC's estimate would seem more appropriate if one considers the underestimation of regional operations by MAC to be roughly equal to its overestimation of domestic air carrier operations. The higher end of the range, or the Council's estimate, is more appropriate if one believes that the overestimation of domestic air carrier operations is relatively small and offset by an underestimation of future regional operations by the Council.

Also, we conclude that:

- **Unless the hubbing ratio increases as MAC and the Council forecast, enplanement growth may lag behind forecast amounts.**

Stronger than anticipated growth in regional airline enplanements could offset some of the lower than forecast growth in domestic air carrier enplanements. However, without future growth in the hubbing ratio, the overall result could be one to two million fewer total annual enplanements than forecast by either MAC or the Council for the year 2020.

### Uncertainty

**Aviation forecasts are inherently uncertain.**

The above conclusions represent our best judgment as to the reasonableness of the long-term forecasts made by MAC and the Council. However, we also conclude that:

- **There is considerable uncertainty inherent in forecasting long-term, and even short-term, changes in airport activity.**

First, because of the poor financial condition of the airline industry in general and Northwest Airlines in particular, there is now a risk that these forecasts may be too high. The forecasts assume that the domestic air carriers will work through their financial problems and that Northwest will continue to exist. In fact, the forecasts also assume that domestic air carrier operations will grow at MSP with only a modest increase in air fares over the long run. However, without a financially viable Northwest Airlines, it is likely that MSP with minimal improvements would be adequate for at least the next 20 to 25 years. Planners generally agree that, without Northwest, domestic air carrier operations would decline significantly at MSP since no other airline would likely replace most of the hubbing activity currently conducted by Northwest.

However, one of the ironies of Northwest's unfortunate financial difficulties is that it has caused operations at MSP to increase at least in the short run as Northwest looks to more profitable ways to serve customers. In September 1992, Northwest added an additional bank of flights at MSP as it reduced its hubbing operations at Memphis, Tennessee, and reduced direct service to and from Milwaukee, Wisconsin. Northwest added some new non-stop service from MSP and routed more passengers through the MSP hub. The net effect, when seasonally adjusted, was to add about 6,000 additional operations at

MSP from September 1992 through December 1992. If continued in the future, these additional operations would amount to about 20,000 operations on an annual basis. Thus, Northwest's financial condition, while presenting a significant downside risk to the forecasts, can also produce some increase in operations at least in the short term, if not for a longer period of time. The casual observer probably would not have expected an increase in MSP operations given Northwest's financial condition. And, indeed, the financial condition of the airline industry makes forecasting airport operations difficult in both the short and long run even for professional analysts.

Second, there are numerous other factors which present significant uncertainty which is difficult to anticipate in any forecast. These factors include: 1) demographic trends (area income and employment) which deviate from forecast levels; 2) a change in the level of air fares compared to forecast levels; 3) a change in the historical relationship between air travel and employment, income, and air fares; 4) technological changes (such as vertical lift-off aircraft); 5) the possibility that a low-cost airline may come into MSP and significantly expand service on certain heavily traveled routes; and 6) increased international flights over forecast levels due to Northwest's partnership with KLM or the potential opening of Canadian air markets. Also, as we pointed out earlier, the hubbing decisions of domestic air carriers and the overall growth in regional airline operations are hard to forecast accurately.

In their 1988 and 1990 forecasts, the Council's consultants attempted to account for uncertainty by conducting a risk analysis. This analysis required the consultant to forecast not only the average value for variables used in the forecast but also the probability distributions of each variable. Based on these assumptions, the consultant used a "Monte Carlo" computer simulation to calculate probability distributions for future operations and enplanements. For example, the consultant was estimating the probability that total operations in the year 2020 (and other years) would exceed 500,000 (and other specified totals).

This type of analysis, while useful in conveying the uncertainty involved in forecasting, can create a feeling of "false precision" and can be wrong about the range of future operations if the consultant does not accurately forecast the input variables and their probability distributions. The lay reader may get the impression from this sort of risk analysis that forecasts can actually be very precise about the probability distributions of future enplanements. However, just the opposite is true. The final results of this risk analysis are dependent on whether the consultant is correct in the assumptions made about the averages and distributions of variables modeled in the analysis.

For example, in the 1990 forecasts, the Council's consultants assumed that, in the year 2020, there would be a 90 percent chance that the hubbing ratio would exceed 2.30, a 50 percent chance that the ratio would exceed 2.40, and a 10 percent chance that it would exceed 2.80. However, as we pointed out earlier, there is good reason to question this assumption. If the risk analysis were rerun without a forecast change in the hubbing ratio over the 1992 level,

the analysis would likely show significantly different results. A risk analysis can only be accurate about the uncertainty in the forecasts if the consultants can accurately foresee the probabilities they assign to future values of input variables or if each mistake they make is offset by another.

**The Council should replace its risk analysis.**

We do not think that risk analysis is particularly useful in dealing with forecast uncertainty. Perhaps a better way of dealing with that uncertainty is to develop a series of strategies which, after careful analysis and public debate, are determined to be the region's best responses to future levels of operations. The strategies would be designed to respond to the following sorts of issues:

- **What capital improvement plan (including no change, various options for expanding MSP, and a new airport) would be best suited to respond to airport operations at various annual levels (such as 500,000, 600,000, or 700,000 annual operations)?**

- **How much does the result depend on how the annual operations are distributed throughout the year and the average day?**

- **Under what circumstances would it make sense to construct one or more runways at MSP and use that facility before constructing a new airport?**

In short, we do not feel that an elaborate risk analysis is particularly useful for decision-making purposes. Instead, development of strategies to address this uncertainty in a flexible and economically effective way seems more appropriate. In Chapter 4, we examine whether the dual-track process is adequately developing such strategies.

# Technical Review of Forecasts and Related Work

For both the 1988 and 1990 forecasts, the Council used expert panels to provide its staff and consultants with advice prior to its preparation of activity forecasts and economic analyses. In addition, the Council and MAC have various committees which have reviewed work produced during the airport planning process. These sorts of reviews are helpful and are probably more open than airport planning processes elsewhere. However, they are not detecting some technical concerns which need to be addressed.

In addition to the concerns we expressed above regarding the 1988 and 1990 forecasts, our concerns are that:

- **Council staff and consultants have been using a different series of historical data to analyze trends in the MSP hubbing ratio than MAC and its consultants. The Council data set shows much stronger growth in MSP's hubbing ratio since 1983 but is inappropriate and should not continue to be used for the purpose of illustrating historical trends.**

- **Council staff was unaware of the problem with the probability analysis done by the Council's consultants during the adequacy study. Furthermore, staff could not explain some of the key assumptions used in the analysis.**

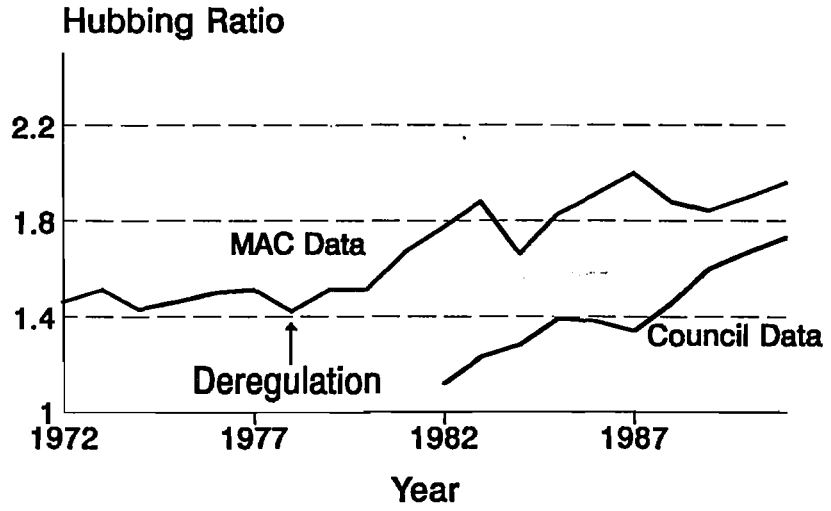
- **Council and MAC consultants have used some very different assumptions about existing delay times at the airport to generate estimates of the current and future expected economic loss due to airport delays.**

- **In estimating delay costs during the adequacy study, Council consultants used a measure of airline operations and maintenance costs per hour which was not appropriate considering its forecast of dramatically increasing regional airline operations.**

**Council consultants and staff have used the wrong data to assess hubbing ratio trends.**

Figure 2.11 shows the difference in the hubbing ratio data which has been used by MAC and the Council. The Council's data set, which consists of data reported to MSP airport officials by airlines, shows much greater recent growth. Between 1983 and 1991, the Council's data show the hubbing ratio growing from 1.23 to 1.73, a total growth of 41 percent or an annual growth rate of 4.4 percent annually. In contrast, the MAC data set shows a hubbing ratio growing very slowly since 1983 -- from 1.88 to 1.96 by 1991. The growth in the MAC data is only 4 percent, or 0.5 percent annually. The MAC data set is based on sample data collected by the United States Department of Transportation from actual airline tickets.

**Figure 2.11: Hubbing Ratio, MAC and Metropolitan Council Data, 1972-91**




Sources: Metropolitan Airports Commission and Metropolitan Council.

The Council consultants and staff have used the MAC data set in all of their forecasts although there was some confusion in materials presented to expert panels as late as December 1989. However, the consultants and staff have twice used the Council data set to analyze trends in hubbing ratios at MSP. This was first done in February 1992 in the Council's annual contingency assessment report. As recently as October 1992, the Council data were used to explain to the public and to those reviewing the 1990 forecast that historical hubbing ratio growth exceeds the forecast's projected growth. An October 1992 report said:

> In the 1990 forecast, MSP hubbing was expected to grow by 0.3 percent annually through the year 2000. The hubbing ratio between 1982 and 1991 actually grew by 4.9 percent annually.[15]

This statement is misleading both because the more appropriate data set used by MAC shows a much slower rate of growth since 1983 and because the forecast growth in the hubbing ratio by both MAC and the Council is much higher, not lower, than past growth. As we mentioned earlier, the annual rate of growth between 1983 and 1991 was 0.5 percent per year according to data used by MAC's consultants. Between 1982 and 1991, the growth rate was 1.1 percent annually. The forecast growth rate was higher than recent growth -- 2.1 percent annually between 1988 and 2000.

We asked Council staff and consultants for an explanation of the difference between the two data sets and for their opinion as to the better of the two sets for forecasting purposes. Council staff could not explain the difference and the Council's principal consultant referred us to MAC's principal consulting firm. MAC's consultants offered a reasonable explanation which is not disputed by the Council's staff or consultants. The conclusion of MAC's consultants is that the data sets are derived from two different sources and the source of the Council's data inappropriately counts "interline transfers" as originating passengers rather than connecting passengers. For example, a passenger arriving from Chicago on one major airline but transferring to another major airline and proceeding to Seattle is an interline transfer and should be counted as a connecting passenger at MSP. While the MAC data set counts that passenger correctly, the Council data set inappropriately counts that passenger as an MSP origination. Consequently, the Council hubbing ratios are less than the MAC hubbing ratios. Furthermore, as interline transfers have decreased at MSP, the source of the difference in the two data sets has shrunk. The result is that the Council data set is converging toward the MAC data set and growing much faster as interline transfers decrease.

After we explained our concerns about their analysis of hubbing ratio trends, Council staff and consultants discontinued use of the Council data set. However, we noted that members of the expert panel which reviewed the forecast assumptions in November 1992 were not given any historical data on MSP hubbing ratios to compare to the current hubbing ratio forecasts.

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*15* Metropolitan Airports Commission and Metropolitan Council, *The 1990 Dual-Track Forecast Process: Long-Term Aviation Activity Forecast for Twin Cities Region* (October 1992), 16.

**The Council consultant's adequacy analysis has problems.**

A second technical concern relates to the probability analysis which was prominently used in the adequacy study and was conducted for the 1990 forecasts but not widely circulated. This analysis provided statements regarding the probability that the existing airport with or without various improvements would be inadequate in future years. As we pointed out earlier, this analysis is not the best tool for estimating the time at which an airport improvement such as a runway is needed. In fact, it tends to overstate the immediacy with which improvements are needed. We found that Council staff were unable to identify how the consultant determined, based on demand and capacity probability distributions, whether the airport was adequate. More important, the staff were not aware of any potential problems with this type of analysis.

Third, in estimating the economic costs of airport delays, Council and MAC consultants have used radically different data on the existing average delay per operation at MSP. During the adequacy study, the Council's consultant used an average delay of 14.1 minutes per operation for 1988. In contrast, the MAC's consultants used a figure of 1.9 minutes for 1987 in its 1988 planning work and a figure of 2.7 minutes for 1989 in its Long-Term Comprehensive Plan. As Table 2.15 indicates, the Council's consultant estimated in 1988 that the average delay per operation would increase to 50.4 minutes in 2008 and that the estimated delays would cause additional annual operating costs for aircraft using MSP of $84.3 million in 1988 and $507.4 million in 2008. MAC consultants forecast significantly lower average delays (9.6 minutes) and delay costs ($87.3 million) for 2008.

## Table 2.15: Estimates of Average Delay Times and Annual Delay Costs to Aircraft

| Year | Agency | Average Delay Per Operation | Annual Hours of Delay | Cost Per Hour of Delay | Annual Aircraft Operating Costs Lost to Delays |
|---|---|---|---|---|---|
| 1987 | Metropolitan Airports Commission | 1.9 minutes | 12,189 | $ 941 | $11.5 million |
| 1988 | Metropolitan Council | 14.1 minutes | 75,577 | 1,116 | 84.3 million |
| 2008 | Metropolitan Airports Commission | 9.6 minutes | 92,571 | 943 | 87.3 million |
| 2008 | Metropolitan Council | 50.4 minutes | 439,731 | 1,154 | 507.4 million |
| 2008 | Metropolitan Airports Commission with technological improvements[a] | 5.9 minutes | 57,237 | 921 | 52.7 million |

Sources: Metropolitan Airports Commission and Metropolitan Council.

[a]This estimate assumes a 10 percent improvement in technology including use of a radar system permitting independent use of MSP's parallel runways during IFR conditions. The other estimates assume no improvements to MSP.

Council consultants and staff believe their analysis was more comprehensive because it included airspace delays, not just airfield delays, as MAC included in 1988. In addition, they used an FAA Model (ADSIM) which, while not the most sophisticated FAA model, was respected and within their budget. However, more recent comprehensive estimates by MAC's consultants using a more sophisticated model (SIMMOD) shows delays similar to those estimated by MAC consultants in 1988. Preliminary results from the ongoing FAA

**Council consultants used estimates of airport delays which were too high.**

Capacity Study of MSP also suggest that the Council estimates of delay times were far too high. The preliminary FAA estimates appear to estimate delay times slightly higher than estimated by MAC's consultants.[16]

This suggests that the Council estimates were not realistic. Although the Council estimates appear to be made in good faith, we think that the estimate of a 14 minute delay per operation in 1988 should have been an indication that the model or assumptions being used needed to be reexamined before results were used in a benefit/cost analysis and published.

Finally, there is a question regarding the airlines' operations and maintenance costs per hour which have been used by both agencies in the past to estimate the costs of delays. MAC's hourly cost estimates are lower than the Council's estimates. In addition, MAC's estimates are appropriately adjusted to reflect forecast changes in aircraft mix at MSP. Even though the Council's consultant was forecasting that regional operations would grow from about 13 percent to over half of the airport's operations, the Council's consultant did not adjust the figures to reflect the lower hourly cost of operating regional aircraft compared to planes used by large domestic air carriers.

## Presentation of Forecasts

Forecasting can be a very complex and mysterious exercise for policymakers and the public to understand. An important aspect of activity forecasting is thus the degree to which the agencies and their consultants have adequately communicated the essential elements of their forecasts to a broader audience. In particular, it is important that policymakers are provided with a good understanding of the forecasts so they can make appropriate decisions based on those forecasts. This means that the forecasters should adequately explain: 1) the overall growth in operations and enplanements, 2) the major types of operations and enplanments which are projected to change significantly, 3) the major factors causing growth, 4) the limitations of the forecasts, and 5) the implications of the forecasts for the airport planning process. In addition, the written products should include both the details which document how the forecasts were derived and a clear summary of the main features of the forecasts and their implications.

We found that the MAC and Council forecasts and accompanying materials differed in terms of how well they communicated the important details of the forecasts and their implications. In general:

- **The MAC forecasts of operations and enplanements were presented clearly and were itemized by type of aircraft.**

- **The MAC forecasts were accompanied by lengthy documentation which explained their derivation.**

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*16* Federal Aviation Administration Technical Center, *Minneapolis-St. Paul International Airport Data Package No. 5: Airport Capacity Enhancement Design Team Study* (January 1993).

**The Council's forecasts have not been as well presented and documented as MAC's forecasts.**

In contrast:

- **The Council's adequacy study and the consultant's final report did not contain a numerical presentation of the Council's 1988 forecasts. An accompanying consultant paper contained the total number of forecast operations and enplanements but did not provide a breakdown by type of aircraft.**

- **The Council's 1990 forecasts of total operations and enplanments were contained in a report to the Legislature, but the report did not contain a numerical itemization of the forecasts by type of aircraft.**

An additional concern we have about the Council's forecasts is the documentation of the forecast assumptions. We found it difficult to determine exactly what assumptions were used by the Council's consultants in their forecasts because that information is not contained in a single document like the documentation for MAC's forecasts. Instead, there are multiple documents, which together do not always provide complete information for every forecast year or provide some contradictory information.

We also conclude that:

- **Both MAC and Council forecasts and their key assumptions could have been summarized better for policymakers and the public.**

For example, in the case of the 1988 forecasts, the agencies should have emphasized the importance of the forecasts of regional airline growth. The Council's consultants projected a more than seven-fold increase in regional operations from 51,000 in 1986 to 372,000 in 2018. That 321,000 increase in operations accounted for the vast majority of the forecast increase in total operations. However, various consultant and Council reports do not disclose or emphasize this fact and do not highlight the methods used to produce the regional operations forecast.

In the case of the 1990 forecasts, both the forecast growth in domestic air carrier operations and in regional operations should have been emphasized in a summary since the two accounted for over 90 percent of the growth forecast by either MAC or the Council for the period 1988-2020. Because the 1990 MAC and Council forecasts differed, particularly on regional operations, the two factors accounted for different portions of the total growth. In the MAC forecast, 61 percent of the growth in total operations came from domestic air carriers, 30 percent from regional carriers, and less than 10 percent from other types of operations. In the Council forecast, 38 percent of the growth in operations was from domestic air carriers, 55 percent from regional airlines, and 7 percent from other types of operations. The methods and assumptions used to forecast the significantly different regional forecasts of the MAC and the Council should have been highlighted for policymakers as well as the fact that both these regional forecasts were dramatically lowered from the estimates used in 1988. This could have stimulated greater debate about the possible

need to refine the regional estimates and reach some consensus between the agencies.

**Both agencies need to better summarize and more clearly present their forecasts.**

In addition, the agencies could have summarized enplanement and operations growth for domestic air carriers in the following manner. From 1988 to the year 2020, enplanements were expected to grow 96 percent in the MAC forecast, with originations growing about 54 percent and connecting passengers growing 144 percent. The growth in domestic air carrier operations, however, was expected to be less than the 96 percent overall growth in passengers largely due to the airlines expected use of larger planes. A projected 33 percent increase in the average number of passengers per departing aircraft would hold the operations increase through the year 2020 to about 46 percent.

Furthermore, the key factors causing (or limiting the increase) in operations should have been highlighted. They include: 1) a growth in the hubbing ratio from 1.88 to 2.40 total passengers per originating passenger; 2) a 54 percent growth in originating passengers due to a forecast increase of 23 percent in area employment, 29 percent in real per capita income, and an 8 percent decline in airfares; and 3) a 33 percent increase in the passengers per aircraft due to a 24 percent increase in the average number of seats on aircraft and a 6 percent increase in percentage of seats that are filled.

A final aspect about the presentation of the forecasts concerns how the agencies have explained the uncertainty underlying forecast assumptions and the forecasts themselves. Generally, MAC's consultant has made forecasts of operations and enplanements but has not done much to discuss or quantify the uncertainty of the forecasts. The Council's main consultant has left more of the main forecasting work to MAC's consultant, except in the areas of domestic air carriers and regional airlines, and has served the role of discussing and quantifying uncertainty. As we have discussed previously in this chapter, the Council consultant's risk analysis is useful in explaining to policymakers and the public that there is a tremendous amount of uncertainty underlying the assumptions and the resulting forecasts. However:

- **The risk analysis, particularly as presented in the adequacy study, has an element of "false precision."**

Risk analysis requires that the forecasters make assumptions not only about the average of each variable which is an input into their forecast but also about the probabilities that each variable will be somewhat higher or lower than the average. If the forecaster is wrong about the probability distributions of the variables, then all this precision could result in a major misstatement of the probability that future operations would exceed the airport's capacity. Thus, it is not clear that the precision of the risk analysis provides very meaningful results. It might suffice to say that no one forecast can be entirely relied on since forecasters simply do not know for sure what will happen in the future, particularly in an industry as volatile as the airline industry is today.

# IMPLICATIONS OF THE FORECASTS

In this section, we examine what the implications of the forecasts are for the need to build extra runway capacity at either MSP or a new airport. In addition, we review how well the implications have been made clear to policymakers. Finally, we examine whether modifications to the stated implications should be made in light of more recent knowledge.

In particular, we focus on how much longer it might be before a new runway is needed at MSP. One of the key premises underlying the adequacy study's recommendation of a dual-track process was that a new runway at MSP would be needed between 1993 and 1998 and another new runway between 2003 and 2018. Before new runways were added to MSP, the adequacy study reasoned that a new airport should be evaluated and a new airport site should be selected so that, if the planning process determined that the new airport was the region's best option, a viable site would be available. If, however, the need for a new runway at MSP is sufficiently farther off in the future than estimated in 1988, it might make sense to delay at least some aspects of the dual-track planning process. The environmental impact statement needed prior to any major capital improvement at MSP or a new airport site has a limited shelf life. If that work is completed in 1996 but additional runway capacity is not needed until 2005 or later, the planning work may need to be redone at significant expense. Under that scenario, policymakers might want to delay some of the detailed work now scheduled to be done over the next three years until a more appropriate time.

**The implications for airport adequacy changed when the forecasts were revised in 1990.**

Overall, we found that:

- **The implications of the forecasts regarding the timing of additional capacity needs have changed significantly since the adequacy study because the forecasts were revised downward.**

However:

- **The timing of the need for a new runway was not clear from the consultants' 1990 forecasts and related work since the MAC and Council consultants had different forecasts, used different methods for determining runway needs, and did not make the implications or their methods entirely clear.**

- **The methods used by the consultants did not yet include some factors which should be included and may be included in the analyses to be conducted over the next three years.**

- **Recent events suggest that, while the long-term forecasts of operations made in 1990 may be reasonable, the growth in operations may possibly come quicker than forecast.**

# Background

It should be first stated that deriving implications for airport adequacy requires quite a few more steps than just estimating the future annual levels of operations and enplanements. The consultants made assumptions about the monthly and hourly distribution of airport activity. In fact, they made such assumptions about each type of operation and then aggregated them to produce a forecast of the distribution of total operations by month, for the average day of each month, and for each hour of the average day of each month. In addition, the consultants made estimates of the hourly capacity of the existing airport, as well as numerous expansion options. Capacity estimates vary depending on weather conditions. Hourly capacity is higher under VFR (Visual Flight Rule) conditions and lower under IFR (Instrument Flight Rule) conditions.

Evaluating the need for additional capacity usually involves comparing hourly capacity to hourly demand. In addition, the annualized cost of delays for the current airport can be estimated for future years and compared to the lower annual delay costs which are estimated to occur under various expansion options. The economic benefits of expansion, consisting of the lower annual delay costs, can then be compared to the expansion costs to see if the present discounted value of future benefits exceeds the present value of the expansion costs. If the benefits exceed costs, the expansion project makes economic sense.

The benefits can be narrowly defined to include only the operating cost savings to airlines which result from fewer delays. In that case, the comparison of benefits to costs shows whether it is in the general interest of the aircraft using the airport to have the facility expanded. The benefits could also be defined more broadly to include the reduced time delays for the passengers using the airport. However, if the value of people's time savings from reduced air delays is included as a benefit of expansion, then the value of people's time should be included as a cost for any option which requires people to travel greater average distances on the ground to reach a more remote airport than the current one. Finally, a decision about airport expansion will likely involve other economic, social, and environmental considerations which cannot necessarily be quantified or included in a benefit/cost analysis.

# Consultants' Conclusions in 1990

The MAC consultant was responsible not only for revising the forecasts but also for developing a long-term comprehensive plan for MSP. The plan was intended to recommend the expansion which was needed to meet estimated airport activity for the year 2020. The long-term plan adopted by MAC included a new North-South runway on the west side of MSP, some new taxiways for aircraft, a new terminal on the northwest end of MSP, and an underground people mover system. Unlike the 1988 adequacy study:

- **The MAC consultant concluded that the revised 1990 forecasts meant that only one new runway would be needed through 2020.**

- **The consultant's work was not entirely clear on when that runway was needed but MAC staff told us that, assuming airport activity grows as forecast, the new runway would probably be needed between 2005 and 2010.**[17]

The consultant's analysis of expansion alternatives involved comparing the hourly demand on the average day of the average month to estimated hourly capacity under both VFR and IFR conditions. The consultant also estimated the annual delay costs for the existing airport and various expansion alternatives.[18] Delay costs included the operating costs to aircraft but did not include the costs to passengers of delays. The MAC consultant concluded that, while one additional runway was needed before 2020, any additional runways would provide minimal delay cost savings compared to the cost of constructing them.

**The conclusions reached by the Council and MAC are different.**

The conclusions reached by the Council consultants and staff in 1990, while different from those of the adequacy study, were not identical to those of MAC. The analysis done by the Council's consultant was never published, but the Council reported in its first annual contingency assessment of the dual-track planning process that:

- Based on the revised Council forecasts, an additional runway would be needed by the late 1990s.

- The benefits of runway construction would exceed the costs by $2.4 billion.

- Even with a new runway, MSP activity would be running close to capacity (95 percent of capacity) by the year 2020.

Furthermore, the Council report argued that FAA forecasts were higher than Council forecasts and showed the airport activity levels at 150 percent of capacity in 2020 even with the one new runway. The Council's consultant estimated that the benefits of the new airport option still exceeded its costs by $2 billion in present value even if the new airport were commissioned in the year 2009, as stated in the adequacy study. The Council's report recommended that the scope or timing of the dual-track process should be seriously reconsidered only if the forecasts of the Council, MAC, and the FAA all agree that long-term growth rate of operations at MSP would be 0.7 to 0.8 percent annually or less. The report recommended that reconsideration should commence if the

*17* MAC staff characterized this estimate as preliminary and subject to change with further analysis.

*18* Delay costs were also estimated for various options assuming that FAA rules will be changed in the future to permit the airport's existing parallel runways to be operated independently during IFR conditions.

three agencies' forecasts all estimate a long-term growth rate of one percent or less.[19]

The Council consultant's work was not published but was apparently based on a comparison of airport activity during the peak hour of the average day of the peak month, while the MAC consultant used the peak hour of the average day of the average month. The Council consultant's benefit/cost figures were apparently based on the same methodology the consultant used during the adequacy study. Thus, like the MAC figures, the figures included operating cost savings to aircraft from reduced delays and, unlike MAC figures they include passenger time savings from reduced air delays.

## Discussion

There are several possible sources of the difference between the MAC and Council conclusions about airport adequacy. One is the difference in forecast levels of operations: 527,000 for MAC and 588,000 for the Council by the year 2020. This does not, however, appear to be a principal source of the differences. Through the year 2000, MAC is forecasting more operations than the Council yet the Council conclusion is that a new runway will be needed in the late 1990s and MAC staff indicate that 2005 to 2010 is more appropriate timing for a new runway.

More likely sources of the differences in conclusions are the differences in methodology. The Council consultant compares peak hour activity in the peak month, rather than the average month, to estimated hourly capacity. In addition, the consultants do not always have the same estimates of hourly capacity.

**The difference in conclusions is due to differences in methods for analyzing airport adequacy and estimating future delays.**

Regarding benefit/cost calculations, the consultants also differ in their methodology. As noted above, unlike the MAC consultant, the Council consultant includes passenger time savings from fewer air delays. More important:

- **The two consultants have used significantly different estimates of the average delay per operation thus resulting in dramatically different estimates of delay costs.**

We noted earlier in this chapter that, during the adequacy study, the Council's consultant was using estimates of average delay times per aircraft operation which were greatly in excess of those used by the MAC consultant. This is a significant source of the different conclusions.

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*19* Metropolitan Council, *First Annual Contingency Assessment: Major Airport Strategy* (February 1990), 21-24. Based on 1990 operations and this stated policy, we estimate that the three agencies would have to forecast 512,000 operations or less for the year 2020 in order for reconsideration to commence and 468,000 to 482,000 operations or less for serious reconsideration of the dual-track planning process. The 1990 MAC and Council forecasts for 2020 are 527,000 and 588,000 operations respectively, but the FAA forecast was substantially above these levels.

Generally:

- **We are more comfortable with the MAC methodology because it has been documented better and seems more reasonable.**

While it is important to see how peak hour activity in the peak month compares to capacity, it does not appear correct to say that a new runway is needed as soon as that activity exceeds capacity. Capacity may not be exceeded in other months; and, if there is excess capacity around the peak hour of the peak month, then the delays may be small in their economic impact compared to the cost of adding capacity.

In addition, the Council's consultant has used some methods to estimate the economic benefits of expansion that may not be appropriate. As previously mentioned, because the Council's consultant has overestimated average delay times, the conclusions of the consultant's benefit/cost analysis would likely be changed.

**MAC's methods are better than the Council's, but both agencies will be including other important factors in their future analyses.**

Also, the Council's consultant included passenger time savings from fewer air delays as a benefit to airport expansion and new airport construction, but did not include an estimate of the additional annual costs (time and automobile expenses) to airport passengers and visitors from the longer ground transportation travel times to get to a new airport which is located farther out of the center of the metropolitan area.

However:

- **The analyses of both consultants could be considered less than definitive since neither included all the factors which may yet be included in the reports issued by the end of the dual-track process.**

MAC's analysis does not consider any time savings or costs from reduced air delays or increased ground travel times. Neither the 1990 MAC analysis nor the Council's 1990 analysis included possible economic growth benefits to the region from expansion of MSP or a new airport. Neither analysis included the costs of noise mitigation. Thus, it could be argued that adequacy conclusions to date are at best very preliminary.

# Recent Events

If one were to accept the MAC forecast and implications, one might conclude that the dual-track process's timing needs adjustment. If an additional runway is not needed until 2005 or 2010, then the completion of a detailed environmental impact statement by 1995 or 1996 might be premature and result in the need to redo the analysis closer to the time when a major capacity addition is needed.

However:

- **There appears to be a sufficient probability that growth at MSP may occur faster in the short-term than forecast in 1990.**

Although operations at MSP had not grown between 1985 and 1991, 1992 saw a significant growth in activity. Operations grew from 382,000 in 1991 to 416,000 in 1992. Despite Northwest Airlines' financial condition, most of the growth occurred in the operations of domestic air carriers, which grew by about 18,000 operations. Regional airline operations also grew by about 10,000 operations.

Some of the 1992 growth in domestic air carrier operations was due to the decision of Northwest Airlines to add an additional bank of flights to its schedule and to add direct service to some additional cities. This action came as Northwest, in response to its financial condition, decided to emphasize its MSP and Detroit hubs at the expense of other airports. This decision, implemented in September 1992, added about 6,000 operations to MSP's total for the year. If the schedule continues, it will add another 13,000 operations to MSP's total for 1993.

**There is uncertainty about short-term growth in operations at MSP.**

Very slow growth at best is expected from Northwest from 1993 through the late 1990s since the size of Northwest's aircraft fleet will be limited due to financial limitations. However, as mentioned earlier in this chapter, a Northwest official mentioned possible plans which would have Northwest's regional airline partners expanding their operations at MSP to half of Northwest's MSP operation level over the next five to seven years. Such an increase, when combined with the expected short-term growth for domestic air carriers and other types of operations, suggests that MSP could experience a level of operations in the range of 470,000 to 490,000 by the late 1990s. This is a level comparable to what the 1990 MAC forecasts predicted for the period 2005-2010, which is the same period for which MAC consultants and staff concluded that a new runway would be needed at MSP. This does not mean that this scenario will actually happen. However, it does suggest that, if Northwest survives the substantial restructuring it is undergoing, then MSP's existing capacity could be exceeded before the year 2000.

Furthermore, it seems that the additional bank of flights has had adverse consequences for delays. The bank has caused greater pressure on MSP's capacity at times adjacent to one of the peak hours of activity. This has diminished the airport's ability to limit the delays by shifting some of the peak hour traffic to the beginning of the next hour. When activity during several adjacent hours is close to capacity, the ability to shift is more limited and delay problems are compounded. This bank was added at a time which forecasters had not anticipated. Forecasters say that, when the forecasts were prepared, airline officials had indicated that a more favorable time for an additional bank would likely be selected. Consequently, the timing of the bank creates additional problems which the 1990 forecast did not incorporate.

At this point, however, it is not entirely clear what the likelihood is of the above short-term scenario. MAC and Council staff will need to see whether the statements of one Northwest official are representative of policy and plans of Northwest Airlines and their regional airline partners. Shortly before publication of this report, a Northwest official told us that the expansion of regional airline activity depends on whether it is economical and that Northwest and its regional airline partners have not yet examined its economic feasibility. Furthermore, the official suggested that expansion of regional activity would probably not be economical if the growth in operations required the addition of a new runway at MSP.

In addition, the long-term significance of the new bank for delays is not yet clear. Some lessening of the delays experienced in late 1992 may be expected as airport officials adjust to the new schedule.

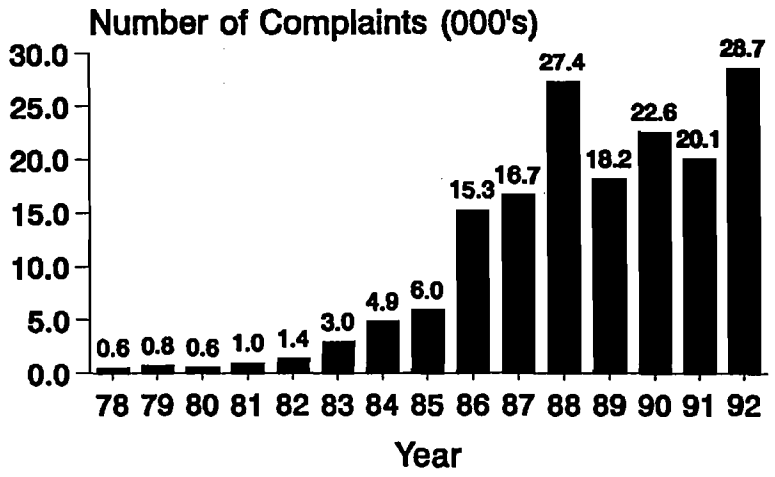
# Airport Noise Analysis and Planning

**CHAPTER 3**

As we observed earlier, the dual-track planning process was prompted by concern over the rapid increase in airport operations that occurred in the 1970s. In Chapter 2, we saw that both operations and passenger traffic grew rapidly during this period. Increased operations also gave rise to increasingly frequent complaints about airport noise. As Figure 3.1 shows, noise complaints tabulated by the Metropolitan Airports Commission (MAC) increased from 561 in 1978 to 15,297 in 1986.

**Noise complaints have grown rapidly in recent years.**

**Figure 3.1: Number of Noise Complaints Reported to the Metropolitan Airports Commission, 1978-92**




Source: Metropolitan Airports Commission.

Concern about airport noise was responsible, in part, for legislative action in 1987 calling for a study of the Minneapolis-St. Paul International Airport (MSP). The Metropolitan Council was directed to analyze the physical and environmental capacity of the airport.[1] Assisted by its consultant, Apogee Research, the Council conducted an extensive study of airport noise at MSP and published its results in its 1988 airport adequacy study.

1 *Minn. Laws* (1987), Ch. 223.

In this chapter, we examine the way the Metropolitan Council and MAC have studied the noise problem at MSP. We asked:

- **Have the Metropolitan Council and MAC used appropriate methods and data in studying airport noise and its effect on Twin Cities neighborhoods?**

- **Have the agencies' analyses of noise been free of technical errors and accurately summarized for policy makers and the public?**

So far, the principal products of the two agencies' noise analyses are the discussion of airport noise in the Metropolitan Council's 1988 airport adequacy study and the noise analysis conducted by the staff and consultants of the Metropolitan Airports Commission, presented in the MSP Long-Term Comprehensive Plan and other documents. We extensively reviewed these documents and others. We also interviewed staff members at the two agencies, their consultants, and national noise experts.

**We conclude that the adequacy study's noise analysis contained significant errors.**

As with other aspects of airport planning, we examined noise-related planning against the general criteria of objectivity, completeness, technical competence, timeliness, and responsiveness to the needs of policy makers who called for the studies in the first place.

Overall, we conclude that the Council's 1988 noise analysis was seriously flawed and that its results were not clearly presented to policy makers. In our view, the Council's conclusion that airport noise at MSP will be much worse in the middle of the next decade is not supported by the evidence. We found MAC's work, on the other hand, to be consistent with the approach recommended by acoustical scientists and regulatory authorities. Largely for that reason, MAC's conclusion that airport noise at MSP will diminish over the next decade is more credible and realistic. MAC's other analyses of the noise effects of options under the dual-track planning process remain to be completed.

# EVALUATION APPROACH

In order to evaluate noise analysis and noise-related planning conducted by the Council, the MAC, and their consultants, we reviewed the history of government noise regulation and pertinent literature on noise measurement.

There are two basic approaches to measuring community noise effects:

1. Cumulative noise exposure over a stated period of time;

2. A statistical description of exposure to a given level of noise, such as how much time is spent above a certain level.

In regulating noise as in regulating other forms of environmental contaminants, measures are needed that are reasonably comprehensive in scope, simple enough to calculate reliably, and validated by substantial experience. According to governmental and academic studies, the measure that best meets this definition is Ldn (or DNL) the day-night noise exposure level. It is a measure of the first type listed above, a cumulative measure of annual noise exposure.

Noise is a form of energy that causes a change in the atmosphere or other medium. Noise is perceived by humans as fluctuations in barometric pressure around a static level. Noise is described in terms of sound level (decibels) and frequency (cycles per second or hertz). The sound made by an airplane is a complex mixture of frequencies generated at varying levels, for varying times. The human ear is able to detect sound between about 20 and 20,000 hertz, but it is much more sensitive to the middle part of this range, around 2,000 to 8,000 hertz. For this reason, when the concern is human response to noise, the measure of noise usually employed is weighted toward the responsiveness of the human ear. This measure is called the "A-weighted decibel scale," abbreviated dBA.

**We reviewed the history of noise measurement and regulation.**

The decibel itself is calibrated in reference to human hearing. One decibel is the threshold of human hearing and a reading of 120 decibels indicates a painfully loud noise. Table 3.1 shows the decibel level of various indoor and outdoor sounds. Note that a 10 decibel increase represents a doubling of perceived sound. Thus, 80 decibels represents a sound that is twice as loud as one that is 70 decibels.

The logarithmic nature of the decibel scale means that two 70 decibel sound sources would, if added together, equal 73 decibels. The decibel level of any two equally loud sources would add 3 decibels to the sound level of either source. For example, imagine two table radios set to play at equal volume next to each other, only one of which is playing. Turning the second radio on adds perceptibly to the sound in the room, but clearly does not double the intensity of the sound. If two substantially unequal sources are added together, there is little or no perceived increment in sound over the louder source.

## Measurement and Regulation of Community Noise Impacts

In 1972, Congress enacted the Noise Control Act (Public Law 92-574) that included a requirement to "...publish information on the levels of environmental noise, the attainment and maintenance of which in defined areas under various conditions are requisite to protect the public health and welfare with an adequate margin of safety." The resulting report produced by the Environmental

## Table 3.1: Common Sounds on the Decibel (dBA) Scale

| Sound | Sound Level (dBA) | Relative Loudness (Approximate) | Relative Sound Energy |
|---|---|---|---|
| Military jet fighter takeoff at 500 feet; Armored personnel carrier | 130 | 128 | 10,000,000 |
| Rock music with amplifier (uncomfortably loud) | 120 | 64 | 1,000,000 |
| Loud motor cycle at 20 feet; Riveting machine | 110 | 32 | 100,000 |
| Boiler shop; Power mower (very loud); Jet plane takeoff (B-727) at 1000 feet | 100 | 16 | 10,000 |
| Orchestral crescendo at 25 feet; Motorcycle at 25 feet; Diesel locomotive (20-30 mph) at 50 feet | 90 | 8 | 1,000 |
| Busy street; Diesel truck (moderately loud) 40 mph at 50 feet | 80 | 4 | 100 |
| Interior of department store; Vacuum cleaner at 10 feet | 70 | 2 | 10 |
| Ordinary conversation at 3 feet; Air conditioner at 20 feet | 60 | 1 | 1 |
| Quiet urban daytime; Dishwasher next room | 50 | 1/2 | .1 |
| Average office | 40 | 1/4 | .01 |
| City residence (very quiet) | 30 | 1/8 | .001 |
| Quiet country residence | 20 | 1/16 | .0001 |
| Rustle of leaves (just audible) | 10 | 1/32 | .00001 |
| Threshold of human hearing | 0 | 1/64 | .000001 |

Source: Metropolitan Airports Commission from HNTB.

Protection Agency (EPA), influential for years to come, is known as the EPA "Levels Document."[2]

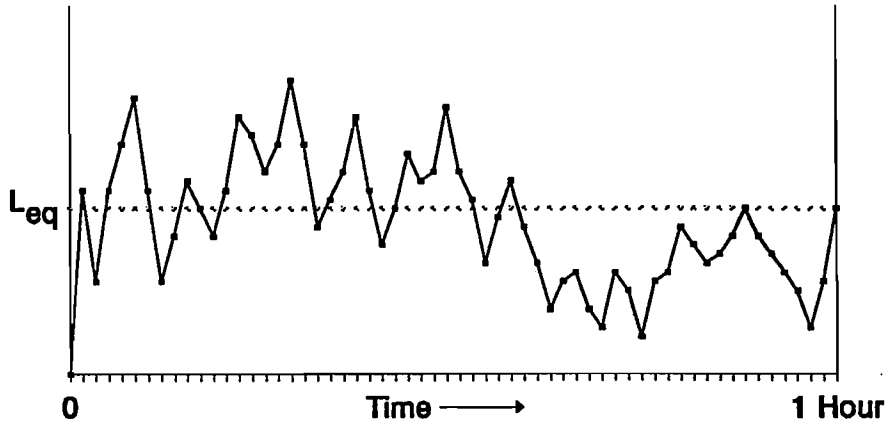
In the Levels Document, the EPA concluded that the best measures for describing the effects of environmental noise in a simple, uniform, and appropriate way were:

- The Long-Term Equivalent A-Weighted Sound Level (Leq); and
- The Day-Night Average Sound Level (Ldn, also symbolized as DNL), a variant of Leq that incorporates a 10 dB penalty for nighttime noise.

2 EPA Office of Noise Abatement and Control, EPA Report No. 550/0-74-004 (1974), *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.*

Figures 3.2 and 3.3 present graphical illustrations of these two measures.[3] As shown in Figure 3.3, Ldn is based on Leq. During nighttime hours (10 PM to 7 AM) a 10 decibel penalty is assigned to hourly Leq levels actually observed. This is equivalent to counting nighttime flights as twice as loud as they would be counted during the day. Figure 3.3 shows Ldn computed for part of a 24-hour period, but yearly Ldn averages are computed and used in noise regulation by the federal government.

**Figure 3.2: Definition of Leq (Equivalent Sound Level)**




Note: Leq is the continuous sound level in decibels that produces the same energy as observed fluctuating levels.

Source: Metropolitan Airports Commission.

In response to a request in 1972 by EPA, the National Academy of Science's Committee on Hearing, Bioacoustics and Biomechanics (CHABA) held deliberations between 1972 and 1976 and published Guidelines for Preparing Environmental Impact Statements on Noise.[4] Following the publication of these guidelines, an acoustical scientist, T. J. Schultz, published an influential article which reviewed previous research on noise annoyance and its effect on land-use criteria and regulation.[5] This article and the studies reviewed in it provide the basis for the noise related land use policies of various government agencies. A key finding from the article (which we will examine below in greater detail) is that Ldn level 65 represents an important threshold of annoyance.

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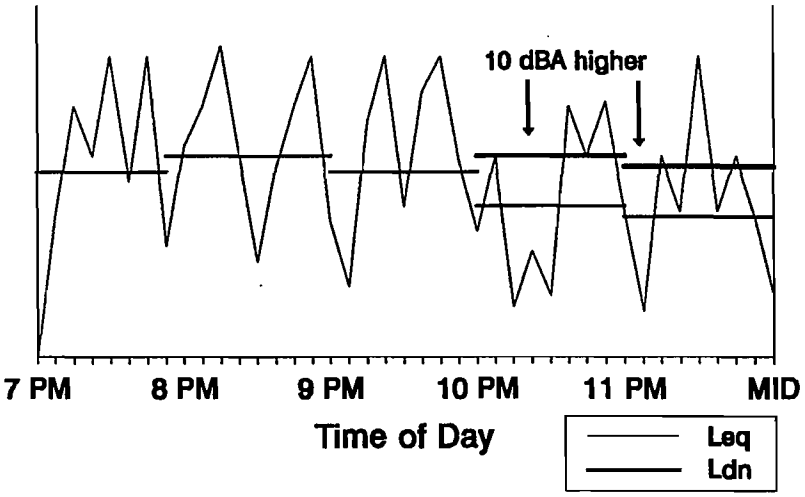
3 Leq is the continuous sound level (in decibels) that would produce the same amount of sound energy as actual recorded (fluctuating) sound levels actually observed. Leq is shown in Figure 3.2 for a one hour time period, but can be computed over any time interval.

4 National Research Council Assembly of Behavioral and Social Sciences. Committee on Hearing, Bioacoustics, and Biometrics (CHABA) (1977), *Guidelines for Preparing Environmental Impact Statements on Noise.* Report of Working Group 69.

5 Schultz, T. J., "Synthesis of Social Surveys on Noise Annoyance," *Journal of the Acoustical Society of America* 64 (2), 377-405.

**Figure 3.3: Definition of Ldn (Day-Night Average Sound Level)**




Note: Ldn is based on Leq. A 10 decibel penalty is assigned to hourly values between 10 pm and 8 am.

Source: Metropolitan Airports Commission.

**The day-night average sound level (Ldn) is a key measure of community noise exposure.**

The next major milestone in governmental regulation of airport noise was the establishment in 1979 of the Federal Interagency Committee on Urban Noise (FICUN). The FICUN committee included EPA, the U.S. Department of Transportation, the Department of Housing and Urban Development, the Department of Defense, and the Veterans Administration. The committee published a report in 1980 which specified Ldn as the descriptor to be used for all noise sources.[6] In 1981, the Acoustical Society of America also specified Ldn as the acoustical measure to be used in land use planning.

Around the same time, Congress directed the FAA to establish a single way to measure noise at airports, establish a single system for determining the exposure of individuals to airport noise, and identify land uses compatible with given levels of noise. In 1981, in response, the FAA formally adopted Ldn as the single measure for determining the exposure of individuals to airport noise as part of its agency rules.[7]

In 1982, the EPA published its Guidelines for Noise Impact Analysis based on the CHABA Guidelines.[8] In 1990, the American National Standards Institute revised its 1980 standards on compatible land use.[9] This standard continues to identify Ldn as "the acoustical measure to be used in assessing compatibility between various land uses and outdoor noise environment."

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6 Federal Interagency Committee on Urban Noise (FICUN), *Guidelines for Considering Noise in Land Use Planning and Control,* U.S. Government Printing Office Report 1981-337-066/8071.

7 Airport Noise Compatibility Planning, 14 CFR 150.

8 EPA Report 550/9-82-105.

9 "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S1240-1991.

In 1990, about 10 years after the meetings of FICUN, another interagency committee was formed, the Federal Interagency Committee on Noise (FICON). The FICON committee once again revisited these issues as well as research on community noise effects that had been conducted since the 1970s. FICON was formed at the direction of the Environmental Protection Agency and the Federal Aviation Administration in December 1990 with a basic charter to review airport noise impacts in connection with the National Environmental Policy Act, and to make recommendations for potential improvements. The makeup of the FICON committee was similar to the 1980 FICUN committee, and included representatives of the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and Urban Development, the Environmental Protection Agency, and the Council on Environmental Quality.

**A major U.S. Government study recently reaffirmed the use of Ldn for community noise effects near airports.**

The FICON committee's conclusions are clear and unequivocal:

- "There are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL (also abbreviated as Ldn) cumulative noise exposure metric."
- "The methodology employing DNL as the noise exposure metric ... to determine noise impacts on populations is considered the proper one for civil and military aviation scenarios in the general vicinity of airports."

The main policy recommendations of the FICON committee are:

- "Continue use of the DNL metric as the principal means for describing long-term noise exposure of civil and military aircraft operations."
- "Improve public understanding of the DNL, supplemental methodologies and aircraft noise impacts."[10]

## Ldn and Community Noise Annoyance

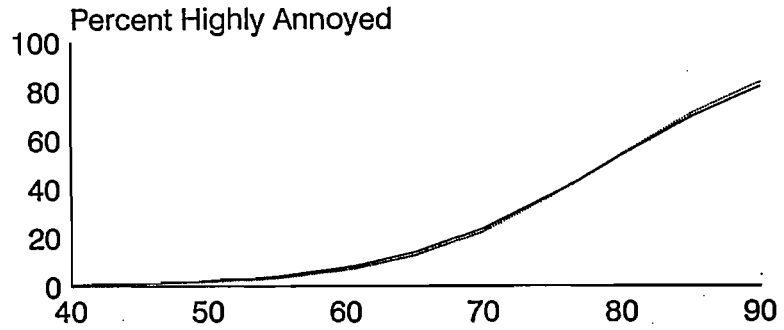
The key research issue on which land use regulation around airports rests is the relationship between community noise annoyance and Ldn, the noise measure which has been discussed and examined in the various committees and organizations listed above. Figure 3.4, taken from the 1992 FICON report, is presented below.[11] This figure presents the so-called "Schultz curve" relating the percent of the population "highly annoyed" by airport noise to annual Ldn levels. It is clear from the chart that the percent highly annoyed increases significantly above approximately Ldn 65. At Ldn 60 the percent highly annoyed is between 6 and 8 percent, at 65 it is 12 to 14 percent, and at 70 it is 22 to 24 percent, according to the data presented in Figure 3.4. This relationship is the basis for FAA policy on land use, and airport environmental effects. Analyses of Ldn 65 contours are required as part of the environmental impact

*10* Federal Interagency Committee on Noise, *Federal Agency Review of Selected Airport Noise Issues* (August 1992), ES-1 to ES-4.

*11* FICON, *op. cit.*, 3-6.

**Community noise annoyance increases significantly above Ldn 65.**

## Figure 3.4: Predicted Noise Annoyance Levels




| | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| New Study— | 0.4 | 0.8 | 1.7 | 3.3 | 6.5 | 12.3 | 22.1 | 36.5 | 53.7 | 70.2 | 82.6 |
| Old Study— | 0.6 | 1.1 | 2.1 | 4 | 7.5 | 13.6 | 23.3 | 37.1 | 53.3 | 68.8 | 81 |

Source: Interagency Committee on Noise

statements that need to be prepared and approved in order to build an airfield or expand an existing airport. The original study by Schultz reviewed 12 studies and estimated the relationship between Ldn and annoyance on the measurement of 161 data points. Subsequent studies brought the number of data points to 400, but the new data changed neither the basic relationship nor scientists' conclusions about it.[12] Thus the relationship established by previous researchers that formed the basis of regulatory policy in the United States was affirmed in the 1992 FICON report.

The purpose of the foregoing review of 20 years of noise-related research and policy development is to make the following points:

- **There is general agreement among acoustical scientists and government agencies concerned with environmental noise on how to measure airport noise for the purpose of regulating land use in the vicinity of airports.**

- **Federal policy does not preclude state or local areas from conducting supplementary studies, but federal regulation of airport noise substantially preempts local regulation under existing legal decisions.**

- **FAA approval is required for airport construction and FAA prescribed noise analysis is required. Airport planners in**

*12* Figure 3.4 shows the original Schulz curve and the curve estimated from the additional data points.

**Minnesota must meet federal FAA and EPA standards. This requires tying land-use policy to the noise metric Ldn in order to obtain federal noise abatement funds under the FAR Part 150 program.**

- **Given the practice of federal regulatory agencies and the endorsement of acoustical scientists through their professional organizations, Ldn would seem the logical basis for the Metropolitan Council and MAC to use in defining compatible land uses around either the old or new airport sites, supplemented by other measures as needed.**

**In general, residential use is incompatible where Ldn levels are above 65.**

# Land Use Compatibility

Various federal agencies have developed land-use policies defined by Ldn exposure. The FAA rules are presented in Federal Aviation Regulations Part 150. In general terms, residential uses are permitted in areas where Ldn is 65 or less, commercial use is permitted where Ldn is 70 or less, and manufacturing and production uses are permitted where Ldn is 80 or less, assuming indoor noise reduction is achieved in office and other noise sensitive areas. Residential and commercial uses can be permitted at levels higher than noted if special conditions are met in construction or sound insulation.

Noise annoyance is partly a product of the level of ambient noise in addition to noise created by aircraft. Table 3.2 shows the approximate levels of outdoor community noise exposure levels in various settings. The ambient level of noise in an ordinary urban area is Ldn 58 to 62, a small town or quiet suburban area is 45 to 55, and a rural area is 40 to 48.

Ldn takes into consideration both the level and number of noise events during a 24-hour period. As noted, the Ldn metric applies a 10 decibel penalty to events occurring between 10 PM and 7 AM. Recall that 10 decibels represents an effective doubling of sound intensity, so a flyover occurring at night would be counted as twice as loud as the same flyover during the day. In order to gain an appreciation of how much airline traffic is required to achieve a read-

## Table 3.2: Typical Ldn Values in Residential Areas

| Description | Typical Range Ldn in dB | Average Ldn in dB | Population Density People/Square Mile |
|---|---|---|---|
| Quiet Suburban Residential | 48-52 | 50 | 630 |
| Normal Suburban Residential | 53-57 | 55 | 2,000 |
| Urban Residential | 58-62 | 60 | 6,300 |
| Noisy Urban Residential | 63-67 | 65 | 20,000 |
| Very Noisy Urban Residential | 68-72 | 70 | 63,000 |

Source: U.S. EPA 1974 in FICON 1992.

ing of Ldn 65, it is useful to consider the following examples taken from the 1992 FICON Report: If one 100 decibel flyover lasting 30 seconds occurred each 24 hours (during the day) of the year, the annual Ldn would be 65.5. If 10 overflights occurred (all during daytime hours, the Ldn level would be 75.5. If all occurred at night the Ldn would be 85.5.[13]

Thus, FAA policy would basically disallow residential use of land exposed to one jet aircraft flyover generating 100 dB of sound for 30 seconds per day. The Ldn metric is quite sensitive to single noisy events. However, the logarithmic nature of the decibel scale means that a 10-fold increase in frequency is necessary to raise Ldn 10 points. However, a 10 point increase to Ldn 75 would be achieved by as few as 10 30-second 100 decibel overflights per day, and this would clearly disqualify residential use of the affected area.[14]

## Ldn Noise Contours

Figure 3.5 presents a map showing 1991 Ldn noise contours around MSP. As this figure shows, a substantial area in Minneapolis, Richfield, and communities southeast of the airport are subject to noises above Ldn 65. Some residential areas are subject to noise above Ldn 70 and 75 levels, levels of noise which are incompatible with residential use according to land use standards of the FAA.

**The population exposed to high levels of airport noise is projected to decline by the turn of the century.**

Figure 3.6 shows Ldn 65 contours around the airport in 1989 and the projected contour for 2000 when most noisy "Stage II" aircraft are scheduled to be replaced with quieter "Stage III" aircraft. The substitution of newer, quieter aircraft for older, noisier equipment will have a significant effect on Ldn by the end of this decade. The new equipment is around 15 decibels quieter than the old, meaning less than half as noisy to a person on the ground. Figure 3.6 demonstrates the point:

- **Assuming that quieter aircraft are phased in on schedule, the area exposed to unacceptably high noise levels will shrink in the next decade.**

The area exposed to noise is actually projected to shrink from present levels to a low in 2005 then increase slightly to the year 2020, the end of the 30 year planning cycle. Figure 3.7 shows the Ldn 65 noise contour comparison between 2000, 2005, and 2020.[15]

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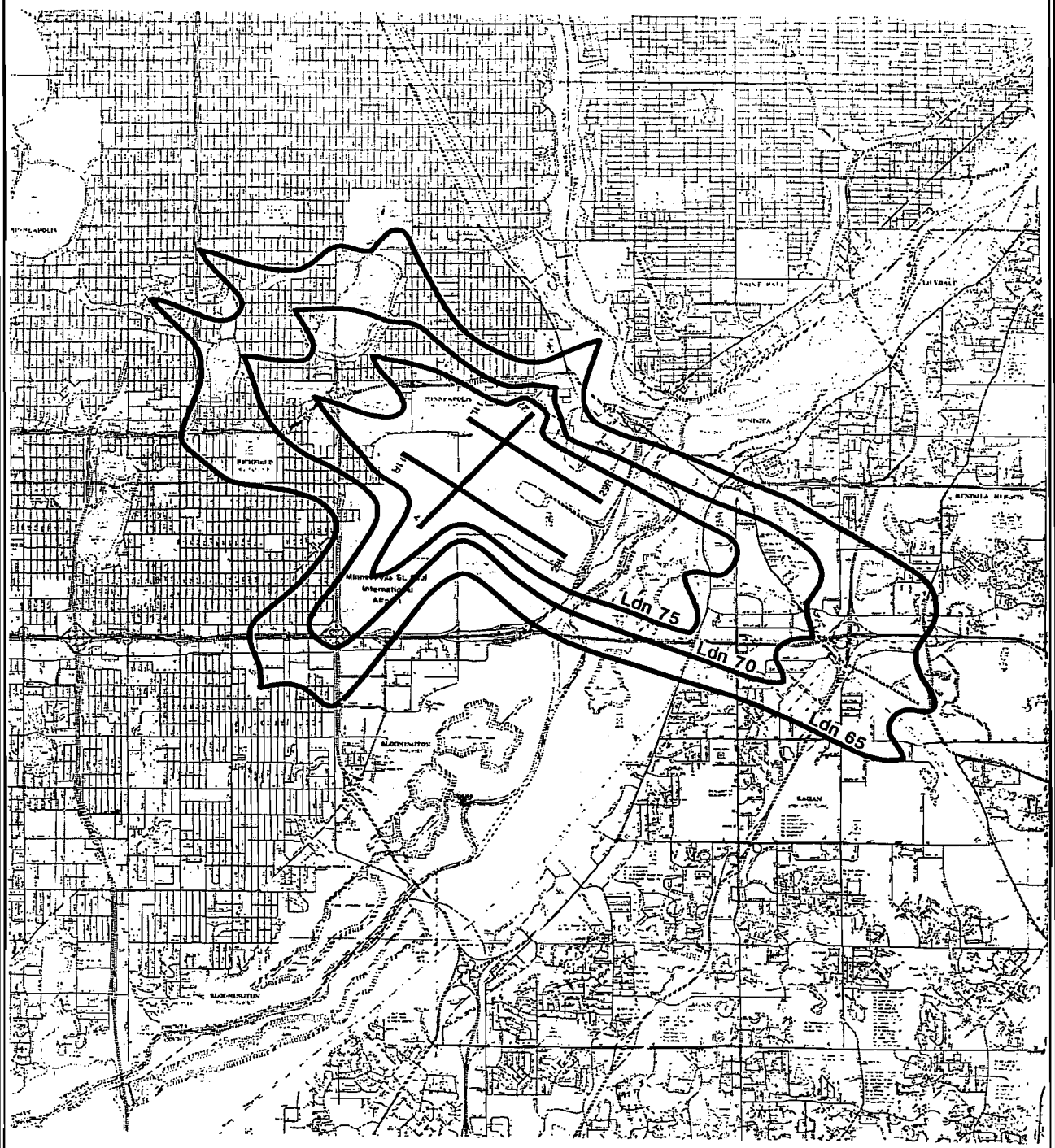
*13* FICON, *op. cit.*, 2-3.

*14* Residential use is prohibited in case of new construction. Existing use is grandfathered in. Projections of airport noise suggests, however, that it would be feasible to virtually eliminate residential use of land exposed to Ldn 65 since about 3,000 people are projected to live in such areas by 2005.

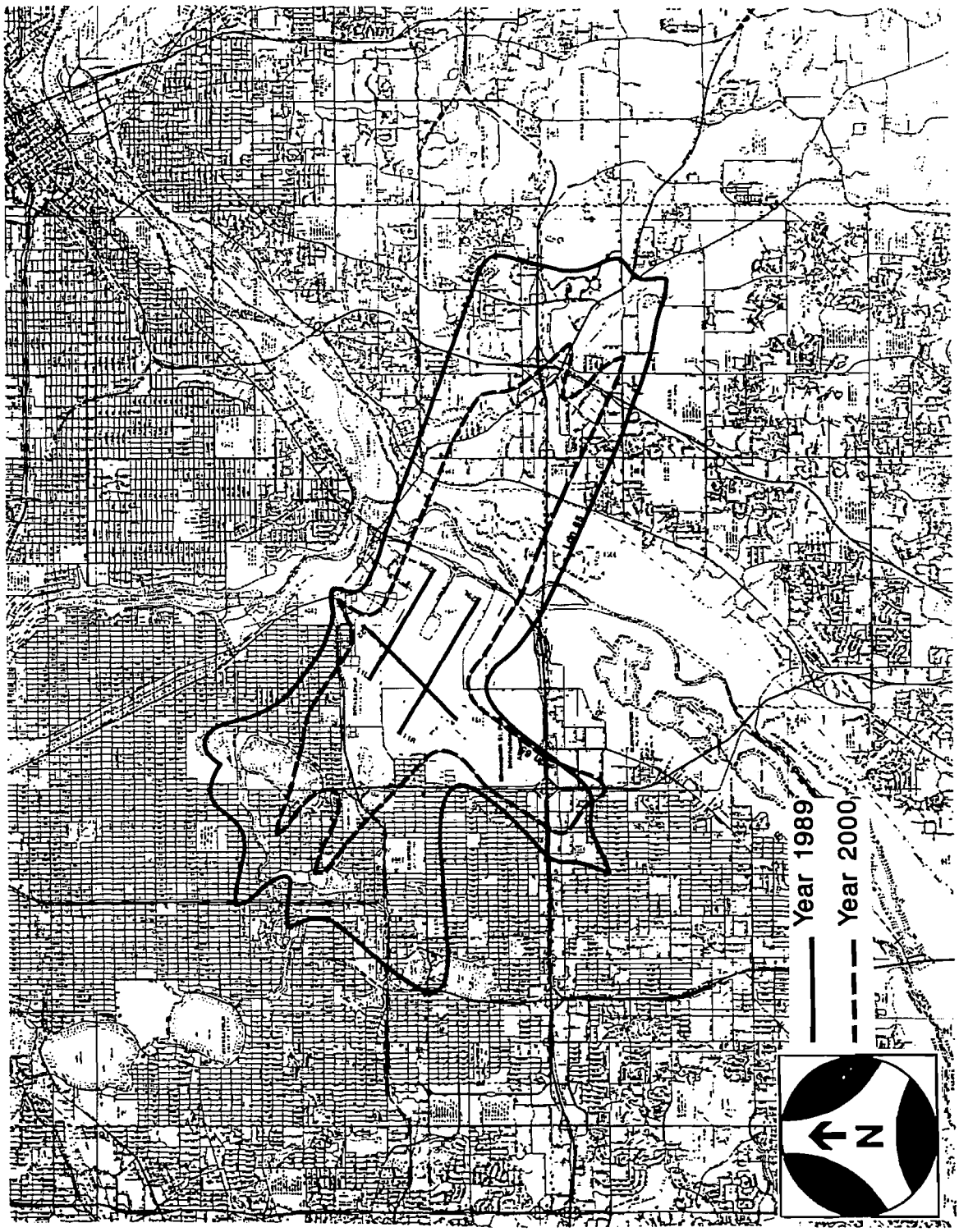
*15* This map shows the contours that would result if a north parallel runway were added to the current airport along with the proposed extension of runway 4-22. This exhibit is the only one available to show what is expected to happen between 2005 and 2020. MAC's preferred approach to expanding MSP is construction of a north-south runway. No noise map is currently available with projections to 2020 using the north-south runway, although MAC reports that the noise contours around a north-south runway would also expand slightly between 2005 and 2020.

## Figure 3.5: 1991 Ldn Contours



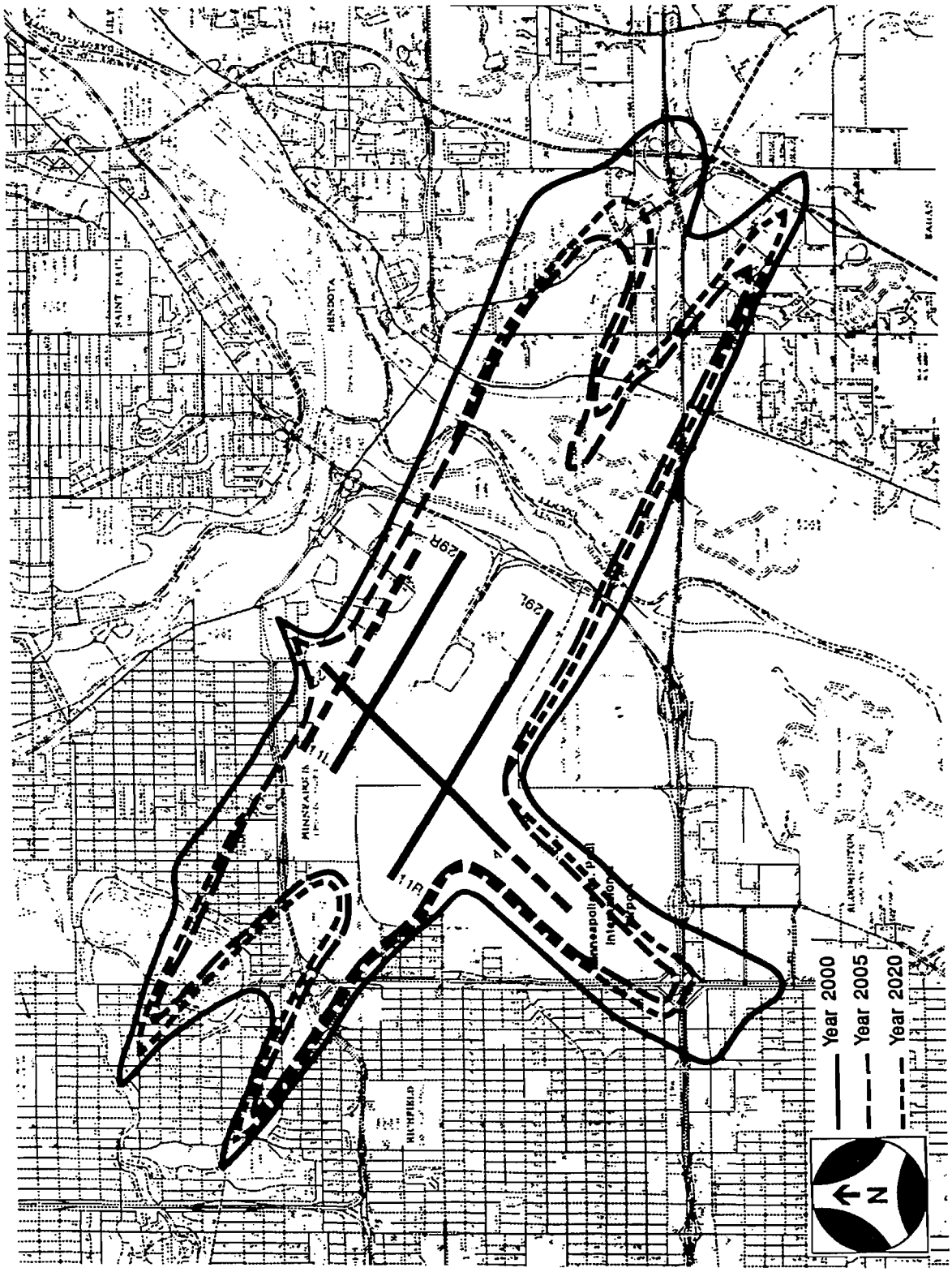

Source: Metropolitan Airports Commission

## Figure 3.6: Ldn 65 Noise Contour Comparison--1989 vs. 2000 With No New Runways




Source: Metropolitan Airports Commission.

**Figure 3.7: Ldn 65 Noise Contour Comparison, Year 2000, 2005, and 2020**




Source: Metropolitan Airports Commission.

Many other noise maps have been published by MAC showing noise contours that will result from various development alternatives at MSP. These noise contour projections depend on assumptions about the mix of equipment, the level of activity, the pace of Stage III equipment phase-in, and the operating assumptions used as input to the computer programs that produce the noise contour numbers.

Recently, the major carrier serving the Twin Cities, Northwest Airlines, announced a delay in phasing in Stage III equipment from previously announced schedules. Also, as noted in Chapter 2, Northwest recently shifted some hubbing activity to MSP. These actions may have increased noise in the short run at MSP or left it the same when it was expected to decrease. But in the longer range, over the next decade or two, the introduction of newer aircraft is still expected to have a bigger effect than increased operations on the overall level of noise. Stage II equipment is outlawed nationally by 2003 under terms of the 1990 Airport Noise and Capacity Act, and at least 85 percent of equipment must be Stage III by 2000.

All the noise maps presented above are subject to measurement error, however. Complaints of frequent or loud overflights by people outside the 65 Ldn Contour should not be summarily dismissed, since the computer models on which the contours are based may differ from noise recorded on the ground in particular locations. A new noise monitoring system just now being implemented can and should be used to test the noise contours produced by MAC using FAA computer models. Also, as the noise map shows, at present and in the future there are residential areas subjected to Ldn 65 and higher levels.

**Assuming quieter equipment is phased in on schedule, about 3,000 people will be exposed to Ldn 65 or higher levels of noise in 2005.**

## Population Exposed to Ldn 65

As the noise maps suggest, and as further noise analysis performed by MAC's consultants demonstrates:

- **The population exposed to Ldn 65 or higher will sharply decrease in the next twelve years, assuming there is no major change in the scheduled phaseout of Stage II equipment.**

Table 3.3 shows estimates of the residential population inside the Ldn 65 noise contour in 1996 (assuming the runway 4-22 extension is built), and in 2000 and 2005 under both a no-build alternative and a new north-south runway alternative. As Table 3.3 shows, it is estimated that 30,370 people now live within the Ldn 65 contour. By 1996, this number is projected to drop to 23,100, and by 2000 the number is projected to drop to 12,850 if no runway is built and to 11,540 if a new north-south runway is built.

By 2005, the population exposed to Ldn 65 is estimated at 2,690 under the no-build alternative, and 3,340 if a new north-south runway is built. These two estimates were made by Howard Needles Tammen & Bergendoff (HNTB),

## Table 3.3: Population Within the Ldn 65 Contour, 1991-2005

| | | | 2000 | | 2005 | |
|---|---|---|---|---|---|---|
| | 1991 | 1996 | No-Build | N-S Runway | No-Build | N-S Runway |
| Population | 30,370 | 23,100 | 12,850 | 11,540 | 2,690 | 3,340 |

Note: Alternatives shown are No-Build, and a new North-South Runway, MAC's preferred alternative for developing MSP.

Sources: 1991 and 1996, FAR Part 150 Study, March 1992; 2000, Long-Term Comprehensive Plan (LTCP), V.5, December 1991; 2005, unpublished LTCP analysis, HNTB.

the lead airport planning consultant to the Metropolitan Airports Commission.[16] No estimates were provided of the population exposed to Ldn 65 for years beyond 2005. As we have seen from Figure 3.5, however, there will be some relatively small expansion of the geographic area exposed to Ldn 65 by 2020 and presumably an increase in the population exposed, holding other factors constant.

# DUAL-TRACK PLANNING NOISE ANALYSIS

We have devoted considerable space in the preceding section to a description of the technical consensus on noise analysis that has developed over the last 20 years because it sets the standard we use for evaluating the noise analysis studies done by the Metropolitan Council and MAC. We have also reviewed some descriptive and analytical information on noise effects in order to provide a context for understanding this work. In the following sections we discuss, in turn, noise analysis and planning by the Council and MAC.

## Airport Adequacy Study Noise Analysis

We reviewed both the technical and substantive basis for the major findings of the noise analysis contained in the Metropolitan Council's 1988 Adequacy Study. Below, we discuss several serious technical problems with the study, and our conclusion that the widely circulated summaries of the study overstate the findings of the study itself.

The Metropolitan Council's noise analysis proceeds from a valid observation: the most commonly used measure of community noise, Ldn, does not tell the whole story about airport noise and ought to be supplemented by additional measures and analysis. To demonstrate this point, the study constructs a measure of noise induced stress, using a survey sponsored by MAC two years

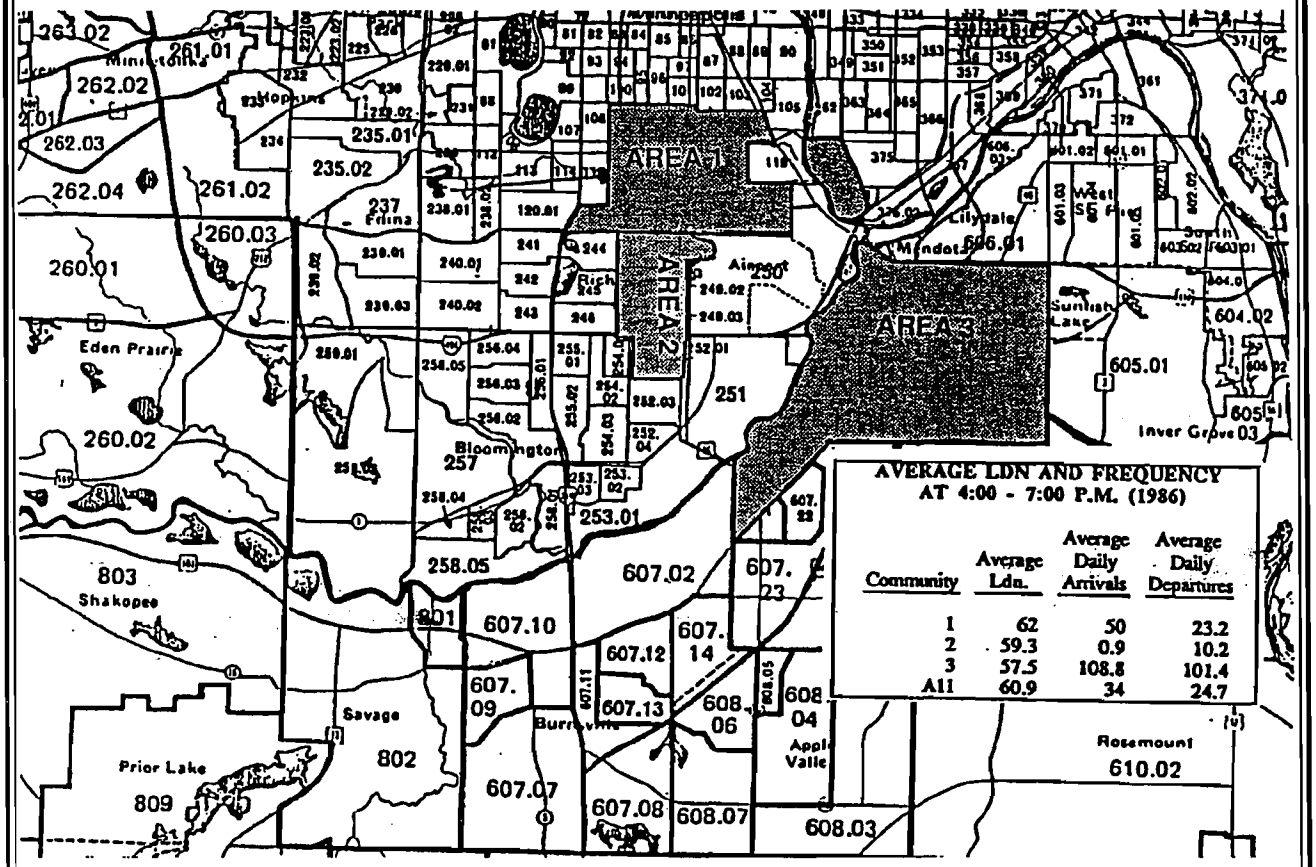
*16* The population projections used 1980 census numbers, but since the population within the Ldn 65 contour is not growing much if at all, use of later data should not make much difference.

earlier, and relates this measure to rough estimates of the aircraft noise and overflight exposure of survey respondents in three neighborhoods.[17]

The data used to measure noise annoyance were collected through a telephone survey of 1025 people in 22 census tracts around the airport, but Ldn, arrivals, and departures were estimated only for each census tract.[18]

The regression equations were estimated for each of three neighborhoods. A map showing the location of the three neighborhoods, Ldn levels, arrivals, and departures, is shown in Figure 3.8. We present the results of the regression analysis in Appendix A.

**Figure 3.8: Areas Used for Regression Analyses**




Source: Metropolitan Council.

*17* The regression equation estimated in the study has the following general form:

CNSI = $a + b_1$ Ldn + $b_2$ Arrivals + $b_3$ Departures.

CNSI = Community Noise Stress Index, measured by asking survey respondents to rate their degree of annoyance on a scale from 1 to 5.

Ldn = Day-night noise level.

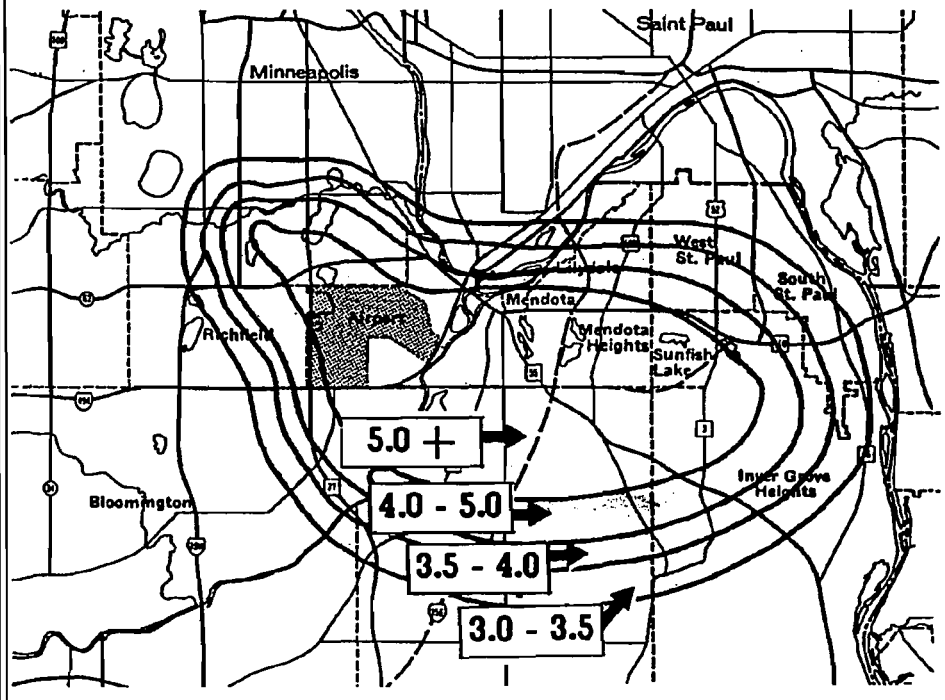
Arrivals and Departures = arriving and departing overflights of the communities studied.

*18* The census tracts are of varying size: there are eleven tracts in neighborhood 1, eight in neighborhood 2, and three in neighborhood 3.

The relationships between annoyance and arrivals, departures, and Ldn were extrapolated to neighborhoods not included in the original survey based on estimates of Ldn and overflights that these areas will be exposed to in the future. Figure 3.9 shows an example of the "noise stress contours" estimated in this fashion. The noise stress contours at the highest annoyance level extend far south and east of the airport. The stress contours suggest a much larger area of high noise annoyance than that described by Ldn contours presented earlier. As discussed, the relationship of varying Ldn levels to community noise annoyance has been extensively documented and validated. The Ldn 65 contours for 2005 presented in Figure 3.6 cover a much smaller geographic area, for example. The results of the Ldn analysis and the CNSI analysis are fundamentally irreconcilable. The basic contradiction between the two analyses of noise leads the Council and MAC to reach opposite conclusions. As noted earlier, MAC concludes that noise exposure will lessen; the Council concludes that the problem will get worse.

**The Metropolitan Council's noise analysis reaches a conclusion opposite to that of MAC's noise analysis.**

**Figure 3.9: Community Noise-Stress Levels Around MSP, Year 2008 (includes North-South Runway)**




Source: Metropolitan Council.

# Technical Flaws

We reviewed the technical competence of the adequacy study and conclude that the noise analysis conducted as part of the study contains a number of serious technical flaws. We performed our own technical review of the study and reviewed the criticism of others. The main issue in our technical review was whether the main conclusions of the study are supported by the evidence, ac-

cording to technical standards used by statisticians and social scientists. Among these standards are rules of statistical inference from sample data, validity and reliability of the measures used, relationship of the current study to previous research conducted elsewhere, and objectivity and fairness in the selection of findings to report and emphasize. As a result of our review (and that of the statistical experts) we note the following significant flaws:

**The Council's noise study contains several technical flaws.**

1. The tests of statistical significance used in the studies are misapplied. The number of independent observations on which the tests should be based is not the over 1000 survey responses actually used in statistical significance tests reported in the study. Noise and overflight numbers were assigned to only a total of 22 census tracts and when results are reported for individual neighborhoods the number is less than this. In neighborhood 3, for example, there are only three census tracts, thus only three measures of noise, arrivals, and departures. All estimates of the effects of arrivals, departures, and Ldn for neighborhood three are based on only three independent observations, although 85 respondents were interviewed in this area, and provided data on annoyance. Since the significance tests reported in the study were based on the number of respondents, all the tests of significance used in the study are applied incorrectly. For this reason alone, the study results cannot be taken seriously as a basis for policy decisions.

2. The annoyance scale used as the dependent variable in the study is not a normed or validated attitude scale such as those widely used in the social sciences. There are no data offered to validate the scale or to show why the scale can be used in regression analyses which assumes that the scale is an interval scale where the difference between 1 and 2 on the scale represents the same attitudinal distance as the difference between 3 and 4, or any other interval nominally measured as one unit. This is a problem given the close interpretation of regression coefficients and elasticities. Another problem is that Ldn is a logarithmic scale and the interpretation of elasticity in the report is inaccurate. A one percent change in Ldn does not mean a one percent change in noise.

3. The regression equations do not achieve a high level of explained variation in the dependent variable (R squared). At best, the proportion of explained variation is 25 percent. The theoretical adequacy of the identified determinants of noise annoyance, or measurement problems in the study, are possible explanations, but without more study it would be best to keep the speculative findings of this study in-house and not widely circulated. One possible source of measurement error is that Ldn, arrivals, and departures probably vary considerably over census tracts, but only one number per tract was available.

4. The noise-induced stress index and contours presented in the study are based on readings for three neighborhoods consisting of a total of 22 census tracts. A typical readout for the Federal Aviation Authority's Integrated Noise Model presents data for hundreds of points. These

modelled results have been validated against noise monitors on the ground and their accuracy, while not perfect, is a known quantity. No discussion of the accuracy of the noise-stress contours is offered because their accuracy is completely unstudied, and the extrapolation of the results obtained in one community to many others is not only unstudied but is unlikely given the results of the study itself. The three neighborhoods show a very different reaction to the independent variables. Ldn, arrivals, and departures have a different effect in different communities. Our best guess is that most of these differences are spurious, but if they are not, it is incorrect to extrapolate one community's reaction to another.

5. Finally, an examination of the noise analysis numbers against computer output reveals that many simple transcription errors were made in preparing the report for publication. The regression coefficients for arrivals and departures were transposed in several tables, including the table presented in one summary report. Many tables in the October 1988 Noise Analysis report presenting regression estimates for various time periods contain errors. There are errors on pages 17, 19, 21, 23, 25, and elsewhere. The corrected version of the table containing the main regression results used (4 PM to 7 PM) provided to us by the Council still contained errors.

In the course of conducting this review we learned that the study had been strongly criticized around the time of its publication by two statistical consultants to MAC. One, Prof. Frank Martin, a University of Minnesota statistician, summarized his evaluation as follows:

- "The study is so crudely conducted that it could easily do a disservice to the facts if being read by a lay person with no statistical training. The study has no value as support for the theory that substantial increases in flight frequency will cause an increase in the amount of noise annoyance during a period when engine noise is being reduced."[19]

We agree with this general point and other major criticisms by Prof. Martin and those of made by MACs chief airport planning consultant, Howard Needles Tammen & Bergendoff (HNTB).

## Adequacy of Summary Reports

**The Council's adequacy study findings were too strongly and precisely stated.**

Our final criticism of the study relates not to its technical defects but to the certainty with which the conclusions were reported in widely circulated summaries in contrast with the more tentative tone of the detailed study itself. For example, the detailed study said:

> "the results ... indicate that quieter aircraft engines will *not necessarily* offset the impact of higher traffic levels on the amount of noise-related stress and annoyance in the community." (p. 7)

*19* Written statement by Prof. Martin, dated January 27, 1989.

But in a 1988 report to the Legislature, the Council's research was summarized as follows:

> "Even with the steady introduction of quieter aircraft, a growing frequency of flights *will increase* noise stress on most surrounding communities affecting more households over time."[20]

The Adequacy Study was also summarized in a short, widely circulated "Report to the Community." This report presents more extensive findings from the noise analysis and suggests that different communities will respond differently to changes in noise energy and the number of overflights. The report says:

- "In cities near the airport such as Eagan and Mendota Heights, frequency exceeds noise energy as the main source of discomfort."
- "For most people in Minneapolis, Richfield and East Bloomington, noise energy causes more discomfort than flight frequency."

In our view, these widely communicated findings of the study are too strongly and precisely stated. This is especially unfortunate, since the airport noise issue is of considerable concern in communities around the airport which today are affected by a serious level of noise that would not be permitted under regulations for new airport development.

# MAC NOISE ANALYSIS

The dual-track planning process started with the 1988 Adequacy Study of the Metropolitan Council. For the Council, noise analysis basically began and ended with this study. The Council views noise analysis as primarily the responsibility of the Metropolitan Airports Commission since MAC is responsible for the Environmental Impact Statements that will be prepared for either expansion of MSP or construction of a replacement airport.

**MAC's noise analysis appears in several lengthy, complex documents.**

We are midstream in a process that is due to end in 1996. The major environmental studies, including noise analyses, that will be done either on MSP or the new airport have yet to be done. However, MAC has a track record in noise analysis and planning as it has in activity forecasts and other components of airport planning, and we reviewed several work products to see what they say about MACs approach to noise analysis and planning. These documents are:

- The MSP Long Term Comprehensive Plan, December 1991;
- The Report of the MSP Interactive Planning Group, July 1991;

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*20* Metropolitan Council, *Twin Cities Air Travel: A Strategy for Growth,* A Report to the Minnesota Legislature (December 1988). Emphasis added in the examples above.

- The Federal Air Regulations (FAR) Part 150 Study, March 1992;
- The Draft Environmental Impact Statement for the Proposed Extension of the Cross-wind Runway at MSP.

The Long Term Plan for MSP covers a 30-year time horizon, and is a multi-volume work covering all aspects of airport operations. The section of the plan of interest here is the analysis of off-site effects of six developmental concepts for expanding terminals and runways at MSP, especially analysis of the noise effects of building a new north-south runway.

The MSP Interactive Planning Group was established by MAC to advise the Commission on the MSP track of the dual-track planning process. Six cities in the vicinity of the airport were represented. The MAC staff and consultants provided technical and staff support. The IPG was charged with two tasks: the first was to identify off-site impacts associated with each of the six development concepts; the second was to develop measures to ease the identified negative impacts.

As noted earlier, Federal Aviation Regulation (FAR) Part 150 was promulgated in 1984 in order to establish a uniform system of describing aircraft noise and noise exposure nationally, and to provide guidance to localities in developing land use compatibility criteria. The FAR Part 150 Study is a proposal and status report for the main noise-abatement program of the MAC. It is the instrument by which federal aid is obtained and progress is reported to the FAA.

**The technical content of MAC's noise analysis is reviewed by the FAA.**

The Environmental Impact Statement (EIS) for the proposed extension of runway 4-22 (the cross-wind runway) is not part of the dual-track planning process, since a proposed extension of the cross-wind runway at MSP was in the works prior to the initiation of the dual-track process. But, it is relevant because MAC regards the noise analysis contained in this EIS to be a model of what it plans to do in subsequent environmental impact studies relating to MSP expansion and development of a new airport.

Taken together, these documents present a lot of information. These documents were produced by specialized consultants using FAA approved computer models, methods, and procedures, and MAC must certify the accuracy of the information to the FAA. The FAA reviews the Part 150 Study and the environmental review documents for technical accuracy. According to the FAA, we can have reasonable confidence in the numbers on noise exposure. The FAA recently developed its own projection of the population exposed to Ldn 65 levels around MSP through the 1990s, and arrived at estimates similar to those of MAC for the year 2000.

We evaluated these documents for the plausibility of analytical results, their significance for policy makers, the clarity of presentation, the omission of important information in light of policy makers' needs, and adherence to regulatory requirements and technical standards.

**MAC has not yet carried out an analysis of airport noise effects for all airport development alternatives.**

Our major findings are as follows:

- **MAC has not yet analyzed the noise impact of the various airport development options to be included in the dual-track process. That is planned for a later date in the planning process.**
- **But, in our view, MAC's approach to the analysis of noise so far is technically sound and thorough.**
- **MAC's noise planning documents are technical and complex and some important points are not well explained or summarized for a general audience.**

## Approach to Noise Analysis

The Metropolitan Airports Commission must prepare a noise analysis and noise abatement program that meets the terms of FAA requirements and qualifies for FAA funding. As described elsewhere, the FAA and other federal regulatory agencies have developed standards for noise measurement and regulation which are well established and which airport operators like MAC must meet.

The FAR Part 150 study published in March 1992 presents this information and a variety of data on the history and accomplishments of noise abatement at MSP. The 1987 FAR Part 150 Study was approved by the FAA in 1990; presumably, this year's study will be approved within a couple of years. No effort will be made to summarize this report here except to note that noise abatement efforts involve regulation of equipment, operations, and land use (including prevention of incompatible land use and sound insulation of existing buildings).

As noted earlier, by 2000 with a possible extension to 2003, Stage II aircraft are expected to be phased out in the U.S. and replaced with Stage III equipment which is less than half as noisy. The current fleet consists of about 65 percent Stage II aircraft, so there is considerable potential for noise abatement.

The existing program at MSP consists of various organizational and operational activities relating to noise abatement and land use. Minnesota has a good national reputation for its noise abatement program that saw the establishment of the Metropolitan Aircraft Sound Abatement Council (MASAC) in 1969, a nonprofit organization that studies and negotiates noise control policies, provides a public forum, and serves an educational function. MAC also points to its Voluntary Noise Budget program, voluntary nighttime limit on flights, restriction on training flights at MSP, a runway use system implemented in 1990 to concentrate operations in the corridor to the south and east of the airport, and a noise and operations monitoring system (ANOMS) that is soon to be operational.

**The FAA provided about $3.5 million to MAC for noise abatement in 1992.**

MAC received a noise abatement grant of $3.5 million from the FAA in 1992 and added $880,000, for a total of $4.4 million. Most of these funds will go to insulating homes in communities around the airport.

According to the FAA, MAC has been slower than some airport operators in the Midwest to get a noise insulation program up and running, although the FAA confirms that MAC was earlier than other authorities to establish an organization like MASAC and voluntary noise abatement agreements. According to the FAA, those opposed to future operation of the current airport are opposed to investment in noise abatement around MSP.

MAC has come under criticism recently for some of its noise related proposals. The cross-wind runway expansion is controversial, for example, because it would shift noise exposure around. Because noise abatement costs money and does not completely solve the problem, almost none of these efforts is without controversy. In addition, voluntary agreements can be abrogated or they can expire, operational restrictions can be ignored or changed, and the FAA can disapprove steps that MAC or other local agencies want to implement. All these things have happened to one degree or another. The noise budget negotiated by MAC and the airlines has recently been exceeded, there is controversy over the use of the Eagan-Mendota Heights corridor, and the recent quality of the discussions in MASAC is more rancorous and less constructive than in the past.

**There is a lot of controversy about operating policies and restrictions at MSP.**

In our judgment, however, this reflects the sensitive nature of the issue itself, rather than a failure of MAC to provide a public forum, provide accurate data, or to conduct an aggressive program of noise abatement. This is not to say that noise analysis and planning cannot be improved, and we discuss possible ways of doing this in a subsequent section.

In general, our basic conclusion is that MACs approach to noise analysis is fair, competent, and complete. The basis for this conclusion is a review of the documents listed above, discussions with policy makers and FAA officials, numerous discussions with MAC staff and consultants, and interviews with various others knowledgeable about the airport planning process. Specifically:

- **MAC's approach to noise measurement is consistent with that recommended by technical experts and regulatory agencies.**

We reviewed this issue at length in an earlier section. The Long Term Comprehensive Plan, the Far Part 150 Study, the IPG report and the runway 4-22 EIS present a variety of data on Ldn contours, populations exposed to varying noise levels, projections of noise contours and population exposed to noise, runway and flight track use, overflights, and other information.

Following the requirements of the FAA and the standards in general use, the Ldn 65 contour is of special importance in setting the basis for land use restrictions and remedial noise-abatement programs, but the documents present data

**MAC needs to improve its communication of study results to policy-makers and the public.**

on Ldn 60 contours, L1065 contours and various supplementary measures.[21] According to MAC staff members, MAC plans to present more rather than less information on noise effects in the environmental impact documents for each track of the planning process.

This leads to another point: There is currently a lot of information about airport noise, but it is found in various technical documents not likely to be encountered by policy makers. Some findings of considerable importance that we anticipate will be highly relevant to a decision on which airport development track to take are only to be found in relatively inaccessible sources.

We anticipate that policy makers will want to know if airport noise will get better or worse in the future, and what the relative effectiveness of various noise abatement strategies will be. Lacking an absolute standard on which to judge noise, policy makers may want to know how noise exposure around MSP or a new airport will compare to airports in other metropolitan centers. It is also likely that policy makers will be interested in knowing what the cost will be of various noise-abatement programs and strategies. In connection with the 1996 decision on a new airport site, they will want to know how effectively and at what cost noise can be controlled at either location.

Much of the information described above is available, but difficult to find and hard for the non-specialist to understand. For those who want to pursue these issues we offer the following general guide. The best historical description of noise-abatement activities and future plans is the FAR Part 150 study that presents the current program, and historical accomplishments. The best general introduction to noise measurement along with the analysis of cross-wind runway alternatives appears in the 4-22 Environmental Impact Statement. The Long Term Comprehensive Plan for MSP published in December 1991 presents an analysis of development alternatives for MSP, and noise exposure consequences of the major alternatives compared to a no-build scenario. The fourth document listed above, the Interactive Planning Group report, presents more detailed community by community information on off-site environmental effects including noise. Some, but not all important information from this report is included in the Long Term Comprehensive Plan.

We also think that cost estimates of noise abatement appearing in the Summary Report of the MSP Long Term Comprehensive Plan are difficult to understand, yet of such interest that they should have been explained properly. The report estimates that the cost of mitigation of community disruption for the major development options would exceed $3 billion. But it also reports that "noise mitigation per FAR Part 150 Criteria" would cost $100 million. Non-specialists in the airport issue will undoubtedly be confused by these figures. The FAR Part 150 criteria relate to accepted noise measures, the Ldn 65 level, federal funding criteria, and studies relating noise annoyance to noise measures in a variety of settings. The IPG estimates are provided by cities, using their own criteria and estimates, not reviewed for consistency or accuracy

*21* L1065 represents the area exposed to 65 decibels or more during 10 percent (six minutes) of the noisiest hour of the day. The six minutes so measured does not have to be continuous.

by MAC or consultants, and not offered by the cities themselves as realistic. This is clear from a reading of the detailed IPG report and from interviews with city officials who participated in the Interactive Planning Group, but it is not clear from the most widely circulated report of those efforts.

Distorted estimates of costs and benefits are a predictable accompaniment to major capital improvement proposals, and presumably these will be put in perspective by the time the dual-track planning process is completed. But as long as participants to the process consist mainly of parties with a strong special interest in the outcome of the process, the danger remains that such misleading data will be offered for one purpose or another. To the extent that MAC or the Metropolitan Council allow this to happen, they have failed in one of their primary airport planning responsibilities as we see it: to provide objective and accurate information.

**MAC and the Council need to be a source of clear, reliable information. Both agencies have failed at times to meet this standard.**

This point, however, is the chief exception to our otherwise positive assessment of MACs competence, objectivity, and thoroughness. In addition, MAC has provided many occasions for public input and discussion of airport development options. Finally, we think before much longer MAC and the Council are going to have to focus more clearly on the critical part of the dual-track planning process: the decision on whether, where, and when to develop additional airport capacity.

# SUMMARY

In this chapter we have seen that the noise analysis conducted by the Metropolitan Council staff and consultants, and reported in the 1988 Adequacy Study, was misleading and technically flawed. In its analysis, the Council did not use widely accepted measures of community noise effects. Also, the main finding of the study, that airport noise will get worse at MSP in the future despite the introduction of quieter aircraft, is not supported by the evidence.

The noise analysis performed by the Metropolitan Airports Commission, on the other hand, is technically sound and consistent with the methods recommended by most national experts. The main finding of MAC's analysis, that airport noise will improve at MSP in the next decade because of the introduction of quieter aircraft, seems well supported by the evidence available at this time.

More analyses on the noise impact of airport development options under the dual-track planning process remain to be done. In our view, MAC should take the lead in conducting future noise studies while the Metropolitan Council should improve its role as a vigorous, outside critic of MAC.

# Discussion and Recommendations

**CHAPTER 4**

This chapter synthesizes the findings of Chapters 2 and 3 into more general findings about the dual-track planning process. Based on these findings, this chapter also presents general and specific recommendations for the remaining three and one-half years of the dual-track planning process. It should be clear, however, that our research has primarily focused on aviation forecasting, analyses of airport adequacy, benefit/cost analyses, and noise analyses which have been done so far. Our research did not include an in-depth analysis of the search area or site selection processes and thus our general conclusions are not intended to apply to these or other areas not studied.

The general issues raised in this chapter concern:

- the technical adequacy of work products;
- the need for forecast revisions;
- the timing of the dual-track process;
- the scope of the process; and
- the need for strategic and flexible planning.

## TECHNICAL ADEQUACY

**MAC's work has generally been technically competent.**

Although we differ with MAC consultants and staff regarding some of their forecast assumptions and results, we generally found their work to be technically competent. The Council consultants and staff have appropriately attempted to provide a more comprehensive view of some issues than MAC and to summarize the broader implications for airport planning. This led the Council consultants during the adequacy study to attempt to make very precise statements about future airport adequacy, to examine more comprehensively the benefits and costs of capacity enhancement, and to look for an alternative noise measurement tool which would better capture the conflicting effects of increasing flights and quieter aircraft on noise stress. However, we found that:

- **The Metropolitan Council consultants and staff have used a number of questionable methods to reach certain key conclusions.**

**Council consultants and staff have made a number of technical errors.**

These problems, which we identified in Chapters 2 and 3, included the Council consultants' method for defining airport adequacy, the estimates of delay times per operation and annual delay costs, the noise analysis in the adequacy study, and analyses of hubbing ratio trends. In earlier chapters, we also expressed concern over the lack of adequate documentation of analyses done by Council consultants. Finally, we found that both agencies could improve the clarity with which they present the findings and assumptions of their technical studies and analyses.

These concerns obviously do not apply to all of the airport planning work done by the agencies. For example, we found that the forecasting methods used by the agencies and overall long-run operations forecasts made by the agencies in 1990 are very reasonable. In addition, the noise analysis the agencies are planning to use in the dual-track process is reasonable.

In addition, these criticisms of the Council's technical expertise in airport planning should not be taken as a blanket criticism of the Council's transportation staff and management. Indeed, last year we gave the Council and its transportation staff good marks for their work on transit and highway issues. We particularly noted the recent improvements the Council and staff had made in developing a regional transit facilities plan.

However, we conclude that it is very important to ensure that future work done during the dual-track process is technically competent and well communicated to policymakers and the public. Based on our findings, we are particularly concerned that the Metropolitan Council improve its staff and consultant support for airport planning.

Both agencies are very dependent on the work of consultants. Neither agency has more than one or two full-time equivalent staff assigned to the dual-track process. Most of the planning work has been done by consultants hired by each agency. In MAC's case, however, its staff is more equipped by training to deal with airport planning issues and its principal consulting firm has worked with MAC and the MSP facility for quite some time. In contrast:

- **The Council staff assigned to the dual-track planning process, while good general planners and facilitators of the planning process, are not well equipped to evaluate the technical merits of analyses done by either the Council or MAC consultants.**

- **The Council's consultants, while providing a useful contrast to MAC consultants and some valuable insights, have made some questionable judgments in methodologies and conclusions.**

We think that these weaknesses in airport planning could be addressed in a number of ways. We recommend that:

- **The Metropolitan Council should shift additional staff resources to the dual-track planning process or hire an additional staff person to focus on the technical aspects of the planning process.**

- **The Metropolitan Council should consider supplementing or restructuring the existing consultant services.**

- **The Council and Metropolitan Airports Commission, their staffs, and consultants should coordinate efforts to ensure that the agencies are using similar and appropriate analyses.**

**The Council should promptly strengthen its technical support.**

- **Expert panels should be used for key analyses and studies as they have been for forecasts. However, the agencies should consider using expert panels after a key analysis or study is completed and prior to presentation to either the Council or MAC. Most expert panels have been convened prior to the beginning of a study. This practice is useful and should be continued but should be supplemented by an expert review at a later stage.**

- **Council and MAC staff should make sure that the principal conclusions of analyses and their key assumptions are summarized better for policymakers.**

- **Council staff and consultants should also document the detailed methods and analyses better than has been done in the past.**

# FORECASTING

Chapter 2 concluded that the adequacy study overstated the crisis in future airport adequacy but found that the general forecasting methods used in 1990 were satisfactory and that the forecasts of long-term growth in operations were reasonable. We recommend that the Council and MAC, along with their staffs and consultants, consider the following issues during their current and future efforts to review and revise the 1990 forecasts:

- **The Council and MAC should consider revising downward their forecast of long-term enplanements based primarily on a downward revision of the future hubbing ratio.**

- **The Council should drop the formal use of risk analysis but continue to emphasize the fundamental uncertainty of the forecasts to other policymakers and the public.**

- **The Council and MAC should closely monitor the short-term plans of Northwest Airlines and its regional airline partners since they account for more than 60 percent of total MSP operations and have**

**a significant effect on MSP's trends in operations and enplanements.**

- **The Council and MAC should consider developing a better model for forecasting long-term regional airline operations and enplanements.**

The Council's consultant has made the useful suggestion that regional airline growth might be better forecast if regional carrier markets are divided into three segments: 1) mature markets which already have good service, 2) non-mature markets which have not yet received frequent (5 to 6 flights per day) service, and 3) potential new markets which could be served by regional jets when they are available in the future.

# TIMING OF THE PROCESS

**MSP's existing capacity may be adequate for the near term, but there are reasons to continue the planning process as scheduled.**

A case can be made for delaying some of the more detailed work of dual-track process, while proceeding to refine overall costs and benefits of alternatives, conducting economic and benefit/cost analyses, and formulating a strategy for addressing capacity problems. The arguments for delay are: 1) the 1990 forecasts which suggest that MSP may not need a new runway until 2005 or 2010 according to MAC staff, 2) the present downside risk for MSP operations if Northwest Airlines' financial situation does not improve enough, 3) Northwest's inability and unwillingness to pay for facility improvements even more modest than a new runway, and 4) the risk that some elements of the Environmental Impact Statement expected to be completed by 1996 may have to be redone if expansion is not necessary within 5 to 10 years of its completion.

However, there are also advantages to keeping the process on its current schedule. Those advantages include: 1) the recent increase in MSP operations as Northwest shifted more of its operations to MSP and Detroit, 2) the possible plan of Northwest and its regional airline partners to increase regional operations, and 3) possible opposition from those living near MSP and the new airport site in Dakota County. Residents near MSP would probably object to any delay due to the recent increase in noise around MSP as Northwest has added flights and has cancelled or postponed the purchase of quieter aircraft for a number of years. Residents living in or near the new airport search area might object to delaying the EIS since some believe that the search area is unacceptable for environmental reasons and that should be resolved and not delayed.

In our view, it is a difficult judgment call which policymakers need to make. As a result, this report does not specifically recommend changing the timing of the dual-track process at this time. However, we recommend that:

- **The Council and MAC staff and consultants should clarify the implications of the most recent forecasts to policymakers and assess**

**whether, given recent events, there is sufficient risk that the region may need a new runway before the year 2005.**

This analysis should be done as soon as possible, preferably as part of the current reforecasting process and should be presented to the Council, MAC, and the Legislature. Furthermore:

- **The Council and MAC should closely monitor Northwest's financial condition and be prepared to modify the dual-track process if warranted.**

# SCOPE OF THE PROCESS

**The dual-track process appears to be comprehensive and strategic.**

Generally, we found that the Council and MAC staff have outlined a fairly comprehensive set of issues which will be addressed over the next three years. The set of issues is contained in a draft decision document outline which was first prepared for a public hearing in July 1992. The document lists issues to be studied for each of a number of decision factors. These factors include investment assessment, air service quality, regional economic impacts, regional and community impacts, environmental effects, and financial issues. In addition, it lists a number of strategic concerns for airport development and expansion.

While the document is fairly comprehensive, it is somewhat difficult to fully endorse the comprehensiveness of the process. The document does not explain what methods will be used to address the issues. As we found with studies already done, some of the methods used have been inappropriate. The best way to ensure adequate methodology and judgment is to implement the recommendations made earlier regarding improving the technical adequacy of future studies and analyses.

# STRATEGIC AND FLEXIBLE PLANNING

It is clear to us that one of most difficult elements to deal with in airport planning is the considerable uncertainty facing those trying to forecast future airport activity. As a result, we are convinced that:

- **Strategic and flexible planning is very important in airport planning.**

Strategic planning means that planners consider more than one alternative scenario for future airport activity since they cannot accurately forecast future activity levels. In addition, planners need to consider alternative plans, which reflect the alternative scenarios the region might face. Flexible planning means that planners consider how well an option used to address one forecast scenario can be adapted to address a different scenario.

In the dual-track process, this means that planners should not just develop a plan to address one specific scenario or forecast. Instead they need to consider multiple alternatives at both MSP and a new airport site. For example, they should consider what improvements at MSP would be needed to meet various levels (and distributions) of airport activity. In addition, they should consider whether all the improvements recommended in MAC's long-term plan for MSP are desirable if a move to a new airport is indicated in the long run. More limited improvements which would get the airport through a period of 10 or more years might make more sense than massive improvements that are not economical. Planning for a new airport should consider staged construction. Not all the potential runways or terminal gates, which ultimately might be needed, should be built immediately; but a new airport should be designed so that additions to its capacity can be built economically and without creating excessive operational problems for passengers and airlines.

It appears that the Council and MAC in their draft outline of a decision document are taking a strategic and flexible approach in their planning. In addition, our discussions with staff and consultants indicate their intent to orient the process in this way.

**The region needs to protect viable expansion options at the current site, as well as at the new airport site.**

However, in one crucial respect, the Council and its staff may not have taken adequate steps to protect the flexibility of the planning process. The one important piece of planning work that had been missing from the Council's agenda, until we brought it to the attention of the Council chair and staff, is that:

- **The Council had not done, or planned to do, the necessary planning work to protect the North/South runway or other runway and development options at MSP.**

The North/South runway is MAC's preferred option for adding capacity at MSP if and when it is needed and the region decides that option is better than a new airport or should be done prior to construction of a new airport. That option would require acquisition of several hotels in Bloomington which are in the flight path or safety zone of the runway as well as some property in Richfield. Yet, we found that Council staff assigned to the dual-track process were not aware of whether the Council has sufficient authority to prevent significant new development from occurring on or near the flight path to the south of the proposed runway. In addition, the Council and staff had no firm plans to work with either the affected communities or the Legislature to make sure that any development would be compatible with that option or other runway options. This situation is in direct contrast with the new airport search area where the Council has direct statutory authority to limit development.

Following our discussion of this issue with the Council chair and staff, the Council has begun to seek consultant and legal advice on how best to address this issue. We recommend that:

- **The Metropolitan Council should have its staff report to the Council on whether the Council needs more authority or needs to be more proactive in working with affected communities to ensure that future development around MSP does not unduly jeopardize viable expansion options at MSP.**

# Adequacy Study Noise Analysis

**APPENDIX A**

Below we discuss the regression results reported by the Metropolitan Council's Adequacy Study Noise Analysis. The study asked questions about noise annoyance at various times of day and seasons of the year, and many separate regression equations were estimated, but the most widely reported estimates of the separate effect of Ldn, arrivals, and departures are those for the 4 PM to 7 PM time period. These results are produced below in Tables A.1 and A.2.[1]

## Table A.1: Ordinary Least Squares Regression Estimates for the 4:00 PM - 7:00 PM Time Period

| Independent Variables | Neighborhood 1 Noise Annoyance Index | Neighborhood 2 Noise Annoyance Index | Neighborhood 3 Noise Annoyance Index |
|---|---|---|---|
| Constant | -1.85<br>(3.26) | 1.25<br>(1.42) | -26.19<br>(3.33) |
| Ldn | 0.08<br>(8.27) | 0.03<br>(2.11) | 0.10<br>(2.27) |
| Departures | 0.15<br>(1.78) | 0.52<br>(1.92) | 0.74<br>(4.90) |
| Arrivals | 0.06<br>(3.68) | -3.40<br>(-2.60) | 1.74<br>(2.32) |
| $R^2$ | .19 | .04 | .25 |

Note: Regression coefficients based on citizen noise annoyance survey (July 1986, Mid-Continent Research, Inc.). T-Ratios are given in parenthesis.

Source: Metropolitan Council.

In neighborhood 1, the effect of Ldn is estimated to be greater than the effect of arrivals or departures. In fact, as Table A.2 shows, the Ldn elasticity is higher. (Elasticity measures the percentage change in the dependent variable attributable to a one percent change in an independent variable). Using this method, in neighborhood 3, the analysis suggests the effect of arrivals is

1 *Is the Airport Adequate? Part II: Study Issues and Analysis*, 62, as corrected by us to correspond with computer output provided by the Council. The published table transposed coefficients for arrivals and departures and even a corrected version provided to us in December contained errors.

## Table A.2: Estimated Mean Elasticities

| | Neighborhood 1 | Neighborhood 2 | Neighborhood 3 |
|---|---|---|---|
| Ldn Elasticity | 1.35 | 0.58 | 1.77 |
| Departures Elasticity | 0.07 | 0.12 | 1.81 |
| Arrivals Elasticity | 0.08 | -0.08 | 5.81 |

Source: Metropolitan Council.

strongest, departures next and Ldn still lower. In neighborhood 2 the analysis suggests the number of arrivals is negatively related to annoyance. The more arrivals, the lower the noise annoyance. The Council's published report actually has these negative numbers for departures. In checking out this unlikely result, we found an error in the adequacy study final report. The report transposed the regression coefficients for arrivals and departures in all three neighborhoods. We found this error when checking the published report against copies of computer output provided by the Council. Of course, it makes little sense that either takeoffs or landings should be negatively related to annoyance.

The noise analysis presented detailed estimates of noise effects during various times of day and seasons of the year. Separate estimates are, for example, presented for the three communities for 6 AM to 9 AM, 9 AM to 4 PM, 4 PM to 7 PM, 7 PM to 11 PM, and 11 PM to 6 AM.

Looking over the regression coefficients for each of five time periods in each of three communities we see contradictory results, statistically insignificant results and implausible results. These details were not presented in the adequacy study final report or other summary reports, nor should they have been, but the variation in findings across time periods and neighborhoods should have cautioned the council staff and consultants against reaching any firm conclusions.

It is not just the detailed study findings that are variable and inconsistent, the study results that were included in the adequacy study final report, regression results pertaining to the 4 PM to 7 PM time period, presented in Table A.1 are inconsistent in that the effects of noise and overflights are quite different across the three communities, and, in the case of a negative effect of arrivals, are contrary to common sense. This is obviously an implausible result that by itself should have caused the Council to promulgate no strong conclusion from the study. Instead, the study's findings were extrapolated to a big part of the metropolitan region.

Certain differences in coefficients are taken as meaningful, for example, the careful distinction made in the Council's Report to the Community between the relative impact of noise and overflight frequency on annoyance. One is supposed to be more important than the other in one place, but not another.

This may be true but the study does not really support this close level of analysis. If it did, something would have to be made of the fact that the regression equation for different times of the day show very different results. For example, if overflights are annoying at 4 PM to 7 PM they should be annoying at 9 AM to 4 PM, but the noise analysis shows inconsistent results. For example the noise analysis shows a negative relationship between the frequency of arrivals and annoyance for two of three neighborhoods for this time period.[2] In this case, (and many others) all three independent variables explain almost no variation in the dependent variable noise-induced stress. In the case at hand all the independent variables taken together explain seven percent of the variation in neighborhood 1, and one percent in neighborhoods 2 and 3. In our view, the appropriate response to data such as these is to reach no firm conclusions at all.

Numerous other examples could be given. The general point is that the report selected findings from 27 different equations that tend to support plausible hypothesized relationships. Contrary and inconclusive results were glossed over in widely circulated summaries. In fairness, the detailed report did provide enough detail to show the variability of results across neighborhoods and time periods. The Council did provide enough detail to allow readers with statistical expertise to put the report in the proper perspective. Unfortunately, this detail was absent from the widely circulated summary reports and the general reader was expected to take the study findings as valid.

2 Metropolitan Council, *MSP Airport Adequacy Study Noise Analysis,* (October 1988), 19, Table 3.

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Office of Executive Director


February 11, 1993

Roger Brooks
Deputy Legislative Auditor
Office of the Legislative Auditor
Centennial Building
St. Paul, MN 55155

Dear Mr. Brooks:

Thank you for the opportunity to review and comment on the draft report on Airport Planning. We appreciate the work your staff has put into this effort and the understanding that has been developed of a technically complex project. We are pleased that you have not recommended changing the timing of the Dual Track Airport Planning Process; we feel that continuation of the process will provide useful information for decision-makers regarding airport issues and will allow for broad public discussion of these issues. In our opinion, this is a key element of the report and should be highlighted in the same manner as other recommendations.

We agree with your comments regarding readability of the various technical reports that have been prepared as part of this planning process. The MAC has initiated steps to help alleviate this problem by publishing a series of brochures related to key steps in the process in an effort to provide readily understood information to both decision-makers and the general public. We will continue to take steps in this direction with regard specifically to the update of the activity forecasts, the site selection process, and the environmental process.

The report provides a series of recommendations as to how the forecasts should be modified. The MAC and Metro Council have established an open and public process for updating the forecasts, including the use of expert panels at both the initial and latter steps in the process, and by using alternate scenarios to evaluate the impact of potential changes in the underlying assumptions. Expert panels have already met to assist in developing the underlying assumptions that are being used to update the base forecasts. It is our feeling that this process should proceed in an open manner without attempting to prejudge the results.

We appreciate the positive statements regarding the noise analyses carried out by the MAC as a part of this process, and the overall MAC noise abatement program. You have correctly identified the complexity of this issue and the need to continue to move ahead aggressively with a noise abatement program while considering the effects on the aviation industry. The MAC is committed to continuing this approach.

Thank you again for the opportunity to comment on this report.

Sincerely,

Jeffrey W. Hamiel
Executive Director

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February 11, 1993

Members
Legislative Audit Commission

The Metropolitan Council is pleased that the auditor's report recommends continuing the dual-track process and that the report does not call for any significant changes to it. This two-pronged process ensures safe, efficient airport facilities will be available to support the economy of the Twin Cities metropolitan area in the future.

One track focuses on improving and expanding the existing airport; the other track explores building a new airport. The Metropolitan Airports Commission (MAC) has developed a long-range comprehensive plan that spells out possible improvements at the Minneapolis-St. Paul International Airport (MSP).

On the other track, the Council has completed a study of a 14-county area around the Twin Cities and selected a "search area" or general location in east-central Dakota County for a possible replacement airport.

Now the MAC, with the help of the Council and affected local governments, is looking at locating a specific airport site within the Dakota County Search Area and is conducting related studies. The auditor's report does not include a study of the site selection process. Both agencies will report results of their planning and recommended options to the 1996 legislature, which ultimately will select the option to be implemented.

Through the dual-track process, the Met Council has made some major contributions to airport planning by:

- Addressing a major regional issue in 1987--the long-term adequacy of the major airport--at a time when only short-term incremental improvements were contemplated.
- Proposing a strategic planning process to cope with the uncertainty of the major airport issue, rather than prescribing the wrong solution.
- Developing and implementing a remarkably open process in which all interested parties could help shape the dual-track strategy and the subsequent planning work.
- Seeking national experts to advise on many different issues, rather than exclusively relying on either local expertise or a single consultant.
- Improving the working relationships between the Council and the MAC after many years of disagreements and open conflicts.

The auditor's report raises questions about the methods used to determine adequacy in 1988. However, it is important to note that the auditor's report acknowledges the uncertainty and complexity implicit in this type of forecasting. The Council fully agrees. That is why we included a "self-correcting" mechanism into the dual-track process through an annual contingency report. This already has led to mid-course corrections, including the revision of aviation forecasts in 1990, and a second reevaluation of this forecasting is under way.

Our current consultant has made solid contributions to the process. However, we have chosen to identify and select a new lead consultant because allegations in the auditor's report about our current consultant could be damaging to the credibility of the dual-track process. The dual-track process will involve many years of careful work and the analysis of vast amounts of data upon completion in 1996. We do not want the validity of these important findings questioned because of a controversy over the consultant.

Council staff members have done professional work and have managed the process carefully. For example, the consulting team evolved over time as needs changed. A lot of the auditor's technical criticism--which is addressed in the attachment to this letter--is directed at work done by a former consultant. In 1990, staff members had some reservations about that consultant's work and chose to discontinue the consulting relationship.

The report admonishes the Council for not preserving the north-south runway option at the existing airport. We concur that it is essential to preserve this option and believe it is important to work closely with the cities of Richfield and Bloomington to this end. However, we strongly disagree with auditor's assessment of our efforts in this area. We have worked to protect the option, as evidenced by these two examples;

- In July 1990, Council staff recommended against approving land use changes for a proposed development in the Rich Acres subdivision of Richfield because of its potential impact on MSP development and, in particular, on a north-south runway. The Council placed a 90-day prior notice on a reuse/development activity.

- In the January 1992 review of the MAC 1992 Capital Improvement Program (CIP), Council staff questioned the consistency of the construction of a hangar in the north-south runway alignment. The proposal then was withdrawn by MAC.

There are many other examples of our efforts in this area, which space limitations preclude us from mentioning. But in each case we have managed to preserve this option, frequently by working with MAC and the communities. However, our current land use control powers are limited. We're working to get those powers strengthened through the passage of new legislation this session. Even with additional authority, though, we still believe it will be important to work cooperatively with the communities involved in development questions.

Again, we want to emphasize that on matters of major importance--such as the timing and viability of the dual-track study process--we agree with the auditor's report. This is an important process that must continue for the long-term safety and efficiency of air travel in the metropolitan area, as well as ensuring adequate airport facilities to support the economy of the Twin Cities metropolitan area in the future.

Sincerely,

Dottie Rietow

Dottie Rietow
Chair
Metropolitan Council

ATTACHMENT

These are the Metropolitan Council's responses to the major technical criticisms of the dual-track process in the auditor's report.

A. Delays. The report claims "delays were overestimated per flight."

While we used the best methodology available at the time, the study's self-correcting nature will ensure that methodologies, forecasts and assumptions are reevaluated before final recommendations are made to the legislature in 1996. It is important to note that the delay model we used in 1988 was originally developed by the FAA Technical Center and was considered state-of-the-art in the late 1980s.

B. Adequacy. The report states that we used "questionable" methods to determined the adequacy of the current runway system and that our study "prematurely signals a need to add capacity before it makes economic sense."

Again, our study employed a standard industry procedure for analyzing capacity by comparing capacity and operations. Far from suggesting that now is the time to add capacity, our study simply raised the red flag identifying a trend that could lead to future adequacy problems. The issue of timing and making investments will be firmly addressed when we make our recommendations to the legislature in 1996. Moreover, we fully agree with the auditor that capacity only should be added when it makes economic sense to do so.

C. Hubbing. The report criticizes the Council and the MAC as being "too optimistic: about future hubbing activity at the MSP. It also takes issues with the 1991 data used to monitor hubbing activity at the airport.

Assumptions about future hubbing activities currently are being reevaluated and will be lowered if warranted. As correctly pointed out by the auditor, in 1991 the monitoring data we used included some non-originating passengers. It is critical to note that this data was used strictly for monitoring and did not form the basis of any tangible part of our study. However, this inadvertently indicated a stronger growth in hubbing activity than actually was true. This deficiency has been corrected in the 1992 contingency planning report.

D. Noise. The report criticizes the statistical analysis and methods used by the noise analysis.

The key reason for the dual-track process was not noise abatement but solving a potential capacity problem. But in the area of noise we looked not only at intensity, but also frequency of flight noise. This was an innovative approach to measuring the true stress caused by aircraft noise. Our main conclusion was that the noise problem will not go away, even with the use of quieter aircraft.

# Recent Program Evaluations

| | |
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| *Petrofund Reimbursement for Leaking Storage Tanks*, January 1993 | 93-01 |
| *Airport Planning*, February 1993 | 93-02 |
| *Higher Education Programs*, forthcoming | |
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