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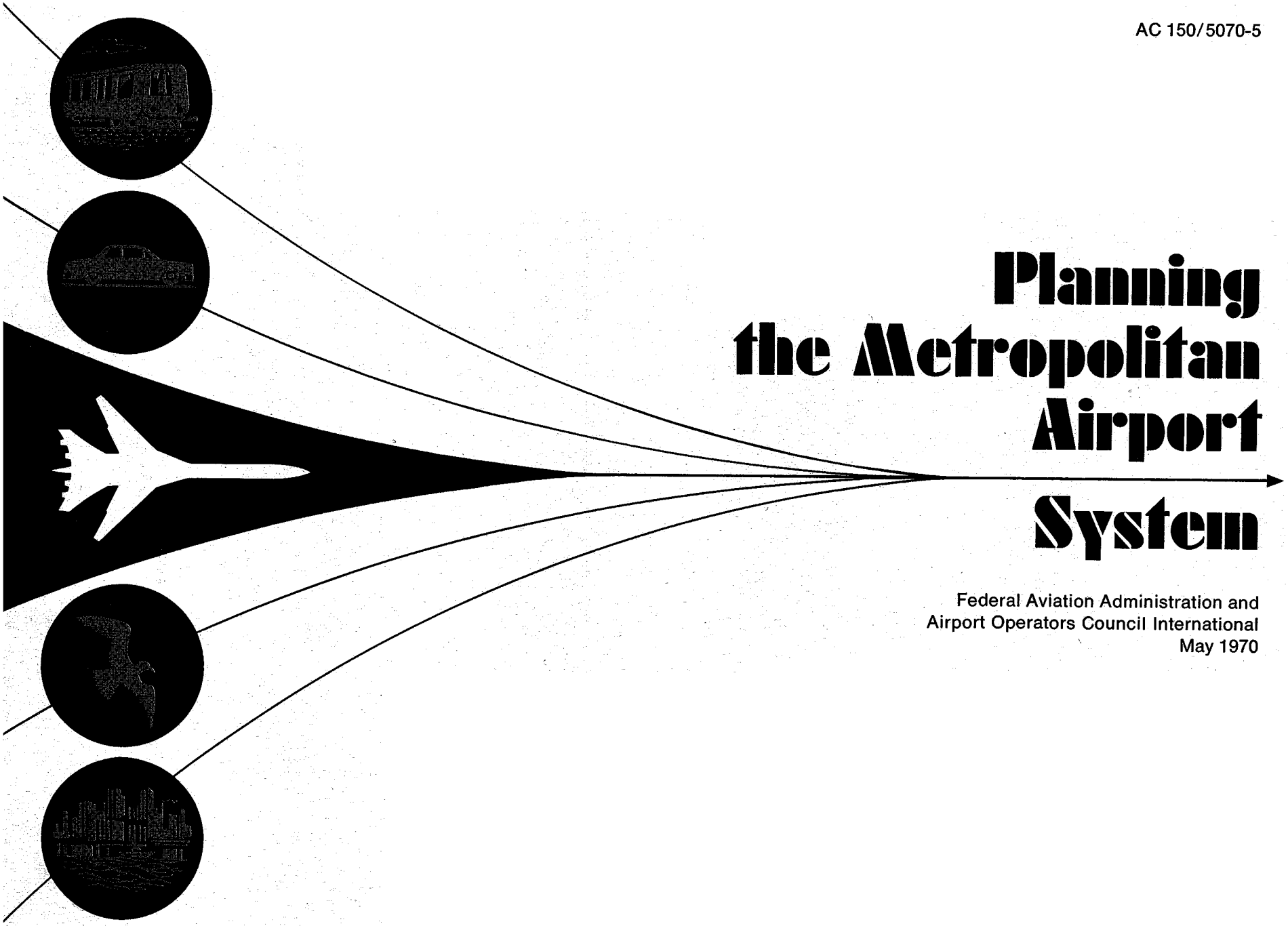

Planning the Metropolitan Airport System

Federal Aviation Administration and
Airport Operators Council International
May 1970

PLANNING THE METROPOLITAN AIRPORT SYSTEM

May 1970

Prepared by a Joint Committee of the
Federal Aviation Administration
and
Airport Operators Council International
in cooperation with the
Department of Housing and Urban Development
and
Federal Highway Administration

Department of Transportation
FEDERAL AVIATION ADMINISTRATION
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Section I. Introduction

CHAPTER 1. BACKGROUND

1. Purpose of this Publication. It is evident that the majority of the much publicized problems in civil aviation today result from the concentrations of high density air traffic in the vicinities of our larger urban population centers. Expressions like "air congestion" and "aircraft noise and pollution" have become commonplace amongst air travelers and the residents of the cities. With ever-increasing frequency, these topics are taking their places alongside other priority issues of national import in the Executive and Legislative Branches of the Federal Government.

The remedial measures proposed for these problems have included the construction of new "jetports" away from the built-up areas, with price tags in the hundreds of millions of dollars; the development of "satellite" fields for general aviation; the use of Vertical/-Short Take-off and Landing Aircraft (VTOL and STOL) to take advantage of available lower altitude airspace; restrictions on and distribution of airline schedules; restrictions on general aviation usage of major airports; and special operational procedures at existing airports.

Unfortunately, many of these remedies treat the symptoms rather than their common cause. The rapid advance in aviation technology and the unprecedented growth in the number of users of air transportation require creative planning on a systems basis and aggressive marshalling of political and financial resources. Today we are faced with a dual job, that of solving current problems and, at the same time, planning for a future era in transportation that could overshadow today's crisis.

This document, then, is in recognition of the need for guidance in airport planning for the Nation's large metropolitan areas. A large metropolitan area is defined as one which has more than one publicly owned airport and can be expected to have at least 500,000 population or which generates annually over 250,000 scheduled airline enplaned passengers within the planning time frame. It is these large urban areas that are most significant in the national air transportation system. The principles set forth in this document can also be used, in part, for correcting immediate problems and identifying priority development requirements.

A joint publication of the FAA and National Association of State Aviation Officials (NASAO), entitled "Planning the State Airport System", provides guidance for developing state airport system plans, including, in a limited fashion, metropolitan airport system planning guidance. That document and this manual should serve as core material for a systematic approach to planning for the Nation's airport needs.

It is a fair contention that an SMSA centered airport system, which often exceeds the boundaries of a given metropolitan area, might also be considered "regional" in scope. Also, it may be appropriate to combine the planning for two or more metropolitan areas on a "regional" basis. The guidance in this document is applicable to such "regional" planning.

2. AOCI/DOT/HUD Cooperative Effort. Airport planning and development at the metropolitan level requires extensive cooperation and coordination between aviation interests and those responsible for ground transportation and other areawide planning and development activities. In recognition of this, the FAA and Airport Operators Council International (AOCI), with the cooperation of the Federal Highway Administration (FHWA) and the Department of Housing and Urban Development (HUD), developed this document.

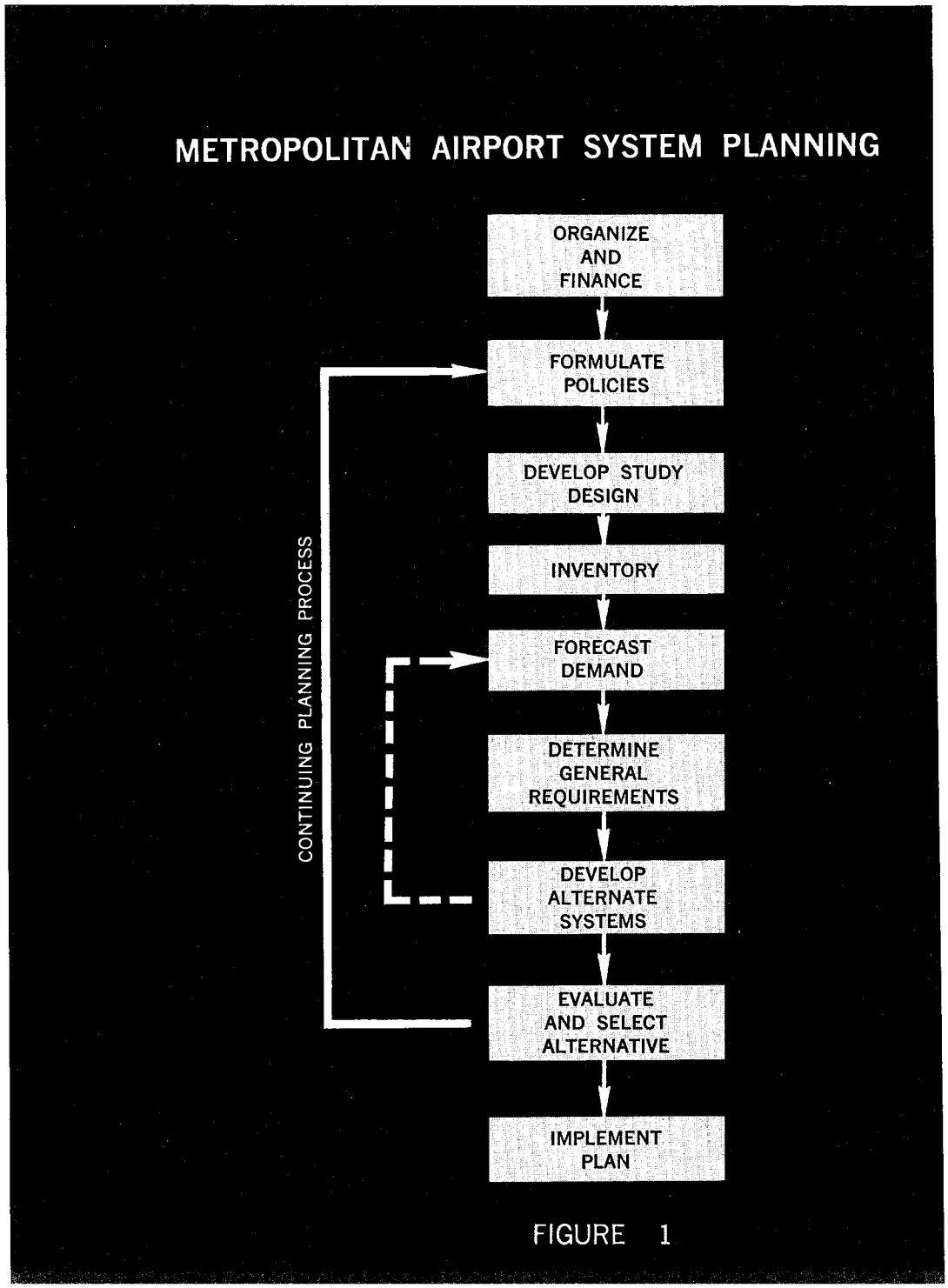


FIGURE 1

CHAPTER 2. DEFINITION AND GOALS

3. Definition. The metropolitan airport system plan is a representation of the aviation facilities required to meet the immediate and future air transportation needs of the metropolitan area. It recommends the general location for and characteristics of new airports and the nature of expansion for existing ones. It shows the timing and estimated costs of development and relates airport system planning to the policy and coordinative planning for the area, and particularly to ground transportation and land use planning and the urban environment. It provides the basis for definitive and detailed individual airport planning.

4. Goals. The metropolitan airport system planning process involves the preparation of both broad and specific policies, plans, and programs needed to establish a viable, integrated network of airports at the metropolitan level. The goals of the metropolitan airport system planning process should be to:

— Provide for the orderly and timely development of a system of airports adequate to meet the present and future air transportation needs of the metropolitan area.

— Place aviation in its proper perspective relative to a balanced, regional multi-modal, transportation system plan and to the area-wide comprehensive plan. Also to provide a basis for coordinating airport plans with other planning efforts—local, regional, and state.

— Protect and enhance the environment through the location and expansion of aviation facilities in such a way that impairment of the ecology and the intrusion of unacceptable levels of noise and air pollution into the community are avoided.

— Promote the establishment of an effective governmental organization for implementing the plan in a systematic fashion.

— Provide a framework for individual airport development programs consistent with short, intermediate, and long-range metropolitan airport system requirements.

— Assure compatibility with the content, format, standards, and criteria of the Federal Aviation Administration's National Airport System Plan to the extent that applicable portions, if not all, of the metropolitan airport system plan may be incorporaed therein.

— Accomplish coordination of the metropolitan airport system plan with the state airport system plan and regional air transportation plans.

— Serve as a basis for coordinating plans for air navigation facilities, airspace use, and air traffic control procedures.

— Inform public and private aviation interests, as well as the general public, of aviation requirements, and create a general awareness of the need for a systematic approach to planning and developing airports in a metropolitan area.

— Develop the aviation portion of long-range fiscal plans and establish appropriate priorities for airport financing in short-term governmental budgeting for public facilities.

— Optimize the use of land and airspace resources which are inherently limited in large metropolitan areas.

— Use air transportation facilities to help guide the growth pattern of the metropolitan area and the state, according to comprehensive planning goals and objectives promulgated by the community.

— Provide a planning organization which enables affected political entities to participate in the planning of air facilities.

— Preserve those existing key public use airport facilities which are consistent with the overall objectives of the long-range plan.

CHAPTER 3. RELATION TO OTHER PLANNING EFFORTS

5. Relation to Other Airport Planning Efforts. Large capital investments have been made in airport development across the Nation. The expenditure of development dollars is a result of planning actions. One requirement of the metropolitan airport planning process is the review of planning that has or is being done in relation to total airport requirements in the metropolitan area. The results of this review help determine if modifications to current and past planning are required.

For example, the demand forecasts for an air carrier airport may now project a high volume of general aviation activity based on past experience, whereas a reduction in this forecast could reduce the need for very expensive development that has been planned. By the use of a metropolitan system approach, the provision of less costly separate general aviation facilities in the right place at the right time might well reduce expenditures and result in a better air transportation system for the area.

The metropolitan airport system plan should be properly interfaced with the *state airport system plan,* with particular emphasis given to dove-tailing the two plans in geographic areas which lie immediately beyond the limits of the metropolitan area. It is in these

areas that many units of the metropolitan airport system will probably be located. This will be especially true for new airports where a scarcity of land and airspace precludes close-in locations.

Also, where a metropolitan area spans several states, its airports may serve states other than those in which they are physically located. The relationships to these various state airport plans are, therefore, significant.

The demand forecasts for airports in the state airport plan, especially those for short-haul air carrier and general aviation traffic, must be reviewed for their effect on the demand forecasts at the metropolitan system airports.

In those cases where state financial assistance is a consideration in metropolitan airport development, it will be necessary to correlate closely the metropolitan and state plans for purposes of financing development.

Regional airport system plans for geographically extensive areas should be reviewed to ascertain what will be happening beyond the metropolitan area. A need may be indicated for bringing together several metropolitan areas in one planning effort. This may result in recommendations which conserve resources by avoiding duplication of facilities and which improve overall quality of service to the public.

The metropolitan airport system plan should contain sufficient information to render applicable portions acceptable for inclusion in the FAA *National Airport System Plan (NASP)*. In formulating a NASP, the FAA will include recommendations contained in the metropolitan plan, when the recommendations are in the national interest.

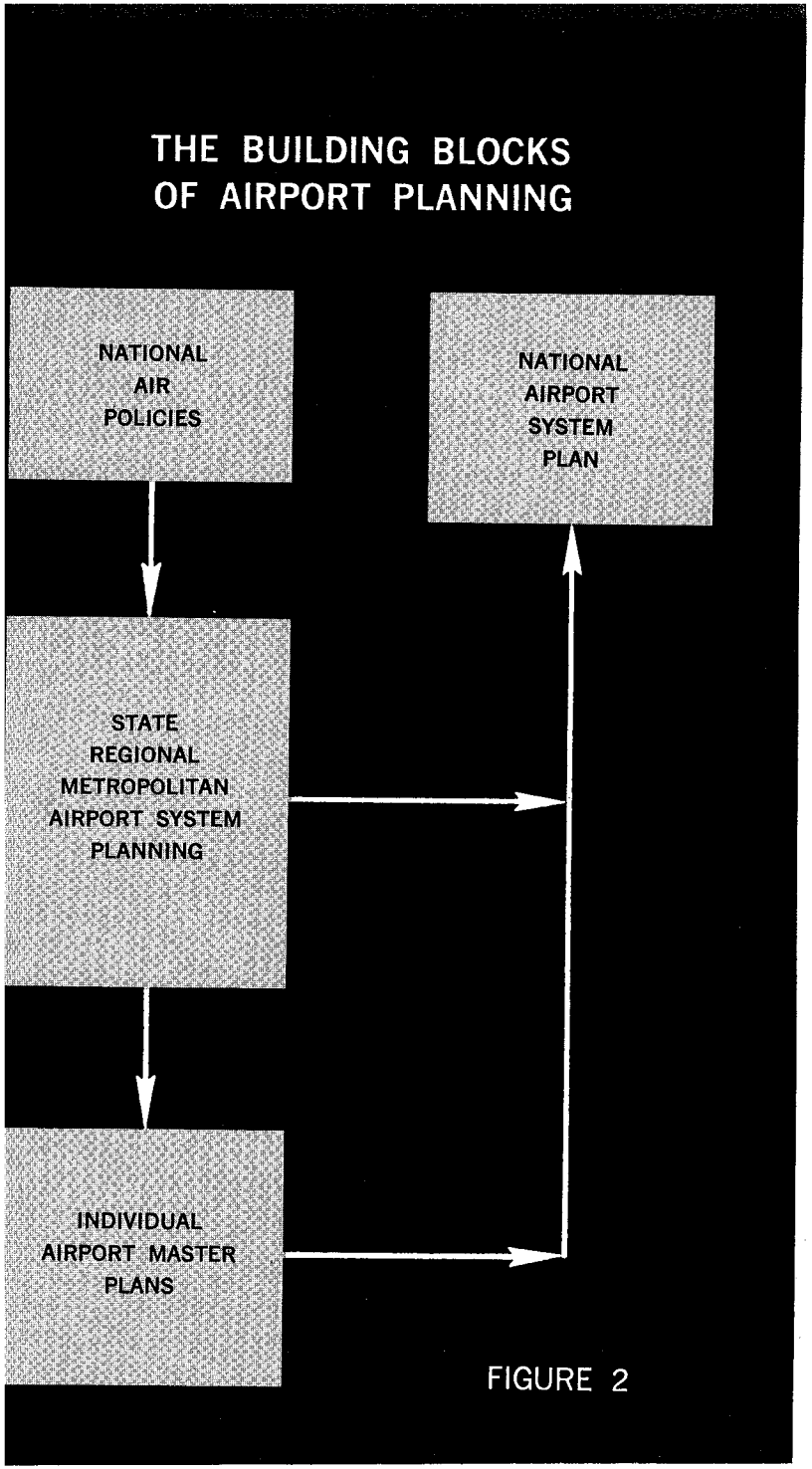
With the high concentration of air traffic in a metropolitan area and with the scarcity of available land and airspace to accommodate airport development, each airport in the system should normally be projected for maximum utilization. Accordingly, the importance of these airports in terms of their contribution to the overall objective of providing safe and efficient air transportation to and from these economically important areas, supports a basic assumption of national interest in their development. Thus, it is likely that these plans, upon receiving concurrence by the FAA, will be incorporated in the NASP.

The reader's attention is directed to Figure 2, "The Building Blocks of Airport Planning."

6. Relation to Comprehensive and Urban Transportation Planning. The airport system must be recognized as a key element in metropolitan planning and development, by virtue of its nature as a major consumer of urban land, a principal environmental influence, an important stimulant to intensive urban development, and a significant consumer of ground transportation services.

All large metropolitan areas have some type of metropolitan planning agency carrying on a continuing comprehensive planning effort which aims to construct the framework for metropolitan development. Also, all large metropolitan areas have a specific urban transportation planning process dealing with ground transportation. The relationship between these two planning efforts varies from virtual separation to, in a few cases, complete merging.

Since an airport is one of the most important public facilities in a metropolitan area, there is a need to mesh airport system planning with these other planning efforts. This merging or other lesser coordination of planning programs should take place during the organization phase of the airport system planning endeavor and should continue throughout the several stages of initial plan preparation, adoption, implementation, and continuing planning.


THE BUILDING BLOCKS
OF AIRPORT PLANNING
NATIONAL
AIR
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REGIONAL
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AIRPORT SYSTEM
PLANNING
INDIVIDUAL
AIRPORT MASTER
PLANS

FIGURE 2

Section II. Organization and Funding

CHAPTER 4. ORGANIZATION FOR THE AIRPORT SYSTEM PLANNING PROCESS

7. General. Organizational arrangements for the airport system planning process will vary from one metropolitan area to another depending upon (1) their political/jurisdictional makeup; (2) the nature of ownership and control over existing airports; (3) the organization and effectiveness of the areawide comprehensive planning agency and urban transportation planning agencies; and (4) the agency legally responsible for financing the planning effort.

A most effective structure will be one that is capable of (1) establishing policy which is acceptable within the metropolitan area, (2) bringing together for advisory and coordinative purposes all appropriate aviation and nonaviation related interests, and (3) assuring a planning process that is technically sound and responsive to policy and the coordinative process. Most importantly, the arrangement should be such that the plan can be established as an effective, continuing program capable of implementation.

Unless effective organization, in the above terms, is established at the outset, the goals of airport system planning may not be completely fulfilled. A poorly organized effort will result in (1) fragmented public support, including avoidable or uninformed public controversy, for the plan's recommendations; (2) unrealistic recommendations that are not acceptable to the aviation community or to those responsible for comprehensive and surface transportation planning; (3) an end product which is the end of the product—a completed study of no further use and which is not updated in a timely fashion and, most importantly, not implemented. Thus, the importance of effectively organizing the metropolitan system planning effort cannot be overemphasized—it may be the most critical step in the process.

In general, the organization will be structured to perform three principal functions, namely, policy formulation, advice and coordination, and technical planning.

a. Policy formulation—The establishment of basic ground rules, or policies, is necessary to build the framework for the technical planning process. These policies must respond as nearly as possible to the desires, attitudes, and values of the citizenry and, at the same time, give full consideration to meeting the area's long-range air transportation requirements. Additionally, these general policies should directly relate to and be integrated with comprehensive planning policy.

In formulating policy it is necessary to work within the goals cited in Chapter 2, "Definition and Goals." Examples of the kinds of aviation-related policies which should be considered are discussed in Chapter 6, "General Criteria and Policy Objectives."

The policy-making unit of the overall organizational structure is the key body whose decisions will most shape the effort and its end results. This body must be able to speak for the many political jurisdictions insofar as all metropolitan planning is concerned. The policy group must be able to serve as an effective forum for discussion of the issues and should be able to present an acceptable majority position on the system plan that is finally selected.

In serving as a forum for discussion of the issues, the policy body is responsible for the establishment of appropriate mechanisms by which all identifiable citizen viewpoints can be heard. Such mechanisms can take a number of forms, from broad citizen representation on planning boards to advisory councils sitting in regularly on meetings of the policy body. The structuring of such mechanisms should be tailored to most effectively accomplish their purpose, that is, the incorporation of citizen viewpoints in the planning process. It should not be allowed to be a vehicle for volatile and unconstructive actions.

A regional or metropolitan area government with planning responsibilities would be ideal as a single unit for carrying out all functions of the planning process. However, since this kind of governmental unit is essentially nonexistent, one must look to other metropolitan organizations. Typical metropolitan bodies which could best provide the policy direction are Councils of Governments (COG's), Regional Planning Commissions or Councils, City/County Planning Agencies and possibly State Agencies. With the increasing popularity of the COG arrangement for areawide planning policy, a majority of the metropolitan areas could have the COG as the policy unit. It is strongly recommended that the policy unit be an areawide comprehensive planning agency with the inherent or delegated authority to plan for comprehensive physical development and preferably for physical, social, and economic development of the area within which airport development may take place. The power to conduct comprehensive planning and to integrate more detailed functional planning efforts (airports, highways, mass transit, land use, etc.) with one another is essential for effective metropolitan airport system planning.

The following is a description of the typical policy bodies:

(1) Councils of Governments (COG's). Councils of Governments are voluntary associations of local governmental units. They are created under acts of the state legislatures and exist primarily as coordinative agencies among their member governments. They serve to coordinate planning activities having regional implications, to prevent overlapping of various services, and to recommend courses of action beneficial to the region as a whole.

Federal legislation and requirements have led to a rapid increase in COG's. In 1965, COG's were made eligible for Federal matching grants for undertaking planning programs of regionwide application. The Model Cities and Metropolitan Development Act of 1966 provided that a council could be the recipient of a number of grants to foster metropolitan development. Many COG's employ a professional planning staff; others rely mainly on the planning capabilities of their respective member governments.

(2) Regional Planning Commissions or Councils (RPC's). In the past, perhaps one of the most common planning devices has been the Regional Planning Commission or Council, the directors of which represent the constituent political bodies. The typical charge to these regional bodies has been to advise on planning problems and to develop comprehensive long-range plans for regional growth and development. Many regional organizations resulted from a primary interest in transportation planning and have often been spawned by planning funds made available by the Federal-aid Highway Program. Some of the latter types have subsequently broadened their concern to include multiple aspects of regional growth and development.

(3) City/County Planning Agencies. Often, SMSA's represent single counties, and the county or city/county planning agencies are the areawide planning agencies.

(4) State Agencies. Under the state agency arrangement the metropolitan airport planning program could be carried out directly at the state level or indirectly at the metropolitan level. The state could either develop metropolitan airport

policies or have the metropolitan airport interests participate in policy development through some type of ad hoc policy board.

Since many states have enabling legislation to allocate and supplement Federal airport development funds, these states also have authority to do airport planning in the state. In the smallest states, metropolitan airport planning might be best carried out at the state level. In large states, this may not be the case.

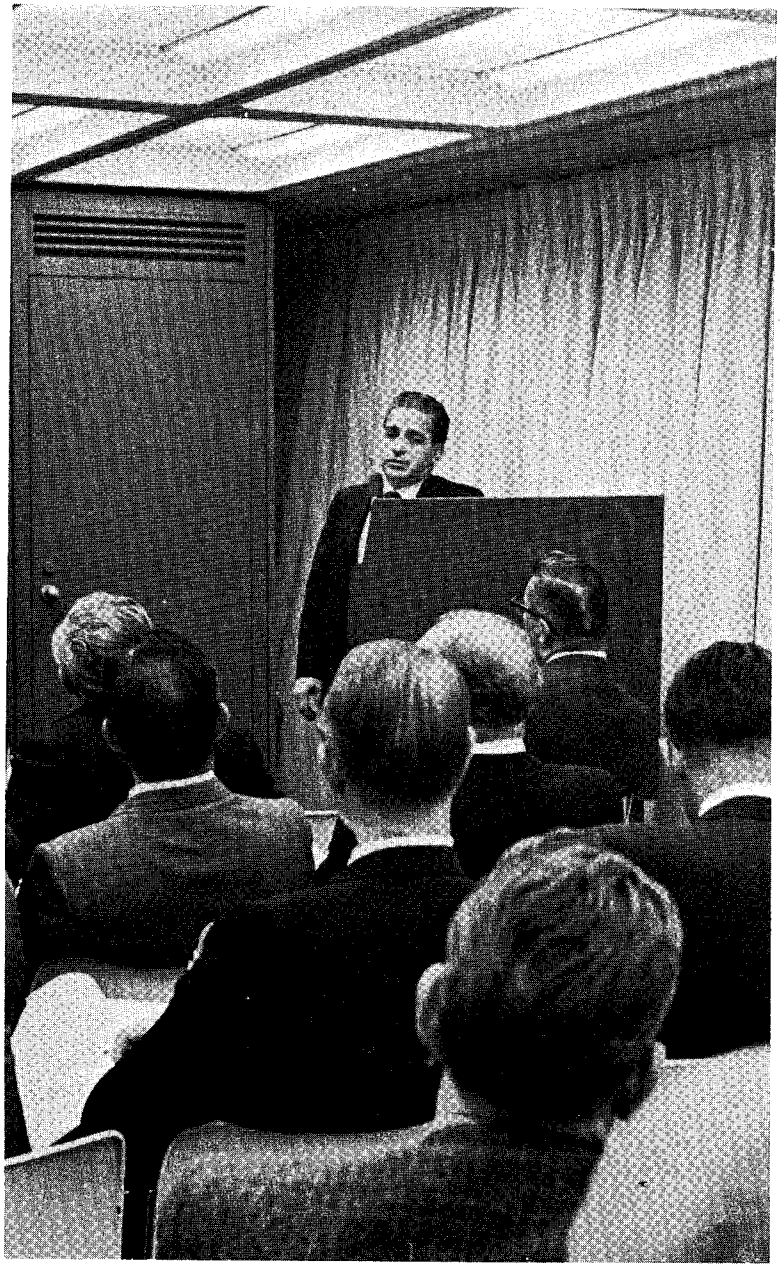
b. Advisory and Coordinative Efforts—In the planning process, the roles of aviation interests and appropriate nonaviation interests must be considered in structuring the organization. On the aviation side, communication with all airport operators in the metropolitan area is an absolute necessity. Participation in terms of coordination, advice and, in many cases, staff support, will be required. The FAA and state aviation organizations should be elements in the organizational structure insofar as coordination, approval, and financial and advisory assistance will be required. It is imperative that ground transportation planning agencies be directly involved in the advisory and coordinative function. Where the advisory and coordinative function in the organizational structure is assigned will depend on the individual organization. More than likely it would be performed at the point in the organization where the technical planning function is accomplished. For example, if a COG is the policy body and the technical planning is done by a metropolitan transportation agency, the advisory and coordinative efforts will probably take place below the policy level, where the technical planning function is being carried on. On the other hand, if the staff of the policy body does the technical planning, the advisory and coordinative efforts would take place at that level.

c. Technical Planning—The technical planning process begins with the inventory step, ending initially after the selection of a preferred alternative, but repeated during the continuing planning process. Normally, the technical planning will be done by an airport system planning staff administered by the policy body or a transportation agency. This organization will draw upon its own staff and other planning agency staffs, possibly those of the local airport operators and, as needed, from a consultant firm, or firms, to do the technical planning. While COG's, RPC's, special transportation authorities, cities, counties, states, and urban transportation planning agencies may have planning staffs of their own, it is not likely that they have sufficient aviation expertise and will require a supplemental technical aviation staff and consultants. Typical technical planning bodies are:

(1) Areawide Transportation Planning Agencies. In virtually all urban areas with a population of more than 50,000, an urban transportation study exists. These urban transportation studies were originally established to develop long-range highway plans and programs that would be coordinated with other forms of transportation and with land use plans for the area. These programs are required by Section 134 of the Federal-aid Highway Act of 1962 (Title 23, USC), which provides that highway projects must be based on a continuing comprehensive transportation planning process. While this requirement exists, it is recognized that some programs fall short of being truly comprehensive and are highway-oriented.

In furtherance of the Highway Act many state highway departments have secured agreements among local jurisdic-

The policy group serves as an effective forum for discussion of the issues.



tions in metropolitan areas and regions to jointly plan transportation facilities. These agreements are rather general, and could include airport planning without being rewritten.

Increasingly these transportation planning programs are producing plans for mass transit systems. Planning future surface transportation to existing and future airports is already a recognized responsibility of these urban studies. It is obvious, then, that airports system planning should be integrated with such efforts.

In many cases, these urban transportation studies are so organized that locally elected officials act collectively as a transportation policy committee to guide the study, with locally derived plans and objectives serving as a basis for developing transportation plans. Probably these studies have already developed forecasts for future population and economic growth for the area, and in many cases already have data showing travel to and from airports.

There would be substantial mutual benefits in eventually linking the airport system planning program directly to the existing urban transportation program as closely related functional efforts. This would provide the mechanisms whereby airport system plans could be properly coordinated with plans for highways and mass transit to serve airports. It would also produce numerous efficiencies and economies through the use of the same basic data and studies for airport as well as for surface transportation system planning.

(2) *Special Transportation Authorities.* There are a number of transportation authorities throughout the country which have been established for specific purposes such as the planning,

construction, and operation of bridges, toll roads, ports and airports. Authorities are created by state legislatures and act as more or less autonomous units independent of local governments. Authorities may issue revenue bonds and contract with local governments for service.

8. Optional Organizational Structures. As previously stated, the oganizational arrangement for metropolitan airport system planning will vary among metropolitan areas. A typical organization is suggested in Figure 3. Here, the COG is the principal policy element and the technical planning is done by an airport system study element administered by the COG.

Variations of this arrangement would include:

(1) RPC's City/County Planning Agencies, State Agencies as the principal policy elements.

(2) Areawide Transportation Planning Agencies or Special Transportation Authorities as the principal technical planning elements.

Advisory and coordinative components are separated into participating and nonparticipating elements. Participating elements are those directly concerned with the study and who will participate in technical committee meetings on a continuing basis. Nonparticipating elements are those who share a continuing interest in the effort but who are called upon by the technical committee as needed. It may be appropriate for participating and nonparticipating elements to coordinate with each other.

TYPICAL ORGANIZATION STRUCTURE

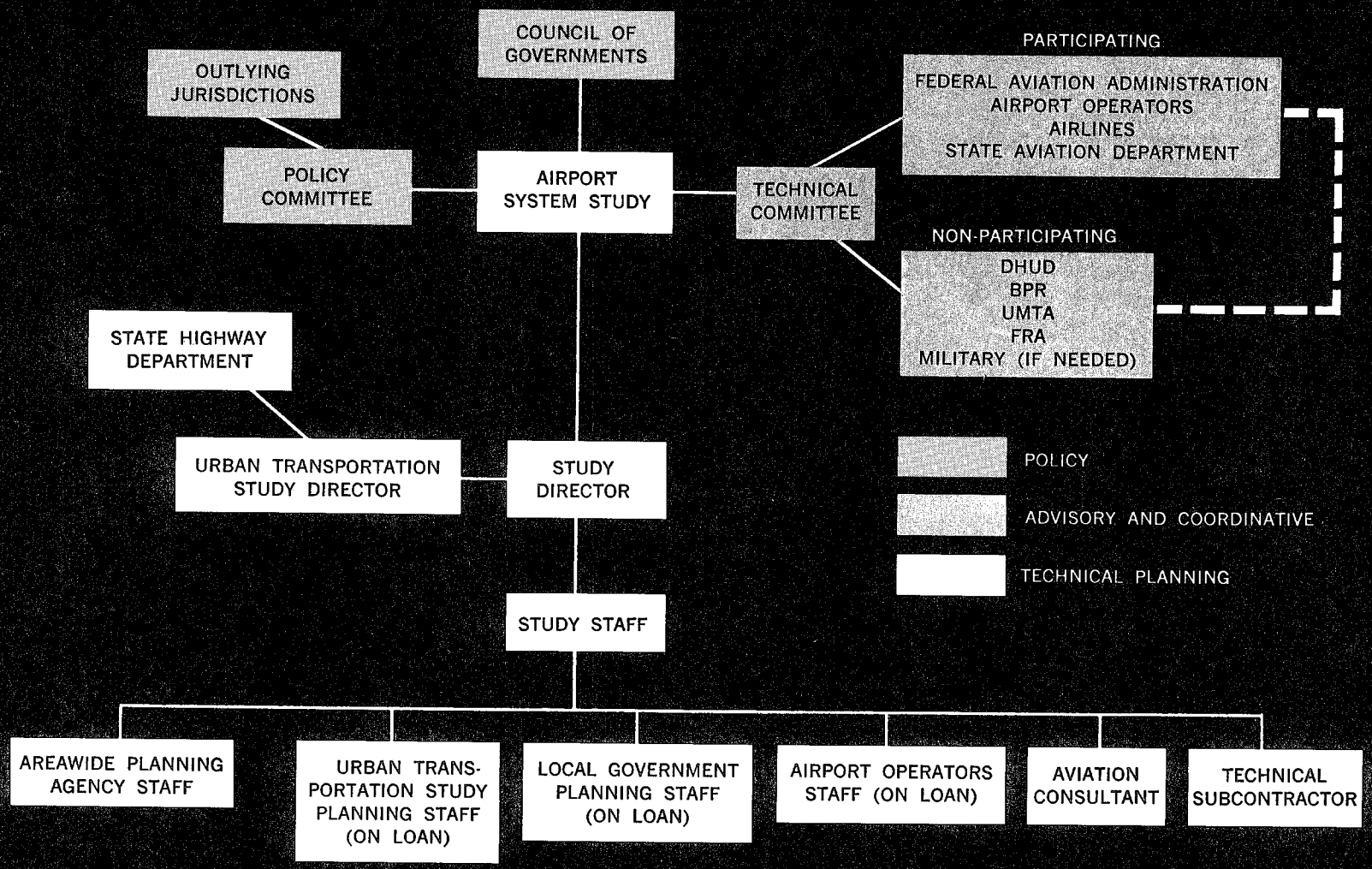


FIGURE 3

THE RELATIONSHIP OF METROPOLITAN AIRPORT SYSTEM PLANNING TO AREAWIDE COMPREHENSIVE PLANNING

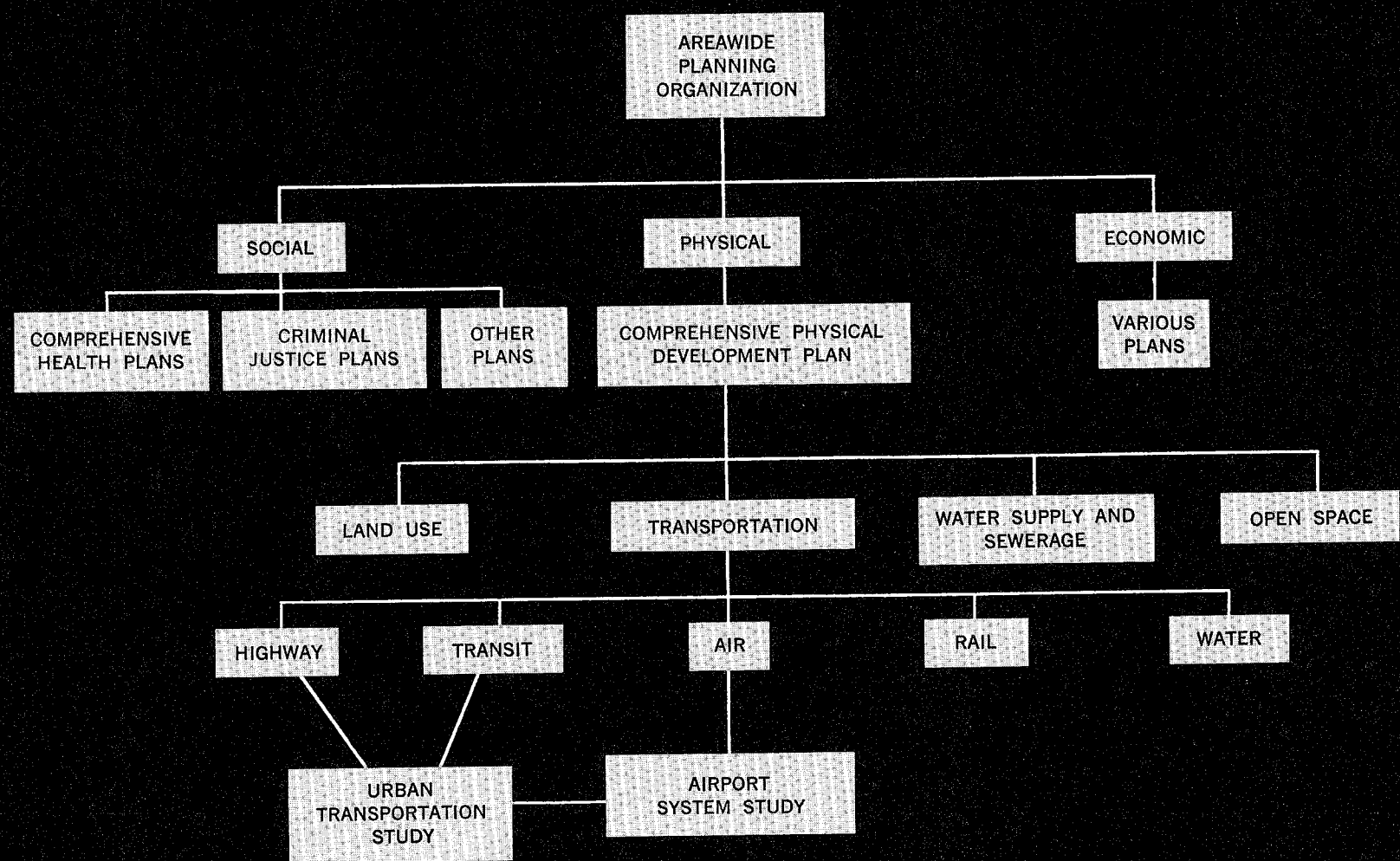


FIGURE 4

The typical relationship of metropolitan airport system planning and other functional planning activities to areawide comprehensive planning is shown in Figure 4.

CHAPTER 5. FUNDING THE PLANNING PROCESS

9. General. Due to the extensive nature of the metropolitan airport system planning effort, substantial financial resources will be required. In order to stimulate adequacy in planning, legislation at the Federal and state levels in several program areas provides financial aid for airport system planning. Current sources of such assistance are listed herein. Of course, the inability to secure outside funds fore the planning effort should not deter total local financing of the effort, for the ultimate benefits will justify the expenditure.

In order to be eligible for consideration for planning assistance under a Federal program, the proposed planning project must be evaluated by certain planning and development clearinghouses in furtherance of Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966 and Title IV of the Intergovernmental Cooperation Act of 1968, pursuant to Bureau of Budget Circular No. A–95.

The purpose of these evaluations is to determine the extent to which the planning study is consistent with or contributes to the fulfillment of comprehensive planning and the achievement of the objectives of the state, region, metropolitan area, or locality.

As appropriate to the area being planned, the planning and development clearinghouses may be a state or regional clearinghouse designated by the Governor or a metropolitan areawide agency that BOB recognizes as an appropriate agency to perform review functions under Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966.

10. Airport and Airways Development Act of 1970. The FAA administers a planning grant program under which grants of up to two-thirds of the eligible cost of airport system planning studies are made to areawide planning agencies. This program also provides grants to public agencies for individual airport master planning. The specific regulations and procedures for this program may be obtained from the FAA.

11. "701" Comprehensive Planning Assistance Program. The Department of Housing and Urban Development has funded airport system planning through its Comprehensive Planning Assistance Program, as authorized by Section 701 of the Housing Act of 1954 (as amended). Under this program HUD has given grants of up to two-thirds of the cost of the study, as long as such study is part of an overall comprehensive planning program.

12. Economic Development Administration (EDA). In certain areas of the country which are economically depressed, the EDA of the Department of Commerce has authorized the establishment of Economic Development Districts (EDD's). These districts have representation from the towns and counties within their borders and have professional planning staffs. The districts are concerned with and promote economic development of all types. Some are assuming the roles of regional planning agencies.

Under their authorizing legislation, EDD's are allowed to supplement other Federal funds up to 80 percent of the total project costs, depending on a particular project's qualifications. The applicable statutes specify criteria. Airport planning can be included in the EDD's activities.

This particular program may not hold much promise for the metropolitan areas discussed in this document. However, should the area of aviation consideration extend beyond the boundaries of the traditional SMSA into an economically depressed county(s), an EDA supplemented planning grant might be available to cover part of the costs of a study.

13. Regional Development Commissions. The Appalachian Regional Development Act of 1965, which established the Appalachian Regional Commission, set the stage for large multi-state regional development commissions. Following the Appalachian Act, Congress passed the Public Works and Economic Development Act of 1965 which allowed 5 more commissions to be established: Coastal Plains, Four Corners, Upper Great Lakes, New England, and Ozarks. These commissions are chaired by Federal and state co-chairmen and represent a significant joint Federal-state working relationship. These commissions, like the EDA, can supplement other Federal grants up to 80 percent of a total project cost or can contribute the entire 80 percent on special projects. States and localities would contribute the balance.

Transportation planning has been recognized as a vital part of the Commissions' planning programs, and airport system planning is a vital part of the overall transportation planning effort. The possibility exists of financial assistance from these commissions for airport system planning.

14. State Aeronautics Commissions. A number of states have developed, or are in the process of developing, a statewide airport system plan. If metropolitan airport system planning is part of the state planning effort, financial assistance from the state may be possible.

Section III. The Planning Process

CHAPTER 6. GENERAL CRITERIA AND POLICY OBJECTIVES

15. General. Having organized for the planning effort and arranged for financial support, the planning process can begin. The process starts with the development of general criteria and policy objectives (sometimes called "policy formulation") and the study design. After these two steps are completed, the technical planning phase begins with an inventory of existing facilities. Next, a forecast of aviation demand is made in order to determine the future facility requirements. Alternate systems to meet the future facility requirements are then developed and evaluated. While this ends the initial planning process, a continuing planning process following these same general procedures is established while implementation of the long-range plan is under way. The reader's attention is directed to the flow chart, Figure 1.

16. General Criteria and Policy Objectives. The first step in the airport system planning process is the establishment of ground rules which may be termed "general criteria and policy objectives." For example, it is necessary to state at the outset the time frame, or planning horizons, for which planning is to be accomplished. The geographic limits of the planning area must also be established in order to guide such elements as data collection, forecasting, and potential site selection. Whether (1) adherence to Federal/state airport design/dimensional standards will be required, and, (2) whether a policy of total public ownership or a combination of public/private ownership might be applicable to system airports, should be determined.

In general, there should be an attempt to relate the communities' individual and sometimes unique objectives to the "Goals" in Chapter 1. One should not assume that all policy can be established at the outset. Airport policy development may take place at several points in the airport system planning process: during preparation, discussion, and initial adoption of an airport system plan; during annual review and amendment of the plan; during major reconsideration of the entire plan; and during consideration of the day-to-day development matters which call for the review of general long-range policies.

17. Planning Horizons. The long-range time period for the plan should generally be twenty years and should include airport, heliport, and STOL port locations, recommended development, timing of development, and order of magnitude costs. Precise development needs and costs should not be required, although a reasonable estimate of needs should be expected. Since it may take as long as 10 years for a major airport to be established after its need has been identified, a twenty-year horizon is not unrealistic.

In establishing the length of time for the *long-range* planning period, consideration should be given to how long the long-range periods are for other area planning efforts such as the transportation and land use plans, with consistency as an objective. The *intermediate range* should be for a 10-year period and should more precisely determine development requirements and associated cost estimates than specified in the *long-range* planning period.

The *short-range* period should be for 2 to 5 years and should include a detailed treatment of facility needs and cost estimates. The latter should be sufficiently accurate to permit financial planning and budgeting that is consistent with the airport financing programs at the state and Federal levels, and the local budgeting process.

Because of the reliance of demand forecasts on certain statistical data from the National Census, planning periods ending on the

decade should be considered. Also, consistency with the time frames of state and regional airport system plans should be sought.

18. Area Limits. In Chapter 4 the organization for the airport system planning process was discussed. It is appropriate, when organizing, to establish the political boundaries of the area in order to determine jurisdictional involvement. However, the geographical areas beyond these jurisdictional boundaries may generate aviation demand and may contain real estate and uncongested airspace not otherwise available within the metropolitan area or region. It is necessary, therefore, for data collection, forecasting, and potential site selection to look beyond the immediate confines of the metropolitan area. Each metropolitan area is unique; therefore, it is not feasible to attempt to define for all cases how far beyond a metropolitan area's jurisdictional boundaries one should go when identifying an airport system primary service area. This will have to be determined according to the individual situation by the planners involved. It is suggested, however, that in instances where the SMSA obviously does not represent the primary service area, the Rand McNally *Commercial Atlas and Marketing Guide* be consulted and the appropriate "Basic Trading Area" be consisdered for use as a guide. This Basic Trading Area is related to the principal city within the metropolitan area. That city is recognized for its importance as a center of shopping goods purchases, and, as a result, is a center to which shoppers may travel some distance to make purchases. Such centers are also well suited for other shopper activities in such fields as entertainment, education, and medical care. Using the same general criteria, it can be said that people will travel like distances to obtain scheduled air transportation.

19. Types of Airports. The metropolitan airport system plan will include one or more airports whose principal function is to accommodate scheduled airline operations with transport-type conventional aircraft. Additionally, it will include a number of airports whose primary function is to serve general aviation aircraft ranging in size from the small single-engine variety to the sophisticated business or corporate turbojet, and with varying roles such as the accommodation of air taxi service.

A unique feature of the large metropolitan areas is the role of general aviation airports in providing traffic relief to the air carrier airport(s). Separate general aviation airports tend to divert general aviation from the scheduled air carrier airports, thus providing separate facilities at less cost and with less mutual interference of aircraft operating at different speeds and with different functions. These general aviation airports have been referred to as "reliever" airports because of their obvious role in the system, complementing the air carrier facilities.

V/STOL (Vertical and Short Takeoff and Landing Aircraft, including helicopters) ports should be an important future element of the metropolitan airports system plan. These aircraft can operate from small landing areas in built-up areas, supplemental strips located on air carrier airports, and from general aviation airports. Facilities for seaplane or float aircraft may, in a few situations, be components of the metropolitan airport system.

Military airports must be viewed as having potential joint civil/military use. The possibility of military withdrawal from the facility and its potential for full civil usage must be considered carefully.

20. Development Standards. Adherence to design/dimensional standards promulgated by the Federal Aviation Administra-

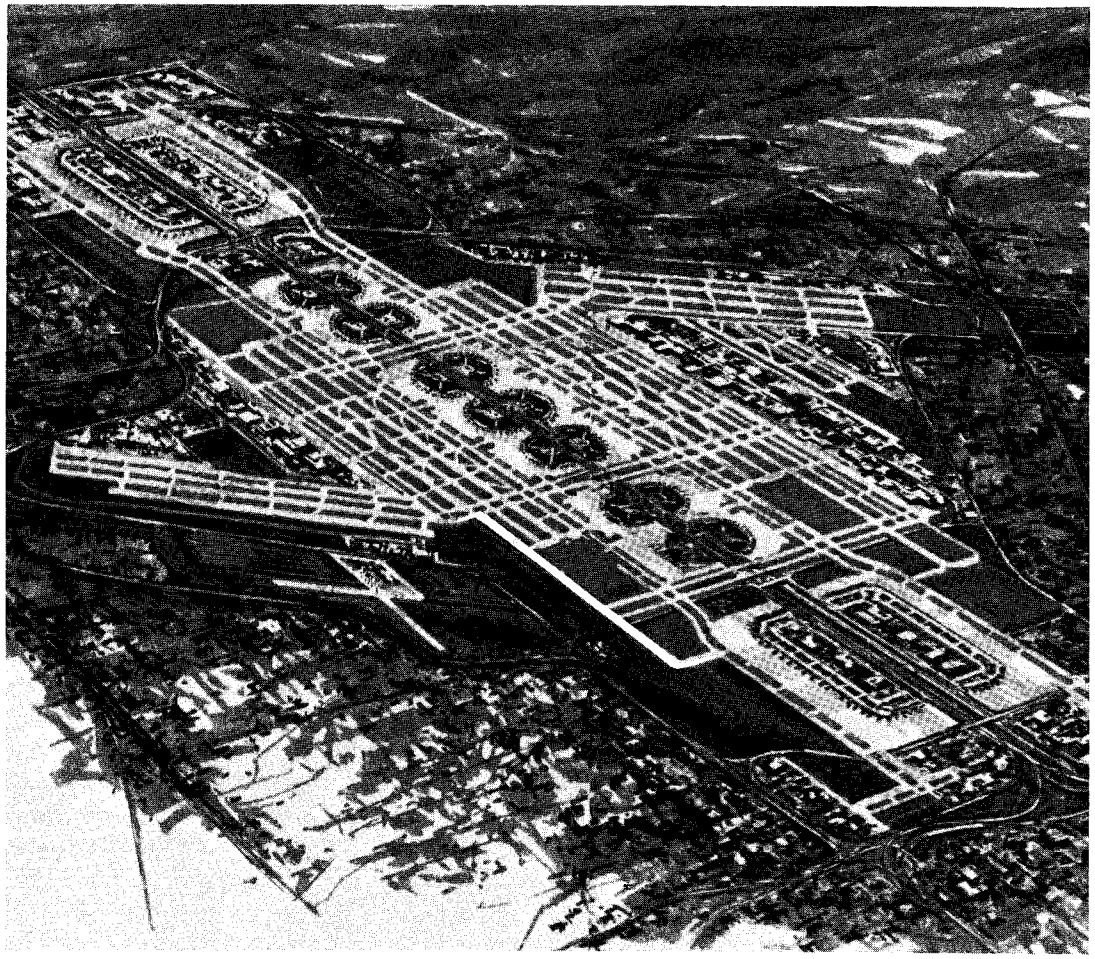
tion is mandatory at airports receiving Federal financial assistance. Further, where state financial assistance is received, there may be additional design/dimensional standards required by state aviation organizations.

Therefore, it may be prudent to require that such criteria be adhered to in airport development in order to maximize the potential for outside financial aid.

It is likely that all airports comprising the metropolitan airport system will eventually experience exceptionally high levels of utilization because of the concentrations of air traffic in areas which have inherently limited airspace and real estate. To optimize the use of these limited resources, it will be necessary to establish as a basic premise that the system's airports be planned for maximum utilization. Thus, if at all practical, parallel runways and IFR capability for general aviation airports should be objectives. It is suggested also that general aviation airports should, at the minimum, be planned to meet the FAA "General Utility" category, with at least one of the general aviation airports planned to FAA "Basic Transport" criteria.

21. Facility Ownership and Operation. Currently, ownership and operation of airports in a typical large metropolitan area are divided among various local governmental units and private individuals. The advantages of public ownership are clear: relative stability is assured; Federal, and often state, financial aid is available; and certain powers, such as that of eminent domain, are available. Privately owned airports do not enjoy these benefits; thus expansion potential and continuity in the system are inhibited. Because of increasing land values, many of our cities lose key private airports to other land uses.

New Dallas-Ft. Worth Regional Airport (under construction)



With the rapidly decreasing availability of real estate for airport development, it would appear that a community's objective would be the public ownership and operation of all planned system airports. On the other hand, the availability of an adequate private airport, at least on an interim basis, allows the allocation of financial resources to other important airport development projects. In the establishment of ownership objectives, it should be remembered that the basic requirement is the continuing availability of airport sites—accomplished by a systematic program of public acquisition of private airports, by acquisition on a "when available" basis, or by a program of tax incentives whereby the private owner is encouraged to keep the airport in the system.

Another ownership objective which might be established at the outset is the grouping together of key airports under one organizational structure such as a regional airports authority. It is more likely, however, that a recommendation for or against such an organization would result as a product of the planning process rather than an initial policy objective.

22. Miscellaneous. There are several areas not mentioned previously for which the setting of policy objectives may be appropriate at the outset of the planning process. These would include, but not be limited to, (1) the financial arrangements for implementing the plan; (2) specific limitations to be imposed on existing facilities because of well-established environmental and political considerations; (3) fiscal priorities of air transportation versus other community improvement needs; (4) the extent to which airports will guide and stimulate community growth patterns.

CHAPTER 7. STUDY DESIGN

23. General. After the development of an organization for the planning effort and the establishment, insofar as possible, of the general criteria and policy objectives, a study design should be developed. The study design provides the framework of the effort, identifying the issues, the work schedule and budget, and the organization and procedures of the planning agency. For general guidance on the various considerations involved in a metropolitan airport system study see the outline in Appendix A.

24. Identification of Issues.

a. Discussion of the major aviation-oriented problems, issues, and opportunities of the metropolitan area for which the airport system plan is to be developed.

b. Ranking of these issues by order of importance in relation to the goals and objectives of the metropolitan area.

c. Analysis of the strategies by which the issues might be successfully approached.

d. Description of the general criteria and policy objectives to be adhered to or developed.

25. Work Schedule and Budget.

a. Identification of the scope of the study and its major components.

b. Description of the anticipated format of the end product.

c. Identification of the area to be studied, as well as the appropriate geo-political areas encompassing the study area.

d. Description of the job activities needed to accomplish the scope of the study and its components.

e. Specification of each of the following factors for each component of the study:

(1) Approach and techniques to be used.
(2) Assessment of data and studies already available.
(3) Resource requirements in terms of man-hours by types of disciplines.
(4) Allocation of work between the planning agency staff, consultants, and others.
(5) Time schedule
(6) Costs
(7) Scope of funds.

26. Organization and Procedures.

(1) Description of the organizational structure delineating the composition of the policy body; who is to do the technical planning; who is to provide advice and coordination, including a breakdown of the participating and non-participating elements.
(2) The extent of financial and in-kind or service contributions by members.
(3) Staffing requirements.
(4) Committee requirements.
(5) Legal basis for the organization doing the study.
(6) Mechanisms for citizen participation and for informing the general public of the progress and results of the planning process, including the nature of arrangements for public hearings.
(7) Procedures for coordination and review activities of participating and nonparticipating public and private agencies.
(8) Organizational arrangements and procedures for implementing the plan.

(9) Organizational arrangements and procedures for establishing and implementing a continuing planning process.

(10) Evidence of satisfaction of Federal requirements if Federal financial assistance is to be obtained.

CHAPTER 8. INVENTORIES

27. General. The initial step in the technical planning phase of the airport system planning process is data collection or inventories. At this point, the planner determines the nature of existing aviation facilities and activities, and what is happening in the metropolitan area which may affect airport system planning. The scope of the data collection activity will depend upon the limits of the area under study as well as the geo-political areas encompassing the study area and the amount, type, and quality of data already available from current sources.

Armed with the essential data, the planner can then proceed to the next steps in the technical planning phase, namely, the forecasting of aviation demand, the determination of facility requirements, and the development of alternative system plans.

A helpful tool in the aviation facilities data collection phase is a base map showing all existing airports and their configurations. Additional maps or overlays showing the airspace structure, the existing and planned ground transportation systems, and existing/projected land uses are also useful. (See Figures 5–9)

28. Airports and Facilities. A key source document for airport information is the FAA Form 5010–1 (See Figure 6). This form provides the most essential landing area data. Appropriate Aeronautical Charts, the Airman's Information Manual (AIM), Obstruction Charts, and individual layout plans, if available, will also give pertinent information.

Visits to the individual airports will be necessary to obtain data not available from the above sources and to verify the accuracy and currency of information. Such information should include a complete description of all buildings and related areas and aeronautical activities.

A summary of the key historical factors which may have influenced the development of the airport will prove useful. It is important to record the nature and extent of limitations to current operations or future development for each airport. Limitations would include adverse terrain; the existence of natural or man-made obstructions; densely populated areas in the immediate environs (exposed to noise and air pollution) and other environmental considerations; military restrictions applicable to a joint use airport; limited access potential; potential conversion to nonaeronautical use; restrictions to types/classes of users; etc.

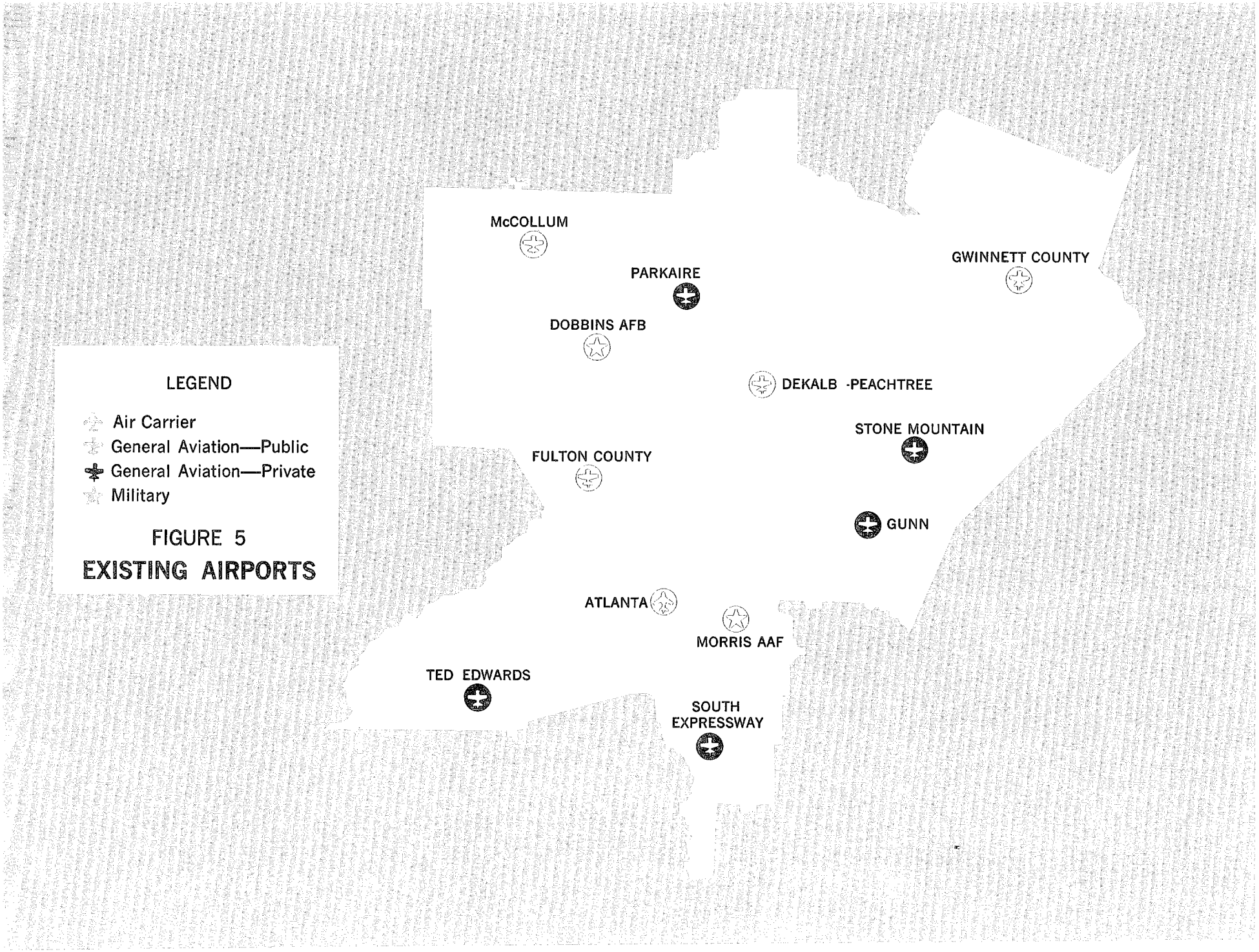


FIGURE 5
EXISTING AIRPORTS

FORM APPROVED: BUDGET BUREAU NO. 04-R0051

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

FAA AIRPORT MASTER RECORD

DATE OF PRINT	06/01/70
1 SITE NUMBER	3643
5 REGION & AREA	SO ATL
6 ARPT OPEN TO PUBLIC	Y

8 ASSOCIATED CITY	ATLANTA	9 STATE	GA
21 DSTC & DRCTN TO ARPT FM ASSOCD CITY	09NE	22 NAP/FEDERAL AGREEMENTS	NAGPY
10 OFFICIAL AIRPORT NAME	DEKALB-PEACHTREE	23 ARPT LAT.	33 52 30N
24 LONG.	84 18 08W	25 ARP	Y
26 ELEVATION	1002S	11 NEAREST CITY	CHAMBLEE
12 STATE	GA	27 HUB TYPE	L
28 MAGNETIC VARIATION	00 40E	29 NORMAL MAX. TEMP.	89
13 COUNTY (Arpt located in).	DEKALB	14 STATE	GA
30 RESERVED		31 SMSA	011
15 OWNER: NAME	DEKALB COUNTY	16 ADDRESS	DEKALB COUNTY COURTHOUSE DECATUR,GA 30030
17 OWNERSHIP CLASS	PU	18 MANAGER: NAME	HF MANGET, JR.
19 ADDRESS	DEKALB PEACHTREE ARPT ATLANTA,GA 30341	20 PHONE	404 457-7236

33 RUNWAY	34 PHYS LENGTH	35 WIDTH	36 SURFACE COMPOSITION	FAA GROSS WT. STRENGTH (1000 lbs.) 37 SNGL WHL	38 DUAL WHL	39 DUAL TAND	40 % EFF GRADIENT	41 % WIND COVERAGE	42 MARKING TYPE-CONDITION	43 CL LGTS	RUNWAY LGTS 44 TYPE	45 INTST
02L/20R	3739	150	ASPH	20			0.56	*89.7	BASIC-G	N		
09/27	3378	150	ASPH	20			0.73	95.6	BASIC-F	N	L819	H
16/34	3970	150	ASPH	20			0.25	92.5	BASIC-F	N	L8028	M
02R/20L	5001	100	CONC	46	66	90	0.25	89.7	BASIC-G	N	L819	H

71 STANDARD TIME ZONE	+05
72 DAYLIGHT SAVING TIME	Y
73 RNWY LGT OPER SKED	DUSK-DAWN
74 AIRPORT ATTENDANCE SCHEDULE	MONTHS: ALL; DAYS: ALL; HOURS: 0700-2300
75 ARPT BEACON LGT	*C-G
76 OPERATING SCHEDULE	DUSK-DAWN
77 LANDING FEES FOR NON-COMMERCIAL USERS	N
81 TAXIWAY LIGHTS	Y
78 STATE LICENSING CLASSIFICATION	
82 WIND INDICATOR	Y
79 CUSTOMS AIRPORT OF ENTRY	N
83 SEGMENTED CIRCLE	N
80 CUSTOMS LANDING RIGHTS AIRPORT	N
84 AC 150/5210-6 INDEX	4
85 FIRE & RESCUE EQPMT AS SUGGESTED BY AC 150/5210-6	N
IF NOT: 86 * 800 GAL. WATER & 410 LBS. CHEMICAL IMMEDIATELY AVBL.	
87 EMGCY MED FACILITIES AS SUGGESTED BY AC150/5210-2	N
88 SNOW REMOVAL PLAN	N
112 NUMBER OF FIXED BASE OPERATORS	2
89 OPERATIONS AREA SWEPT	
113 TYPES OF FIXED BASE OPERATORS	CHRTR/INSTRN/PATROL/SALES /SURVEY
90 WRECKAGE REMOVAL PLAN	Y
91 EMGCY READINESS PLAN	Y
92 DESIGNATED CD SHELTER	Y
93 HELIPAD ON AIRPORT	N
114 FUEL AVAILABLE FOR PUBLIC SALE	
94 WEATHER STN ON ARPT	N
95 ADMIN/TRML BLDG	*Y
96 ARPT INFO DESK	N
97 CARGO HANDLING	
98 NO. T-TYPE HANGARS	30
99 NO. CONVENTIONAL HNGRS	4
ENGINE OIL 100 PISTON	Y
ENGINE OIL 101 TURBINE	Y
REPAIRS MAJOR	
REPAIRS MINOR	
AIRFRAME 102	Y
AIRFRAME 103	Y
POWER PLANT 104	Y
POWER PLANT 105	Y
OXYGEN 106 HI PRESSURE	Y
OXYGEN 107 LO PRESSURE	N
OXYGEN REPL BOTTLES 108 HI PRESSURE	Y
OXYGEN REPL BOTTLES 109 LO PRESSURE	N
110 AUX POWER FOR OPRNL FAC	
111 ARPT AIRSPACE ANALYSIS DTRMN	NOT ANALYZED
115 MILITARY JOINT USE AGREEMENT	N
116 MILITARY LANDING RIGHTS	Y
117 BASED MILITARY & TYPE OPERATIONS	
118 TYPE & NO. MILITARY ACFT	NONE

TYPE	UNDERGROUND (100 GAL)	ABOVE GROUND (100 GAL)
F-12	120	20
F-15		
F-18	130	29
F-22		
F-30		
F-34	100	37
F-40		
F-45		

RUNWAY END	47 HI SPEED EXIT	48 APPROACH	49 TO ZONE	50 REIL	51 APCH SLOPE INDCR	52 RVR	53 RVV	54 CTLG OBSTRUCTION (Marked-Lighted)	55 DSTC FM THRESH	56 APCH RATIO	57 CLOSE IN OBST	58 RGT TFC	59 BLAST FENCE	60 TYPE ARRESTING DEVICE (Far end)
02L	N		N	N	NONE	N	N			50+-1	N	N	N	
20R	N		N	N	NONE	N	N	TREES	3019	29-1	N	N	N	
09	N		N	N	NONE	N	N	TREES	1100	18-1	N	N	N	
27	N		N	N	NONE	N	N	TREES	2700	23-1	N	N	N	
16	N		N	N	NONE	N	N	ROAD	1300	21-1	N	N	N	
34	N		N	N	NONE	N	N	TREES	1750	22-1	N	N	N	
02R	N		N	N	NONE	N	N	TREES	1090	40-1	N	N	N	
20L	N		N	N	NONE	N	N	TREES	3143	25-1	N	N	N	

RUNWAY END	61 THRESHOLD DISPLACED	62 LANDING	63 TAKEOFF	64 LATITUDE	65 LONGITUDE	70 ELEVATION
02L						
20R						
09						
27						
16						
34						
02R						
20L						

137 RE E-041 RWY 02L WIND COVERAGE BASED ON 15MPH WIND ROSE RE E-075 ROTG BCN ELEV 1083MSL. RE E-086 1 500GPM PUMPER /150 GAL H20/,1-1000GPM PUMPER /500 H20/,1-150GPM PUMPER /150 GAL WATER/. RE E-095 5782 SF IN TERMINAL AREA GA 01. RNWY AND TXWY PAVEMENT-G,APRON-F 02. RE E60ND ARRESTING GEAR ALL RNWY ENDS. 03. FIRST 850FT RWY 9 & TXWY ADJOINING NOT VISIBLE FROM TWR.

119 ESTD. TOTAL ANNUAL MILITARY OPERATIONS	985
120 ESTIMATED ANNUAL AIR TAXI OPERATIONS	1000

ESTD. GENERAL AVIATION OPERATIONS

121 ANNUAL LOCAL	122 ANNUAL ITNRNT	123 TOT. PEAK MO.
87319	110603	19296

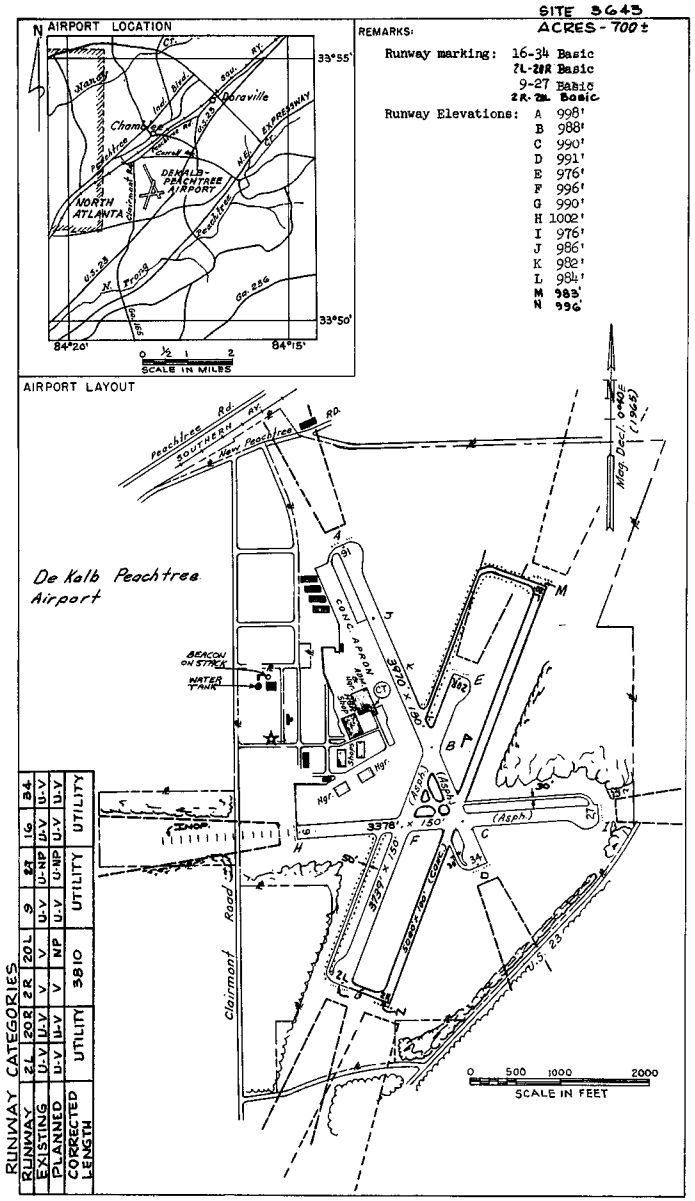
BASED GEN. AVIATION ACFT		SEAPLANE BASE DATA	
124 SINGLE ENG. 4 PLACE & OVER	207	129 SHELTERED	
125 SINGLE ENG. UNDER 4 PLACE	045	130 MOORING BUOYS	
126 MULTI-ENG	099	131 DOCKS	
127 HELICOPTER	09	132 RAMP	
128 SEAPLANE	00	133 BEACHING GEAR	
TOTAL	360		

134 AIRPORT SERVED BY SCHEDULED AIR CARRIER	N
135 LATEST INSP OR INFO REQ.	04/10/70
136 INSP.	Y

FAA Form 5010-1 (9-68) SUPERSEDES FAA FORM 29A

"Y"=YES; "N"=NO; " * "=SEE REMARKS IN ITEM #137. ABBREVIATIONS ARE LISTED IN THE CONTRACTIONS HANDBOOK, ORDER 7340.1A

FIGURE 6



29. Airspace Structure and Navaids. It is necessary to identify how the airspace is used in the vicinity of each airport and throughout the area; all air navigation aids and aviation communication facilities serving the area; and natural or man-made obstructions or structures which affect the use of the airspace.

The airway and jet-route structure have a significant effect on the utility of existing and future airport locations and should be ascertained. The dimensions and configurations of the control zones and transition areas should be noted. These segments of controlled airspace are designed to accommodate only specific instrument flight rules (IFR) requirements such as instrument approach, departure, holding and transition flight maneuvers. Thus, the inventory will show the current use of the area's IFR airspace and the balance of the airspace available for future use. Charts which will prove useful in identifying the airspace structure are the Federal and state aeronautical charts, instrument approach and departure charts, Jeppeson Company and other recognized aeronautical publications.

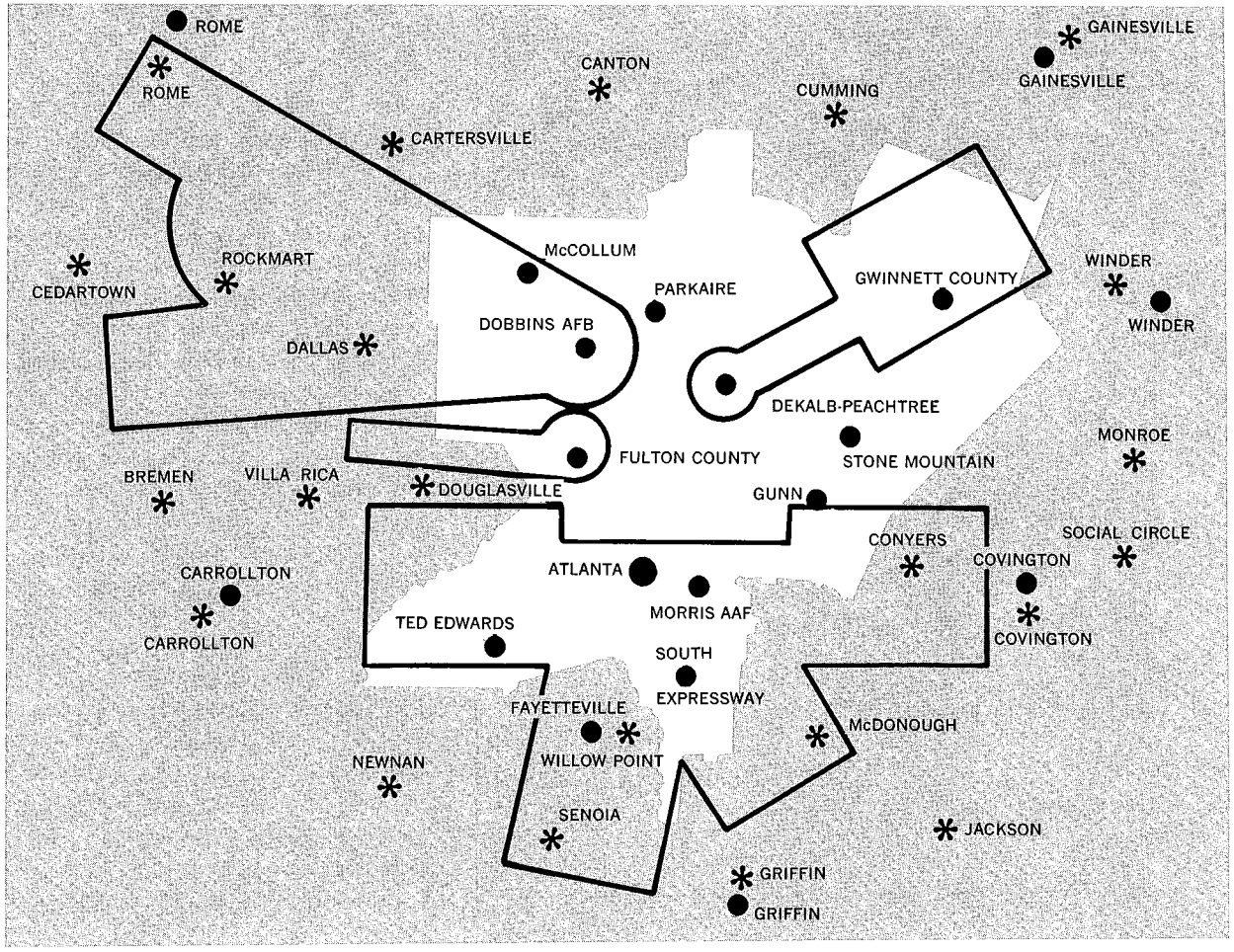
The appropriate information should be depicted graphically. Later in the planning process, proposed expansion of new airports can be related to the existing airspace structure and compatibility verified, or adjustment to proposed development made.

30. Airport Related Land Use, Environmental Considerations. An inventory of land uses in the vicinity of each existing airport is necessary so that later in the planning process a determination can be made on the feasibility of expansion and whether an expanded airport will be compatible with the surrounding area and vice versa. Current and planned land use should be displayed graphically to assist in later steps of the planning process. Also, if feasible, an estimate of the land values should be made.

BACK

FIGURE 6a

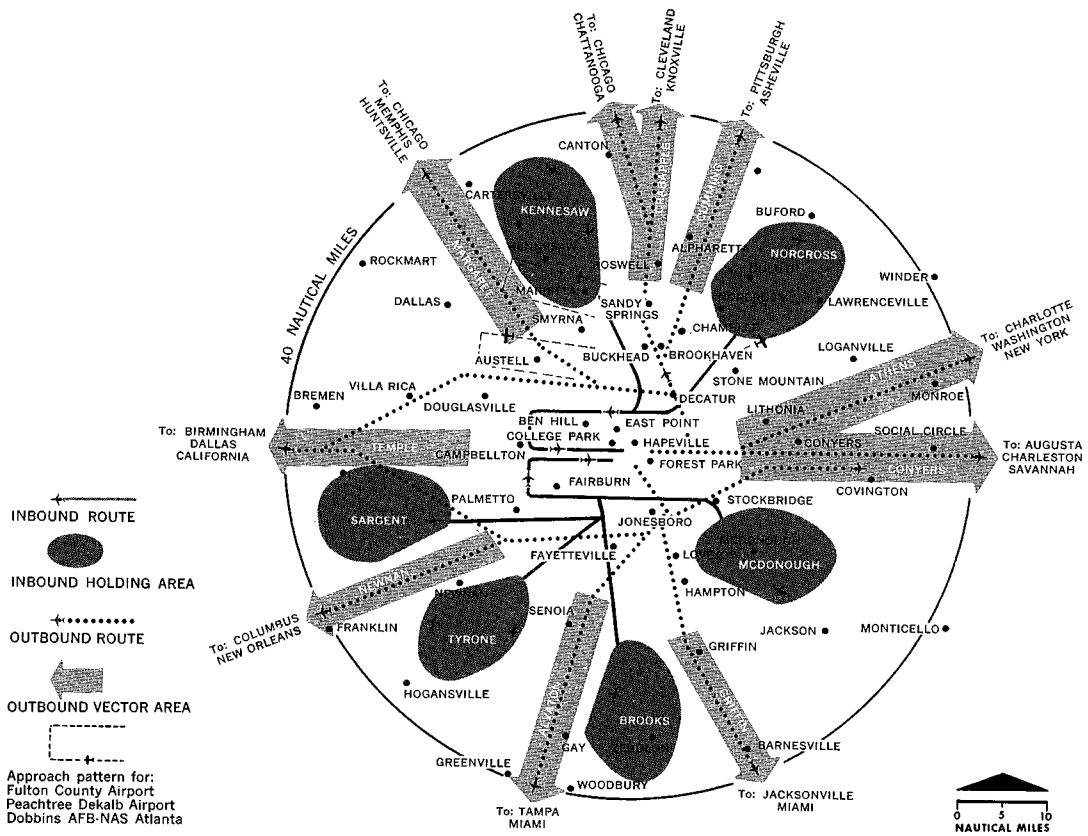
FIGURE 7a. AIRSPACE STRUCTURE The map outlines areas allocated to aircraft performing instrument approaches to the region's four tower-controlled airports: Atlanta, DeKalb-Peachtree, Fulton County, and Dobbins' military traffic. (Airports are identified by a star, cities by a black dot.) Under Instrument Flight Rules (IFR), aircraft destined to DeKalb-Peachtree Airport may land under minimum conditions with a ceiling of 700 feet and one to two miles visibility. Aircraft destined to Fulton County Airport may land under minimum conditions with a ceiling of 600 feet and one to one-and-a-half miles visibility. Atlanta is the only civil airport in the area served by an Instrument Landing System (ILS), permitting landings under conditions down to a 200-foot ceiling and one-half mile visibility; steps are now being taken toward reducing these minima to 100 and one-fourth, respectively. The IFR operations areas of Atlanta and Dobbins obviously restrict the possibility of providing an ILS at any of the general aviation airports in the metropolitan region: for example, an ILS at Fulton County might accommodate approaches only from the west, and at DeKalb-Peachtree only from the northeast.



* TOWN

● AIRPORT

FIGURE 7b. AIR TRAFFIC This simplified picture af air routes into and out of the region vividly illustrates the increasingly difficult problem of traffic control at a major air center (with over 90 aircraft landing and taking off, at Atlanta Airport alone, during a peak hour). An extensive area is needed to marshal this traffic in a safe and orderly fashion, blanketing a large portion of north Georgia. (Another area nearly half as large, extending northwestward, is required for high-performance military jets landing at Dobbins.) The pattern shown is followed when landings and takeoffs at Atlanta are being made toward the east; others are used when wind conditions require westerly or northwestward operations.



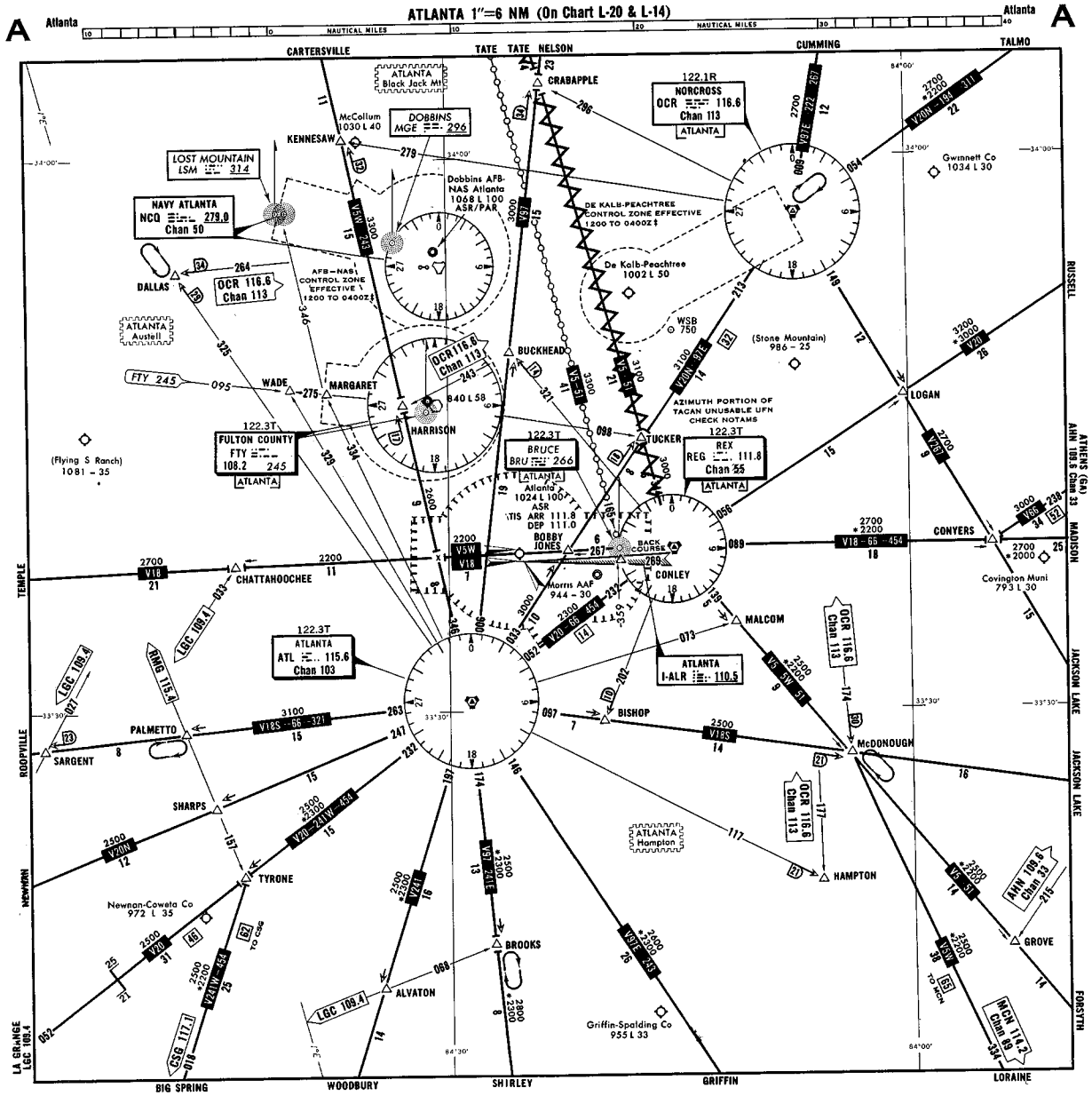


FIGURE 8

NAVIGATIONAL AIDS

Environmental data must also be gathered. Current aircraft noise exposure in the vicinity of the airport should be ascertained. This can most thoroughly be determined by graphically depicting the noise exposure by use of techniques promulgated by the FAA. Such techniques are the Composite Noise Rating (CNR) and the Noise Exposure Forecast (NEF) methods. However, the planner may consider it desirable during the inventory stage simply to qualitatively document the current noise impact and perform a detailed noise analysis when developing alternative system plans (See Chapter 12).

There should be a description of land use for all recreation and conservation activities which could be potentially incompatible with aeronautical activities. Thus, the location of current and planned public parks, recreation areas, wildlife/waterfowl refuges, and historical monuments should be noted and displayed on the land use map.

31. Comprehensive Plan. Obtain the current comprehensive plan showing existing and planned land uses, utilities, schools, hospitals, and particularly the planned ground transportation systems from the metropolitan planning agency. This will be used in later steps of the planning process in relating alternative airport system plans to other planned community development and land use patterns.

32. Ground Transportation Data. Gather detailed data on the existing ground transportation systems from the urban transportation planning agency; collect available data on the volume and dispersion of airport-oriented surface travel.

The urban transportation planning agency in most instances will have conducted an O–D survey for the entire metropolitan area

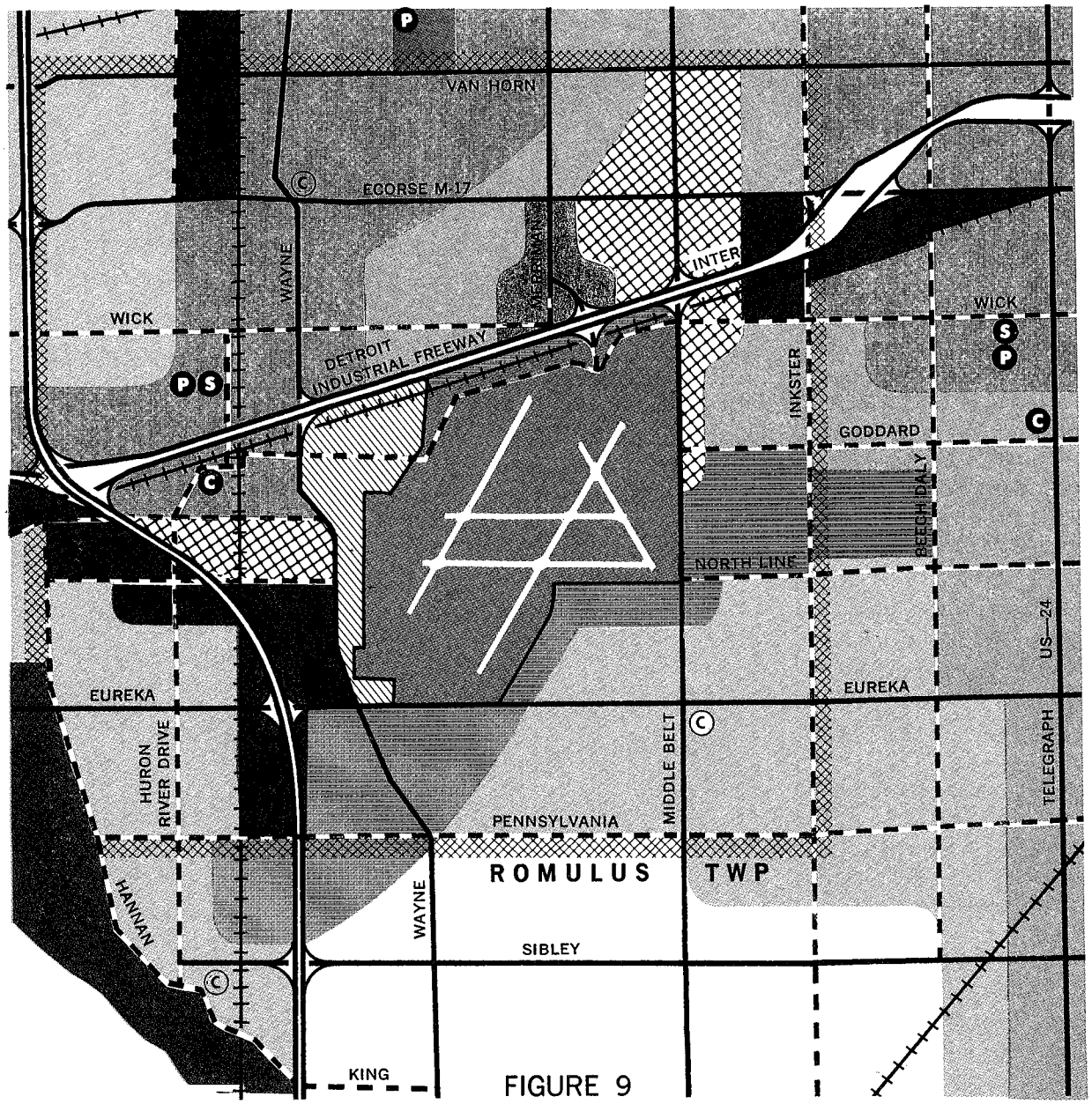


FIGURE 9

EXISTING AND PROPOSED LAND USES

RESIDENTIAL
- MEDIUM DENSITY
- LOW DENSITY
- SUBURBAN

COMMERCIAL
- COMMUNITY CENTER
- SUBCENTER
- AIRPORT RELATED

INDUSTRIAL
- HIGH DENSITY
- LOW DENSITY
- AIRPORT RELATED

COMMUNITY FACILITIES
- HIGH SCHOOL
- COMMUNITY FACILITIES

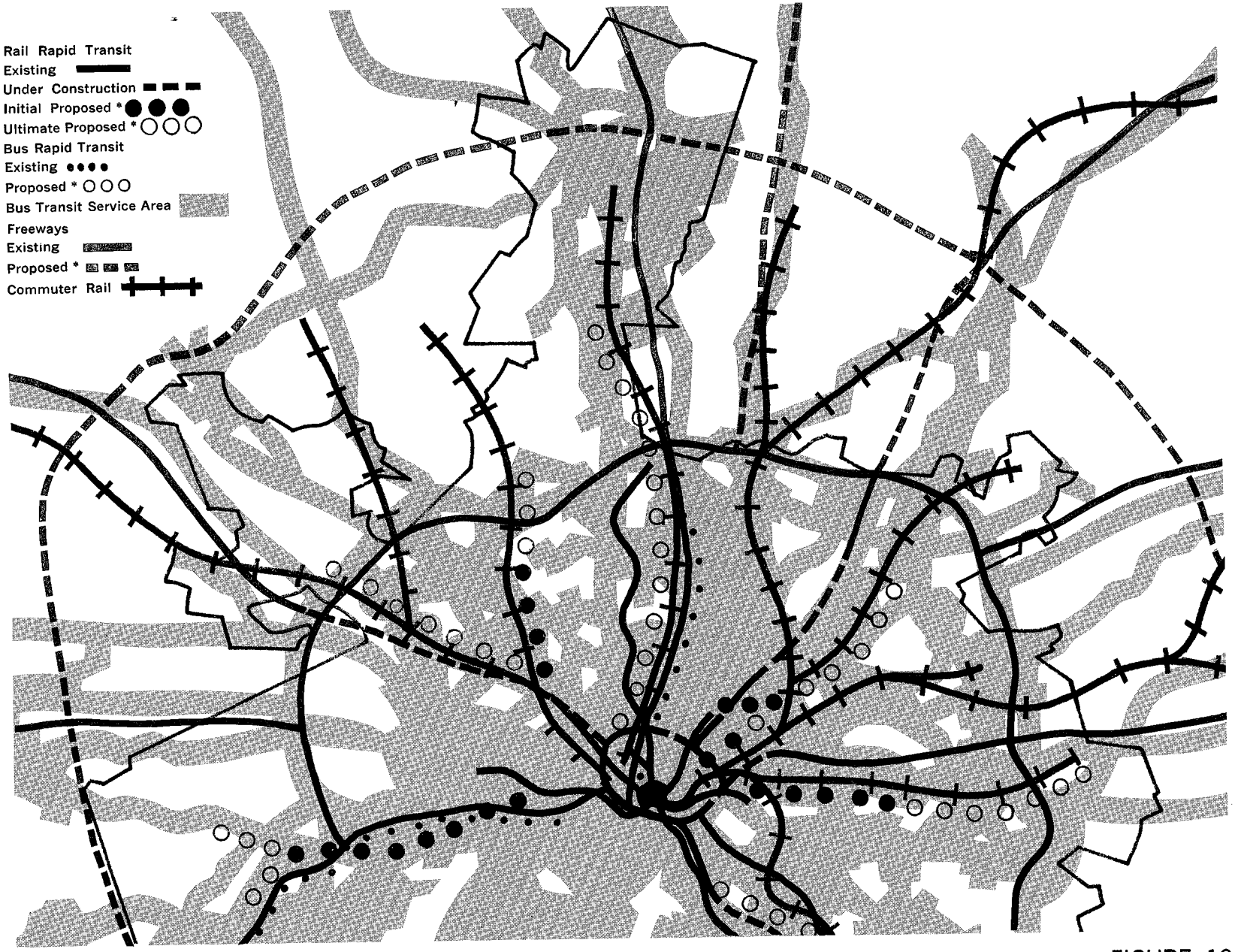
OPEN USES
- REGIONAL PARK
- OTHER PUBLIC SPACE
- AGRICULTURAL
- TRANSITIONAL

TRANSPORTATION
- AIRPORT
- RAILROAD
- FREEWAY
- REGIONAL THOROUGHFARE
- LOCAL THOROUGHFARE

and, in conjunction with this survey, will have collected socio-economic and land use data. The study uses roadside interviews and home interviews to determine the travel pattern (zone to zone movements) of the entire urban area by mode and purpose. From these data, relationships between trips and those variables which generate trips can also be established for use in determining future surface travel demands.

To look more closely at airport-oriented surface travel, it is possible through the urban transportation planning process, to single out the airport as an analysis zone and examine only those trips which are airport-oriented. This procedure may prove to be an effective method for providing a base for ground access to airport planning, because it will show the number and distribution of airport-oriented surface travel as well as the relationships which are used to forecast future travel demand.

However, since the airport travel is only one segment of an urban transportation study, in some instances the data may not be as complete or detailed as necessary. In those cases where the data is not adequate to describe the airport travel patterns, it may be desirable to conduct an airport O–D survey. This type of survey is similar to those conducted by urban transportation studies, but it is limited to only airport-oriented travel and obtains travel and socio-economic information through an interview with the airport user. The survey samples a portion of all ground travel entering or leaving the airport, including the air traveler, the employee, and the visitor. Information may also be collected on parking and commodity movements. Sufficient data is obtained to establish the travel patterns of airport-oriented trips and to develop relationships that will be used to determine future travel patterns.



EXISTING AND PLANNED GROUND TRANSPORTATION SYSTEM

FIGURE 10

Airports O–D studies are particularly desirable for the high activity air carrier airports.

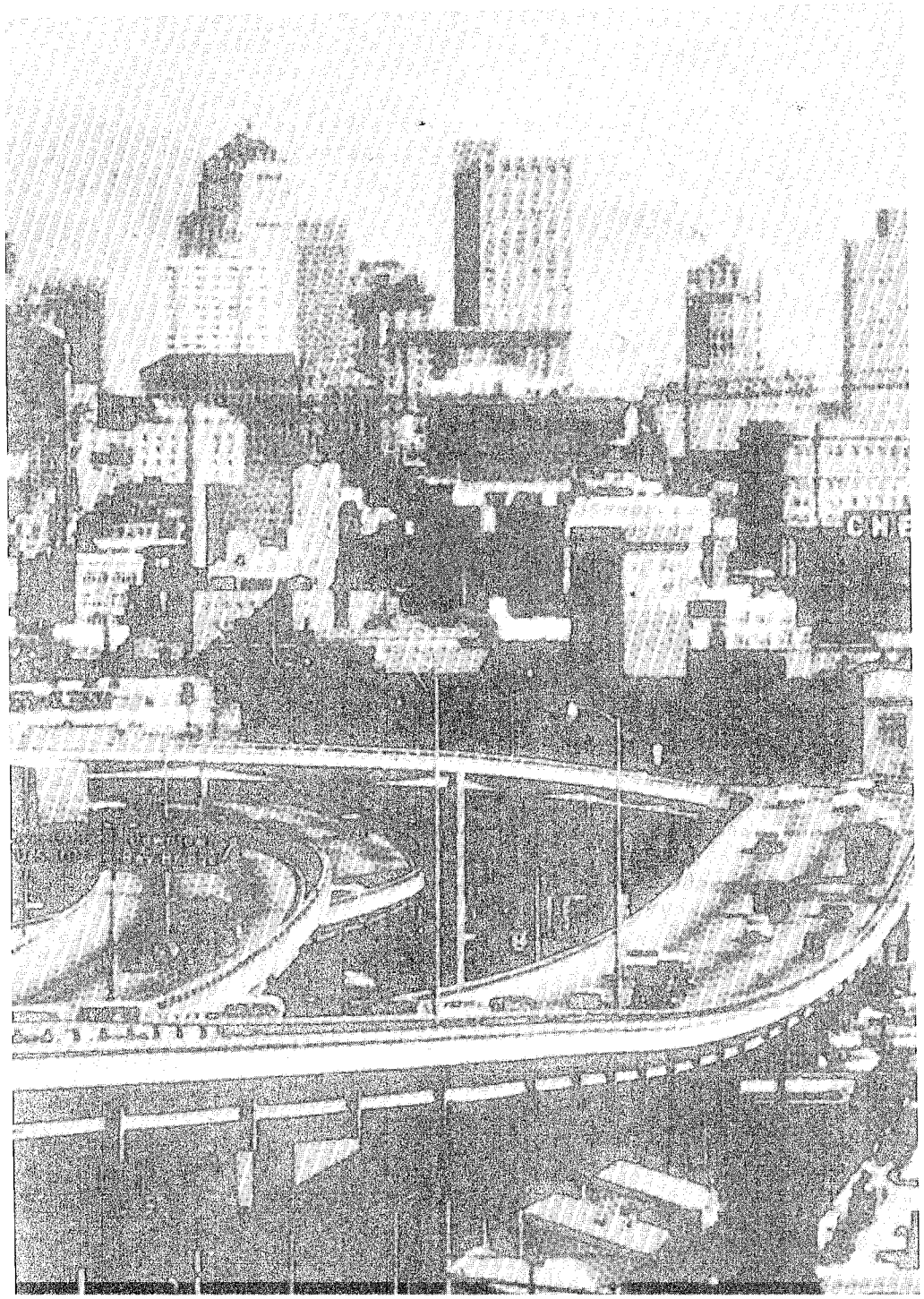
33. Laws and Ordinances. Obtain copies of zoning laws, building codes, and other regulations/ordinances which may be applicable to airport planning. Study relevant state enabling statutes, laws pertaining to eminent domain, and interjurisdictional compacts.

34. Financial Resources. In addition to a history of the nature and extent of airport financing, note the kinds of airport development financing available within the metropolitan area. The potential for raising large sums of money for airport development should be measured against the community's attitude on general obligation funding (although the use of revenue bond financing for the larger airports is increasing) and the scope of other community financial needs.

35. Socio-Economic Factors. The collection and analysis of socio-economic data for a metropolitan area helps answer the basic questions regarding the type, volume, and concentration centers of future aviation activity in the region. Accordingly, the determinants (what causes a market to be the size it is) of a market for airports should be established. What industries need air transportation? Do they have need for better air transportation facilities? How many people will be available in the future who possess the income to make use of air service? Will the people and industries having the wherewithal to utilize the airport be there? Since people are associated with a multitude of income-earning and income-spending activities at any particular location from and to which they travel, transportation facilities are needed between those points where the future travel is expected to occur. Statistics and forecasts of population, economic activity, land uses, alternate means of transportation, etc., assist in determining the future market potential. The basic step to be accomplished prior to forecasting aeronautical activity, as outlined in Chapter 9, is a socio-economic analysis of the primary forces that determine economic change in the metropolitan area. The actual application of this socio-economic analysis involves many methods and approaches which vary with the individual analyst or situation. The intent is not to provide a standard methodology but to show the importance of and need for socio-economic sudies. From this viewpoint, the primary forces that measure and help determine economic change, and a general rationale for their use in accounting for air transportation demand, are summarized below. Note, however, that there may be an abundance of data already available such as that gathered in the comprehensive planning process or in the urban transportation planning process for a specific area. It is essential that the availability of such information be ascertained prior to collecting new data and that the study areas should be made consistent with those for which general statistics, history, and forecasts are available.

a. Population. Analyze the population distribution of the metropolitan area, including the commuting areas, the suburban concentrations of industry, recreational facilities, and institutions. Record trends in the overall regional or metropolitan area population growth, density and shift in the region, based on the latest population statistics (Federal and local). These factors, categorized by income, education, occupation, and age, indicate what the volume of future air travel may be.

b. Economy. Use data and forecasts on the national level to ascertain total economic health and to compare with regional and local data. Some of the most important national standard measures



Airport ground access—
a major consideration.

are: population size and its structural aspects, Gross National Product, labor force, employment, industry statistics, disposable personal income, per capita personal consumption expenditures, and per capita consumption of passenger miles. The economic viability of the metropolitan area is indicated by a comparison of the national, regional, and state growth rates for these standard measures with the local growth rates for the same or similar measures. Another indication of the economic character of the metropolitan area can be determined from market statistics provided by private sources such as trade associations, trade papers, and special publications. *Sales Management,* a trade publication, conducts a "Survey of Buying Power" and develops the effective buying income (income after taxes) for the Standard Metropolitan Statistical Areas. Special publications are usually available when an enterprise (railroad, utility, etc.) strives to attract new business by publishing statistics on the market situation.

Socio-economic studies can establish the per capita purchasing power and income distribution of a metropolitan area. Metropolitan area aviation activities are generally responsive to the volume and distribution of population and the purchasing power of the population. As an example, the traditional market survey method treats non-business air travel as a commodity competing with alternate potential uses for the consumer's dollar. It assumes that the decision that the consumer makes in spending his dollar is a factor of his socio-economic characteristics—such as income, occupation, age, and education. In the case of business travel, the standard measure of activity that helped determine the economic character of the metropolitan area is used to classify the population according to occupation, industry, and income.

Finally, the key to the entire economic study is the integration of all appropriate material which can be of aid in making an analysis of the metropolitan area's economic potential to generate a demand for air transportation and aeronautical services. For instance, the Civil Aeronautics Board's Origin and Destination Surveys of Airline Passenger Traffic may not seem as related to economics as employment statistics or personal income. However, O & D studies give the professional analyst leads as to the amount of economic community of interest linkage between areas.

c. Sources of Socio-Economic Data. The sources for most of the statistics regarding the economic character of a state, county, or community are the Federal and state governments and trade association publications. The source for some of these statistics, as well as the frequency of publication and whether the data are applicable to the national, regional, or local level, are provided in Appendix D—Sources of Socio-Economic Data.

36. Aeronautical Activity. The principal determinant of future airport system requirements is the amount of aeronautical activity that will be generated in the metropolitan area. A record of current aviation statistics as well as a consideration of historical airport traffic data for such elements as passenger and air cargo traffic, aircraft movements, and aircraft mix is necessary to forecast aeronautical activity. The assessment of these aviation statistics, along with consideration of the socio-economic attributes for the area, forms the basis for forecasts of aeronautical activity for the metropolitan area. The forecasts of aeronautical activity, in turn, form the basis for facilities planning for future requirements.

Aviation statistical data include national and regional statistics as they relate to the metropolitan area situation and the collection of as many pertinent local statistics as can be obtained. At the local level, use surveys and questionnaires to supplement data on operations, frequency, and hours of use of general aviation aircraft, and origins and destination of travelers. The primary aviation statistics needed for metropolitan area planning are (1) the types of civil airport users served—air carrier, scheduled air taxi, general aviation, and the military services, where applicable; (2) the types and volume of operational activity provided for—aircraft operations, passengers and cargo, based aircraft, etc.; and (3) the aircraft mix accommodated—supersonic and large capacity subsonic jet transport aircraft, conventional subsonic transport aircraft, smaller commercial, business, and pleasure aircraft, future V/STOL (Vertical/Short Takeoff and Landing) aircraft, etc. The projection of these three elements form the basis for determining the future airport requirements of the metropolitan area.

A classification of aviation statistical information and a brief description of the content and source of the data, as well as the frequency of publication and whether the data are applicable to the national, regional, or local level, are provided in Appendix C—Sources of Aviation Statistics.

37. Community Values. A very important factor in the airport system planning process is the determination of the attitude of the community towards airport development. Poor airport-community relations, unless changed, could influence the ability to implement a needed airport system. A history of noise complaints throughout the community also could influence the selection of an alternate system plan. On the other hand, a recognition by the community of the need for progress in the development of air transportation can have a positive influence in minimizing complaints.

Thus, it is necessary to place airport development in its proper

perspective relative to community values. Recognition of this relationship will assist in determining which alternative plan is likely to be implemented and to promote the development of an adequate airport system.

CHAPTER 9. FORECASTING

38. General. As noted in the preceding chapter, the principal determinant of future airport system requirements is the amount of aeronautical activity that will be generated in the metropolitan area. Forecasts of aeronautical activity, therefore, form the basis for facilities planning for future requirements. The guidance given in this forecasting chapter will assist metropolitan airport planners in their development or review of aeronautical activity forecasts.

The basic ingredient of a sound and unified approach to forecasting is a common-sense analysis of the important forces that account for air transportation demand. Socio-economic analysis of the metropolitan area helps to answer the basic questions regarding the type, volume, and location of future aviation demand.

The initial step in any valid approach to forecasting aeronautical activity for a metropolitan area is to relate the primary socio-economic forces that determine economic change in the area being studied to aviation statistics that measure the demand for air transportation services in the area. For instance, economic indices such as quality of the market, effective buying income, or retail sales may indicate that the historic growth of aircraft operations will continue. Or, indices of the propensity to own general aviation aircraft may be developed from forecasts of population and personal income by small zones. To apply this approach successfully in making forecasts, three interacting factors—information, judgment, and analysis—are utilized to provide the working tools needed. First, judgment is used to interpret and apply information; then it is used to select and appraise methods of analysis; and finally, it is used to evaluate forecasts already made—either one's own or someone else's.

Often the forecaster, in trying to make his predictions under the constraints of inadequate or inconclusive data, must rely on his own best judgment and experiences and come up with something more in the nature of an "educated guess". Forecasting is, therefore, not an exact science but an analytical approach to empirical data that improves with experience.

Various yardsticks are helpful in evaluating forecasts, but they cannot provide exact measures of success. Reference is made here to "yardsticks" that can be applied to forecasts or projections to gauge their acceptability or merit, such as: (1) consistency with past trends; (2) comparison of forecasted trends and realization; (3) comparisons of rates of change; and (4) comparisons of economic indicators.

39. Forecasting Methods. There are many ways to predict future trends and various methods may be used for the same forecast. In some instances, one method supplements another. Some methods are applicable primarily to the very near future—a month, a quarter, at most a year—while others are best used for longer-range forecasting. What is being forecasted also helps to determine the method to use. An appropriate forecasting method can best be selected when the peculiarities of each approach are known. Brief descriptions of the principal forecasting methods are as follows:

a. Mechanical extrapolation. The rationale underlying ex-

trapolation procedures is that some past tendency or trend in the variable (activity or item) being forecasted reflects what is going to happen. It may be possible to quantify (to measure the quantity of) this tendency or trend and derive forecasts by extrapolating the relation into the future.

This may be done by developing measures of correlation between series of numbers. For example, aviation growth may be, say, 1.2 times the growth in population.

Ratios are sometimes used when totals for larger areas are projected and the analyst wishes to allocate them to smaller areas. For example, if a state is projected to have 4,000 aircraft in 1980, it may be assumed that the aircraft will be distributed among counties in the same ratio as exists in current registration records.

Another mechanical method is by use of analogy. That is, it may be known that where an airport was built three years ago there are now seven based planes and an estimated 3,000 annual itinerant operations. It might then be assumed that this type of growth could occur at a similar community where a new airport is developed.

Projections can be done mechanically by assuming either a straight line type of growth or a compound interest type of growth. A straight line type assumes an addition of a constant amount of increase each year while the compound type implies a constant percentage rate of increase each year using the previous year as a base; that is, the increment of growth becomes greater each year in the future. In general, although the cautious use of any mechanical method is advised when extending a forecast too far ahead, the straight line method is preferable in all but the most sophisticated analysis. The reason is that if calculations are carried too far into the future, the compound interest type of approach may yield exceptionally large values.

b. Surveys of anticipations or expectations. The survey approach is based on the premise that if you want to know what is going to happen in a particular sector, you should go out and ask those who will be making things happen. Although an informative method, it is not nearly as simple and as rational as it sounds. Surveys are usually expensive; designing meaningful questions and obtaining reliable answers are not easy tasks; and, additional uncertainity can be injected by widely varying viewpoints.

c. Analytical forecasts. In this type of approach (which essentially combines diagnosis with prediction) explanations are sought for the factors influencing the variable to be forecast, and a mathematical relationship is developed between these factors and the given variable for projecting into the future.

Analytical projection methods differ from mechanical methods in that additional thought is given to explaining reasons for change. For example, in analytical forecasting one would try to determine the reasons for the trip and how, over time, these reasons change. How much of a trip can be "explained" by occurrences at the trip's origin and how much by occurrences at the trip's destination? If a person flies from his home to a resort for a vacation, is it because of his income level, because of the attractiveness of new resort facilities, or because of the time saved and convenience of flying? How do changes in other modes of transportation such as the decline of the passenger train or the competition of the interstate highway system affect demand for air travel? The introduction of technological improvements can also affect the demand for air travel. For instance, it can be shown historically that the introduction of jet service into a community will accelerate the demand for air transportation.

It is probably best to base projections on both mechanical and analytical factors. It is difficult to justify the mechanical techniques unless some form of analysis has determined their suitability; however, mechanical techniques are easily understood and are objective.

d. Judgment forecasts. The judgment method is basically an estimate made by an individual who is closely acquainted with the factors related to the variable being forecast. These factors are weighed and evaluated according to the experience and intuition of the analyst. This method permits a variety of information (national trends, sales reports, political situations, etc.) to be considered in the formulation of the forecast. It is especially advantageous when used in conjunction with any of the above methods, and where there are a large number of variables for which relatively little data are available or when intangible factors are expected to play a major role. However, the resultant forecasts from use of this method alone are the most difficult to defend under close scrutiny and may be subject to any strong bias of the individual involved in the forecasting process.

40. Designing a Forecasting Approach. Recommended first steps are to consult others with some experience in projecting travel demand and to use, or apply the guidance given herein to modify, any reasonably acceptable forecasts done by other sources. Usually state highway departments and the urban transportation planning agencies are experienced in projecting travel demand. Also, the central state planning office may have developed methods of projecting population, economic activity, and public facility needs. In addition, they can provide other data upon which aeronautical forecasts will be based. Other sources for metropolitan area aeronautical forecasts are the Federal Aviation Administration (FAA), Air Transport Association (ATA), the General Aviation Manufacturers Association, and aeronautically-oriented consultants.

Forecasts should also be designed so that their results can be verified. Planning and forecasting are continuing activities and any forecast methodology should be easily updated. Most important of all, one should attempt to verify this year those forecasts that were made last year. Understanding the difference between activity which was forecast and that which actually occurred is another useful analytical tool.

41. Professional Services. It must be emphasized that the preparation of forecasts is a complex task and should be accomplished only by a staff having background and experience in the forecasting field. This is especially so when preparing forecasts for primary air carrier airports serving large metropolitan areas.

For those metropolitan areas which do not have an adequate planning staff, it is highly recommended that the services of a professional economist, statistician, and/or econometrician, be employed in the selection of the methods and development of the aeronautical activity forecasts to be used in metropolitan area airport system planning. The possibility of arranging for such assistance from other planning agencies may prove feasible and desirable.

42. Aeronautical Activity. Forecasts of aeronautical activity form the basis for facilities planning. There is a need to know (1) *the types of civil airport users*—air carrier, scheduled air taxi, general aviation, and the military services where applicable; (2) *the types and volume of operational* activity—aircraft operations, passengers and cargo, based aircraft, etc.; and (3) *the aircraft mix*—supersonic and large capacity subsonic transport aircraft, smaller commercial, business, and pleasure aircraft, future Vertical/Short

Air carriers transported more than 168,000,000 passengers in 1969.

Takeoff and Landing aircraft (V/STOL) etc. Collectively, these three elements constitute the determinants of future airport requirements and are needed to plan for aircraft hangaring/parking and to undertake airfield, terminal area, and terminal building-access capacity/demand analyses.

43. Civil Airport Users. The current CAB/FAA airport user categories have been modified in this section in that regional service, intrastate, STOL, and VTOL have been separately defined under air carrier. Scheduled air taxi has not been classified as general aviation. This modification in detail is more ideal for determining the types of future airport facilities required at individual airports. Although the current CAB/FAA data aggregation may have to be used because of present data collection problems, it is suggested that the airport planner should attempt to develop forecasts of aeronautical activity for the following four major user categories as applicable to the airport(s) or location(s) under construction:

a. Air Carrier. As used here, "air carrier" refers to airline aircraft operators holding Certificates of Public Convenience and Necessity issued by the Civil Aeronautics Board authorizing them to perform passenger and cargo services, as well as to intrastate carriers as identified in (4). This general air carrier grouping includes the certificated route all-purpose (passenger/cargo) and all-cargo carriers, and the supplemental (passenger and/or cargo charter service) carriers. Air carrier service is further classified as to:

(1) Domestic Trunk—Air carriers operating mainly within the geographical limits of the 48 contiguous states and D.C. over routes serving primarily the larger communities. (Most trunk carriers also have international and territorial operations which are classified separately.)

(2) *Intra-Alaska and Intra-Hawaii*—certificated domestic route air carriers conducting operations entirely within the States of Alaska or Hawaii.

(3) *International and Territorial*—Air carriers conducting operations outside territory of the U. S., including operations between U. S. points separated by foreign territory or major expanses of international waters.

(4) *Regional Service*—Air carriers normally operating routes of lesser density between the smaller traffic centers and between those centers and principal centers (often referred to as "Local Service").

(5) *Intrastate*—Air carriers operating solely within a state which are not subject to CAB regulation.

(6) *STOL*—Air carriers operating STOL aircraft.

(7) *Helicopter-VTOL*—Air carriers operating helicopters or VTOL aircraft.

b. Scheduled Air Taxi (Commuter-Local Airlines). Aircraft operators for hire which engage in the scheduled transportation of passengers and/or property as authorized by an FAA-issued Air Taxi Operating Certificate, and which generally do not operate large aircraft (over 12,500 pounds maximum takeoff weight) *nor* hold a CAB issued Certificate of Public Convenience and Necessity. This category *excludes* unscheduled air taxi services and charter services.

c. General Aviation. As used here, "general aviation" refers to that segment of civil aviation which encompasses all facets of aviation except air carrier and scheduled air taxi as defined above. General aviation is further classified as to:

(1) Unscheduled air taxi (charter) services

(2) Business (corporate—executive transportation)

(3) Commercial (aerial application—industrial—special)

(4) Personal (recreation—flight proficiency)

d. Military. As used here, "military" refers to the operators of all military (Air Force, Army, Navy, U.S. Coast Guard, Air National Guard, and military reserve organizations) aircraft utilizing civil airports.

44. Operational Activity. Annual forecasts of airport traffic (for 5-, 10-, and 20-year periods) form the principal basis for future airport facility requirement planning. It is essential to develop activity forecasts by the type of major user categories (air carrier, scheduled air taxi, general aviation, and military) as described in Paragraph 43.

In the development of the operational activity forecasts, it is suggested that an unconstrained approach be used for most areas. The "unconstrained" forecast represents the potential aviation market in which all of the basic factors that tend to create aviation demand are used, without regard to any constraining circumstances (i.e., limited airport expansion capability, airspace, access, etc.) that could affect aviation growth at any specific airport or location.

It is advisable to review and relate national and/or local historical needs and forecast data to the areas under study as a guide for future planning. With this approach, it is possible to determine the theoretical development needs in accordance with the total demand potential. In the exceptionally high activity metropolitan areas, however, potential constraints and alternative methods for their reduction should also be considered.

There are five major types of operational activity forecasts con-

Typical air taxi—a rapidly growing segment of air transportation

sidered necessary to determine future facility requirements:

a. Enplaning passengers—total number of passengers (air carrier, scheduled air taxi and general aviation) departing on aircraft at an airport; originations, stopover, and transfer passengers should be identified separately.

Influencing factors considered for *air carrier passenger* traffic, in most forecasting methods, include: historical trends in the national percentage participation rates for both the metropolitan area and its major city—pair markets; local and regional population, and socioeconomic trends; and the business/personal composition of the metropolitan area's traffic. These factors are used to develop future participation rates and ultimately to translate national projections into metropolitan area forecasts. Sometimes, two series will be correlated to a degree where one may be capable of measuring the other. For example, some communities' numbers of U.S. international passengers are sufficiently correlated with the domestic to assume that the relationship will continue.

The number of *enplaned general aviation passengers* could be estimated for the area by first developing load factors for the future average number of passengers per plane and then by multiplying these factors by one-half the total number of forecasted general aviation itinerant operations.

b. Enplaning air cargo—total tonnage of priority, nonpriority, and foreign mail, express and freight (property other than baggage accompanying passengers) departing on aircraft at an airport, including originations, stopover, and transfer cargo. Where applicable, identify domestic and international cargo separately.

The air cargo industry (like most industries) depends on population growth, continuing gains in the Gross National Product (GNP),

and the export-import increases produced by a free trade market. However, the dynamic equipment and marketing changes that are expected to occur in the air cargo industry within the next two decades, and the lack of a comprehensive data base, make the forecasting of air cargo traffic a difficult task.

Most forecasters make use of both judgment and statistical techniques to develop percentage growth factors derived from such investigative approaches as follow:

(1) An extrapolation of past trends of all commerce, with particular attention to air commerce and the metropolitan regions' share of air commerce.
(2) A review of national air cargo forecasts by airlines, aircraft manufacturers, governmental agencies, and trade associations.
(3) Consideration of the effect on the growth of mail by such factors as conflicting mail data, world conflict, changing Post Office policies and methods, and possible actions of Congress.
(4) A projection of air transport cargo lift potential—the impact of new cargo aircraft.
(5) The potential of air cargo penetration into other transport modes—such as water transport for the overseas market and long-haul common carrier truck for the domestic market—due to marketing changes in air cargo transportation.
(6) The trend and effect of tariffs and regulatory actions by International Air Transport Association and the Civil Aeronautics Board.
(7) Future costs of ground freight transport as compared with air transport and domestic shipper practices.

Two general methods, therefore, of forecasting a metropolitan area's air cargo are: using area annual growth rates applied to the area's current cargo base; or calculating a percentage ratio of the area's cargo to the national total and projecting a future trend to apply to an acceptable national forecast of air cargo.

c. Aircraft operations (movements)—total number of landings (arrivals) at and takeoffs (departures) from an airport. There are two types of operations—local and itinerant—which should be separately identified:

(1) Local operations—performed by aircraft which (1) operate in the local traffic pattern or within sight of the tower, (2) are known to be departing for or arriving from flight in local practice and flight test areas located within a 20-mile radius of the airport and/or control tower, (3) execute simulated instrument approaches or low passes at the airport.
(2) Itinerant operations—all aircraft arrivals and departures other than local operations described above. Where applicable, domestic and international itinerant operations should be identified separately.

Except for local training flights at some airports, *air carrier aircraft movements* are itinerant operations. The basic premise underlying the methodology for forecasting air carrier operations by airport is that a relationship exists between the number of enplaned passengers and cargo shipments and the level of service provided. It is assumed that the number of aircraft seats for transiting and enplaning passengers and the number of flights by type of aircraft have been a function of the traffic demand and traffic characteristics of the community as well as the route structure and operating policies and practices of the individual carriers. It is also assumed that these same factors will continue to determine the level of operations in the future.

An often used forecast method for air carrier operations can be summarized as follows:

The total generated seats at each airport are forecast to increase as a function of the forecast of enplaned passengers.

The analysis and forecast of aircraft mix is an internal part of the methodology to determine the number of air carrier operations because the total forecast seats are distributed among the type of aircraft the carriers are expected to operate at each airport in the forecast year. The seat totals, by aircraft type, are divided by average seating capacities to yield the number of aircraft operations by aircraft type required. Total air carriers operations are determined by summing the operations by aircraft type.

In metropolitan areas with more than one major air carrier airport, determine the operations at each airport. The estimated future domestic and overseas passenger demand can be distributed to its probable local origin or destination among the metropolitan area counties. The county passenger demand can then be subdivided into long and short haul service and assigned to the existing airports on the basis of air service availability and probable minimum ground travel time to each airport.

General aviation aircraft movements can be either itinerant or local operations. Since general aviation activity is related to such parameters as population, employment, income, and based aircraft in the metropolitan region, most methods of estimating its future level are centered around historical growth trends and operations per based aircraft. Since trends can be misleading, supporting rationale should be developed for any conclusions reached by using historical trends. Methods of forecasting general aviation operations at *air carrier and general aviation control tower airports* in a metro-

General aviation: 124,000 aircraft in 1969; in 1980—225,000.

politan area should take into account such factors as: (1) the past trend of general aviation operations at each air carrier airport, (2) the air carrier activity forecast for the airport. This may be large enough to cause general aviation restrictions. Any surplus in general aviation activity should be allocated to other airports in the area, (3) the number of towers planned or programmed for general aviation in the area, and (4) discussions with airport management and FAA.

Future general aviation activity at air carrier and general aviation control tower airports will generally be developed from historical growth trends, considering the above factors and adjusting the trends based upon knowledge of the individual airport's potential and the economic expectation of its associated community. An alternate, approximate method for general aviation control tower airports might be to determine and project their percent of U.S. towers' operations and apply the derived percentage factors to the FAA's national forecasts of tower operations, adjusted for the addition of new tower airports. (See FAA publication, *Aviation Forecasts,* which is issued annually).

One approach to forecasting general aviation activity at *general aviation nontower airports* is to establish a relationship between operations and based general aviation aircraft and to apply this relationship to an acceptable forecast of based aircraft. Base norms are determined for the airport's local and itinerant operations per based aircraft. These base norms are then adjusted for normal growth and multiplied by the number of projected based aircraft to obtain future activity.

The use of *VTOL or STOL aircraft* for air taxi operations and general aviation services is increasing steadily with the increase in air congestion at existing airports. The forecast should indicate the number of V/STOL general aviation operations and the number of CTOL general aviation operations. Furthermore, the effect of continued employment of V/STOL in general aviation and its influence on future forecasts should be indicated.

Future forecasts of *military operations* may be projected based on past trends and information provided by military sources.

d. Based aircraft—total number of active general aviation aircraft which use or may be expected to use an airport as "home base." General aviation based aircraft should be separately identified as single-engine, multi-engine, piston or turbine, CTOL or V/STOL.

Forecasts of general aviation aircraft within the metropolitan area may be based upon growth rates reflected for national totals in the FAA annual publication, *Aviation Forecasts,* which establishes an annual percentage increase in based aircraft for single-engine, multi-engine, and turbine aircraft. These forecasts should be modified to reflect special conditions at each metropolitan area. A method of forecasting based aircraft by this procedure is presented in Appendix E—Example of Methods Developed for Forecasting Aviation Demand at the Nation's Air Transportation Hubs. This is a suggested practical method which can also be used to check the reasonableness of more sophisticated techniques based upon economic relationships such as the propensity of the population to own general aviation aircraft in any particular population zone.

e. Busy hour operations—total number of aircraft operations expected to occur at an airport at its busiest hour, computed by averaging two adjacent busiest hours of a typically high activity day. One definition of typically high activity day would be the average day of the busiest month of the year. Another choice for

a typically high activity day would be the 37th busy day obtained from a rank order of aircraft operations. Busy hour operations should be identified by major user category, as applicable.

The operations forecast should be translated to reflect the *total number of aircraft operations* expected to occur at an airport during a *busy hour* of a typically high activity day. The percent this day is of the annual operations should be computed from previous records.

Also, the air carrier busy hour should be selected. Assuming that this hour and the percent of daily passengers and aircraft operations, together with the percent of annual operations, would remain the same, it is possible to apply these percentages to future passenger and operations forecast to obtain the busy hour operations number for the forecast period. Also, a certain percentage of the future estimated annual cargo volumes are translated into all-cargo plane movements based on market survey and projected average cargo lift per movement. However, past records of all-cargo aircraft movements, by month, day of week, and hour of day, indicate that only a few of the all-cargo plane movements operate in peak periods. During the average busy hour of passenger plane movements, therefore, only few all-cargo plane movements should be expected. However, this descriptive characteristic for all-cargo operations may be altered by future developments.

The annual operations forecast must also reflect the *total number of general aviation operations* at each airport in the metropolitan region during a *busy hour* of a typically high activity day. In general, the method of forecasting general avitation peak hour operations follows the steps in forecasting air carrier busy hour operations. In addition, the number of general aviation operations expected to occur at each airport during the air carrier busy hour must be also considered in estimating the total busy hour operations at each airport.

Military operations will probably not have to be considered in the busy hour since the military services avoid congested time periods at civil airports. At air carrier tower airports, one method of developing military busy hour is to consider that itinerant and local military busy day operations tend toward a constant percentage of annual operations for each category. The military percentages of the busy day during the air carrier busy hour could be developed from national hourly distributions of itinerant and local military flying.

An illustration of the development of busy hour operations is provided in Appendix E—Example of Methods Developed for Forecasting Aviation Demand at the Nation's Air Transportation Hubs.

45. Aircraft Mix. In determining future metropolitan airport system development requirements, it is necessary to forecast the types or categories of aircraft (aircraft mix) which are to be accommodated at the airport(s) or location(s) under consideration. Therefore, it is essential to keep abreast of technological advances in aircraft design (such as the SST, large capacity subsonic transport aircraft, VTOL, STOL, air-bus aircraft, etc.) in order to assure the provision of adequate airfield and terminal design at the airports from which they are to operate. Generally, passenger and cargo volume forecasts will indicate the types of terminal facilities required, whereas, volume of aircraft operations will indicate airfield configuration. Forecasts of aircraft mix should be summarized into: (1) *Seating capacity* groups for air carrier aircraft, and (2) *operational characteristics* groups for all four of the major airport user categories.

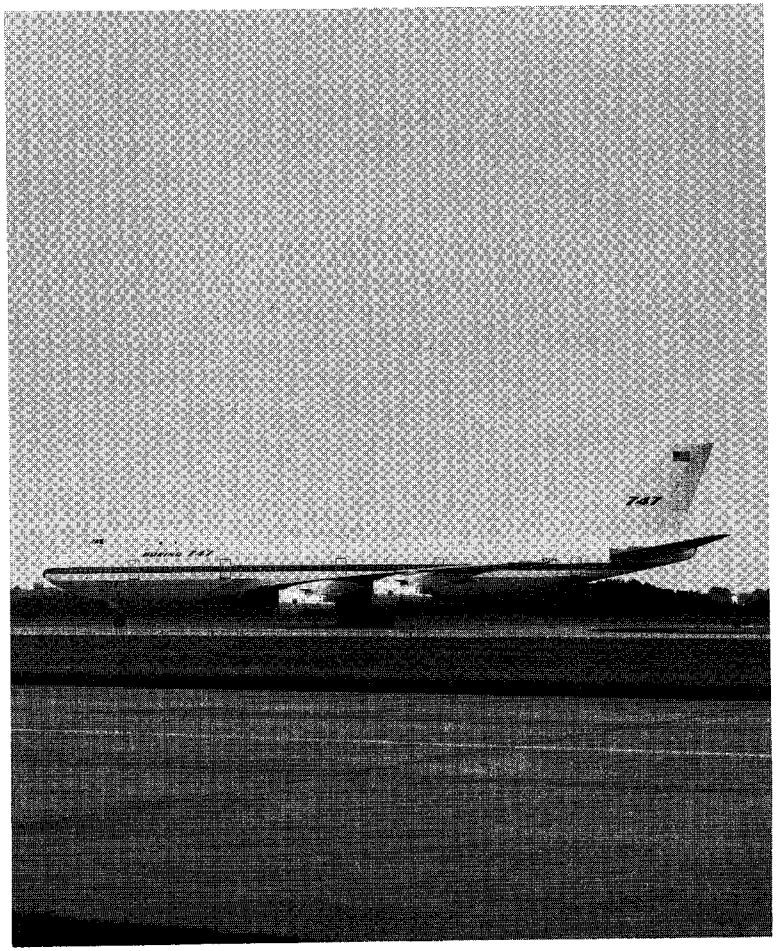
The annual FAA report, *Aviation Forecasts*, gives national and regional trends in both air carrier and general aviation aircraft mix. An illustration of the development of an aircraft mix is provided in Appendix E—Example of Methods Developed for Forecasting Aviation Demand at the Nation's Air Transportation Hubs.

46. Ground Transportation Data. Consideration of the future surface travel demand to and from an airport is necessary to assure the accessibility of the airport to the users of air transportation. Three basic approaches can be used in determining the future distribution of airport-oriented surface trips:

(1) Paragraph 44 discussed the stratification of enplaning passengers and cargo into organizations, stopovers, or transfer groups. The forecasted originations and stopover groups can be translated into the numbers of people and goods traveling to and from an airport by ground transportation modes. Adding the future employees and visitors will give the total airport oriented surface trips. The transfer group has been excluded because this group does not leave the airport by surface modes.

(2) As discussed in Chapter 12, the urban transportation planning process collects data on urban area travel, socio-economic and land use characteristics, and with these data establishes relationships to describe the urban area travel pattern. Forecasts of land use and socio-economic data provide the necessary inputs to these relationships to determine future trip making. Again surface trips to the airport are included in this process; the airport can be singled out and the distribution of airport-oriented surface trips by mode can be examined.

Increased aircraft size presents unique challenges in airport planning.



(3) An airport O-D survey may provide the data base through which future surface trips to airports are forecast. As discussed in Chapter 12, the airport O-D survey collects data which are used to develop relationships which describe airport-oriented travel. Forecasts of the variables which generate trips (socio-economic and land use data) provide the necessary inputs to these relationships to determine future airport-oriented surface trip making (the number and dispersion of trips by mode).

A comparison of these three methods indicates that the first one lacks two elements essential to meaningful planning for ground access to airports; it provides no indication of where the airport-oriented surface trips are coming from or by what mode. The results obtained by the three methods should be comparable, however, and it may be feasible to use results obtained from one method as a control for another.

47. Forecasting Examples. When use is made of previously developed area forecasts, no single method for distributing total activity among all the airports in the area can be validly applied to all airports because of the varied differences underlying individual traffic development. Allocation of activity will depend upon the basic forecast assumptions, the number of individual airport forecasts developed, and the application of local, individual airport experience to derive distribution ratios. However, the FAA reports, *Aviation Demand and Airport Facility Requirement Forecasts for Large Air Transportation Hubs Through 1980,* August 1967, and *Aviation Demand and Airport Facility Requirement Forecasts for Medium Air Transportation Hubs Through 1980,* January 1969, can serve as guides in the development of operational activity forecasts for specific metropolitan areas. Appendices to the reports contain methodology developed by the FAA to obtain unconstrained aviation demand forecasts and illustrate how various forecasting techniques can be applied. These methods are provided for general guidance in Appendix E—Example of Methods Developed for Forecasting Aviation Demand at the Nation's Air Transportation Hubs. The reference material and source documents used are listed with each method. These methods and techniques were developed primarily to obtain aggregate aeronautical activity forecasts for each hub location. With some modification, they can be applied to almost any airport or location for which aviation demand forecasts are required.

Another example is the *Airport Demand Forecast Study* of the Air Transport Association of America (ATA). Their study group is composed of members from the airline industry as well as contributors from the FAA and other government agencies or sources. The initial *ATA Airline Airport Demand Forecasts,* July 1969, produced industry traffic and aircraft movement forecasts for the U. S. and for the Atlanta, Detroit, Miami/Fort Lauderdale, Philadelphia, and Seattle/Tacoma air traffic hubs. Individual forecasts will also be developed by ATA for seventeen (17) additional major air traffic hubs.

Metropolitan airport system planners should attempt to correlate their projections with those presented in the FAA publication, *Aviation Forecasts.* For instance, take the FAA's national forecast and allocate to the state its share of the projected national activity. Then, allocate to each metropolitan area or airport within the area its share of the projected state activity. (For example, if a state has two percent of the Nation's population and 1.2 percent of the Nation's based aircraft today, assume that in 1980 it will have 0.6 times its future percentage of the Nation's population times the FAA's projected fleet.)

Use the FAA's allocation among single or multi-engine piston, turbine, etc., unless it is known that the state presently has a different proportional distribution of aircraft by type. These planes could then be assigned to counties or airports on the basis of the same distribution which exists today or in terms of population as it is projected to be distributed in 1980. Methods such as this show how one could determine a number of based aircraft for each airport in 1980.

In order to check the reasonableness of other forecasts, similar methods could be used to project additional aviation statistics for each airport. For example ,one might also assume that each air carrier community will continue to handle its percentage of national activity. In general, one should attempt to use his own intuition to assign to each airport its projected share of the FAA's projected national total figures. These are merely suggestions for a relatively simplified approach. They are not meant to discourage more sophisticated or even simpler approaches.

48. Special Problems. Except for scheduled air carrier operations, relatively little statistical information is available at nontower airports on other aircraft operations. It may be necessary to conduct one or more surveys at airports (or mail surveys of airport users) to determine a pattern of present usage which can, with modification, be projected into the future. Surveys such as this can also be used to formulate numeric measurements such as ratio of total operations to based planes at various airports, patterns of seasonal usage, number of occupants, weight of cargo, navigation equipment aboard planes, etc. Estimates of operations can also be obtained with mechanical counters which are specifically designed to count aircraft movements.

One difficult problem in forecasting aeronautical needs is that not only is the total aviation industry growing at an astounding rate, but all aspects of aviation are growing simultaneously. How long the present growth distribution pattern will continue is difficult to assess.

The introduction of aircraft types which are not yet on the drawing board could drastically change air transportation patterns. Consequently, growth in aeronautics is multidimensional and no single series of numbers can be used to accurately project change.

Another major problem in metropolitan airport system planning is that much aeronautical activity is actually intermetropolitan area or transient in nature. A metropolitan area must also build its airports to serve traffic from other regions or areas. Consequently, if one is basing his area's aeronautical demand projections on all aircraft which might be using the airports in question, the relationships to air transportation demands of surrounding areas must be considered as well.

It is especially difficult to project aeronautical activity at very small airports or at airports which are yet to be built. This is often a "chicken-egg" type of analytical problem. After two similar airports have been built in two smaller communities, one airport may have developed considerably more activity than the other. The reason for this is frequently a progressive fixed-base operator. Possibly, a resort in the area has been able to attract a large number of customers who fly in. In any event, causes such as these are so peculiar to a specific situation that it is difficult for one to project aviation activity. New airports also create activity. For years, airport advocates have spoken of the "telephone" analogy in building airports. That is, the more airports that are built the more useful each

existing one becomes.

Finally, any projections should be viewed as estimates of what might reasonably be expected under the conditions assumed and not as predictions of what will actually occur. Due to the effects of unpredictable events and short-term fluctuations in economic activity, these estimates are only average or trend values. These limitations, common to any projection, do not invalidate the use of such forecasts as guides for long-range planning.

CHAPTER 10. CONSIDERATION OF NEW TECHNOLOGY

49. General. The rapidly changing aviation technology will undoubtedly affect the forecast of system requirements, particularly towards the latter years of the forecast period. While the plan will be shaped by today's knowledge there must be insight into what could happen in the future and the plan made flexible enough to accommodate aeronautical breakthroughs and different basic concepts in air travel.

Because aviation and the environment it affects, and is affected by, are not static, the need for a continuing program of metropolitan system planning is mandatory. One must expect that the plan will be changed, and possibly quite radically, as the years pass. The test of a good plan will be how well it meets air transportation demands as they are encountered over the years, irrespective of the revisions to the basic system that are required. If the plan is shaped in such a manner as to effectively allow for the potential revisions, it will accomplish its objectives.

Government, industry, and the airport owners recognize the need to predict what could happen on the aviation technology front and the potential effects on the national aviation system. All continually sponsor research so the public can be made aware, as far in advance as possible, of the potential impact on the existing system. The Federal Government, through the FAA, provides guidance in advance of standards, so that existing facilities can be updated and new facilities can be designed so that they will not be outmoded when they become operational.

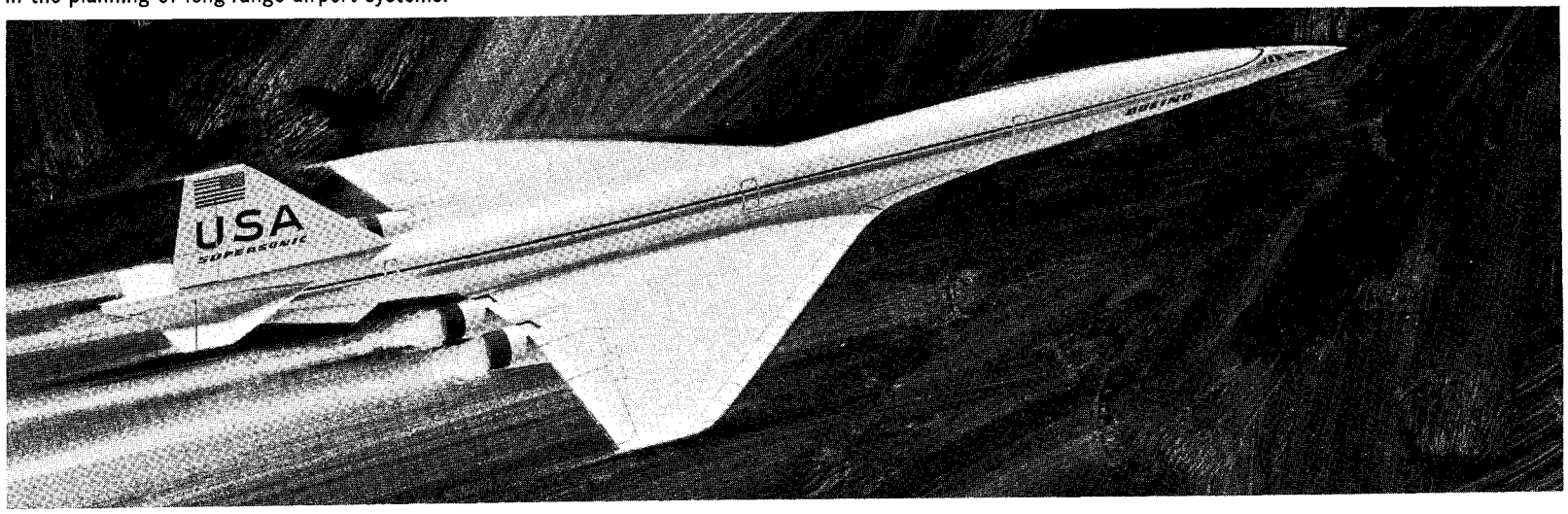
50. The Aircraft. Advance guidance documents on new aircraft are listed in the Bibliography. Areas of changing technology which the planner should be particularly aware of are:

a. Conventional Takeoff and Landing Aircraft (CTOL)— These aircraft are continuing to experience increases in passenger carrying capabilities which result in increases in gross weights, wingspans, overall lengths, heights of passenger doors and tails, etc. For

"Sky-lounge" concept—one of many technological innovations studied.

example, the Aerospace Industries Association of America predicts that the gross weights of 350,000 pounds in 1969 may be dwarfed by the two million pound gross weights of aircraft in the late 1980's. Aircraft lengths and wingspans could double in the same time period. Consequently, long-range planning must reflect these developments in increased pavement strengths, greater clearances between runway and taxiways, etc. Essentially, the planner can expect that the overall airport geometry will be substantially broadened. However, required runway lengths are not expected to increase proportionately in the future. Historically this has not held true, for as aircraft have increased in passenger capacity, so have runway lengths increased. The industry predicts that, finally, required runway lengths have stabilized, principally due to more powerful engines.

Supersonic transport (SST)—a critical consideration in the planning of long-range airport systems.



A critical element is the ability of terminal building facilties to handle the great numbers of people, their baggage, and cargo from individual aircraft. In the same sense, ground access facilities must be prepared for the onslaught of the air traveler and his well wishers, the airport employees who are essential to his trip, and the air freight which must be moved speedily to its ultimate destination.

The critical factor with respect to the SST will probably be noise. The sonic boom element may have a direct effect on its initial use in the system, restricting supersonic speeds to overwater areas. Also, lateral noise in the immediate vicinity of the airport may be much more severe than that resulting from subsonic aircraft.

b. Vertical/Short Takeoff and Landing Aircraft (V/STOL)—Recent developments in aircraft capable of takeoff and landing vertically or in short distances signal their use on an extensive basis in the future. Particularly important is the STOL aircraft which should be acceptable from an economy-of-operation standpoint.

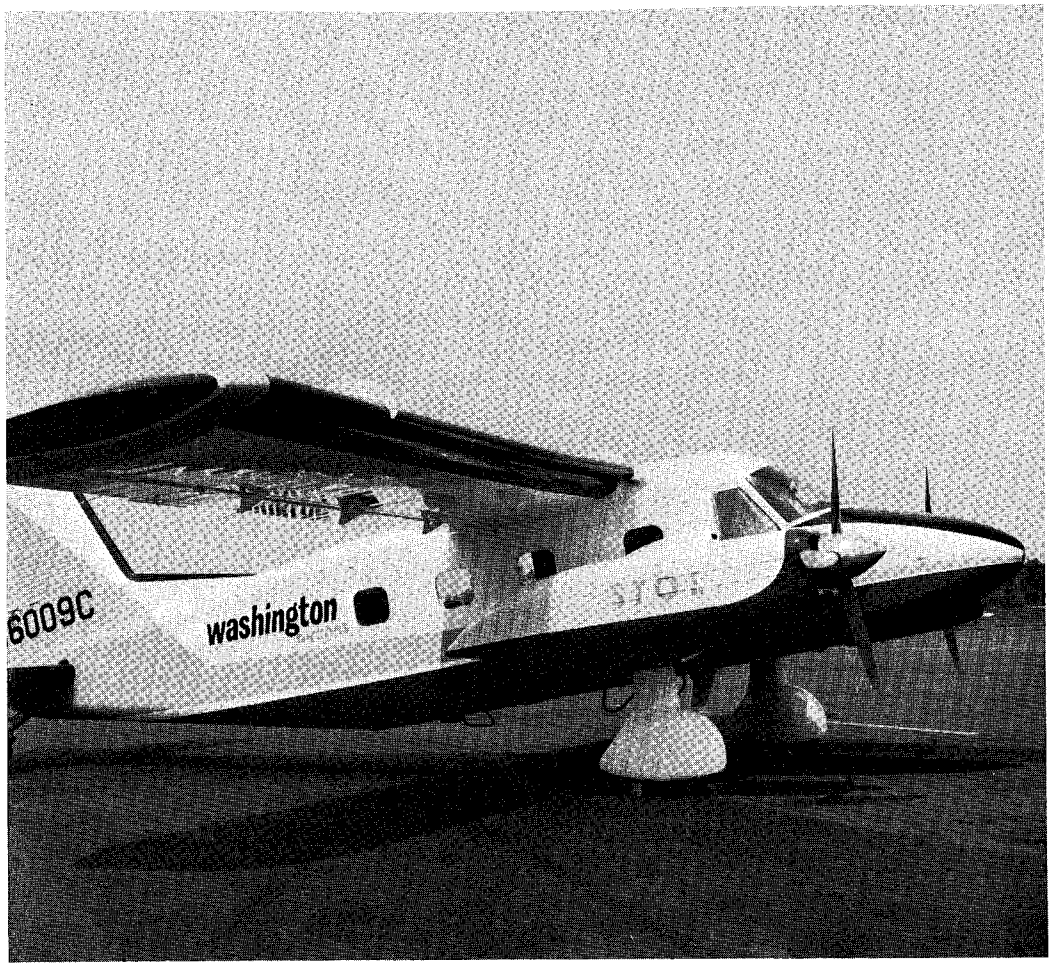
The advantages of a STOL aircraft are its abilities to efficiently utilize the airspace and to operate from small landing areas and from separate runways on airline airports. With land for conventional airports becoming extremely scarce in urban areas and with the higher altitude airspace becoming increasingly saturated in high density terminal areas and en route between them, the STOL aircraft is expected to become a principal form of air transportation in the short-haul interurban markets. Also, STOL aircraft, due to their capability to takeoff and land steeply, reduce noise exposure areas and make landing area siting more readily possible. The present deterrent to large-scale use of STOL is the lack of high-capacity and economically competitive vehicles and STOL port facilities. It is anticipated that STOL aircraft in the 50- to 150-passenger size will be manufactured in the mid 1970's.

STOL aircraft can also have a potential for intraurban transportation and particularly for access to conventional airports, although this potential has not been explored in depth. It is believed that the initial large scale use will be in the short-haul (150 to 500 miles) interurban markets, particularly in such as the Northeast Corridor, Southern California, and Chicago-Cleveland. At some future time, large regional airports located at substantial distances from the major metropolitan areas may become necessary. In order to provide efficient access to the users of these airports, the STOL aircraft, in addition to ground transportation modes such as high-speed rail, ground effect vehicles, limited access highways, etc., will be called upon. The FAA has published design criteria for STOL ports.

The helicopter, a VTOL vehicle, should continue to play an important role in urban transportation, although present designs are somewhat limited in size. The current military helicopter transports could be developed into 50- to 80-passenger transports having the speed and comfort of today's conventional aircraft.

51. Air Navigation. Along with the advances foreseen in aircraft design and performance, new navigational guidance methods are also on the horizon. For example, the planner can expect significant advances in airborne guidance equipment technology within the next few years. Some equipment models which permit area navigation have been in limited production for some years. Recently, it has been determined that these new techniques, utilizing existing VOR/DME ground signals, inertial platforms, doppler radar systems, and other systems, are accurate and reliable enough to permit realization of advantages in the expeditious movement and control of air traffic.

Typical short takeoff and landing (STOL) aircraft



The use of airborne guidance equipment, together with development of suitable control techniques, will evolve into an area navigation system. This will permit utilization of more airspace by providing additional routes not limited by air navigation facility location. Additional routes provide system advantages for pilots and controllers by increasing route capacity and flexibility. The economy of point-to-point navigation and bypass of congested areas are other advantages of area navigation systems.

In addition, use of airborne area navigation equipment may, in the future, significantly increase the instrument flight capability of an entire metropolitan area by providing access under IFR weather conditions to more airports and more runways at present instrument airports in the area. Instrument approach procedures developed for area navigation equipment will utilize waypoints in lieu of ground-installed final-approach fixes. Such waypoints, however, will require the same consideration pertaining to runway length and orientation, obstructions, traffic flow, etc., that are presently associated with conventional ground-located navigation aids. Thus, the planner must be aware of the continuing need for interference-free siting for the facilities required and the growing need for control of obstructions to air navigation. Since the primary responsibility for establishing, operating, and maintaining air navigation facilities and for providing air traffic control services belongs to the Federal Government, coordination with the FAA must be effected at the earliest planning stage.

Together with the above described technology, the planner should also be aware of other related air navigation systems of the future. Certainly, more ILS installations will be needed to provide for greater use of parallel approaches and for all-weather utilization of reliever airports. Many ILS installations may, at the lower density airports,

be in the next generation category of lower cost-partial system installations. Perfection of steep gradient glide path systems might become a critical factor in the success of V/STOL all-weather operations. Other potential equipment development relates to signalling devices to direct taxiing aircraft and the use of computer-generated flow control and traffic metering devices to increase the efficiency of terminal area operations.

Again, the planner must recognize the dynamic forces influencing the demands on the air navigation and air traffic control system. More sophisticated equipment than that now known will certainly reach the industry's inventory before the end of the normal long-range planning time frame.

52. Ground Access. With the demand for new and larger airports, sites may be located outside the fringe of a metropolitan area where suitable parcels of vacant land still exist. With the introduction of V/STOL air carriers, new airport facilities may be located in downtown centers and other business districts throughout a metropolitan area. Therefore, in order to keep airport access times in their proper perspective relative to total trip times, the application of new ground movement technology may be required. The ground movement systems of today, mainly automotive, bus, and train, which originated fifty years ago, may not prove entirely adequate for airport access purposes. New ground movement systems should be explored as they are developed as important potential inputs into the planning of the metropolitan airport system. For example, the gravitrain, an underground rail carrier propelled by forced air and gravity, may be desirable to carry air passengers quickly from large public airports far outside the metropolitan fringe to downtown areas. Rapid rail or automatic high-speed guideway highways may be used for the same purpose. Automated dual-mode bus systems which combine the high-speed capacity of a rail system operating on a private right-of-way, with the flexibility and adaptability of a city bus, may be the solution for ground transportation to conventional airport facilities. Downtown STOL terminals may be part of a larger transportation terminal, a modal mix, or interface terminal, accommodating all the ground movement systems. Such terminals could be built as transportation joint development projects over existing city freeways or beltways or on top of vertical parking garages.

Other examples of surface systems are: the pallet or ferry systems which can move conventional automobiles, minibuses or freight on high-speed guideways to airports; a downtown dial-a-bus terminal, where special buses, activated on demand by a potential airport passenger through a computer network, could move people from downtown centers to airports; and new ground movement systems within airport facility complexes, making use of such innovations as moving belts or internal capsule transit systems.

Note, however, that these innovative ideas require large concentrations of trip ends at limited locations, whereas large portions of the trip ends are normally dispersed throughout the urban area. In any case, innovation in ground movement transportation will greatly affect metropolitan airport system planning.

CHAPTER 11. GENERAL FACILITY REQUIREMENTS

53. General. After aeronautical demand has been determined, the next step in the technical planning process is the assessment of facility requirements. This assessment will provide insight in terms of what portion of the demand the existing aeronautical facilities can accommodate and what is needed in terms of additional facilities to meet the balance of forecast demand.

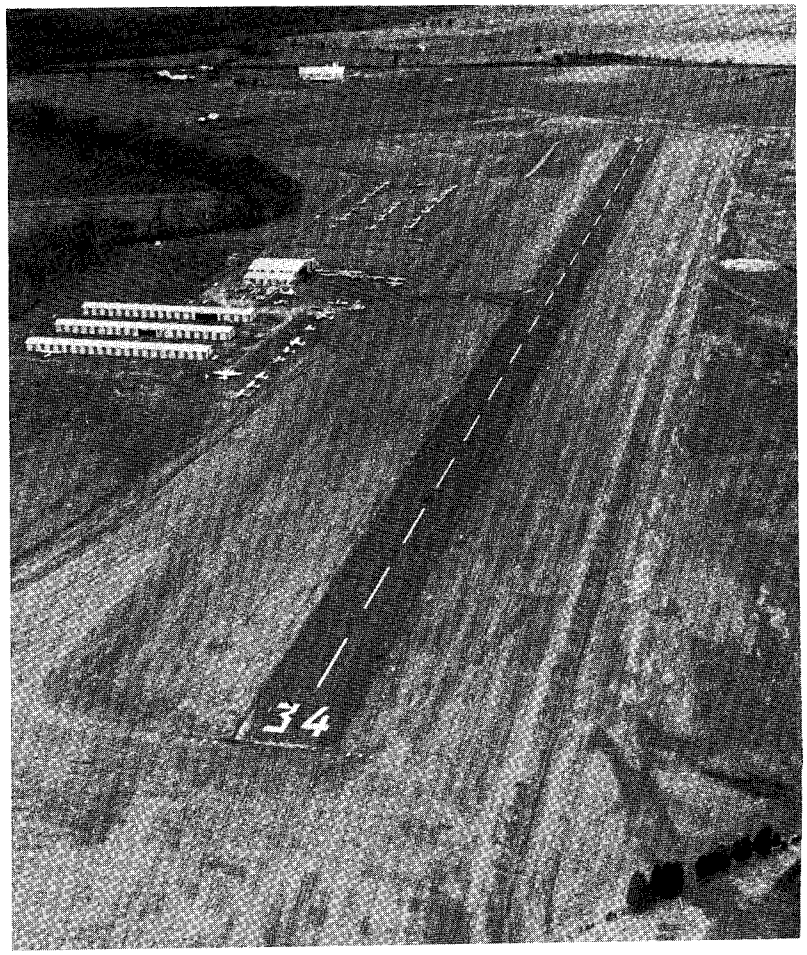
This step may not provide specific details on the location of new airports and, in some cases, may not even provide a specific answer on whether a new airport should be developed or an existing one expanded. These questions will be answered in the development and evaluation of alternative system plans as discussed in subsequent chapters. Also, the facility requirements will be, for the most part, unconstrained. An analysis of constraints may result in a requirement to adjust demand data and reevaluate the gross requirements.

54. Aircraft Operational Requirements. The forecasts of aviation activity will indicate the kinds of aircraft anticipated to use the airport system. The frequency of use, passenger/cargo load factors, and lengths of outbound nonstop flights will also be indicated. From this demand data the planner can ascertain the required physical dimensions of the aircraft operational areas.

While a capacity analysis provides requirements in terms of numbers of runways/taxiways, etc., the analysis of aircraft operational requirements allows the determination of runway/taxiway/apron dimensions, strengths, and lateral clearances between airport areas. Of course, both of these analyses are inter-related and must be accomplished simultaneously in order to determine system requirements.

Consultation with the airlines and general aviation community is essential in verifying forecast equipment usage and in ascertaining user plans. Guidance on all facets of airport development related to

General aviation airports provide a balance in airport system capacity.



aircraft operational requirements may be obtained through consultation with the FAA and is contained in FAA Advisory Circulars (AC 150/5300 series).

55. Capacity Analysis. An analysis of the air traffic capacity of the existing metropolitan area airports leads to a determination of how much and when additional capacity is required to accommodate forecast aviation demand. Three distinct elements require investigation, namely:

a. The airfield,
b. The terminal area,
c. The airspace.

The maximum capacity will depend on the capacity limitations in any of these three elements. A fourth element, ground access, must also match the capacity of the other three. This element is discussed in paragraph 56. Also, the aircraft operational requirements discussed in paragraph 53, relating to dimensional requirements of aircraft operational areas, are accountable in the capacity analysis.

An example of a metropolitan area system capacity analysis is the FAA Staff Study entitled "1980 Metropolitan Area Airport Capacity Analysis. Location—Atlanta, Georgia."

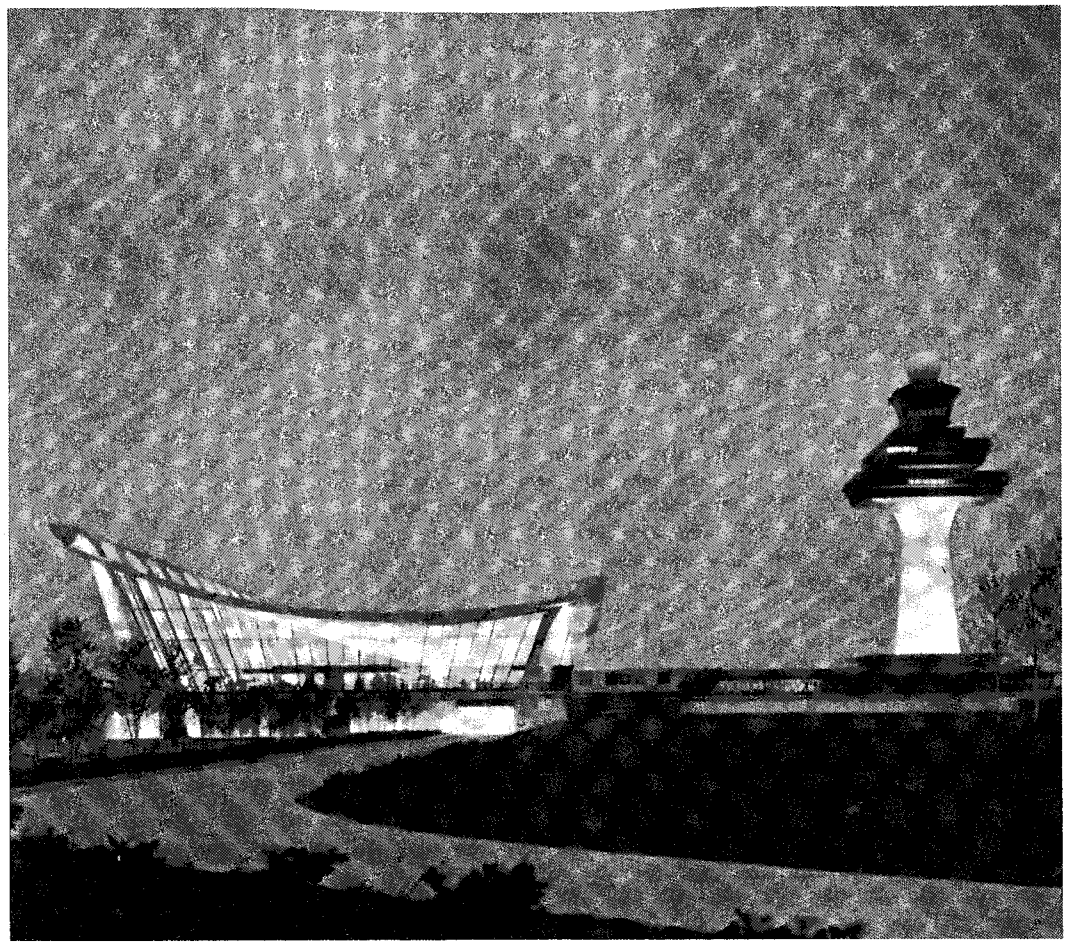
When the airfield terminal area and airspace capacity of the existing system (those airports most likely to be retained in the system) have been determined, the forecasted demand is imposed on the system, distributed in accordance with demand patterns that would exist if no new airports were considered in the system, and the additional capacity required (runways and taxiways) is determined. At this point, the ability of the existing airports to accommodate the additional capacity that is required should be ascertained. Where it is clear that an unsatisfied balance of demand will exist, the need for new airport locations will be indicated (assuming that aircraft operational area dimensional requirements such as runway lengths and strengths, lateral clearances, etc., and the surface access capacities discussed later have been considered when analyzing existing airport expansion capabilities).

The new airports should be placed in general areas in and adjacent to the metropolitan area. The locations should be selected on the basis of utilization consistent with the geographic distribution of air transportation users, the availability of adequate real estate, and minimum environmental problems.

When the new airports are theoretically in place, a redistribution of demand may be necessary before the extent and timing of facilities required can be determined. For example, if a new air carrier airport is needed, a new split in airline operations will result and a shift of substantial numbers of operations to the new airport may preclude the requirement for extensive expansion at the existing airport. Moreover, additional general aviation capacity may be provided at the existing air carrier airport, affecting the initial distribution of general aviation demand. Additionally, the treatment given to existing military airports will be an important factor. The impact of continued use of the airspace and the potential for additional civil capacity must be ascertained.

The expansion of existing airports, as well as the need for and general location of new airports, is theoretical at this point in the planning process. It is likely that several alternative schemes with more specific, but not precise, locations will be developed for evaluation and final selection after constraints are considered and after other community factors are accounted for (as outlined in Chapters 12 and 13).

Terminal—Dulles International Airport



a. The Airfield. Airfield capacity is the rate of aircraft movements on the runway/taxiway system which results in a given level of delay. According to current methodology employed by the FAA, capacity is reached when delays to departures average four minutes during the two adjacent normal peak hours of the week for large transport type aircraft operations. For general aviation type operations of small aircraft, the significant average delay level is two minutes for the peak hour of the week.

The methods presented in FAA Advisory Circular 150/5060–3A, Airport Capacity Criteria Used in Long-Range Planning, should normally provide adequate approximate capacities for intermediate and long-range planning. FAA AC 150/5060–1A, Airport Capacity Criteria Used in Preparing the National Airport Plan, and "The Airport Capacity Handbook—Second Edition" provide more complete methods for determining more exact airfield capacities. The use of these two publications is suggested for the short-range (first 5 years) analysis and particularly wherever highly complex analyses are required. For example, where the correct decision relating to building of a new airport versus expanding an existing one is not clear-cut, the use of the more precise methodology is indicated. In detailed design and economic analysis which are normally beyond the scope of the metropolitan planning effort, the use of these publications is necessary.

b. Terminal Area Capacity. Terminal area capacity is the ability of the terminal area to accept the passengers, cargo, and aircraft that the airfield accommodates. After determining the potential airfield capacity, the potential capacity of the terminal elements for each airport should be ascertained. Individual elements within terminal areas must be evaluated to determine overall terminal ca-

pacity.

The analysis may point out a need to redistribute demand throughout the system due to an insufficiency of one or more elements. For example, the limited potential of tie-down and hangar facilities for general aviation may cause a lowering and redistribution of the general aviation demand, while not affecting air carrier demand.

In comparing the terminal area capacity to the airfield capacity, use common demand terminology. Thus, the airfield capacity must be translated into numbers of passengers, tons of cargo, etc., in order to express the capacities in equivalent terms.

Terminal elements to be included in the analysis are:

(1) Airline and cargo apron area and gate positions;
(2) General aviation apron areas, tie-down, and hangaring facilities;
(3) Airline passenger and general aviation terminal buildings and cargo buildings;
(4) Automobile parking;
(5) Aircraft maintenance facilities.

An example of how to determine terminal area requirements from demand levels is contained in the two FAA publications *Aviation Demand and Airport Facility Requirement Forecasts for Large (Medium) Air Transportation Hubs Through 1980.* In addition, the advice of industry organizations should be sought in determining acceptable current relationships between activity levels and terminal requirements.

Note that requirements will also depend upon the terminal concept employed. For example, suburban or downtown passenger collection/processing/baggage check points will substantially lower the on-airport passenger terminal building requirements, and convenient mass transit systems will alter auto parking needs. Consideration of the various terminal concepts and surface access systems may best take place when developing and evaluating alternative system plans.

c. The Airspace. The proximity of airports to one another, the relationship of runway alignments, and the nature of operations (IFR and VFR) are the principal inter-airport considerations which will affect the overall capacity of the airspace used by metropolitan system airports. For example, it is not uncommon in a large metropolitan area to have major or secondary airports spaced so closely that they share one discrete parcel of airspace. In such cases there may be a reduction in the IFR capacity for the airports involved due to the intermixing of traffic within the common parcel of airspace. When this occurs, aircraft, regardless of destination, must be sequenced with the proper separation standards. This reduces the IFR capacity for a specific airport.

The FAA Order 7480.1, "Guidelines for Airport Spacing and Traffic Pattern Airspace Areas", gives the planner general guidance in determining areas of airspace interaction. Additional information or inter-airport relations for airspace capacity purposes may be obtained from the document "Capacity of Airport Systems in Metropolitan Areas—Methodology of Analysis—FAA/BRD 403."

At this point, assistance should be asked from the FAA office having jurisdiction for FAA matters in the metropolitan area. Responsibility for planning and design of the controlled airspace structure rests with the FAA.

56. Ground Access. Having made a preliminary determination of the potential capacities available from the airspace, airfield, and terminal area, the critical capacity (the lesser of the three capacities) should be translated into numbers of movements by people and auto-

mobiles. With a knowledge of the trip ends dispersion throughout the urban area, a preliminary examination of existing and planned highway and mass transit systems allows a judgment on availability of ground access capacity.

In determining the volume of people, it is necessary to establish the percentage of passengers, visitors, and airport employees. This can vary from one urban area to another and from one site to another. Information on the subject of airport access is contained in several publications, including those of the American Society of Civil Engineers and the Highway Research Board. (See Appendix B—Bibliography.)

To ascertain such important data as the total number of people expected to travel by private automobile to and from the airport, and the distribution of their travel routes throughout the metro area, consult the Regional Federal Highway Administrator or Bureau of Public Roads Division Engineers Office, as well as state and local highway offices. While Federal officials may not be able to supply data directly, they provide a link for contacting the urban transportation planning agency. The urban transportation planning program will be an essential and valuable source of information. If mass transit systems that serve the airport are in place or being planned, the metropolitan transit authority should be consulted for guidance in determining potential surface access capacity. While airport facilities can be adequately planned by knowing the activity generated by the airport alone, the planning for surface access to airports relies on a knowledge of the activities generated at both ends of the airport trip. Taking into account the relative attractiveness of the several zones in the urban area, distribute these trips in a systematic manner and assign them to a highway and transit system serving an airport. In some cases, an airport origin and destination study may be required if not already available in the urban transportation study.

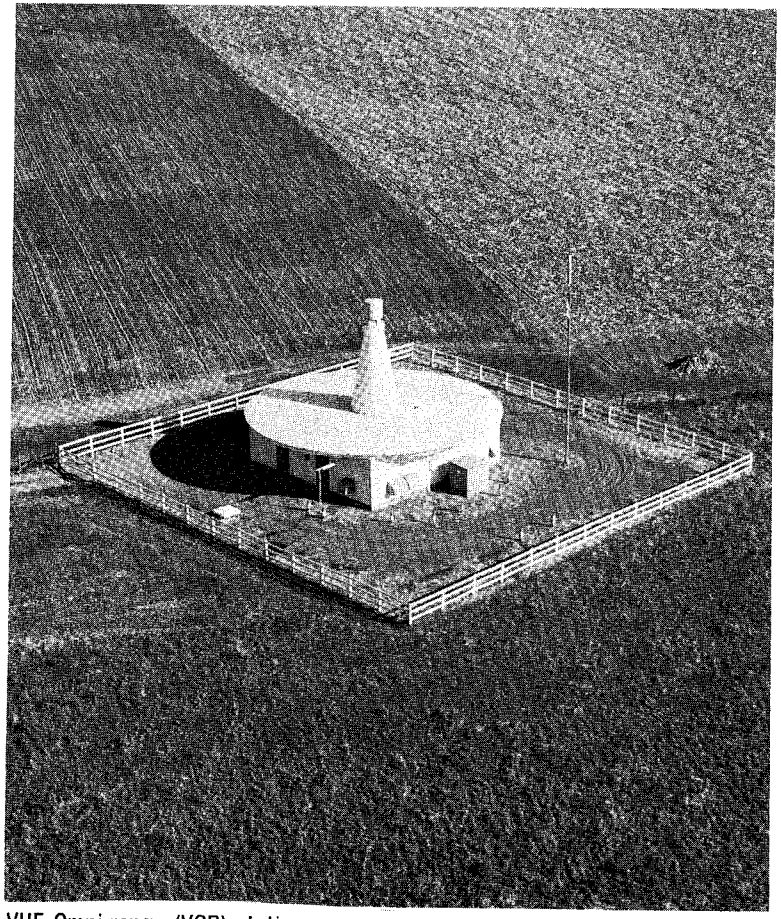
Surface access capacity is a principal consideration in the analysis of airports serving scheduled air passengers. While surface access is not as critical an element for general aviation airports, it is a major consideration inasmuch as lack of surface access can severely affect airport utilization.

57. Air Traffic Control/Navaids. The demand forecasts for existing and new system airports will provide insight to the type of air traffic control facilities and air navigation aids that will be needed and when they will be needed.

The airspace available, the volume of traffic projected, and the nature of the operations (IFR and VFR) that could be expected are the determining factors.

The capability of sustaining instrument operations should be included in the planning of new general aviation airports to serve the metropolitan area. The demand forecasts will usually verify this requirement, and should indicate the operational reliability (approach minima) required. This, in turn, will dictate the kind of equipment (ILS, VOR, etc.). All air carrier airports should be planned for the most sophisticated instrumentation available.

Since the FAA can be expected to continue its role as the supplier and operator of navaids and air traffic control facilities, obtain current eligibility criteria for such installations from that organization. Early consultation with the FAA is necessary at this point in order to ascertain its views on future instrumentation requirements/capabilities at area airports.



VHF Omni-range (VOR) station

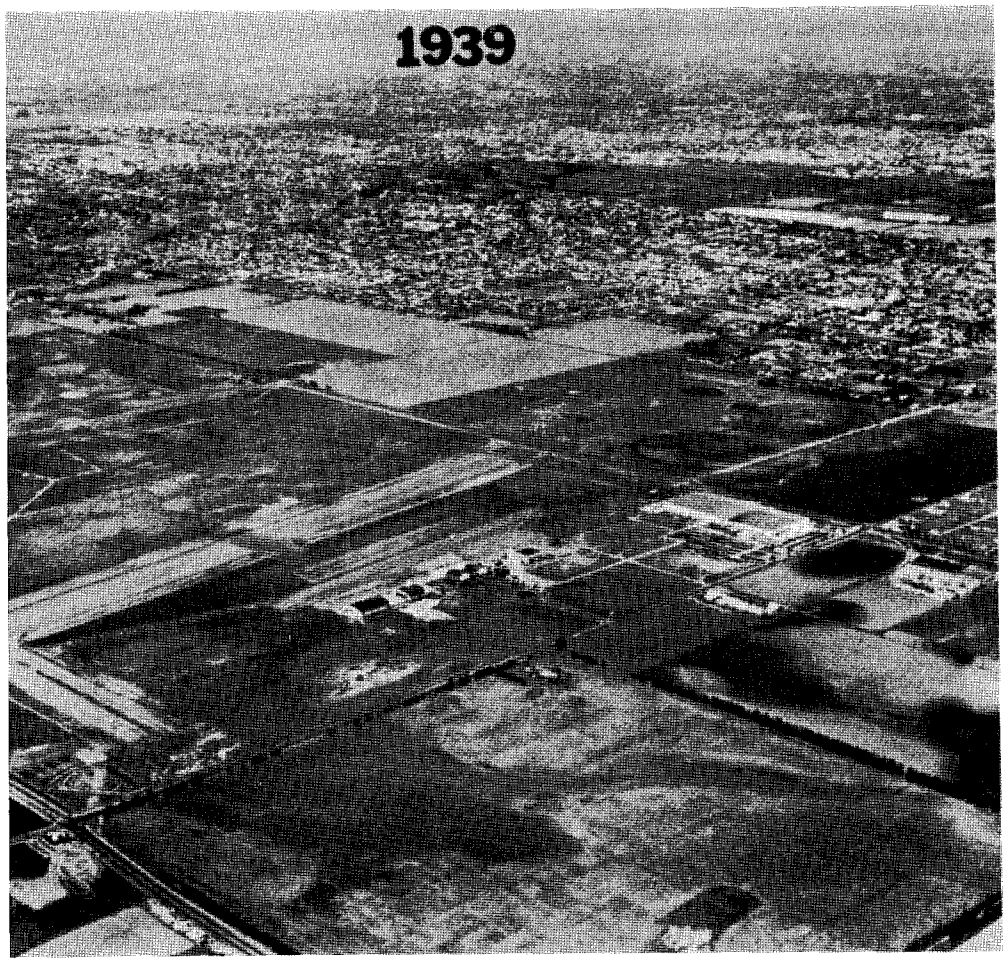
CHAPTER 12. DEVELOPMENT OF ALTERNATIVE SYSTEM PLANS

58. General. When the unsatisfied system demand and the timing and extent of aviation facilities required to meet it have been determined, develop alternative system plans. Essentially, this involves cut and dry steps, performed concurrently, and consisting of (1) comparing the relative merits of developing new airports versus full or partial expansion of existing airports; (2) the placement of new airports at alternative general locations in and adjacent to the metropolitan area in keeping with the general areas determined in the previous step (Chapter 11—General Facility Requirements); and (3) determining the primary constraints to forecast demand levels for individual alternative systems and suggesting means for reducing them. The feasibility of the alternative system plans should be clearly ascertained before they can be considered as true alternatives for further consideration.

Maps or overlays, beginning with the base maps suggested in Chapter 8, "Inventories," are helpful. These maps graphically portray the alternative systems and show the resultant airspace structure and the land use and ground transportation plans.

A tabulation which compares important data for each alternative system is helpful also. The essential ingredients of such a tabulation are:

(1) Description of the consistency with the areawide comprehensive and surface transportation plan.
(2) The approximate dollar cost of aviation-oriented development for each period, including land acquisition costs.
(3) The approximate social cost in terms of the numbers and nature of residential, institutional, business/industry displacements required by land acquisition; and a qualitative description and rating of the environmental impact, including noise



exposure and ecological impairment.

(4) Airport access costs to the user of air transportation, both in time and dollars.

(5) Aircraft delay costs to the passenger and aircraft operator.

(6) Dollar costs of access systems.

(7) A rating for how well the airspace will be utilized and the efficiency of air traffic handling.

(8) Quantitative value for constraints (reductions to unconstrained forecast of potential aviation demand).

(9) Qualitative assessment of political and citizen acceptability.

59. The Airspace. The element most likely to have the greatest effect on the number of alternatives that can be considered will be airspace requirements. In inventorying the existing system (Chapter 8), the current use of the airspace was ascertained. In developing general facility requirements, the feasibility of expanding existing airports was determined based, in part, on the availability of adequate airspace. In assembling the various alternative systems, inter-airport airspace relationships must be examined, eliminating those that clearly will not be acceptable from the standpoint of the safe and efficient use of the airspace. The FAA will indicate which alternatives are clearly not acceptable, those that are most acceptable, and those that are acceptable with limitations.

60. Land Use and the Environment. Improvements in the aviation system, particularly major expansion of existing airports and the development of new airports, will produce impacts, both positive and negative, on the environment. The development of facilities as part of the comprehensive plans and policies for the metropolitan area will assure maximum benefit to the affected community. The aviation system development will benefit from zoning protection in

those areas not controlled by the aviation authority.

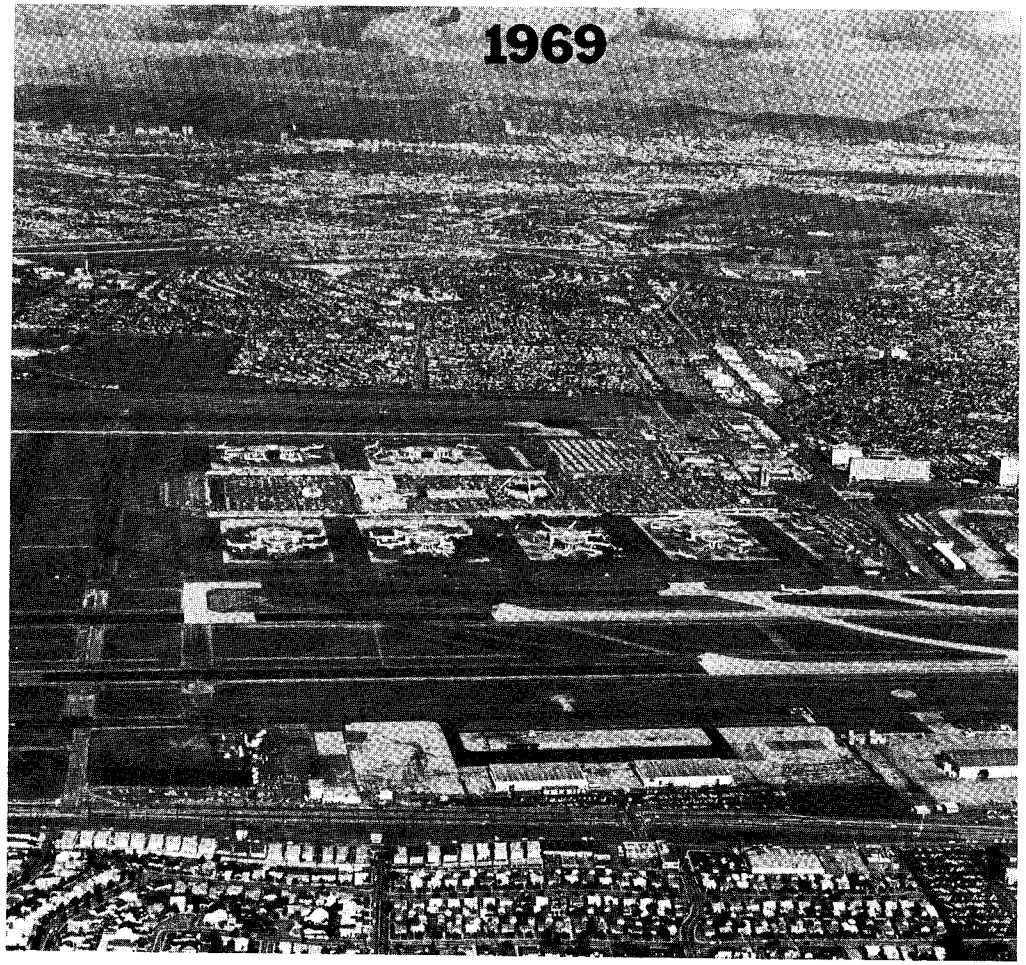
An important planning tool in fitting the alternative airport systems into the public plans and policies of the metropolitan area in terms of land use and the environment is the areawide Comprehensive Plan. The Comprehensive Plan provides a long-range statement of goals and objectives for a wide range of metropolitan development activities, including highway, transit, recreation, open spaces, water, sewerage, and utility systems, and residential, industrial, commercial, and institutional land uses.

The principal impact on the positive side is the obvious stimulus for economic growth and the requirements for related facilities and services. However, this generation of productivity and related employment opportunities could be offset by the negative impacts in terms of noise and air pollution and ecological compromises.

Thus the sought-after goal is the mutual compatibility between airports and their environs.

a. Social and Physical Environment—Major developments in aviation may affect the urban and natural environment. Through the creation of greater accessibility and urban land markets, major developments in aviation may affect metropolitan and community development. The direct impact, therefore, upon the social environment and the physical environment conceivably renders aviation system development an extremely strong force in shaping community form. This is the real nature of environmental impact of aviation system development upon the principal external determinants of community form.

One may view the principal internal determinants of community form as the linkage system, the support facilities system, and the housing system. The physical environmental impact of aviation fa-



cility development obviously relates to these basic internal determinants of community form. It is, therefore, obvious that coordination of aviation system development with community planning, design, construction, and management is essential so that impact may be positive and constructive.

b. Aircraft Noise—In developing the alternative systems the planner must carefully assess the potential noise impact of each system and what would have to be done at each airport and its environs in each alternative system in order to minimize the noise effect. The aircraft noise problem is probably the severest of the negative environmental impact aspects of airport development and the principal cause of the unpopularity of airports. A coordinated approach to the noise problem requires action on the part of government, the manufacturers, the operator, and finally, the community.

A national program of engine modification to reduce the noise at the source should result in somewhat quieter aircraft in the future. Noise abatement procedures and special operational restrictions have resulted in substantial noise reduction at existing airports. Airport layouts which direct the noise away from built up areas must be a principal consideration in the development of new airport facilities.

However, the most effective means of reducing noise impact is through land use controls on and surrounding the airport. The effectiveness of the principle of land use control will depend on whether the environs are open or built up. At existing impacted urban airports, land use controls are of limited value. In any event the strategy employed in a given situation will depend on whether its application is preventative or remedial in nature. Methods of land use control include (1) purchase for direct airport use; (2) conversion to a use compatible with expected noise levels; (3) acquisition of avigation easements; (4) application of zoning and building codes.

(1) Ownership of Land—Airport ownership of noise-exposed land is the most positive method of providing space between noise generated from aircraft operations and the surrounding noise sensitive areas, particularly residential developments.

Land may be acquired for future airport expansion or for other public purposes but Federal airport development funding is available only for demonstrated airport expansion needs. If for airport development, it may be possible to utilize the land in the interim for aviation-related activities or for agriculture and recreation uses which are not sensitive to air and noise pollution. Factors to be considered would be applicable Federal regulations covering the use of land acquired for Federally financed airport development projects and the Federal tax laws relating to the tax-exempt status of so-called "industrial development" bonds. If land is acquired for non-airport development, the airport authority will probably require the enactment of comprehensive new enabling legislation. Where such acquisition is made, uses compatible with higher noise levels and with local community development should be encouraged.

Current Federal studies indicate that at existing airports in built-up areas, the costs of all but very limited land conversion programs are astronomical. Available data also indicate that resale of acquired land for noise-compatible uses can recover only a fraction of the costs of acquisition.

There are also many financial and legal obstacles to such a program, including local legal and fiscal restraints which in-

hibit the availability of public funds to acquire the property for conversion. But the most serious obstacles are social and political. A study at one major metropolitan airport showed that even a limited land acquisition program would displace more people than the total number of people displaced during the entire 20-year history of the Federal urban renewal program throughout the United States!

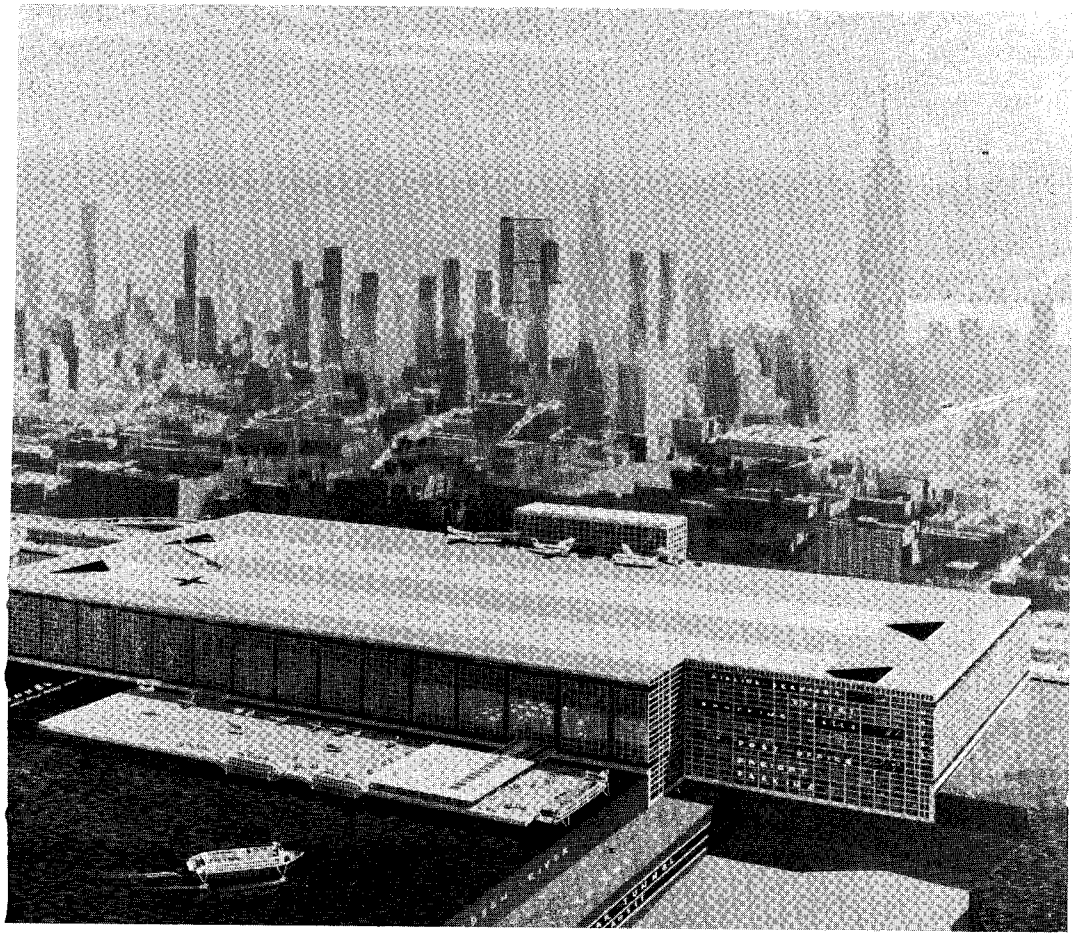
(2) *Avigation Easements*—A method for controlling land use short of outright purchase is the acquisition of an avigation easement, which is the purchase of the right for aircraft to fly over a property. One drawback of this method is that easements may, in the long run, cost more than outright purchase if the character of the airport changes substantially and creates possible liability for a second "taking."

(3) *Zoning*—Zoning, in general, falls into two distinct categories. One is a "police" type zoning, which is based upon safety. A typical example is zoning to limit the height of tall buildings, towers, or other structures which penetrate the flight path of aircraft taking off or approaching an airport. The other type of zoning is an "economic use" type of land use zoning. It normally protects residential areas from encroachment by industry and business. In a few cases, it protects industry and business from residential encroachment. It is the latter type of zoning that is desired near airports.

The use of the zoning power has a number of major shortcomings. First, it is not retroactive and does not affect present zoning uses that will conflict with airport operations.

Second, the prospective application of noise zoning may well result in an impermissible appropriation of property. For

Proposed STOL-port for downtown New York City



example, the zoning of vacant land in a residential area for industrial use where there is no demand for such activity would constitute an unconstitutional taking. Indeed, the use of the zoning power to solve a noise problem by regulating the adversely affected property in a way which would cause financial loss to the owner, may well be an invalid use of the zoning power.

Third, jurisdictions with zoning power (usually cities, towns, and sometimes counties) rarely take effective zoning action. This is partly because practically all airports affect several jurisdictions and the coordination of zoning is difficult, and partly because the zoning power lies not with the airport operator but with local communities that are often subject to local political and development pressures. When land developers wish to promote residential development, they are often successful because they have more politically persuasive powers than do the aviation interests. This problem is particularly acute when one political jurisdiction owns the airport and the surrounding area is in other political jurisdictions.

Fourth, zoning based on the noise sensitivity of various land uses and activities will require the development of a more sophisticated vocabulary on this subject than is presently available. One complication to the noise zoning approach is the vast difference between activities that fall into the same land use category. Another is the varying noise sensitivity that would result, not from the activity itself, but from the construction characteristics of the affected building.

In any event, an important point to be remembered concerning zoning philosophy is that zoning should be used to protect the airport and its vicinity once a good airport location has been selected rather than to overcome the problems of an impacted urban location. Several sources of information on airport zoning are *Local Planning Administration* (edited by Mary McLean) and *Land Use Control* (Interagency Group on International Aviation . . .) (See Appendix B—Bibliography). The latter contains suggestions for innovative concepts for compatible land use development. The reader's attention is also called to the Minneapolis-St. Paul "Airport Zoning Act"; Appendix F.

(4) *Compatibility in Peripheral Areas*—While noise problems are most critical immediately adjacent to the airport and under major flight paths, residential areas, either existing or proposed, in peripheral areas may also be affected. Acoustical insulation can provide considerable attenuation of noise inside residences; therefore, it may be possible to use building methods effectively to minimize the impact of the noise environment. The same building qualities which provide thermal insulation are usually effective for acoustical insulation and vice versa; therefore, the cost of improved acoustical qualities can be shared with other benefits. The financing of improvements in the acoustical attenuation of residences subject to noise exposure would be materially assisted by programs to recognize and reimburse the social costs of aircraft noise impact.

A serious drawback to the concept of insulation of structures, as applied to residential properties, arises from the fact that people use and enjoy the outside areas of their property during certain months of the year fully as much as the inside areas

of structures on the property. Yet expensive building insulation provides no protection from aircraft noise for such outdoor activities.

Moreover, the possibility that municipalities surrounding airports might adopt local building codes which require land owners to insulate their homes against aircraft noise may present grave constitutional problems. The United States Supreme Court has held that it is the aviation industry which causes the noise and it is not the affected property owner who must bear the unavoidable damages and costs resulting from low overhead flights that constitute "taking" of property within the meaning of applicable constitutional provisions. [United States v. Causby, 328 U. S. 256 (1946); Griggs v. Allegheny County, 369 U. S. 84 (1962).]

It must be stressed that in the more critically affected areas, any actions taken in respect to noncompatible uses should, in some way, contribute toward the eventual conversion of that land to noise compatible usage.

(5) *Calculating Noise Exposure*—The calculation of forecast cumulative noise exposure for each airport in each of the alternatives can be accomplished by use of FAA promulgated methodolgy. Currently in use for determining noise exposure is the Composite Noise Rating (CNR) technique contained in the Bolt, Beranek, and Newman Report "Land Use Planning Relating to Aircraft Noise" (October, 1964). It is expected that a new methodology, the Noise Exposure Forecast (NEF technique) will replace the CNR method. See figure 11.

It is emphasized that the CNR and NEF forecasting techniques are useful for planning purposes only. They provide a valuable estimate of aircraft noise impact over a large area. Neither a CNR nor an NEF can accurately determine the actual aircraft noise annoyance—that is, the degree of interference, if any, with the use of property—at any given specific location.

Advanced technology aircraft such as the supersonic transport will require individual analysis and attention as information on their noise characteristics becomes available.

With proper planning, airports can be compatible with residential areas such as these.

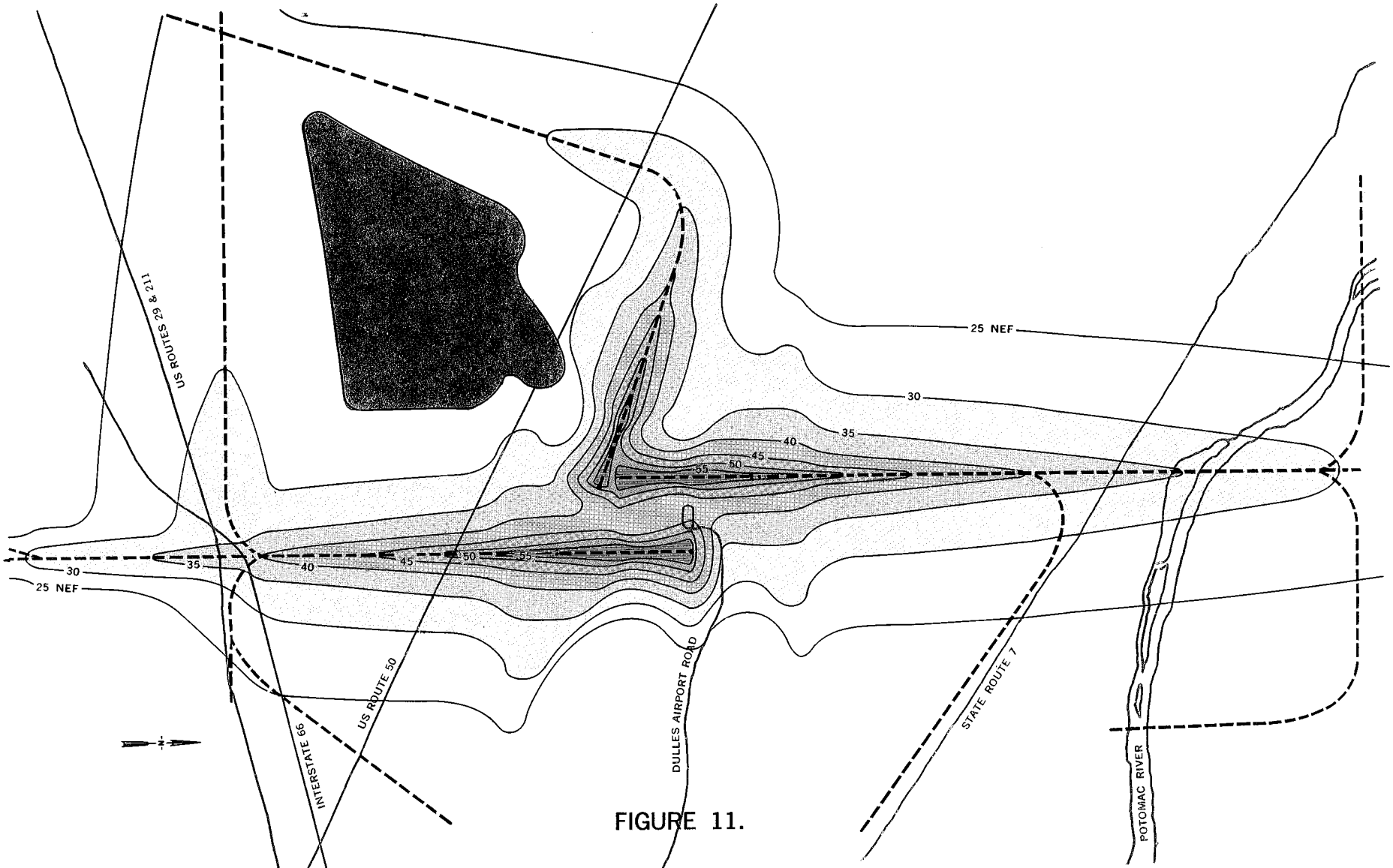


FIGURE 11.

NOISE EXPOSURE FORECAST (NEF) CONTOURS FOR 1975 OPERATIONS—
DULLES INTERNATIONAL AIRPORT, WASHINGTON, D.C.

c. Air Pollution—While there is evidence that aircraft engine emissions constitute only one percent of the total air pollutants in a typical metropolitan area, this facet of the environmental impact of airport operations cannot be overlooked. It is evident to the observer on the ground that exhaust smoke does exist and that contaminants are emitted into the environment.

The Federal Government and industry also are keenly aware of the public reaction to engine exhaust emissions and are jointly working towards alleviating the problem. As this is an easier problem to resolve from a technical and economic aspect than the noise alleviation problem, it will likely be eliminated in the foreseeable future as a factor which the airport system planner must deal with.

d. Natural Environmental Values—Public opposition to aircraft noise and the increasing requirements for land and airspace are causing new airports to be located away from built-up areas. But the open countryside does not necessarily produce an environmental acceptable site. Potential effect on the ecology must be considered in developing the alternative systems.

Sites located in or near national parks and wilderness areas or areas designated as wildlife/waterfowi refuges, public recreation areas, and historical monuments should not be considered for airport development unless there are no feasible alternatives. Also, expansion of existing airports into, or adjacent to, such areas should be avoided where possible.

e. Federal Role in Environmental Problems—Section 4(f) of the Department of Transportation Act requires responsible Federal action in assuring the protection of natural environmental values through the following provision:

"It is hereby declared to be the national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites. The Secretary of Transportation shall cooperate and consult with the Secretaries of the Interior, Housing and Urban Development, and Agriculture, and with the states in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed. After the effective date of the Federal-aid Highway Act of 1968, the Secretary shall not approve any program or project which requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowi refuge of national, state, or local significance as determined by the Federal, state, or local officials having jurisdiction thereof, or any land from an historic site of national, state, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use."

Section 4(f) represents an important step in an attempt to prevent further encroachment on environmental values. A new awareness has been created at all levels of government, and in the public in general, that our natural resources are being threatened and that this threat must be alleviated. A far-reaching Federal law to protect and enhance the quality of the Nation's environment and natural resources was enacted on January 1, 1970. Public Law 91–190, the National Environmental Policy Act of 1969, declares a broad national environmental policy which calls on the Federal Government to exercise leadership and use all practicable means for improving and coordinating Federal plans, functions, programs and use of re-

sources with the goals of preventing damage either to the environment or ecological systems and encouraging mutual productive harmony between man and his environment. The Law also established, in the Executive Office of the President, a Council on Environmental Quality to develop guidelines for agencies affected by the Law.

Insofar as airport development is concerned, any required Federal actions regarding proposals that significantly affect the quality of the human environment must be accompanied by findings concerning:

(1) The environmental impact of the proposed action.
(2) Any adverse environmental effects which cannot be avoided should the proposal be implemented.
(3) Alternatives to the proposed action.
(4) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
(5) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action, should it be implemented.

All forms of transportation have been focused on as principal contributors to environmental pollution. The noise and exhaust emissions from motor vehicles and aircraft as well as the rights of way and structures on which they operate have been identified as problems.

A new dimension has been added to the airport planner's job. Airport development that focuses only on the requirements of the user without emphasis on the protection, and even enhancement, of the environment, will no longer be tolerated. This added dimension should not be viewed as a deterrent to technical progress, but as an opportunity to develop new and innovative ideas that enhance technical progress by linking it to the preservation of natural aesthetic land functions.

Involvement in the development of the system plan by new disciplines capable of thoroughly analyzing the environmental aspects of the several alternatives must be considered. Thus, the normal professional staff consisting of architects, engineers, economists, and planners should be enlarged to include the environmental specialist, or ecologist.

61. Ground Transportation Planning. In determining general facility requirements (Chapter 11), general areas for new airports were based, in part, on accessibility to the users of air transportation. In developing alternative systems, which include new airport sites that are more specifically (but not precisely) plotted, the relationship of the new airports, as well as the existing ones, to ground transportation facilities is a significant one. The obvious necessity for developing aviation system facilities in a manner consistent with the development of other modes of transportation in the metropolitan area is recognized. Such coordinated development will insure maximum effectiveness to users of the metropolitan airport system.

The urban transportation studies established under the 1962 Highway Act in most metropolitan areas are typically responsible for the planning of freeways and other major highways and streets. As the magnitude of traffic surcharge generated by major aviation system facility development may be staggering, the volume and distribution of the surface trip ends throughout the urban area for each alternate airport system should be obtained. A modal split and assignment can be made to determine relative impacts as far as traffic volumes, user costs, travel times, and access facility costs are concerned.

In many metropolitan areas a designated public agency is responsible for conducting a study of conventional mass transportation. These studies have been funded under programs of the Department of Housing and Urban Development. Presently, funding is principally available through the Urban Mass Transportation Adminstration of the United States Department of Transportation.

Close examination must be made of possible programs employing new and innovative approaches to high speed ground access to major aviation system facilities. It is anticipated that in many metropolitan areas such high speed ground access will be required after the facility is opened and at such a time when conventional ground access, by way of freeways and conventional mass transit, will become inadequate to service traffic demands generated by the aviation system and its component facilities.

Basic to the transportation planning process is a specific analysis of the inter-relationship of economic activity and surface transportation. Forecasts of levels of population, employment, retail sales, etc., may be correlated with transportation system requirements. A preliminary analysis of proposed aviation system facility development in a given metropolitan area may well indicate that a demand for travel by surface highway access alone would exceed that which could be handled by such facilities.

Any transportation analysis associated with the development of major aviation facilities must include an investigation of terminal and transfer requirements, recognizing the role of all appropriate modes of transportation. Transport planning, a vital part of the comprehensive planning process in a metropolitan area, must include a comprehensive evaluation of all possible systems for transportation to and within the aviation facility development.

The development of major aviation facilities may provide opportunities within a community for successful mass transportation operations not otherwise possible. Mass transportation has failed economically in many large metropolitan areas with large central business districts as massive single traffic generators. Studies have revealed that the failure of public transit in many major metropolitan areas may be attributed to the lack of sufficient demand on both ends of proposed transit corridors. In many large cities, transit corridors extend into suburban fringes which generate little sustaining transit patronge. Major aviation system development may create the necessary demand for a transit corridor in many metropolitan areas.

On the other hand, airport surface travel demand may not be able to support an exclusive mass transportation line or system. Airport mass transportation service can generally be justified only when considered as a portion of an overall metropolitan-wide system. This is because the greatest percentage of airport-oriented trips are dispersed throughout the urban area.

62. Military Airports. Some of the large metropolitan areas will have one or more military owned airfields in or adjacent to them. Whether and for how long these airports will continue on an active basis are critical determinants in the development of alternative systems. The airspace consumed by such facilities may be extensive and the potential civil use may be considerable. Thus, deactivation may be a worthwhile action. Experience has shown that answers to questions on the long range, and even immediate, posture of military facilities are often difficult to ascertain. It may be necessary in some cases to place qualifications on the alternative systems pending answers to questions on future military activities. Where

conversion of military facilities to joint use or total civil use could profoundly benefit the metropolitan airport system, community leaders should aggressively pursue this objective. Where applicable, the alternative should outline the necessary steps for civil acquisition or joint use through coordinative efforts with the local base commander and the Department of Defense. The FAA should be called upon for advice in this endeavor.

63. Demand Constraints. Some, if not all, of the alternative systems, may indicate potential constraints to forecast demand. Potential constraining factors which may be applicable individually or in combination are:

a. Airspace Limitations—Interaction between airports, particularly for IFR operations, may preclude the provision of sufficient capacity in terms of additional runways and new airports. The planner should consult the FAA to determine precisely what limitations will prevail and what infringement to spacing guidelines are acceptable. Potential improvements in airspace capacity, such as new developments in area navigation, should be accounted for in long-range planning. The possibility of reducing the constraint by including a greater share of the short-haul (150 to 500 miles) airline traffic in the V/STOL demand may be necessary. In this way, there is a resultant efficiency in the use of airspace, and there is greater flexibility in locating landing areas.

b. Land Limitations. Existing airports may be locked in from an expansion standpoint, and possible new airport sites may be at such a distance from the users that high costs of ground travel will preclude realization of potential cargo and passenger traffic (particularly short-haul traffic). A re-evaluation of the unconstrained forecasts may be necessary to adjust the distribution of short/long-haul passenger traffic and the cargo totals. Consideration must be given to competitive surface transport modes and their effect on the forecasts and to the potential of V/STOL for carrying a greater share of the demand. Additionally, commuter airlines and air taxis can provide an important transportation service by accommodating the feeder service (50- to 150-mile trips) at major activity centers served by general aviation airports.

c. Airport Ground Access—Improvement of surface transportation may not be possible for carrying peak airport loads, thus making airport capacity improvements pointless. Again, the potential of V/STOL should be re-examined, as well as the potential of competing modes, particularly for the short-haul traffic.

d. Environmental Impact—Although existing airports may be expandable physically and economically, such expansion may be unfeasible because of a history of mass complaints from highly built-up residential areas, hospitals, schools, etc., about noise. The potential for developing new airports within reasonable access to the users may be limited by these factors.

Also, the expansion potential of existing airports, in addition to the sites for new airports, may be affected if airport development impairs the natural beauty of the countryside or public recreation wildlife and waterfowl areas, or places of historical significance. Usually, this constraint relates to conventional airports. If there is no practical alternative in terms of CTOL airport development, V/STOL and other modes of transportation might be considered for reduction to constrained demand forecasts.

e. Financial Considerations—A basic justification for the system plan and the development timing will be the benefits they produce relative to their cost. While this relationship must be a favor-

able one, it is possible that the development financing is not available. In estimating potential Federal and state matching grants, local revenue and general obligation lending capabilities and what reasonable revenue-producing concessionaire and user charges can be expected, it may be determined that capital alternatives and alterations to the plan's timing must be considered. This may constrain demand or produce a less favorable benefit-to-cost relationship.

As an example, the ideal plan may propose the establishment of a new jetport convenient to the center city. The benefits to the users in surface access costs are obvious but the land costs may be unusually high. If such a facility is contemplated to be built in a body of water, the construction cost may be exceptionally high. The alternative that considers a location considerably further away from the city center may be within financial reason but may produce high surface access costs to the passenger. The immediate provision of an additional runway at an airport may prevent aircraft delays and thus lower aircraft owner costs; however, the expense of the development may preclude its immediate implementation in favor of increasing aircraft delays to a tolerable, yet somewhat costly level.

f. Political Considerations—Without political support, the "best" alternative plan may never be implemented. This document stresses the importance of appropriate participation and agreements among the many political entities involved in airport planning and development in the metropolitan community. Keeping the significant authorities informed and involved in the planning effort is necessary if the required support is to be generated. This continuing communication also gives the planner insight as to which alternatives will not be acceptable, which to pursue, and accordingly, how to adjust the plan to make it politically acceptable. Environmental and financial problems may result in a plan that is politically unsupportable. On the other hand, there will be cases where a political subdivision covets the location of an airport in its jurisdiction because of potential economic gain.

64. Identification of "Reliever" Airports. The Airport and Airways Development Act of 1970 gives top priority to financing development for airports which primarily serve general aviation and provide relief to air carrier-served airports by diverting the general aviation traffic from them. This lessens the mixing of aircraft of different performance characteristics at the air carrier airport and provides additional capacity at less cost than would be incurred at the air carrier airport.

The criteria for what constitutes a "reliever" airport are promulgated by the FAA and are contained in the instructions to FAA field personnel for preparing the National Airport System Plan. It is highly desirable to apply these criteria to the alternative systems and identify the general aviation airports which qualify as "relievers" and are entitled to special considerations in Federal financial assistance. The FAA should be contacted for these criteria.

CHAPTER 13. EVALUATION OF ALTERNATIVES

65. General. Having developed several alternative system plans (Chapter 12) it is now necessary to select the "best" alternative, keeping in mind that a second, or even third, alternative may be that which is finally selected. The comparative data tabulation suggested in Chapter 12 is most useful in the process of selecting the best alternative.

Since this is the final stage in developing the basic system plan, it is necessary to secure a firm position on the various alternatives from the FAA which manages the airspace and air traffic control system and which will probably share a substantial portion of the capital improvement costs. Also of great importance will be a firm statement by the airlines on the airline-oriented development contemplated in each of the alternatives insofar as the carriers will be financially involved in the development costs.

While the various alternatives that have been considered will have taken into account the views of the participating and non-participating agencies, formal coordinations with them should take place after selecting the "best" alternative and prior to adoption.

66. Coordination. Coordinate with the following agencies at the local, metropolitan, state, and Federal levels:

— areawide metropolitan planning agency
— other regional planning agencies
— metropolitan transportation study agency
— metropolitan transit authority
— airport or port authorities
— statewide planning office
— state department of transportation and/or state highway department
— state aviation department
— special service districts
— U.S. Department of Transportation field offices (including FAA and FHWA)
— Urban Mass Transit Administration (UMTA)
— U.S. Department of Housing and Urban Development
— U.S. Department of Interior (Bureau of Outdoor Recreation State Director)

67. Plan Adoption. Adoption of the airport system plan by the airport policy-making body is meant to be more than a formality. It provides assurance that the airport system plan represents a unified set of policies agreed to by the policy-making body. The crucial point is not whether this group takes the formal step of adopting the plan but whether the plan actually embodies the policies of the group.

Primary responsibility for adoption of the metropolitan airport system plan rests with the policy body (see Chapter 4, "Organization for the Airport System Planning Process"). The areawide airport system plan should attempt to reflect the mutually agreed upon policies of all public and private agencies having an airport interest within the metropolitan area. It is desirable for the plan to be adopted or approved in principle by all agencies concerned. This would include local jurisdictions such as cities, counties, and special districts whose jurisdiction underlies flight patterns; who plan, construct, and maintain airport facilities (e.g., the county general aviation airport); who lie adjacent to an airport facility; or who are affected by operations related thereto.

Private airport interests do not adopt the airport system plan as governmental agencies adopt it. It is desirable, however, for the board of directors or other policy-making body of these private interest groups to recognize the metropolitan airport system plan by resolution.

Metropolitan airport system plans must inevitably reflect a great number of compromises by the area's public and private airport interests. Normally long periods of debate, discussion, and mutual education will be required. The period between the first presentation of the metropolitan airport system plan in tentative form and its ultimate adoption by the responsible airport planning agency in revised form may take six months to two years. During this period,

the various airport interests will be engaged in studying the proposed plan, devoting work sessions to it, and conducting hearings.

Quick adoption of a metropolitan airport system plan can be a long-term mistake if sufficient time is not provided for expression of the legitimate interests of all parties involved.

The generalized sequence of activity leading to and including the adoption are:

1. Staff preparation of the preliminary version of the plan;
2. Presentation to the policy-making body (and policy-advising body, if any);
3. A period of review by the agency and the public;
4. Adoption of the plan by the policy-making body, by resolution since the plan is not a legislative document; and
5. Mutual adoption as is appropriate by other jurisdictions within the metropolitan area with an interest in the airport system plan.

Upon adoption, the metropolitan airport system plan should be forwarded to all appropriate public agencies. The purpose is not to solicit reaction, but to communicate the publicly expressed adopted policies which henceforth will guide airport development within the metropolitan area.

If the policy body has statutory authority, it may wish to adopt official maps designating parcels needed for sites and access rights-of-way for airport facilities for future or expanded airport facilities shown in the metropolitan airport system plan. Adoption of official maps is a logical step subsequent to plan adoption. Depending upon the relative scarcity of large usable and available tracts of land required for tomorrow's airports, this legislative step may be critical in the provision of airport facilities which the metropolitan area determines will be needed.

The policy body may work with and encourage local jurisdictions within the metropolitan area to adopt official maps for airport facilities shown on the metropolitan system plan which lie within those local jurisdictions.

68. Plan Format. The format of the plan should consist of a summary document for general public consumption and one or more technical documents for those who need to be familiar with the detailed basis for the system plan.

The *summary document* should be concise, avoid highly technical discussions, and be well illustrated. Illustrations should include a plan portrayal showing the locations and general configurations of each existing and new airport in the system for the three time periods and showing the projected land uses and urban ground transportation systems. See Figure 12.

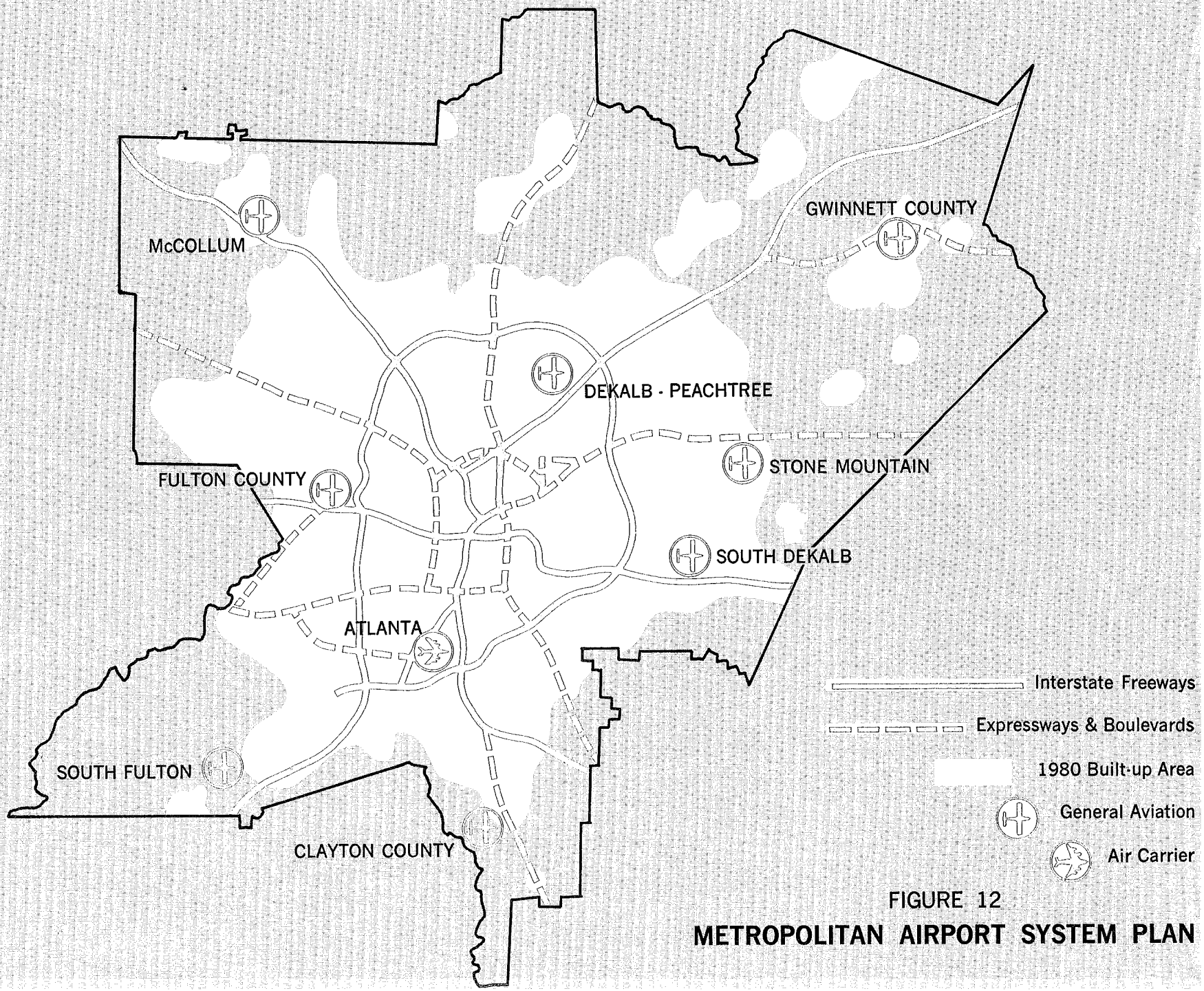


FIGURE 12

METROPOLITAN AIRPORT SYSTEM PLAN

Discussions should include a description of the expansion proposed for each existing airport in the system for the three time periods, as well as the timing, type of development proposed, and general locations of new airports. A description of the existing and recommended types and timing of air navigation aids and air traffic control facilities should also be provided.

A history of aviation development in the metropolitan area, the Nation, the future air transportation scenario, and the related rationale for the development proposed should be discussed.

An illustration and discussion of the organizational structure of the airport system planning study should be provided, as well as a discussion on how the airport system plan relates to the comprehensive and urban ground transportation plans and the urban environment.

Finally, there should be provided a summary of costs and anticipated revenues; a financial plan; a discussion of how the plan will be implemented; and a description of the organization and procedures for the continuing planning function.

The technical documents should include a complete description of the technical planning process and all of the inventory and study data developed, and, as appropriate, background on the organization of the study and a description of the coordination results. The rationale for the financial and implementation plans and the organization and procedures of the continuing planning process should be provided.

Section IV. Implementation and Continuing Planning

CHAPTER 14. PLAN IMPLEMENTATION

69. General. Assuming that there has been general adoption by public airport owners of a system plan, the recommended development should be undertaken in a timely fashion. Depending on the relative ease with which the plan was accepted in the public arena, opposition to development should be minimum, at least substantially less than that which could have been expected without a well-publicized plan. Additionally, the complexities of applying for and receiving Federal and state financial assistance as well as favorable airspace determinations should be substantially reduced and the eligibility and priority of development clearly established.

Chapter 6, General Criteria and Policy Objectives, pointed out that the feasibility of establishing a regional airport authority to own and operate key system airports should be a policy consideration at the outset or later in the planning process. Such a consideration is highly warranted in view of the benefits that are possible, particularly in the implementation of the plan. Regardless of the reaction of the public airport operators in the metropolitan area to the plan, there will exist a competition for services, for the aviation market and most importantly for resources. The efficiency indicated by reducing this competition by the establishment of a single airport authority is well worth an attempt to organize as many public airports as possible under one roof.

70. Financing. The implementation of the metropolitan area airport system plan is largely dependent on the proper financing of capital improvements. There are many ways in which public financing of airport development can be accomplished.

The primary responsibility for financing the development plans remains in the hands of the local operating agencies or authorities. Financing may be raised from taxes, General Obligation Bonds, Revenue Bonds, private financing, and Federal and state assistance.

General Obligation Bond financing for airport improvements, backed by taxing powers, has been used for financing. However, fiscal pressures on local governments for all manners of activities have been especially great in recent years. The need for school construction and other essential public works has required a considerable volume of general obligation bond financing. In numerous cases local governments have reached statutory bond limits, or they desire to reserve whatever margin is left for more general functions of government. It is becoming increasingly difficult to obtain taxpayer approval for general obligation bond issues for airports.

Revenue bond financing for airport improvements has become the most common financing method. Financing with revenue bonds presents an opportunity to provide improvements without a direct burden on the taxpayer.

Private financing of specific facilities such as hangars, fuel distribution systems, even hotels and the like, may be practical. Such facilities can be constructed with private capital on land leased from the airport. The obvious advantage of such an arrangement is that it relieves the community of all responsibility for raising the capital funds for the particular improvements involved.

Another method of obtaining capital for the construction of buildings is through the nonprofit corporation approach. In some jurisdictions, the law provides for the formation of a nonprofit corporation to be used for the financing of improvements for the benefit of a local governmental agency. The principal requirement is that the improvements constructed will revert to the governmental agency after the bonds issued for the construction of the facilities have been retired. This method of financing can be used for the construction

of facilities to be used by single airlines for a maintenance hangar and air cargo terminals.

71. Land Acquisition. Although land requirements will vary considerably as to the type of aviation facility to be developed, it will be necessary to formalize a program for the acquisition of land to insure that the land will be available when projected demand for the facility becomes apparent. Various methods for acquiring land such as negotiated purchase and eminent domain proceedings can be utilized. However, the actual method adopted will depend on the municipality where the land is situated.

Rapid urbanization and the accompanying competition for large, well located tracts of land in and near metropolitan areas will make future airport sites scarce, unavailable, and expensive. Advanced land acquisition for future airport development is thus highly desirable, if not a necessity. The Federal Government has had a program of financial assistance for advance land acquisition. Under the Housing and Urban Development Act of 1965, grants are authorized not in excess of the aggregate amount of reasonable interest charges on funds borrowed locally to finance acquisition for a period of five years from the date the loan is made or such financial obligation is incurred until an earlier date when construction starts.

While zoning and land-use planning can be considered as devices for protecting open areas for future airport use, their effectiveness is questionable. The outright purchase of the land, although politically difficult, remains as the most effective measure for reserving future airport sites. While today's purchase price will undoubtedly be surpassed substantially by the future value of the land, the current expense will be significant. However, interim income producing use can be accommodated as long as such use will not derogate the future of the site or its environs for airport purposes.

Other methods for reserving future airport sites are: the purchase or an option to buy at some future date; the purchase of easements structured in a manner that would make future airport development practical; and the purchase and resale of the land with deed restrictions.

CHAPTER 15. THE CONTINUING PLANNING PROCESS

72. General. A continuing airport system planning process is necessary in order to respond to the air transportation needs of the community in a changing environment. Changes in community policies, inability to implement some elements in the original plan, advances in aviation technology, and revisions to comprehensive and surface transportation plans must be accounted for in the airports system planning process. Current, valid data concerning land use, travel, and transportation facilities must be maintained as well as a continuing validation of demand forecasts, airport operation and utilization, environmental impact, and financial capabilities.

A continuing reappraisal of the organizational structure and its effectiveness in carrying out the continuing planning function may also be appropriate. It is becoming increasingly evident, for example, that substantial mutual benefits would be accrued from "total" transportation planning in a metropolitan area by directly linking the airport system planning program to the existing urban transportation planning program. Whereas the urban transportation study as required by the Federal Highway Act of 1962 may have been highway-oriented in the past, the bringing together of most Federal transportation programs under one unit of government, the Department of Transportation, signals a shift in this orientation at the local level to total transportation planning.

Thus, if the organizational structure for airport system planning does not provide for the urban transportation agency as the key technical planning body, this possibility should be explored for the continuing planning effort.

The essential ingredients of the continuing airport system planning process are surveillance, reappraisal, service, and a periodic report.

73. Surveillance. The maintenance of aviation demand, land use and environmental impact data, airport system, and surface transportation system characteristics on a current basis is necessary, (1) to properly compare and evaluate the existing conditions in relation to the forecasts made in developing the recommended plans and programs and, (2) to determine if the assumptions made previously are holding over time. Current estimates of changes in other metropolitan area characteristics such as population, employment, or other socio-economic factors are required. The urban transportation planning study, as well as other metropolitan planning efforts, should be drawn upon for essential data. A most important ingredient of the surveillance program is the maintenance of information concerning the progress of airport development projects and how the complete projects are affecting demand characteristics and other airport-related elements.

Direct indications of traffic growth can be determined from the airport operator, and the FAA and CAB through their annual statistical publications.

Changes in land development policy should be identified in the detail necessary to evaluate their effect upon the future plans. These changes could be identified by recording new zoning ordinances, approved changes in existing ordinances, major zoning variances, new utility installations, transportation improvement projects, flood control, land reclamation projects, etc.

Other actions taken by local, state, and Federal governments and major private developers should be identified so that their effect can also be evaluated. These actions could include the approval of urban renewal projects, public housing, major subdivisions or industrial parks, water and sewer programs, open space, transit grants, and the action of local jurisdictions on the adoption of the plan.

The surveillance program should be conducted annually or semi-annually as each individual situation may dictate.

74. Reappraisal. Reappraisal is the systematic sequence of activities directed at maintaining the planning process as a valid and effective program.

The surveillance program should provide information on major changes of specific elements and signal the need for reappraisal of the current plan in light of the changes. In any event, a reappraisal of the plan would be indicated at least every five years. At that time, the forecast period should be pushed forward by five years.

The reappraisal, or plan reevaluation, should consider all the elements of the original planning process, including a reconsideration of community policy objectives, the planning organization itself, and a restudy of the financial resources and the development priorities. Also of importance will be an examination and updating of the technical procedures being used in light of the continually evolving transportation and comprehensive planning technology.

Should a major revision of the plan be indicated from the results of the reappraisal, a new plan, following essentially the same steps as were used in developing the original plan, should be developed and adopted.

75. Service. One of the main objectives of the continuing airport system planning process is the development of the capability to provide needed planning data and assistance to those responsible for plan implementation. The output derived from the planning forecasts and analyses has limited value until applied to the decision-making process. The service function should not be limited to the study participants; it should also include the other public and private sectors involved in community development and implementation programs.

Such services might include: supplying current and forecast socio-economic, land use, and traffic data; preparation and updating of maps; publicizing study recommendations; detailed analysis of various elements of the recommended plan; assistance in the development of state and Federal needs estimates; assistance to operating agencies responsible for implementing various proposals; and evaluation of alternative development plans that may be proposed from time to time. The true effectiveness of the planning process will ultimately be measured by the extent of its contribution to proper project selection and design.

76. Periodic Report. The continuing airport system planning process should not be limited to technicians and to technical and policy committee members. The entire process should be given exposure to demonstrate that the process is truly taking place and also to justify to the local citizens the continual expenditure of public funds.

The report, prepared to coincide with completion of a surveillance program, should include a quantitative summary of all surveillance items and, more importantly, it should summarize the degree to which the process has been successful. This can be accomplished through several analyses. First, what has been the progress in implementing the recommended airport system plan? Is land development occurring in a pattern that is consistent with the land use plan? The answers to these questions will lead to a re-examination of the total comprehensive planning and also of the steps taken to implement these plans.

In order to help coordinate private development with the construction of airport improvements, it is suggested that consideration be given to using the periodic report as a means of publishing results of the revised plan.

Appendix A. A Suggested Outline for a Metropolitan Airport System Study

A. Summary

1. Purpose and methodology
2. Conclusions
3. Recommendations

B. Study Organization

1. Policy objectives
2. Identification of issues
3. Limitations
4. Organization and procedures

C. Inventories

1. Airports
   a. Civil
      (1) Air carrier
      (2) General aviation
         (a) Publicly owned
         (b) Privately owned
      (3) V/STOL
      (4) Special purpose
   b. Military
   c. Expansion possibilities
   d. General operating criteria
2. Airspace and Navaids
3. Aeronautical activity
   a. Air carrier
      (1) Operations
      (2) Passengers
      (3) Cargo/mail
      (4) Local origins/destinations
   b. General aviation operations, based aircraft, owner distribution
   c. Air taxi operations/passengers
   d. Military operations
4. Environmental factors
5. Comprehensive/land use plans
6. Transportation plans
7. Socio-economic factors
8. Applicable laws, ordinances, regulations
9. Financial resources

D. Forecasting

1. Scheduled aviation
   a. Air carrier
      (1) Operations
      (2) Passengers
      (3) Cargo/mail
      (4) Local origins/destinations
   b. Air taxi
   c. V/STOL
2. General aviation
   a. Operations
   b. Based aircraft
   c. Distribution of owners
3. Military
   a. Operations at military fields

b. Operations at civil airports

4. Aircraft mix

E. Consideration of new technology

1. Aircraft
2. Air navigation
3. Ground access

F. System requirements

1. Aircraft operational requirements
2. Capacity/demand analysis
   a. Airfield
   b. Terminal
   c. Airspace
   d. Ground access

G. Alternative systems

1. Ranking of alternatives
2. Selection of system

H. Plan implementation

1. Political considerations
2. Environmental considerations
3. Timing of projects
4. Financing
5. Land acquisition
6. Recommended legislation/regulations/land use controls

Appendix B. Bibliography

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AC 150/5050-2 Compatible Land Use Planning in the Vicinity of Airports
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AC 150/5060-2 Airport Site Selection
AC 150/5060-3A Airport Capacity Criteria Used in Long-Range Planning
AC 150/5070-3 Planning the Airport Industrial Park
AC 150/5090-1 Regional Air Carrier Airport Planning
AC 150/5100-3A Federal-aid Airport Program—Procedures Guide for Sponsors
AC 150/5100-5 Land Acquisition in the Federal-aid Airport Program
AC 150/5150-2 Federal Surplus Personal Property for Public Airport Purposes
AC 150/5190-1 Minimum Standards for Commercial Aeronautical Activities on Public Airports
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Refer to Appendices C, Sources of Aviation Statistics, and D, Sources of Socio-Economic Data

Appendix C. Sources of Aviation Statistics

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
A. FORECASTS 1. Government	Aviation industry and air traffic activity at FAA towers:	National, Aviation industry	Active general aviation aircraft by FAA region	Annual	*Aviation Forecasts, Fiscal Years 19__–19__*, Office of Aviation Economics, Aviation Forecast Division, Federal Aviation Administration (FAA)
	Air carrier traffic, air carrier fleet, general aviation flying and aircraft fleet, domestic aviation fuel consumption, civil aircraft and engine production, and operations.	FAA towers—air traffic activity	10 year forecasts		
	Aviation demand and airport facility requirements at large air traffic hubs: Aviation demand for each hub, 1970, 1975, 1980. Includes methodology.		22 Hubs	August, 1967 only	*Aviation Demand and Airport Facility Requirement Forecasts for Large Air Transportation Hubs through 1980 FAA.*
	Aviation facility requirements for each hub for 1980. Includes methodology.				
	Same as above but for medium air traffic hubs.		35 Hubs	January 1969 only	*Aviation Demand and Airport Facility Requirement Forecasts for Medium Air Transportation Hubs Through 1980, FAA.*
	Air carrier departures and passengers for each air carrier airport; based aircraft Forecasts for each airport for total, itinerant, and instrument operations and instrument approaches.	SMSA's, Cities and Urban Places	Includes all air carrier and tower airports, but only non-tower meeting certain admission criteria.	Annual	*Terminal Locations for Planning Purposes CY 19__*, Air Traffic Service, Executive Staff, FAA.

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
	Forecast of domestic passenger traffic for scheduled air carrier service. Three (3) forecasts based upon three different assumptions for fares.	Domestic trunk line carriers	Revenue passenger miles only.	Irregular	*Forecast of Domestic Passenger Traffic for the Eleven Trunkline Carriers, Scheduled Service, 1968–1977*, Bureau of Economics, Civil Aeronautics Board (CAB).
2. Industry	Forecasts for planning airport facilities: National aggregate and individual airport forecasts for passengers, cargo, and aircraft movements—1970, 1975, 1985.	National, 22 Hubs.		Project by phases	*ATA Airline Airport Demand Forecasts*, Air Transport Association (ATA).[1] [1] This is a continuing joint Airport Demand Forecast Study by ATA, member airlines, and gov't./private contributors.
	General aviation history and forecasts for the general aviation fleet; distribution of fleet in 75 top SMSA's; hours flown; aircraft movements; airmen; and,economic impact.	National	Total only aircraft in SMSA distribution. Forecast years 1970, 1975, and 1980.	April 1969, only.	*Fact Book on the Magnitude and Economic Impact of General Aviation*, Aerospace Industries Association (AIA).[1] [1] This report was condensed from a study of the general aviation industry which was prepared by an aviation consultant firm for the Utility Airplane Council of AIA. (Now the General Aviation Manufacturers Association)
3. Consultants	Depends upon the method of economic analysis used by any particular consultant and the metropolitan area situation.	Variable		Irregular	Aviation-oriented consultant firms.[1] [1] Desired aviation statistics for any particular metro. area are obtained either by an information search for what has been previously done by consultants or by a contracted research effort.

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
B. AIRPORT					
1. Airport facilities	Airport facilities listing by state and county—(by airport and associated city): Based aircraft, operations, runway length, acres, fuel used, etc.	7 FAA Regions, 50 States, All counties, and Urban Places		Annual	*Airport Facilities Listing by State and County,* (Machine tabulation, Report No. AS-5010-5), Airports Service, System Planning Div., FAA.
	U.S. civil and joint-use airport facilities on record with FAA, Dec. 31: Total facilities; Abandonments; Lighting and paving data; Runway length; Population size-group served.	National, 50 States		Annual	*FAA Statistical Handbook of Aviation,* Office of Management Systems, Information and Statistics Division, FAA.
	FAA Form 5010-1—Airport master Record.	All airports of record		Annual Inspection	Filed at FAA Headquarters, Regional and Area Offices
2. Airports	Appraisal of U.S. civil airport needs for commercial and private flying: Airports by city and state. Recommended construction for 5 years. Improvements—runway, taxiways and other airport safety requirements. Airport development cost.	National, 50 States, All Cities, and Urban Places, Puerto Rico and Virgin Islands	Not all airports of record. Only ones meeting NAP admission criteria	Annual	*National Airport System Plan,* FAA.
	Federal-aid-Airport Program, as of December 31. Funds: Total, Federal, sponsor. Number of Airports, projects.	National, 50 States, Puerto Rico and Virgin Islands		Annual	*FAA Statistical Handbook of Aviation,* Office of Management Services, Information and Statistics Div., FAA.
	Listing of aircraft landing places: Airport bulletins, weather and flight information numbers, airport customs facilities, landing fees, etc.	50 States, Puerto Rico, Guam, and Virgin Islands		Annual	*AOPA Airport Directory,* Aircraft Owners and Pilot Association (AOPA).

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
2. Airports cont.	A listing of public use airports, which qualify for an FAA determination of the effect a structure near an airport would have on the safe and efficient use of airspace; as provided in FAR Part 77, *Objects Affecting Navigable Airspace.*	All qualified public use airports, per FAR, Part 77		Semi-annual	(1) *Airman's Information Manual, Part 2, Airport Directory,* Air *Traffic Service, Flight Services Div., FAA.*
				Monthly	(2) *Alaska Airman's Guide and Chart Supplement,* Coast and Geodetic Survey, Dept. of Commerce.
				Monthly	(3) *Pacific Chart Supplement,* Air Traffic Service, Flight Services Div., FAA.
C. AIRCRAFT INVENTORY					
1. Active civil aircraft	States ranked by active aircraft ownership per 1,000 sq. miles, per 10,000 population	National, Reional, 50 States, All Counties		Annual	*Ce nsus of U.S. Civil Aircraft,* as of Dec. 31, Office of Management Systems, Information and Statistics Division, FAA.
	Civil aircraft: Eligible, ineligible.	"		Annual	*Ibid.*
	By year of manufacture:				
	Active aircraft annually registered with FAA, each of past 10 yrs:				
	Total; rank of State				
	Active U.S. aircraft:	"		Annual	*Ibid.*
	Total; aircarrier, December 31; general aviation—multi-engine, 4+place single engine; rotorcraft; all other.				

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
1. Active civil aircraft cont.	Aircraft registered with FAA, December 31: Eligible: Total; air carrier; general aviation, by type Total; eligible: Current year and two prior years Eligible: Total; by year of manufacture: Per 1,000 sq. mi.; per 10,000 population Area of State (sq. mi.); average per 1,000 square miles.	National, 50 States Puerto Rico and Virgin Islands		Annual	*FAA Statistical Handbook of Aviation,* Office of Management Systems, Information and Statistics Division, FAA.
	Summary of eligible aircraft by state and county.	National, 50 States		Semi-annual	*Summary of Eligible Aircraft by State and County,* (Machine tabulation, Report No. MS 8070–6), Office of Management Systems, Information and Statistics Div., FAA.
	General aviation total based aircraft by airport	All airports of record		Annual	*General Aviation Total Based Aircraft by Airport,* (Machine tabulation, Report No. MS 8070–10), Office of Management Systems, Information and Statistics Div., FAA.
	Registered general aviation aircraft (county data converted to a community data base): Total, single-engine, multi-engine.	All SMSA's, all Hubs., Cities, and Urban Places.	All non-SMSA cities with 50 or more based aircraft	November 1968, only	*Registered General Aviation Aircraft by Community Size,* Air Traffic Service, Executive Staff, FAA.

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
1. Active civil aircraft cont.	Scheduled air carrier flight data by type of equipment.	Scheduled air carriers		Semi-annual	*Scheduled Air Carrier Flight Data by Type of Equipment* (Machine tabulation, Report No. PO 1800-1), Office of Aviation Economics, Aviation Forecast Division, FAA.
2. General Aviation based aircraft	FAA Form 5010-1	All airports of record		Annual Inspection	Filed at FAA Headquarters, Regional, and Area Offices
3. Air Taxi	Activities of scheduled air taxi operators: No. of operators and aircraft.	Registered operators		Periodic	*Scheduled Air Taxi Operators as of November 1968*, Office of Management Systems, Information and Statistics Div., FAA.[1] [1] Scarcity of information for this category. Best private source is the National Air Taxi Conference or an individual airport survey
D. ACTIVITY					
1. Certificated Airline Operations (Includes passengers & cargo)	Aircraft departures: Total performed Scheduled; nonscheduled;	All scheduled air carrier airports; Hubs.	Only certificated route carriers	Semi-annual	*Airport Activity Statistics of Certificated Route Air Carriers*, CAB and FAA.
	On-line revenue traffic:				
	Passengers: enplanements:				
	Originations, scheduled service				
	Freight, express, and mail originations (tons) scheduled				

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
2. FAA operated tower operations	Aircraft operations: Total; itinerant; local; instrument.	National, Regional States, Puerto Rico, Virgin Islands, Cities, and Urban Places.	Only airports with FAA—operated tower	Semi-annual	*FAA Air Traffic Activity,* Office of Management Systems, Information and Statistics Division, FAA.
	FAA flight service stations and combined station-towers: Total flight services; aircraft contacted; flight plans originated; pilot briefs; airport advisories; flight condition messages	National, Regional, States, Puerto Rico, Virgin Islands, Cities, and Urban Places.	Only airports with FAA—operated tower	Semi-annual	*FAA Air Traffic Activity,* Office of Management Systems, Information and Statistics Division, FAA
	Daily tower operations: air carrier, general aviation, military	Tower airports	All large hubs and % of medium hub airports only	Monthly	FAA Form 886, *Monthly Airport Traffic Record,* Filed at airport towers and regional offices, FAA.
	Peak day and peak hour at traffic control towers: air commerce airports, general aviation airports; (includes methodology).		303 towers in FY 1968 publication	Irregular	*Terminal Area Air Traffic Relationships,* Office of Management Systems, Information and Statistics Div., FAA.
3. Air taxi operations (includes passengers)	Information on departures, passengers, fuel consumed, employment and similar data compiled to produce a profile of the air taxi industry	National		May 1968 Only	*1966 Census of Air Taxi Operators,* Office of Management Systems, Information and Statistics Division, FAA[1]. [1] Scarcity of information for this category. Best private source is the National Air Taxi Conference or an individual airport survey.

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
4. General Aviation Operations at Nontower Airports (Includes passengers)	General aviation aircraft flight hours by airports	All airports of record		Annual	*General Aviation Aircraft Flight Hours by Airports,* (Machine tabulation, Report No. MS 8070–9), Office of Management Systems, Information and Statistics Div., FAA. [1] Scarcity of information for this category. Best sources are FAA Form 5010–1, or by an individual airport survey.
5. Military Operations at Military Bases	Military air traffic activity	National, Military Bases		Annual	*Military Air Traffic Activity Report,* Office of Management Systems, Information and Statistics Division, FAA
6. Demand	Domestic and U.S. flag international origin and destination surveys	Scheduled air carriers		Quarterly, Annual, Semi-annual	*Origin and Destination Surveys,* CAB/ATA [1] Basis for reporting and the content for these O&D surveys change from time to time. For current information, contact Chief, Office of Carrier Accounts and Statistics, CAB, For purchase, contact Vice President, Finance and Accounting, ATA.
7. Scheduling	Arrivals and departures from and to all locations with scheduled airline service.	National, Int'l., Cities, and Urban Places	Bimonthly		*Official Airlines Guide—Quick Reference Editions,* R H Donnelly Corp.

Appendix C. Sources of Aviation Statistics—*Continued*

Subject	Tabular Detail	Area		Frequency	Source and Notes
		Area and Size Limitations	Other Limitations		
E. REPORTS, PUBLICATIONS AND SPECIAL TABULATIONS					
1. Specific, individual locations					[1] Desired aviation statistics for any particular metropolitan area can be obtained either by a diligent information search for what has been previously done by others or by an individual research effort
2. General					[1] I. Advisory circulars and special reports and tabulations by the Federal Aviation Administration. II. Reports and publications of: (1) Aerospace Industries Association of America (AIA) (2) Airport Operators Council International (AOCI) (3) Air Transport Association (ATA) (4) Association of Local Transport Airlines (ALTA) (5) Consultant firms (6) Helicopter Association of America (7) International Air Transport Association (IATA) (8) National Air Taxi Conference (NATC) (9) National Association of State Aviation Officials (NASAO) (10) National Business Aircraft Association

Appendix D. Sources of Socio-Economic Data

A. Guides to the Use of Federal and State Statistics

1. *Directory of Federal Statistics for Local Areas,* U.S. Department of Commerce, Bureau of the Census, U.S. Government Printing Office.

2. *Measuring Markets, A Guide to the Use of Federal and State Statistical Data,* Business and Defense Services Administration, Office of Marketing and Services, U.S. Government Printing Office.

Part I—Describes some of the measurable characteristics and dimensions of a market.
Part II—Lists the principal statistical series of interest.
Part III—Provides a series of cases which illustrate how Government statistics can aid in measuring markets.
Part IV—Bibliography—Listing of Government and nongovernmental materials which are useful in measuring markets, arranged by sources of statistical data, methods of analysis, bibliographies, and directories.

3. *Guide to U.S. Government Serials and Periodicals,* 1969 Edition, Volumes 1 and 2: Copyright by John L. Andriot, Documents Index, Box 195, McLean, Virginia 22101. (Issued annually in March)

B. Historical Trends

1. *Historical Statistics of the United States, Colonial Times to 1957:* 1960, the U.S. Bureau of the Census, U.S. Government Printing Office.

2. *Historical Statistics . . . Continuation to 1962 and Revisions:* 1965, the U.S. Bureau of the Census, U.S. Government Printing Office.

3. *Long Term Economic Growth, 1860–1965:* 1966, the U.S. Bureau of the Census, U.S. Government Printing Office.

C. Market Statistics, Private Sources

1. *Sales Management* (semimonthly, and *Annual Survey of Buying Power*). Sales Mgt., Inc., 630 Third Ave., New York, N. Y. 10017.

2. *Rand-McNally Commercial Atlas and Marketing Guide* (Annual). Rand-McNally and Co., 405 Park Avenue, New York, N. Y.

D. Government Data

1. Publications

a. *County and City Data Book, (latest) edition,* by the U.S. Bureau of the Census, U.S. Government Printing Office. A statistical abstract supplement published after each decennial and quinquennial economic census.

b. *Congressional District Data Book* (Districts of the 88th Congress) and updated by *Supplements, Redistricted States.* Data Book prepared 1963—U.S. Government Printing Office. *Supplements*—89th Congress 1965: 90th Congress 1966, obtained on request from the Bureau of the Census, Washington, D.C. 20233.

2. Measurements

Measurement	*Frequency of Publication*	*Source*
a. Population		
(1) Population growth	Decennial (all censuses)	Federal Gov't., Bureau of the Census
(2) Resident and civilian population	Annual	"
(3) Land area	Decennial (all censuses)	"
(4) Population per square mile, urban and rural	"	"
(5) Population age distribution	"	"
(6) Resident population by age groups	Annual	"
(7) Education distribution	Decennial (all censuses)	"
b. Income		
(1) Median family income by income size classes	Decennial (all censuses)	Federal Gov't. Bureau of the Census
(2) Total and per capita personal income	Annual	Federal Gov't., Office of Business Economics
(3) Aggregate personal and per capita income by type of income and industrial source	Annual	Federal Gov't., Office of Business Economics
(4) Disposable personal income	For selected years	"
(5) Taxable income, classified by size of adjusted income	Annual	Federal Gov't., Internal Revenue Service
c. Employment		
(1) Percent employment in white collar occupations	Decennial (all censuses)	Federal Gov't., Bureau of the Census
(2) Percent unemployment rate	Annual	Federal Gov't., Bureau of Labor Statistics

Measurement	*Frequency of Publication*	*Source*
(3) Employment and earnings statistics	Quinquennial (all censuses and Annual	Federal Gov't., Bureau of the Census and Bureau of Labor Statistics
(4) Employment in agriculture	Quinquennial (all censuses)	Federal Gov't., Bureau of the Census
(5) Employment in durable goods manufacturing	"	"
(6) Employment in non-durable goods manufacturing	"	"
(7) Employment in mineral industries	"	"
(8) Employment in transportation, communication and other public utilities	"	"
(9) Employment in wholesale and retail trade	"	"
(10) Employment in public administration	"	"
d. Sales		
(1) Value added by manufacture	Quinquennial and Annual	Federal Gov't , Bureau of the Census
(2) Value of shipments	Quinquennial	"
(3) Retail sales	Quinquennial (all censuses)	"
(4) Wholesale sales	"	"

Appendix E. Methods Developed for Forecasting Aviation Demand at the Nation's Medium Air Transportation Hubs, 1965–1980

INTRODUCTION

The airport activity forecast methods contained herein were developed by the Federal Aviation Administration for use in forecasting aeronautical demand at the Nation's medium air transportation hubs. The methodology was developed in the mid-1960's and was applied to the forecast period 1965–1980. As a result, some of the publication dates mentioned may seem outdated; the basic methodology, however, is still quite valid, and later-dated publications of the same name can be substituted as applicable.

Methods used in forecasting activity at the 34 major air carrier airports within the 34 medium hubs and for Las Vegas were developed by the Office of Policy Development. Forecast methods used for the other 269 tower and nontower airports within these medium hubs were developed jointly by the Airports and Air Traffic Services. The demand forecasts resulting from the application of these methods will, in turn, be used to predict selected airport terminal facility requirements of the hubs.

National planning assumptions and forecasts relevant to the future of the economy, and to the aviation industry as a whole, are those contained within the FAA publication, *Aviation Forecasts, Fiscal Years 1968–1979,* dated January 1968, and as extended by the Office of Policy Development through 1980. In the development of the specific airport activity forecast methods, it was necessary to make additional basic assumptions applicable to each type of activity. These assumptions are described briefly with the method.

The forecast methods have been tested, and the products checked against other forecast data as to their validity. The results have been reasonable. However, it is recognized that these methods must be refined and updated as additional information becomes available.

I. ENPLANED PASSENGERS

A. Air Carrier—*Basic Assumptions/Source Data.*

(1) The thirty-four medium air transportation hubs regularly account for about one-sixth of the national total of airline passengers. All of these hubs have some common characteristics and through time each tends to maintain a generally consistent relationship to the national total. Nevertheless, there are sufficient differences to necessitate forecasting each on an individual basis.

(2) The total traffic of the nation is composed of almost a dozen series of domestic and international services such as Domestic Scheduled Services, International Nonscheduled Services, etc. The services for each community were identified and their source data assembled for separate forecasting of each series. These data were then reviewed and adjusted to correct for fluctuation resulting from temporary influences, such as management/labor difficulties, World Fairs, etc.

Method: The projection methods used were as follows. Most community forecasts required more than one of the methodologies.

(1) *Percentage Method.* There are cases where the range through time of a community's percentage of national passengers is so tight that a permanent relationship may be assumed. The national forecast for a future year may be multiplied by the typical percentage to obtain a reasonable estimate of the domestic passenger volume of the community for that year.

(2) *Statistical Method.* Numbers of passengers at a community may display a rate growth that is regular but not satisfactorily correlated with the national trend. A statistical technique such as the method of least squares can be employed. Such a statistical technique can also be applied to other than just the domestic series of passengers.

(3) *Data Series Comparison Method.* Two series will sometimes be correlated to a degree where one may be capable of measuring the other.

For example, some communities' numbers of U.S. international passengers are sufficiently correlated with the domestic to assume that the relationhip will continue.

(4) The final forecast for each community is the sum of the projections for all the types of service it receives.

B. General Aviation—*Basic Assumptions/Source Data*

(1) The number of enplaned general aviation passengers can be estimated for hub by use of a passenger load factor and one-half the total number of general aviation itinerant operations.

(2) It is assumed that the average number of passengers per plane will increase in the future years as larger general aviation aircraft are introduced into the fleet. It is also assumed that for most medium hubs the following factors can be applied across the board for 1965, 70,75, and 80.

TABLE 1. Average Number of Passengers Per Plane

Airport Type	FY 1965	1970	1975	1980
Air Carrier Airports	2.77	3.02	2.26	3.36
Other Airports	1.70	1.90	2.20	2.50

METHOD: Multiply the average number of passengers per plane by one-half the total number of general aviation itinerant operations.

II. AIRCRAFT OPERATIONS

A. Air Carrier (Itinerant)—*Basic Assumption/Source Data*

(1) The basic premise underlying the methodolgy for forecasting air carrier operations by airport is that a relationship exists between the number of enplaned passengers and the level of service provided. It is assumed that the number of aircraft seats for transiting and enplaning passengers and the number of flights by type of aircraft have been a function of the traffic demand and traffic characteristics of the community as well as the route structure and operating policies and practices of the individual carriers. And, it is assumed that these same factors will continue to determine the level of operations in the future.

(2) The base year, FY 1967, operations by individual air carrier by aircraft type were developed from the "aircraft departures performed" data published in the CAB/FAA report, *Airport Activity Statistics of Certificated Route Air Carriers*. Where appropriate, additions were made for foreign and large intrastate air carrier operations based on an examination of published schedules. A further adjustment was made for each airport forecast to balance the sum of the above operations with the total air carrier operations reported in the FAA publication, *FAA Air Traffic Activity, FY 1967*. This adjustment was necessary to account for supplemental air carrier and other unidentified operations.

(3) The total seats provided by each aircraft type were determined by multiplying the operations by an average number of seats installed. The total seats generated during the base year for all transiting and enplaning passengers were the sum of the seats provided by the various aircraft types. A percentage distribution of seats by each aircraft type was also computed.

Forecast Methodology

(1) The total base year seats at each airport were forecast to increase at the same rate as the forecast of enplaned passengers.

(2) The forecast of aircraft operations was determined by reversing the steps followed in developing the base year data. The total forecast seats were distributed among the types of aircraft the carriers are expected to operate at each airport in the forecast year. The seat totals, by aircraft type, were divided by average seating capacities to get the number of aircraft operations required. Total air carrier operations were determined by summing the operations by aircraft type.

B. General Aviation (Local and Itinerant)—*Basic Assumptions/Source Data*

(1) Air Carrier Airports

a. Base year data for numbers of general aviation operations at air carrier airports were obtained from the FAA publication, *FAA Air Traffic Activity, FY 1967*.

b. General aviation itinerant growth rates have varied considerably among the leading air carrier airports, and it was assumed that individual differences would continue throughout the forecast period.

c. The nominal capacity of the airport was assumed to be the

level at which the general aviation growth rate would begin to decline.

d. It was assumed that local operations would be the first diverted.

(2) General Aviation Airports

a. Actual FY 1965 data for numbers of general aviation local and itinerant operations at FAA tower airports within each hub are obtained from the FAA publication, *FAA Air Traffic Activity, FY 1965.*

General aviation local and itinerant operations at nontowered airports are estimated for FY 1965 (use mid-year, no interpolation if within six months) from data reported on FAA Airport Master Records (Form 5010–1); or, if available from the FAA publication, *Terminal Locations for Planning Purposes, CY 1965.* It is assumed that the same relationship existing between current number of based aircraft and numbers of local and itinerant operations can be used in forecasting future operations activity.

The foregoing tower and nontower airport figures are added together to obtain each hub's total general aviation local and itinerant operations for FY 1965.

b. Forecasts of future general aviation operations at FAA tower airports and at publicly owned nontower airports identified as potential candidates for air traffic control were obtained from the Terminal Area Plan for 1969.

The concept and operation of terminal area planning for internal management use is set forth in agency Order 1800.15A of the FAA *National Airspace System Management Handbook.*

This handbook governs the FAA in its management of the modernization, improvement, and augmentation of the National Airspace System. The information provided in terminal area planning is based upon specialized knowledge or information made available by the regional or area Air Traffic, Airports, and Flight Standards offices.

c. The forecasts of local and itinerant operation at all *nontower* airports not included in the 1969 Terminal Area Plan were derived as a product of the number of projected based aircraft for each period times an adjusted base norm for the number of operations per based aircraft. Table 2 lists the ratio increases used to adjust the base norm.

TABLE 2. Ratio Increases for Adjusting Base Norm for Local or Itinerant Operations per Based Aircraft

Base Norm for Operations per Based Aircraft- Local or Itinerant	Ratio to Base Year Increase 1970	1975	1980
FY 1965 Base	1.05	1.10	1.15
FY 1966 Base	1.04	1.09	1.14
FY 1967 Base	1.03	1.08	1.13

Forecast Methodology

(1) Air Carrier Airports

a. Each airport was forecast separately.

b. Each forecast was prepared on a judgment basis considering such factors as:

1. The past trend of general aviation operations at each airport.
2. The air carrier activity forecast for the airport.
3. The nominal capacity of the airport.
4. The number of general aviation airports for the community that were coded "Reliever" in the FAA's *National Airport Plan.*
5. The number of towers planned or programmed for general aviation in the area.
6. The number of operations at general aviation airports serving the community.
7. Discussions with airport management and FAA regional personnel.

(2) General Aviation Airports

a. Tower Airports

The Terminal Area Plan utilized local planning information in conjunction with the forecasting methods of the

FAA publication, *Terminal Locations for Planning Purposes, CY 1966.* The following method presents a generalized approach which follows the Terminal Area Plan forecasting guidance for estimating aircraft operations at general aviation tower airports.

1. Determine airport's percent of U.S. towers' total operations and total itinerant operations, using prior year publications of *FAA Air Traffic Activity, FY 19XX* and knowledge of the individual airport's potential and the economic expectations of its associated community.
2. Forecasts of future aircraft operations at FAA tower airports were taken from the FAA publication, *Aviation Forecasts, FY 1968–1979* and extended to 1980 by the Office of Policy Development. These forecasts are:

Aircraft Operations at FAA Tower Airports (Millions)	1970	1975	1980
Total	68.5	112.5	184.9
Itinerant	40.8	63.2	95.7

3. Apply the derived percentage factors to the national forecasts' years to obtain the airport's forecast for total operations and total itinerant operations.
4. Forecast military itinerant and local operations as shown for tower airports in Section C., Military (Local and Itinerant).
5. Subtract forecast of military itinerant operations from forecast of total itinerant operations to get forecast of general aviation itinerant operations.
6. Subtract forecast of total itinerant operations from forecast of total operations to get forecast of *total local operations.*
7. Subtract forecast of military local operations from forecast of total local operations to get forecast of *general aviation local operations.*

b. Nontower Airports Included in the 1969 Terminal Area Plan

The forecasts for nontower airports included in the 1969 Terminal Area Plan were accepted in their entirety. The itinerant and local operation estimates were determined by the procedures described in the FAA publication, *Terminal Locations for Planning Purposes, CY 1966.* Straight line interpolation and extrapolation were then utilized to obtain the estimates for the desired years.

With the exception of using the ratio increases in Table 2 to adjust the base norm for operations per based aircraft, a generalized approach which follows the Terminal Area Plan forecasting guidance for estimating aircraft operations at general aviation nontower airports is presented under c. below.

c. Nontower Airports Not Included in the 1969 Terminal Area Plan

Forecasts for nontower airports not included in the Terminal Area Plan were developed by the following method:

1. Study the historical records of Form 5010–1 to determine base norms for local and itinerant operations per based aircraft. Choose or develop base norms from the years 1965–1967 which are typical of the airport. As an aid to judgment, the following norms for General Aviation Airports from the FAA publications, *Terminal Locations for Planning Purposes, CY 1966* are useful:

	Low Typical	Median	High Typical
General Aviation Local Operations per Based Aircraft	170	375	690
General Aviation Itinerant Operations per Based Aircraft	125	210	450

2. For all forecast years, multiply the base year norms determined above for local and itinerant operations per based aircraft by the applicable ratio to base year increases given in Table 2.
3. Forecast total general aviation based aircraft as described in Part IV, *Based Aircraft.*

4. Multiply the number of based aircraft forecast for each future period by the adjusted average number of local and itinerant operations per based aircraft (estimated in step 2 above) to obtain local and itinerant operations for 1970, 1975, and 1980.

C. Military (Local and Itinerant)—*Basic Assumptions/Source Data*

(1) FY 1965 data for number of military local and itinerant operations at FAA tower airports within each hub are obtained from the FAA publication, *FAA Air Traffic Activity, FY 1965.*

(2) Military local and itinerant operations at nontowered airports can be estimated for FY 1965 from data reported on FAA Airport Master Records (Form 5010–1), where military activity is indicated.

(3) The foregoing tower and nontower airport data of (1) and (2) above are added together to obtain each hub's total military local and itinerant operations for FY 1965.

(4) It is assumed that the same ratio of local to itinerant military operations at airports in the hub can be used in the forecast of future operations activity.

(5) At non-air-carrier airports, it is also assumed that military operations will remain constant over the future time period at the level of the most current data available.

Forecast Methodology

(1) *Air Carrier Airports*—Base year data were projected based on past trends and information provided by military sources.

(2) *General Aviation Tower Airports*—FY 1965 data obtained from noted source document. Forecast periods will remain constant to most current data available.

(3) *Nontower Airports*—FY 1965 data estimated from Form 5010–1 for airport, if indicated. Forecast periods will remain constant to most current data available.

III. ENPLANED AIR CARGO (TONS)

A. Air Carrier—*Basic Assumptions/Source Data*

(1) For the forecast period it was assumed that the air cargo growth rates will continue in the area of 19–20% annually for total domestic cargo, and approximately 25% annually for international cargo.

(2) Data on domestic, international (foreign and U.S. flag), nonscheduled, intra-line transfers, and other segments of the cargo industry were derived from CAB/FAA publications, individual airports, air carriers, and other sources.

Forecast Methodology

(1) Each airport was examined and forecast separately.

(2) The forecasts were developed considering the airport's past relationship to national and international trends as well as the historical growth pattern of the individual airport.

(3) Domestic, international, nonscheduled, and intra-line transfers were considered and treated separately where circumstances dictated.

IV. BASED AIRCRAFT

A. General Aviation—*Basic Assumptions/Source Data*

(1) Actual FY 1965 data for number and types of general aviation based aircraft within hub were obtained from FAA Airport Master Records (Form 5010–1) for each airport. These were added together to obtain total number within hub.

(2) Forecasts of general aviation aircraft for all airports within the hub are based upon growth rates reflected for national and regional totals in the FAA publication, *Aviation Forecasts, FY 1968–79.* Forecast data were extended to 1980 by the Office of Policy Development.

The following tables can be used to develop estimates for future periods:

Forecast Methodology

(1) Study the historical records of Form 5010–1 and use the ratio to base year increases listed in Table 3 as an aid to judgment. Choose a base from the years 1965–1967 that gives the most logical total based aircraft for 1970.

(2) Use Table 3 and the total based aircraft in the base year chosen to estimate the total based aircraft for all forecast years.

(3) Study the yearly historical trend of the percent of multi-engine to total based aircraft and estimate a percent ratio for 1970. Increase this 1970 ratio by the ratio to base year increases in Table 4 to obtain the 1975 and 1980 percentages of multi-engines to total based aircraft.

(4) Total multi-engine aircraft for FY 1965 will be the actual count taken from the Form 5010–1, and for each of the forecast years it will be the product of total based aircraft times the percent ratios developed in step (3) above.

(5) If there were no multi-engine based aircraft at the airport, assume zero based aircraft for total multi-engine in 1970, one in 1975, and two in 1980.

(6) Total single-engine aircraft for FY 1965 will be the actual count taken from the Form 5010–1, and for each of the forecast years, it will be the difference between total based aircraft and total multiengine aircraft.

(7) To obtain a split between multi-engine piston and multi-engine turbine aircraft (Necessary to Obtain Aircraft Mix—see Part VI, B.), apply the percentage factors of Table 5 to the total multi-engine aircraft for each year to obtain multi-engine turbine aircraft. Total multi-engine minus multi-engine turbine equals multi-engine piston aircraft.

V. BUSY HOUR OPERATIONS

A. Air Carrier Airports—*Basic Assumptions/Source Data*

(1) Air Carrier

a. A study was made of the relationship of air carrier busy day to annual operations utilizing a tabulation of daily operations from Form 886, *Monthly Airport Traffic Record,* which was available for the large hubs and about one-fourth of the medium hubs. It was determined that the air carrier busy day percentage of annual operations fluctuated in a relatively narrow range about a constant value regardless of the size of annual operations. This value was selected as the air carrier busy day percentage of annual operations for the medium hub forecasts.

b. Another special tabulation of published *Official Airline Guide* schedules for May, 1967, was made for all air carrier operations by hour of the day by individual airport. The peak air carrier hour was selected from the list. It was assumed this hour and the percent of daily passengers carried during this hour would remain the same through the forecast period.

(2) General Aviation

a. The smaller large hubs, whose traffic most nearly resembled that of the medium hubs, and those medium hubs for which the Form 886 tabulations existed were used to develop a relationship between general aviation busy day and annual operations. Separate relationships were established for general aviation itinerant and local operations by means of regression analyses.

b. The hourly distributions for general aviation operations were based upon a national profile for general aviation local and itinerant flying. The general aviation operations for these categories during the air carrier peak hours were then identified.

(3) Military

a. An examination of the Form 886 tabulations for the large hubs for which the tabulations were available indicated that itinerant and local military busy day operations tended toward a constant percentage of annual operations for each category.

b. The military percentages of the busy day during the air carrier peak hours were selected from national hourly distributions of itinerant and local military flying.

TABLE 3. Regional Ratio Increases for Total General Aviation Based Aircraft

Region and Base FY	Actual Count Base Year	Ratio to Base Year Increase		
		1970	1975	1980
Eastern				
FY 1965	X	1.43	1.79	2.15

Table 3 continued

Region and Base FY	Actual Count Base Year	Ratio to Base Year Increase		
		1970	1975	1980
FY 1966	X	1.30	1.62	1.94
FY 1967	X	1.16	1.45	1.74
Southern				
FY 1965	X	1.61	2.35	3.29
FY 1966	X	1.46	2.13	2.98
FY 1967	X	1.29	1.88	2.63
Southwest				
FY 1965	X	1.39	1.81	2.06
FY 1966	X	1.30	1.69	1.93
FY 1967	X	1.20	1.56	1.78
Central				
FY 1965	X	1.36	1.70	2.07
FY 1966	X	1.29	1.61	1.96
FY 1967	X	1.20	1.50	1.83
Western				
FY 1965	X	1.50	2.04	2.71
FY 1966	X	1.41	1.92	2.55
FY 1967	X	1.29	1.75	2.33

TABLE 4. National Ratio Increases for Base Percent of Total Multi-engine to Total General Aviation Based Aircraft

FY 1965	1970 Base Percent	Ratio to Base Year Increase	
		1975	1980
Actual Count of Total ME-Form 5010-1	Historical Estimate of Base Percent	1.12	1.18

TABLE 5. National Turbine Percentage Share of Total Multi-engine General Aviation Based Aircraft

Percent Turbine			
FY 1965	1970	1975	1980
2.9	11.0	16.4	22.0

Forecast Methodology

(1) Air Carrier

a. The number of seats required during the peak hour for each forecast year was determined by first multiplying the annual seats required by the base year busy day percentage. The busy day seats required were then multiplied by the base year peak hour percentage of the busy day.

b. The peak hour seats required were allocated among the various types of aircraft the carriers are expected to operate during the forecast years, based on the distribution of total seats offered by aircraft type during the base year.

c. The seats required by aircraft type were then divided by an average capacity to determine the aircraft operations required. The total number of peak hour aircraft operations was the sum of the operations by aircraft type.

(2) General Aviation

In general, the methodology for forecasting general aviation peak hour operations follows the steps in forecasting air carrier peak hour operations.

a. The annual operations were multiplied by the base year busy day percentage.

b. The busy day operations were then multiplied by the base year peak hour percentage to yield peak hour operations.

(3) Military

The forecast methodology was the same as that applied to the general aviation sector.

B. General Aviation Airports—*Basic Assumptions/Source Data*

(1) Depending on the aircraft mix, busy hour of the week is a percent of peak daily traffic. Peak hour general aviation total operations can be determined by using the FAA Advisory Circular AC 150/5060–1A, *Airport Capacity Criteria Used in Preparing the National Airport Plan, July 1968.* This circular provides an annual demand-weighted hourly demand relationship.

Forecast Methodology

(1) *Tower*—Base year general aviation busy hour is obtained from the FAA publication, *Terminal Area Air Traffic Relationships, FY 1965.* The forecast years are obtained by using Figure 9, "Hourly versus Annual Capacity" in Appendix 2 of AC 150/5060-1A.

Enter the total annual aircraft operations on the graph and, depending on the general aviation aircraft mix, read the peak hour demand (weighted hourly capacity operations per hour) that is obtained from the intersection of annual operations and the aircraft mix population curves.

(2) *Nontower*—With the exception that the base year peak hour demand must be obtained from Appendix 2 of AC 150/5060–1A, the procedure for Nontower General Aviation Airports is identical with that for Tower General Aviation Airports.

(3) *Military*—Military operations were not considered in the busy hour since the military services try to avoid congested time periods at civil airports.

I. AIRCRAFT MIX

A. Air Carrier—*Basic Assumptions/Source Data*

(1) The underlying assumption for the methodology of forecasting the air carrier aircraft mix is that the assignment of an aircraft type for service at an airport has been, and will continue to be, in response to the traffic demand of the community and the route structure, the fleet, and operating practices of the carriers. It is also assumed that the traffic characteristics of each community as they would influence the assignment of aircraft types will remain relatively unchanged. For example, a community which generates primarily long-haul trips will continue to do so in the forecast period.

(2) The analysis and forecast of the aircraft mix is an internal part of the methodology to determine the number of air carrier operations described in Part II.

(3) The aircraft types in the base year were ranked according to size from four-engine turbojets to two-engine piston aircraft and a percentage distribution was computed for the corresponding total seats generated.

Forecast Methodology

(1) The total forecast seats were allocated to the categories of aircraft types in about the same proportion as the seat distribution in the base year. This step considered the individual carriers serving each community, the respective fleets, and the aircraft on order.

(2) The phasing out process of aircraft such as the two-engine piston models was accomplished by substituting, for example, two-engine turboprops and two-engine turbojets.

(3) The forecasts of aircraft types were summarized into the seating capacity groups X through T and operational groups A and B as described in the table under VI.B. "Forecast Methodology."

B. General Aviation—*Basic Assumptions/source Data*

(1) It is assumed that general aviation aircraft mix is by type according to the classification of the based aircraft. This is predicated on a similarity of transient general aviation and based aircraft by type and equipment. Thus, general aviation operations by aircraft type follow operational levels according to the percentage distribution of based aircraft and the national forecast for aircraft by make and model in the FAA publication ,*Aviation Forecasts, FY 1968–79.*

(2) For operational performance, two factors are significant, type and number of engines (multi-engine) and weight (greater than 12,500 pounds). It has been assumed that all turbine-powered airplanes and ten percent of the multi-engine piston airplanes will have the operational performance characteristics of Type C aircraft. Type D and E have been combined

throughout the tabulations. See following aircraft type descriptions.

(3) For passenger capacity, general aviation aircraft are considered as all Group T aircraft.

(4) It is assumed that helicopter and other nonfixed wing aircraft activities would probably remain relatively small until after the 1980 forecast period and can be disregarded.

(5) Based aircraft for each airport within the hub for the FY 1965 are available on the FAA Airport Master Records (Form 5010–1) by type airplane; i.e., multi-engine and all others. Forecast based aircraft is discussed in Part IV, *Based Aircraft.*

Forecast Methodology

Determine the forecast of general aviation based aircraft as shown in Part IV, *Based Aircraft,* and calculate Groups C and combined D and E as percent of total:

(1) Add ten percent (10%) of the total multi-engine piston aircraft to the total multi-engine turbine based aircraft.

(2) Divide the above sum by total based aircraft and multiply by 100 to obtain the percent Group C operations and Group T passenger capacity based aircraft mix.

(3) One hundred minus the percent Group C and T based aircraft mix equals percent Group D and E operation and Group T passenger capacity based aircraft mix.

CIVIL AIRCRAFT TYPES BY USER CATEGORY
CLASSED BY CAPACITY AND OPERATIONAL GROUPS

Aircraft Type By User	Capacity Group[1] by Operational Group[2] A	B	C	D/E
Turbojet —4-engine—standard	L			
—stretched	X			
—jumbo	X			
—Concorde	L			
—U.S. SST	X			
—3-engine—standard		M		
—stretched		L		
—2-engine—standard		M		
—jumbo		X		
Turboprop—4-engine		M		
—2-engine		T		
Piston —4-engine		S		
—2-engine		T		
Turbin-powered			T	
Piston-powered				T

[1]*Capacity Group*
X—+200 seats
L— 120–199 seats
M— 75–119 seats
S— 55– 74 seats
T— 54 and under

[2]*Operational Group*
A—Air Carrier—4 engine turbojet
B—Air carrier—all other aircraft
C—General aviation turbine powere
D/E—General aviation—all other acft

C. Military—*Basic Assumptions/Source Data*

(1) It is assumed that military aircraft mix % by type accord ing to the aforementioned classifications is the same as tha of the military aircraft operating nationally.

(2) It is assumed that military operations by aircraft type follov national data for busy day, 1960, which was approximatel 40% jet, (Group B) and 32 % multi-engine and 28% single engine (together 60% Group C).

(3) Forecasts for 1970, 1975, and 1980 military, itinerant an local operations are based on a constant level of activity witl little change in aircraft characteristics.

Forecast Methodology

Use estimated % based on national military activity:

	FY 1965	1970	1975	1980
Percent Military Operations				
Group B	40	40	40	40
Group C	60	60	60	60

VII. HUB SUMMATION ADJUSTMENTS

A. Introduction

The hub summation represents an estimate of aviation demand for the entire geographical area of the hub and has been constrained by the physical capacity of any airport. Analysis and judgment are required to arrive at a total hub demand estimate.

The hub summation is a culmination of the forecasts of a large number of variables ranging from those for which relatively little data are available or where intangible factors are expected to play a major role to those having a fairly stable historical series. All the factors must be weighed and evaluated according to the experience and intuition of the analyst. The two primary evaluations and adjustments used for the medium hubs were concerned with the air carrier and general aviation tower airports.

B. Air Carrier Airport Adjustments to the Hub

(1) Although the forecasts by the Office of Policy Development for air carrier passengers and operations were not constrained, general aviation and military were restricted by the physical capacity of the airport.

(2) In order to determine each air carrier airport's full impact in the total hub structure, graphical trend analyses of all historical and forecast data were made. From these analyses the adjustments were as follows:

a. All air carrier forecast statistics developed by the Office of Policy Development were used as "bench marks" and were not adjusted in any manner.

b. Reasonable trends for unconstrained general aviation and military operations were determined by graphical analyses of historical data and all available forecasts. These trends were balanced to logical total aircraft operations for the hub.

c. The Table 1 average number of passengers/plane for "Other Airports" were applied to the difference between the general aviation itinerant operations determined in step (b) above and those developed by the Office of Policy Development to obtain general aviation passengers not constrained by airport capacity.

d. Total general aviation passengers for the hub were the summation of step (c) above and those developed by the Office of Policy Development.

e. General aviation busy hour not at the air carrier peak was based on the total of general aviation operations and calculated as described in Part V. *Busy Hour Operations,* B, General Aviation Airports.

C. General Aviation Tower Airport Adjustments to the Hub

(1) In order to ascertain the validity of the forecasts and to determine each tower airport's full impact in the total hub structure, graphical analyses of all historical and forecast data were made. From these analyses, the adjustments for aircraft operations were as follows:

a. Reasonable trends not constrained by the physical capacity of any airport were determined by graphical analyses of historical data and all available forecasts. These trends were balanced to logical total aircraft operations for the hub.

b. The above adjustment for aircraft operations was of primary concern. Once this base was established, all other activity variables were forecast by the methods outlined for general aviation airports.

VIII. SUMMARY OF MEDIUM HUB FORECASTING METHODS

Total airport aviation activity for each hub is the summation of four forecasting categories:

A. Air carrier airports.

B. General aviation tower airports and nontower airports identified as potential candidates for air traffic control services or navigational aids.

C. General aviation nontower reliever airports and airports with 50 or more based aircraft which were not included in Category B.

D. All other general aviation nontower airports with less than 50 based aircraft and which are open to the public. The base data for all airports in this category were added to totals and forecast as one group.

Appendix F. Airport Zoning Act (Example)

State of Minnesota

Chapter 1111, 1969 Session Laws

relating to the use and development of property in the metropolitan area affected by the operation of a new major airport; conferring certain powers and duties on the metropolitan council, the Minneapolis-Saint Paul metropolitan airports commission, and other government units in the area; and enlarging the territorial jurisdiction of the Minneapolis-Saint Paul metropolitan airports commission.

Be it enacted by the Legislature of the State of Minnesota:

SECTION 1. NEW MAJOR AIRPORT; AIRPORT DEVELOPMENT AREA. Subdivision 1. *Metropolitan Council; Land Use Criteria and Guidelines.* Within 120 days after the selection by the commission of a site in the metropolitan area for a new major airport to serve as a terminal for regular, scheduled air passenger service and the approval thereof by the metropolitan council, the council shall adopt criteria and guidelines for the regulation of use and development of all or a portion of the property in the metropolitan area extending out three miles from the proposed boundaries of the site, or out five miles from the boundaries in any direction the council determines is necessary to protect natural resources of the metropolitan area, which property shall be known as an airport development area. The criteria and guidelines shall establish the boundaries of the airport development area and shall include a statement of goals and policies to be accomplished by regulation of the use and development of property in the area. They may relate to all types of land use and development control measures, including zoning ordinances, building codes, subdivision regulations, and official maps. The criteria and guidelines shall encourage controls for the use and development of property and the planning of public facilities for the purposes of protecting inhabitants of the airport development area from aircraft noise and preserving natural underground water reservoirs and other natural resources of the metropolitan area, and such purposes are hereby declared to be public purposes upon which land use and development control measures adopted by any government unit pursuant to law may be based. The criteria and guidelines shall be a part of the metropolitan development guide when it is adopted, and a copy of the criteria and guidelines and any amendment thereto shall be mailed to the governing body of each government unit having authority to adopt land use and development control measures applicable to the airport development area under Minnesota Statutes, Sections 360.061 to 360.073, Chapter 394, or Chapter 462, or any other law, to the commission, and to the state commissioner of aeronautics. The council may amend the criteria and guidelines from time to time, and shall reestablish the airport development area whenever the airport site boundaries are altered.

Subd. 2. *Local Zoning and Land Use and Development Controls.* Upon the selection and approval of a site for a new major airport in the metropolitan area, all land within its airport development area which is not then zoned for other use is zoned for use exclusively for agricultural purposes, except that a prior nonconforming use established with reference to any lot or parcel of land may be continued and all land zoned by this subdivision for agricultural purposes may be rezoned by the appropriate government unit upon compliance with this subdivision. Thereafter the governing body of each government unit proposing to adopt a land use and development control measure applicable to the airport development area, or any amendment thereto, shall submit it to the metropolitan council for review, and within 120 days after receipt of the council's criteria and guidelines shall make and submit to the council for review such changes in its existing land use and development control measures as it deems necessary to make them consistent with the criteria and guidelines. The council or a committee designated by it shall hold a hearing on the control measures submitted by each government unit within 60 days after they are submitted, or written notice mailed to the governing body of the government unit not less than 15 days before the hearing. At the hearing the government unit shall be allowed to present all data and information which support the control measures submitted to the council. The council shall approve each such measure or amendment within 120 days after it is received, with such changes as it deems necessary to make it consistent with the criteria and guidelines, and the government unit submitting it shall take all actions necessary to put it into effect within 60 days after it is approved. If the council amends its criteria and guidelines, the procedures set forth in this subdivision shall be followed to insure that applicable land use and development control measures are consistent with the amendment.

Sudb. 3. *Enforcement of Local Measures.* After the selection and approval of a site for a new major airport in the metropolitan area, no public or private use contrary to subdivision 2 or any land use and development control measure then in effect shall be made of the property to which it applies within an airport development area, and no government unit shall issue a permit for the use, construction, alteration or planting of any property, building, structure or tree not in accordance with its general provisions, except for minor footage variances, until the council has approved changes or variances in such control measure pursuant to subdivision 2. After the council has approved a land use and development control measure pursuant to Subdivision 2, no public or private use contrary to its provisions shall be made of the property to which it applies, and no government unit shall issue a permit for the use, construction, alteration, or planting of any property, building, structure or tree not in accordance with its general provisions; and no special use permit or variance may be granted which authorizes a use or development which is contrary to the council's criteria and guidelines.

Subd. 4. *Control Measure Review Before Site Selection.* After the com

mission has called a hearing for the selection of a site for a new major airport in the metropolitan area pursuant to Minnesota Statutes, Section 360.124, and until the commission has determined not to use the site described in the notice of hearing for a new major airport, the governing body of each government unit in the metropolitan area shall submit to the council for review and comment in accordance with and submit to the provisions of Minnesota Statutes, Section 473B.06, Subdivision 7, any land use and development control measure applicable to or proposed for the site described in the notice of hearing or to any property within five miles thereof, and any proposed amendments or variance thereto. During the period described above, no government unit shall construct a public building or facility on the proposed airport site or within five miles thereof until it has submitted its plan therefor to the metropolitan council for review and comment as provided in this subdivision.

SEC. 2. AIRCRAFT NOISE ZONES. Within 120 days after the selection and approval of a site for a new major airport in the metropolitan area, the metropolitan council shall determine the probable levels of noise which will result in various parts of the metropolitan area from the operation of aircraft using the site, shall establish aircraft noise zones based thereon applicable to property affected by such noise, and shall establish acceptable levels of perceived noise decibels for each land use, using the composite noise rating method and tables or the noise exposure forecast method and tables. Each government unit having power to adopt land use and development control measures applicable to property included in any aircraft noise zone, shall adopt or incorporate in existing land use and development control measures the applicable acceptable level of perceived noise decibels established by the council, and shall adopt such other control measures as may be necessary to prevent the use, construction or improvement of property and buildings under its jurisdiction so that persons using the property and buildings are subjected to a level of perceived noise decibels in excess of the acceptable level established for that land use. A map showing the aircraft noise zones and a copy of the applicable acceptable levels of perceived noise decibels shall be mailed to the governing body of each government unit having authority to adopt land use and development control measures applicable to property in each aircraft noise zone, to the commission, and to the state commissioner of aeronautics. The control measures adopted by a government unit to comply with this section shall be submitted to and reviewed, changed and approved by the council, and placed into effect by the government unit, in the manner prescribed in section 1 subdivision 2. The council may make changes in the aircraft noise zones and the applicable acceptable levels of perceived noise decibels to conform with the actual levels of noise produced by aircraft using the airport site when it is in operation, and may require changes in control measures applicable to airport noise zones to conform with changes made by it. No property shall be used, and no building or other structure shall be constructed or improved, within any aircraft noise zone, so that persons using the property and buildings are subjected to a level of perceived noise decibels in excess of the acceptable level established by the council for that land use.

SEC. 3. CONTROL MEASURE INVOLVING TAKING; CONDEMNATION BY COMMISSION. Subdivision 1. If either the provisions or the application of section 1, subdivision 2, or any land use and development control measure applicable to public or private property in an airport development area is determined by a court of competent jurisdiction to constitute a taking, the commission in the exercise of its power to acquire lands for the airport shall have the power to acquire the property or any similar property or to acquire an interest therein to the extent needed for the application of such measure, by eminent domain exercised in accordance with Minnesota Statutes, Chapter 117. The right to eminent domain shall be exercised if the commission has or will have funds to pay the condemnation award and the council determines that it is necessary to protect the airport from encroachment or hazards, or to protect residents in the area, or to encourage the most appropriate use of property in the airport development area, or to protect and conserve the natural resources of the metropolitan area.

Subd. 2. The commission may retain any property now owned by it or acquired pursuant to subdivision 1 and use it for a lawful purpose, or it may provide for the sale or other disposition of the property in accordance with a redevelopment plan in the same manner and upon the same terms as the housing and redevelopment authority and governing body of a municipality under the provisions of Minnesota Statutes, Section 462.525, all subject to the provisions of section 1, subdivision 2, or existing land use and development control measures approved by the council.

Subd. 3. The commission and any other government unit in the metropolitan area may enter into an agreement whereby the cost of acquiring any property and the proceeds from the sale or other disposition thereof pursuant to subdivision 2 are to be shared by the commission and such government unit. The commission, the metropolitan council, or any government unit may also enter into any agreements with the United States or the State of Minnesota, or any agency or subdivision thereof, and do all acts and things required by State or Federal law or regulations as a condition or consideration, for the loan or grant of funds or property for the purpose of land acquisition or improvement pursuant to subdivisions 1 and 2.

SEC. 4. RELATION TO AIRPORT HAZARD ZONING. Sections 1 and 2 and any criteria, guidelines or land use and development control measure approved by the council pursuant thereto shall in no way supersede or limit the powers conferred on a municipality to do airport hazard zoning or the commissioners of aeronautics by Minnesota Statutes, Sections 360.061 to 360.073, and shall be consistent with any exercise of such power by the commissioner.

SEC. 5. GOVERNMENT UNITS IN AIRPORT DEVELOPMENT AREA; TAX SHARING. The legislature determines that the location of a new major airport in the metropolitan area will increase the value and rate of development of land in the airport development area; that the airport development area may comprise property located in several government units; that the exercise of the powers and duties conferred on government units by sections 1 to 3 to control develop-

ment of land in an airport development area may result in greater development of such land within one government unit than another; that the control of such development will be of benefit to the entire airport development area; and that the assessed value of taxable property and the tax resources in the government unit where the most development takes place may be significantly greater than in other government units in the area. Therefore, to encourage the protection of inhabitants of the area and natural resources of the metropolitan area, to increase the likelihood of orderly development in an airport development area, and to provide a way for all government units in the area to share in the tax resources generated by growth of the area, the governing bodies of all government units located wholly or partly in an airport development area shall jointly study and decide upon a plan for the sharing of property tax revenues derived from property located in an airport development area. If 80 percent of the government units having territory within the airport development area agree upon a plan, such plan shall be put into effect and all government units shall enter into such agreements as may be necessary for this purpose, provided that the plan shall not impair the existing contract obligations of any government units. This section shall not apply to the commission or the council.

SEC. 6. DEFINITIONS. Subdivision 1. For the purpose of this act the terms defined in this section have the meanings given them.

Subd. 2. "Commission" means the Minneapolis-Saint Paul metropolitan airports commission.

Subd. 3. "Government unit" means any county, city, village, borough, town, council, commission or school district.

Subd. 4. "Metropolitan area" means the area of the counties of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington.

SEC. 7. Notwithstanding any provisions of Minnesota Statutes, Section 360.101 to 360.144, or any other law to the contrary, the commission may select a site and exercise the powers, control and jurisdiction granted it by law at any place or over any other airport within 35 miles of the city hall of either city as defined in Minnesota Statutes, Section 360.102, Subdivision 9.

SEC. 8. SEVERABILITY CLAUSE. If any court determines that any provision of this act or any application thereof to any facts is invalid for any reason, such invalidity shall not affect any other provision or application of provisions of this act, each of which is declared to be severable.