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Federal Aviation Administration

Advisory Circular

Subject: AIRPORT MASTER PLANS

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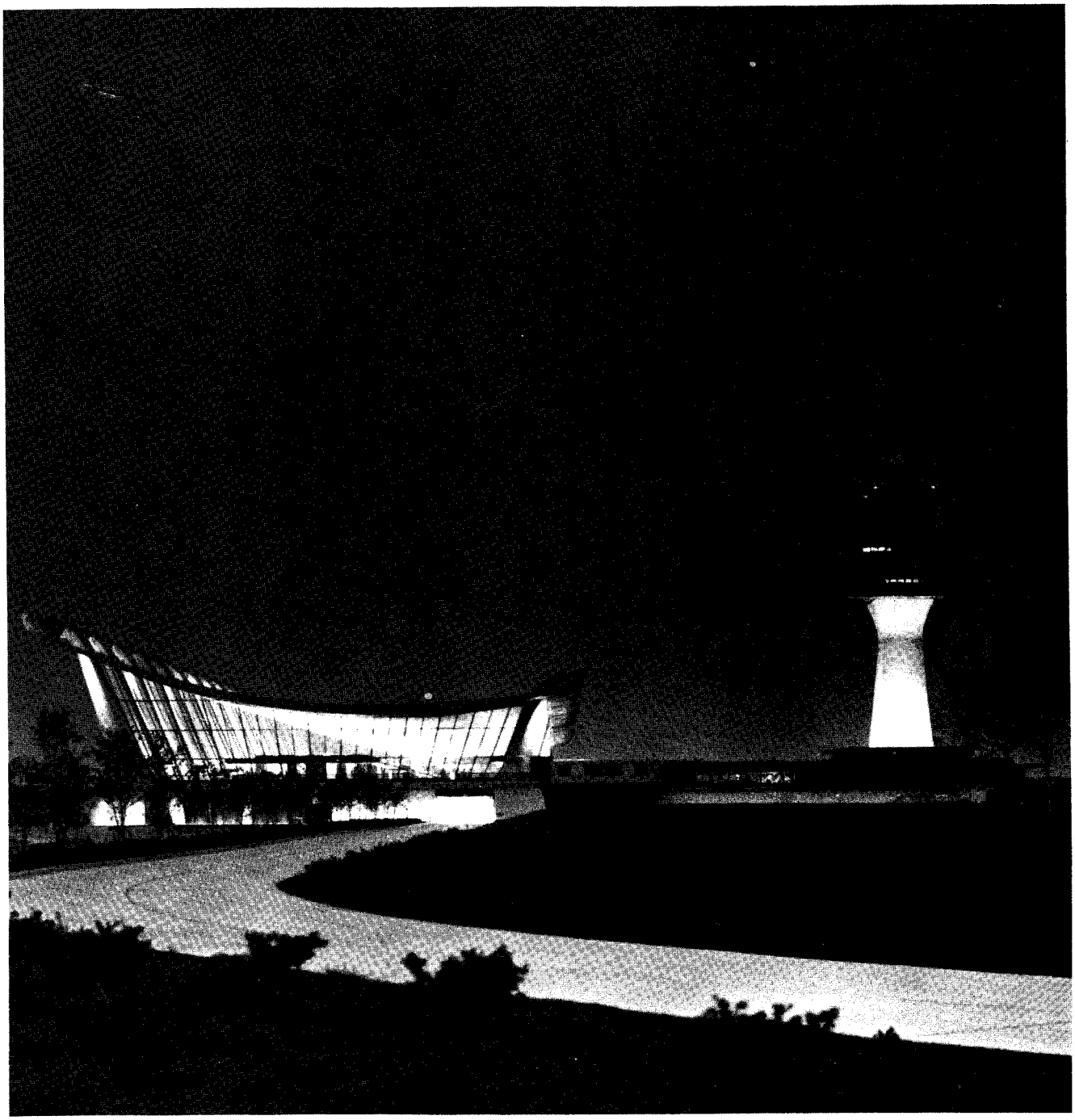

SUBJECT: AIRPORT MASTER PLANS

1. **Purpose.** This advisory circular provides guidance for the preparation of airport master plans, pursuant to the provisions of the Airport and Airway Improvement Act of 1982.

2. **Background.** The Advisory Circular 150/5070-6, "Airport Master Plans," published in February 1971, guided the preparation of master plans since enactment of the Airport and Airway Development Act of 1970. Significant experience has been gained and airport and related planning processes have undergone basic changes, with more attention to the environmental consequences of airport development. There is a need for updated airport master planning guidance, consistent with contemporary airport planning requirements and processes.

3. **Cancellation.** This cancels Advisory Circular 150/5070-6, Airport Master Plans, dated February 5, 1971.

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CHAPTER 1 INTRODUCTION

Final Approach to Washington National Airport

1. **GENERAL.**

This advisory circular (AC) provides national guidance for the preparation of airport master plans. It may be used for preparing individual airport master plans pursuant to the provisions of the Airport and Airway Improvement Act of 1982, or for airport planning generally, irrespective of Federal involvement.

b. This publication is intended primarily for use by the aviation community, especially those directly involved in preparing master plans—airport operators, staffs, and their airport consultants. It will also be useful to state aviation officials, airport board members, municipal officials, state/regional/local planning personnel and the general public, all of whom are part of the airport planning process.

c. AC 150/5070-6, "Airport Master Plans," published in February, 1971, has guided the preparation of master plans since enactment of the Airport and Airway Development Act of 1970. During this period, significant experience has been gained due to the stimulus in airport planning activities provided by this law. Over 1500 master planning projects have received Federal aid.

d. Airport and related planning processes have changed. The integration of airport planning

with the other planning processes at state and regional governmental levels has introduced broader policy and planning considerations. The direct involvement in airport planning by state transportation authorities and regional transportation planning organizations has reinforced this change.

e. The National Environmental Policy Act of 1969 (NEPA) has significantly affected airport planning, requiring that environmental impacts be considered early and throughout the planning process. The investigation of alternative development concepts and the mitigation of environmental impacts extend the planning process beyond aeronautical and cost considerations.

f. The Airport and Airway Improvement Act of 1982 responds to the airport and airway system needs of the eighties by providing substantial increases in financial assistance for development and planning. Revised guidance for airport master planning, based upon contemporary processes and methods, is needed to accommodate the anticipated level of planning activities.

2. **MASTER PLAN DEFINITION.** The airport master plan is the planner's concept of the long-term development of an airport. It displays the concept graphically and reports the data and logic upon which the plan is based. Master plans are prepared to support modernization of existing airports and creation of new airports, regardless of size, complexity, or role.

3. **GOAL AND OBJECTIVES OF A MASTER PLAN.** The goal of a master plan is to provide guidelines for future airport development which will satisfy aviation demand in a financially feasible manner, while at the same time resolving the aviation, environmental and socioeconomic issues existing in the community. Specific objectives are:

a. To provide an effective graphic presentation of the future development of the airport and anticipated land uses in the vicinity of the airport.

b. To establish a realistic schedule for the implementation of the development proposed in the plan, particularly for the short term capital improvement program.

c. To propose an achievable financial plan to support the implementation schedule.

d. To justify the plan technically and procedurally through a thorough investigation of concepts and alternatives on technical, economic and environmental grounds.

e. To present for public consideration, in a convincing and candid manner, a plan which adequately addresses the issues and satisfies local, state and Federal regulations.

f. To document policies and future aeronautical demands for reference in municipal deliberations on spending and debt incurrence and land use controls, e.g., subdivision regulations and the erection of potential obstructions to air navigation.

g. To set the stage and establish the framework for a continuing planning process. Such a process should monitor key conditions and adjust plan recommendations if required by changed circumstances.

4. **ORGANIZATION AND USE OF THE ADVISORY CIRCULAR.**

a. The information presented in this AC covers the planning requirements for all airports, regardless of size, complexity or role. However, the scope of a study must be tailored to the individual airport, with the level of effort limited to its specific needs and problems. Based on an airport's specific needs, certain master planning elements may be emphasized while others will not be considered at all.

b. In using this AC, it should be remembered that the guiding principle of the planning process is the development of a safe and efficient airport through the use of acceptable standards.

c. The steps in a master planning process are not necessarily mutually exclusive. There are certain considerations, particularly financial and environmental, which must be accounted for throughout the process. While this AC treats them in separate chapters, they are not intended to be applied piecemeal or sequentially, but in an iterative way throughout the planning process.

d. The availability of planning information from Federal, state and local governmental organizations may eliminate the need for developing similar information in the master planning effort.

e. A master planning effort may involve only the verification of the currency of available information, the updating of plans and implementation schedules, and the production of an abbreviated report.

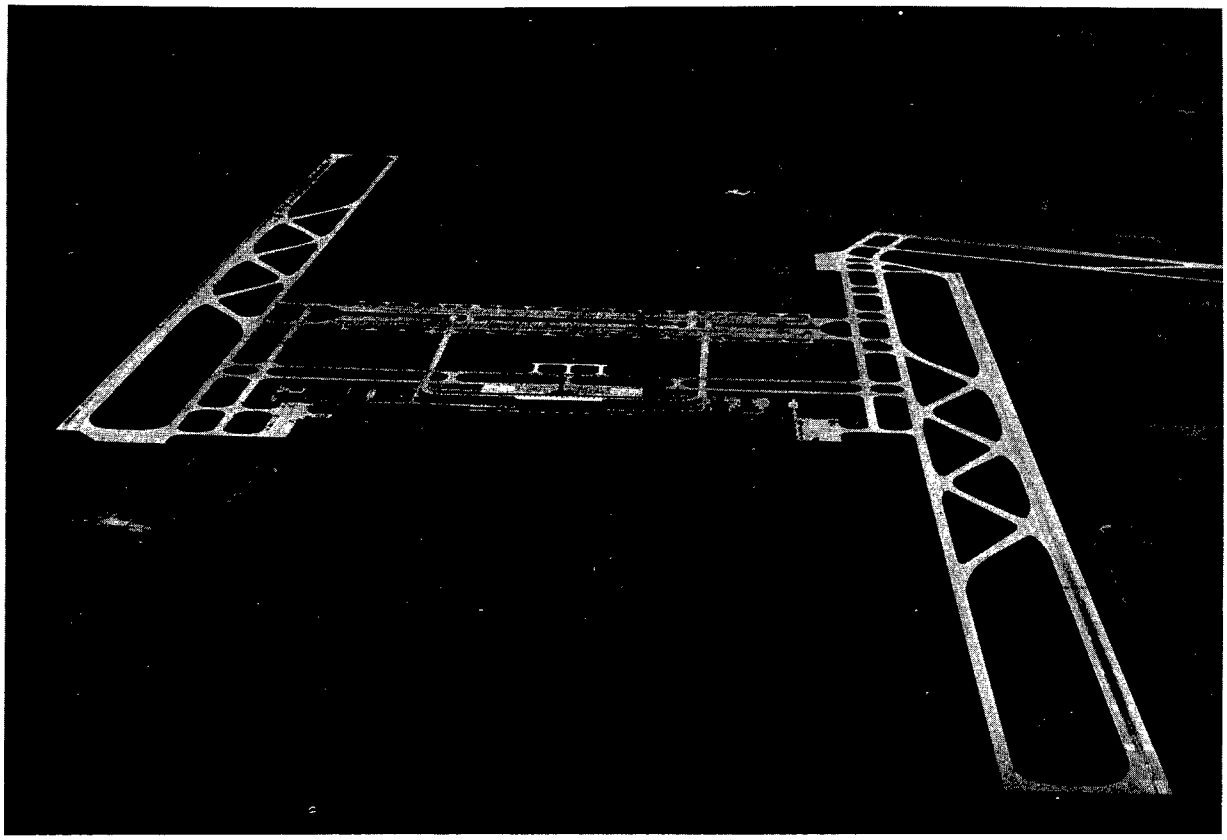
f. This AC does not provide information on airport design. That information is available in other FAA publications, which are referenced herein.

5. INTERNATIONAL APPLICATION.

a. This AC applies to U.S. airports with international aviation roles and may be useful in planning airports outside the U.S. Planners should be aware of the existence and applicability of international standards and recommended practices.

b. Standards and recommended practices for airports used in international civil aviation are promulgated by the International Civil Aviation Organization (ICAO), headquartered in Montreal. See "Annex 14 to the convention on International Civil Aviation." ICAO also publishes, from time to time, relevant information on airport master planning, land use and environmental controls, etc., which the planner may find useful.

CHAPTER 2 THE PLANNING PROCESS



Dulles International Airport

1. **GENERAL.**

a. The airport master planning process involves collecting data, forecasting demand, determining facility requirements and developing plans and schedules. These steps cannot be undertaken effectively without understanding other aviation, transportation and comprehensive planning requirements.

b. The master planning process must consider airport tenants and users as well as the general public who may be affected by its results. Their involvement throughout the master planning process avoids "surprises" and helps develop a consensus. Early progress towards consensus on master plan recommendations can pave the way for effective environmental assessment and impact statement reviews. Public involvement in master planning can also lead to productive public hearings when they are required to determine the consistency of individual projects with a community's goals and objectives.

c. Thorough preplanning activities can expedite a project and identify issues, decide which existing data will be used, clarify airport operator/consultant relationships, and establish schedules, financial resources and overall project scope.

d. Figures 2-1, 2-2 and 2-3 depict the steps in the master planning process, including organization and preplanning.

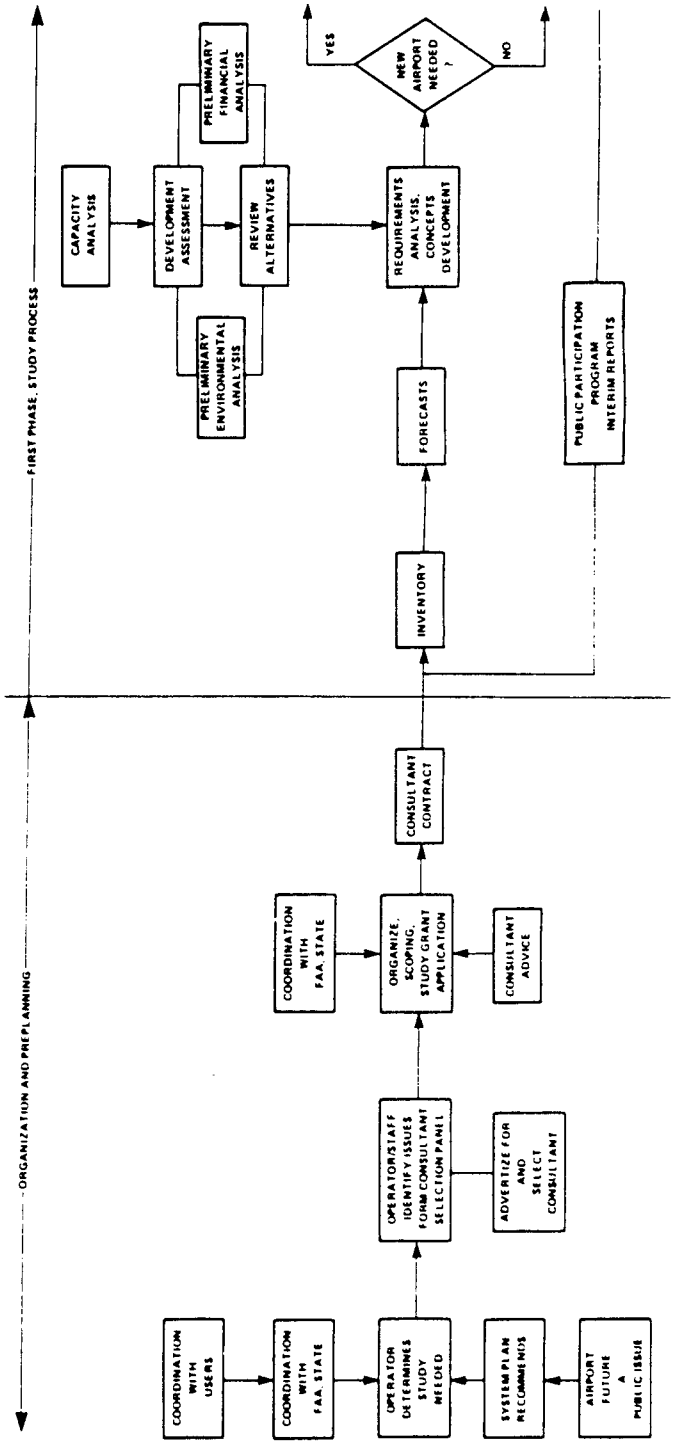


FIGURE 2-1. STEPS IN THE MASTER PLANNING PROCESS—ORGANIZATION AND PREPLANNING AND FIRST PHASE

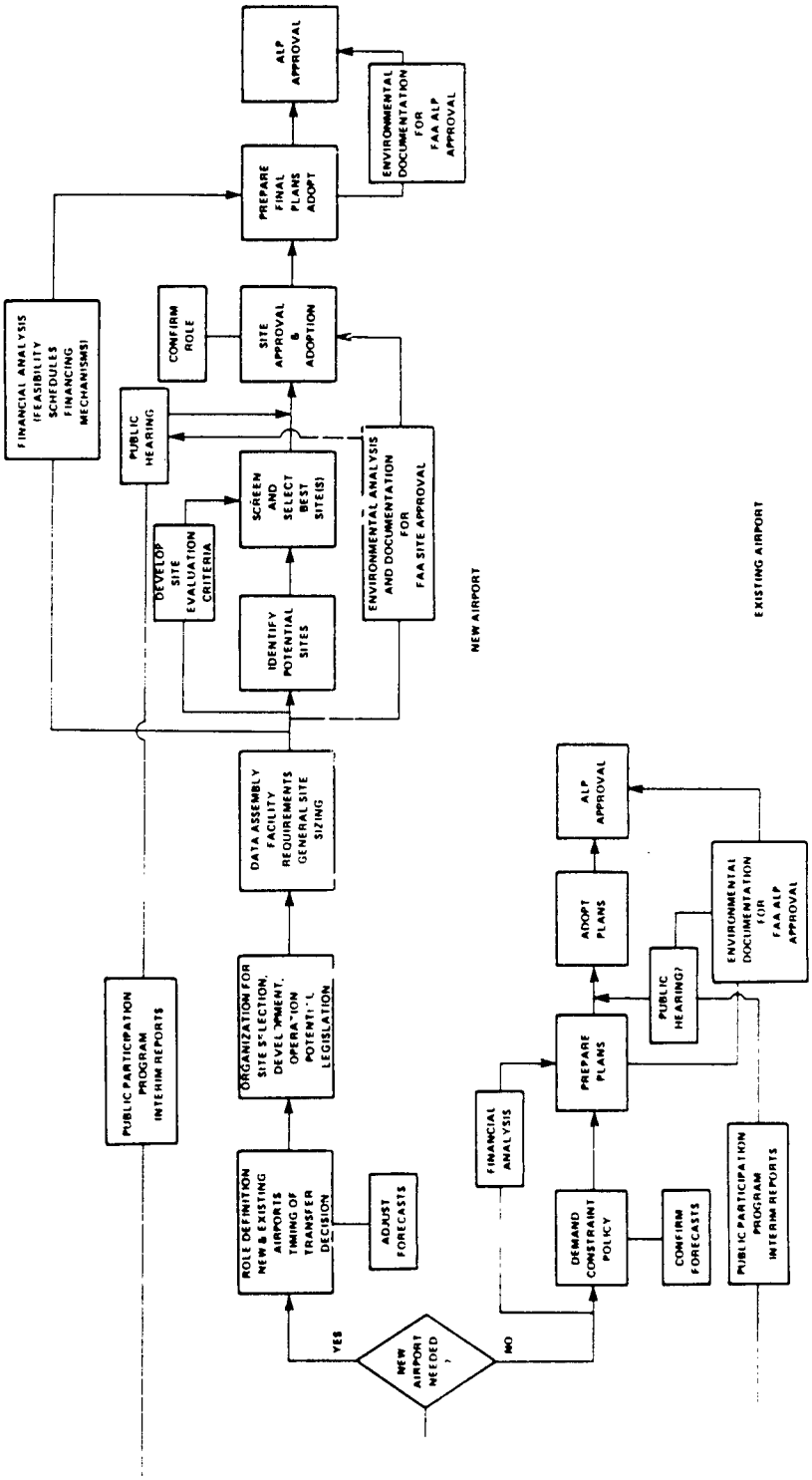


FIGURE 2-2. STEPS IN THE MASTER PLANNING PROCESS, SECOND PHASE—PLANNING THE EXISTING AIRPORT

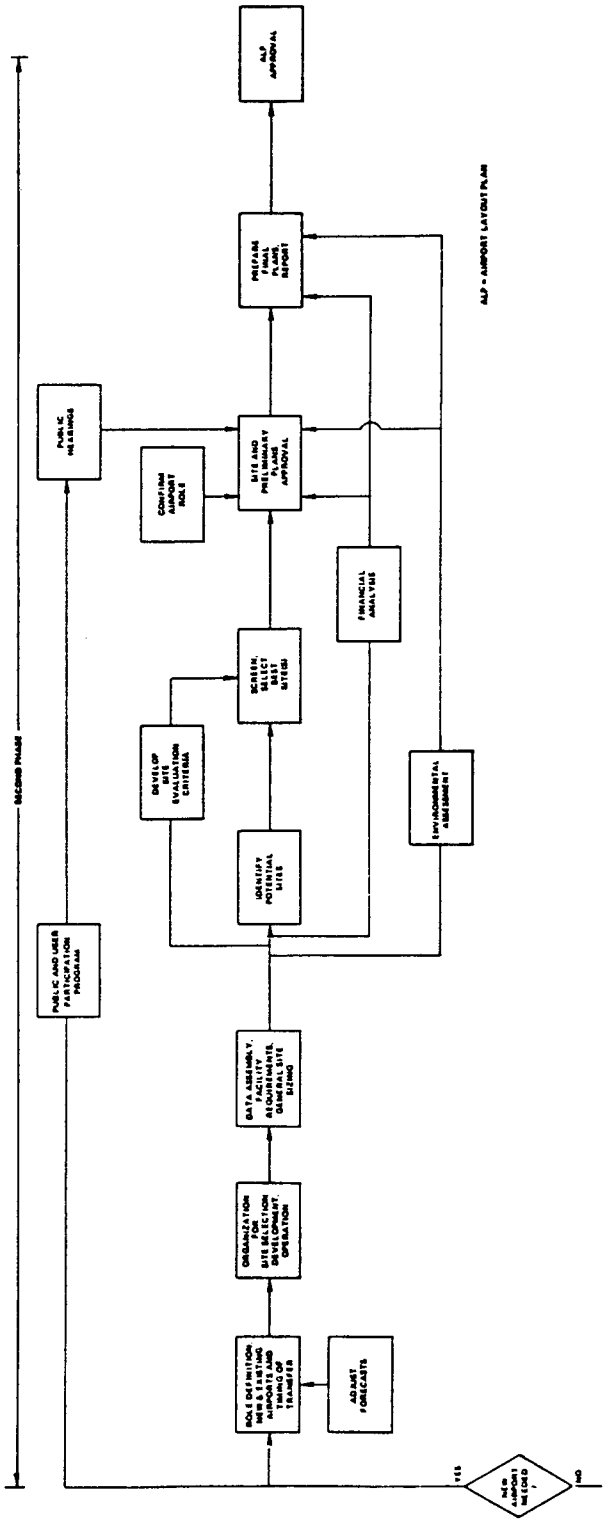


FIGURE 2-3. STEPS IN THE MASTER PLANNING PROCESS, SECOND PHASE—NEW AIRPORT SITE SELECTION

2. THE HIERARCHY OF PLANNING.

a. Airport plans at the national, state, region/metropolitan area and individual airport levels of government are formulated on the basis of overall transportation demands and coordinated with other transportation planning and comprehensive land use planning.

b. Airport planning in the United States is performed at several levels as follows:

(1) The National Plan of Integrated Airport Systems, a 10-year plan continually updated and published biennially by the FAA, lists the public use airports and their development which are considered to be in the national interest and thus eligible for financial assistance for airport planning and development under the Airport and Airway Improvement Act of 1982.

(2) Statewide Integrated Airport Systems Planning identifies the general location and characteristics of new airports and the general expansion needs of existing airports to meet statewide air transportation goals. This planning is performed by state transportation or aviation planning agencies.

(3) Regional/Metropolitan Integrated Airport Systems Planning identifies airport needs for large regional/metropolitan areas. Needs are stated in general terms and incorporated into statewide system plans. This planning is done by regional/metropolitan planning agencies.

(4) Airport Master Plans are prepared by the operators of individual airports, usually with the assistance of consultants. They detail the specific long-range plans of the individual airport within the framework of statewide and regional/metropolitan system plans.

c. Airport master planning must be responsive to areawide comprehensive transportation planning. This can be achieved by building into the master planning process appropriate review, coordinative and participatory mechanisms.

3. MASTER PLANNING ELEMENTS.

a. The elements of a master planning process will vary in complexity and degree of application, depending on the size, function and problems of the individual airport. The technical steps described in this AC are generally applicable. Each step should be undertaken only to the extent necessary to produce a meaningful product for a specific airport. It is not always necessary to undertake every task.

b. For example, a general aviation airport in a non-urban environment with, 25,000 annual operations, might only require the production of a set of plans and a brief report giving the basis for what is contained in the plans. Extensive inventory and background information would not be necessary. Forecasts and capacity data would probably be available from local, state or federal agencies, and the balance of the planning process, with the possible exception of the financial plan, is usually straightforward.

c. Study elements for complex, busy airports may involve sophistication beyond that detailed in this AC. For example, off airport land use planning strategies and public participation processes may require highly innovative approaches. Environmental impact assessments may require techniques not discussed here, and evaluation criteria for alternatives analysis may be predicated on circumstances not covered in this AC.

d. The master planning study, as an activity aimed at problem solving, may require emphasis on certain elements, depending on the airport. As examples:

- Where there is a question whether to recommend pavement reconstruction or an overlay, a preliminary pavement evaluation study including testing and coring may be necessary. The study should be limited in scope to that required to make the determination.
- Obstruction evaluation, including survey work, may be an important safety issue.
- Feasibility study of potential non-aeronautical revenue producing property, including possible industrial park development, long term leases and land releases may be advantageous.
- The cost effectiveness of a specific development recommendation may have to be carefully weighed. For instance, there may be a theoretical need for a runway

extension, but the cost may be high. Another example is whether a 150 ft. wide runway should be extended at that width when only a 100 ft. wide runway is required to meet current standards.

e. Master plan elements in general are:

(1) *Existing Conditions and Issues.* After the organization and preplanning phase, an inventory is made of pertinent data. Data is collected on the airport and airspace infrastructure and airport-related land uses. Pertinent airport-related issues and institutional mechanisms are defined.

(2) *Aviation Demand Forecasts.* Aeronautical demand, expressed in units necessary to determine the required capacity of airport facilities, is forecast for short, intermediate and long range time frames. While 20-year periods are usually targeted for long-range projections, a 10-year intermediate period is a more reasonable target in terms of forecast accuracy. A 5-year forecast should be of sufficient accuracy to justify a short-term capital improvement program.

(3) *Requirements Analysis and Concepts Development.* The capability of the existing airport to support the forecast demand must be determined. Airside capacity requirements are expressed in numbers and dimensions of runways and associated taxiways, apron areas, etc. Landside capacity requirements include terminal building space, auto parking and surface access. Should it be determined that the airport is capable of providing the required capacity, then the detailed planning steps for the existing site ensue. If there are serious reservations about the capacity of the existing site, there must be an investigation of alternatives such as developing new, replacement or additional sites, modifying the role of the existing airport or providing new general aviation facilities.

(4) *Airport Site Selection.* When the capability of the existing airport to meet forecast demand is questionable or when there has been a decision to construct a new airport, a site selection process is necessary. In the former case, the emphasis is on the need for and feasibility of a new airport. The review of potential new sites should, at least initially, be limited in scope to that which is necessary to make that kind of decision. In the latter case, the process will be significantly more detailed, leading to the selection of a specific site.

(5) *Environmental Procedures and Analysis.* Existing and potential environmental impacts and appropriate mitigating measures must be considered throughout the master planning process. Airport development projects must eventually meet the requirements of NEPA in order to receive Federal financial support. The master planning process is an ideal vehicle for reviewing potential environmental conflicts.

(6) *Simulation.* A useful tool in determining the most efficient airport configuration is the airport simulation model. Computer simulation may be warranted for a complex airport or when development of great magnitude is being considered. Simulation allows the planner to analyze the merits of alternative development proposals, particularly as they relate to time and fuel savings. A variety of simulation models have been developed for airport planning. A careful review is needed to determine which is best for a particular application. Computer simulation often involves considerable expense for data collection and analysis and should only be undertaken when benefits are expected to exceed these expenses.

(7) *Airport Plans.* A set of drawings is the product of the master planning process. The individual plans described here may be combined for low activity airports.

(a) The Airport Layout Plan (ALP) shows the airport boundary, the landing area configuration and the areas reserved for landside facilities. The location of navigational facilities and approach and runway clear zone areas are also depicted on the ALP.

(b) The Land Use Plan shows areas recommended for the passenger terminal complex, maintenance and cargo facilities, general aviation fixed base operator facilities, commercial and industrial areas, and other facilities within the airport boundary. Existing and recommended off-airport land uses should also be shown, based on considerations of noise levels, obstruction clearance criteria, and any activities which may affect the safety of aircraft operations.

(c) The Terminal Area Plan displays the various terminal area components and their relationships. Separate large scale drawings may be appropriate for important elements of the terminal area plan, such as terminal building areas, cargo building areas, and hangar areas.

(d) Access plans will show major highway routes from the airport to the Central Business District and points of connection with key arterial systems. They will also show other modes of access such as rail, if appropriate. The development of access plans involves cooperation with surface transportation agencies, particularly for access routings beyond the airport boundary. Special studies of access systems beyond the airport boundary are not normally included in a master planning project.

(8) *Plan Implementation.* This step involves the preparation of development schedules and costs. The schedules for development must be financially feasible. The master plan must show the sources of revenue which will cover capital improvement program costs as well as operation and maintenance costs. Financial feasibility must be considered throughout the planning process, especially during the requirements analysis and site selection activity. Schedules are normally based on short (5 years), intermediate (10 years) and long term (20 years) development needs.

4. **MASTER PLANNING PRODUCTS.** The products of the master planning process will vary with the complexity of the project. The basic documents are the master plan report and a set of drawings. The master plan report should contain the results of those investigations and analyses accomplished during the development of the plan. There should be an explanation if facilities are located or sized in an unusual way or variances to FAA standards are required or have been granted. Supporting technical reports may supplement the master plan report.

A summary document is useful to bring together pertinent facts, conclusions and recommendations for public consumption. This is an excellent place for highlighting the economic benefits which flow to the community from the airport. These may offset negative impacts such as noise. For small projects, the master plan report and summary report may be combined, especially if wide distribution is not anticipated.

The airport operator may also find visual aids, including slides and models, useful in explaining the development plan.

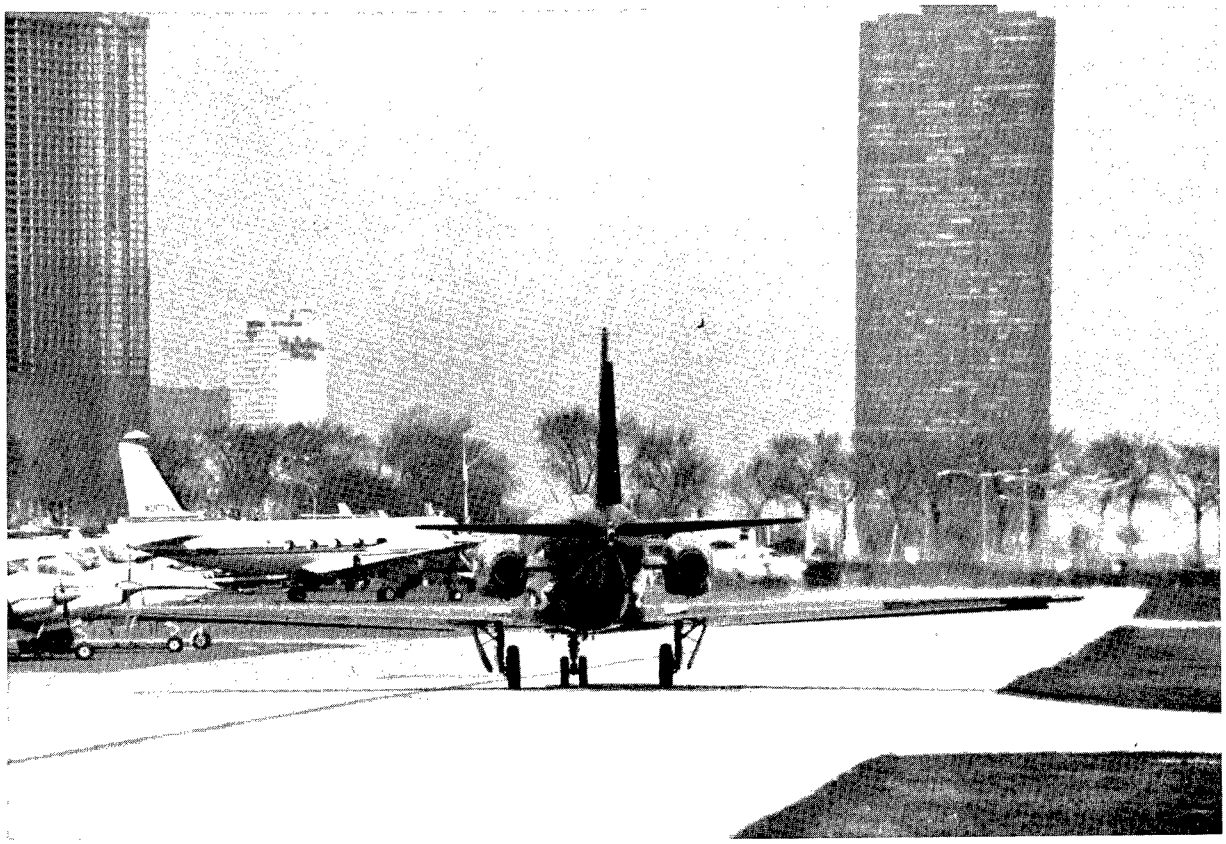
During complex master planning, it may be necessary to produce interim reports for coordination with FAA, state and users and for public information as required by a public participation program.

5. **PLAN CURRENCY.** Ideally, the master plan should reflect an up-to-date assessment of what exists and what is required. For the larger airports, with active management and staffs, this is feasible and also necessary in view of the active, sometimes confrontational, relationship between the airport and the community it serves. Maintenance of demand data allows a continuing assessment of the credibility of forecasts, enabling adjustment of development schedules that are demand sensitive. The data from noise monitoring systems can be used in conjunction with a review of aircraft operational procedures to determine the appropriate off-airport land use strategies.

Updating airport plans to reflect airport modification and off airport development is a necessity. In fact, airports receiving Federal financial assistance are required to keep their airport layout plan current. Aside from maintaining the currency of its airport layout plan, smaller airports do not require a continuing updating of the master plan. Once an adequate master plan has been produced, a revision should only be necessary to deal with unforeseen and substantive changes in activity or the emergence of critical issues.

6. **PRODUCT APPROVAL.** The approval of the products of the master planning process by the airport operator should be timely so as to expedite consultant reimbursement and FAA payments under federally assisted planning projects. FAA approval of the master plan extends only to assuring completion of work elements specified in the grant agreement.

CHAPTER 3 ORGANIZATION AND PREPLANNING



Parking Apron Congestion

1. **GENERAL.** Critical to the success of the master planning process is the preplanning stage. This is where an organization for the study is established, the work program developed, and the means for financing the effort are worked out. The need for a master planning study will have been identified by the airport operator based on obvious existing or potential shortcomings. These deficiencies may be the result of demand exceeding capacity, the introduction of more demanding aircraft, or the emergence of a critical environmental problem. National, state, or regional planning may have called attention to demands deserving planning attention on the part of the operator. On the other hand, airport users, such as the scheduled airlines, may have identified demands which prompted the airport operator to undertake the study. Such demands are often identified in Joint Planning Conferences, held at the airport.

2. **ORGANIZATION.** Once it has been determined that an airport master plan would be useful, an organization for its accomplishment must be established. The sophistication of the organization will depend on the complexity of the project. In any case, the airport operator must be the focus of the organization and take the lead in the initiation and accomplishment of the master planning project.

An airport operator's understanding of the premises and facts underlying the plan's recomendations can be crucial in gaining political approval for implementation. In addition, the airport operator's awareness of the usefulness of certain types of data in the planning process could result in that data being continually collected to maintain master plan currency.

a. For less complex projects, an airport operator and a consultant may be the only organization required, as long as there is coordination with appropriate municipal officials and the airport board as well as citizen participation through public information sessions, conducted separately or in conjunction with other public meetings or events. Coordination with areawide or state aviation, transportation and comprehensive planning agencies, and the FAA may occur through written communication and informal contact, rather than formal committees.

b. For complex projects, it may well be necessary to organize in a more sophisticated fashion with formal policy, technical and review committees meeting on a regular basis and with structured communications systems, including public hearings and public information sessions. These mechanisms can exist exclusively at the regional or state governmental levels or with a mutual state-regional effort.

Participation of the FAA as well as aviation industry organizations is generally considered a must. FAA's advice concerning airspace management, navigation aid and approach aid installation, instrument runway designation, potential financing of planning and development, and safety and security matters will be essential. The local FAA Airports Program representative can coordinate the several FAA organizational interests in the airport's development and operation. Advice from the airlines concerning aircraft types, operational and financial matters, will also be vital for effective planning.

Airport management staff will likely participate in the day to day activities of the master planning project in a working as well as management role. The large airport operator will likely have a more extensive management staff structure than the operators of smaller airports.

c. Airport management staff can be expected to keep a master plan, or at least the drawings, current and to update the plan routinely when necessary. However, the initial planning study and any major revision will usually require professional assistance by airport consultants. The selection of a consultant should take place early in the organizational phase so that timely professional advice during preplanning can be obtained.

3. **CONSULTANT SELECTION.** The selection of a consultant should be done by an unbiased and technically qualified selection panel, which solicits and reviews technical qualifications from a number of firms. The FAA should not be expected to serve on this panel. The qualifications of the firms should be judged on experience in similar work and professional credentials. The master planning project team proposed by the consultant should be composed of individuals experienced in their respective areas of involvement and committed to the project in the amount of time specified. It is not uncommon for several firms to join together for purposes of providing specialized skills or local expertise.

While the review of the technical qualifications of numerous firms is appropriate, the actual solicitation of technical proposals should be limited to a few. The preparation and presentation of quality technical proposals is time consuming and costly. Moreover, the selection panel cannot be expected to make a thorough assessment of the technical proposals and conduct effective interviews when a multitude of consultants are involved.

Before soliciting technical proposals and interviewing consultants, the airport operator should have a clear understanding of the issues and why the airport needs a master plan. The consultant is hired to provide the technical expertise which the airport operator cannot supply, not to manage totally the master planning process and control its results, or, on the other hand, to justify a decision already made. The airport operator must take responsibility for the overall policy direction, management and control of the planning process, including the study.

AC 150/5100-14, "Architectural, Engineering and Planning Consultant Services for Airport Grant

Projects" provides important guidance for consultant selection, and its use is recommended.

4. **PROJECT SCOPING.** After the organizational phase but prior to the award of a consultant contract, the airport operator and consultant should (1) identify the pertinent issues involved in the airport's development and (2) determine the type and magnitude of effort needed to address each issue individually. This step, known as "scoping," is an important one in designing the master planning study, regardless of its complexity. It is at this point that the aviation-related issues in particular are reviewed and a preliminary assessment is made of what it will take to resolve each of them. Typical issues for large airports may relate to noise problems, potential need for a replacement or supplemental airport, internal or external surface access limitations, etc. For smaller airports, the issues might include financial solvency, maintenance of scheduled service, operational safety or reliability.

a. If the project will involve the investigation of new airport sites, this is the time to decide whether the site selection process will be sufficiently detailed to recommend a specific site or whether its focus will be only on the analysis of alternatives, e.g., whether to select a new site or other alternatives, with detailed site investigation to occur later under a new project.

b. An attempt should be made to determine the required environmental documentation for the development which will be recommended; that is, whether an environmental assessment will likely be required or whether categorical exclusions will apply. If an assessment is likely to be required, then there should be an indication of the nature of the alternatives that must be reviewed. Also, it may be useful to determine whether to seek a long-term unconditional approval of the airport layout plan, or unconditional approval of only short-term development items.

c. Available data such as the activity forecasts and capacity assessments produced by state and regional system plans and FAA Terminal Area Forecasts must be reviewed and decisions made on potential use. If these data are not to be used, the reasons for their inadequacy should be well understood and accepted by all parties, including the FAA. This is especially true for low activity airports where demand/capacity relationships are not critical.

d. The length of the short, intermediate and long-term activity forecasts should be decided. while 5-10-20 year time frames are typical, there may be justification for using different time frames. In any event, the short-term forecast should support a capital improvement program, the intermediate-term a realistic assessment of needs, and the long-term a concept oriented statement of needs.

The schedules for airport development that are directly related to forecast demand levels should be tied to such levels, rather than dates, because of the possibility of the forecasts being off target.

e. Schedules showing milestones for completion of technical products as well as coordination/review activities must be agreed upon. The need for realism in schedule development is important. From a practical standpoint, adhering to schedules for controversial projects, such as long-range plans for high activity airports, is very difficult. For small airport projects this should not be the case. However, experience has shown that even with the noncontroversial airports, completion schedules for master plans should be set, insofar as possible, so that all reviewing officials are aware of their responsibilities with respect to the agreed upon time targets.

There must be a clear identification of decision points, beyond which work should not proceed without airport operator approval. The airport operator should recognize the importance of timely decisions in meeting planning process deadlines.

f. The specific products of the master planning process should be agreed upon at the outset. The number, type and format of reports and drawings should be specified in the consultant contract.

5. **CONSULTANT CONTRACTS.** After scoping the project and selecting a consultant, a price for the consulting services must be agreed upon and a contractual arrangement entered into. The normal type of agreement between the airport operator and the consultant will be a firm fixed price contract. This is advisable whenever the level of effort can be

fairly well predicted and where reasonable prices can be established at the outset.

Where the level of effort or duration of the project is uncertain, a cost-plus-fixed-fee contract or time and materials contract may be necessary. The fixed price type of arrangement is preferable, however, and most common for master planning projects. This type of contract imposes a minimum administrative burden and provides incentive for effective cost control and contract performance. Contracts based on a cost plus percentage of cost are not recommended and are not allowable if Federal financial assistance for the project is contemplated.

6. **PROJECT APPLICATION.** Most master planning projects for public airports are supported financially with Federal funds. An application for such funding should be prepared by the airport operator, with assistance from the consultant, after coordination with FAA regarding eligibility and need. FAA involvement in the scoping process is essential to the development of a financially supportable planning project that can be processed in a timely fashion. Indeed, FAA involvement prior to scoping or designing the study is important if financial aid in project formulation costs is to be requested.

CHAPTER 4 ISSUES AND EXISTING CONDITIONS

Operation at a Commercial Service airport

1. **GENERAL.** While an overview of issues and existing conditions should occur at the preplanning stage in order to effectively scope the project, an early activity in the study will be to assemble and review all existing information pertinent to the accomplishment of subsequent planning steps. For example, an understanding of the aeronautical, environmental and socioeconomic issues related to the airport will be necessary in order to deal with them in the planning exercise. A knowledge of the institutional and policy framework within which the master planning will take place is essential in order to produce an implementable plan.

A compilation of prior planning studies and knowledge of other planning efforts which are underway should provide a valuable resource and avoid duplication. An inventory of the existing physical plant and an assessment of its condition and useful life are critical to determining the need for expanding facilities. An assessment of land use on and adjacent to the airport will provide a basis for decisions on the potential expansion.

Site-specific knowledge of air traffic management will influence capacity determinations. Data on airport revenues and expenses will assist in determining the financial feasibility of airport improvements, while an array of aviation, socioeconomic and demographic information will provide the basis for aviation forecasts.

While the types of data discussed herein will be generally required for most master planning projects, the degree and emphasis of the data collection will vary substantially with the size and complexity of the airport.

2. **THE ISSUES.** The issues which may influence the master plan's recommendations should be identified through discussions with the airport operator, airlines and other users, the FAA, and public officials responsible for policy, land use and transportation planning. A thorough identification of the issues will assist in developing strategies for dealing with them, including study emphasis.

Typical issues may include:

— Aviation growth, in general; expansion of scheduled service; expectations of obtaining regional carrier service.
— The potential need for a new airport and the roles of the existing and new airports.
— Major expansion for capacity.
— Ground access problems. For example, the expansion of terminal capacity may be dependent on gaining approval for a major interchange; thus the sequencing of airport and off-airport actions is crucial.
— Relocation problems related to roads, powerlines and people.
— Obstructions and landfill site problems.

Many issues relate to the environmental impact of an airport. At an existing airport avoidance of increased noise affecting residents of adjacent communities while increasing airport capacity is perhaps the most notable environmental problem. However, other environmental considerations may be more important when planning a new airport.

3. **BACKGROUND.** The accumulation of concise information on how the airport evolved, its aeronautical role, its place in the community's public facility infrastructure, and a quantification/qualification of socioeconomic benefits and costs may prove useful in planning and as background information for the master plan report and summary document. The practice of collecting quantities of remotely relevant information for use as filler material is to be avoided, however.

4. **EXISTING PLANT.** The existing airport facilities can be inventoried by referring to current plans, as built drawings and other documents on file with airport management. If there are no verifiable reports on the condition of individual facilities, such as airfield pavements, lighting, drainage and utilities and landside buildings, roads, utilities, then visual inspection and inquiries may be appropriate in determining condition and useful life. Typical airport facilities to be inventoried would be:

— Runways, taxiways and aprons and related lighting, marking and signing;
— Passenger and cargo buildings and other terminal buildings and areas, by function;
— General aviation buildings and areas, by function; fire fighting and rescue buildings, Federal facilities;
— Aviation fuel and aircraft servicing systems;
— Utilities, including water, gas, electric, telephone, drainage and sewage.

5. **LAND USE.** Land uses on the airport property and immediately adjacent to it must be reviewed together because the planning does not end at the airport property line. Access systems and commercial areas which serve the airport, or are served by it, are important in planning for airport modernization and expansion. Also it is important to know the land uses in those environs which will be exposed to the airport's negative impacts of noise and air pollution. Land usage is a continuously changing process, particularly in urban environments. Therefore, the land use inventory must include all available intelligence on planned and proposed land uses, in addition to the data on existing uses.

Most land uses are considered compatible with noise levels less than the 65 day-night average sound level (Ldn) contour. (See AC 150/5020-1, Noise Control Compatibility Planning for Airports and AC 150/5050-6 Airport-Land Use Compatibility Planning.) While the land use inventory may begin early in the study, its completion should await the estimation of the Ldn generated by the aircraft using the airport in question.

If the airport operator has undertaken a noise compatibility planning program under the provisions of the Aviation Safety and Noise Abatement

Act of 1979, a wealth of land use information will exist.

The existence of any governmental programs designed to direct land use patterns in the area under review should be noted. General property values based on recent sales figures and tax assessments should be identified.

A collection of all applicable documents, such as official maps, the latest areawide comprehensive land use and transportation plan, applicable municipal zoning ordinances and other land use controls and unusual building code provisions, will be needed. Important to recommending practical land use strategies will be an understanding of the contemporary political context and local preference regarding potential land use projects.

Land uses which may affect the safe operation of the airport, or which may influence the way it can be expended, must be ascertained. Principal among the concerns are the location of structures which could constitute obstructions to air navigation or the existence of other airports which may interfere with the operations of the airport being studied. Land uses which may be attractive to birds, thus presenting a potential hazard to aircraft, should be identified. For example, such land uses as flood control areas, stockyards, and sanitary land fills, may be critical if located near the airport.

Aerial photographs, topographical maps, obstruction charts, aeronautical charts, approach plates and other mapping tools should be used to examine and display land use details.

6. **GROUND ACCESS, CIRCULATION AND PARKING.** Data should be gathered about on-airport access roads, circulation and service roads, parking and curb space. Data should include alignments, condition and capacity. Public transportation services, such as bus, rail, taxi and limousine, should be noted. The split between personal and public transportation should be ascertained. Consultation with state and local transportation agencies responsible for planning and operating surface transportation systems should produce data on proposed highway and transit plans as well as traffic density statistics relative to surface systems leading to and from the airport. These data will be used to project surface access requirements.

7. **ENVIRONMENTAL DATA.** In addition to the land uses discussed in paragraph 5, there may be other land uses or conditions which must be identified in order to account for environmental consequences. These consequences will likely not be as critical as the noise impacts but, nonetheless, must be investigated. Information to be collected will include air and water quality data used in determining compliance with Federal and state standards. Other data to be collected, where applicable, would include:

- — solid waste generation and disposal;
- — toxic material disposal;
- — floodplains, wetlands;
- — endangered/threatened flora and fauna;
- — biotic communities;
- — parklands/recreational areas;
- — historic/architectural/archaelogical/cultural resources, and prime and unique farmland.

Additionally, the assessment of impacts of potential major expansion or transfer to a new site may require socioeconomic data to determine employment losses or community disruptions.

8. **AIR TRAFFIC MANAGEMENT.** Information should be compiled on the use of the airspace and how the airport's air traffic is, or will be, managed. This would include information on operational limitations due to traffic interaction with other airports or reserved airspace, obstructions, noise abatement procedures, airfield or navigation aid shortcomings. This type of information can be obtained from FAA personnel who can also provide suggestions on how to mitigate the limitations. The FAA can also provide information on plans for installation of air navigation and approach aids and designation of instrument runways. Available aeronautical charts and instrument approach and departure plates should be examined.

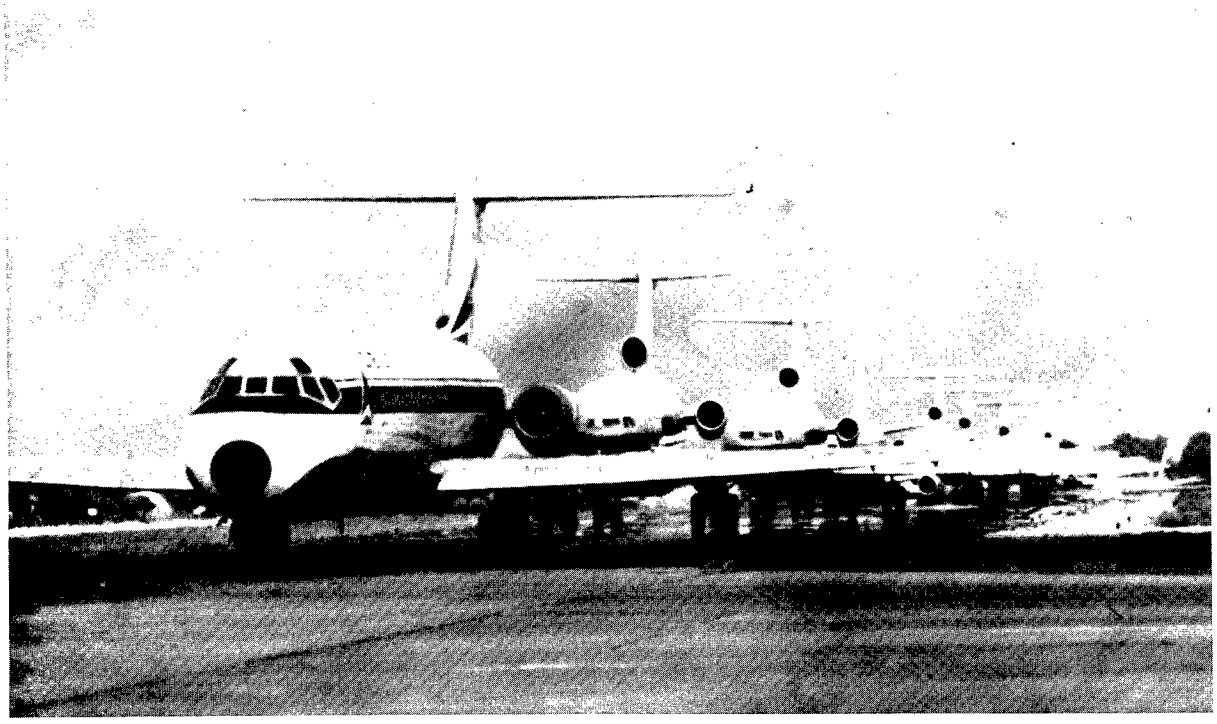
9. **METEOROLOGICAL DATA.** Historical data on weather conditions need to be ascertained because of the weather's effect on airport operations and capacity. In determining runway orientation and use, it is important to know the location's prevailing wind direction and velocity over time. Also, the average annual ceiling and visibility conditions affect airport capacity because aircraft spacing usually must increase as these conditions deteriorate.

Weather data for specific locations is available from the National Oceanic and Atmospheric Administration's Environmental Data Service (EDS). The EDS's National Climatic Center is located in the Federal Building, Asheville, N.C. 28801.

10. **FINANCIAL DATA.** In order to determine the financial feasibility of the master plan's recommendations and to develop a financial plan, it is necessary to assemble current financial data. A compilation of current revenues and costs should be available from airport management. Typical revenues would come from landing, parking and hangar fees, ground handling charges, aviation fuel and oil concessions, fixed base operator rentals and concessions. Typical sources of terminal area revenue would include terminal rentals and concessions for airline ticketing, shops, restaurants, bars; auto rental and parking concessions; rentals for hotels and other on-airport commercial facilities. Costs are incurred in operations, maintenance, administration, and amortization of outstanding debt.

11. **AVIATION ACTIVITY, SOCIO-ECONOMIC, DEMOGRAPHIC DATA.** The body of data necessary for forecasting aviation demand is discussed in detail in Chapter 5, Aviation Forecasts. The assembly of this data should take place early in the inventory phase.

CHAPTER 5 AVIATION FORECASTS



Queueing up for takeoff

1. **GENERAL.** Estimates of the timing of certain threshold events are the basis for effective planning decisions. In airport master planning, these events correspond to levels of aviation demand which exceed existing or planned capacities of the airport.

a. *Level of Effort.* Forecasts of these thresholds for different airport master planning projects have ranged from informed guesses to highly structured projections. While the art of forecasting can be practiced with a wide range of tools and techniques, it is important to gear the level of forecast effort employed to the level of costs "at risk" at the airport if the forecast proves to be substantially in error. Thus, for a major project at a large airport, more effort and expense in reducing the probability and range of error in the forecast is justified than for a minor project or a smaller airport with respectively lesser costs due to forecast error.

b. *Cost of Forecast Errors.* In the case of airport master planning forecasts, the "costs" of errors in forecasts are related to the timing for investments to be made to meet new demands at the airport. The costs of forecast errors can be substantial.

(1) If investments are made too early because of an overly optimistic forecast of growth in aviation activity, premature capital costs and unnecessary operating expenses can be incurred, and

more efficient uses of the investment capital can be lost.

(2) If investments are made too late because of underestimation of aviation growth, lost revenues and inconvenience can be substantial. In some cases, the costs of forecast errors can spill over in the form of adverse impacts on the general public outside the airport.

c. *Purpose of Forecasts.* The purpose of aviation forecasts is to indicate the relative timing for airport investments in a manner that minimizes forecast error costs. The idea is to forecast the different elements of aviation demand, compare that demand over time with the capacity of an airport's various facilities, and to identify the time when new or expanded airport facilities may be necessary. When this basic approach is integrated into a continuous master planning process, during which actual aviation activity is compared with previously forecast demand for that period, the future year forecasts can be updated to reflect the appropriate time for phasing in capital investments or other measures.

2. **FORECAST ELEMENTS.** There are certain specific aviation demand elements which must be forecast for the development of a master plan at an individual airport.

a. *Types of Activity.* To determine the new demands at a master plan airport, it is essential to develop forecasts for aircraft operations and for enplaning passengers at the airport. The number of based aircraft and the mix of aircraft must also be considered, as well as additional aviation demand elements for some special purpose or large airports.

(1) In regard to aircraft operations, the total number of landings (arrivals) and takeoffs (departures) from an airport must be forecast. There are two types of operations—local and itinerant—which should be separately forecast. Estimates of the local and itinerant aircraft operations must be developed for each of the four major user categories: Air Carriers, Air Taxi and Commuters (Regionals), General Aviation, and Military.

(a) *Local Operations.* Arrivals and departures of aircraft which operate in the local traffic pattern or within sight of the tower and are known to be departing for or arriving from flights in local practice areas within a 20-mile radius of the airport and/or control tower; plus simulated instrument approaches or low passes at the airport executed by any aircraft.

(b) *Itinerant Operations.* All aircraft arrivals and departures other than the local operations described above. Additionally, for those airports where instrument operations are possible, there should be a forecast of instrument activity. Where capacity may be a problem and when appropriate weather data is available, forecasts should be for instrument operations during specific instrument meterological conditions (IMC).

(2) *For enplaning passengers,* the total number of passengers departing an airport, on aircraft including originations and transfer passengers, must be forecast. Passenger enplanement forecasts should be made for each of the three civil user categories: Air Carriers, Air Taxis, and Commuters (Regionals).

(3) The mix of aircraft which will be based at the airport should be forecast. This can be particularly important if basic changes in the types of aircraft are expected. For example, a number of design criteria for length, width, and strength of runways and taxiways are tied directly to the weight, wing span, and speed of the aircraft that will use the facilities.

(4) *Annual Instrument Approaches (AIA)* at the master plan airport should be forecast where such information is needed for planning or upgrading of navigational aids and landing systems.

(5) At those airports where special facilities are now provided or anticipated for processing domestic and international passengers, or for other categories of passenger enplanements, each such category of traffic should be forecast. Similarly, if general aviation passenger facilities are located apart from facilities for other passenger traffic, or if general aviation passenger traffic is a significant portion of total passenger traffic, then a separate forecast should be prepared.

(6) If *air cargo or air mail* is a major factor at the master plan airport, that type of activity should also be forecast. Helicopter operations at the airport may need to be forecasted as well.

(7) *Summary.* The aviation demand elements that need to be forecast for airport master planning are:

Mandatory	*Additional Where Appropriate*
Aircraft Operations	Domestic vs. International
Itinerant	Annual Instrument Approaches
Air Carrier	IFR vs. VFR Operations
Air Taxi & Commuter (Regional)	Helicopter
General Aviation	
Military	
Local	
General Aviation	
Military	
Passenger	Domestic vs. International
Enplanements	General Aviation
Air Carrier	Helicopter
Air Taxi	
Commuter	
Based Aircraft	Air Cargo and Air Mail
Aircraft Mix	

b. *Levels of Annual Activity.* Forecasts for airport master planning purposes are usually prepared in terms of levels of annual activity for 5, 10 and 20 year horizons. In this way the forecasts for years 1-5 can be the focus for short-term operational planning and 6-10 the focus for intermediate-term capital improvements. The longer range estimates can be useful for long-term general concept planning.

c. *Peak Load Forecasts.* Demand at many master plan airports may be relatively smoothly distributed over the hours, days, and months of operation of the airport. However, there may be many airports with peak periods of demand that far surpass the average conditions. This situation is particularly important for airports that serve as hubs in a hub-spoke route system for one or more air carriers, or airports with high levels of international traffic. Whether it involves peak numbers of passengers traversing the terminal building and landside access or peak numbers of aircraft operations, or both, it is important to try to mitigate the extreme stresses demand peaks put on airport facilities.

It is not appropriate to design airport facilities to meet infrequent and short-lived peaks in demand—this would be an inefficient use of limited resources. Rather, some middle ground between average and peak requirements needs to be estimated in order to predict the extent and timing of the capacity-expanding investments that may be needed in the future. A commonly used concept in this regard is the "design hour" which is an estimate of the peak hour of the average day of the busiest month. This concept is needed for applying several planning tools cited elsewhere in this Circular.

For the busier airports, where there may be several busy months, a more desirable design hour may be the peak hour which occurs about 10 percent of the days of the year.

Additional peaking characteristics may need to be forecast in planning commercial service airport terminal facilities, such as peak 20 minutes (baggage claim facilities) or the ratio of enplaned to deplaned passengers during the design hour. Should these forecasts not be possible, there are alternative ways of sizing terminal components such as the Equivalent Aircraft (EQA) factor used in AC 150/5360-7A "Planning and Design Guidelines for Airport Terminal Facilities."

3. **FACTORS AFFECTING DEMAND FORECASTS.** The art of forecasting the elements of aviation demand has undergone considerable study and advancement in recent years. The following six factors have been found to be of particular significance and should be considered in forecasting demand for individual airport master plans and in updating and refining those forecasts.

a. *Economic Growth and Changes in Industrial Activity.* A community's economic character affects its air traffic generating potential. In addition to overall national and regional economic activity, this factor includes consideration of specific, identifiable, local activity that distinguishes the geographic area served by the airport from the aggregate conditions across the region. This factor is particularly important in connection with business travel by commercial and general aviation and with air freight traffic. Manufacturing and many service industries tend to generate greater air transport activity than primary

and resource industries, such as mining. Also, much can depend on established and potential patterns of trade, both within and outside the airport area. Other aviation activities such as agricultural and instructional flying and aircraft sales are included in this factor.

b. *Demographic Patterns.* The size and composition of the area's population—and its potential growth rate—are basic ingredients in creating demand for air transportation services. This includes an area's population profile and changes in its age, educational and occupational distribution. Demographic factors influence the level of airport traffic, its composition, and its growth—both in terms of incoming traffic from other states, regions, or cities, and traffic generated by the local or regional populations. In this regard, identifiable changes or differences in local conditions compared to regional average conditions in leisure time and recreational activities along with other local lifestyle factors indicating a propensity for aviation activity, may be important factors but difficult to measure.

c. *Disposable Personal Income.* The discretionary purchasing power available to residents over any period of time is a good indicator of consumers' financial ability to travel. High levels of average personal disposable income in the area served by the master plan airport provide a strong basis for higher than average levels of consumer spending on air travel. Distinct local preferences for particular modes of transportation may be a factor; but in some cases, alternative modes of transportation may not be available or economically feasible. For these reasons, significant and identifiable changes or differences in local levels of disposable personal income per capita and transportation preferences, compared to regional average conditions may be important factors for updating existing forecasts for the master plan airport.

d. *Geographic Attributes.* The geographic distribution and distances between populations and centers of commerce within the area served by the master plan airport may have a direct bearing on the type and level of transportation services that will be demanded. The physical characteristics of the land and local climatic differences may also be important, sometimes limiting aviation demand. On the other hand, physical and climatic attractions often stimulate holiday traffic and tourism and the demand for aviation services that they generate. The relationship of the master plan airport to other airports and to the routes and airways in the regional and national systems may have a strong bearing on types and levels of aviation services that might be demanded at the master plan airport. To the extent that local conditions and differences from regional averages can be identified, there might be a basis for adjusting existing forecasts for the airport.

e. *Other External Factors.* There are a number of other factors that might affect aviation demand at all or certain types of airports or at a specific airport. Fuel price changes, changes in the regulatory environment, changes in the levels and types of taxes, fees, and currency restrictions are such factors. To the extent such factors may affect all aviation activity in a region or nationally, their impacts will be reflected in the corresponding forecasts prepared by the FAA. However, one or another of these factors may affect aviation demand in a particular locale and then the appropriate adjustments should be made in the forecasts for master plan airports. In addition, changes in local attitudes toward the environmental impacts of aviation may affect demand and should be considered in forecasting or updating forecasts. Similarly, the granting of new routes for international air service can induce important changes in the volume of traffic at the specific airports receiving the international service.

f. *Local Aviation Actions.* There are a number of actions that local airport authorities take that have the conscious or unintended effect of either stimulating or retarding growth in aviation demand at the airport. The types of ground access and support services provided, user charges, and plans for future development can each affect future growth of aviation demand. The development of a master plan for the airport and the implementation of investment decisions generated by the plan, of course, can produce some significant changes by removing physical constraints to airport growth and the forecasts should reflect these changes.

4. FORECASTING STEPS.

a. The forecast process for airport master planning consists of six standard steps which vary from

airport to airport only in the degree of effort expended on each step. They are:

(1) Obtain existing FAA and other related forecasts for the area served by the master plan airport.

(2) Determine if there are significant local conditions or changes in forecast factors.

(3) Make and document any adjustments to the aviation activity forecast to account for such conditions or factors.

(4) Where applicable, consider the effects of changes in uncertain factors affecting demand for the airport services.

(5) Evaluate the potential for peak loads within the overall forecasts of aviation activity.

(6) Monitor actual activity levels over time to determine if adjustments are necessary in the forecasts.

b. Each of these six steps are described in the following paragraphs.

(1) *Existing FAA and Other Forecasts.* As part of its comprehensive forecasting program, the FAA produces forecasts each year for over 3600 airports in the National Plan of Integrated Airport Systems (NPIAS). These forecasts are based on, and controlled in the aggregate by, the FAA National Aviation Forecasts. The airport forecasts provide estimates for each of the next 15 years for the mandatory aviation demand measures, as well as for the instrument operations. These estimates are available in the Terminal Area Forecast Data System (TAFDS), which also lists actual historical demand for the past five years. The TAFDS also provides airport identification information, tower status, and the number of currently based aircraft.

Any assumptions specific to the forecast for a particular airport are also provided in the TAFDS listing. The underlying assumptions for the general forecast factors are provided in the FAA national aviation forecast report. For airports located in major hubs, additional information on assumptions is provided in the respective hub forecast report prepared by the FAA. The TAFDS information for the top 900 airports is also available in the Annual Terminal Area Forecast Report, along with regional and state summaries of aviation activity which are used in determining forecast growth rates for the remaining airports in each respective area.

State and regional aviation activity forecasts produced under system planning activities are important because they reflect local conditions and policy considerations. Access to these and to FAA forecasts, explanations of special forecast factors affecting the master plan airport, and assistance in locating other sources of forecast factor estimates can be obtained through the FAA Regional Office. Other sources are listed in the FAA reports cited.

The Air Transportation Association of America (ATA) prepares "Airline Airport Demand Forecast Reports" which, along with individual airline forecasts, should be secured when master planning an airport served by the scheduled airlines. Appendix 2 shows the Airport Master Planning Questionnaire used by ATA. Information of this type should prove highly useful in the planning for commercial service airports.

(2) *Significant Local Conditions.* There are two noteworthy situations in which the FAA and other forecasts for the master plan airport may need to be adjusted for master plan purposes: unusual local conditions or changed local conditions not accounted for in the existing forecasts. *For unusual local conditions,* the forecaster needs to identify and document any ways in which the forecast factors for the area served by the airport differ radically from areas served by other similarly-sized airports in the region. For example, the economy and population of the airport service area may be growing faster, the disposable personal income in the area may be above average, or the geographic attributes of the site may generate a higher than average aviation demand.

In the case of *changed local conditions,* attention should be paid to predictable changes from past trends, e.g., sharp changes from growth trends for the local economy, disposable income, or demographic characteristics. In addition, some factors specific to the master plan airport may be constraining demand forecasts, such as limited airport capacity or ground access or environmental constraints. To the extent that plans for removal or abatement of these constraints can be documented, the basis may exist for adjusting the aviation de-

mand forecast. For instance, if the existing forecast is based on a limited number of based aircraft, and plans to increase tie-downs or to establish a new fixed base operator can be documented, there may be a reason to adjust the aviation demand forecast.

(3) *Adjustments to Forecasts.* If the forecaster is able to identify any unusual local conditions or changed local conditions, then adjustments should be made in the existing master plan forecasts. For this purpose, there are three general methods that might be used to develop new demand estimates: extrapolation, analysis, and judgment. All the underlying assumptions, deductions and methods used to adjust forecast numbers for aviation demand need to be well documented because they will be reviewed by the FAA.

(a) *Extrapolation.* The rationale underlying the extrapolation procedure is that some past tendency or trend in the demand for aviation reflects future trends. It may be possible to quantify this tendency or trend and to infer its effect on future demand by projecting the numbers derived from the past into the future. This approach would be useful where there are unusual local conditions that are expected to continue and which differentiate the master plan airport from other airports in the region.

(b) *Analysis.* This approach essentially combines diagnosis and prediction. Explanations are sought of the factors influencing the activity levels to be forecast and a mathematical relationship is estimated between these factors and future demand. Analytical forecasting requires complete and consistent data series on the factors causing the change in aviation demand.

(c) *Judgment.* This method entails an individual who is closely acquainted with the factors related to the demand being forecasted making an estimate of future demand. The demand-affecting factors are weighed and evaluated according to the experience and intuition of the analyst. This method permits a broad range of information to be brought to bear on the forecast—national trends, local employment, political considerations, etc. This method is especially advantageous when used in conjunction with the other methods where there are a large number of demand elements for which little data are available, or when intangible factors are expected to play a major role. On the other hand, the forecasts derived from this method alone are the most difficult to defend under scrutiny and may be subject to the forecaster's biases.

(4) *Uncertain Factors.* If aviation demand at the master plan airport is expected to be particularly sensitive to one or a small number of forecast factors or events, then the planner should estimate the impact on future demand that would likely result from a reasonable change in any such factors which is different from the underlying assumptions. The usual effect will be to accelerate or retard the growth in aviation demand. The problem for the forecaster becomes one of estimating the displacement, in terms of time, of the affected threshold. For example, if future expected growth in aircraft operations is highly dependent on the continued existence of a fixed base operator (FBO) and there is a reasonable possibility that the FBO may close, then the impact in the form of delay in timing for reaching one of the threshold levels of demand should be estimated.

If there are major determining factors and their timing is uncertain, the forecaster can construct a time line illustrating the length of time during which an investment or demand constraints or diversion of air traffic to another airport may be needed—depending on the occurrence of the uncertain demand generation factor. In this respect, the number of operations or enplanements forecast for any specific future year becomes less important than the estimate that a particular threshold will be breached during the planning period and that the threshold may fall within a certain time range, say 5 to 8 years forward of the base period. This approach highlights, first, that demand may exceed the capacity of one or more of the airport's facilities; and second, that there is a range of time (with a range of forecast error costs) in which this problem will have to be dealt with.

(5) *Evaluating Peak Loads.* The determination of a design hour is a key step in the forecasting process for high activity airports. A case-by-case analysis will be necessary, taking into account the airport specific factors which shape peaking characteristics. Reference should be made to AC 150/5060-5 and 150/5360-7A.

It is important that design hour forecasts be subjected to a rigorous testing of their sensitivity to

the factors underlying their prediction. This is particularly important if the design hour figure possesses an abnormal peaking characteristic, compared to the average airport with a similar role and demand level as the master plan airport.

The typical peaking characteristics against which the forecast design hour should be compared are:

- The ratio of peak hour operations to average daily operations (for the busiest month), which may range from 7-11 percent, and
- The ratio of average daily operations to annual operations, which may range from 0.29 percent to 0.34 percent.

These ratios are directly related to the size and demand level of the airport—with the lower percentages common to the busiest commercial service airports and the highest common to the low activity airport. It should be noted that these ratios should not go below 6.25 percent (16 hour day) and 0.27 percent, respectively, which represents a steady, no peak demand pattern.

(6) *Monitoring Actual Activity.* Continuous planning will help cut down forecast error costs. For a truly effective continuous planning process, demand at the master plan airport needs to be monitored so that adjustments can be made in the forecasts. In this way the forecaster can not only update and refine the forecast demand levels for the years ahead, but can also narrow the time band of the period within which a threshold will be reached.

The accuracy of the base data for forecasting and monitoring aviation activity at the master plan airport is often as important as the method used for forecasting. In many cases, more accurate and useful forecasts can be obtained through extra effort on improving the data base than on more sophisticated forecast methods. This is particularly the case for non-towered airports where such techniques as actual counts during survey periods and mechanical or acoustical counters can be used to establish accurate data on actual demand. Periodic surveys to establish general relationships between numbers of itinerant operations and enplanements can also be useful.

5. **SOURCES OF INFORMATION AND ASSISTANCE.** The following are sources of information and assistance for master plan forecasting.

a. *Terminal Area Forecasts.* The initial basis for forecasts at any public use airport in the United States is the FAA Terminal Area Forecast (TAF). The TAF is available as an annual document from FAA Regional Offices and from the FAA Office of Aviation Policy and Plans in Washington, D.C. The TAF is also available as the Terminal Area Forecast Data System (TAFDS), a data base on a commercial computer time-sharing service. Information and assistance on obtaining access to the TAFDS are available from the Regional Offices of the FAA.

b. *National Forecasts.* The FAA Office of Aviation Policy and Plans publishes an annual report entitled FAA Aviation Forecasts, which provides national and regional summary forecasts of aviation activity at FAA facilities. These facilities include airports with FAA control towers, air route traffic control centers, and flight service stations. Detailed forecasts are made for the four major users of the national aviation system: air carriers, air taxi/commuters, general aviation, and the military. This document also presents descriptions of the FAA forecast modeling methodology, assumptions, and historical data bases.

c. *Historical Data Sources.* Both the TAF and the FAA national forecasts present historical data on aviation activity. Prior to January 1, 1985, enplanements were based on data submitted to the Civil Aeronautics Board (CAB). However, since the Sunset of the CAB, enplanements are based on data submitted to the Research and Special Programs Administration of the Department of Transportation. U.S. certificated air carriers submit enplanement data on RSPA Form 41 while Regional Air Carriers (commuters) provide data on RSPA Form 298. These data are supplemented by an FAA survey of air taxi operators, and by reports of foreign flag traffic from the Immigration and Naturalization Service. State aviation commission reports and airport manager reports are used to complement and verify enplanements.

Historical operations data at FAA towered airports are from FAA Air Traffic Activity reports. U.S. air carrier departures at non-towered airports are obtained from RSPA form 41 reports. Other opera-

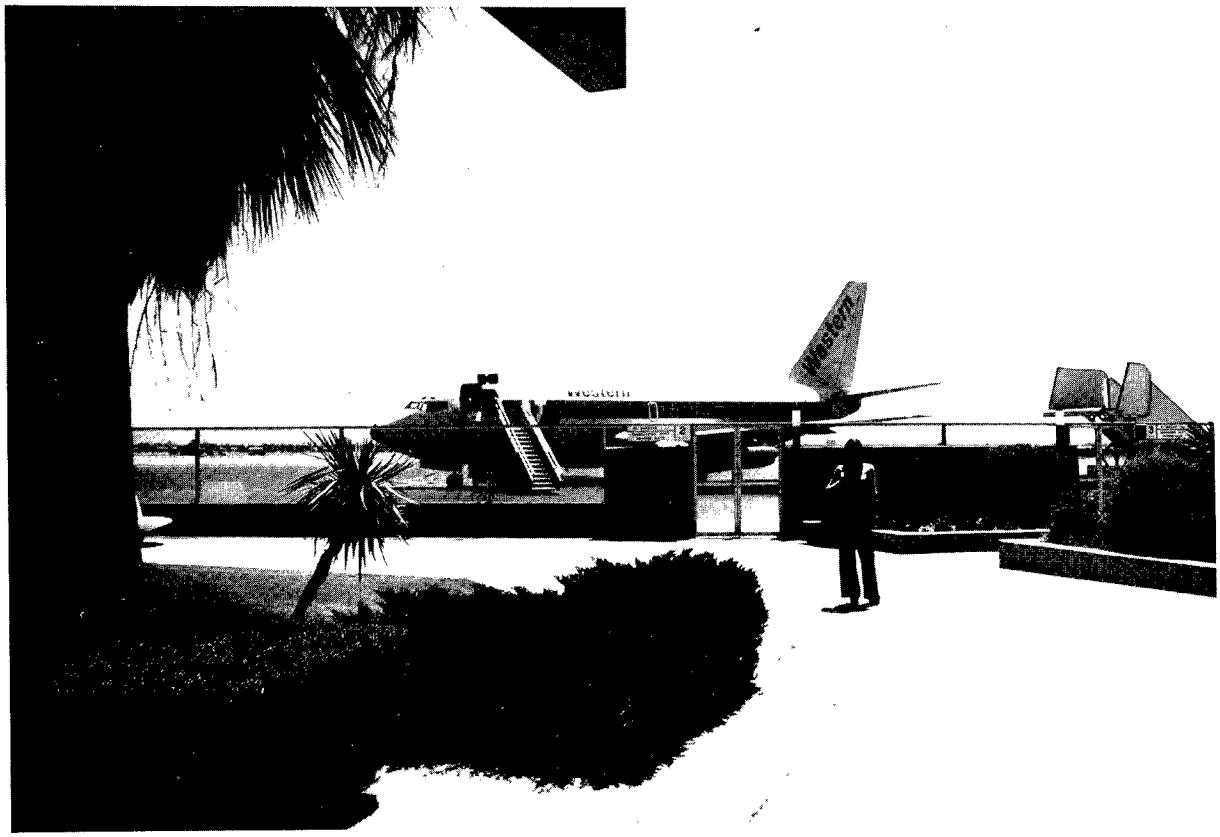
tions at non-towered airports are based on special traffic surveys and estimates provided in the FAA Airport Master Record Form 5010-1. Instrument operations handled by FAA towered airports and air route traffic control centers and instrument approaches for all airports are reported in the FAA Air Traffic Activity and the FAA Airport Activity Statistics.

d. *Statistical Sampling.* Activity counts at non towered airports can be obtained by using statistical methods for estimating aircraft operations. Handbook FAA-APO-85-7 Statistical Sampling of Aircraft Operations at Non Towered Airports provides a sound method for estimating aircraft operations and is written for planners, engineers, airport operators responsible for airport planning, and persons who collect data for FAA Airport Master Records.

e. Further assistance in forecasting tools, techniques, and methods can be obtained from FAA Regional Offices. Whether the aviation forecasts are being prepared by the airport planning staff or by consultants, early and periodic discussions with FAA airports and forecasting staffs are encouraged. These discussions on forecasts are particularly important where significantly different forecast assumptions and methods are contemplated in developing the basis for a specific airport master plan or where there are differences between existing forecasts covering the airport.

These early discussions will also be especially useful where the forecast development results indicate that expenditure of federal funds for airport improvements would be justified at an earlier time than indicated in the existing FAA Terminal Area Forecast for the master plan airport.

CHAPTER 6 REQUIREMENTS ANALYSIS AND CONCEPTS DEVELOPMENT



Terminal gate at a Commercial Service airport

1. **GENERAL.** Armed with demand forecasts and having inventoried the existing airport plant and reviewed its condition, the planning proceeds to an investigation of the capability of the airport to accomodate the forecasted demand. The unconstrained airside and landside capacity needs are determined. Should there be financial, physical or environmental limitations in accomodating capacity expansion, then the possibilities of diverting air traffic to another airport or providing for a new facility must be addressed. The latter will involve decisions on the roles of the existing and new airports and the extent of development at each.

The time frame for assessing development needs usually involves short (up to 5 years), intermediate (10 years) and long term (20 years) periods. While this is discussed further in Chapter 10, "Plan Implementation", long range planning is concerned with the ultimate role of the airport and its related development. The intermediate range involves a more detailed assessment of needs. The short term is geared to an immediate action program and may include details not appropriate to the longer time periods. On the other hand, the intermediate and long term periods will target development needs based on the attainment of specific demand levels.

2. **DEMAND-CAPACITY ANALYSIS.** Airside capacity is calculated and matched against aircraft demand forecasts to determine the need and timing for investments. AC 150/5060-5, "Airport Capacity and Delay," presents a straightforward methodology for performing this analysis. The methodology gives hourly capacities and annual service volumes, and permits the estimation of aircraft delay levels as demand approaches and exceeds the "throughput" capacity of the airfield configuration being reviewed.

Decisions can be made on the timing of new airside components by comparing the cost of the facilities with the benefits of avoiding delays. A comparison of annual delay with and without the additional facilities produces a theoretical delay reduction in units of time. This total, when multiplied by average unit aircraft operational costs and passenger time values, can be compared with the annual debt amortization, operational and maintenance costs of the new facilities to arrive at a cost/benefit relationship.

a. Landside capacity is determined for terminal area and gates, curbside, surface access and automobile parking. For commercial service airports the AC 150/5360-7A, "Planning and Design Guidelines for Airport Terminal Facilities" provides guidance of a general nature for airports of all activity levels. The AC 150/5360-9, "Planning and Design of Airport Terminal Facilities at Nonhub Locations" provides comprehensive guidance applicable to the lower activity commercial service airports. The FAA Report (DTFA-01-83-P-88004), "Access to Commercial Service Airports" is a useful reference for the planning of an on-airport ground access systems.

For general aviation airports, the guidance in AC 150/5300-4B, "Utility Airports, Air Access to National Transportation", should prove useful.

b. The level of detail of airside and landside demand/capacity analyses will vary with the complexity of the airport. For low activity airports, capacity needs may, like the forecasts, already be available from other studies. If not, the determination of airside capacity can be readily obtained by using AC 150/5060-5.

c. For highly complex airport planning studies, it may be necessary to employ computer programs for capacity and delay analyses, such as the FAA's Upgraded Airfield Capacity Model and Annual Delay Model, for which tapes are available. Report DOT/FAA/PM-84/2 Airfield Delay Simulation Model (ADSIM) can also be used to study airport capacity and delay.

For determining terminal capacity for a highly complex study, research of available literature on the subject as well as visits to airports where state of the art landside planning has taken place may be desirable.

As with aviation demand forecasting, the effort and expense in capacity and delay analyses should be geared to the investment error costs of inadequate analysis.

3. **DEVELOPMENT ASSESSMENT.** The unconstrained airside and landside capacity requirements are imposed on the existing airport and an assessment is made as to whether and how the expanded facilities can be accommodated. This process includes a melding of airside and landside concepts to achieve a balance in capacity among all components. In addition to determining the physical capability of expansion, as well as its timing based on development costs versus delay reduction benefits, operational reliability and safety are critical considerations. Of course, the ability of the airport authority to finance the improvements is crucial to the timing decision and must be reviewed at this point.

a. The airport must be designed to standards which will accommodate the most demanding airplane (critical aircraft). Key guidance documents to be used in the assessment of an airports physical development capability are the current editions of AC 150/5300-12, "Airport Design Standards - Transport Airports" and AC 150-5300-4B, "Utility Airports, Air Access to National Transportation." The latter document contains terminal guidance for general aviation airports as well as physical standards for airports serving aircraft having approach speeds of less than 121 knots. An assessment of the landside expansion capability of airports with scheduled airline service can be guided by the information contained in the publications listed in paragraph 2.

In developing the scope of the master plan study consideration must be given to rotocraft operations. Even at airports which presently have few helicopter operations the master plan should include approximations of future activity, designation of current and proposed operating areas and estimates of related facility requirements. At most airports in depth studies will not be required, only coverage appropriate to realistic expectations. It should not be assumed however that even when rotorcraft requirements are nominal, they can be planned independent of the airport. Likewise, development proposed for fixed-wing aircraft should be reviewed to make sure it does not adversely impact present or projected rotorcraft operations. Rotorcraft guidance can be obtained in the current edition of AC 150/5390-1 "Heliport Design Guide".

While deviations from FAA standards are not encouraged, it is at the planning stage that the airport operator should discuss with the FAA potential deviations. If deviations from standards must occur, there should be a complete discussion in the master planning documentation of the rationale and coordination that led to the adjustment.

b. Coordination with local transportation planning authorities during the inventory phase should have produced sufficient information to allow an assessment of surface access capability, and whether that which exists or is planned can meet airport demand.

With the exception of the busier commercial service airports where access is a capacity constraint, airport access planning by local transportation agencies has historically been effective and probably will not emerge as the critical constraint of airport capacity expansion. This is not to say that off-airport access requirements should be limited in emphasis. To the contrary, the master planning study should produce specific recommendations for removing any existing or potential limitations to efficient airport access.

The study effort can also serve as an opportunity for a dialogue on eliminating minor bottlenecks or achieving more efficient access through immediately implementable non-capital intensive measures such as signing, directional flow control, etc.

c. In addition to the assessment of the physical capability of the airport to accommodate expansion, consideration must be given to the environmental consequences of an expanded airport operation and whether they are acceptable. The potential environmental impacts must be considered while reviewing the alternative airside and landside concepts for achieving balanced capacity, thus introducing an element which could severely limit the available options. The requirements and process for considering environmental impacts are covered in detail in Chapter 8.

4. **LAND USE CRITERIA.** Land use criteria provide the policy and priorities that will dictate the general arrangement and sizing of landside facilities and their relationship to airside facilities. The land use criteria also suggest the potential requirements for capital investment and the opportunities for revenue production.

Land use criteria will vary in accordance with the role of the airport, primarily whether it be a commercial service or general aviation airport, and the policy requirements of the airport operator. There are, however, criteria which will likely be applicable in all cases, such as:

- Adherence to standards in support of safety in aircraft operations. These include FAA design and obstruction standards, such as building restriction lines, distances between taxiway centerlines and aircraft parking aprons and obstacles and obstructions defined by the imaginary surfaces established in Federal Aviation Regulation, Part 77.
- Non-interference with line of sight or other operational restrictions inherent in siting criteria for FAA control towers, navigation aids, weather equipment, etc. For example, to protect line of sight from an existing or planned air traffic control tower, a shadow diagram should be included as part of the master plan. Guidance is provided in FAA Order 6480.4 "Airport Traffic Control Tower Siting Criteria" which may be reviewed at FAA Regional Offices.
- Use of existing facilities, insofar as possible and depending on their location, con-

dition, and any obligations with respect to their use such as long term leases.
- Attention to factors which may affect construction cost such as available utilities and topography.
- Flexibility in being able to accomodate changes in demand and expansion, both vertically and horizontally.
- Efficiency in ground access to the served communities.
- Priority accorded aeronautical activities where available land is limited.
- Encouragement of revenue producing land uses which support an aviation-oriented infrastructure.
- Flexibility of non-aeronautical uses so as to permit expansion of aeronautical facilities.

In developing and applying the land use criteria, attention must be given to the existing and potential uses of land in the vicinity of the airport. This is necessary in view of the possible need to acquire additional land for airport related activities; because of environmental impacts which may be minimized through some form of land use control; and because of the need to protect aircraft operations from hazards to air navigation, i.e., the erection of tall structures, operation of other landing areas or establishment of land uses attractive to birds.

Direct control, such as ownership, by the airport operator of land use within the 75 LDN noise contour is a desirable objective, but it is not always achievable. If the airport operator, in conjunction with municipal authorities, can influence how the environmentally sensitive areas are used, the reduction of impacts can be achieved without land acquisition. If the land can be devoted to such aviation-related activities as air parcel handling facilities, off-airport long-term parking, rental auto parking and processing, etc., both the airport and the environs benefit. For a discussion of noise planning compatibility see Chapter 9, Par. 5 "Noise Compatibility Plan".

5. **TERMINAL PLANNING CRITERIA.** In addition to the application of land use criteria, as outlined in paragraph 4, the following considerations are important in applying and integrating landside and airside concepts.

a. *General Aviation Airports.*

- Locate the administration area within easy access of auto parking and public transportation.
- Fixed base operator facilities should be located so as to maximize exposure to marketing opportunities, but separate from the administration building.
- Minimize the separation, or splitting, of general aviation functional areas.
- Minimize taxiing times from parking, tie down, hangar storage, and fixed base operator areas, with priority access to itinerant operations.
- Locate itinerant operational and fueling areas close to the administration building.

b. *Commercial Service Airports.*

- Separate airline, general aviation and commuter traffic in the apron area but provide for easy access of general aviation and commuter passengers to the airline terminal.
- Consolidate general aviation functional areas.
- Separate special air carrier functions such as shuttle, commuter, charter and international, but provide for ease of access to each other and to domestic services.
- Facilitate the inter-airline transfer of passengers and baggage.
- Encourage the joint use of airline facilities.
- Minimize the curbside to apron walking distance, processing and transit time.
- Minimize auto parking to curbside access time and walking distance and access times to rental car facilities.
- Provide a convenient and reliable public transportation - curbside interface.
- Simplify internal airport vehicle circulation and terminal access systems; separate commercial/service vehicles from passenger vehicles.
- Centralize administration facilities and provide adequate employee service facilities, such as convenient auto parking, access to public transportation and direct access to off airport highway systems.

- Allow for cargo growth potential and possible expansion of all-cargo aircraft activity. Facilitate cargo transfer and access. If separate cargo buildings are warranted, they should be in reasonable proximity to the passenger terminal.
- Provide for potential growth in helicopter traffic.
- Provide for efficiency in apron operations, particularly with respect to aircraft and service vehicle maneuvering.
- Locate modern fire, crash and rescue facilities so as to meet or exceed response time criteria.
- Locate aircraft refueling facility within reasonable proximity to terminal area and provide access separate from public entrance road.
- Locate rental car maintenance facilities so that they are accessible to terminal area.

The application of these criteria, as well as the development and application of other criteria appropriate to the individual airport case, should be a coordinated undertaking among airport operator, consultant and users.

6. **ALTERNATIVES REVIEW.** Should the assessment of the airport's capacity show that substantial expansion would be necessary to accommodate projected demand, there should be an investigation of alternatives. The alternative of doing nothing and transferring some or all of the operations to another airport (existing or new) should be studied in order to determine whether the investment required to expand the existing airport's capacity can be supported on aeronautical, financial and environmental grounds. A most important objective in this review is making the best use of existing facilities.

a. The consequences of doing nothing should be carefully investigated and reviewed in the light of the community's social and economic goals. The short term consequences of inaction may not be readily quantifiable but the long-term impacts may be severe and the opportunities for providing additional capacity diminished.

b. The provision of separate "reliever" airports for general aviation that will draw traffic from the busy commercial service airport is a well recognized way of reducing general aviation demand. The division of airline traffic by type, such as international, domestic, and shuttle among two or more airports can systematically balance demand and capacity.

c. The investigation of new site possibilities should be general in nature, and limited in scope to that which is necessary to make a decision on alternatives. The principal considerations for comparison of new sites to the existing airport will be airspace and airspace capacity, airfield and ground access development costs, user ground access costs, (including value of time), aircraft operational costs, environmental impacts, financial feasibility, and long-term viability. Consideration also must be given to alternative roles for the existing airport and alternative transfer times to a hypothetical new airport.

7. **AIRSPACE AND AIR TRAFFIC CONTROL.** In discharging its responsibility for managing the air traffic control system and in assuring flight safety, the FAA performs a number of functions which have a direct bearing on the development of the airport master plan. The planner should be familiar with the pertinent activities and how and when they may be applicable.

Areas of particular importance involve the establishment of air traffic procedures concerned with the use of the terminal airspace, particularly for approaches and departures; the determination of what constitutes an obstruction to air navigation; and the provision of electronic and visual approach and landing aids.

The airport master planning and layout plan approval process serves as a focal point for FAA recommendations with respect to the future development and operation of the airport.

a. In developing instrument terminal flight procedures, the FAA is guided by the document "United States Terminal Instrument Procedures" (TERPS) and by FAR Part 91 for VFR procedures. A similar document, "Procedures for Air Navigation Services - Aircraft Operations" (PANS-OPS), promulgated by ICAO, is applicable in the development of procedures for non-U.S. airports. Familiarity with the material contained in these publications will assist the planner in determining

potential interaction of contemplated operations at the airport under study and other airports, and possible obstructions to aircraft operations.

In using AC 150/5060-5 for determining airport capacity, the planner should be aware the guidance assumes there are no airspace limitations which would adversely affect flight operations or otherwise restrict aircraft which could operate at the airport. The "throughput" model on which the capacity and delay data are based assumes the continuous demand by an aircraft to be serviced by the runway system. Limitations on terminal airspace could limit the ability of the system to deliver aircraft, uninterrupted, to the landing area. Therefore, consultation with the FAA on potential airspace limitations is advisable.The causes of airspace limitations could include:

- Permanent obstructions to operations such as high terrain and buildings which could limit the creation of additional arrival streams or maneuvering areas;
- The need to restrict the use of the airspace at one airport to accomodate operations at another where there is a sharing of airspace due to their proximity;
- Requirements for circuitous routing through intermediate control points;
- An overloading of the air traffic control system due to peak demands and adverse weather; and
- Electromagnetic interference affecting communications or navigational equipment in the cockpit or on the ground.

A typical traffic pattern for an individual runway at an airport is shown in Fig. 6-1. Fig. 6-2 shows the controlled airspace for an airport with a control tower. The Airman's Information Manual (AIM) (Basic Flight Information and ATC Procedures) gives a description of terminal flight procedures for both Visual Flight Rule (VFR) and Instrument Flight Rule (IFR) cases.

Under Part 157 of the Federal Aviation Regulations, "Notice of Construction, Alteration, Activation, and Deactivation of Airports," proponents of such actions must give notice to the FAA. The FAA, in turn, conducts an aeronautical study of the proposal and advises the proponent as to its effect on the safe and efficient use of the airspace. Timely coordination with the FAA during the course of the master plan study, particularly during review and approval of the airport layout plan, should facilitate the development of an acceptable plan.

AC 70-2D, "Airspace Utilization Considerations in the Proposed Construction, Alteration, Activation and Deactivation of Airports" may prove to be a useful reference.

b. *Obstructions to Air Navigation.* As discussed in paragraph 7a., the application of TERPS will give the planner insight on the relationship of objects which penetrate the airspace and aircraft operations. The FAA applies the TERPS in its studies of objects which may affect the navigable airspace under PART 77 of the Federal Aviation Regulations, "Objects Affecting Navigable Airspace." Under this regulation, standards are promulgated for determining obstructions to air navigation, requirements are established for proponents of proposed construction to notify the FAA of same, and provisions are made for the FAA to conduct aeronautical studies of the proposals to determine their effect on the safe and efficient use of the airspace by aircraft.

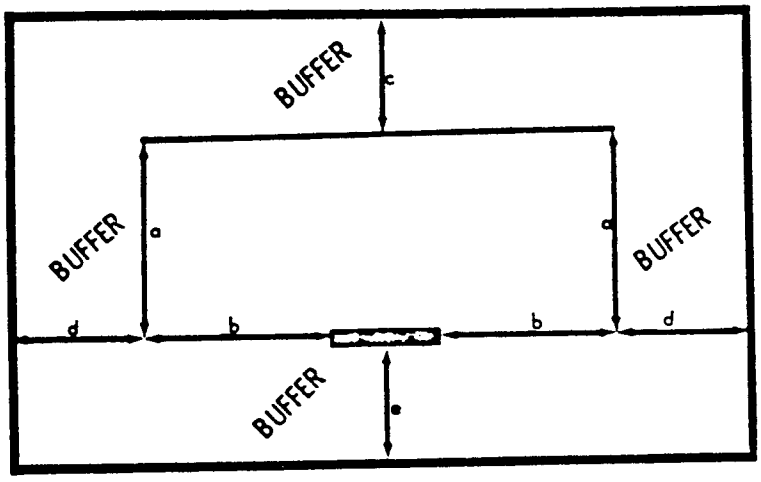
The planner should be familiar with the standards set forth in this regulation and may want to refer to the AC 70/7460-2G, "Proposed Construction or Alteration of Objects That May Affect the Navigable Airspace." Obstructions in the vicinity of an airport, as determined by these standards, may not necessarily constitute hazards to aircraft operations or impose strict limitations on the way aircraft can operate to and from the airport. However, the standards will serve as useful geometric measures for examining airfield configuration alternatives, signaling potential operational limitations, and triggering more detailed analysis under TERPS.

c. The FAA establishes, operates and maintains the principal electronic and visual approach and landing aids (the airport operator is responsible for airfield lighting) at an airport. The need for such facilities, in accordance with the demand forecasts of traffic and occurence of adverse weather, should be determined based on interpretation of FAA criteria for their establishment. FAA's Airway Planning Standard No. 1 gives activity levels at which an airport will be an eligible candidate for the establishment of such air traffic control, navigation aid and approach and landing aids as control towers,

DISTANCE IN NAUTICAL MILES

AIRCRAFT CATEGORY TYPES	a	b	c	d	e
A	.75	.75	.5	.5	.25
B	1.00	1.00	.5	.5	.25
C	1.75	1.75	.5	.5	.5
D	3.00	2.00	1.0	1.0	.5

NOTE: The above trafic pattern airspace should be increased by one-half the length of "b" (final and departure dimensions) when more than four aircraft of the same category are anticipated operating in the traffic pattern at any one time.



LEGEND

a. Base leg and crosswind.
b. Final and departure. (Measure from end of runway)
c. Downwind buffer area.
d. Base leg and crosswind buffer area.
e. Final and departure buffer area

FIGURE 6-1. TRAFFIC PATTERN AIRSPACE

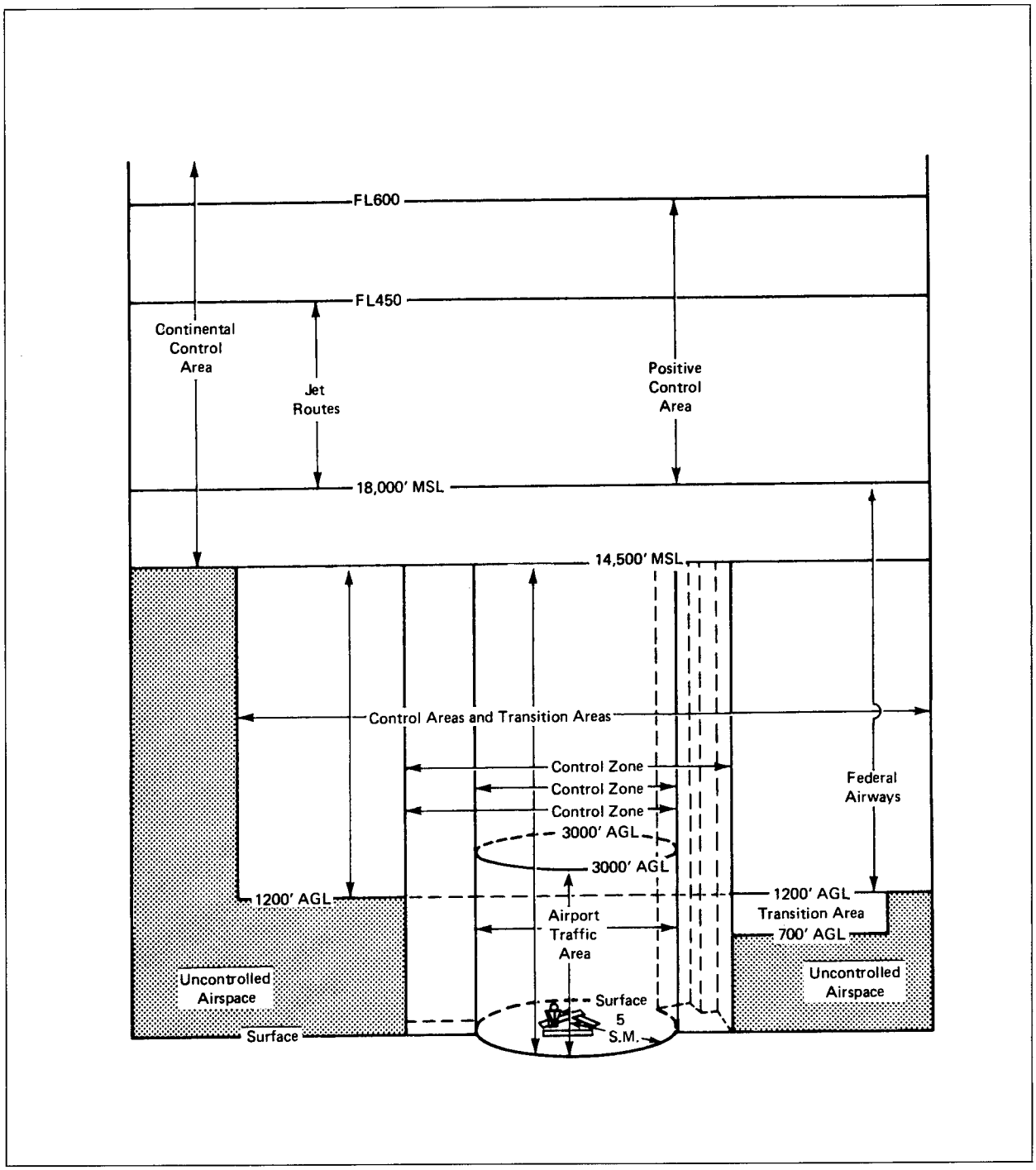


FIGURE 6-2. CONTROLLED AIRSPACE

tion and plans. Also, the FAA should be consulted early with respect to the designation of the airports instrument runway(s), a responsibility of the agency. Early designation of the instrument runway(s) and its depiction on the airport layout plan is important so that long-term protection can be facilitated for instrument operations under the contemplated weather minima.

8. **TECHNOLOGY AND OPERATIONAL IMPROVEMENTS.** Airport capacity analysis, using current FAA guidance may not take into account long term improvements in operational environment or technology which could increase efficiency and enhance airport capacity. For long-term planning purposes, it may be useful to consider potential state of the art improvements which could affect the timing of investment decisions.

Any decisions related to long range planning should consider how sensitive the plan is to the possible occurrence of various events, be they improvements in capacity or changes in demand forecasts. Thus, the need to adjust forecasts based on experience will go hand in hand with a requirement to monitor the potential for capacity enhancement through technology advances and improved operational environments.

a. A significant factor affecting airport capacity is the longitudinal spacing required between aircraft in landing and in departing because this affects the number of aircraft that can be delivered to or released from a runway in a given unit of time. Before the introduction of wide-bodied jets, the landing separation standard under instrument flight rules was 3 miles. The advent of the heavy jet (greater than 300,000 pounds) added new separation standards of 4, 5 and 6 miles due to the wake vortex phenomenon (the smaller the following aircraft the larger the separation) and doubled departure release times from 60 seconds to 120 seconds. At the busiest airports with a substantial percentage of heavy jets, capacity can be reduced almost 20 percent because of wake vortex. Research and development on wake vortex advisory and avoidance systems indicate a capability of substantially reducing the problem. The complete elimination of the problem can only be achieved by aerodynamic modifications, something probably not likely in the foreseeable future.

A key R&D program that could, in the long term, achieve a goal of 2.5 mile standard separation (for an aircraft pair least sensitive to wake vortex) in conjunction with a satisfactory wake vortex avoidance system involves metering and spacing. The automation assistance in the rate, order and separation of successive aircraft may result in significant overall airport capacity increases.

It is expected that these potential efficiencies in terminal airspace operations will be consistent with an improved system of delivering aircraft to terminal airspace as a result of implementation of FAA's National Airspace System Plan, which is a complete modernization of the ATC system.

b. The Microwave Landing System (MLS) which will eventually replace the Instrument Landing System (ILS), will be gradually integrated into the National Airspace System with implementation of 1250 MLS's by the year 2000 (see Figure 6-3). The MLS will provide:

- Precision instrument guidance where ILS is not practical;
- Ease of siting, allowing more flexibility in planning airport facilities;
- Enhanced airport capacity by its application to short, converging and triple parallel runways, and by its capability to allow higher angle glide paths, wide angle coverage and multiple glide paths possible;
- Precision instrument approach capability for helicopters;
- Reduced weather minima due to siting flexibility;
- A reliable and accurate signal; and
- Help in avoiding wake vortex by allowing light aircraft trailing heavy aircraft to approach and land at a higher glide angle.

c. The most critical capacity determinant is the runway use configuration. The second most critical is runway occupancy time which might otherwise permit substantial reductions in arrival spacing of aircraft. Operational improvements in the way runway systems are used are important. For example, computerized airfield/airspace management systems at the busier airports could be used to instantly select the highest capacity and most energy efficient runway use configuration for the prevailing circumstances of wind, visibility, traffic mix, arrival-to-departure ratio, and noise abatement.

Improved surveillance equipment and procedures could result in reduced runway separation standards. A substantial reduction from the current 4300 feet in parallel runway separation for independent IFR operations may be achievable. Also, the current minimum 3 mile separation to a third paral-

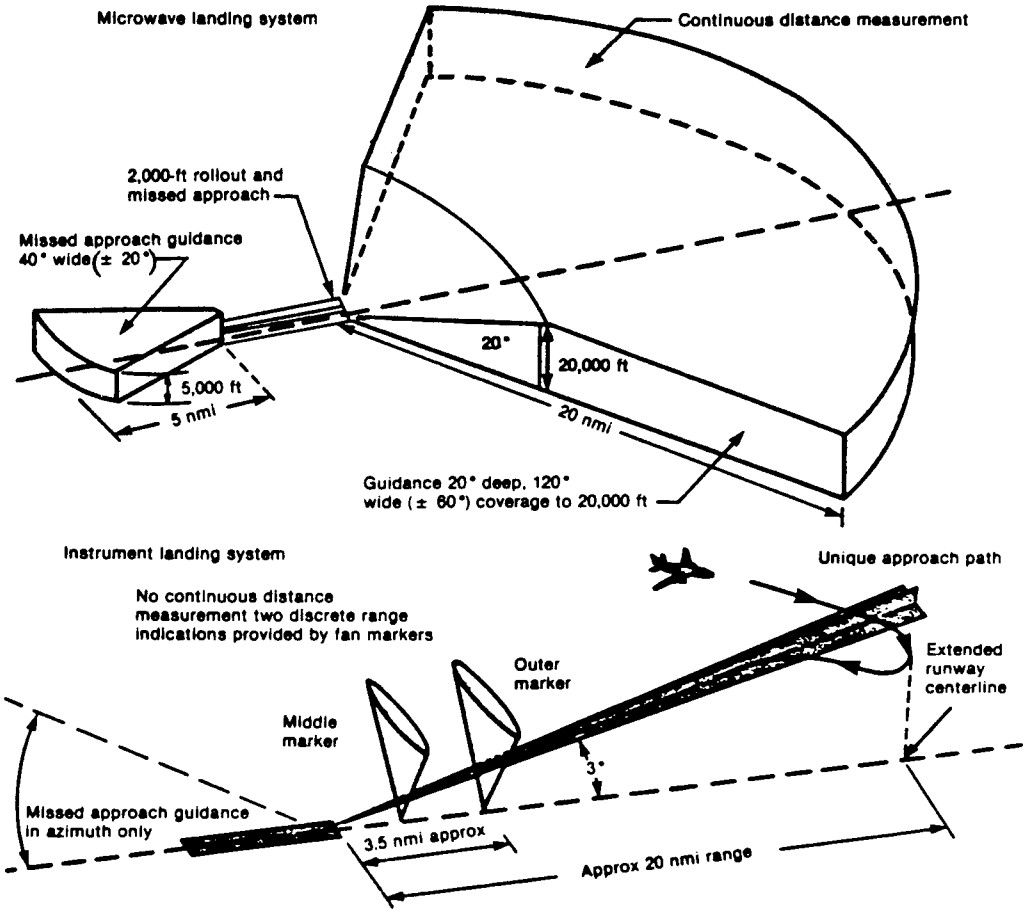


FIGURE 6-3. COMPARISON OF MICROWAVE LANDING SYSTEM AND INSTRUMENT LANDING SYSTEM

lel runway for three independent IFR arrival streams could be reduced by application of MLS and procedural changes. While runway separation standards are the responsibility of the FAA, and the planner does not have the discretion to apply reductions, knowledge of these potential changes should prove useful.

CHAPTER 7 AIRPORT SITE SELECTION

Raleigh County Memorial, Beckley W. Virginia

1. **GENERAL.** Selecting a site for a new airport comes from a decision that existing airport facilities cannot be expanded to accommodate aviation demand. In arriving at such a decision, there will likely have been an investigation of potential new airport sites for comparison with the alternative of continuing all operations at the existing airport.

Master planning for high activity airports will often include an investigation of potential new sites to permit a review of all options for providing additional capacity, as discussed in Chapter 6. In these cases the emphasis is on the need for and feasibility of a new airport; the site investigation is limited in scope to that which is necessary to make an informed decision. If the decision points to the need for a new airport then there should be a preliminary determination on the role of the existing airport, the limits to which it might be upgraded and the timing of transfer of some, or all, operations to the new location.

Thus, the site selection process may be a refinement of the preliminary investigation of alternatives during the master planning of an existing airport. On the other hand, it may result from a need identified in other prior or ongoing study efforts as in regional or state system planning.

Prior to initiating a detailed site selection study, there should be sufficient evidence of the need for a

new airport and its viability in terms of potential community and user support as well as the legal, organizational and financial capability to build and operate it.

The scope of the site selection process will vary with the size, complexity and role of the proposed airport. While many of the steps will be equivalent, the sophistication of the analysis and the complexity of the decision making process can vary greatly, in line with the magnitude of the potential development investment.

2. **STUDY ORGANIZATION AND ROLE DEFINITION.** While the organization and preplanning considerations outlined in Chapter 3 are generally appropriate to a site selection study, there may exist the possibility that a public agency other than that which operates the existing airport would construct and operate a new airport. If the establishment of a new organization is an issue, this may be a study element in the project, or a parallel activity that involves timely enactment of enabling legislation. It is also possible that a new organization would sponsor the site selection study. In any case, the agency sponsoring the study should be one that is legally and financially capable of developing the airport. This is a requirement if Federal financial assistance for the planning study is contemplated.

There should be a consensus as to the intended role of the new airport, at least to the extent that its requirements and size can be ascertained. Prior master or system planning studies will likely have made this preliminary determination. This does not rule out a changing of the new airport's role as a result of the study findings. This could occur for a new commercial service airport based on environmental impacts, site remoteness or financial limitations. This should not be the case for general aviation or reliever airports. The role of a new commercial service airport could be:

- Supplement the existing commercial service airport, with emphasis on a specific type of traffic such as international and long haul domestic;
- Replace the existing airport for all operations, with the existing airport reverting to non-aviation use; and
- Replace the existing airport for all air carrier operations with the existing airport reverting to general aviation status with the possibility of limited air carrier shuttle or short haul traffic.

An airport site can be selected and preserved, or land banked, for potential future use. Detailed planning for the site would then be delayed until justified by demand. The opportunity for this should not be overlooked when an existing military facility becomes a candidate site. Innovative interim uses may be possible to assure its availability if cessation of military activity is contemplated.

3. **SITE SELECTION PROCESS, OVERVIEW.** In many cases site selection follows from recommendations made in prior studies of existing airports to accommodate increased aviation demand. Therefore, much of the information, such as demand forecasts and capacity needs, will be available and can be used with minimum refinement to determine general airport size and requirements. If this is not the case, then of course, this kind of information must be compiled.

a. When basic information has been assembled the process moves on to a screening of potential sites and the selection of the most appropriate candidate. Again, prior studies may have identified and evaluated potential sites and the process may consist largely of a review and refinement of this work. Whatever the case, there is a systematic evaluation of all potential sites, screening out those that have obvious shortcomings in terms of construction costs, topography, airspace, access, and environmental impacts. The number of candidates is narrowed to the fewest possible. Then there is detailed review of each for comparative purposes.

This review can be aided by the application of comprehensive evaluation criteria based on community and regional values and plans as well as traditional technical factors. The evaluation process must include a visual inspection of candidate sites.

b. Where the need for the new airport is not immediate, it will be necessary to make a transfer analysis. This will compare quantifiable costs of various transfer times from the existing to new airport, assisting in decisions on scheduling land acquisition, construction and financing for the new

facility as well as modernization decisions relative to the existing airport.

c. The site finally selected will be subjected to the rigorous review of alternatives as required under the NEPA and commitments will be made on specific environmental mitigative measures. It will likely receive a large measure of public scrutiny through information sessions, representation on policy, advisory and review committees and finally, public hearings.

The site must also receive the required Federal, state and local governmental approvals and certifications, and the need for a new airport will be indicated in the FAA's National Plan of Integrated Airport Systems.

d. The process then moves on to the plans development stage where airfield, terminal and access concepts are detailed within the context of the approved site. This assumes that the transfer analysis supports an early initiation of the planning and design activities.

4. **DATA ASSEMBLY AND FACILITY REQUIREMENTS.** Information may be available from a prior master planning study done for an existing airport which found that a new airport is needed. At most, an updating of this basic data will be needed. Additional information on a region-wide basis will be necessary in support of the site investigation activity and will include:

- Mapping for the region within which candidate sites could conceivably be located, including aerial photogrammetry, topographical and geological maps;
- Comprehensive land use and transportation plans;
- Utility networks, both above and below ground;
- Data and charts on ground and surface water conditions and flow;
- Specific data on soil conditions and availability of construction materials;
- Pertinent land use controls and building regulations;
- General information on land ownership and value;
- Environmental information on a regional basis similar to that discussed in Chapter 4, paragraphs 5 and 7;
- Aeronautical charts and other appropriate airspace and air traffic control information;
- Meteorological information, including wind data, for all relevant stations—these conditions can vary significantly from airport to airport within the same general region, and
- Information on structures that could constitute obstructions and land uses which could attract birds.

The level of detail required for some of this information, such as local land use controls, ownership and values, and soil conditions will be greatest, of course, for the final candidate sites.

Facility requirements and general airport sizing may have been determined in prior studies or there may be sufficient information to develop a preliminary conceptual configuration and airport size, which should be sufficient for initial site screening purposes. However, when the candidate sites are narrowed down to a final few, it will be necessary to refine the concepts to fit site specific requirements. The guidance in Chapter 6 should be followed in developing site-oriented concepts. It can be expected that the concepts presented for the site finalists may be modified during the plans development stage and possibly even further during design. However, modification should not be so extensive as to invalidate the environmental impact statement or jeopardize local support.

5. **EVALUATION CRITERIA.** To evaluate candidate sites systematically, there must be criteria which can be applied to each site as a basis for comparison. Values must be assigned to each of the criterion based on relative importance. The assignment of values may be difficult due to different points of view of what is important and because the nature of the available data will preclude some of the criteria from being quantified. There also may be cases where a unique consideration exists which cannot be applied to all sites and has to be treated separately. On the other hand, there may be one overriding factor which rules out the need for a systematic evaluation.

If a systematic evaluation of candidate sites is appropriate, the following types of evaluation criteria should be considered.

a. *Operational Capability* - Even if all candidate sites, once developed, could provide the operational capability required by the airport's role, there may be a variation among sites as to how well each can perform. For example, the achievement of lowest category II minima at a site may not be possible. While this may not be critical, the occasional requirement for such capability would indicate a small reduction in service reliability and would constitute a limitation.

b. *Capacity Potential* - If the need for the new airport is based largely on the requirement for additional capacity, the capability of the site to provide long term capacity is important. Demand forecasts beyond the traditional planning horizons of, say, 20 years will be highly speculative. However, insuring capacity capability for long-term forecast demand is important. Key factors are land availability, topography, environmental impacts, and airspace use.

c. *Ground Access* - An important consideration in how well an airport serves the public's air transportation needs is the airport's accessibility. The key factor is access time, which depends on distance and the ground transportation infrastructure. Another factor is cost of personal and public transportation and operating/maintenance costs for public transportation services.

d. *Development Costs* - Development costs include airfield, terminal, and ground transportation capital costs and land acquisition costs. The importance of development costs are obvious. Also obvious is the fact that there are limits beyond which the project may not be financially feasible or at which the costs far outweigh the benefits. This threshold is quantifiable and easily understood. Relative cost data will suffice. Precise figures are not necessary. The key factors influencing construction costs are topography, geology, ground access distance and systems, land values and utility system availability.

e. *Environmental Consequences* - The environmental impacts associated with airport development and operation cannot be overemphasized in that they may be critical to gaining site approval, regardless of where the site may fall in the ranking process. Environmental impacts must be assessed in terms of both the human and natural environment.

(1) Aircraft noise is usually the first impact which comes to mind. It can be determined through the use of noise contours based on the general airport configuration, runway use and activity forecasts. The noise impact factor will probably have the greatest influence on how the site fares in term of public acceptance.

(2) The impact of the airports location on the flora and fauna and biotic communities, while important, may not weigh heavily during the early stages of the site evaluation process, unless there are endangered species which will be affected.

(3) While air quality and ground/surface water quality impacts are important, they will likely not differ significantly from one site to the other. Water quality impacts can usually be minimized through airport planning and design treatment. The air quality impacts are not usually significant, except in densely populated urban environments where the airport, along with other sources, jointly contribute to the violation of air quality standards.

(4) A change in the use of the land, either direct or induced, from agricultural and forest to more intense development is a quantifiable factor, but its relative value is subjective.

(5) The existence of endangered species; the presence of historic, archaeological, architectural and cultural resources; and a potential effect on parks and recreation areas are evaluation factors which are unique and require separate consideration.

f. *Socio-Economic Factors* - These include the relocation of families and businesses, changes in employment and commercial patterns, changes in tax base and the demand for new public services at the new site.

g. *Consistency with Areawide Planning* - A major airport can be one of the most crucial influences on regional growth patterns. Even a small airport can have substantial impacts on land use patterns. How well the candidate site fits regional land use policy

as expressed in the comprehensive land use and transportation plan or in a regional airports system plan will be a key factor in gaining public acceptance.

6. **SITE EVALUATION.** If the screening of sites results in more than one solid candidate, then an application of the evaluation criteria discussed in paragraph 5 will be appropriate. If it is not clear which site is superior, then there must be a further, more rigorous, application of the evaluation criteria.

This will involve assigning values to the criteria, rating each site and summing the weighted ratings. The summations and the weighted ratings are then reviewed and subjected to a sensitivity analysis to detect distortions in the logic.

It cannot be assumed that this analysis conclusively points to the best site or that which will finally be selected. There may be overriding political, jurisdictional, institutional, environmental or financial considerations which may influence the choice of sites.

a. The process of assigning values to evaluation criteria and rating sites will usually be performed, at least initially, by the consultant, individually or in conjunction with the airport operator. In the more complex studies, there may be more extensive participation in determining values for criteria and in ratings. For example, it may be useful to conduct surveys among members of an appropriate advisory committee or committees to obtain values for the criteria, or a consensus may be required from members of the policy committee as to the assignment of values.

b. The application of evaluation criteria will be aided by field investigation. This will involve the physical inspection of candidate sites to review pertinent physical characteristics. It may be necessary to take soil samples and borings. Access times over different routings should be noted as well as any other pertinent observations. Ground level photographs, including a 360 degree horizon profile, will prove useful. An aerial inspection of potential sites may prove highly desirable in gaining a visual overview. This may include simulating approaches and departures to hypothetical runways and, if possible, taking aerial photographs.

7. **TRANSFER ANALYSIS.** A comparative analysis should be performed for the existing airport and the new airport to determine the best timing for transfer of all or part of the existing operations to the new airport. The transfer analysis may assist in scheduling development of the new site and in determining whether interim expansion of the existing airport's capacity to prolong its useful life is economically justified.

a. The analysis is an economic one and does not treat social, environmental and political issues. Total cash costs for different transfer dates are computed and the date with the lowest cash cost is the theoretically best transfer date from an economic standpoint. Cash costs include those attributable to airport and access construction costs, aircraft delay costs and user ground access costs. The costs are computed in constant (today's) dollars and converted to "present value". (Present value is a concept used to compare costs incurred in different time periods. The present value is the amount of money necessary to invest today at the going interest rate in order to have a specific sum of money available at a given date in the future. The interest rate used should reflect the market cost of capital.)

b. Construction costs and aircraft delay costs can be estimated with sufficient accuracy consistent with the nature of the analysis. However, the economic analysis may be highly sensitive to the value of time assigned to passenger airborne delay costs and to airport user ground access costs. For example, the assignment of high value for time in computing user ground access costs will likely favor a later transfer date to a remote new airport site. On the other hand, assessment of a higher value to passenger airborne delay costs will favor early transfer from the congested existing airport. While it is appropriate to consider dollar "proxies" for the value of time (and probably most appropriate to assign conservative values), the planner should understand the sensitivity of the transfer analysis to these assumptions.

8. **REGIONAL AIRPORTS.** The potential for having one airport serve the aeronautical interests of two or more communities, which would otherwise have individual airports, should not be overlooked during requirements analysis and site selection activities. Such consideration is most appropriate

when two or more nearby communities are in need of major airport improvements or new sites.

a. The benefits of regional airports are numerous. The consolidation of general aviation activities results in better services for the user and the consolidation of commercial service will result in better schedules and frequencies for the passenger.

The higher revenues, lower overall operational and maintenance costs, and possibly even lower capital costs, could result in a self-sufficient airport operation. If this is not feasible, at least the distribution of airport costs over a larger population is a distinct advantage.

b. In analyzing the potential benefits that might be derived from consolidation of demand, the key factor will be user access distance and time. The elasticity of the ground access will directly influence the meeting of demand and should be carefully evaluated through user surveys and examination of the regional transportation infrastructure.

c. If the benefits of the regional alternative clearly outweigh the costs, endorsement by the directly involved communities may be achievable.

d. Early identification of the potential for regional airport applications is a function of airport system planning. Should the concept prove feasible as a result of a follow on master planning study, the support of state authorities should be enlisted for purposes of state financial assistance and the establishment of a regional airport authority.

9. **SITE APPROVAL.** Timely site approval by the sponsor who will develop and operate the airport is important because it permits implementation of the necessary steps to assure airport establishment while the decision making apparatus is politically and organizationally intact. The extensive coordinative activities that may have taken place to gain public consensus on the need for an airport and where it should be located should not be wasted due to inaction.

Assuming that state and regional approval procedures have been followed, an important next step will be Federal approval. FAA approval is necessary if financial assistance under the Airport and Airway Improvement Act for follow on planning or site acquisition and development is contemplated. Such approval must be supported by environmental documentation (see Chapter 8), public hearings and evidence that the proposed airport will be reasonably consistent with the planning for the area in which it is to be located.

Regardless of the applicability of Federal financial assistance in the planning or development of the airport, the FAA will advise on the aeronautical suitability of the site after having studied the site from the standpoint of airspace use as required by FAR part 157.

CHAPTER 8 ENVIRONMENTAL PROCEDURES AND ANALYSIS

Wide body takeoff

1. **GENERAL.** Prior to 1970, environmental matters were not a prime consideration in airport master planning. Now, environmental feasibility is as important as economic or engineering feasibility. The phrase "environmental feasibility" means capable of being accomplished from an environmental standpoint, paralleling the meanings of economic or engineering feasibility. There have been cases where there was no question of need, or economic and engineering feasibility, but where the absence of environmental feasibility stopped the proposed development completely.

There was a time, also, when environmental documentation was considered as merely another justification document to be prepared after the development decision had been made. Today, environmental considerations begin to play a role when the scope of work of a master plan is developed, and this early input provides an opportunity for not only avoiding, or mitigating impacts, but also for developing innovative and creative approaches for enhancement of the environment.

a. Environmental feasibility has several components. A major component, often not adequately recognized, is political acceptability. The master plan, whether it contemplates a new airport or improvements to an existing airport, must be acceptable to the public and the public's representatives, if

it is to be useful. This "public" includes the public at large, the airport neighbors, and the airport users.

The other obvious component of environmental feasibility is compliance with regulatory and statutory requirements. However, there have been cases where proposals documented by fully approved environmental impact statements, and judged in complete compliance with these requirements have failed because of public opposition based on the public's perception of environmental impacts. And sometimes the opposite is also true. In spite of public support, environmental consequences which are unacceptable to government authorities have resulted in a decision to proceed no further.

The responsible airport master planner must recognize both of these factors and design a program through which the public is completely and truthfully informed. A creative approach to environmental considerations, results in a better overall design, and a greater possibility of public support, rather than just meeting the statutory requirements.

b. Just as a proposal can be halted by economic or engineering infeasibility, so also can it be halted by environmental infeasibility. Consequently, the environmental investigations must proceed, at an appropriate level, in parallel with the other investigations. The environmental task is not something to be undertaken after other tasks have been completed, or completed before other tasks can be started.

It follows that, in preparing a scope and schedule of work, environmental tasks must be integrated with the whole planning process. At the same time, the environmental effort should be sized and resources allocated appropriately to the expected size and complexity of the planning effort. As will be discussed in section 4, the appropriate environmental effort may range from little or no effort to an examination of several alternatives and mitigation measures to eliminate significant impacts.

2. **ENVIRONMENTAL ACTIONS.** Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508), issued by the President's Council on Environmental Quality, provide for three categories of environmental actions. Every proposed project will eventually be classified as one of these three categories. Further, as will be discussed later, under the heading Cumulative Impact, projects are not to be considered as individual work items, but from a broader program context. Any program will be categorized according to the project or combination of projects with the greatest environmental significance.

The three categories are:

a) Categorical Exclusions
b) Actions normally requiring an environmental assessment
c) Actions normally requiring an environmental impact statement

a. FAA Order 5050.4, *Airport Environmental Handbook* (or subsequent revisions), specifies the procedures applicable to airport actions. In general, actions categorically excluded are actions which have been found, in normal circumstances, to have no potential for significant environmental impact. (See Paragraph 23 of FAA Order 5050.4). Under extraordinary circumstances (see Paragraph 24 of FAA Order 5050.4), an action which would ordinarily be categorically excluded may require an environmental assessment. For example, the addition of extended safety areas to a runway would not be categorically excluded if it involved wetlands, critical habitat of an endangered species, or a floodplain.

b. Actions normally requiring an environmental assessment (see Paragraph 22 of FAA Order 5050.4) are actions which have been found by experience to sometimes have significant environmental impacts, and sometimes not. Actions having significant impacts will require the preparation of an environmental impact statement. There may be actions with minor potential impacts which could be eliminated or minimized through mitigating actions. Hence, the environmental assessment process provides the opportunity for the critical and useful function of focusing attention on mitigation measures at a time in the planning process when they can be incorporated without significant disruption or commitments made. The purpose of an environmental assessment is to determine whether

or not a proposed action will have, or is likely to have, one or more significant impacts.

Based upon the results reported in an environmental assessment, and any other investigations deemed necessary, the FAA will prepare either a finding of no significant impact, or an environmental impact statement. The mitigation measures developed in the planning process and documented in the environmental assessment can be made conditions of a finding of no significant impact, and may, in many cases, make an environmental impact statement unnecessary.

c. Relatively few airport actions require an environmental impact statement (see Paragraph 21 of FAA Order 5050.4). If, because of potential significant impacts, an environmental impact statement is required, the process should be initiated as soon as possible in order to minimize delays. Preparation of an environmental impact statement in accordance with the NEPA is the responsibility of the FAA. It is often possible to adjust the plans so that significant impacts can be avoided, thus avoiding the necessity to prepare an environmental impact statement.

Obviously, if there are two development choices available which will meet the need equally well, one with significant impacts and one without, the one without significant impacts will proceed much more rapidly. Indeed, the choice of a development proposal with significant impacts may never proceed, because in many cases there is a requirement that a finding be made that no feasible and prudent alternative exists, and such a finding is unlikely in the face of the existence of a viable alternative.

3. APPLICATION TO AIRPORT MASTER PLANNING.

a. The FAA does not approve a master plan. However, a major product of the master planning effort is an airport layout plan (ALP), showing existing and ultimate facilities. Federal Aviation Regulations require that a sponsor seeking a grant for airport improvement, or seeking unconditional approval of a new or revised ALP must submit with the plan an environmental assessment prepared in accordance with FAA Order 5050.4, if an assessment is required by FAA Order 5050.4. The FAA will not approve a grant for airport development unless the airport operator has a current approved ALP.

b. Of course, little purpose is served by preparing a plan showing development which is infeasible because of cost or engineering requirements, or which cannot be approved because of failure to adhere to design standards. Similarly, an ALP prepared in the absence of environmental considerations, unless it consists solely of items which are categorically excluded, may not be acceptable because of either perceived or actual environmental problems. For environmental activities which are part of master planning for an airport requiring ALP approval, the primary reference document is FAA Order 5050.4 (or subsequent revisions).

c. An ALP is approved unconditionally when all items on the plan which are items normally requiring either an environmental impact statement or an environmental assessment have in fact received environmental approval. Such approval is evidenced either by a finding of no significant impact, or in the case of items covered by an environmental impact statement, a record of decision at least 30 days after the date of the environmental impact statement. When environmental approval has not been completed, an ALP may receive a conditional approval, which identifies the items which have not received environmental approval and specifies that they shall not be undertaken without such approval (see Paragraph 30 of FAA Order 5050.4).

d. It is the responsibility of the planner preparing a master plan to prepare the environmental assessment, unless the development proposed consists entirely of items categorically excluded, with no exceptional circumstances requiring environmental assessment, as defined in Paragraph 24 of FAA Order 5050.4. Based on the data in the assessment, and such other information as may be pertinent, the FAA will either issue a finding of no significant impact, or prepare an environmental impact statement.

4. DESIGN OF THE ENVIRONMENTAL STUDY.

The environmental work must be undertaken by an environmental professional who is experienced with and skilled in the environmental disciplines.

Depending upon the particular situation, more highly specialized skills may be required. Just as the skills of a soil or pavement engineer may be required in some cases but not in others, so may there sometimes be requirements for the skills of a marine biologist, an acoustical engineer or a public communication specialist. The environmental professional who is skilled in the regulatory requirements, in the environmental process, and in the recognition and identification of problems requiring specialty assistance should be an active participant in the master planning process from the very beginning.

When the scope and schedule of work for preparing an airport master plan is developed, it is the responsibility of an environmental specialist to assure that the environmental effort to be undertaken is appropriate to the overall task. The planner, the airport operator, and the FAA should agree on the development to be covered in the environmental documentation, particularly if an environmental impact statement is expected to ultimately be required. This subject was mentioned briefly in paragraph 4 of Chapter 3.

a. Depending upon the issues involved, a decision must be made as to the kinds of projects that are likely to be proposed and whether there may be impacts of potential significance. If the planner, in the light of the identified issues and concerns of the airport operator, can estimate the time and resources needed for the planning process, he or she must have some idea of the types of projects which are likely to be examined. If a proposal is to be examined for technical or financial feasibility, it should also be examined for environmental feasibility. To the extent that alternatives are expected to have different environmental impacts, provision for examining these differences should be made in the study design.

Sometimes it will be clear at the beginning that an environmental impact statement will ultimately be required, because a significant impact appears to be unavoidable. However, it will often be wise to postpone the allocation of resources for an environmental impact statement until the issues have been clearly identified by means of an environmental assessment. The expected significant impact may not materialize, or may be successfully mitigated, or other equally significant impacts may emerge from the initial studies. Sometimes, particularly with smaller airports, it will be clear that all proposals will be categorically excluded. However, in many cases an environmental assessment will be required, specifying appropriate mitigation measures.

The purpose of an environmental assessment is to determine if the potential impacts are significant, explore alternatives and mitigation measures, and provide the information to determine whether or not an environmental impact statement is required. FAA Order 5050.4, in Paragraph 47, describes the format and the content of an environmental assessment. In preparing a master plan for an airport, the planner should not be required to do more than is required for an environmental assessment, which is a limited investigation. If significant (as defined in FAA Order 5050.4) potential environmental impacts are identified which cannot be mitigated, they should be identified in the final report.

The document called an "Environmental Assessment" is simply a record of these preliminary investigations. After reviewing an environmental assessment, if the FAA determines that there are no significant impacts, or that with appropriate mitigation the impacts could be prevented or minimized to the point that they are not significant, the FAA will issue a finding of no significant impact. On the other hand, if an environmental impact statement is required, it is an FAA responsibility.

b. In a master planning effort, it may be tempting to go into greater depth or detail than is required for an environmental assessment by Paragraph 47 of FAA Order 5050.4. There are, however, good reasons why such effort should not be committed at the beginning of the study. As stated, the purpose of an environmental assessment is to determine if significant impacts cannot be avoided and an environmental impact statement will be required. In developing the information for this decision, it will be determined which of the potential impacts may be significant.

The environmental impact statement process starts with a "scoping process" which determines which of the possible impacts should be addressed in the impact statement. Investigations conducted before scoping which are beyond that necessary for

the assessment will require effort which is difficult to estimate and ultimately may not be required at all. In these circumstances it is almost inevitable that the estimated effort will be either too large or too small.

In the initial design of the environmental study as part of a master plan, therefore, it is necessary to consider the probable proposals in the planning process, and the environmental analysis required in an environmental assessment for these proposals. For example, consider the requirements of FAA Order 5050.4, Paragraph 47 (e) (1) regarding noise. Sub-paragraph (a) defines conditions where no noise analysis is required. If these conditions are not met, then an initial analysis is required, which does not necessarily involve the use of the FAA's Integrated Noise Model. Depending upon the number and kinds of present and projected operations, simple hand or graphic calculations may be all that is necessary.

If the thresholds specified in Paragraph 47 of FAA Order 5050.4 will be exceeded, then an environmental impact statement will likely be required. With the knowledge gained from the assessment, a determination of the effort required for the noise study will be much easier than it would have been without the assessment. The same reasoning applies to other investigations. Normally, the impact statement would be expected to discuss only those impacts which exceed the threshold of significance in Paragraph 47 of FAA Order 5050.4, and estimating the resources to be devoted to an Environmental Impact Statement being prepared should not be difficult after the impacts to be investigated have been identified.

5. **CUMULATIVE IMPACT AND TIERING.** The Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508) contain specific requirements on the subject of cumulative impact. The Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508) also introduce the concept of tiering of environmental actions. Tiering and cumulative impact may appear to be contradictory, but they are often mutually supportive.

a. Cumulative impact is discussed in Paragraph 26 of FAA Order 5050.4. The requirement to consider cumulative impact stems from the situations where individually minor but collectively significant actions take place over a period of time. Assume that a master plan has been prepared for a general aviation airport, containing a number of items, e.g., lengthening the runway, adding an MLS, providing for additional fixed base operators, and expanding terminal facilities including conference space, etc. to attract business jet aircraft and relieve a neighboring air carrier airport. It is not enough to conclude, because any one of these actions will not cause a significant change in the fleet mix or a significant increase in traffic, that together they will not result in a significant change.

b. The concept of tiering is discussed in Paragraph 101 of FAA Order 5050.4. The basic idea is that decisions should be made when the time is ripe, but need not be made earlier. For example, an airport master plan may contain a development program which is expected to cover, say, a period of twenty years, contingent upon certain demand forecasts. The master plan may show specific proposals for the first phase, say five or ten years, and conceptual proposals for the remaining development. If the first phase is sufficient for a safe and efficient airport, and is covered by appropriate environmental documentation (categorical exclusion, finding of no significant impact or environmental impact statement), then the ALP for the first phase can be unconditionally approved, with a conditional approval of the remaining phases, subject to environmental documentation (categorical exclusion, finding of no significant impact or environmental impact statement) at the time that the requirement for the future development is ripe.

Clearly, even though the environmental documentation and unconditional approval of the ALP may cover only the short term, the environmental documentation, whether it be a categorical exclusion, finding of no significant impact or an environmental impact statement, must consider the cumulative impacts of the approved short-term development over a longer period. Traffic on a new runway, for example, will continue to grow past the development period.

c. An alternative course of action is to consider the environmental impacts of the total long-term proposed development, which is then subject to a written re-evaluation to assure that the conditions have not changed. For example, suppose that a new runway is planned approximately ten years after the master plan is completed. An environmental impact statement is approved, with the statement that there will be no residential development within a specified distance of the ends of the proposed new runway. The re-evaluation should verify that, in fact, no residential development has taken place in the interim between the approval and the actual construction.

If, on the other hand, the requirements have so changed in the intervening period that the airport development proposed is now different, then new environmental documentation (categorical exclusion, finding of no significant impact or environmental impact statement) will be necessary for the new development program.

6. **PUBLIC PARTICIPATION.** There are statutory requirements for public information and participation; there are regulatory requirements for public participation; and there are often political requirements. It is sometimes true that the political requirements are the most stringent; it is often true that they are the least recognized.

a. Public acceptance is dependent upon whether the potentially affected public understands and accepts the need for the development; receives complete, truthful and unbiased information about the impacts; and recognizes that public concerns have been considered adequately and fairly. The only way to achieve these conditions is by designing and accomplishing a program to achieve them. One cannot gloss over unfavorable impacts or attempt to hide the true purpose of a development without arousing suspicion and opposition. It follows that the program for public involvement must be designed with careful consideration for not only providing accurate and unbiased information, but also for the perception of openness and completeness, along with a demonstrated commitment to the development of mitigation measures appropriate to the situation.

If there is initially the slightest indication of potential problems with public acceptance, then consideration should be given to opening the public involvement program with public discussion of the aviation problems and the potential alternatives, including taking no action or demand constraint. The objective is not to sell airport development, but to provide an understanding of the reasons why development is being considered, and a recognition that it will not be forced on the public. Comment should be solicited, accepted and considered.

Information about alternatives, and their financial, social and environmental costs and benefits should be made available to the public as it is developed. The objective is to identify and air all of the problems before the decision is imminent. The probability of political acceptance is much enhanced if the public, and its representatives, elected or otherwise, understand the process and the results by participation rather than by having the conclusions and recommendations presented as decisions already made.

Each public involvement or public participation program should be tailored to the situation. The more complex and far reaching the development that is proposed, the more complex and far reaching the public involvement program that may be required.

b. The Council on Environmental Quality's *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*, 40 CFR Part 1506.6 contains the regulatory requirements for public involvement. Federal agencies are directed to:

(1) Make diligent effort to involve the public in implementing NEPA procedures.

(2) Provide public notice of NEPA related hearings, meetings, and the availability of environmental documentation (categorical exclusions, findings of no significant impact or environmental impact statements).

(3) Hold public hearings when appropriate.

(4) Solicit information from the public.

(5) Make findings of no significant impact and environmental impact statements and underlying documents available to the public.

Detail about each of these is given in 40 CFR 1506.6, including a list of suggested means for keeping the public informed.

c. For certain projects, even if there appears to be neither public interest nor controversy, an opportunity for a public hearing is required by statute for a new airport, a new runway, or a major runway extension. A major runway extension is defined in Paragraph 5 of FAA Order 5050.4. A proposed development program which includes any of these (or some other items as specified in Paragraph 22 of FAA Order 5050.4) requires an environmental assessment, followed by a finding of no significant impact or an environmental impact statement. The assessment is provided to the public as an information document in advance of the public hearing. Directions for public hearings are provided in Paragraph 49 of FAA Order 5050.4. For the three types of development listed, the opportunity for a public hearing is required. Without this minimum public participation Federal action will not be taken.

7. **POTENTIAL ENVIRONMENTAL IMPACTS.** The possible impacts of airport development can run the gamut of impacts that might be the result of any construction. However, some are more common than others.

Paragraph 47 (e) of FAA Order 5050.4 discusses types of impact and thresholds which determine whether or not the impact is significant. Sometimes the determination is made by measurement, by calculation, or by observation. Other times it may be determined by correspondence with local, state or Federal authorities, relying on determinations already made. In the case of Federal authorities, the procedures are often specified by Federal regulations of the department involved. In each case, Paragraph 47 (e) has been designed to provide overall guidance.

However, it must be remembered that environmental requirements are still changing. Since FAA Order 5050.4 was originally published in 1980, there have been some significant changes in procedures, requirements and levels of significant impact. These include changes in noise, air quality, and farmland considerations, along with new categories involving Wild and Scenic Rivers and the Coastal Barriers Resources Act. Although FAA Order 5050.4 is updated from time to time, further changes will undoubtedly occur. It is therefore important that an organization undertaking a master plan establish and maintain a current knowledge, through FAA contacts, of the environmental requirements.

Often, when an impact is found to cross the threshold of significance, it is possible to modify the proposal so as to mitigate the impact. Mitigation takes many forms, depending upon the type of impact. If the mitigation changes the impact so it is no longer significant, then an environmental impact statement will not be required. However, any mitigation measures specified in a finding of no significant impact, or in an environmental impact statement, must be implemented. The environmental approval, be it incorporated in a finding of no significant impact, or in a record of decision, will be contingent upon the mitigation measures specified. Therefore, the planner should make sure that the airport operator, or other responsible authority, recognizes and accepts the obligation to incorporate the mitigation measures in the development.

a. Certainly the most common impact encountered is that of noise. Aviation noise extends beyond the boundary of the airport, into areas over which the airport operator has no authority. However, the airport operator is considered responsible for the noise resulting from aircraft operations. If there are noise sensitive activities within specified noise levels, then there is a significant impact. There may also be a significant impact if the noise increase on noise sensitive areas exceeds a specified level.

Sometimes there are obvious mitigation measures which can eliminate significant noise impacts, such as acquisition, runway realignment, or changing a runway extension from one end to the other. For more complex cases, a structured approach to airport noise compatibility planning is provided by FAR Part 150 and AC 150/5020-1. Airport noise compatibility planning may include consideration of runway use programs, takeoff and landing profiles and power settings, and approach and departure tracks as well as strategies for encouraging and maintaining land uses compatible with the noise levels projected. Chapter 9 contains a more complete discussion.

Noise problems have sometimes developed around airports because the communities have not been farsighted enough to limit development to compatible uses. The consequence has been community unrest, lawsuits, stifling of needed airport development, and expensive acquisition of developed property for clearing or conversion to airport compatible use.

Therefore, even when it is concluded that no significant impact exists and that there should be no land use problem, appropriate steps should be taken to prevent the encroachment of incompatible uses. At the least, the sponsor must be able to provide assurance in accordance with the Airport and Airway Improvement Act of 1982 that appropriate action, including the adoption of zoning laws, has been or will be taken, to the extent reasonable, to restrict the use of the land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of airplanes. This required assurance is discussed more fully in Paragraph 47 (e) of FAA Order 5050.4.

b. Social impacts arise from the disruption of established communities, the necessity for relocation, altered transportation patterns, changes in employment patterns, and so forth. They may or may not be present. They are obviously more common in established metropolitan areas than in rural areas, and are less probable if land acquisition is not part of the proposal. Along with incompatible land use and social impacts, there may be induced socioeconomic impacts. These are indirect, rather than direct, impacts. Basically, they may be estimated by examining the projected state of the community with the proposed development as compared with the state if there is no airport development. If the purpose of the development is to attract industry and promote growth, then it should not be claimed that there will be no induced socioeconomic impacts. The purpose is to induce impacts. They may not be significant in terms of the natural environment, but their impact in terms of the human environment should be recognized.

c. There are other potential impacts upon the man made environment than the socioeconomic impacts. Under various statutes, consideration must be given to the potential impacts of proposals upon public parks, recreation areas, wildlife or waterfowl refuges, historic sites, and historic and cultural properties, including archaeological sites. The details for these determinations are usually procedural, but it may be necessary in some cases to conduct surveys. The planner and the airport operator should be aware, however, that proposed development affecting public parks and similar areas is almost impossible, by virtue of statutes and decisions of the Supreme Court. The procedural details are given in Paragraph 47 (e) (7) & (8) of FAA Order 5050.4.

d. Air quality is usually not a significant factor in airport development. Procedures for determining the extent, if any, of air quality analysis required is contained in a document entitled *Air Quality Procedures for Civilian Airports and Air Force Bases,* (report No. FAA-EE-82-21).

e. Water quality impacts may be more of a potential problem, depending upon current water quality and quantity, and the location of the proposed development with respect to sources. If the proposed development involves an airport location, runway location, or a major runway extension, then a certification is required from the Governor of the State that there is reasonable assurance that the project will be located, designed, constructed and operated in compliance with the applicable air and water quality standards.

f. Routine detailed inventory of biotic communities in environmental documents, as was common in the past, is not necessary. Consideration of biotic impact now emphasizes quality, not quantity. It is necessary to be alert to potential impacts of significance, as already mentioned, on wildlife and waterfowl refuges and on water resources. Other areas requiring consideration are rare and endangered species, alteration of existing habitat (which may not be significant), and wetlands. The consideration of effects on wetlands may include not only the issues of water quality and quantity, but also the biotic communities in the wetlands, and their place in the overall ecology. Special permits may be required from the Corps of Engineers or from the state, even if the impacts are not significant. Procedures have been published, and an interagency agreement reached between the Department of Transportation and the Department of the Army.

Detailed procedures are given in Paragraph 47 (e) (9), (10) and (11) of FAA Order 5050.4.

g. Special consideration has been extended to floodplains by Executive Order 11988. If a proposal involves a 100 year floodplain, then some mitigation measures may avoid significant impacts. Details are in Paragraph 47 (e) (12).

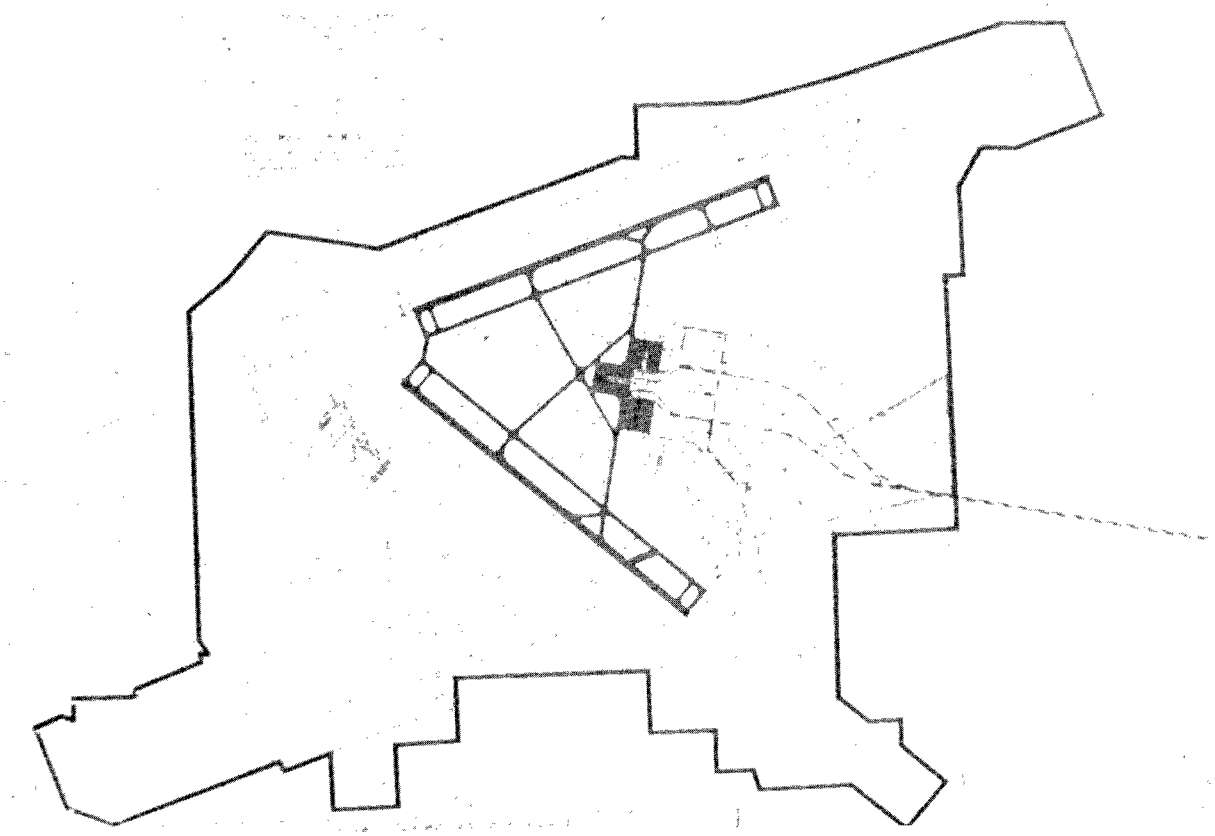
h. Consistency of proposed development with approved coastal zone management programs is another requirement. It is not uncommon to find that a generic basis for airport development has been included in an approved plan. Procedures for checking are found in Paragraph 47 (e) (13) of FAA Order 5050.4. The Coastal Barriers Resources Act prohibits development on undeveloped coastal barriers along the Atlantic and Gulf coasts, as more specifically discussed in Paragraph 47 (e) (14) of Order 5050.4.

i. If farmland is to be converted to other uses, it must be determined whether any of that land is prime or unique, or of state or local significance, which would be protected under The Farmland Protection Policy Act. Procedures for determining the Acts' applicability and for evaluating the land are contained in Paragraph 47 (e) (16) of Order 5050.4.

j. Occasionally, wild and scenic rivers (Paragraph 47 (e) (15)) light emissions (Paragraph 47 (e) (18)) or solid waste disposal (Paragraph 47 (e) (19)) may be issues. For major developments in some areas, energy requirements which are significant with respect to local supply (Paragraph 47 (e) (17)) may be an issue.

k. Finally, it is common that, because of the surrounding habitat, drainage, water quality, human habitation or other situations particular to the site, special mitigation measures must be taken during construction. For example, in a case of a runway extension requiring fill into deep water, special measures to control silting away from the construction site may be necessary. Any such measures should be specified.

CHAPTER 9 AIRPORT PLANS



Typical Layout Plan

1. **GENERAL.** Upon completion of the requirements analysis and, where appropriate, the selection of a new airport site, the master planning proceeds to the synthesis of airside and landside concepts and the development of plans. These include airport layout plans, and landside plans.

The development of plans under the master planning effort does not include plans normally associated with design such as architectural drawings, grading and drainage details, runway profiles, paving sections, etc.

The complexity and number of planning documents will vary with the size of the airport. The high activity commercial service airport may require a series of supplemental plans to clarify the basic drawings. This may be particularly appropriate for the terminal area. Also, there should be a title page giving a title and revision blocks, sponsor approval block, sheet index, wind roses and data and location map.

On the other hand, the low activity general aviation and commercial service airport may have landside plans incorporated in the airport layout plan.

2. **AIRPORT LAYOUT PLAN.** The airport layout plan (ALP) is a graphic presentation to scale of existing and ultimate airport facilities, their location

on the airport and the pertinent clearance and dimensional information required to show relationships with applicable standards.

The ALP is a key document which should be kept current, reflecting changes in physical features on the airport and critical land use changes in the vicinity which may affect the navigable airspace or the ability of the airport to expand.

The ALP serves as a public document which is a record of aeronautical requirements, both present and future, and as a reference for community deliberations on land use proposals and budget and resource planning. As a record of aeronautical requirements, it is referred to by the FAA in its review and findings on proposals involving the development of other nearby airports and objects which may affect the navigable airspace.

Along with the airfield configuration of runways, taxiways and aprons, the terminal area is shown schematically. Runway approach and clear zones should be included. A separate drawing extending beyond the immediate airport vicinity should show the imaginary surfaces described in FAR Part 77, "Objects Affecting Navigable Airspace." A property map, which may be separate, should be included.

In most cases involving low activity general aviation and commercial service airports, it will not be necessary to develop separate terminal area and access plans. These plans may be included on the ALP where this level of detail will suffice. Off airport land use plans may also be included on the ALP for these airports unless aircraft noise is a local issue requiring land use controls and changes.

Photogrammetry should prove useful in the preparation of the ALP and new photogrammetry should be considered when there is none available. Photographs should be of such quality to depict 1'-2' contour intervals.

a. *ALP drawing.* This drawing should have, as a minimum, the layout of the airport, terminal area and on-airport access systems and land uses within the airport property. There should be a basic data table, wind information, a vicinity map and location map. However, it is not necessary to include these on the drawing. It may be more appropriate to include these on a separate sheet such as a title page. The use of a light background photo base is encouraged.

(1) *Airport layout.* The drawing should depict the existing and ultimate airport development and land uses, to scale. Included should be:

(a) Prominent airport facilities such as runways, taxiways, blast pads, stabilized shoulders and runway safety areas, buildings, navaids, parking areas, roads, lighting, runway marking, pipelines, fences, major drainage facilities, segmented circle, wind indicators, and beacon.

(b) Prominent natural and man-made features such as trees, streams, ponds, rock outcrops, ditches, railroads, power lines, and towers.

(c) Revenue-producing non-aviation-related property, with the current status and use specified. The details of this property may be shown on a separate property map for clarity.

(d) Areas reserved for existing and future aviation development and services such as for general aviation fixed base operations, heliports, cargo facilities, airport maintenance, or service areas, etc.

(e) Areas reserved for non-aviation development, such as industrial areas, motels, etc.

(f) Existing ground contours to an interval that does not clutter the drawing (up to 10', depending on terrain), drawn lightly, but legibly. Similarly, a light overlay of the state grid coordinate system (where applicable) may facilitate the location of coordinates.

(g) Fueling facilities and tiedown areas.

(h) Facilities that are to be phased out.

(i) Airport boundaries and areas owned or controlled by the sponsor, including avigation easements; section and township corners, survey control points and bench marks, with adequate property ties should be shown.

(j) Runway clear zones and associated approach surfaces, indicating height and location of controlling objects, i.e., usually the tallest object within a limited area exceeding obstruction criteria if this information is not given on other drawings. This can be a note if the objects are located outside the limits of the drawing.

(k) Airport reference point (ARP) with latitude and longitude to the nearest second based on the U.S. Geological Survey grid system. There should be coordination with FAA to determine the need for accuracy closer than one second.

(l) Latitude, longitude and elevation of existing and ultimate runway ends and thresholds; elevation of high and low points, and runway intersections. For ILS runways, changes in elevation within 3,000 feet of the threshold should be shown.

(m) True azimuth of runways (measured from true north).

(n) North point - true and magnetic, with the magnetic declination and epoch year.

(o) Pertinent dimensional data - runway and taxiway widths and runway lengths, taxiway-runway-apron clearances, apron dimensions, building clearance lines, runway clear zones, and parallel runway separation. Deviations from FAA standards should be noted.

(p) A 24" × 36" layout sheet should be used as a minimum, with a minimum lettering size of .120". If necessary, increase the sheet size but maintain the same ratio of sheet height to length. Oversized sheets are discouraged.

i. The map scale should be between 200 to 600 feet to the inch, depending on the size of the airport, and illustrated on the layout. It is advisable to coordinate the sheet sizing and scales with FAA, if non-standard size is contemplated.

ii. Include a legend in graphic and descriptive form with symbols that differentiate between existing and ultimate development.

iii. Provide space for the title, revision, and necessary approvals.

iv. Avoid the use of shading and "shadow" lettering.

(2) *Location Map.* This is a map drawn to scale (1:500,000) sufficient to depict the airport, cities, railroads, major roads and tall towers within 25 to 50 miles of the airport. A sectional aeronautical chart may be used. This may be shown on the title page in lieu of the ALP.

(3) *Vicinity Map.* This is a map showing the relationship of the airport to the city or cities, nearby airports, roads, railroads, and built-up areas. It should be drawn to a scale of 1:24,000 (U.S.G.S. 7 minute quadrangle). A vicinity map may be omitted if sufficient detail is covered on the Approach and Runway Clear Zone Layout.

(4) *Basic Data Table.* This table contains the following information on existing and ultimate runway and airport conditions where applicable:

(a) Airport elevation (highest point of the usable landing area), to the nearest tenth of a foot.

(b) Airport reference point coordinates, to the nearest second.

(c) Airport magnetic variation, to the nearest minute.

(d) Mean maximum daily temperature for the hottest month.

(e) Airport and terminal navaids.

(f) Runway identification, magnetic numerical, such as 13/31, 4/22.

(g) Percent effective runway gradient for each existing and proposed runway.

(h) Percent wind coverage by runway.

(i) Designated instrument runway.

(j) Pavement type (sod, asphalt, concrete).

(k) Pavement strength of each runway in gross weight and type of main gear (single, dual, dual tandem), as appropriate.

(l) Approach surfaces for each runway (by individual end, if different).

(m) Runway lighting.

(n) Runway marking.

(o) Electronic and visual approach aids and weather facilities.

(5) *Wind Information.* A wind rose should be presented, with the runway orientation superimposed. Crosswind coverage at 12 mph (all runways) and 15 mph (transport category runways) for each runway and combinations and the weather station source and time period of data should also be given.

This data may be on a separate sheet or sheets, such as the title sheet, especially if low visibility wind data are given. Wind information should be for all-weather conditions, supplemented by instrument meteorological conditions (visibility less than 3 miles and ceiling less than 1000 ft.) where annual instrument approaches exist or are expected.

At locations where no satisfactory wind data exist, the basis for the wind analysis and runway alignment should be given in the master plan documentation and an appropriate note included on the plan. Where the principal runway is not aligned with the main wind coverage, note why. Wind should be presented on a 36 point compass.

Information on wind analysis and display is contained in AC 150/5300-4B, "Utility Airports-Air Access to National Transportation."

(6) *Designated Instrument Runway.* The runway, or runways, that are to be planned for precision instrument approach procedures (both horizontal and vertical instrument guidance) and ultimately have an instrument landing system and related facilities installed by FAA, must be indicated on the plan and in the basic data table. The FAA designates the instrument runway(s) based on coordinated airport operator planning recommendations. It is important that the planning for this key element be well coordinated with FAA and that its designation on the ALP be timely.

(7) *Detail Required.* To avoid clutter, all items need not be drawn if a note can adequately cover the development or facility under consideration. For example, standard taxiway lighting, runway and taxiway marking, and the taxiway sign system can be covered by a note in the basic data table. Where detailed planning has not been performed for areas reserved for future aviation or non-aviation development, an outline of these areas is generally adequate.

b. *Approach and Runway Clear Zone Drawing.* This should depict the following information:

(1) Area under the imaginary surfaces as defined in FAR Part 77, Objects Affecting Navigable Airspace.

(2) Existing and ultimate approach slopes and any height or slope protection established by local zoning ordinance.

(3) A plan and profile of the runway clear zones, approach zones and surfaces showing the controlling structures and trees therein (i.e., usually the tallest object within a cluster) and their elevations. Also roads, railroads, and polelines that cross clear zones and approach areas should be shown on the profile (highest elevation). It is highly important that there be clear topographic detail and dimensions of close-in obstructions. Roads and railroads should be shown on the profile to the highest elevation plus the added elevation specified in FAR Part 77.

(4) Location and elevation of obstructions exceeding criteria in FAR Part 77. Obstructions off the plan may be indicated by a note or by extending the plan and profile to its full length (with a possible break, where such obstructions are significant - such as a mountain range). For a cluster of tall objects within close proximity of each other, only the elevation of the tallest object need be shown. There should be a listing of all obstructions and the measures taken to remove, light, mark or waiver them. Any plans concerning the alteration or removal of obstructions should be noted on the plan and in the basic data table. Where an obstruction chart (O.C.) exists, it should be used as a basic reference.

(5) In the approach areas, tall smokestacks, television, and radio transmission towers; garbage dumps or other areas which could attract a large number of birds; and any other potential hazard to aircraft flight.

(6) Where obstructions are a significant problem, the plan and profile graphics should be in appropriate detail.

c. *Property map.* The property map should show ownership or interest in each tract within the airport boundaries. How and when the airport property was obtained should be noted or described separately. Detailed ownership or interest in property immediately adjacent to the airport is not necessary unless germaine to airport operation or expansion. If there have been obligations incurred as a result of obtaining property, or an inter-

est therein, this should be noted. Important, from an FAA perspective, are obligations that stem from a Federal grant or obligations under FAA-administered land transfer programs such as surplus property programs.

In cases where interests are uncomplicated and where ownership information can be shown on the ALP, a separate property map will not be necessary.

d. *Master Utility Drawing.* Preparation of a master drawing showing the type, size and routing of utilities on and serving the airport will prove highly useful to the airport operator as well as in follow-on planning.

e. *Airport Layout Plan Approval.* Regardless of the existence of a comprehensive master planning study, the airport operator must have an FAA approved ALP in order to receive financial assistance under the terms of the Airport and Airway Improvement Act of 1982 (AIP). The maintenance of an up-to-date plan and conformity to the plan are obligations at an airport on which Federal funds have been expended under the AIP and the previous airport development programs, the 1970 Airport Development Aid Program (ADAP) and Federal Aid Airports Program (FAAP) of 1946, as amended.

While ALP's are not required for airports other than those developed with assistance under the aforementioned Federal programs, their utility justifies their preparation.

f. *Airport Layout Plan Examples.* An example of an ALP for a commercial service airport is shown in Figure 9-1. Figure 9-2 shows a typical approach and runway clear zone drawing. It should be emphasized that these are guides only, and an ALP should be tailored to meet the individual airport study requirements. For an example of an ALP for a utility airport consult the AC 150/5300-4B. Utility Airports - Air Access to National Transportation.

3. **TERMINAL AREA PLAN.** Airport terminal area plans should be limited to conceptual drawings. This will include the basic sizing of overall areas on ALP's and, for the higher activity commercial service airports, the development of schematic drawings adequate for delineating basic flows of passengers, baggage, cargo and vehicles. This will include movement from car parking areas or curb space to aircraft and back again. The development of details which are required in construction drawings and specifications should not be included in the airport master plan. Concept drawings should not be so definitive as to preclude important changes which will evolve with the development of detailed plans. Such changes are inevitable as an airport project moves through final design and construction.

Terminal area plans for the higher activity commercial service airport should first provide an overall view of the terminal area (scale of 1″ = 500′ to 1″ = 1000′) and should then provide large scale drawings (scale of 1″ = 50′ to 1″ = 100′) of important segments within the overall plan. Thus, large scale views should be provided of terminal building areas, including aircraft parking and maneuvering areas, cargo building areas, hangar areas, airport motel sites, service facilities, and airport entrance and service roads, as appropriate to the particular airport.

4. **AIRPORT ACCESS PLANS.** This element of the airport master plan should indicate proposed or existing routes from the airport to central business districts and to points of connection with existing or planned ground transportation arteries and beltways. All modes of access should be considered including highways, rapid transit, and access by helicopters. The airport access plan should be of a general nature since detailed plans of access outside the boundaries of the airport will be developed by highway departments, transit authorities, and comprehensive planning bodies. Special studies of access systems beyond the airport boundary will normally not be included in a master plan effort. For general aviation airports and all but the high activity commercial service airports, it will only be necessary to show existing and planned access systems on the airport layout plan and vicinity map.

5. **NOISE COMPATIBILITY PLAN.** The airport operator is encouraged to undertake a noise compatibility planning program, i.e., develop noise exposure maps and noise compatibility programs, under the provisions of the Aviation Safety and Noise Abatement Act of 1979. This voluntary program, for airports with existing or potential noise

problems, is carried out by the airport operator in conjunction with local and state officials, following the guidelines contained in FAR Part 150 and elaborated on in AC 150/5020-1, "Noise Control and Compatibility Planning for Airports."

The FAR provides for the airport operator to submit to the FAA a noise exposure map and noise compatibility program which outlines noise control and land use planning strategies to minimize noise impacts. Financial assistance for the planning is available under the Airport and Airway Improvement Act of 1982 (AIP). Projects to carry out elements of approved noise compatibility programs are eligible for Federal participation under the AIP.

Noise compatibility planning should be accomplished at the same time as the master plan because of the interrelationship of the two.

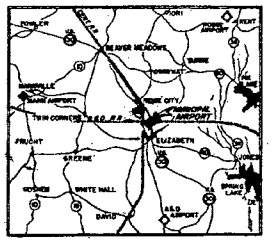
Should the master planning precede the noise compatibility planning or should special noise compatibility planning not be anticipated, it may be necessary to prepare noise contours as a part of the master planning study. These noise contours, overlayed on existing land use maps, should be used to identify existing and potential noise sensitive land uses. For high activity airports, or for airports where existing or potential land uses may be a problem, it will be necessary to develop an off-airport land use plan. This plan should display recommended land use compatibility actions where such actions may be achievable. Coordination with local land use authorities is a must.

For a complex airport, the noise contours should be developed using an FAA-approved computer-based mathematical model, such as the FAA's Integrated Noise Model (INM). The standard Ldn metric should be used with land use planning recommendations given for areas exposed to an Ldn level of 65 or higher. Guidelines for determining land use compatibility with various noise levels are contained in a number of publications, including the AC 150/5020-1.

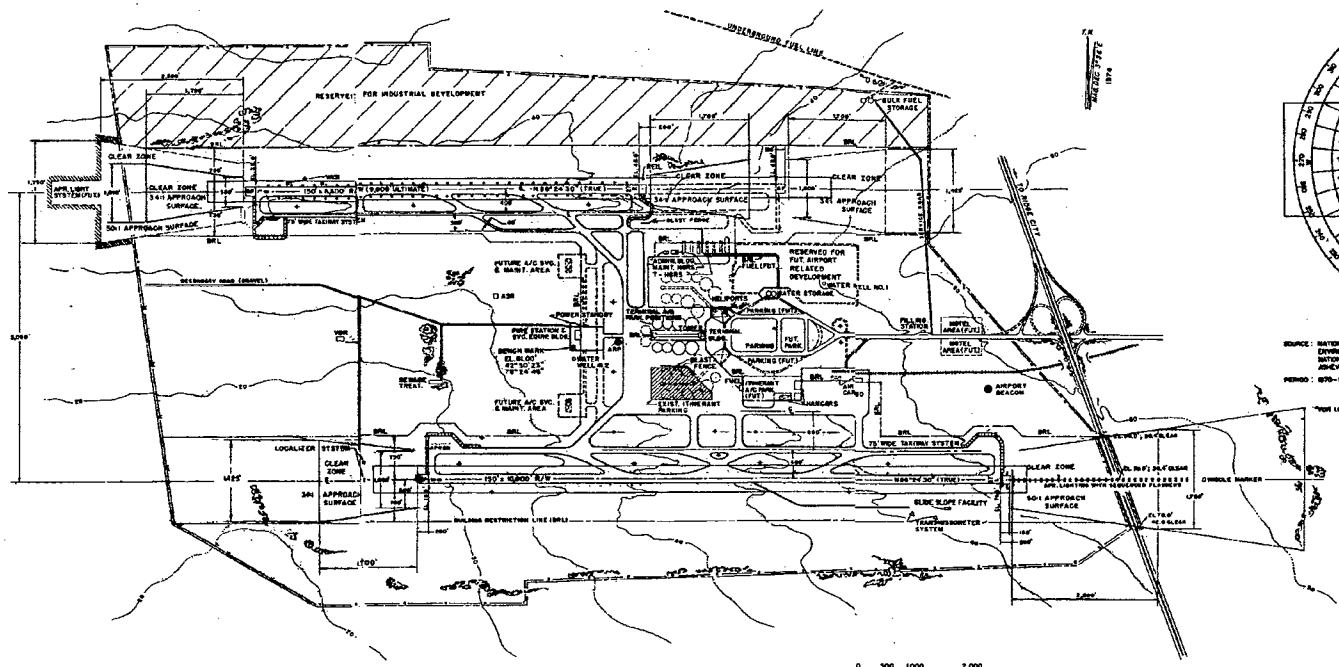
For the general aviation airport or low activity commercial service airport, where noise problems are minimal, the preparation of an individual land use plan will not be necessary.

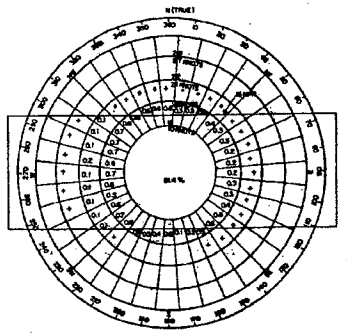
Reference should be made to FAA Order 5050.4, "Airport Environmental Handbook" which defines the conditions under which noise may be a problem and where off-airport land use planning may be needed.

FIGURE 9-1



LOCATION MAP





SOURCE: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION ENVIRONMENTAL DATA SERVICE NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

EARTH CROSSWIND COMPONENT = 19.7%
% V.F.R. WEATHER = 90.5
% I.F.R. WEATHER = 9.5

PERIOD: 1970 - 1980 (104,936 OBSERVATIONS)

** WIND ROSE (ALL WEATHER)

*FOR I.F.R. WIND DATA, SEE SUPPLEMENTAL SHEET

BASIC DATA TABLE

RUNWAY DATA

	RUNWAY 06 - 24		RUNWAY 24 - 6	
	EXISTING	ULTIMATE	EXISTING	ULTIMATE
EFFECTIVE GRADIENT	0.5%	SAME	0.2%	0.3%
% WIND COVERAGE	98%	SAME	98%	SAME
INSTRUMENT RUNWAY	✓	✓	✓	✓
PAVEMENT STRENGTH	1700, 3000#	SAME	85,400 DUAL TANDEM	1700, 3000#
APPROACH SURFACES	34:1 & 50:1	SAME	34:1	50:1 & 34:1
RUNWAY LIGHTING	M.I.R.	SAME	MIRL	SAME
RUNWAY MARKING	PRECISION	SAME	NON-PRECISION	PRECISION
RAWINS, VISUAL AIDS	ALS, ILS	SAME	REIL, VASI	ADD ALS, ALS

1. RELOCATED FROM R/W 24 TO 06 WHEN ILS AND ALS IS ADDED TO R/W 24.
2. VALUES GIVEN ARE THE GROSS WEIGHT IN 1000 LBS. FOR SINGLE (S), DUAL (D), AND DUAL TANDEM (DT) GEAR AIRCRAFT.

BASIC DATA TABLE

AIRPORT DATA

	EXISTING	ULTIMATE
AIRPORT ELEVATION	1090' MSL	SAME
AIRPORT REFERENCE POINT (ARP) COORDINATES	42° 50' 23" N 78° 24' 46" W	SAME
NORMAL MAXIMUM TEMPERATURE	80°F	SAME
AIRPORT AND TERMINAL NAV. AIDS	VOR, ASR	SAME
AIRPORT CATEGORY	TRANSPORT	SAME
MISCELLANEOUS FACILITIES TAXIWAY LIGHTING, CENTERLINE MARKING AND SIGN SYSTEM	✓	✓

LEGEND

EXISTING	ULTIMATE	
		BOUNDARY FENCE
		STORM-WATER INLETS
		GROUND CONTOURS
		THRESHOLD BAR (MLS)
		FACILITIES
		SHOULDER STABILIZATION
		EASEMENT
		PROPERTY LINE
		BUILDING RESTRICTION LINE (BRL)
BP	BP	BLAST PAD
		STORM INLET
		RAILROAD TRACK

NOTE

1. THESE PLANS SHOULD NOT BE USED AS STANDARDS FOR PLANNING OR DESIGN.

NO.	REVISIONS	BY	APP.	DATE

SUBMITTED BY: E. B. PETROLE INC. CONSULTING ENGINEERS — DATE: 6-7-84

APPROVAL BLOCK

RIDGE CITY AIRPORT COMMISSION

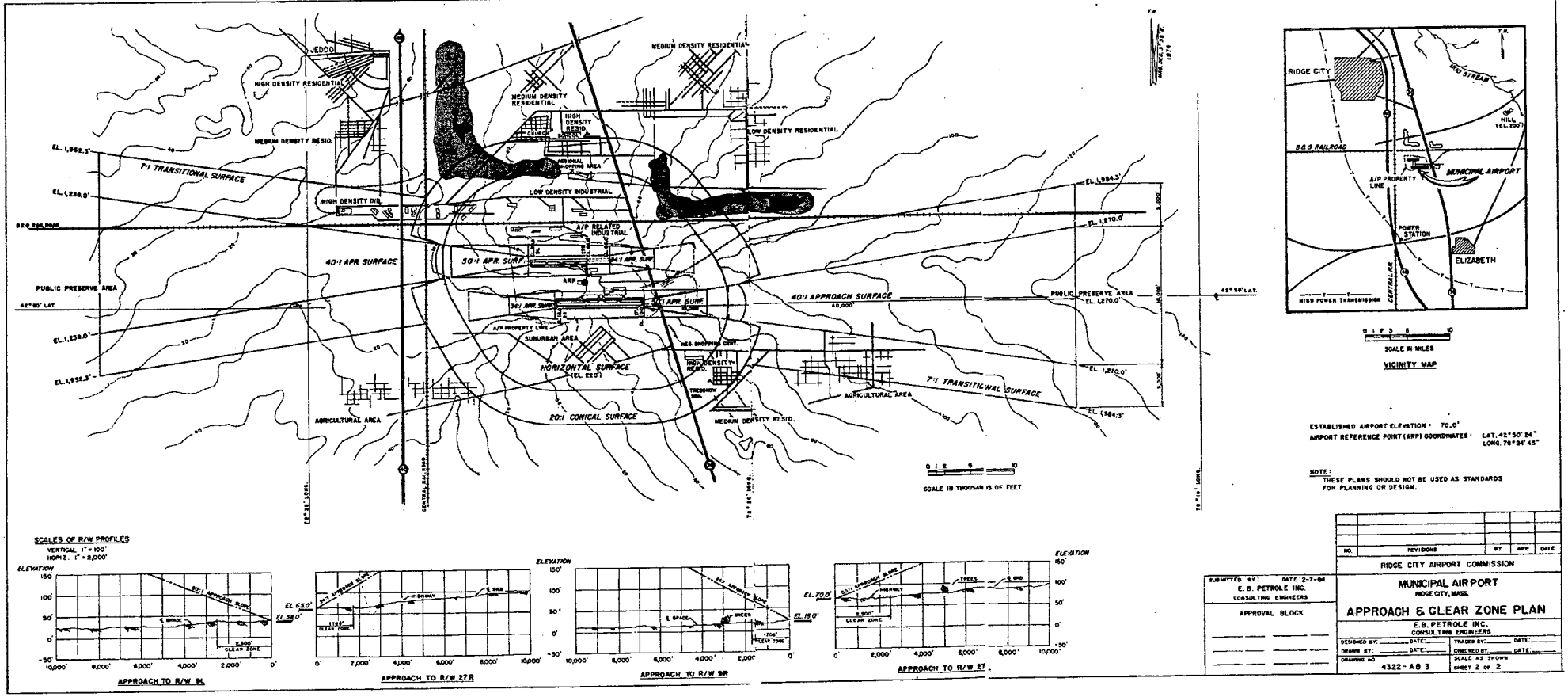
MUNICIPAL AIRPORT
RIDGE CITY, MASS.

AIRPORT LAYOUT PLAN

E. B. PETROLE INC.
CONSULTING ENGINEERS

DESIGNED BY: _____ DATE: _____ | TRACED BY: _____ DATE: _____
DRAWN BY: _____ DATE: _____ | CHECKED BY: _____ DATE: _____
DRAWING NO: 4322 - A83 | SCALE AS SHOWN | SHEET 1 OF 2

FIGURE 9-2



VICINITY MAP

ESTABLISHED AIRPORT ELEVATION : 70.0'
AIRPORT REFERENCE POINT (ARP) COORDINATES : LAT. 42°30'24"
LONG. 76°24'45"

NOTE:
THESE PLANS SHOULD NOT BE USED AS STANDARDS FOR PLANNING OR DESIGN.

SCALES OF R/W PROFILES
VERTICAL 1" = 100'
HORIZ. 1" = 2,000'

APPROACH TO R/W 9L
APPROACH TO R/W 27R
APPROACH TO R/W 9R
APPROACH TO R/W 27L

NO.	REVISIONS	BY	APP.	DATE

RIDGE CITY AIRPORT COMMISSION

SUBMITTED BY: DATE: 2-7-84
E. B. PETROLE INC.
CONSULTING ENGINEERS

APPROVAL BLOCK

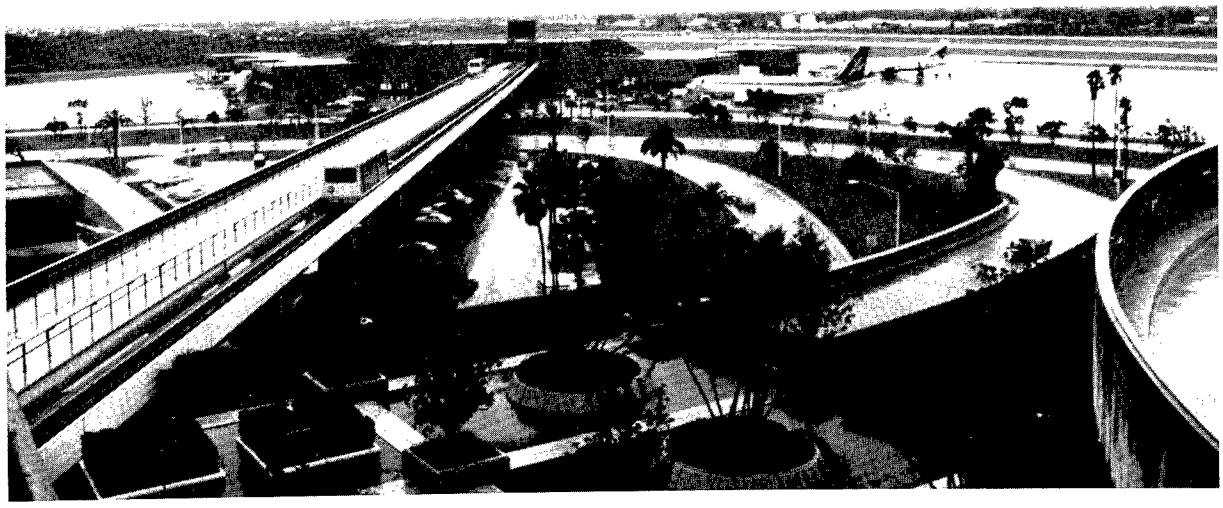
MUNICIPAL AIRPORT
RIDGE CITY, MASS.

APPROACH & CLEAR ZONE PLAN

E.B. PETROLE INC.
CONSULTING ENGINEERS

DESIGNED BY: DATE:
DRAWN BY: DATE:
TRACED BY: DATE:
CHECKED BY: DATE:
DRAWING NO. 4322 - AB 3
SCALE AS SHOWN
SHEET 2 OF 2

CHAPTER 10 PLAN IMPLEMENTATION



Remote gate, Tampa International

1. **GENERAL.** There should be reasonable assurance prior to undertaking the master plan study and during the organizational phase that the airport operator generally will have the financial capability to undertake airport development. Also, as stated earlier, there should be repeated testing of the financial feasibility of development concepts throughout the requirements analysis and site selection activities.

After the implementation schedule has been adopted, it must be periodically subjected to economic analysis to ascertain whether the financial considerations upon which it is predicated remain reasonably on target.

The financial planning in support of the implementation schedule involves the strategies for obtaining capital financing and the identification and projection of current and future revenues to cover all or part of the cost of capital financing and airport operations.

2. **IMPLEMENTATION SCHEDULE.** The implementation schedule and cost estimates will evolve from technical and financial considerations. The technical considerations include the time it will take to acquire land, develop the engineering design and complete construction. This assumes all necessary approvals and prerequisites, such as the environ-

mental impact statement, have been completed. For a new airport there may be organizational activities required such as the enactment of enabling legislation.

The financial considerations which may affect the schedule relate to the availability and timing of capital financing. Federal and state aid may be limited, current indebtedness could delay early debt incurrence, or the financial market may not be suitable for debt financing. Therefore, there may be some adjustment in scheduling priorities. For example, a secondary priority obstacle clearance project may appear in the short-term capital improvement program in lieu of a higher priority runway extension due to short term financial limitations.

The participation of the airport operator in developing the implementation schedule is critical in that the operator, rather than the consultant, is able to ascertain and adjust priorities.

Schedules should be based on short (up to 5 year), intermediate (10 year) and long term (20 year) development requirements. Capacity oriented development which relates directly to demand levels should be scheduled at the occurrence of these demand thresholds rather than at a specific point in time. This would not normally apply to the near term improvements where forecasts are likely to be met.

The long-range plan identifies the ultimate role of the airport, airport design type and the concept for accommodating ultimate facility requirements. The intermediate-range plan is a more detailed description for sizing airport requirements and layout. The short-term plan is an immediate action program which recognizes realistic local, state and federal funding levels. The immediate action program should be a useful document for FAA's AIP program formulation and should not overlook such items as pavement rehabilitation, obstruction removal, safety areas and other items.

The master plan should include a drawing, or drawings, showing the development phases (see Figures 10-1, 10-2, 10-3) which in turn should be keyed to a schedule and descriptive narrative (see Tables 10-1, 10-2, 10-3). For the low activity airports with an uncomplicated development schedule, it may suffice to display the development phases on the airport layout plan.

Total development costs should be shown in constant dollars. Costs should include a percentage for engineering, inspection, legal and administration and a percentage for contingencies. Land acquisition should include relocation, legal and any other relevant costs. If costs are to be financed with revenue bonds, they should be grouped by functional area, insofar as possible, to facilitate cost allocations for financial planning.

3. **FINANCIAL PLAN.** The financial plan in support of the implementation schedule will vary, according to the type and activity level of the airport and its ability to generate revenue.

Low activity commercial service airports and general aviation airports historically have operated without operating revenue surplus. Thus, without sufficient revenue to support both operations and capital improvement programs, the municipalities must rely on Federal and State assistance with the local share derived from municipal operating funds or general obligation bonds.

Master planning for the low activity airport should recognize the dependence on Federal and state aid for improvements but should not place reliance on availability. Instead, optional financial plans should be considered which propose alternative strategies for developing financing. The master plan should discuss realistically the investment requirements and the cost effectiveness and benefits that may result from the proposed development so that the airport operator can make practical decisions predicated on availability of funds and community public investment priorities.

AC 150/5300-4B, "Utility Airports - Air Access to National Transportation," provides some useful information regarding financial considerations for low activity general aviation airports.

On the other end of the scale, the high activity commercial service airports usually generate sufficient revenue to support revenue bond financing for capital improvements. The requirement to supplement bond financing with Federal aid will vary in degree, usually in relation to activity levels.

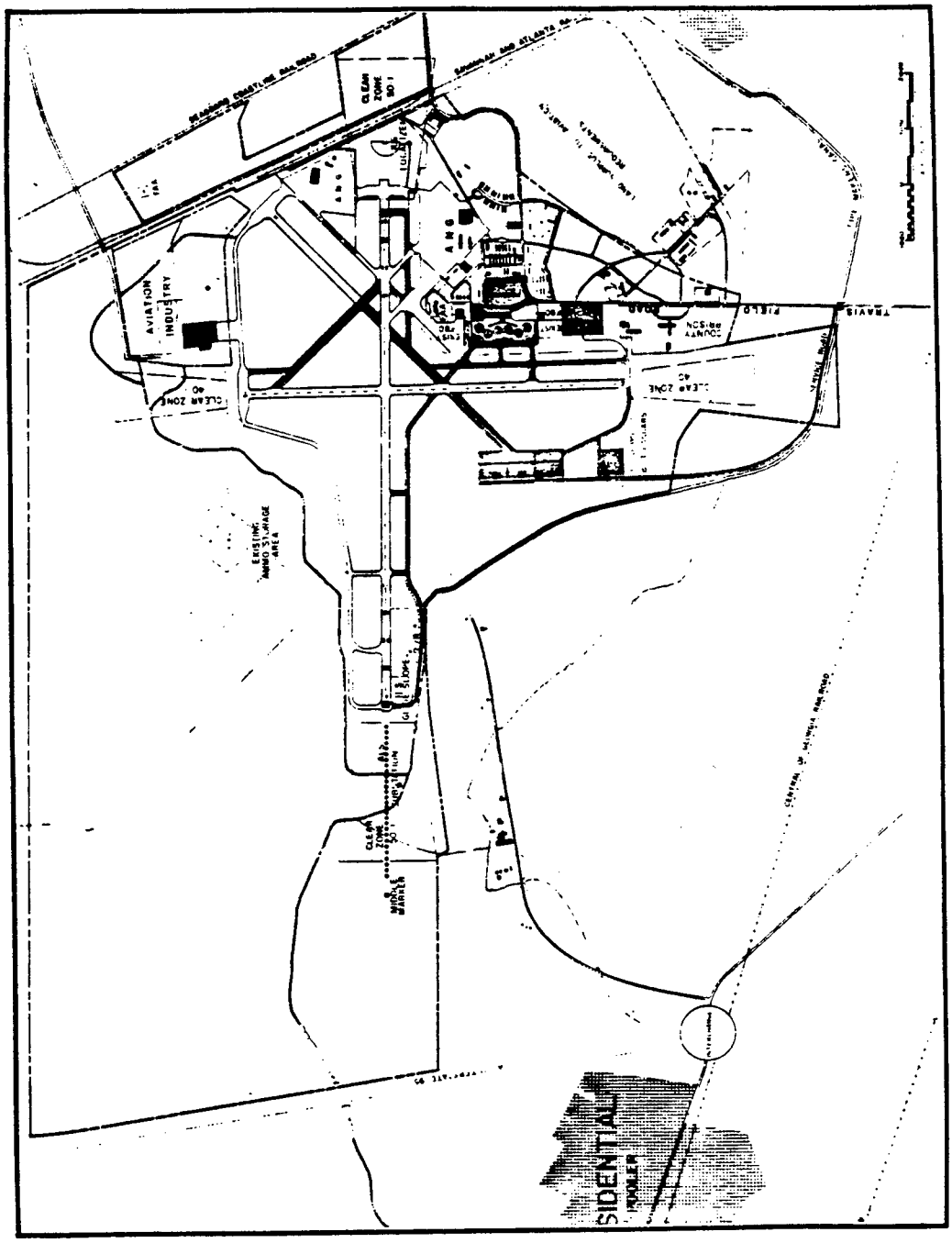


FIGURE 10-1. FIRST STAGE DEVELOPMENT

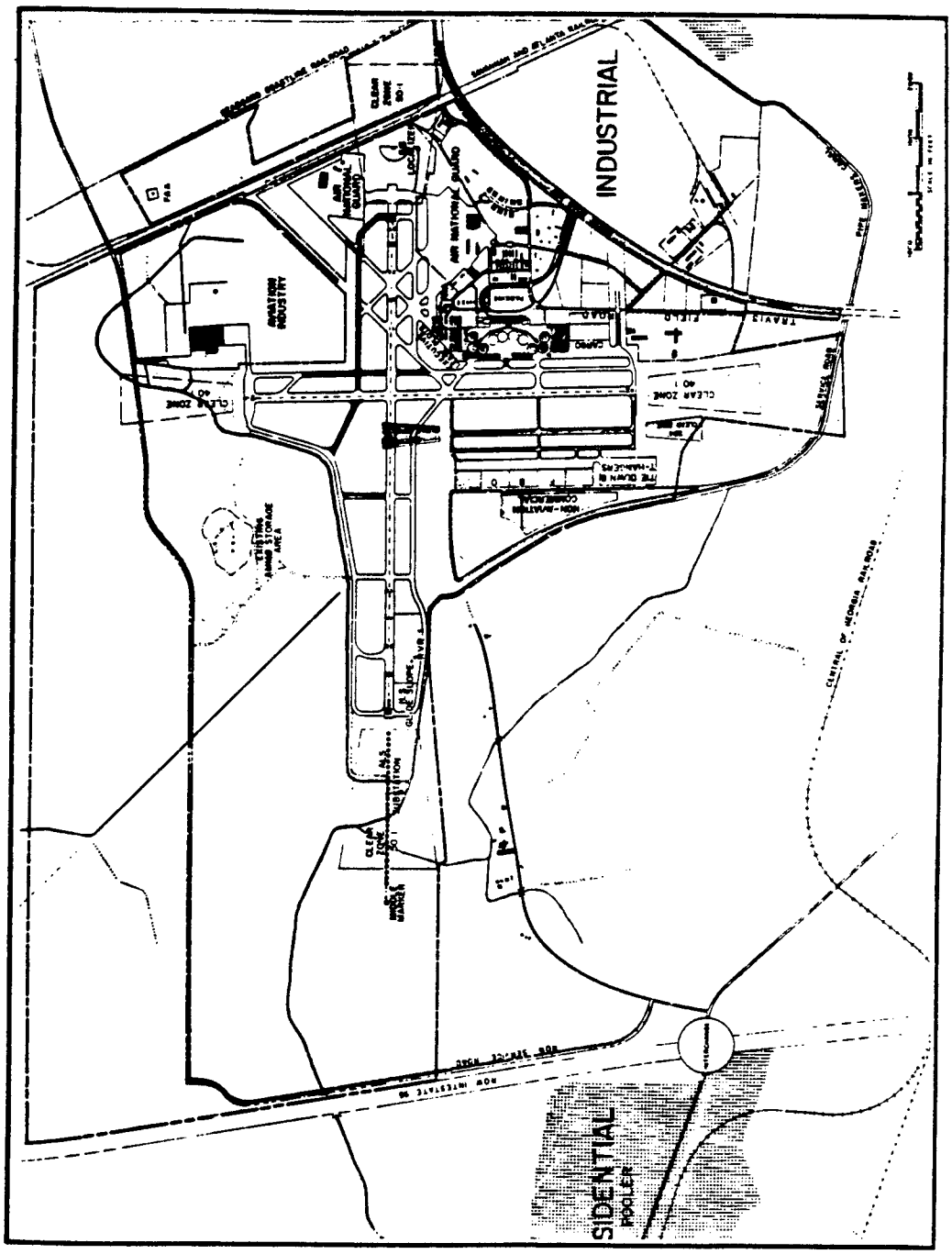


FIGURE 10-2. SECOND STAGE DEVELOPMENT

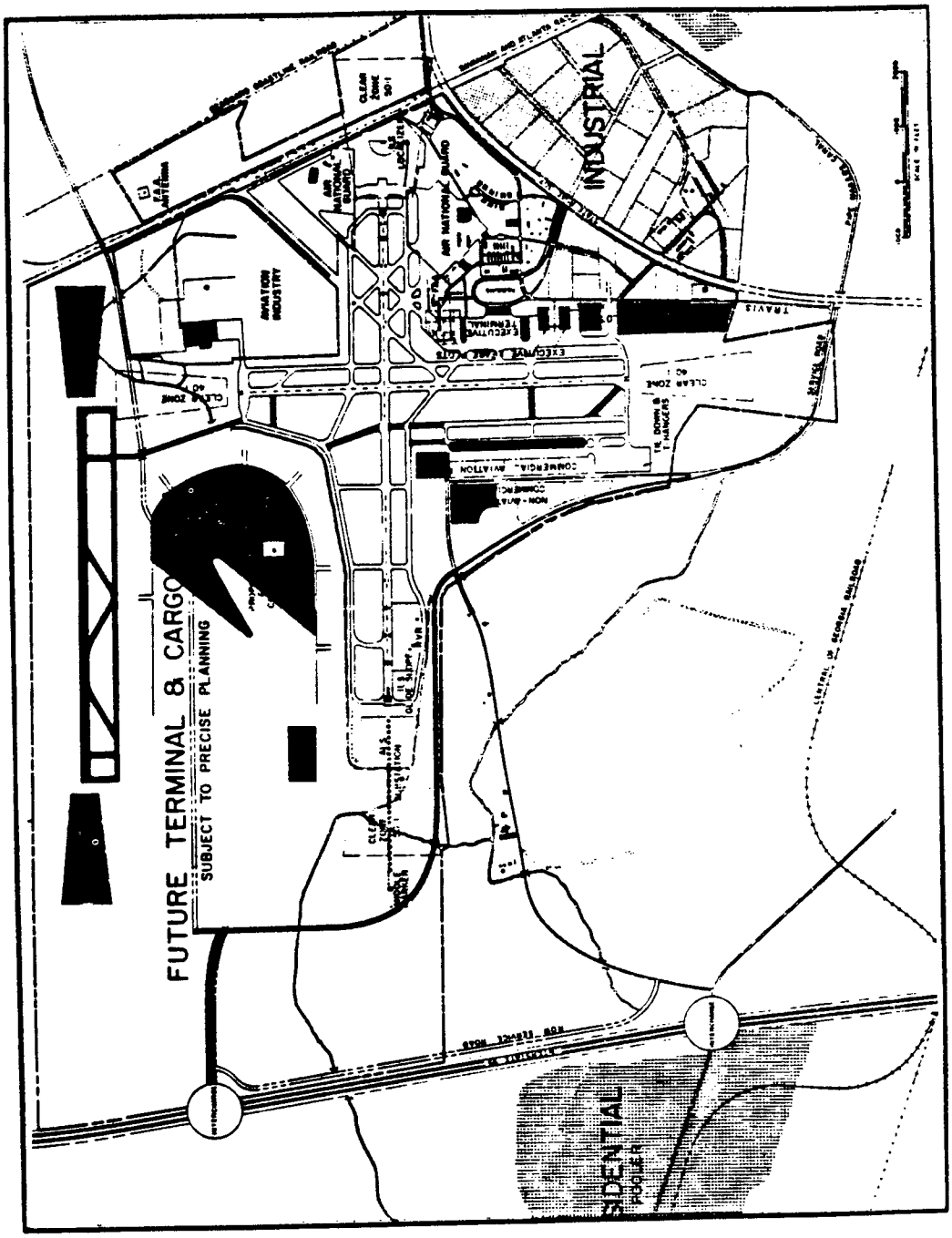


FIGURE 10-3. THIRD STAGE DEVELOPMENT

TABLE 10-1 - First stage preliminary project cost estimate* (1985-1989)

	1985	1986	1987	1988	1989	Total Costs
Paving						
Airfield: (includes lights						
Runway			460,000	568,000		1,028,000
Taxiways			575,000	600,000	429,000	1,604,000
Aprons			205,000	197,000		402,000
Roads:						
Terminal and service			236,000	236,000		472,000
Parking lot		120,000				120,000
Buildings						
Expansion of existing terminal		374,000	656,000	1,140,000	463,000	2,633,000
Relocation						
Fixed base operator		204,000	253,000			457,000
National Guard		105,000				105,000
Airport maintenance	87,000					87,000
Miscellaneous						
Electrical			40,000	120,000	125,000	285,000
Utilities					128,000	128,000
Drainage			86,000			86,000
Fencing					31,000	31,000
Site preparation	137,000	220,000	380,000			737,000
TOTAL	224,000	1.023,000	2,891,000	2,861,000	1,176,000	8,175,000

* Constant Dollars including 20% for engineering, legal, administrative and 10% contingencies

TABLE 10-2 - Second stage preliminary project cost estimate* (1990-1994)

Paving	
Airfield: (includes lights)	
Runways	$ 240,000
Taxiways	950,000
Aprons	378,000
Roads:	
Terminal and service	365,000
Buildings	
Expansion of existing terminal	787,000
Relocation	
National Guard	225,000
Miscellaneous	
Electrical	65,000
Drainage	45,000
Site preparation	$ 292,000
TOTAL	$ 3,347,000

Note: Develop 18R-36L, including taxiways, aprons to serve annual level of 200,000 operations.

TABLE 10-3 - Third stage preliminary project cost estimate* (1995+)

Paving	
Airfield: (includes lights)	
Runways	$ 2,798,000
Taxiways	2,240,000
Aprons	1,980,000
Roads:	
Terminal and service	1,550,000
Parking lot	302,000
Buildings	
New Terminal	12,737,000
Fire/crash	298,000
Airport maintenance	340,000
Miscellaneous	
Electrical	202,000
Utilities	475,000
Drainage	375,000
Landscaping	402,000
Fencing	86,000
Site preparation	1,204,000
TOTAL	$ 24,989,000

Note: Develop new runway 9L-27R and North terminal complex to serve total annual passenger level of 2,500,000.

*In constant (1984) dollars, adjusted for 20% engineering, legal, administrative and 10% contingencies.

Because the high activity commercial service airports are self-sufficient, the offsetting of costs with revenues is figured on a break even basis with costs allocated to revenue producing areas and a balance achieved through revenue or cost adjustments.

a. *Cost allocation.* For the high activity commercial service airport, where revenue bond financing instruments are applicable, it is necessary to assure that the individual components of the airport are generating an appropriate portion of the revenue. Therefore, the airport is divided into cost centers to allow allocation of costs following generally acceptable cost accounting principles. Of course, if there is current capital indebtedness, new costs are added on to them. Capital costs for non-revenue areas must be allocated to various operations based on a logical relationship to service requirements.

Projected expenses for operations (including maintenance and administration) should be developed for each cost center based on unit costs for direct expenses. For non-revenue areas these expenses must be distributed to various airport operations.

These cost allocation procedures would not necessarily be productive for airports with low overall operating revenues.

b. *Financing mechanisms.* There are many ways in which financing of airport development can be accomplished. Financing may flow directly from the municipal operating budget, or through bank loans, general obligation and revenue bonds, nonprofit corporation bonding, industrial development bonds, private financing, Federal and state aid, or a combination of these.

(1) *General obligation bonds,* backed by the municipality's creditworthiness and taxing power, have been the most common funding mechanism. They usually bear relatively low interest rates, possibly 1 to 1.5 percent lower than revenue bonds, because of their high degree of security. However, as a municipality's overall debt is limited by state law, competition from other community financing requirements could preclude availability for an airport project. In some states, there is an allowance to the debt limitation rule for general obligation bonds which are for a revenue producing enterprise. The general obligation bond is sold in the open market, usually by banks.

(2) *Revenue bonds assume* payoff on the basis of revenues from the particular facility being constructed. This type of financing instrument is popular because it does not burden the taxpayer. However, its use is limited to those airports with sufficient operating surplus to cover their debt servicing. Projected revenues must exceed debt service requirements by as high as 2 to 1. Interest rates may be dependent on the ratio, but in any case will be higher than general obligation bonds. Interest rates can be favorably affected by airline backing by which the airlines guarantee that landing fees and space rentals will be sufficient to cover debt service, even if adjustments are required.

(3) *Non-profit corporation bonding* is backed by special use taxes. In some instances the law provides for the formation of non-profit corporations for financing improvements, with the improvements reverting to the local government agency when the bonds are retired. This method of funding can be used for such facilities as maintenance hangars and air cargo terminals. Interest rates usually are lower than for revenue bonds.

(4) *Industrial development authority bonds* can be issued and underwritten by a corporation locating at an airport.

(5) *Private financing* of facilities such as hangars, hotels, fuel distribution systems and, possibly, terminals on land leased from the airport relieves the municipality of responsibility for raising capital. Creative financing of airport landside facilities, based on favorable tax implications, may prove to be an interesting alternative.

The Airport Operators Council International (AOCI) may prove a helpful source for information on financing trends at air carrier airports.

c. *Revenue sources.* For the high activity commercial service airports with operating surplus, the sum of operating and debt service expenses should establish a break-even revenue requirement for each cost center and for the airport as a whole. Revenues are projected based on current fee schedules and anticipated activity changes with adjustments made in fee schedules and leases based on break-even revenue requirements.

For the lower activity airports with no operating surplus, it will not be possible to balance operating revenues with debt service and operating costs. There should be an attempt, however, to improve the revenue situation by a comprehensive review and possible realignment of revenue arrangements, such as leases. A goal should be to relieve the municipal operating budget as much as possible from airport related expenses.

Revenue producing areas are listed for a typical high activity commercial service airport. Many of these revenue producing facilities would not be applicable to a low activity airport. Of interest is that about one-third of an air carrier airports' revenue comes from the landing area, including aircraft parking and aprons. However, for the low activity general aviation airport where landing fees are usually not assessed, landing area revenues, primarily from fuel flowage charges, account for less than 20 percent of the airport revenue. Building and ground rentals form the principal sources of revenue.

(1) *Landing Area.* This area includes runways and related taxiways and circulation taxiways. Landing fee revenues are collected from among scheduled airlines, other commercial service users, and general aviation. Landing fees should provide sufficient revenues to cover the landing area break-even need if cost allocation procedures are used.

(2) *Aircraft Aprons and Parking Areas.* Fees for the use of airline terminal aprons and cargo aprons are assigned to the scheduled airlines. Fees for the use of general aviation ramps are assigned to private aircraft. The fees are established to provide sufficient revenues to cover the break-even needs for specific aircraft aprons and parking areas.

(3) *Airline Terminal Buildings.* Revenues from concessionaires and ground transportation services are usually based on a percentage of gross income with a fixed-rate minimum for each type of service. Space for scheduled airlines and other users is paid for on a fixed rental. In order to establish rental rates, forecasts of potential revenue from concessions and ground transportation must be established. Rental rates are based on the break-even need of the terminal building, after giving credit for forecasted revenues from concessions and ground transportation services.

(4) *Public Parking Areas.* Public parking is usually operated on a concessionaire basis with revenues obtained from rentals based on a percentage of gross income with a fixed-rate minimum. The revenue amount required to meet break-even needs will depend on whether parking facilities are constructed by the airport owner or under provisions of the concessionaire contract. These revenues apply to public parking for both airline and general aviation terminals. Revenues in excess of the break-even need for public parking are allocated to the break-even need for the airport as a whole.

(5) *Cargo Buildings.* Rentals are usually charged on a rate per square foot and cover investments in employee parking, truck unloading docks, as well as building space. Rates are established to meet break-even needs.

(6) *Aviation Fuel.* Fees charged to aviation fuel handling concessionaires cover the costs of fuel storage areas and associated pumping, piping, and hydrant systems.

(7) *Hangars.* Rentals are usually based on a rate per square foot and cover investments in associated aircraft apron space and hangar related employee parking. Hangar office space is charged on a similar basis and covers office related employee parking.

(8) *Commercial Facilities.* Airport office buildings, industrial facilities, and hotels are usually operated on a lessee-management basis with revenues obtained from rentals on a square foot basis. The facilities are often financed by private capital. Revenues in excess of the break-even need are allocated to the break-even need of the airport as a whole.

(9) *Other Usable Areas.* Various uses of ground space for activities such as gasoline stations, service facilities for rental car operators, and bus and limousine operators usually obtain revenues on a flat rate basis. Those facilities are often financed by private capital. Revenues in excess of the break-even need are allocated to the break-even need of the airport as a whole.

4. **FINANCIAL FEASIBILITY AND ECONOMIC ANALYSIS.** The general tests of financial feasibility applied at the outset and throughout the planning process measure the ability of the airport operator

to cover the potential costs of alternative development concepts and schedules.

The ability to support development costs is based on the likelihood of obtaining Federal and state aid, the willingness to engage a financial instrument to generate a share of the costs and the amount of revenue attributable to airport operations.

a. For the high activity commercial service airports, the analysis of financial feasibility is straightforward. Applying the break-even concept, the revenue bond requirements can be balanced with readily projectable revenues to shape the development schedule. Periodic economic analysis of the development plan may require its adjustment if revenues and costs and Federal aid are not on track. Should the analysis show, for example, that the projects' cost effectiveness has changed then the scope or timing of the project may require adjustment.

b. For airports without sufficient revenues to support operations costs and provide adequate coverage for revenue bond financing of capital improvements, the Federal/state aid levels and public willingness to issue general obligation bonds are significant issues. The willingness of the community to support general obligation bond financing may be a critical issue. The argument that a general aviation airport is a public utility and a necessary element in the community's public service infrastructure with unquantifiable indirect benefits, may not be convincing. At least it will not be as convincing as the argument in support of an airport which provides scheduled service.

A traditional cost-benefit analysis may not necessarily provide the required measure of support because it may not withstand critical scrutiny due to the subjectivity and difficulty of quantification. However, a return on investment analysis which quantifies all sources of revenue such as tax accruals from net property and sales tax may prove useful in showing a point during the period of debt service when total revenues begin to exceed total outlays. For the low activity airport this point may not occur early and total costs over the debt service period may exceed revenues, even with a maximum of Federal and state aid. Nevertheless, a more acceptable balancing of costs and revenues than anticipated may be demonstrated.

For the high activity general aviation airport, such as a reliever, the return on investment analysis may show that total revenues (including sales and net property taxes) do exceed costs for the debt service period, even with less than maximum Federal and state aid. Of course, reliever airports have the added economic benefit of reducing the marginal capacity costs at the busy commercial service airports.

c. In performing return on investment analysis one should not be bound to consider the Federal and state funds as investments requiring revenue coverage. The purpose of the governmental assistance programs is to meet overall system needs where it has been determined that such needs cannot be achieved through local revenue sources alone. Instead, the individual airports share in the revenues (user taxes) collected at the national and state levels.

APPENDIX 1 BIBLIOGRAPHY

1. The latest issuance of the following AC's may be obtained from the Department of Transportation, Publications Section, M-442.32, Washington, D.C. 20590. AC 00-2, updated tri-annually, contains the listing of all current issuances of these AC's and changes thereto.

a. 150/5300-2D, Airport Design Standards-Site Requirements for Terminal Navigational Facilities. Provides information regarding the relative location and siting requirements for the terminal navigation facilities located on or close to an airport.

b. 150/5300-4B, Utility Airports—Air Access to National Transportation. Establishes design standards for utility airports which are constructed for and intended to be used by airplanes with approach speeds of less than 121 knots.

c. 150/5300-12, Airport Design Standards, Transport Airports. Provides recommended design criteria for the development of larger than utility airports.

d. 150/5325-5, Aircraft Data. Presents a listing of aircraft and data pertinent to airport design.

e. 150/5325-3, Background Information on Aircraft Performance Curves for Large Airplanes. Gives background infor mation on performance curves to assist in interpretation.

f. 150/5325-4, Runway Length Requirements for Airport Design. Give performance curves and standards for determining runway lengths for design and planning.

g. 150/5390-1C, Heliport Design Guide. Contains general and technical information pertaining to the establishment or improvement of heliports.

h. 150/5060-5, Airport Capacity and Delay. Explains how to compute airport capacity and aircraft delay for airport planning and design.

i. 150/5360-7A, Planning and Design Guidelines for Airport Terminal Facilities. Consolidates existing FAA guidance on the subject.

j. 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-hub Locations. Provides guidance material for terminal facilities at low activity airports.

k. 150/5190-4, a Model Zoning Ordinance to Limit Height of Objects Around Airports. Provides guidance in controlling heights of objects around airports.

l. 150/5020-1, Noise Control and Compatibility Planning for Airports. Provides guidance for airports under FAR-Part 150 and the Aviation Safety and Noise Abatement Act of 1979.

m. Airport Environmental Handbook (Order 5050.4). Contains information needed to meet procedural and substantive environmental requirements for airport related actions. (This is the text of Appendix 6 of FAA Order 1050.1C, Policies and Procedures for Considering Environmental Impacts, which covers the broad range of FAA programs.)

n. 150/5100-14, Architectural, Engineering and Planning Consultant Services for Airport Grant Projects. Provides guidance for airport sponsors in the selection and employment of architectural, engineering and planning consultants.

o. United States Standards for Terminal Instrument Procedures (TERPS), Order 8260.3B. Contains criteria for instrument approach and departure procedures.

p. 90-66, Recommended Standard Traffic Patterns for Airplane Operations at Uncontrolled Airports. Explains regulatory requirements for airplane operations at uncontrolled airports, including traffic patterns.

q. 70-2D, Airspace Utilization Considerations in the Proposed Construction, Alteration, Activation and Deactivation of Airports. Advises on notification requirements and some of the airspace utilization factors which should be considered in plans for construction, alteration, activtion and deactivation of civil and joint use airports.

r. 70/7460-2G, Proposed Construction or Alteration of Objects that may Affect the Navigable Airspace. Advises of notification requirements.

s. 150/5395-1, Seaplane Bases. Contains guidance pertaining to the establishment or improvement of seaplane bases.

2. The following Government reports are for sale and may be obtained from the National Technical Information Service (NTIS), Springfield, Virginia 22151. The number in brackets following the report title represents the NTIS ordering number.

a. FAA-RD-73-82, The Apron-Terminal Complex (AD-771 186).

b. FAA-RD-75-191, The Apron and Terminal Building Planning Report (AD-A018 120).

c. FAA A5-75-1, Developing Noise Exposure Contours for General Aviation Airports.

d. FAA-EE-82-21, Air Quality Procedures for Civilian Airports and Air Force Bases.

e. Access to Commercial Service Airports, contract DTFA 01-83-D 88004.

f. Airfield Delay Simulation Model (ADSIM) User's Guide DOT/FAA/PM-84/2.

g. FAA-APO-85-7, Statistical Sampling of Aircraft Operations at Non Towered Airports.

3. The following publications are available from the U.S. Government Printing Office, Washington, D.C.

a. U.S. Department of Transportation, Federal Aviation Administration, Office of Aviation Policy and Plans, *Aircraft Operations Sampling Handbook* (1984).

b. *FAA Aviation Forecasts* (annually).

c. *FAA Terminal Area Forecasts* (annually).

d. Federal Aviation Regulation, Part 150, Airport Noise Compatibility Planning, January 1981.

e. Airport System Development, Office of Technology Assessment (U.S. Government Printing Office, Wash. D.C. 20402 Stock No. 052-003-00957-9).

4. The following publications are available as noted below.

a. Airports — U.S.A. and Preclearance, Facilities Guidelines for Federal Inspection Services. This document is free and can be ordered from the U.S. Customs Service, 1301 Constitution Avenue, N.W., Washington, D.C. 20229.

b. Airline Aircraft Gates and Passenger Terminal Space Approximations. Available from the Air Transport Association of America, 1079 New York Avenue, N.W., Washington, D.C. 20006.

c. Airport Terminals Reference Manual. Available from the International Air Transport Association, P.O. Box 550, 1000 Sherbrooke Street West, Montreal, Quebec, Canada H3A 2R4.

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k. Economic Benefits and Financing of General Aviation Airports (Transportation Research Board Circular 259, 1983; TRB 2101 Constitution Ave., N.W., Washington, D.C. 20418)

l. deNeufville, Dr. Richard, Air Cargo in the 1980's and Beyond (Transportation Systems Center Contract DTRS-57-83-C-00065)

m. Norman Ashford & Paul Wright, Airport Engineering (John Wiley & Son)

5. ICAO Documents - Available from ICAO, Attn: Distribution Officer, P.O. BOx 400, Place de l'Aviation internationial, 100 Sherbrooke St. West, Montreal, Quebec, Canada, H3A-2R2.

a. Annex 14 - Aerodromes

b. Annex 16 - Environmental Protection

c. Construction of Visual and Instrument Flight Procedures (PANS-OPS)

d. Airport Planning Manual

Part 1 - Master Planning

Part 2- Land Use and Environmental Control

e. Stolport Manual

AIRPORT MASTER PLANNING QUESTIONNAIRE

AIRPORT _____ DATE _____
AIRLINE _____ PREPARED BY _____
ADDRESS _____ PHONE _____
_____ _____
_____ _____
_____ _____

A. FORECAST OF PASSENGER ACTIVITY

	Base Year 19 __	FORECAST 5 Year 19 __	10 Year 19 __	20 Year 19____
1. PASSENGER ENPLANEMENTS				
• Annual				
• Average Day - Peak Month (AD - PM)				
• Peak Hour (AD - PM)				
2. PASSENGER DEPLANEMENTS				
• Peak Hour (AD-PM)				
3. OTHER				
• Percent of Transfer Passengers				
• 19 __ Peak Month is ____				
• Time of Day for Peak Hour Enplanements ____ and Deplanements ____				

B. FORECAST OF AIRCRAFT DEPARTURES

	Base Year 19 __	FORECAST 5 Year 19 __	10 Year 19 __	20 Year 19____
1. AVERAGE DAY - PEAK MONTH (By Type of Aircraft)				
_____				
_____				
_____				
_____				
TOTAL				
2. PEAK HOUR (AD-PM) (By Type of Aircraft)				
_____				
_____				
TOTAL				

C. FORECAST OF REQUIRED AIRCRAFT PARKING POSITIONS (GATES)

		FORECAST		
	Base Year 19 __	5 Year 19 __	10 Year 19 __	20 Year 19____
TYPE OF AIRCRAFT AND PARKING METHOD (POWER OUT, POWER BACK OR PUSH BACK)				
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
NUMBER OF OVERNIGHT PARKING POSITIONS	_____	_____	_____	_____

D. FORECAST OF PASSENGER TERMINAL BUILDING FACILITIES

		FORECAST		
	Base Year 19 __	5 Year 19 __	10 Year 19 __	20 Year 19____
1. ATO COUNTER - L.F.	_____	_____	_____	_____
2. ATO OFFICES (INCL. COUNTER AREA) S.F.	_____	_____	_____	_____
3. OPERATIONS OFFICES - S.F.	_____	_____	_____	_____
4. BAGGABE MAKE-UP - S.F.	_____	_____	_____	_____
5. BAGGAGE CLAIM (MOVING) DEVICE - L.F.	_____	_____	_____	_____
6. DEPARTURE LOUNGES NUMBER/ AREA - S.F.	_____	_____	_____	_____
7. OTHERS (DESCRIBE)	_____	_____	_____	_____

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8. ANY REMARKS INCLUDING LOCATION OF ABOVE FACILITIES (MAIN TERMINAL, CONCOURSES, ETC.)

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