California Airport Land Use Planning Handbook

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Division of Aeronautics

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Guidance for Airport Land Use Compatibility Planning

INTRODUCTION

This *California Airport Land Use Planning Handbook* is published by the California Department of Transportation Division of Aeronautics. Its purpose is to support and amplify the article of the State Aeronautics Act (California Public Utilities Code, Section 21670 et seq.) which establishes statewide requirements for the conduct of airport land use compatibility planning. The *Handbook* provides compatibility planning guidance to airport land use commissions (ALUCs), their staffs and consultants, the counties and cities having jurisdiction over airport area land uses, and airport proprietors.

This volume represents the third edition of the *Handbook*. Although similar in overall organization to the previous edition published in 1993, this 2002 edition has been thoroughly revised. New material is presented on a variety of subjects. Most important, though, is a change in the overall tone of the document. The 1993 *Handbook* emphasized the concepts and processes involved in airport land use compatibility planning. The views expressed were characterized as only "suggestions and recommendations." Moreover, those views—while consistent with those of the Division of Aeronautics—were primarily the consultant's.

The status of the *Handbook* changed in 1994, however. Legislation passed in that year established a requirement that airport land use commissions "shall be guided by information" in the *Handbook* (or any future updates) when formulating, adopting, or amending an airport land use compatibility plan. Consequently, this 2002 edition is much more definitive in the guidance it provides and this guidance is expressly that of the Division of Aeronautics. *However, despite the statutory references to it, the* Handbook *does not constitute formal state policy or regulation.*

This summary section provides guidance on a variety of key issues and indicates the locations in the document where additional discussion can be found. Other guidance is contained in various checklists, tables, and figures

DEPT. OF TRANSPORTATION GUIDANCE
Throughout this document, Division of Aeronautics guidance deserving of special emphasis is indicated in sidebars marked with the California Department of Transportation logo as shown here.

located elsewhere in the document. These latter features have been added in order to make the *Handbook* more readily usable by all of its audiences.

One final introductory note of importance is to acknowledge the role of the Handbook Advisory Committee in preparation of this edition of the *Handbook*. Over the duration of the project, the committee met in Sacramento on numerous occasions. Committee members discussed the many major issues associated with airport land use compatibility planning and also reviewed and commented on drafts of this document. Their participation has been invaluable and greatly appreciated.

DOCUMENT ORGANIZATION

Following this summary section, the *Handbook* contents are organized into three parts:

➤ **Part I: ALUC Procedures and Plans**—This part begins with an examination of how airport land use commissions are structured and function. General factors to be considered and specific guidance to be followed in preparing airport land use compatibility plans and in formulating compatibility policies are discussed in the next two chapters. Chapter 4 outlines the process which ALUCs should follow in reviewing individual land use proposals. The final chapter in Part I addresses the important responsibilities which local agencies have in promoting airport land use compatibility. All of the chapters include extensive references to the applicable sections of state law.

➤ **Part II: Airport Land Use Compatibility Issues**—The four chapters in Part II provide detailed assessments of the noise and safety components of airport land use compatibility planning. Chapters 6 and 8 contain background data and other information regarding measurement of noise and the characteristics of aircraft accidents. Chapters 7 and 9 focus on development of noise and safety compatibility policies. After describing existing policy foundations and basic compatibility concepts, specific guidance is offered on establishment of appropriate noise and safety compatibility criteria.

➤ **Part III: Appendices**—The appendices contain various supporting and reference materials. Copies of state statutes are included, as is a glossary of airport land use compatibility planning terms. Also in the appendices are sample implementation documents for use by ALUCs and affected local jurisdictions.

GENERAL GUIDANCE

For further details, refer to the following statutes and pages of this *Handbook*:

Use of this *Handbook*

➤ **How should the "be guided by" requirement of the Aeronautics Act be interpreted?**

To be guided by this *Handbook* in the preparation or modification of airport land use compatibility plans, ALUCs must at least have examined and duly considered the material contained herein. Furthermore, the burden is presumed to be on ALUCs to demonstrate their reasons for deviating greatly from the guidance which this *Handbook* provides. These requirements notwithstanding, ALUCs have a significant degree of flexibility to make planning decisions as they deem appropriate for the airports within their jurisdictions. The *Handbook* is not regulatory in nature and does not take precedence over locally adopted compatibility plans. When in doubt regarding the *Handbook* guidance, ALUCs are encouraged to contact Division of Aeronautics staff directly. Also, where interpretation of the law is involved, ALUCs should consult with their own legal counsel.

Public Utilities Code (PUC), Section 21674.7

➤ **Are ALUCs required to modify their compatibility plans to reflect the guidance provided by this Handbook?**

ALUCs are not required to amend their compatibility plans in response to this *Handbook*. Nevertheless, ALUCs are encouraged to review and, when appropriate, to update their compatibility plans at least every five years and publication of this *Handbook* is a good justification for doing so. More frequent reviews may be appropriate for airports or communities where conditions are changing rapidly (amendments can be made no more than once per calendar year, however).

PUC Section 21675(a)

➤ **What is the role of the Handbook with respect to preparation of environmental documents under the California Environmental Quality Act (CEQA)?**

Legislation passed in 1994 requires that, when preparing an environmental impact report for any project situated within an airport influence area as defined in an ALUC compatibility plan (or, if a compatibility plan has not been adopted, within two nautical miles of a public-use airport), lead agencies shall utilize the *Handbook* as a technical resource with respect to airport noise and safety compatibility issues.

Public Resources Code, Section 21096

Formation of ALUCs

➤ **Are all counties required to have an ALUC?**

With limited exceptions, yes, although different formats are available. For example, a board or commission established for another purpose can be designated as the ALUC. The principal exceptions to formation of an ALUC require a county either to declare that it has no airport "noise, public safety, or land use issues" or to establish what is referred to as the "alternative process."

PUC Sections 21670(b), 21670.1(a), 21670.1(c)
Page 1-4

For further details, refer to the following statutes and pages of this *Handbook*:

PUC Section 21670.1(c)
Pages 1-8, 5-13

➤ **How can the alternative process be established?**

The specific requirements are set forth in the statutes. The Division of Aeronautics has the responsibility for reviewing and approving the particular methods which a county and each affected city in the county decide upon. Of particular importance are the methods to be used to implement the airport land use compatibility planning objectives of the law. The alternative process does not eliminate the requirements for counties and cities to engage in compatibility planning, it only eliminates the requirement to have an ALUC.

PUC Sections 21674(c), 21674(d), 21675(a)
Page 1-2

➤ **What are the basic duties of an ALUC?**

ALUCs have two specific duties:

- Preparation and adoption of airport land use compatibility plans; and
- Review of certain local agency land use actions and airport plans for consistency with the compatibility plan.

GUIDANCE FOR AIRPORT LAND USE COMMISSIONS

Procedural Matters

Page 1-14

➤ **What happens when the terms of office for ALUC members expire?**

The practice on many ALUCs is for members to continue to serve past the date when their terms expire. If this is the intent of the appointing body, it should be so stated when the appointment is made. Members should otherwise not continue to serve beyond the end of their terms. Doing so could call into question any decisions rendered by the commission during this period. It is therefore essential for the bodies responsible for appointment of members to the ALUC to fill any vacancies as quickly as possible.

PUC Section 21670(d)
Page 1-15

➤ **Are ALUC members required to appoint proxies?**

On standard, single-purpose ALUCs, each member is required to appoint a proxy. The law does not say whether this requirement extends to members of designated bodies which function as an ALUC.

Page 1-15

➤ **What constitutes a conflict of interest by an ALUC member?**

As with members of most public boards or commissions, an ALUC member who has a personal financial interest in an action under consideration by the commission is generally deemed to have a conflict of interest and should not participate as an ALUC member in the debate or decision making regarding that action. A legal conflict of interest does not result when an ALUC member also serves on another body which may also have responsibilities to act on a land use plan or development proposal.

Preparation and Adoption of Compatibility Plans

PUC Sections 21675(a), 21675(b)
Pages 2-4, 3-32

➤ **For which airports should compatibility plans be adopted?**

ALUCs are required to adopt a compatibility plan for each public-use airport in their jurisdiction. In instances where an airport's influence area crosses county boundaries, each ALUC should adopt a compatibility plan for its respective portion (alternatively, a separate intercounty ALUC can be set up with membership from each jurisdiction). Additionally, ALUCs have the option of adopting compatibility plans for military airfields and special-use airports and heliports (such as those at hospitals). A separate plan can be prepared for each airport in the ALUC's jurisdiction or multiple airport plans may be combined into a single countywide document.

For further details, refer to the following statutes and pages of this *Handbook*:

➤ **How does a compatibility plan relate to the master plan for the same airport?**

If a long-range master plan has been adopted by the airport proprietor, the compatibility plan must "be based on" that plan. This requirement means that the compatibility plan must be consistent with the expectations of the airport proprietor with respect to the future development and use of the airport. The compatibility plan should explicitly indicate the version of the master plan upon which it is based.

PUC Section 21675(a)
Page 2-5

➤ **What should be done if a master plan does not exist or is not current?**

In these circumstances, a current airport layout plan drawing can be used. ALUCs must obtain written approval from The Division of Aeronautics to use an airport layout plan for compatibility planning purposes. (Any ALUC which has used a layout plan as the basis for a compatibility plan without Division of Aeronautics approval is encouraged to obtain the approval and then readopt the plan for that airport.) If an official airport layout plan also does not exist or is not current, ALUCs may first need to prepare at least a simplified diagram of the existing airport configuration. No future improvements not formally adopted by the airport proprietor should be shown on this layout diagram.

PUC Section 21675(a)
Page 2-6

➤ **What time frame should a compatibility plan cover?**

A compatibility plan *must* have a planning horizon of at least 20 years, but *should* take a longer time perspective to the extent practical. This time frame often means that the forecasts indicated in an adopted master plan must be extended farther into the future. Any assumptions which ALUCs make regarding the future aircraft activity at an airport must be consistent with the role of the airport as identified in the master plan adopted by the airport proprietor. For busy airports in metropolitan areas, basing the compatibility plan on the airport capacity may be an appropriate assumption.

PUC Section 21675(a)
Pages 2-8, 7-18

➤ **What are the essential elements of a compatibility plan?**

Compatibility plans should:

- Clearly indicate the scope of the plan, geographically and in terms of authority and purpose;
- Describe information about the airport and airport plans which provide the basis for the compatibility plan;
- List compatibility policies and criteria;
- Include appropriate maps of the airport compatibility zones;
- Indicate the procedures to be used in conducting compatibility reviews; and

Checklist of Essential Elements: Table 2A, page 2-13
Checklist of Optional Elements: Table 2B, page 2-15

For further details, refer to the following statutes and pages of this *Handbook*:

- Provide an initial assessment of the consistency between general plans and other applicable ordinances and regulations adopted by counties and cities and the policies set forth in the compatibility plan.

Other information may be included on an optional basis.

➤ **Must ALUCs involve local jurisdictions in establishment of compatibility plan boundaries?**

PUC Section 21675(c)
Page 2-11

Before adopting new or revised planning area boundaries, ALUCs must consult with affected jurisdictions. Meetings with the staff of these jurisdictions may be insufficient to fulfill this requirement. Caution suggests that ALUCs afford elected officials of those jurisdictions the opportunity to meet jointly with the commission to discuss planning boundaries and other compatibility issues. This process need not be separate from actions necessary to adopt the compatibility plan itself. However, the intent to adopt new or revised planning boundaries should be specifically identified in public hearing notices and plan adoption resolutions.

➤ **What type of environmental document is required in conjunction with adoption or amendment of a compatibility plan?**

Page 2-16

Depending upon the circumstances, ALUCs have used a variety of different options to meet the requirements of the California Environmental Quality Act (CEQA). Legal opinion diverges greatly as to which option should be used and there is currently little case law. ALUCs are therefore strongly encouraged to consult their respective legal counsel when considering which CEQA action to take when adopting or amending compatibility plans.

➤ **What public notice is required with respect to adoption or amendment of a compatibility plan?**

PUC Section 21675.2(d)
Page 2-18

ALUCs should follow the same notice procedures as are applicable to adoption or amendment of general plans and specific plans.

Formulating Airport Land Use Compatibility Policies

➤ **What types of concerns should compatibility plans address?**

Page 3-1

Noise and safety are the two fundamental compatibility concerns identified in the statutes. In addressing noise concerns, consideration should also be given to the impacts of aircraft overflights in locations beyond the normally mapped noise contours. Safety compatibility policies should address both protection of people and property on the ground near airports and protection of airport airspace from obstructions and other hazards to flight.

➤ **How should compatibility policies for a particular airport be determined?**

Pages 3-2 through 3-8

Appropriate compatibility policies differ from airport to airport and community to community. No single solution is universally applicable. Nevertheless, common objectives and strategies can be identified, as can the factors which should be considered when setting airport-specific policies. These are outlined in the beginning of Chapter 3.

➤ **Do basic compatibility policy guidelines exist?**

Guidelines regarding establishment of airport noise and safety compatibility policies are provided in Chapters 7 and 9, respectively. A summary of suggested criteria is presented in Table S-1 of this summary section. Two points should be emphasized about this listing of guidelines:

- The criteria are written in general, qualitative (not precise, quantitative) terms. In effect, they are a criteria checklist rather than actual, airport-specific criteria. For use in a compatibility plan, the criteria need to be more fully defined to suit local circumstances. Also, the boundaries of the zones within which each criterion applies must be delineated with respect to the conditions at a specific airport.
- Secondly, even in their general form, these criteria provide only basic guidance—a starting point for the detailed analyses and examination of issues essential to creation of individual airport land use compatibility plans. *These criteria are not intended to be treated as state-mandated standards.*

For further details, refer to the following statutes and pages of this *Handbook*:

Suggested Compatibility Criteria: Table S-1, page Summary-8
Chapters 7, 9

➤ **How should compatibility policies be structured?**

Compatibility policies consist of two basic components: a set of criteria indicating the compatibility or incompatibility of various categories of land uses; and a map or maps showing where within the airport environs the criteria apply. Especially with respect to safety policies, formulation of criteria must be closely coordinated with delineation of compatibility zones. Beyond these basic requirements, several options are acceptable. For example, noise and safety compatibility criteria can be combined into one composite set of criteria and the compatibility maps drawn accordingly. Also, land uses can be categorized using a detailed list of land use types or by defining more functional or performance-oriented characteristics (such as people per acre as a basis for evaluating safety compatibility of nonresidential uses).

Pages 3-8 through 3-14

➤ **Should existing land uses be considered when establishing compatibility policies?**

ALUCs have no authority over existing land uses (more precisely, areas "already devoted to incompatible uses"). Compatibility planning boundaries, though, should cover all of an airport's influence area, including portions which are already developed. Existing development which is incompatible becomes a nonconforming use with respect to ALUC criteria. Any redevelopment of these areas would be subject to ALUC policies.

Pages 1-3, 3-17 through 3-21

Project Reviews

➤ **What factors should ALUCs examine when reviewing county and city general plans for consistency with the compatibility plan?**

ALUCs should carefully review not only the general plan itself, but also any associated ordinances and regulations which set forth implementation measures in greater detail. ALUCs should recognize that, once they concur that a county or city general plan is consistent with the compatibility plan, subsequent individual development proposals which are consistent with the general plan are not subject to mandatory ALUC review.

Page 4-16
General Plan Consistency Checklist: Table 5A, page 5-5

GENERAL GUIDANCE

For additional guidance see:
Page Summary-3

- ➤ This table provides basic guidance for establishment of airport land use compatibility zones and associated criteria. The general bounds of appropriate compatibility measures are outlined. However, unquestioning adherence to this guidance is neither intended nor expected—rather than being a state mandate, the guidance should be regarded as a starting point for development of policies best suited to individual airports and communities.

Page 3-9

- ➤ The following guidance separately addresses noise, overflight, safety, and airspace protection compatibility concerns. Some ALUCs establish zones and criteria representing combinations of these concerns. Separate and composite formats are both acceptable.

NOISE

Basis for Compatibility Zone Delineation

Pages 3-2, 6-22

- ➤ Compatibility zones normally utilize Community Noise Equivalent Level (CNEL) contours created with FAA Integrated Noise Model (INM) or, for military airports, U.S. Air Force NOISEMAP model.

Page 7-18

- ➤ Compatibility plans should be based upon the noise contours for the time frame that results in the greatest noise impacts. Usually, this time frame is the long-range future (at least 20 years), but sometimes can be the present or a combination of the two. Also, for busy airports, the capacity of the runway system may be the best representation of potential long-range future activity levels.

Pages 7-19, 7-30

- ➤ Noise contours usually represent an average day of the year. For airports with distinct seasonal or even daily variations in activity, analysis of additional scenarios may be appropriate.

Page 6-30

- ➤ Because of the many variables and assumptions involved in noise contour calculation, particularly projected contours, their precision typically is in the range of ±1 dB to ±3 dB. Precision diminishes with increased distance from the runways.

Suggested Compatibility Criteria

Pages 3-3, 7-23
Normalization Factors:
Table 7B, page 7-26
Noise Criteria Options:
Table 7C, page 7-29

- ➤ The noise level considered acceptable for new development varies from one community to another. Noise criteria therefore need to be adjusted or normalized to reflect the characteristics of a particular community.
  - ▪ CNEL 65 dB is not an appropriate criterion for new residential development around most airports, especially those which are primarily general aviation facilities.
  - ▪ CNEL 60 dB, or in some locations, even CNEL 55 dB may be more appropriate for land use planning purposes.

Pages 7-7, 7-34

- ➤ For residences, the standard for interior noise levels due to exterior noise sources should be CNEL 45 dB or lower.

Page 7-35

- ➤ Sound insulation should not be regarded as a mitigation measure which allows noise-sensitive land uses to be developed in areas of high noise exposure—it is not a substitute for good land use compatibility planning. Nevertheless, in some circumstances—infill or redevelopment, for example—new construction may be unavoidable in areas where noise exposure is high.
  - ▪ The need for sound insulation of new structures should be evaluated wherever exterior noise levels exceed CNEL 60 dB.
  - ▪ In any situation where sound insulation is required as a condition for development approval, ALUCs should require that an avigation easement be dedicated to the airport proprietor.
  - ▪ In no case should residential or other noise-sensitive land uses be approved within an airport's current or future CNEL 65 dB contour unless an avigation easement addressing noise impacts is dedicated to the airport proprietor.

TABLE S-1

Summary of Suggested Compatibility Criteria

For additional guidance see:

OVERFLIGHT

Basis for Compatibility Zone Delineation

Pages 3-3, 7-34

- ➤ The area of concern encompasses locations where frequent aircraft overflights can result in annoyance and complaints on the part of some residents.
  - At general aviation airports, these locations include areas beneath the standard traffic patterns, portions of the pattern entry and departure routes flown at traffic pattern altitude, and sometimes additional places which experience a high concentration of overflights. Airspace protection surfaces defined in accordance with FAR Part 77 provide a useful starting point for delineating an overflight zone.
  - At all airports, common instrument arrival and departure routes should also be considered when establishing an overflight zone.

Suggested Compatibility Criteria

Pages 3-25, 7-38

- ➤ Measures which alert prospective property buyers to the existence of overflight impacts are appropriate for all parts of the airport influence area.

Page 3-25

- ➤ Recording of deed notices describing airport impacts should be required as a condition for development approval anywhere in the airport influence area where avigation easements are not obtained.

Page 3-26

- ➤ ALUCs are encouraged to adopt policies defining the area within which information regarding airport noise impacts should be disclosed as part of real estate transactions.

Page 3-25

- ➤ Avigation easements also serve a buyer awareness function. However, requirements for their dedication as a condition for development approval should be limited to locations where high noise levels exist or are projected to occur and/or the heights of objects need to be significantly restricted.

SAFETY

Basis for Compatibility Zone Delineation

General aviation aircraft accident database: Appendix F
Air carrier accidents: Figure 8D, page 8-11

- ➤ The historical spatial distribution of aircraft accidents for various categories of runways is the primary basis for delineation of safety compatibility zones. The spatial distribution indicates where accidents are most likely to occur when they occur.

Page 9-29
Safety Compatibility Zone Examples: Figures 9K, 9L, pages 9-38, 39, 40
Adjustment Factors: Table 9A, page 9-41

- ➤ Safety compatibility zones must take into account the type of aircraft usage, flight procedures, and other operational characteristics particular to each runway end. The examples provided in Chapter 9 are a starting point for this process. In many cases, a combination of the shapes and sizes from different examples may be appropriate.

Page 9-37

- ➤ Adjustment of safety compatibility zones in response to existing urban development patterns may be reasonable in locations where safety concerns are moderate to low. However, care must be taken in making adjustments in critical locations close to runway ends—it is better for existing development to be deemed nonconforming if it is indeed incompatible with airport activity.

TABLE S-1 *CONTINUED*

For additional guidance see:
Pages 9-35, 9-42

Suggested Compatibility Criteria

- The definition of safety compatibility criteria must be done in unison with the delineation of safety compatibility zones. Changes to one of these two components may also necessitate changes to the other.

Pages 3-6, 9-42
Basic Safety Compatibility Qualities: Table 9B, page 9-44
Safety Compatibility Criteria Guidelines: Table 9C, page 9-47

- The principal safety compatibility strategy is to limit the number of people (residential densities and nonresidential intensities) in the most risky locations near airports. Additionally, certain types of highly risk-sensitive uses (schools and hospitals, for example) should be avoided regardless of the number of people involved. Specific suggested criteria are included in Chapter 9.

Pages 3-6, 9-53

- To enhance the chances for survival of aircraft occupants in the event of an emergency off-airport landing, preservation of open land near airports is a desirable safety compatibility objective. Guidelines regarding the characteristics of useful open land and the amount which should be preserved are provided in Chapter 9.

AIRSPACE PROTECTION

Basis for Compatibility Zone Delineation

Pages 3-7, 9-5, 9-56

- The locations within which limits on the heights of structures and other objects are necessary in order to protect airport airspace should primarily be defined in accordance with Federal Aviation Regulations (FAR) Part 77. Additional consideration may need to be given to airspace critical to certain components of instrument approach procedures, particularly approaches not aligned with the runway, circle-to-land procedures, and missed approaches.

Pages 3-8, 9-6, 9-56

- Zones defining where other hazards to flight, especially bird strikes, are a concern should be established in accordance with FAA criteria.

Suggested Compatibility Criteria

Pages 3-8, 9-6, 9-56

- FAR Part 77 provides the basic guidance for restrictions on the heights of objects near airports. Allowances need to be made for areas of high terrain. Also, heights associated with normal use of a property generally should be permitted unless avigation easements are obtained.

Page 9-6

- FAA aeronautical studies conducted in accordance with FAR Part 77 are concerned only with airspace hazards, not hazards to people and property on the ground. An FAA determination of "no hazard" says nothing about whether the proposed construction is compatible with airport activity in terms of safety and noise impacts.

Pages 3-8, 9-6, 9-56

- Land uses which produce increased attraction of birds should be avoided in accordance with FAA standards. Activities likely to create visual or electronic hazards to flight (distracting lights, glare, interference with aircraft instruments or radio communication) also should be prevented.

TABLE S-1 *CONTINUED*

For further details, refer to the following statutes and pages of this *Handbook*:

- **How late into the approval process of individual development proposals can ALUCs still review a project?**

  Page 3-19

  ALUC involvement in approval of a development proposal is generally most effective when it begins early—ideally with review of the general plan. ALUCs, though, have the authority to get involved even relatively late in the development approval process. Case law has established that a development does not need to be completed in order to be considered devoted to the use. In general, a vacant property should be considered devoted to a particular use only when all discretionary local government approvals have been issued and only ministerial approvals remain. Because ALUCs have some leeway with regard to what they deem to comprise existing development for compatibility planning purposes, compatibility plans should include a definition of the term.

- **What are ALUC responsibilities with respect to review of airport development?**

  PUC Section 21676(c)
  Pages 4-7, 4-11, 4-19

  ALUCs are required to review plans for airport development—especially airport master plans—before the plans are adopted by the airport proprietor. The primary focus of such reviews is on proposed airport features which can have off-airport land use compatibility implications. Any proposed nonaviation development on airport property should be reviewed against the same criteria that would apply if the site were off airport. If an ALUC finds the airport plan to be inconsistent with its own plan, the ALUC has the option of revising its plan. If the ALUC chooses not to modify its plan and the airport plan thus remains inconsistent, the airport proprietor can adopt the airport plan only by taking the steps necessary to overrule the ALUC.

- **Can ALUCs make exceptions to their own policies?**

  Pages 3-22, 3-32, 4-14

  Establishment of compatibility policies addressing every possible land use development circumstance is infeasible. In adopting compatibility policies, ALUCs should allow themselves some degree of flexibility to consider the specific circumstances involved. When evaluating specific projects, ALUCs are sometimes faced with the need to find an otherwise incompatible development to be acceptable. Infill development is an example of such a situation. Special sound insulation requirements, dedication of avigation easements, and other such measures may be appropriate as mitigation for allowing the development to proceed. Most important, when allowing for unique circumstances or otherwise making exceptions to established compatibility criteria, ALUCs need to ensure that the basic objectives of their plan and the integrity of the compatibility planning process set forth in the Aeronautics Act are maintained.

GUIDANCE FOR LOCAL LAND USE JURISDICTIONS

General Plan Consistency Requirements

- **What options does a county or city have with respect to the requirement for consistency between its general plan and the ALUC's compatibility plan?**

For further details, refer to the following statutes and pages of this *Handbook*:

The need to respond to an ALUC's adoption or amendment of a compatibility plan cannot simply be ignored. Local jurisdictions must either make their general plans and affected specific plans consistent with the compatibility plan or take the steps necessary to overrule the ALUC. Until such time as one of these actions has been taken, the county or city must cooperate with any ALUC request to submit for review all or selected land use actions, regulations, and permits affecting the airport influence area. A local jurisdiction's silence can be interpreted as acceptance of the compatibility criteria which the ALUC has set forth.

PUC Section 21676.5(a)
Page 5-1

➤ **What constitutes consistency between a general plan and an ALUC's compatibility plan?**

Pages 4-16, 5-3;
General Plan Consistency Checklist: Table 5A, page 5-5

Consistency does not require being identical. It means only that the concepts, standards, physical characteristics, and resulting consequences of a proposed action must not conflict with the intent of the law or the compatibility plan to which the comparison is being made. To be fully consistent with the compatibility plan, a general plan:

- Must not have any direct conflicts with the compatibility plan; and
- Must delineate a mechanism or process for ensuring that individual land use development proposals comply the ALUC criteria.

➤ **In what forms can compatibility policies be incorporated into local jurisdiction plans?**

Page 5-3

Several different strategies for achieving full general plan consistency are available to counties and cities. These include:

- Incorporating policies into existing general plan elements;
- Adopting a general plan airport element;
- Adopting the compatibility plan as a specific plan;
- Adopting the compatibility plan as a stand-alone document; or
- Adopting an airport combining district or overlay zoning ordinance.

➤ **In lieu of amending its general plan, can a county or city continue to submit land use development proposals for ALUC review?**

PUC Section 21676.5(b)
Pages 4-9, 5-3

At a minimum, direct conflicts between the ALUC and local jurisdiction plans must be eliminated. If the local jurisdiction then chooses not to fully incorporate the compatibility criteria and review processes into its own policies, it can continue to submit individual land use development actions to the ALUC for review. Unlike with actions submitted voluntarily, however, ALUC reviews under these circumstances are not merely advisory—in the event of a disagreement with the ALUC, the local jurisdiction can approve the project only by taking the steps necessary to overrule the commission.

➤ **Can the 180-day statutory time limit for making general plans consistent with the compatibility plan be extended?**

Government Code Section 65302.3
Pages 4-6, 5-2

ALUCs have no authority to modify this time limit. They can, however, agree not to bring action against local governments for taking extra time. Any such agreement should be predicated upon the local agency making substantial progress toward the necessary plan changes and not simply ignoring the need to act.

➤ **What steps must a local jurisdiction take in order to overrule an ALUC?**

The overruling process involves three mandatory steps:

- Holding of a public hearing;
- Making specific findings that the action proposed is consistent with the purposes of the ALUC statute; and
- Approval of the proposed action by a two-thirds vote of the agency's governing body.

Detailed findings are critical to this process. According to case law and the Governor's Office of Planning and Research, the findings cannot merely be a restatement of the law—they must demonstrate how the decision-makers arrived at their decision based upon the facts and established policies before them.

For further details, refer to the following statutes and pages of this *Handbook*:

PUC Sections 21675.1(d), 21676, 21676.5(a)
Page 5-15
OPR, "Bridging the Gap: Using Findings in Local Land Use Decisions" (1989)

Submittal of Projects for ALUC Review

➤ **Which types of land use development actions must be submitted to the ALUC for review?**

Certain types of land use actions *must* be submitted to the ALUC for review *prior* to final approval by the local jurisdictions. These actions include adoption or amendment of a general plan, specific plan, zoning ordinance, building regulations, or other land use ordinance or regulation which affects land within an airport area of influence as defined by the ALUC. The impetus for referral of a general plan or specific plan to the ALUC may come from either of two situations:

- A proposal initiated by the local jurisdiction to adopt or amend an affected plan; or
- The requirements for the local jurisdiction's plans to be reviewed for consistency with an ALUC's newly adopted or amended compatibility plan.

PUC Section 21676(b)
Pages 4-6, 5-10

➤ **What other types of land use development actions are also potentially subject to ALUC review?**

Once a local jurisdiction's general plan has been made fully consistent with the compatibility plan, referral of individual development proposals is voluntary and the ALUC review is advisory (in the event of a disagreement with the ALUC, overruling is not required). If the general plan has not been made fully consistent and the local jurisdiction has not overruled the ALUC, then the ALUC can require that "all actions, regulations, and permits" involving land uses in the vicinity of the airport be submitted for review. In this case, the ALUC review is not merely advisory. Note that, even on an advisory basis, many types of development projects would benefit from ALUC expertise and local jurisdictions are encouraged to continue to submit these actions if requested by the ALUC.

PUC Sections 21676.5(a), 21676.5(b)
Pages 4-8, 5-10

➤ **What obligations do local jurisdictions have with regard to approval of projects for which ALUC review is not required?**

Once a county's or city's general plan has been deemed consistent with the compatibility plan, the burden of ensuring that individual development proposals are compatible with airport activities rests with the local

Pages 4-9, 5-13

For further details, refer to the following statutes and pages of this *Handbook*:

jurisdiction. This obligation exists even if the general plan and associated ordinances and regulations do not restate or reference the ALUC criteria and procedures (as they must if they are to be fully consistent). Unless the local jurisdiction has overruled the ALUC, the applicable compatibility criteria in either situation are the ones adopted by the ALUC.

➤ **What are a local jurisdiction's obligations for ensuring airport land use compatibility when there is no ALUC?**

Page 5-13

Counties and cities are responsible for ensuring compatibility between airports and their environs regardless of whether an ALUC exists. The function of ALUCs is primarily one of oversight, not final approval. Under the alternative process, affected jurisdictions must adopt compatibility criteria in some form and also implement procedures by which individual development proposals are reviewed against these criteria. Even counties which have declared themselves exempt because there are no airport-related noise or safety compatibility issues must continue to take appropriate actions to ensure that such issues do not arise.

GUIDANCE FOR AIRPORT PROPRIETORS

➤ **What types of airport development projects must be submitted to the ALUC for review?**

PUC Sections 21676(c), 21661.5, 21664.5
Pages 4-7, 4-11, 5-11

Before a public agency which owns an airport adopts or modifies a master plan for the airport, the plan must be submitted to the ALUC for review. Also required to be submitted are construction plans for new airports and expansion plans for existing airports to the extent that the expansion involves a new runway, runway extension or realignment, or acquisition of property for these purposes. Proposals for nonaviation development of airport property are another type of airport development subject to ALUC review. Preferably, the characteristics of such development should be indicated in the airport master plan and reviewed as part of the master plan review. In all of these instances, if the ALUC finds the proposed plan or project inconsistent with its compatibility plan, the airport proprietor can adopt the plan or approve the project only by taking the steps necessary to overrule the ALUC.

➤ **What responsibilities do airport proprietors have for ensuring that the uses of land near airports are compatible with airport activity?**

Page 5-20

Land use compatibility policies adopted by ALUCs and the general plans and zoning ordinances adopted by local agencies can only go so far to ensure that privately owned property is used in a manner which is compatible with airport activities. In locations which are particularly critical to the airport—especially runway protection zones and other areas exposed to high noise levels or requiring significant limitations on the heights of objects—airport proprietors should consider acquisition of fee title or avigation easements.

CHAPTER 1

Establishment of Airport Land Use Commissions

PURPOSE OF ALUCs

More than a third of a century has passed since the California state legislature first enacted the portion of the state aeronautics law providing for creation of airport land use commissions (ALUCs). The statutes governing airport land use commissions are set forth in the State Aeronautics Act part of the California Public Utilities Code commencing with Section 21670 (Division 9, Part 1, Chapter 4, Article 3.5).

Amendments to the original 1967 law have been made about every two years since that time. Some of these amendments have involved relatively minor changes deemed necessary to respond to a particular issue or, in some cases, special circumstances in an individual county. Others have had the effect of causing major changes in the requirements for and operation of airport land use commissions.

The California state legislature's purpose in authorizing the creation of air port land use commissions has remained largely unchanged since the early years of the statutes. This purpose is succinctly stated in the current law (Section 21670(a)):

- "It is in the public interest to provide for the orderly development of each public use airport in this state and the area surrounding these airports so as to promote the overall goals and objectives of the California airport noise standards adopted pursuant to Section 21669 and to prevent the creation of new noise and safety problems."
- "It is the purpose of this article to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses."

This chapter focuses on:
- The purpose of ALUCs
- Their powers and duties
- Limitations on ALUC powers
- The composition of ALUCs
- Alternatives to ALUC formation
- ALUC rules and regulations

A brief legislative history of airport land use commissions is included in Appendix A.

As discussed later in this chapter, state law requires nearly every county in California to conduct airport land use compatibility planning. Several alternatives and exceptions to creation of airport land use commissions are provided, however.

AUTHORITY OF ALUCS

The airport land use compatibility planning authority of airport land use commissions is enumerated in various sections of the Aeronautics Act.

Powers and Duties

In the broadest sense, the law defines the powers and duties of ALUCs in terms which parallel the commissions' purpose:

> "To assist local agencies in ensuring compatible land uses in the vicinity of all new airports and in the vicinity of existing airports to the extent that the land in the vicinity of those airports is not already devoted to incompatible uses" (Section 21674(a)).

To fulfill this basic obligation, ALUCs have two specific duties:

- **Prepare Compatibility Plans**—Each commission is required to "prepare and adopt" an airport land use plan for each of the airports within its jurisdiction (Sections 21674(c) and 21675(a)).

Requirements and options regarding preparation of comprehensive land use plans are discussed in Chapter 2 of this *Handbook*. Review procedures are examined in Chapter 4.

- **Review Local Agency Land Use Actions and Airport Plans**—The commissions' second duty is to "review the plans, regulations, and other actions of local agencies and airport operators…" (Section 21674(d)).

The law is less precise regarding how ALUCs are to go about each of these two tasks. Some of the law's provisions are mandatory; others leave substantial discretion to each individual commission. These topics are addressed in the chapters which follow.

Statutory and Practical Limitations on ALUCs

Just as important as the specified powers and duties of ALUCs are the limitations on their authority. Some of these limitations are explicitly noted in the statutes. Other limitations are more implicit or, in some cases, left unaddressed by the Aeronautics Act. Still others result mostly from practical factors involved with implementation of the law.

Existing Land Uses

Perhaps foremost among the statutory limitations on ALUCs is that they have no authority over existing land uses regardless of whether such uses are incompatible with airport activities (Sections 21670(a)(2) and 21674(a)). ALUCs, for example, cannot acquire property or otherwise force changes in the way a property is developed or used.

See Chapter 3 for a discussion of defining existing land uses for the purposes airport land use compatibility planning.

The Aeronautics Act does not define when in the land use planning and development process a proposed new land use effectively becomes an existing use. Also not addressed is the question of whether or how much can an existing use be modified or reconstructed without coming under ALUC review authority. For insights into these types of issues, it is necessary to turn to other state statutes as well as to case law.

Airport Operations

A second explicit limitation on ALUC authority is set forth in Section 21674(e):

> "The powers of the commission shall in no way be construed to give the commission jurisdiction over the operation of any airport."

The meaning of "operation of any airport" is left undefined. Clearly, any actions directed toward the day-to-day activities of an airport or the manner in which aircraft operate are beyond the purview of ALUCs. Equally clearly, ALUCs have authority to review proposed airport plans or development to the extent that such proposals could affect off-airport land uses. Less clear are the limitations on ALUCs' involvement in other facets of airport planning and development such as nonaviation uses of airport property.

One issue which commonly arises is the need to update airport activity forecasts in conjunction with preparation of a compatibility plan. This topic is examined in Chapter 2.

Types of Compatibility Concerns

Several sections of the law (most notably, the declaration of purpose, Section 21670(a)) refer to the commissions' authority to address noise and safety problems. This suggests that the law does not intend for ALUCs to address other types of airport land use compatibility issues such as air quality or ground access traffic. Nothing in the law specifically excludes ALUC consideration of such matters, however.

A discussion of the practical aspects of ALUC involvement in issues other than noise and safety is included in Chapter 2.

Geographic Jurisdiction

Some airports have impacts which extend across county boundaries. Until 1997, the state law did not contain any provisions for dealing with such situations. As discussed later, the addition of Section 21670.4 now permits formation of a separate ALUC with authority to address compatibility issues around "intercounty" airports. Except for this provision and a situation in which a multi-county ALUC has compatibility planning responsibilities in both of the counties involved, no ALUC has jurisdiction over land uses in an adjacent county. (This conclusion has been supported by an opinion of the state Attorney General.) The only other choice for addressing multi-county airport impacts thus is for the ALUC in each of the affected counties to adopt its own compatibility plan for its portion of the airport environs.

Extent of Restrictiveness

Another limitation which airport land use commissions need to consider is the extent to which they can legitimately seek to restrict land uses around an airport. Restrictions have limits even when they are necessary for noise and safety compatibility and have the support of the local agency having land use jurisdiction. This issue comes under the heading of inverse condemnation or *takings* and has been examined at length in other laws and in many court cases. In general, as long as the restrictions allow some remaining economically viable use of the land, a court will usually find them to be legitimate. However, an attempt by an ALUC to preclude all development from an area—the runway protection zones being the primary example—would undoubtedly be deemed a regulatory taking. Where prevention of all development is critical to the operation of an airport, it must

The takings topic is examined in the final portion of Chapter 3. Also addressed in Chapter 3 is the issue of potential overrulings of ALUC actions by local jurisdictions which deem ALUC policies to be unnecessarily restrictive.

be the responsibility of the airport owner to acquire the property or the development rights.

Plan Implementation

The ability of ALUCs to ensure airport land use compatibility is circumscribed by the fact that they are not implementing agencies.

ALUCs exercise approval authority over certain types of local government land use actions as specified in the Aeronautics Act. Local governments also must abide by the provisions of the airport land use planning statutes. Nevertheless, the law only gives ALUCs powers to *assist* local agencies "in ensuring compatible land uses" (Section 21674(a)) and to *coordinate* compatibility planning efforts at the state, regional, and local levels (Section 21674(b)). ALUCs are not implementing agencies in the manner of local governments. Nor do they issue permits for a project such as those typically required both by local governments and various state and federal agencies. The ability of ALUCs to ensure implementation of their plans is thus limited from both a statutory and a practical perspective. For example:

See Chapter 5 for a discussion of steps which a local jurisdiction must take in order to overrule an ALUC decision.

- ALUC decisions can be overruled by the local land use jurisdiction. Although local agencies must adopt findings and take other steps in order to overrule the ALUC, they have that authority.
- The question of a proposed land use's compatibility with an airport is as much a matter of degree as it is a clear, black-and-white issue. Consequently, ALUCs should take care to document the rationale upon which their land use compatibility criteria are based. In the event of a legal challenge, the test will be an objective one, however abstract, and local agencies' views of compatibility may be just as persuasive to a court as that of the ALUC. A court decision thus will turn first on the degree to which studies and evidence—including evidence of consensus among airport and land use planners—support the criteria.
- Even when a local agency clearly stretches the concept of compatibility or otherwise ignores the intent of the state law, most ALUCs lack the resources to challenge the agency's action.
- Lastly, from a practical standpoint, ALUCs rarely become aware that a local agency is intending to overrule a decision of the commission. The law does not require local agencies to notify the commission of such an intent. ALUCs thus seldom get the opportunity to argue their case before a county board of supervisors or city council prior to when the overruling action is voted upon.

REQUIREMENTS FOR CREATION OF ALUCS

The state law governing creation of airport land use commissions applies to every county in California having an airport "operated for the benefit of the general public" (Section 21670(b)). All but one county (San Francisco) contains a public-use airport and is thus subject to the law.

This fundamental requirement notwithstanding, the statutes also include several alternatives and exceptions. One allows counties to avoid having an ALUC if they establish an alternative method of accomplishing airport land use compatibility planning. In other very limited situations, a county can be totally exempted from the requirements.

ALUC Formats

For those counties which have an airport land use commission, the law provides for two basic choices of format. One choice is a separate, single-purpose, entity with representation set in accordance with the provisions of the law. The second basic option is designation of another body, already existing for another purpose, to serve as the ALUC.

Table 1A tabulates the number of counties using each ALUC format as of mid 2001.

A third option applies only in special situations where an airport's influence area boundary encompasses multiple counties.

Single-Purpose Entity

If established as a single-purpose body, the standard membership composition of an airport land use commission consists of seven members selected as follows (Section 21670(b)):

- Two county representatives (selected by the board of supervisors);
- Two city representatives (selected by a committee comprised of the mayors of all cities in the county);
- Two having "expertise in aviation" as defined in Section 21670(e) (selected by a committee of the managers of all public airports in the county); and
- One general public representative (selected by the other six commission members).

Section 21670(e) defines a person with expertise in aviation as either someone "who, by way of education, training, business, experience, vocation, or avocation has acquired and possesses particular knowledge of, and familiarity with, the function, operation, and role of airports" or who is "an elected official of a local agency which owns or operates an airport."

Included in the law are several additional qualifications and provisions for minor variations to this basic composition. In particular:

➤ **City Adjacent to Airport**—If any cities are "contiguous or adjacent to the qualifying airport," at least one of the city representatives shall be from such cities (Section 21670(b)(1)). Where there is more than one public-use airport in a county, this provision presumably needs to be applied only to one of them. Also, this provision might reasonably be interpreted as applying to any city whose boundaries extend into the ALUC's planning area, not just to those bordering the airport.

➤ **No City in County**—If there is no city in a county, then the county and airports each appoint one additional member (Section 21670(b)(1)).

➤ **Ownership by Outside Entity**—If an airport in one county is owned by another county or by a city or special district in that other county, then the other county shall appoint one of the county members and the cities shall appoint one of the city members (Section 21671). This provision pertains to very few existing airports, including:

- Ontario International (owned by the city of Los Angeles, located in county

of San Bernardino, but San Bernardino County does not have an ALUC);
- San Francisco International (owned by city and county of San Francisco, located in county of San Mateo);
- Turlock Municipal (owned by the city of Turlock, located in county of Merced).

In situations where it applies, the result can be more representation associated with the affected airport than for other airports in the county. The adjacent county and cities can decline to appoint representatives if they wish.

Designated Body

If the board of supervisors and the mayors' committee in a county each determine that another body can accomplish essential airport land use compatibility planning, then such a body can be designated to assume the planning responsibilities of the airport land use commission and a separate commission need not be established (Section 21670.1(a)). The designated body must have at least two members with aviation expertise or, when serving as the ALUC, be augmented to have two members thus qualified (Section 21670.1(b)).

The designated body format is quite common among ALUCs—roughly as many counties utilize it as have a separate entity as the ALUC. In most of these instances, a regional planning agency serves as the ALUC. Other options include the board of supervisors, the county planning commission, or the county airport commission.

Intercounty ALUCs

Various airports in the state have noise and safety impacts which extend across county boundaries. These circumstances present a special challenge for compatibility planning. All too often, the result has been a lack of compatibility planning within the county adjacent to the one where the airport is located.

Two options exist as to how ALUC responsibilities for these airports can be coordinated. The most commonly used option is for the ALUC in the second county to adopt its own compatibility plan for the portion of an airport influence area extending into its jurisdiction. Sometimes the ALUC in the county where the airport is located will offer guidance as to suitable compatibility criteria for the adjacent county. The primary ALUC, however, has no jurisdiction over land uses in the adjacent county (except in the case of a regional planning agency serving as a designated airport land use commission for each of the counties). This limitation is delineated in an opinion of the State Attorney General.

As of mid 2001, no counties have exercised the option of forming a separate ALUC for an intercounty airport.

The second choice, one authorized by the legislature in 1997, provides the opportunity for a unified approach to compatibility planning around these so-called "intercounty" airports (Section 21670.4). The law allows the affected counties and cities to create a separate ALUC having authority over all of the impacted environs. This ALUC would be in addition to the ones responsible for compatibility planning around other airports in the respective counties.

Format	**Number of Counties**[a]	
Single-Purpose ALUCs	27	
Designated Body ALUCs	20	
Regional Planning Agency		12[b]
Airport Commission		2
Planning Commission[c]		3
Board of Supervisors[c]		3
Alternative Process	3	
Exceptions	8	
Single-County Exceptions		3
Exempt—No Compatibility Issues		4
Exempt—No Airports		1
None—No Action Taken	0	
Total	*58*	

[a] As of September 2001.

[b] Total represents eight ALUCs — one agency serves as the ALUC for four counties and another for two counties.

[c] Including bodies having additional members when serving as the ALUC.

[d] ALUCs in some of the counties essentially do not exist—they have been formally established, but have never become or no longer are active.

TABLE 1A

ALUC Format Usage

Membership options for an intercounty ALUC are similar to those of other ALUCs. A separate entity can be established, but with the county, city, and airport representation each divided between the two counties. Alternatively, an existing entity can be designated to serve as the ALUC.

Note that the law defines an intercounty airport as one where a county line bisects a runway or any of various safety compatibility zones. No mention is made of situations where only the noise contours or other portion of an airport influence area crosses a county boundary. A reasonable interpretation of the intent of the law, though, would be that an intercounty ALUC could be established any time ALUCs in two separate counties would have a compatibility plan for the same airport.

Alternative Process

Perhaps most significant among the exceptions to the requirements for establishment of ALUCs is one which was added to the law in 1994. This section (21670.1(c)) provides for what is generally referred to as an "alternative process" for a county to conduct airport land use compatibility planning. It eliminates the need for formation of an ALUC, but not for preparation of compatibility plans.

Implementation of the alternative process requires completion of several actions explicitly defined by the law:

- **Determination of Intent**—The county board of supervisors and each affected city must individually determine that proper airport land use compatibility planning in the county can be accomplished without formation of an ALUC.

See Chapter 5 for a discussion of the compatibility planning obligations of counties and cities which elect to follow the alternative process.

- **Adoption of Planning Processes**—The county and each affected city must adopt processes which provide for:
  - Preparation, adoption, and amendment of a compatibility plan for each public-use airport in the county and designation of an agency responsible for these actions;
  - Public and agency notification regarding compatibility plan preparation, adoption, or amendment;
  - Mediation of disputes regarding preparation, adoption, or amendment of compatibility plans; and
  - Amendment of general plans and specific plans to be consistent with the compatibility plans.

These actions must be completed to the satisfaction of the Division of Aeronautics within 120 days of the determination to pursue the alternative process. If not accomplished within that time frame, then an ALUC must be formed.

As of mid 2001, three counties—Inyo, Kings and San Bernardino—had been approved to use the alternative process.

- **Division of Aeronautics Approval**—The Division of Aeronautics is required to approve a proposed alternative process if it determines that the above elements are structured in a manner which will:
  - Result in preparation, adoption, and implementation of compatibility plans within a reasonable amount of time;

- Rely upon the compatibility guidelines set forth in this *Handbook* and any applicable federal regulations; and
- Provide adequate opportunities for public and agency input into the process.

Other Exceptions

Unlike the alternative process, which potentially could be established in any county, several other exceptions to formation of an ALUC are narrowly limited in applicability.

Specific County Exceptions

Three exceptions are specifically directed at a single county:

- **Los Angeles County**—In Los Angeles County, the regional planning commission is given "the responsibility for coordinating the airport planning of public agencies within the county" (Section 21670.2). If an impasse occurs regarding this planning, any public agency involved may appeal the matter to the regional planning commission. The agency whose action led to the appeal may overrule the commission with a four-fifths vote of its governing body.

- **Kern County**—The Kern County exception stipulates that an ALUC need not be formed if the county and affected cities "agree to adopt and implement" a compatibility plan for each airport by May 1995 (Section 21670.1(d)). The plans were required to be reviewed by the Division of Aeronautics and to be consistent with the guidelines indicated in the 1993 edition of this *Handbook*.

- **Santa Cruz County**—This exception is stated as applying to any county which "has only one public use airport that is owned by a city" (Section 21670.1(e)). The intent of the legislation is understood to be that the one city-owned airport is the only public-use airport in the county. Santa Cruz was the only eligible county as of the 1996 cut-off date. As with the Kern County exception, this statute does not exempt the county from conducting airport land use compatibility planning. Specifically, the statutes require that the county and the affected city include within their general plans and any specific plans compatibility criteria which are consistent with the 1993 *Handbook*.

Declaration of Exemption

A final broadly written, but narrowly applicable, exception is one which allows a county board of supervisors to declare the county to be exempt from the requirements for formation of an ALUC if it finds that no airports in the county are affected by any "noise, public safety, or land use issues" (Section 21670(b)). This exception is allowed only if none of the airports in the county are served by a scheduled airline. Also, before taking this action, the board must: consult with airport operators and affected local entities; hold a public hearing; and adopt a resolution supported by find-

Four rural counties—Alpine, Lake, Modoc, and Sierra—have declared themselves exempt.

ings. A copy of the resolution must be transmitted to the Division of Aeronautics.

Dissolution of an Established ALUC

Under the present law, disbanding an ALUC which is already in existence can only be done through implementation of the alternative process, declaration of exemption, or closure of all public-use airports. In the latter instance, the ALUC would simply be dissolved because the county would not longer meet the conditions (specified in Section 21670(b)) under which airport land use compatibility planning is required.

To disband an ALUC in either of the other circumstances the actions which were taken to create the ALUC in the first place would need to be reversed. For most ALUCs, this would mean that majorities of the board of supervisors of the county (or counties in the case of multi-county ALUCs), the selection committee of city mayors, and the selection committee of public airport managers would each have to terminate their appointments of individual commissioners and the disbanding of the commission itself. A county board of supervisors does not have the authority to unilaterally eliminate an ALUC. Additionally, if the alternative process is to be used in lieu of having an ALUC, then the actions outlined earlier in this chapter must be completed.

Comparative Effectiveness of ALUC Options

DEPT. OF TRANSPORTATION GUIDANCE
With limited exceptions, every county in the state is required to engage in airport land use compatibility planning.

A conclusion which can clearly be inferred from the preceding discussion is that, while the state legislature has been willing to allow counties various alternatives to formation of single-purpose airport land use commissions, it continues to give high priority to the need for airport land use compatibility planning. Except for those counties which can document that they have no compatibility issues (or no airports), every county is required to conduct some form of compatibility planning.

The 1967 legislation which originally established the requirements for creation of airport land use commissions was enacted to address significant compatibility issues which were arising at the time. Although other options for engaging in airport land use compatibility planning have since been added to the law, ALUCs continue to represent the most focused method of meeting the law's objectives. This factor notwithstanding, effective airport land use compatibility planning does not necessarily require the existence of an airport land use commission.

DEPT. OF TRANSPORTATION GUIDANCE
If a local jurisdiction elects to take on the compatibility planning responsibilities, its policies must fully set forth the compatibility criteria and review procedures by which it will fulfill these responsibilities. The responsibilities of local jurisdictions with regard to airport land use compatibility planning are outlined in Chapter 5.

With or without an ALUC, the statutes place heavy emphasis on community general plans as essential components of the compatibility planning process. If an ALUC is established, the law expressly requires that local jurisdictions modify their general plans so as to be consistent with the commission's compatibility plans (or that special steps be taken to overrule the ALUC action). In many respects, the function of ALUCs can therefore be viewed as being to establish the criteria and procedures by which local jurisdictions can continue to do compatibility planning on their own. Under the alternative process or the specific-county exceptions, the plan preparation function of ALUCs is bypassed, but local jurisdictions still must engage in compatibility planning. Communities which deem airport land use compatibility planning to be a high priority can be effective in their efforts with or without the existence of an ALUC. The difference between the ALUC and non-ALUC approaches thus is not so much that one is inherently always more effective than the other, but that the existence of an ALUC provides a source of expertise and, more importantly, an oversight function that is otherwise missing.

The form which airport land use compatibility planning takes in any particular county becomes a matter of balancing among several sometimes parallel, but often competing, objectives. Among them:

- Protecting airports from incompatible nearby development.
- Protecting the general public from noise and safety impacts of airports.
- Fulfilling community needs for land use development.
- Maintaining local control over land use decisions.
- Providing an independent oversight of local land use decisions which affect airports.
- Providing a mechanism for mediation of disagreements between airport operators and surrounding land use jurisdictions.
- Minimizing the costs associated with reviewing proposed development for compatibility with airport activities.

Given these many needs and objectives, no one format for airport land use compatibility planning is best for all counties. Listed in Table 1B is a summary of the comparative advantages and disadvantages among the three principal formats: single-purpose ALUCs, designated-body ALUCs, and the alternative compatibility planning process.

Relationship to Other Local Government Bodies

Regardless of whether airport land use commissions are constituted as single-purpose entities or as designated bodies, they function as independent decision-making organizations. In this respect, the authority of ALUCs is sometimes compared to that of local agency formation commissions (LAFCOs). The state law specifically establishes some of the relationships between ALUCs and other local government bodies, but leaves others undefined.

County Government

The relationship between an airport land use commission and the government of the county in which it is formed is perhaps the most often misunderstood. Even though most ALUCs operate under the auspices of county planning departments, the decisions of the commission are final and not subject to board of supervisors approval in order to take effect. This applies with respect to both of the commission's primary responsibilities—adoption of compatibility plans and review of local land use actions and airport plans. It also applies regardless of whether a separate ALUC has been established or some existing county agency such as a planning commission functions as a designated ALUC. A county must follow the same steps as a city if it wishes to overrule an ALUC decision.

The only area in which the Aeronautics Act spells out county authority over an ALUC is with regard to expenditures and staffing. Any compensation for the commission members is determined by the board of supervisors (Section 21671.5(b)). Also, an ALUC cannot hire a staff or contractors without prior approval of the board of supervisors (Section 21671.5(d)). Nevertheless, counties are required to provide staff assistance and cover "usual and necessary" expenses for the operation of ALUCs (Section 21671.5(c)).

Not indicated in the statutes is whether counties are obligated to provide legal counsel to ALUCs and, if so, in what manner. This question can become particularly evident when a legal disagreement occurs between the ALUC and the county. Because they would have a clear conflict of interest in representing both sides, some county counsels have recommended, and boards of supervisors have agreed, that an independent counsel be hired to represent ALUCs. In most situations, though, county counsel represents ALUCs in any legal proceedings.

Regional Planning Agencies

When a regional planning agency serves as a designated ALUC, funding and staffing of ALUC operations is part of the arrangement. The county (or counties) and cities each provide a share of the funding for the regional agency and are represented on the agency's governing body. Generally, though, no single county or city has direct control or veto power over the regional agency's—and thus the ALUC's—decision making. An advantage of this format is elimination of the potential conflict of interest which a county staff can face when representing both an ALUC and the county in matters over which there is a disagreement.

RULES AND REGULATIONS

The discussion here addresses rules and regulations governing the general functioning of airport land use commissions. Procedures addressing the preparation of compatibility plans and the review of local projects are covered in Chapters 2 and 4, respectively.

The aeronautics law specifically gives ALUCs the power to adopt *rules* and *regulations* (also sometimes referred to as *bylaws*) as necessary to carry out their responsibilities (Section 21674(f)). All airport land use commissions should exercise this power. Rules and regulations are particularly necessary for ALUCs established as single-purpose entities. Commissions or other bodies formed for other purposes, but designated to serve as airport land use commissions, may need to augment their rules and regulations to address topics specific to the powers and duties of ALUCs.

The substance of rules and regulations will largely be determined by local experience in the county where the ALUC is formed. The Aeronautics Act sets certain limitations on how ALUCs can conduct business (mostly in Section 21671.5), but does not require that these subjects be addressed in adopted rules and regulations. The only topic which must be covered is conflicts of interest.

The following topics are drawn from various sections of the Aeronautics Act as well as from other state laws and the rules and regulations adopted by

Single-Purpose ALUC
Establish ALUC as a separate, single-purpose entity.

Advantages

- Membership typically includes pilots and others who are very knowledgeable about aviation.
- Members tend to be strong advocates of stringent airport land use compatibility policies.
- With strong aviation interests of members, commission is likely to pursue keeping compatibility plan up to date and to make certain it is implemented by affected jurisdictions.
- Separate, single-purpose ALUC provides independent oversight of local planning decisions affecting airports.

Disadvantages

- Members often not very knowledgeable about land use planning and development process.
- Members may have unrealistic expectations regarding appropriate degree of development restrictions.
- Commissions which meet infrequently tend to run poorly: outdated compatibility plans; unfamiliarity with compatibility policies; vacant membership positions; etc.
- Separate body results in comparatively high staffing and operational costs, especially if commission meets regularly.
- Requirement for ALUC review can increase overall processing time for development approval.
- County staffs can sometimes have conflict of interest when representing ALUCs in disagreements with county boards of supervisors.

Designated Body Serving as ALUC
Designate another, already existing, entity to serve as ALUC.

Advantages

- To the extent that a designated body has other planning responsibilities, members are likely to be familiar with the land use planning and development process.
- Members understanding of other community needs allows balanced approach to planning and development decisions, thus reducing the potential for local jurisdiction overruling of ALUC actions.
- Efficiency of utilizing already established entity as ALUC reduces staffing and operational costs.
- Designation of regional planning agency with its own staff to serve as ALUC eliminates potential conflicts of interest on part of county staff.

Disadvantages

- Members may have little aviation-related knowledge or experience.
- Members may tend to give higher priority to other community development needs to detriment of airport compatibility objectives.
- Requirement for ALUC review may increase overall processing time for development approval.

Alternative Process
Conduct airport land use compatibility planning without forming an ALUC.

Advantages

- If properly implemented, forces compatibility planning issues to be fully addressed in community general plans.
- Minimizes project review costs and may reduce processing time for development approval.

Disadvantages

- No oversight process to assure that affected jurisdictions have prepared compatibility plans as required.
- No checks to determine if compatibility matters are adequately addressed in general plans.
- No assurance that compatibility issues are addressed in review of individual development projects.
- Community planning staffs often lack expertise in airport compatibility concerns.

TABLE 1B

Potential Tradeoffs among ALUC Formats

individual ALUCs in the state. They are listed here as examples of topics which can be included.

Meetings

Normally, ALUC meeting procedures should follow those of the county or designated body under which the commission is organized. Such procedures include: notice of meetings and special meetings; conduct of business; election of officers; open meeting requirements (Brown Act); holding of public hearings; recording of minutes; etc. Among meeting procedures which may be particular to ALUCs are these:

- **Frequency**—The law states that "the commission shall meet at the call of the commission chairperson or at the request of the majority of the commission members" (Section 21671.5(e)). Many ALUCs have an established monthly meeting schedule. However, once an ALUC has adopted a compatibility plan for each of its airports and the affected local plans have been determined to be consistent with it, the types of projects subject to future review are greatly reduced and the need for regular meetings may largely disappear.
- **Quorum**—A majority of the commission's membership comprises a quorum for the purposes of conducting business. However, any action taken by the commission requires a "recorded vote of a majority of the full membership" (Section 21671.5(e)). Proxies (see following discussion) present at a meeting in place of a regular member are counted when determining the existence of a quorum or for voting purposes.

Duties of Members

Term of Office

DEPT. OF TRANSPORTATION GUIDANCE
It is essential for the bodies responsible for appointment of members to the ALUC to fill any vacancies as quickly as possible. Vacancies are particularly common on ALUCs which meet infrequently. Lack of members in turn makes obtaining a quorum for a meeting more difficult.

The members of an airport land use commission organized with a standard composition each serve four-year terms. All terms are to end on the first Monday in May, but are to be rotated so that one or two terms expire each year (Section 21671.5(a)). Members serve at the pleasure of the appointing body and may be removed by that body at any time and for any reason.

The practice on many ALUCs is for members to continue to serve until a replacement is appointed even if their terms of office have expired. If this is the intent of the appointing body, it should be so stated when the appointment is made. Members should otherwise not continue to serve beyond the end of their term. Doing so could call into question any decisions rendered by the commission during this period.

The terms of office for the members of a designated body serving as an ALUC normally follow those of the designated body.

Officers

ALUC rules and regulations should indicate what offices are to be established on the commission, what the duties of each officer are, and when new officers are to be selected.

A designated body serving as an ALUC usually keeps the same officers when sitting as an ALUC as it has when convened in its regular capacity. An exception to this might be when the established body, sitting in the capacity of an ALUC, is augmented by additional members (such as to fulfill the requirement for aviation expertise). In this situation, the rules and regulations should indicate whether a separate vote for ALUC officers is to be taken.

Appointment of Proxies

In addition to an ALUC's regular members, state law provides for the appointment of proxies. Each member is required to appoint a proxy who "shall serve at the pleasure of the appointing member." A signed document designating the proxy is to be kept on file at the commission offices. The proxy represents the regular commission member and is empowered "to vote on all matters when the member is not in attendance" (Section 21670(d)). However, in order to vote on a matter discussed at a previous meeting, a proxy should be current on the documents and issues involved (that is, the proxy generally should either have attended the prior meeting, listened to a recording of the meeting, or read any detailed minutes). Circumstances under which a proxy can or cannot vote on matters previous discussed are appropriated topics for rules and regulations.

The law is silent with respect to the appointment of proxies on designated bodies which serve as an airport land use commission.

Conflicts of Interest

Section 21672 of the Aeronautics Act requires that commissions "adopt rules and regulations with respect to the temporary disqualification of its members from participating in the review or adoption of a proposal because of a conflict of interest…" For guidance as to what circumstances constitute a conflict of interest, reference must be made to other state laws; the subject is not further addressed by the Aeronautics Act. In general, a *personal financial interest* in an action would present a conflict of interest on the part of an ALUC member.

Some ALUCs also consider a commissioner's participation as a member of another agency in prior action on an issue before the commission to represent a conflict of interest. The rationale for disqualification under these circumstances seems questionable, however, especially considering that the commission's members serve as *representatives* of their appointing entities. Nevertheless, airport land use commissioners who also serve on another body should remember that their role—and the factors upon which they base their decisions—is different when serving on the ALUC than it is with the other body. As an ALUC member, their primary responsibility is with regard to prevention of compatibility conflicts between airports and surrounding land uses.

Responsibilities of Staff

ALUCs may wish to include a statement of staff duties and responsibilities in the commission rules and regulations. Among the duties usually delegated to staff are:

- Coordinating with local agency staff to obtain information regarding specific projects to be reviewed by the ALUC;
- Providing general assistance to local agency staff regarding airport compatibility issues;
- Working with the ALUC chairman regarding meeting schedules and agendas;
- Preparing staff reports and meeting agendas;
- Issuing required public notices of pending commission actions;
- Recording meeting minutes; and
- Notifying local agencies of commission decisions on items submitted for review.

Some ALUCs also give staff significant discretion regarding which proposed local projects and other actions are brought to the commission for review and when. Any projects for which ALUC review is mandated by state law *must* be brought before the commission for decision. However, projects submitted on a voluntary basis as a result of agreements between affected jurisdictions and the ALUC do not necessarily require ALUC action. ALUC rules and regulations and/or compatibility plans should be explicit in indicating which types of reviews are delegated to staff for action and which are to be forwarded to the commission for decision. Any proposed land use development actions involving significant compatibility concerns should be examined by the ALUC.

Fees

As further discussed in Chapter 4, the state law (Section 21671.5(f)) allows commissions to charge project proponents for the cost of project reviews. The fee structure and the method and timing of collection are appropriate subjects for ALUC rules and regulations.

CHAPTER 2

Preparation and Adoption of Compatibility Plans

Purpose of Compatibility Plans

As indicated in Chapter 1, the State Aeronautics Act (Public Utilities Code, Section 21670 et seq.) requires preparation of an airport land use compatibility plan for nearly all public-use airports in the state (Section 21675). This requirement applies regardless of whether a county chooses to establish and maintain an airport land use commission or to utilize the alternative process or county-specific exception provisions of the law.

This chapter addresses:
- How compatibility plans are prepared;
- What should be included in them; and
- The process involved in their adoption.

Compatibility plans are the fundamental tool used by airport land use commissions in fulfilling their purpose of promoting airport land use compatibility. The law describes the purpose of these plans in essentially the same terms as it uses with respect to the purpose of the commissions themselves (Section 21675(a)). Specifically, compatibility plans have two purposes:

- To "provide for the orderly growth of each public airport and the area surrounding the airport within the jurisdiction of the commission…" and
- To "safeguard the general welfare of the inhabitants within the vicinity of the airport and the public in general."

The State Aeronautics Act mostly refers to these documents as *comprehensive land use plans* or *CLUPs*, although the term *airport land use plan* is also used. These and other titles—for example, airport land use compatibility plan, airport land use policy plan, airport environs land use plan—are found among the plans prepared by the various county airport land use commissions. Regardless of the name, all are intended to serve the same purpose and must conform to the state law requirements. The generic term *compatibility plan* is primarily used in this *Handbook*.

Preparation of Compatibility Plans

Responsibility for Plan Preparation

The entity having lead responsibility for compatibility plan preparation varies depending upon how the compatibility planning process is structured in a county.

➤ **Plans Prepared under ALUC Direction**—In counties which have an ALUC, compatibility plans are usually prepared either by the commission staff or by consultants under contract to the county or regional planning agency within which the commission operates. This approach generally gives the commission and its staff the most direct involvement in the plan's format and policies.

- **Plans Prepared for Multiple Purposes**—Other compatibility plans are developed as a component of larger planning studies conducted by agencies other than an ALUC. Examples of this process include compatibility plans prepared as part of a *master plan* for an individual airport or a *specific plan* for the portion of a community around an airport. Even though ALUCs do not have the lead role in the plan preparation under these circumstances, they retain the authority to modify or add to the compatibility plan if necessary. All of the essential elements of a compatibility plan must be included in the plan adopted by the ALUC. However, other elements not pertaining to compatibility planning matters may be omitted if appropriate.

Under Public Utilities Code Section 21670.1(c)(3), the Division of Aeronautics is required to review and approve the specific manner in which counties which elect to follow the alternative airport land use compatibility planning process intend to implement that process. Subsequently, the Division of Aeronautics has an implicit on-going responsibility to see that compatibility plans are prepared as required and adopted by the affected jurisdictions.

- **Plans Prepared under Alternative Process**—A mandatory step in establishment of the alternative process is identification of the agency or agencies responsible for preparation of compatibility plans. One option is for the county or a regional agency to take the lead in plan preparation for all of the airports in the county. Other choices might be for either the entities which own the airports or the communities which are impacted to be assigned this responsibility for their respective airports.

Information Resources

A variety of information resources are available to help ALUCs and their staffs with the process of preparing compatibility plans. Among the most important of these are the following:

A 1994 addition to the Aeronautics Act requires that ALUCs "be guided by" information in the *Handbook* when formulating airport land use compatibility plans.

- **ALUC Handbook**—One of the purposes of this *Handbook* is to serve as a source of information regarding compatibility plans and policies. Many of the problems and issues faced by ALUCs when preparing, using, and updating their plans are addressed herein.
- **State Aeronautics Staff**—The California Department of Transportation, Division of Aeronautics staff is available to respond to inquiries regarding state law, compatibility criteria, review procedures, and any other matters involving airport land use commissions.
- **Consultants**—Airport and land use planning consultants often provide services to ALUCs, including drafting of compatibility plans.
- **Other ALUCs**—The experience of other ALUCs is another valuable information resource. Copies of adopted plans generally can be obtained from individual commissions. Also, commission members and their staffs are usually willing to discuss particular issues which they have faced. The Division of Aeronautics maintains a list of contact persons and phone numbers for each of the airport land use commissions in the state.
- **Seminars and Workshops**—ALUC seminars and workshops are held periodically by the Division of Aeronautics and other organizations. These gatherings of airport land use commission members, staffs, and others

involved in airport land use planning facilitate the exchange of information about compatibility planning issues.

Funding for Plan Preparation

Obtaining funds with which to prepare and/or update compatibility plans is an on-going problem for the majority of ALUCs. Sources of funding which the commissions in various counties have drawn upon include:

- **State Funding**—The Department of Transportation has provided grants to local agencies for the preparation of many countywide compatibility plans. This funding has primarily come from California Aid to Airport Program (CAAP) grants which cover 90% of the cost of the plan preparation. The availability of CAAP grant funds for compatibility planning projects varies from year to year depending upon funding levels provided by the legislature and on prioritization guidelines established for airport-related projects by the California Transportation Commission. In addition to the CAAP grants, the state also provides a $10,000 annual grant to each public-use general aviation airport in the state (except those designated as air carrier reliever airports). Some airport proprietors have applied these funds to preparation of compatibility plans.

Preparation of master plans and layout plans for publicly owned airports is also eligible for state funding (through both CAAP grants and annual grants).

- **FAA Funding as Part of an Airport Master Plan Study**—Another option for funding of a compatibility plan is as the land use component of an airport master plan. In this context, preparation of at least portions of the compatibility plan can be eligible for federal funding under the Federal Aviation Administration's Airport Improvement Program. A limitation of this funding source, however, is that it generally allows preparation of a compatibility plan for only a single airport rather than a plan which is countywide in scope.

The state will assist local agencies with funding of the local share of FAA grants for airport and aviation purposes by contributing up to 5% of the federal grant amount.

- **Department of Defense Funding**—Funding for compatibility planning around military airports is potentially available through the Defense Department's Office of Economic Adjustment.
- **Local Funding as Part of Local Plan Preparation**—Some compatibility plans are prepared in conjunction with the preparation or updating of a community general plan or specific plan. Local general funds or other fund sources used for the community plan cover the incremental cost of the compatibility plan.
- **ALUC Fees**—A portion of the fees which ALUCs are permitted to collect for the purpose of conducting compatibility reviews can be allocated to amending or updating of a compatibility plan. ALUCs are not authorized to collect fees if they have not previously adopted a compatibility plan (Section 21671.5(f)).
- **Other Local Funds**—Other local fund sources for preparation of a compatibility plan include direct use of the general fund, airport-derived revenues (particularly at larger airports), and local transportation planning funds.

SCOPE AND CONTENT OF COMPATIBILITY PLANS

When beginning a compatibility planning project, several decisions must be made regarding the scope of the plan. Issues to be considered include:

- Which airports are to be included (if the document is to cover more than one airport);
- The availability of master plans for each airport and the compatibility plan's relationship to these plans (particularly with regard to airport layout plans and activity forecasts);
- The types of airport impacts to be addressed;
- The extent of the geographic area to which the plan applies; and
- The types of projects to be reviewed and the process to be used in conducting the reviews.

These topics are addressed in the following subsections. A final subsection provides checklists of the essential and optional contents of a compatibility plan.

Scope of Airport Coverage

Perhaps most basic among compatibility plan scoping issues is to determine which airports the plan should address.

Types of Airports

The requirements as to which airports should have a compatibility plan are found in the law as follows:

An important distinction here is that the airport need not be publicly *owned* to necessitate preparation of a compatibility plan, just publicly *used*. See the Glossary for definitions of public-use versus other categories of airports.

➤ **Public-Use Airports**—A compatibility plan must be formulated for "each public airport" (that is, each airport served by a scheduled airline or operated for the benefit of the general public) within the jurisdiction of the commission (Section 21675(a)). This requirement is clearly applicable to all *existing* public-use airports. ALUCs, though, have also developed compatibility plans for *proposed* public airports.

➤ **Military Airports**—Commissions have the option of whether or not to develop a compatibility plan for any federal military airport in their jurisdiction (Section 21675(b)).

As discussed in Chapter 1, another option is for both counties to jointly establish a separate ALUC for these "intercounty" airports. That commission would then be responsible for preparation of a compatibility plan for all of the airport's influence area.

➤ **Airports in Adjacent Counties**—Although often overlooked, ALUCs should adopt a compatibility plan for the portion of any airport influence area which is located within its jurisdiction even if the airport itself is in an adjacent county. Typically, the county in which the airport is situated will take the lead in development of a compatibility plan and then request concurrence or adoption by other affected jurisdictions.

A special-use airport or heliport is one which is not open to the general public, but for which the owner allows controlled access in support of commercial activities, public service operations, and/or personal use. Hospital heliports are a primary example of special-use facilities.

➤ **Special-Use Airports and Heliports**—The law does not address the question of compatibility planning for areas around special-use airports and heliports. Perhaps because of their limited activity and impacts, few ALUCs have prepared compatibility plans for these facilities. Nevertheless, because special-use airports and heliports require operating permits from the state, ALUCs have the authority to create compatibility plans for them.

ALUCs may exercise the option not to do so, but should indicate that the reason is the lack of significant noise and safety compatibility concerns. Even in such instances, however, establishing limits on the heights of objects within the approaches to these facilities should be considered.

➤ **Exempt Facilities**—Airports and heliports which are exempt from state permit requirements do not require compatibility plans. These facilities include agricultural landing fields, seaplane landing sites, emergency-use facilities, and personal-use airports in unincorporated areas.

Separate versus Countywide Documents

Compatibility plan documents can be formatted to include only one airport or to cover all of the airports located within a commission's jurisdiction. Each of these two approaches has its advantages and disadvantages and neither is regarded as being superior to the other.

➤ **Individual Airport Plans**—Some ALUCs have separate compatibility plan documents for each of the airports within their jurisdiction. This approach allows the plan to focus on the specific issues relevant to the individual airport and its surrounding land uses and local jurisdictions. It is the format which normally results when the compatibility plan is prepared as an element of an airport master plan or local specific plan.

➤ **Countywide Plan**—Other commissions have prepared a single document in which the compatibility plans for each of the airports are collected. This format promotes consistency among the policies for all of the airports in the commission's jurisdiction. A disadvantage is that, especially for counties with many airports, the plan document can become unwieldy in size and much of it will be irrelevant to jurisdictions affected by only one airport. A variation on the countywide plan is to prepare one document containing introductory information, policies, and other material which apply countywide together with a set of separate documents which include maps and background data for each individual airport.

In addition to the above, some ALUCs have prepared brief summary documents with key policies and information on each airport individually.

Scope of Airport Planning: Relationship to Airport Plans

Another scoping consideration in the preparation of compatibility plans concerns the extent to which ALUCs can or should engage in *airport* planning (as opposed to *airport land use* planning). More specifically, the issue involves the relationship between a *compatibility plan* and a *master plan* or layout plan for the same airport. Two sections of the state law provide the framework for defining this relationship:

- First, as discussed in Chapter 1, Section 21674(e) explicitly states that ALUCs have no "jurisdiction over the operation of any airport."
- Second, Section 21675(a) dictates that a compatibility plan "shall include and shall be based on a long-range master plan or an airport layout plan, as determined by the Division of Aeronautics of the

The general public is often unclear as to the distinction between an *airport land use compatibility plan* and an *airport master plan*. The most fundamental difference is that primary responsibility for adoption of a compatibility plan rests with the ALUC, while responsibility for adoption of an airport master plan belongs to the entity which owns the airport. Additionally, the focus of a compatibility plan is on the land around an airport; the emphasis of an airport master plan normally is on property within the airport boundary.

The state law provision allowing an ALUC's compatibility plan to be based upon an airport layout plan, with the approval of the Division of Aeronautics, was added in 1990. The change was the result of a Riverside County court case (City of Coachella v. Riverside County Airport Land Use Commission, 210 CalApp.3d 1277) which voided a compatibility plan because it was not based upon an airport master plan as the law previously required.

Department of Transportation, that reflects the anticipated growth of the airport during at least the next 20 years."

The relationship between a compatibility plan and an airport master plan centers on two key pieces of information included in the master plan: the current and future airport layout; and the existing and projected airport activity. When these two components are up to date, it is a simple matter for that information to form the basis for compatibility planning.

However, a difficulty which frequently arises in preparation of a compatibility plan is that adopted airport master plans are outdated. Either they have become invalid because of changing conditions or they simply no longer extend the necessary 20 years into the future. In these circumstances, the available plans need to be updated—or, more precisely, *extended* farther into the future.

DEPT. OF TRANSPORTATION GUIDANCE
For a compatibility plan to "be based on" an airport master plan, it must be consistent with the expectations of the airport proprietor with regard to the future development and use of the airport. Furthermore, the compatibility plan should indicate the version of the master plan upon which it is based.

A caution with regard to updating of airport plans and forecasts for compatibility planning purposes, though, is that ALUCs must avoid assuming or suggesting that the layout or operation of the airport will change in a manner not anticipated by the entity responsible for the airport's operation. Assumptions regarding the fundamental *role* of the airport must remain as indicated in the adopted airport master plan or other policies of the airport proprietor. For example, the expected configuration of airport runways (length, approach type, lighting, etc.) must match what is shown in the master plan. Similarly, ALUCs cannot assume that an airport might someday have airline service or intensive usage by large corporate aircraft if such prospects are not anticipated in the master plan.

These limitations must be borne in mind even when the ALUC believes it has information that an airport's future role could result in more expansive development and activity characteristics than indicated by the master plan. The reverse situation can also sometimes occur: one in which the master plan is more optimistic about future expansion and growth of an airport than the ALUC believes to be realistic. In either case, the opportunity for the ALUC to register its concern is when the master plan is in the review and adoption process. Once the master plan has been officially adopted by the airport proprietor, the ALUC is obligated to rely upon the master plan's expectations and provide appropriate land use compatibility protection.

Airport Layout Plan

A compatibility plan should contain a drawing showing the locations of existing and proposed airport runways, runway protection zones, property boundaries, and any other features which have implications for land use compatibility. The drawing may be a formal airport layout plan prepared by the airport proprietor as part of an airport master plan or other planning process. Alternatively, it can be a more simplified drawing emphasizing the airport's fundamental features.

Many times, however, a current layout plan is not available. Either the airport proprietor has not kept it up to date or—particularly common for small, privately owned facilities—no layout plan may have ever been prepared. In such instances, the ALUC may need to prepare or update the drawing in order to meet the needs of the compatibility plan. To again emphasize the point, though, it is not within the purview of an ALUC to add to or subtract from the *proposed* facilities shown in a locally adopted airport master plan or layout plan. ALUCs have no authority to adopt, let alone implement, a master plan for an airport—only the owner/operator of the airport can do that.

With respect to the requirements for Division of Aeronautics involvement in approval of airport plans for compatibility planning purposes (as required by Section 21675(a)), the practice has been as follows:

- **Adopted Master Plan Exists**—The Division of Aeronautics generally does not become involved when a long-range master plan has been adopted by the agency owning the airport and the plan is reasonably current. If the master plan is old, the layout plan contained in it may need to be updated to reflecting recent construction. Such updates should then be submitted to the Division of Aeronautics for approval. Another situation which sometimes arises is that an airport master planning process is being conducted concurrently with the preparation or updating of a compatibility plan. If the master plan is expected to propose airport development which could have airport compatibility implications, it may be advantageous for the compatibility plan to include policies which take into account the anticipated changes. However, the compatibility plan still needs to be based upon the master plan which is in effect.
- **Airport Layout Plan Available**—When a master plan does not exist or was never adopted by the airport owner, but an airport layout plan is available, the Division of Aeronautics will review the plan and any associated activity projections for currency and suitability for airport land use planning purposes. the Division of Aeronautics may suggest modifications to the plan if deemed necessary.
- **No Airport Plan Exists**—When no plan exists, the commission typically will need to prepare a simplified or diagrammatic airport layout drawing on which to base its land use compatibility plan. Such drawings need not be detailed. The only components essential to show are ones which may have off-airport compatibility implications—specifically: runways, runway protection zones, and airport property lines. Also, because lack of an airport layout plan mostly occurs only with regard to low-activity, often privately owned, airports for which few changes are anticipated, the plan merely needs to reflect the existing conditions. ALUCs should seek the assistance of the airport owner in obtaining data for preparing the necessary drawing. Written Division of Aeronautics approval of these substitute airport layout plans is necessary.

In any instance requiring a determination by the Division of Aeronautics, the ALUC staff or consultant should submit the alternative airport plans as early in the compatibility planning process as is practical. Any necessary revisions

DEPT. OF TRANSPORTATION GUIDANCE

ALUCs which have developed compatibility plans for airports not having an adopted master plan should make certain that the Division of Aeronautics has a current layout plan on file for those airports and should seek written Division of Aeronautics acceptance of that plan for compatibility planning purposes. ALUCs also are encouraged to readopt the affected compatibility plans and indicate that these plans are based upon state-approved airport layout plans.

Also see the discussion under *Statutory and Practical Limitations* on ALUCs in Chapter 1.

to the airport plan can thus be taken into account before significant ALUC staff or consultant time is spent in the preparation of the compatibility plan.

Aviation Activity Forecasts

As noted above, the state ALUC statutes require a compatibility plan to have a time horizon of at least 20 years. Since the airport activity forecasts contained in airport master plans normally extend only 20 years, ALUCs will almost always need to review and extend the forecasts farther into the future. In so doing, though, several factors are important to consider.

DEPT. OF TRANSPORTATION GUIDANCE ALUC planning assumptions regarding future aircraft activity at an airport must be consistent with the role of the airport as identified in an airport master plan adopted by the airport proprietor.

Most importantly, as previously stated, new forecasts must remain consistent with the role of the airport as envisioned by the airport proprietor. This caveat particularly applies when a master plan has been adopted for the airport. Forecasts must not be modified in a manner which presumes a future mix of aircraft or other operational characteristics significantly different from those in the plan adopted by the airport's owner/operator. Similarly, forecasts for airports which do not have a long-range master plan, or perhaps even a layout plan, need to be based on the existing airport development and patterns of usage unless facility improvements are known to be planned.

Secondly, the inherent uncertainties in aviation activity forecasts should be recognized. For airline airports, especially those in small or nonhub categories, the number of airline operations may change rapidly depending upon airline decisions and other factors. With general aviation airports, even relatively recent forecasts may not take into account the renewed growth which has been occurring in the industry, especially in the corporate aircraft segment. Even 20 years is probably beyond the time range that can be projected with a high degree of confidence. Anticipating what activity levels might ultimately occur is virtually impossible.

Thirdly, most airports presumably will remain in operation for more than 20 years. This factor combined with the characteristic uncertainty of forecasting suggests that, for the purposes of airport land use compatibility planning, using a high estimate of long-range activity levels is generally preferable to underestimating the future potential. This strategy especially applies with respect to assessment of noise impacts. Too low of a forecast may allow compatibility conflicts that cannot later be undone. On the other hand, activity projections must also be reasonable. An unrealistically high forecast may preclude otherwise appropriate uses of airport-vicinity land.

When current forecasts are not available from other sources, two options for forecast updating—each tied to an aspect of a master plan—are worth considering for the purposes of compatibility planning.

Although this approach would seemingly result in much larger noise contours, the actual effect is relatively small. With all other noise modeling factors held constant, increasing the forecast activity levels by 50% adds only about 1.8 dB to the noise contours. Even a doubling of activity expands the contours by only 3.0 dB.

➤ **Extend Forecasts to 20+ Years**—One choice is to utilize available forecasts for an airport (from master plans or the state airport system plan) and extend them farther into the future. This can be done through extrapolation of the forecast trends or simply by adding a fixed percentage to the most long-range projection of total operations—say 50%, for example. In the latter case, the resulting activity level will be for an indefinite point in time that may be well beyond 20 years.

➤ **Airport Capacity**—Another alternative is to base an airport's noise impact contours on the operational capacity of the airport runway system. This approach is often appropriate at very busy airports in metropolitan areas. The capacity calculations can take into account any planned runway system improvements shown in an adopted airport master plan or layout plan. Reliance upon runway capacity as the basis for compatibility planning may also be reasonable for other airports. In such cases, however, consideration should be given to whether the corresponding activity level would be consistent with the airport's role and be supported by planned facilities in addition to runways. for example, at currently very-low-activity airports in outlying locations, an assumption that a capacity level of operations could some day be reached is likely to be unrealistic and inconsistent with the airport's role.

Scope of ALUC Compatibility Concerns

As noted in Chapter 1, the focus of ALUC compatibility concerns is clearly on broadly defined noise and safety impacts. Among other impacts related to airport activity, the two of potentially greatest consequence are air quality and ground access traffic. Typically, these impacts are issues only at large, primarily major airline, airports. Even at these airports, the manner in which land uses surrounding an airport can or should be restricted on the basis of such impacts is unclear. No ALUCs are known to have established compatibility policies addressing issues not directly related to noise and safety.

To the extent that issues other than noise and safety might arise and be a legitimate concern to ALUCs, it would be with regard to review of airport master plans and other development actions rather than land use development proposals. Under these circumstances, the issue of whether airport expansion would have adverse air quality or ground traffic impacts on surrounding land uses might reasonably be a subject for an ALUC to address if it so chooses.

The practical aspect of an ALUC becoming involved in other types of airport impacts is that the commission would have little established guidance from other sources upon which to base its development of review criteria. Lacking such criteria, the commission would have nothing against which to evaluate a proposed local plan, project, or other action. Given these circumstances, ALUCs would be well advised to generally avoid other types of airport compatibility issues at least until such time as standards evolve to show the connection between the other impacts and the two basic purposes for creation of ALUCs.

The two broad noise and safety categories of airport impacts both have individual components which should be considered in preparation of a compatibility plan.

Approaches to addressing these concerns are outlined in Chapter 3. Also, Part II of the *Handbook* contains an extended background discussion of noise and safety compatibility concepts and issues.

- **Noise Impacts**—Noise-related impacts fall into two general groups distinguishable on a geographic basis:
  - The most intensive and disruptive *noise* impacts are ones occurring within the cumulative noise level contours—measured in California in terms of Community Noise Equivalent Level (CNEL)—typically prepared for airports.
  - Noise exposure in areas beyond the outermost contours can also be annoying and regarded as locally significant. These are generally described under the heading of *overflight* impacts.
- **Safety Impacts**—Two types of aviation-related safety concerns affect land uses near airports:
  - Concerns directed toward minimizing the severity of an aircraft accident by limiting the types of land uses near an airport. (Most compatibility plans simply list this concern under the heading of *safety*.)
  - Concerns regarding land uses that can create hazards to flight. *Airspace protection* primarily involves limitations on the height of objects on the ground near airports. Other concerns include activities which can cause electronic or visual impairments to navigation or attract large numbers of birds.

Geographic Scope: Planning Boundaries

Chapter 3 contains an assessment of factors to be considered in defining the planning area boundary.

DEPT. OF TRANSPORTATION GUIDANCE
See the discussion on page 2-12 regarding the steps which ALUCs must take in adoption of planning boundaries.

Many ALUCs call these planning boundaries *airport areas of influence* or *airport influence areas*. They are also sometimes called *referral area boundaries* in that they set the limits of the area within which proposed land use projects are to be referred to the commission for review.

With certain exceptions, planning area boundaries are determined by:

- The location and configuration of the airport or airports included in the plan; and
- The extent of the noise and safety impacts associated with each airport.

The principal exception is that, with respect to review of proposals for new airports, the geographic scope of ALUC responsibilities extends to anywhere within the county or counties of the ALUC's jurisdiction. Some ALUCs also extend their planning area boundaries to include review of proposed construction, regardless of proximity to an airport, when such construction requires Federal Aviation Administration airspace hazard review under Part 77 of the Federal Aviation Regulations (when not near an airport, such objects generally must be more than 200 feet tall).

Scope of ALUC Review

Compatibility plans should clearly describe the scope of ALUCs' authority and responsibility for conducting project reviews.

Types of Actions Reviewed by ALUCs

Review of local actions pertaining to airport land use compatibility is one of the fundamental reasons for the formation of ALUCs. These local actions fall into two broad groups:

- Local land use plans, projects, and related actions; and
- Airport and heliport plans, including master plans, expansion plans, and plans for construction of a new facility.

Compatibility plan policies should clearly specify the types of actions in each of these categories which are to be submitted to the commission for review. The plan should indicate that submittal of some types of actions is mandatory, while others may be voluntary under certain circumstances. Also important to note is that actions submitted for review on a voluntary basis are generally not subject to the need for overruling in the event that the local agency disagrees with the ALUC's evaluation.

See Chapter 4 for a more detailed discussion of the types of actions to be reviewed by ALUCs and the conditions under which these reviews are mandatory or voluntary.

Review Procedures

The procedures which the ALUC will use in reviewing local actions should be defined in the plan. Among the procedural matters which should be addressed are:

- The types of project information needed to be submitted;
- When an action should be submitted relative to the overall approval process of the local jurisdiction;
- ALUC staff responsibilities, if any, for certain project reviews; and
- The choice of actions available to the ALUC when reviewing a project.

The topic of ALUC review procedures is more fully addressed in Chapter 4.

Compatibility Plan Content

State law provides only limited guidance regarding the specific components of compatibility plans. Consequently, the contents of airport land use compatibility plans vary considerably from one ALUC to another. Nevertheless, certain elements are, or should be, included in every plan. Most important is a clear statement of compatibility criteria and ALUC review procedures. The various scoping issues discussed above also should be addressed. Other compatibility plan elements serve more in a background or supporting capacity or can be considered optional.

Tables 2A and 2B provide checklists of the mandatory and optional contents of compatibility plans, respectively. The listing is based not only upon the law itself, but upon the typical contents of the plans which ALUCs have prepared. Included are references to sections within this chapter, or in Chapters 3 and 4, where more detailed discussion of the various components can be found.

ADOPTION PROCESS

Involvement of Local Agencies

As a practical matter, data and other input from local agencies is essential to preparation of airport land use compatibility plans. Adoption and, ultimately, successful implementation of compatibility plans, though, requires

ALUC adoption or amendment of a compatibility plan begins a statutory 180-day time period within which the county and affected cities must either amend their general plans and applicable specific plans to be consistent with the ALUC's compatibility plan or make appropriate findings and overrule the ALUC. This process is addressed in Chapters 4 and 5.

that this cooperation between ALUCs and affected local land use jurisdictions be continued beyond the plan development stage. During the compatibility plan review and adoption process, the involvement of local agencies typically occurs in two ways.

Informal Negotiations

In many cases, the majority of issues which arise during the review of a draft compatibility plan result more from lack of clarity in proposed policies than from fundamental disagreements over the policy objectives. Informal negotiations between the affected jurisdictions and the ALUC frequently can resolve many of these issues. At least initially, these negotiations ordinarily can take place at the staff level, then involve elected county and city officials and commission members at a later date.

Other disagreements are more substantive. Conflicts may occur because ALUCs and local jurisdictions have different objectives with respect to planning for land uses around airports. For ALUCs, protection of the airports from incompatible development is paramount. For counties and cities, the community needs for new development are also factors in land use decisions. Despite these differences, achieving a mutually acceptable compatibility plan is a desirable goal. Often this means seeking a compromise set of compatibility policies which will adequately protect the airports from incompatible land uses, yet reasonably respond to communities' development needs. When ALUC adoption of compatibility policies and criteria results in local agency overruling actions, little is accomplished to promote airport land use compatibility objectives.

Formal Consultation Requirements

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs are advised not to overlook this consultation requirement. Omission of this step can invalidate the adoption of a compatibility plan.

Formal consultation between ALUCs and affected local jurisdictions is mandatory at only one step of the compatibility plan preparation and adoption process. Specifically, state law (Section 21675(c)) requires that ALUCs establish planning area boundaries "after hearing and consultation with the involved agencies." This requirement comes into play any time a new compatibility plan is proposed for adoption or an existing plan is proposed to be amended in a manner which would modify the planning boundaries (the airport area of influence).

The statutes do not indicate what is meant by "consultation" in this context nor when consultation should occur relative to adoption or amendment of a compatibility plan. However, if new or amended planning boundaries are proposed for adoption, simple discussions with the staff of affected jurisdictions may not be sufficient. Caution suggests that ALUCs should afford elected officials of those jurisdictions the opportunity to meet jointly with the commission to discuss planning boundaries and other compatibility issues. At a minimum, ALUC staff or consultants should offer to make a presentation about the plan to the elected body if the jurisdiction desires.

ALUC review and adoption of planning boundaries need not be a separate process from adoption of a compatibility plan itself. Consultation with

For additional guidance see:	The following items should be addressed in all ALUC compatibility plans:
	➤ **Scope of the Plan**—In a preface or introductory chapter, provide a clear statement describing the scope and function of the plan. Specifically:
Page 1-1	▪ *Authority and Purpose:* Refer to state statutes which authorize establishment of ALUCs and require preparation of compatibility plans. The plan's purpose can be defined in terms of its intended uses and objectives.
Page 2-4	▪ *Airport Identification:* List the airports addressed by the plan.
Pages 1-3, 2-5, 2-10	▪ *Geographic Coverage:* Provide a general description of the geographic extent of the plan; refer to policies chapter(s) for detailed mapping.
Pages 1-11, 2-5, 4-6	▪ *Jurisdictions Affected:* Identify which local jurisdictions—the county and the specific incorporated cities—are affected by the provisions of the plan. The relationship of the ALUC's plan to the plans of local jurisdictions also may be valuable to describe.
Page 1-2	▪ *Limitations of the Plan:* Note the limitations on ALUC jurisdiction over existing land uses and airport operations as stated in the law and applied by the individual ALUC.
	➤ **Airport Information**—Include essential information about the subject airport(s) as necessary to document that the compatibility plan is based upon an adopted airport master plan or an airport layout plan approved by the Division of Aeronautics. Emphasize the aspects of the airport plan which affect off-airport land use compatibility.
Page 2-5	▪ *Planning Status:* Indicate the master plan adoption date or, alternatively, refer to documentation from the Division of Aeronautics approving an airport layout plan as the basis for compatibility planning.
Page 2-6	▪ *Layout Plan:* Include a copy of the official airport layout plan or a more schematic scale drawing such as the one included on FAA Airport Master Record (5010) forms. At a minimum, show the configuration and dimensions of the runways, size and shape of runway protection zones, and location of airport boundaries. Also show planned changes to any of these airport components.
Page 2-8	▪ *Airport Activity:* Document existing and projected airport operational levels. Include data indicating the known or estimated distribution of operations by type of aircraft, time of day, and runway used. As necessary, extend forecasts included in adopted master plans to ensure that the compatibility plan reflects the anticipated growth of airport activity for at least a 20-year period.
	➤ **Compatibility Policies and Criteria**—State all policies and criteria as clearly, precisely, and completely as possible, preferably in a chapter or section separate from background information. As appropriate, use tables to present primary criteria. Address each type of compatibility concern whether separately or in a composite set of criteria:
Pages 3-3, 7-21	▪ *Noise:* Indicate maximum normally acceptable exterior noise levels for new residential and other noise-sensitive land uses. Note interior noise level standards.
Pages 3-5, 7-34	▪ *Overflight:* Indicate how aircraft overflight annoyance concerns are addressed.
Pages 3-7, 9-42	▪ *Safety:* Indicate maximum acceptable land use densities and intensities and the manner in which they are to be measured. List any uses explicitly prohibited from certain zones.
Pages 3-8, 9-56	▪ *Airspace Protection:* Note reliance upon FAR Part 77 (and TERPS if relevant). If applicable, indicate policies addressing objects where ground level exceeds Part 77 criteria. List criteria regarding bird strike hazards and electronic and visual hazards to flight.
	➤ **Compatibility Zone Maps**—For each airport, provide a compatibility zone map or maps. On base map, identify roads, water courses, section lines, and other major natural and man-made features.
Page 7-18	▪ *Noise Contours:* Show noise contours to be used for planning purposes.
Page 7-35	▪ *Safety Zones:* If compatibility policies are based on separate assessment of compatibility concerns, lindicate boundaries and dimensions of safety zones. When basing zones on guidelines in Chapter 9 of this *Handbook*, make adjustments as appropriate to reflect traffic pattern locations and other factors particular to each individual airport.

TABLE 2A

Checklist of Compatibility Plan Contents

Essential Elements

Page 9-56	▪ *Airspace Protection Surfaces:* Include map derived from FAR Part 77 standards indicating allowable heights of objects relative to the airport elevation. Indicate locations where ground exceeds these limits. Base map should show topography.
Page 3-10	▪ *Composite Compatibility Zones:* When using compatibility criteria representing a composite of the above individual compatibility concerns, provide a map showing the boundaries of each zone. When the boundaries do not follow geographic features, indicate distances of boundaries from the airport runways.
Pages 2-10, 3-15	▪ *Airport Influence Area:* Clearly identify the overall the influence (planning) area boundary for each airport.
	➤ **Procedural Policies**— List policies delineating the process the ALUC will use in reviewing local actions. (Alternatively, procedural policies can be set forth in the commission's rules and regulations.)
Pages 2-10, 4-1	▪ *Types of Actions Reviewed:* List the types of local planning actions which are to be submitted for ALUC review. Distinguish between actions for which reviews are mandatory and those for which reviews depend upon agree ment with the local agency involved.
Page 4-11	▪ *Project Information:* List the types of information to be included when a project or action is submitted for ALUC review.
Page 4-12	▪ *Timing of Review:* Define the timing of ALUC reviews relative to local processing of a project and the time limits within which the ALUC must respond.
Page 1-16	▪ *ALUC Staff Responsibilities:* Define staff responsibilities for preliminary review of projects. Indicate whether staff can complete reviews of actions submitted based on agreement with affected jurisdictions.
Page 4-13	▪ *ALUC Action Choices:* Indicate whether the ALUC will base its findings of a project's consistency or inconsistency with compatibility criteria solely on the project description as submitted or whether the commission may make a finding of consistency subject to attached conditions.
Pages 4-16, 5-2	➤ **Initial Review of General Plan Consistency**—Provide an initial assessment of the general plans, specific plans, and relevant land use ordinances and regulations of affected local jurisdictions relative to the compatibility plan as of the when the latter plan is adopted. Identify any direct conflicts needing to be resolved as well as criteria and procedures which need to be defined in order for the local plans to be considered fully consistent with the compatibility plan.

TABLE 2A, *CONTINUED*

For additional guidance see:	The following items, although not essential components of a compatibility plan, may provide helpful additional information for commission members, their staff, and others who use the plan:
	➤ **Land Use Information**—Include maps such as the following:
Page 3-19	▪ *Existing Land Use Development:* Show locations in the airport vicinity where development exists or has been approved. Alternatively, include a high-altitude aerial photograph of the area.
Page 4-6	▪ *Planned Land Uses:* Include a copy of current general plan land use maps or a simplified version combining planned land use data from multiple jurisdictions.
Page 3-1	➤ **Discussion of Compatibility Issues**—Discuss the basic concepts and rationale behind the compatibility policies and criteria. Much information useful for this purpose is included in this *Handbook*.
	➤ **Local Government Action Choices**—Outline basic options available to affected local jurisdictions for making their general plans consistent with the compatibility plan. Provide sample implementation documents such as:
Page 9-51, Appendix C	▪ *Methods for Calculating Usage Intensities:* Include methodologies for how the number of people per acre can be calculated for nonresidential development.
Page 7-38, Appendix D	▪ *Sample Buyer Awareness Measures:* Provide typical language for navigation easements and deed notices if applicable to the compatibility plan.
Appendix D	▪ *Airport Combining Zoning Ordinance:* Describe possible components of an airport combining zoning ordinance which local jurisdictions could adopt as partial means of complying with general plan consistency requirements.
	➤ **Supporting Materials**—For quick reference, include:
Appendix A	▪ *ALUC Statutes in State Aeronautics Act:* Provide a copy of the current state laws pertaining to airport land use commissions. Indicate the date of the latest revisions included in the copy provided.
Appendix B	▪ *Federal Aviation Regulations Part 77:* Provide a copy of these regulations governing objects affecting navigable airspace.
Appendix I	▪ *Glossary:* Prepare a glossary of common aviation terms, particularly those associated with airport land use compatibility planning topics.

TABLE 2B

Checklist of Compatibility Plan Contents

Optional Elements

affected jurisdictions can be scheduled to coincide with review of a draft compatibility plan. Once an ALUC has consulted with these jurisdictions (or the jurisdictions have declined interest), the commission is free to adopt the planning boundaries it believes are supported by evidence as to airport's impact on the surrounding community. It is essential, though, that the intent to adopt new or revised planning boundaries be specifically identified in public hearing notices and plan adoption resolutions.

Plan Amendments

State law (Section 21675(a)) limits amendment of a compatibility plan to no more than once per calendar year. For compatibility plans which pertain to more than one airport, this limitation can be interpreted as allowing separate amendments for the portion dealing with each individual airport. Any policies applicable to all airports in the ALUC's jurisdiction can be amended only once during a year.

This same section of the law also states that a compatibility plan "shall be reviewed as often as necessary in order to accomplish its purpose." A periodic reexamination of the entire plan is strongly encouraged as a means of keeping it up to date with changes in state laws, local land uses, airport development and activity, and current concepts for achieving noise and safety compatibility. Depending upon the rapidity with which these changes occur, a thorough review is appropriate every five to ten years.

As with the initial adoption of the compatibility plan, the local jurisdiction again has 180 days within which to amend its plans to be consistent with the compatibility plan or to approve findings and overrule the ALUC.

The review and amendment process should follow essentially the same steps as noted above for the original adoption process. Certain steps generally can be simplified if the changes to the plan are relatively minor. Coordination with local jurisdictions is nevertheless still important, particularly if the changes involve influence area boundary changes or affect the consistency with local general plans.

Environmental Document Requirements

DEPT. OF TRANSPORTATION GUIDANCE
Legal opinion on this topic diverges greatly and there is currently little case law. ALUCs are therefore strongly encouraged to consult their respective legal counsel when considering which CEQA action to take in conjunction with adoption or amendment of compatibility plans.

One of the decisions which ALUCs and their staffs need to make in conjunction with adoption or amendment of a compatibility plan is what action to take with respect to California Environmental Quality Act (CEQA) compliance. ALUCs have historically taken a variety of different approaches to CEQA. The most fundamental distinction among these approaches concerns whether CEQA applies to adoption of a compatibility plan. In contrast with the statutes governing other special purpose local agencies (local agency formation commissions, for example) where a link to CEQA is explicitly made in state statutes, ALUC statutes provide no guidance on this issue.

CEQA Document Approach

CEQA statutes and guidelines are very broadly written. The intent of CEQA is to encompass all public planning activities that might have physical effects. Although compatibility plans could cause physical effects only indirectly, there is certainly the potential that such effects could occur.

Given these factors, the cautious approach taken by most ALUCs when adopting or amending a compatibility plan is to prepare CEQA documentation. The two options in this regard are:

- An Initial Study and Negative Declaration (or Mitigated Negative Declaration); or
- An Environmental Impact Report.

➤ **Initial Study/Negative Declaration**—Preparation of an Initial Study and a Negative Declaration (or Mitigated Negative Declaration) is the CEQA route most commonly taken by ALUCs when adopting a compatibility plan. In reviewing the environmental impacts of a compatibility plan, most impact categories clearly do not apply. Those that have some application—noise, safety, land use and housing, in particular—are usually examined rather briefly. Of these, the topic most likely to trigger the need for thorough analysis is housing supply. If implementation of ALUC policies would substantially reduce the amount of new housing which could be built in a community in accordance with the current general plan, the impact may need to be analyzed and mitigation identified. In this situation, either a mitigated negative declaration or an environmental impact report would need to be prepared.

➤ **Environmental Impact Report**—Most of the compatibility plans for which EIRs are written are ones prepared in conjunction with a local specific plan or an airport master plan for which an EIR is necessary. Occasionally an ALUC will prepare an EIR simply as means of addressing the concerns of local agencies and landowners over the implications of the compatibility plan. Generally, only unusual circumstances would require preparation of an EIR for a compatibility plan.

CEQA Exemption Approach

Legal counsel for some ALUCs have concluded that adoption of compatibility plans does not require review under CEQA. These determinations have been based upon the opinion that compatibility plans fall within the definitions of either a general or categorical exemption.

➤ **General Exemption**—Some ALUCs have regarded adoption of a compatibility plan to be statutorily exempt from CEQA regulations. This view has been based upon a determination that adoption of a compatibility plan is not a "project" as defined in CEQA. To be a project, an action undertaken by a public agency must be one that "may cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment." Given airport land use commissions' lack of direct authority over land use, CEQA is potentially applicable only where an ALUC's action may cause a reasonably foreseeable indirect physical change in the environment.

Typically, ALUC compatibility plans define the parameters for future development. These parameters may include: exclusion of certain uses, limitations on residential densities and nonresidential occupancy levels, site design requirements, and building height and other building design requirements. An ALUC's planning parameters serve to limit development. Within these limitations, cities and counties are free to determine the specific land uses. Also, these local agencies have the option of overruling the ALUC plan. It thus can be argued that ALUC adoption of a compatibility plan, in and of itself, does not necessarily lead to land use development, let alone any specific development. Moreover, to attempt to anticipate the type of development and the associated environmental impacts which might occur would be speculative. Under these circumstances, compatibility plan adoption might be considered as not being subject to the requirements of CEQA.

A similar position potentially can be taken with regard to ALUC amendment of an existing compatibility plan. The key difference is whether the amendment would permit greater development (e.g., additional uses, greater densities) than allowed under the existing compatibility plan. Where an amendment would not potentially increase permitted development, it could be possible to conclude that the amendment was not a "project" as defined in CEQA. However, if greater development would be possible with the amendment, the ALUC policy change potentially could lead to a reasonably foreseeable indirect physical change in the environment. ALUCs will need to carefully consider the specific circumstances of a compatibility plan amendment before concluding that it would not be a project under CEQA.

➤ **Categorical Exemption**—This approach relies upon one of the classes of categorical exclusions from CEQA which are listed in the CEQA guidelines. Class 8 consists of "actions taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the environment. Construction activities and relaxation of standards allowing environmental degradation are not included in this exemption." The argument made is that compatibility plans serve to protect the environment and are not plans for development. This exemption is not absolute. Unique circumstances—for example, an amendment which would relax the compatibility standards and thus allow additional development—would invalidate the exemption.

Public Notice and Hearing Requirements

The Aeronautics Act does not specifically require that an ALUC provide public notice or hold a public hearing in order to adopt a compatibility plan. Such measures exist elsewhere in state law, however, and in any case are generally prudent.

Public Notice

The only mention of public notice requirements in the ALUC statutes is with regard to ALUC action on land use proposals. Section 21675.2(d) says that: "Nothing in this section diminishes the commission's legal responsibility to provide, where applicable, public notice and hearing before acting on an action, regulation, or permit." By extension, this responsibility can be interpreted as applicable to adoption or amendment of compatibility plans. The question faced by ALUCs and their staffs then becomes one of deciding what type of public notification is appropriate.

The best guidance in this respect is for ALUCs to follow the same notice procedures as are applicable to general plans and specific plans. These requirements are set forth in the Government Code (in particular, Sections 65090, 65091, and 65353). Basically, notice must be sent to each affected property owner unless mailing of more than 1,000 such notices would be necessary. In this case, notice may be published in a newspaper of general circulation serving the area affected.

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs are encouraged to consider When providing public notice for proposed adoption or amendment of a compatibility plan, ALUCs should follow the same notice procedures as are applicable to general plans and specific plans.

Since most compatibility plans—especially countywide plans covering multiple airports—involve more than 1,000 parcels, providing public notice by means of a local newspaper is common. Many ALUCs, though, find it desirable to supplement the newspaper notice with individual mailings to selected property owners. These owners are ones whose property development potential might be reduced by the compatibility plan. Such parcels include agricultural or other large parcels capable of subdivision under local zoning regulations and parcels zoned commercial or industrial on which usage intensity limitations would be applied. To the extent that a compatibility plan would not establish any new restrictions or limit the subdivision potential of existing residential lots, mailing of notices to the individual owners is normally unnecessary.

Public Hearings

ALUC public hearing requirements pertaining to adoption or amendment of compatibility plans arise only with respect to establishment of an airport planning area boundary. Other laws applicable to ALUCs also do not require the holding of a public hearing. The Brown Act requires only that ALUC meetings be open to the public, not that public input be received. Furthermore, nothing in the California Environmental Quality Act mandates a public hearing; public input can be limited to correspondence only. From a practical perspective, however, ALUCs are well advised to solicit public and local agency input before adopting a compatibility plan, even if a formal public hearing process is not utilized.

CHAPTER 3

Formulating Airport Land Use Compatibility Policies

Overview

Compatibility policies, including both criteria and maps, are the central component of any compatibility plan. The purpose of this chapter is to discuss basic concepts and common issues involved in preparing an airport land use compatibility plan and in formulating the policies contained therein. Specific policy guidance regarding noise and safety compatibility concerns is provided in Chapters 7 and 9, respectively.

Topics addressed in chapter include:

- The types of compatibility concerns addressed in compatibility plans;
- Compatibility table and map formats;
- Issues involving existing land uses and other compatibility considerations;
- Factors which limit the degree of restrictiveness ALUCs can apply to land use development; and
- Differences in compatibility planning concerns and approaches among different types of airports.

Types of Compatibility Concerns

As indicated in the preceding chapters, the airport land use compatibility concerns of ALUCs fall under two broad headings identified in state law: noise and safety. However, for the purposes of formulating airport land use compatibility policies and criteria, further dividing these basic concerns into four functional categories is more practical. These categories are:

- *Noise:* As defined by cumulative noise exposure contours describing noise from aircraft operations near an airport.
- *Overflight:* The impacts of routine aircraft flight over a community.
- *Safety:* From the perspective of minimizing the risks of aircraft accidents beyond the runway environment.
- *Airspace Protection:* Accomplished by limits on the height of structures and other objects in the airport vicinity and restrictions on other uses which potentially pose hazards to flight.

The formulation of airport land use compatibility policies and associated criteria in each of these four categories is discussed on the following pages. The emphasis, however, is on ways of *categorizing* and *organizing* the policies rather than on the *concepts* behind them. The latter is the major topic of Part II.

DEPT. OF TRANSPORTATION GUIDANCE
A summary of basic criteria appropriate for each of the four compatibility categories is presented in the Summary section at the front of this *Handbook*.

For each compatibility category, four features are outlined below:

- *Compatibility Objective:* The objective to be sought by establishment and implementation of the compatibility policies;
- *Measurement:* The scale on which attainment of the objectives can be measured;
- *Compatibility Strategies:* The types of strategies which, when formulated as compatibility policies, can be used to accomplish the objectives; and
- *Basis for Setting Criteria:* The factors which should be considered in setting the respective compatibility criteria.

Noise

Noise is one of the most basic airport land use compatibility concerns. Moreover, at major airline airports, many busy general aviation airports, and most military airfields, noise is usually the most geographically extensive form of airport impact.

➤ **Compatibility Objective**—The clear objective of noise compatibility criteria is to minimize the number of people exposed to frequent and/or high levels of airport noise capable of disrupting noise-sensitive activities.

➤ **Measurement**—For the purposes of airport land use compatibility planning, noise generated by the operation of aircraft to, from, and around an airport is primarily measured in terms of the cumulative noise levels of all aircraft operations. In California, the cumulative noise level metric established by state regulations, including for airport noise, is the Community Noise Equivalent Level (CNEL). This metric provides a single measure of the average sound level in decibels (dB) to which any point near an airport is exposed. To reflect an assumed greater community sensitivity to nighttime and evening noise, events during these periods are counted as being louder than actually measured. Cumulative noise levels are usually illustrated on airport area maps as contour lines connecting points of equal noise exposure. Mapped noise contours primarily show areas of significant noise exposures—ones affected by high concentrations of aircraft takeoffs and landings.

The calculation of cumulative noise levels depends upon the number, type, and time of day of aircraft operations, the location of flight tracks, and other data described in Chapter 6. For airports with airport traffic control towers, some of these inputs can be derived from recorded data. Noise monitoring and radar flight tracking data available for airports in most metropolitan areas are other sources of valuable information. At most airports, though, the individual input variables must be estimated. The important point to be made here is that, despite their computer-generated origin, the location of noise contours is not necessarily precise. Where extensive noise monitoring and flight tracking data are available, current contours can be accurate to within ±1 dB. Elsewhere, the level of accuracy has generally been found to be about ±3 dB. Contours representing projections of future noise levels are inherently even less precise.

The CNEL metric used in California is equivalent to the Day-Night Average Sound Level (DNL) metric used elsewhere in the U.S., but adds the evening weighting not included in DNL. See Chapter 6 for an extended review of aircraft noise metrics.

There is on-going nationwide debate regarding the appropriateness of single-event noise level criteria as a supplement or replacement for cumulative noise level metrics. The argument chiefly made is that cumulative noise level metrics may not adequately identify some aspects of noise exposure effects, particularly within the context of assessing the environmental impacts of airport improvement projects. In response, the Federal Interagency Committee on Noise (FICON) has reviewed federal policies governing the assessment of airport noise impacts. FICON's most recent technical conclusion is that "there are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL (CNEL in California) cumulative noise exposure metric." Therefore, this *Handbook* continues to use CNEL as the primary tool for the purpose of land use compatibility planning. This does not, however, limit an ALUC from including other noise measurement tools in its consideration of potential aircraft noise impacts, especially with respect to overflight issues as discussed below.

- **Compatibility Strategies**—The basic strategy for achieving noise compatibility in an airport vicinity is to limit development of land uses which are particularly sensitive to noise. The most acceptable land uses are ones which either involve few people (especially people engaged in noise-sensitive activities) or generate significant noise levels themselves (such as other transportation facilities or some industrial uses).

  On occasion, local considerations outweigh noise impacts and result in decisions by local land use jurisdictions or even ALUCs to allow residential development in locations where this use would normally be considered incompatible. In such circumstances, approval of the development should be conditioned upon dedication of an avigation easement and requirements for sufficient acoustic insulation of structures to assure that aircraft noise is reduced to an interior noise level of 45 dB CNEL or less.

- **Basis for Setting Criteria**—Compatibility criteria related to cumulative noise levels are well-established in federal and state laws and regulations. The basic state criterion sets a CNEL of 65 dB as the maximum noise level normally compatible with urban residential land uses. For many airports and many communities, 65 dB CNEL is too high for land use planning purposes. A process called "normalization" is one means of adjusting the criteria to reflect ambient sound levels, the community's previous exposure to noise, and other local characteristics as outlined in Chapter 7. This process helps to determine what CNEL is of significance to that particular community. Once the baseline maximum acceptable noise level for residential uses is established, criteria for other land uses can be set in a manner consistent with this starting point.

Overflight

As discussed in Chapter 7, experience at many airports has shown that noise-related concerns do not stop at the boundary of the outermost mapped CNEL contour. Many people are sensitive to the frequent presence of aircraft overhead even at noise low levels. These reactions can mostly be expressed in the form of *annoyance*.

As the term is applied herein, an *overflight* means any distinctly visible and audible passage of an aircraft, not necessarily one which is directly overhead.

At many airports, particularly air carrier airports, complaints often come from locations beyond any of the defined noise contours. Indeed, heavily used flight corridors to and from metropolitan areas are known to generate noise complaints 50 miles or more from the associated airport. The basis for such complaints may be a desire and expectation that outside noise sources not be intrusive—or, in some circumstances, even distinctly audible—above the quiet, natural background noise level. Elsewhere, especially in locations beneath the traffic patterns of general aviation airports, a fear factor also contributes to some individuals' sensitivity to aircraft overflights.

While these impacts may be important community concerns, the question of importance here is whether any land use planning actions can be taken to avoid or mitigate the impacts or otherwise address the concerns. Commonly, when overflight impacts are under discussion in a community, the focus is on modification of the flight routes. Indeed, some might argue that overflight impacts should be addressed solely through the aviation side of the equation—not only flight route changes, but other modifications to where, when, and how aircraft are operated.

ALUCs are particularly limited in their ability to deal with overflight concerns. For one, they have no authority over aircraft operations. The most they can do to bring about changes is to make requests or recommendations. Even with regard to land use, the authority of ALUCs extends only to proposed new development.

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs are encouraged to consider aircraft overflight annoyance concerns when developing airport compatibility plans.

These limitations notwithstanding, there are steps which ALUCs can and should take to help minimize overflight impacts.

➤ **Compatibility Objective**—In an idealistic sense, the compatibility objective with respect to overflight is the same as for noise: avoid land use development which can lead to annoyance and complaints. However, given the extensive geographic area over which the impacts occur, this objective is unrealistic except relatively close to the airport. A more realistic objective therefore might be to promote conditions under which annoyance will be minimized. Possible strategies in this regard are described below.

➤ **Measurement**—Determining where to draw boundaries around areas of potentially significant overflight noise exposure is difficult because these locations extend beyond the well-defined CNEL contours which indicate areas of high noise exposure. CNEL contours are not very precise at low noise levels, especially where aircraft flight tracks are widely divergent. The general locations over which aircraft regularly fly as they approach and depart an airport is thus a better indicator of overflight annoyance concerns. For general aviation airports, such locations include areas beneath the standard airport traffic patterns, the portions of the pattern entry and departure routes flown at normal traffic pattern altitude, and perhaps additional places which experience a high concentration of overflights. Also, at all types of airports, common IFR arrival and departure routes can produce overflight concerns, sometimes many miles from the airport.

➤ **Compatibility Strategies**—As noted above, the ideal land use compatibility strategy with respect to overflight annoyance is to avoid development of residential and other noise-sensitive uses in the affected locations. To the extent that this approach is not practical, three different (but not mutually exclusive) strategies are apparent.

Descriptions and discussion of these buyer awareness measures are included later in this chapter.

- One strategy is to help people with above-average sensitivity to aircraft overflights—people who are highly *annoyed* by overflights—to avoid living in locations where frequent overflights occur. This strategy involves making people more aware of an airport's proximity and its current and potential aircraft noise impacts on the community before they move to the area. This can be accomplished through buyer awareness measures such as dedication of avigation or overflight easements, recorded deed notices, and/or real estate disclosure statements. In new residential developments, posting of signs in the real estate sales office and/or at key locations in the subdivision itself can be further means of alerting the initial purchasers about the impacts (signs are of little long-term value, however).

- A second strategy is to minimize annoyance by reducing the intrusiveness of aircraft noise above normal background noise levels. Because ALUCs and local land use authorities have no way of regulating aircraft noise levels, the other option is to promote types of residential land uses which tend to mask the intrusive noise. In this regard, multi-family residences—because they tend to have comparatively little outdoor living areas, fewer external walls through which aircraft noise can intrude, and relatively high noise levels of their own—are preferable to single-family dwellings. Particularly undesirable are "ranchette" style residential areas consisting of large (about an acre on average) lots. Such developments are dense enough to expose many people to overflight noise, yet sufficiently rural in character that background noise levels are likely to be low.
- Finally, for highly noise-sensitive uses, acoustical treatment of the structures, together with dedication of an avigation easement, may be appropriate.

➤ **Basis for Setting Criteria**—The basis for setting criteria is primarily the experience and knowledge that airport proprietors and airport land use commissions have about the noise sensitivity of the specific communities involved.

The overflight issue is being studied by the FAA as part of regional air traffic control and as part of noise issues in national parks and wilderness areas. Useful guidance may come out of these efforts in the future.

Safety

Compared to noise, safety is in many respects a more difficult concern to address in airport land use compatibility policies. A major reason for this difference is that safety policies address uncertain events which *may occur* with *occasional* aircraft operations, whereas noise policies deal with known, more or less predictable events which *do occur* with *every* aircraft operation. Because aircraft accidents happen infrequently and the time, place, and consequences of their occurrence cannot be predicted, the concept of *risk* is central to the assessment of safety compatibility. From the standpoint of land use planning, two variables determine the degree of risk posed by potential aircraft accidents:

- *Accident Frequency:* Where and when aircraft accidents occur in the vicinity of an airport;
- *Accident Consequences:* Land uses and land use characteristics which affect the severity of an accident when one occurs.

➤ **Compatibility Objective**—The overall objective of safety compatibility criteria is simply to minimize the risks associated with potential aircraft accidents. There are two components to this objective, however:

- *Safety on the Ground:* The most fundamental safety compatibility component is to provide for the safety of people and property on the ground in the event of an aircraft accident near an airport.
- *Safety for Aircraft Occupants:* The other important component is to enhance the chances of survival of the occupants of an aircraft involved in an accident which takes place beyond the immediate runway environment.

➤ **Measurement**—In measuring the degree of safety concerns around an airport, the frequency component of risk assessment is most important: what is the potential for an accident to occur? As mentioned above, there are both *where* and *when* variables to the frequency equation:

Except with respect to airspace protection, ALUCs have virtually no powers to implement actions which can reduce the *frequency* of aircraft accidents. An understanding of the *spatial* element of accident frequency as examined in Chapters 8 and 9 is nevertheless essential to ALUC development of effective measures to limit the potential *severity* of accidents.

- *Spatial Element:* The spatial element describes *where* aircraft accidents can be expected to occur. Of all the accidents which occur in the vicinity of airports, what percentage occur in any given location?
- *Time Element:* The time element adds a *when* variable to the assessment of accident frequency. In any given location around a particular airport, what is the chance that an accident will occur in a specified period of time?

➤ **Compatibility Strategies**—Safety compatibility strategies focus on the *consequences* component of risk assessment. Basically, the question is: what land use planning measures can be taken to reduce the severity of an aircraft accident if one occurs in a particular location near an airport? Although there is a significant overlap, specific strategies must consider both components of the safety compatibility objective: protecting people and property on the ground; and enhancing safety for aircraft occupants. In each case, the primary strategy is to limit the intensity of use (the number of people concentrated on the site) in locations most susceptible to an off-airport aircraft accident. This is accomplished by:

Under many circumstances, one means of implementing both the density limitations and open land requirements strategies is through clustering of development. This concept is discussed in Chapter 9.

- *Density and Intensity Limitations:* Establishment of criteria limiting the maximum number of dwellings or people in areas close to the airport is the most direct method of reducing the potential severity of an aircraft accident.
- *Open Land Requirements:* Creation of requirements for open land near an airport addresses the objective of enhancing safety for the occupants of an aircraft forced to make an emergency landing away from a runway.
- *Highly Risk-Sensitive Uses:* Certain critical types of land uses—particularly schools, hospitals, and other uses in which the mobility of occupants is effectively limited—should be avoided near the ends of runways regardless of the number of people involved. Aboveground storage of large quantities of highly flammable or hazardous materials also should be avoided near airports.

➤ **Basis for Setting Criteria**—Setting safety compatibility criteria presents the fundamental question of what is safe. Expressed in another way: what is an *acceptable risk*? In one respect, it may seem ideal to reduce risks to a minimum by prohibiting most types of land use development from areas near airports. However, as addressed later in this chapter, there are usually costs associated with such high degrees of restrictiveness. In practice, safety criteria are set on a progressive scale with the greatest restrictions established in locations with the greatest potential for aircraft accidents.

- *Established Guidance:* As noted in Chapter 9, little established guidance is available to ALUCs regarding how restrictive to make safety criteria for various parts of an airport's environs. Unlike the case with noise, there are no formal federal or state laws or regulations which set safety criteria for airport area land uses for civilian airports except within *runway protection zones* (and with regard to airspace obstructions as described separately in the next section). Federal Aviation Administration safety criteria primarily are focused on the runway and its immediate environment. Runway protection zones—then called *clear zones*—were originally established mostly for the purpose of protecting the occupants of aircraft which overrun or land short of a runway. Now, they are defined by the FAA as intended to enhance the protection of people and property on the ground.
- *New Research:* To provide a better foundation for establishment of safety criteria in other portions of the airport environs, extensive research into the distribution of general aviation aircraft accident locations was conducted in conjunction with the 1993 edition of this *Handbook* and expanded as an initial step in preparation of the present edition. The results are outlined in Appendix G and further examined in Chapter 9. Available information regarding air carrier aircraft accidents is presented as well. However, even with this new data on which to base safety compatibility decisions, the question is still ultimately one of what is acceptable to the local community.

Airspace Protection

Relatively few aircraft accidents are caused by land use conditions which are hazards to flight. The potential exists, however, and protecting against it is essential to airport land use safety compatibility.

➤ **Compatibility Objective**—Because airspace protection is in effect a safety factor, its objective can likewise be thought of in terms of risk. Specifically, the objective is to avoid development of land use conditions which, by posing hazards to flight, can increase the risk of an accident occurring. The particular hazards of concern are:

- Airspace obstructions;
- Wildlife hazards, particularly bird strikes; and
- Land use characteristics which pose other potential hazards to flight by creating visual or electronic interference with air navigation.

Protection of airport airspace is one of the few actions which ALUCs can take to help reduce the *frequency* of aircraft accidents.

Excerpts from Part 77 are included in Appendix B.

As discussed in Chapter 8, a second set of airspace surfaces around airports are ones defined by the *U.S. Standard for Terminal Instrument Procedures* (TERPS). These criteria are used in the design of instrument approach procedures. In most cases, height limitations under TERPS are less restrictive than under FAR Part 77. However, in some situations (such as an approach which is not aligned with the runway), TERPS surfaces need to be considered in order to fully protect an airport's airspace.

➤ **Measurement**—The measurement of requirements for airspace protection around an airport is a function of several variables including: the dimensions and layout of the runway system; the type of operating procedures established for the airport; and, indirectly, the performance capabilities of aircraft operated at the airport.

- *Airspace Obstructions:* Whether a particular object constitutes an airspace obstruction depends upon the height of the object relative to the runway elevation and its proximity to the airport. The acceptable height of objects near an airport is most commonly determined by application of standards set forth in Part 77 of the Federal Aviation Regulations. These regulations establish a three-dimensional space in the air above an airport. Any object which penetrates this volume of airspace is considered to be an obstruction and may affect the aeronautical use of the airspace.
- *Wildlife and Other Hazards to Flight:* The significance of other potential hazards to flight is principally measured in terms of the hazards' specific characteristics and their distance from the airport and/or its normal traffic patterns.

➤ **Compatibility Strategies**—Compatibility strategies for the protection of airport airspace are relatively simple and are directly associated with the individual types of hazards:

- *Airspace Obstructions:* Buildings, antennas, other types of structures, and trees should be limited in height so as not to pose a potential hazard to flight.
- *Wildlife and Other Hazards to Flight*: Land uses which may create other types of hazards to flight near an airport should be avoided or modified so as not to include the offending characteristic.

➤ **Basis for Setting Criteria**—The criteria for determining airspace obstructions and other hazards to flight have been long-established in FAR Part 77 and other Federal Aviation Administration regulations and guidelines. Also, state of California regulation of obstructions under the State Aeronautics Act (Public Utilities Code, Section 21659) is based on FAR Part 77 criteria.

COMPATIBILITY CRITERIA TABLES AND MAPS

Identification of land use compatibility strategies such as those outlined in the preceding section is only one part of the process of developing compatibility policies. The other piece of the puzzle is to relate these strategies to the airport environs both geographically and for various categories of land uses. This is done by means of a compatibility criteria table or tables—although sometimes a list or outline format is used—together with one or more compatibility zone maps.

- **Tables**—Compatibility criteria tables provide the measures by which land use categories of characteristics can be evaluated for compatibility with the airport impacts identified for various portions of the airport environs.
- **Maps**—Compatibility maps show where the various criteria geographically apply within the airport vicinity. Generally, the maps divide the airport environs into a series of zones in which a progressively greater degree of land use restrictions apply the closer the zone is to the airport.

Compatibility Criteria Table and Map Formats

Three basically distinct table and map formats have evolved among the compatibility plans adopted by ALUCs in California. As with many other facets of compatibility planning, there are advantages and disadvantages to each choice with none being clearly the best.

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ALUCs are encouraged to consider All of these formats are acceptable options for airport land use compatibility plans.

Separate Criteria Tables and Maps

The traditional approach to compatibility criteria tables and maps is to have separate sets for each type of impact. For noise, the table indicates whether each land use classification is or is not acceptable within various ranges of noise exposure as measured on the CNEL scale. For safety, the relationship is between each land use category and the degree of accident risk at locations around the airport. An airspace protection map indicates the allowable heights of objects near the airport. Finally, overflight concerns can be addressed by a map showing where any associated compatibility policies apply.

- **Advantages**—The chief advantage to this approach is that the relationships between the noise and safety concerns and the associated criteria are relatively obvious. For example, at a minimum, residences should not be exposed to noise levels above a CNEL of 65 dB and schools and shopping centers should not be situated in a runway protection zone.

  A second advantage is that the resulting large number of zones (because noise and safety each have their own set of zones and airspace protection is also separately considered) gives greater flexibility in adjusting the compatibility criteria to suit the circumstances. This flexibility can be particularly important in urban areas where site design and other specific features of the development can become critical to determining the compatibility of a proposed land use.
- **Disadvantages**—The disadvantages involve ease of use and occasional confusion in application. Although technically sound, the use of separate criteria and maps can be more complicated and require greater understanding of airport land use compatibility concepts. For any given land use classification or individual development proposal to be evaluated, it must be checked against multiple sets of criteria tables and maps—noise, safety, and overflight impacts—as well as a map of protected airspace. The confusion sometimes arises because of the lack of coordination between the impact assessments. For a given location, one type of land

use may be acceptable with respect to noise, but not for safety; another use may be just the opposite; and, taken together, most forms of urban land use development may sometimes appear to be ruled out.

Another disadvantage is the tendency to rigidly apply the delineated zone boundaries, especially for noise, to the evaluation of a particular land use project or action. Although often advantageous from the standpoint of planning practice, rigid application of the boundaries implies a degree of precision which does not exist in the measurement of the airport impacts.

Composite Criteria Table and Map

A different approach, one which has become increasingly common, simplifies compatibility assessments by condensing the various factors down to a single set of criteria presented in one table and one map for each airport. The map defines a small number of discrete zones—preferably no more than five or six—which represent locations with similar *combinations* of noise, safety hazard, and overflight exposure. Airspace protection criteria can sometimes be included as well.

An example of such zones might combine the various factors as follows:

Zone	Location / Compatibility Factors
A	➤ Runway primary surface and runway protection zones
B1	➤ Inner segment of runway approaches ➤ High noise levels; high safety concerns ➤ Low-altitude aircraft overflight ➤ Height limits as little as 50 feet
B2	➤ Adjacent to runway ➤ High noise; moderate safety concerns ➤ Normally no overflights ➤ Transitional surface height limit restrictions
C1	➤ Outer portion of runway approach routes, particularly instrument approaches ➤ Moderate noise; moderate safety concerns ➤ Overflight at less than normal traffic pattern altitude
C2	➤ Remainder of common traffic patterns ➤ Overflight at traffic pattern altitude ➤ Potential overflight annoyance concerns
D	➤ Less frequent overflights ➤ Remainder of airspace protection surfaces

➤ **Advantages**—One advantage to the composite approach is that it allows most land uses to be evaluated with quick reference to a single table and map. More significantly, though, is that it allows more flexibility in the *mapping* of compatibility zones (as compared to the separate criteria and map format which offers higher flexibility in defining the compatibility criteria). As discussed later in this chapter, generic boundaries can be drawn for a limited number of airport classes. These boundaries can then be applied to all similar airports in the ALUC's jurisdiction and adjusted as necessary to reflect atypical airport operational characteristics, local geographic boundaries, and established land uses.

➤ **Disadvantages**—The major disadvantage to combining compatibility criteria into a single table and map is that the basis for location of the zone boundaries is not always clear. If more detailed assessment of a complex land use development proposal is necessary, reference to separate noise and safety compatibility tables and maps is often still required.

Detailed Land Use Map

A final format found among some compatibility plans is a detailed land use map comparable to ones found in general plans or specific plans. This format is most likely to be utilized when the ALUC adopts a compatibility plan which is also prepared for local agency adoption as a specific plan. Depending upon the extent to which the land use categories reflect airport compatibility concerns, a detailed land use map conceivably can bypass the need for compatibility criteria tables.

➤ **Advantages**—Probably the most significant advantage of the detailed land use map approach to compatibility mapping is that it enables the same map to be adopted by the ALUC as a compatibility plan and by the local agency as a specific plan. Because the maps and plans (or at least the airport-related portions of them) are identical, the two are automatically consistent with each other.

➤ **Disadvantages**—A major disadvantage of this approach is that it entails more work to prepare than is necessary for the other formats. A detailed land use map prepared for a specific plan must take into account factors which are not of concern to the ALUC. Close cooperation between the ALUC and the county or city preparing the specific plan is necessary to assure that all essential factors are addressed. Also a potential disadvantage is that a detailed land use map of this type pertains only to a single airport and the compatibility criteria on which it is based may not correspond very closely to criteria used in compatibility plans for other airports within the ALUC's jurisdiction.

Categorization of Land Uses

The other variation in the formatting of compatibility criteria pertains to how land uses are categorized in the compatibility table or tables. There are two different approaches to the listing of land uses. Both are common among ALUC compatibility plans and, as with the overall format of the tables, each has advantages and disadvantages.

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Either of these two formats is accept able. In both cases, however, attention should be paid to minimizing the shortcomings listed among each option's disadvantages.

Detailed Listing Format

One approach to land use categorization is to divide the full range of land uses into specific classes. The number of classifications might be relatively few in number—residential, commercial, industrial, public facility, etc.—as commonly found on general plans or specific plans. Alternatively, a much more narrowly defined listing might be utilized—one in which the broader land use categories are divided into more precise subcategories.

The detailed listing approach to land use categories works with either separate or composite compatibility tables and maps. It is essential if a detailed land use map approach is used.

- **Advantages**—The advantage of the detailed listing approach is that it removes most of the need for interpretation of standards as required within the performance-oriented categories. Each listed use can be denoted as either *compatible* or *incompatible* with a given level of airport impacts. This greatly simplifies the task of local planners when they must evaluate an individual development proposal either with respect to the ALUC's compatibility plan directly or the local agency's general or specific plan.
- **Disadvantages**—The major disadvantage of this method is that, unless the land use categories are defined very narrowly, the usage intensity (the number of people per acre) and other characteristics which affect compatibility might cover a wide range. Indicating that a particular land use is compatible with the airport could result in development of an activity which clearly exceeds the intensity considered acceptable. Oppositely, listing a land use as incompatible might preclude a development which could be a good airport neighbor. Some ALUCs resolve this problem by including a third consistency category: *conditionally compatible*. Assessment of the compatibility of an individual development proposal then usually requires returning to functionally oriented criteria as described below.

  Another potential difficulty with including a detailed listing of land uses in a compatibility plan is that the selected categories may not conform to those used by the local land use jurisdictions. This is particularly likely to occur when the compatibility plan covers multiple airports and encompasses several counties and/or cities, each with its own set of land use categories.

Functional or Performance-Oriented Characteristics

This approach entails dividing land uses according to characteristics related to the previously described compatibility planning strategies. It applies primarily to when a composite compatibility table and map are utilized, but could also be employed as a means of evaluating safety compatibility. The number of categories needed is thus kept small. No distinctions are made among different types of land uses with similar functional or performance-oriented characteristics—for example, between an office and a retail store which attract the same number of people in buildings equivalent in size. When this method of land use categorization is used in a compatibility table, the result for most categories is not an indication of whether the land use is compatible or incompatible. Rather, the table establishes a set of criteria based upon specified performance measures which, if satisfied, will result in compatible land use.

A typical set of performance-oriented land use characteristics and their respective compatibility measures is as follows:

- **Residential Density**—For airport compatibility purposes, the chief distinguishing feature among residential land uses is the number of dwelling units per acre. To be compatible with airport activities, the number of dwelling units per acre should not exceed the criterion specified for the compatibility zone where the use would occur.
- **Nonresidential Usage Intensity**—The most significant factor among most other types of land use development is the number of people attracted by the use. Safety is the principal concern in this regard, although noise could also be evaluated in this manner. With the exception of certain sensitive uses, the nature of the activity associated with the actual land use is not highly relevant to airport land use compatibility objectives.

See Appendix C for guidance on methods of calculating intensities of nonresidential land uses.

- **Sensitive Uses**—This category includes land uses which, because of their special sensitivity, should be excluded from certain locations near airports even if they meet other quantitative criteria. Children's schools, day care centers, hospitals, nursing homes, and other highly risk-sensitive uses are primary examples. Uses involving storage of large quantities of hazardous materials also fit into this category on the basis of safety. In terms of noise, uses such as an amphitheater might be considered unacceptable near an airport regardless of the number of people exposed to the noise.
- **Open Land**—Requirements for open land usable for the emergency landing of aircraft near an airport apply regardless of the overall land use classification of the property. The associated criteria indicate what percentage of the land area in each compatibility zone should be devoted to functional open space.
- **Permitted Heights**—Another land use characteristic that can be incorporated into a composite compatibility table is the height of structures which can clearly be attained without penetration of the airport airspace. Including permitted heights as a criterion in a composite compatibility zone works best at airports in relatively level terrain. At airports where elevations of the surrounding terrain vary substantially, special provisions might need to be made to account for the lack of consistent relationship between the height permitted and the location of the individual compatibility zones.

Advantages and disadvantages of this style of land use categorization include:

- **Advantages**—The principal advantage of performance-oriented categorization of land uses is that this method directly addresses factors pertinent to airport land use compatibility. Recognition is given to significant land use characteristics which might not be distinguished in a traditional listing of land uses.
- **Disadvantages**—The significant disadvantage of performance-based land use categories is that assessing the compatibility of a particular land use designation or individual development proposal requires interpretation of the associated criteria (except for residential uses). If, for example, data

regarding the usage intensity is not available, then compatibility evaluation will require reliance on information sources (building and fire code standards, for example) which may not accurately reflect the aviation-related concerns. The results may not always be consistent with previous determinations.

Preparing Compatibility Maps

Regardless of which format is used for the compatibility table and maps, several important factors should be considered when preparing the maps for a particular airport.

Basic Determinants of Compatibility Zone Boundaries

The manner in which compatibility zone boundaries are determined depends to some extent upon the map format utilized.

- **Separate Compatibility Maps**—With this format, each map directly reflects the associated airport impacts:

  Figure 6G in Chapter 6 depicts an example of a set of noise contours.

  - *Noise:* Community Noise Equivalent Level (CNEL) contours directly from the computer output or with minor graphical clean-up can be utilized. The lowest CNEL contour depicted may vary depending on how sensitive the surrounding community is to aircraft noise.

  Accident location data gathered for the preparation of this *Handbook* can help to refine the boundaries of safety compatibility zones for individual airports. See the discussion in Chapter 9.

  - *Safety:* ALUCs which use separate mapping of each compatibility concern typically establish three to six safety zones reflecting assumed accident potential. The distinct zones might include: the runway protection zone; an approach zone (perhaps divided into two segments); a traffic pattern overflight zone; and sometimes a zone encompassing areas adjacent to the runway.

  An example of a typical civilian airport airspace plan is included in Chapter 9.

  - *Airspace Protection:* The height-limit component of airspace protection can be mapped from the Federal Aviation Regulations, Part 77, airspace plan prepared for the airport. Critical TERPS surfaces can be added as appropriate. Zones related to bird strike hazards and visual and electronic interference concerns are seldom mapped.
  - *Overflight:* Areas where overflight compatibility criteria apply are usually shown on noise or safety compatibility maps rather than separately.

- **Composite Criteria Maps**—Creation of a map of composite compatibility zones for an airport starts with preparation of the separate compatibility maps as described above. These maps are then reviewed in combination with each other to identify locations where the overall extent of noise, risk, and other impacts are similar. Preferably, no more than five or six composite zones should be created.

  Even when a composite map is used for noise, safety, and overflight compatibility evaluation, a separate map is usually prepared to allow precise assessment of airspace protection requirements.

➤ **Detailed Land Use Map**—As with the composite criteria map format, preparation of a detailed land use map requires that the factors affecting land use choices be individually considered and mapped, then combined into a single map using an overlay process. The difference from a composite compatibility criteria map is that the detailed land use map must also take into account nonaviation determinants of land use designations. As indicated in the preceding discussion of land use categories, the designations used in a detailed land use compatibility map should divide the land use types into a sufficient number of categories to enable various degrees of airport compatibility concerns to be recognized. For example, commercial uses should be distinguished as low intensity (few people per acre) versus high intensity (many people per acre).

Relationship of Zone Boundaries to Geographic Features

The location of airport-related impacts is mostly determined by the location of runways, flight routes, and other aviation-related factors, not geographic features of the airport environs. While defining compatibility zone boundaries based strictly on the impacts provides the closest relationship to those impacts, the resulting maps are not as easy for local planners to use. The alternative is to adjust the zone boundaries to follow geographic features, existing land use development, and other local land use characteristics. By so doing, situations where a compatibility zone boundary splits a parcel can be minimized.

Adjustment of boundary lines is generally more practical in urban areas, because they offer more choices of roads, parcel lines, and other geographic features, than in rural locations where these features are more widely spaced. Also, the composite criteria and detailed land use map formats better lend themselves to boundary adjustments than do separate compatibility maps.

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Adjustment of compatibility zone boundaries to follow geographic features is acceptable provided that the area within each of the resulting zones is reasonably uniform with respect to the extent of airport-related impacts which it experiences.

Relationship of Compatibility Zones to Overall Planning Area

The overall planning or influence area for an airport is normally the area encompassed by a composite of each of the individual compatibility zones. For most civilian airports, the most geographically extensive compatibility concern is the airspace protection area defined by the outer edge of the FAR Part 77 conical surface. This distance equals 9,000 feet from the runway primary surface for small airports with no instrument approaches and 14,000 feet for most other civilian airports (the primary surface extends 200 feet beyond the runway end).

There are exceptions to this basic rule, however.

➤ **Precision Instrument Runways**—The FAR Part 77 approach surface for precision instrument runways extends 50,000 feet (nearly 10 miles) from the runway primary surface. Considering that the height limit at this distance is 1,200 feet above the airport elevation, establishing an airport influence area of that size solely for the purposes of airspace protection is usually unnecessary. However, where rising terrain is a factor or where other types of approaches place aircraft at a low altitude several miles from the

An alternative to stretching the airport planning area boundary simply to encompass the outermost limits of the Part 77 airspace surfaces is to require that any proposed construction more than 200 feet in height be submitted to the ALUC for review regardless of where in the county the object would be located. Proposed construction of this height also must referred to the FAA for review in accordance with Part 77 regulations.

runway, extension of the airport influence area beyond the conical surface may be appropriate.

- **Major Flight Routes**—Major flight routes to and from busy airports, especially major airline airports and some military fields, can produce overflight impacts and sometimes even noise contours which extend beyond the FAR Part 77 boundaries. If corresponding compatibility policies are designated for these locations, the airport influence area boundary would be extended accordingly.
- **Limited-Use Airports**—At some airports, aircraft-related impacts are limited almost exclusively just to portions of the airport environs (because certain runways are seldom used, for example, or because the traffic pattern is situated only on one side of the runway). In these situations, the airport influence area can sometimes be reduced to less than the area encompassed by the FAR Part 77 surfaces. If this is done, however, steps need to be taken to assure that tall objects situated within the excluded area do would not constitute significant airspace obstruction concerns.
- **Military Airports**—Military airports have their own separate set of FAR Part 77 airspace surfaces. These surfaces cover a much more extensive area than for civil airports: a minimum of 30,000 feet from the runways in all directions plus 50,000 feet along the runway approaches.
- **Default Boundaries**—If an ALUC has not adopted an influence area boundary for a particular airport, then (in accordance with Section 21675.1(b)) the default "study area" includes all land within two miles of the airport *boundary* (not the runway). Some ALUCs may choose to maintain approximately this boundary when adopting a compatibility plan.

ALUCs should take two additional factors into account when defining airport influence area boundaries. One consideration is that all of the airport influence area should be subject to at least one type of compatibility policy even if it is only height limits. If there are no compatibility restrictions or other conditions applicable within a portion of the influence area, the boundary should be redrawn to reduce its size. The second point—one emphasized in Chapter 2—is that state law (Section 21675(c)) requires ALUCs to consult with affected local jurisdictions before adopting or modifying an airport influence area boundary.

Base Map Alternatives

An important step in the mapping of an airport's compatibility zones is selection of an appropriate base map. Common alternatives include:

- **Geographic Information System (GIS) Mapping**—These computer-based mapping and data systems are becoming increasingly common in county and city government. When used in planning departments, street systems, parcel lines, and other geographic elements usually form the base map and then a variety of information associated with each parcel is included in the database. GIS maps are typically geo-referenced, thus assuring that at least major features—especially section corners—are geographically accurate. When a GIS has been established, addition of compatibility zones as another data layer or "theme" is highly advantageous. By so doing, the likelihood that compatibility criteria will be overlooked during local review of a development proposal is reduced.

➤ **Parcel Maps**—When GIS mapping is not available, a common alternative is a composite parcel map assembled from assessor's maps or other sources. Producing a reasonably accurate base map from smaller parcel maps can often be a challenge.

➤ **Land Use or Zoning Maps**—If sufficiently detailed, the same base maps as used for local land use or zoning purposes offer another alternative when a GIS has not been established.

➤ **Topographic Maps**—Topographic maps prepared by the U.S. Geological Service (USGS) are obtainable for all areas of California in both printed and digital form. Because these maps show ground elevations, they are particularly useful for airspace protection plan mapping. However, topographic maps do not show enough detail to facilitate finding particular locations within urban areas and they are generally outdated as well.

A note of caution regardless of the source of the base map: airport runways frequently are not shown, are not accurately located, or are not the correct length. Since most compatibility zones are typically tied to the runway position, not other geographic features, steps should be taken to assure that the runway is correctly depicted. A current airport layout plan indicating the geographic coordinates of the runway ends is an ideal source of runway location data. When GIS is used, this data can be directly entered into the system. Although normally not as precise, aerial photographs can also be used as a means of establishing the placement of a runway on a base map.

ACCOUNTING FOR EXISTING DEVELOPMENT

The Aeronautics Act gives ALUCs authority to conduct compatibility planning for areas around public airports only "to the extent that these areas are not already devoted to incompatible uses." This phrase is generally accepted to mean that the commissions have no authority over existing development. In formulation of compatibility plan policies, several facets of this limitation are important to take into account.

Defining "Existing"

The first issue to be addressed regarding this topic is to define when during the development process a property becomes "devoted to" a certain use and thus constitutes "existing" development. The Aeronautics Act does not define either term. It is therefore necessary to turn to other statutes together with case law for guidance.

A development does not need to be completed in order to be considered devoted to the use. At a certain time during the development process, approvals become irrevocable and a use must be considered existing insofar as the ability of local governments or airport land use commissions to force changes to a project. In these circumstances, a project proponent is considered to have *vested rights* to proceed with the development. *Vested* means "the irrevocable right to complete construction notwithstanding an intervening change in the law that would otherwise preclude it" [*McCarthy v. California Tahoe Regional Planning Agency*, Cal.App3d 222, 230 (1982)].

For the purposes of this discussion, local government approvals can be divided into three categories:

- Actions which clearly give a developer vested rights;
- Actions which may provide vested rights depending upon the circumstances; and
- Actions which do not provide vested rights.

Development Rights Established

According to the California Supreme Court, the right to develop becomes vested when all *discretionary* approvals for a project have been obtained and only *ministerial* approvals remain. More specifically, vested rights have *not* been established *unless* the developer has:

- Obtained a valid building permit (as distinguished from merely a foundation or other specific permit); *and*
- Performed substantial work; *and*
- Incurred substantial liabilities in good faith reliance upon the permit.

[*AVCO Community Developers, Inc. v. South Coast Regional Commission*, 17 Cal.3d 785, 791 (1976)]

To give further certainty to the development process, the state legislature provided for vested rights to be established by means of two specific types of local actions. One is a *development agreement*. State statutes allow a county or city to enter into a binding agreement with a developer enabling a project to proceed in accordance with policies, rules, and regulations existing and any conditions established at the time of the agreement (Government Code, Section 65864 et seq.). "A development agreement shall specify the duration of the agreement, the permitted uses of the property, the density or intensity of use, the maximum height and size of proposed buildings, and provisions for reservation or dedication of land for public purposes" (Section 65865.2).

The second form of agreement between a developer and the local land use jurisdiction, which establishes vested development rights, is a *vesting tentative map* (Government Code, Section 66498.1 et seq.). Such agreements "confer a vested right to proceed with development in substantial compliance with the ordinances, policies, and standards in effect at the time the vesting tentative map is approved or conditionally approved" (Section 66498.1(b)). A related California Supreme Court decision noted that:

"Tentative map approval is the final discretionary approval issued by a local government under the Map Act; final map approval is merely ministerial if the application for such approval is in substantial compliance with the tentative map and its conditions" [*City of West Hollywood v. Beverly Towers, Inc.*, 52 Cal.3d 1191].

Development Rights Uncertain

The principal local action falling into a middle ground of potentially establishing vested development rights is issuance of government permit other than a building permit—a *conditional use permit* being the primary example. Court decisions have concluded that such permits effectively provide vested rights only when they function much like a building permit. To qualify, the permit must afford "substantially the same specificity and definition to a project as a building permit" [AVCO, 793-794].

Development Rights Not Established

A wide variety of governmental permits and other actions have been determined by state appellate courts as being insufficient to form the basis of a vested right to proceed with a development. Some of the court decisions were based upon narrowly defined sets of circumstances. Nevertheless, while some caution should be exercised in applying this list more broadly, the following types of actions generally do not by themselves establish vested rights:

- Issuance of a tentative tract map (fees and other requirements can be imposed as conditions for subsequent issuance of a building permit);
- Recording of a final tract map;
- Issuance of a demolition permit and a foundation permit;
- Filing of an application for a building permit;
- Establishment of an assessment district;
- Extension and/or installation of infrastructure (e.g., roads and utilities); and
- Issuance of a business license.

Implications for ALUCs

The preceding discussion has several important implications for airport land use commissions.

Define "Existing Land Use"

ALUC policies should declare as clearly as possible the types of local government approvals which, in the ALUC's determination, establish a land use development as effectively existing even if actual construction has not taken place. Such development is not subject to ALUC review and also would not be considered for the purposes of the commission's review of county and city general plans. Developments for which vested rights, as described above, have been obtained must be considered to be existing land uses. Developments which have not become vested may nevertheless be treated as existing land uses, but there is no requirement that the ALUC do so. For

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Because ALUCs have some leeway in how they interpret what constitutes *existing land use*, it is important that a definition be included in the compatibility plan.

example, most ALUCs regard issuance of a valid building permit as giving a development the status of an existing land use even if construction has not yet begun. More broadly, ALUCs typically consider a vacant property as devoted to a particular use once all discretionary local government approvals have been issued and only ministerial approvals remain.

Also important to recognize, however, is that receipt of one of these approvals does not eliminate the obligations of a project proponent to comply with development regulations and conditions which other local and state agencies have established. Thus, while an ALUC cannot force a change in a land use once this approval status has been achieved, it can nevertheless require compliance with height restrictions, intensity limitations, noise level reduction, and other criteria set forth in its policies and implemented by local agencies.

Mapping of Existing Land Uses

A current high-altitude, aerial photograph of the airport environs is an excellent tool for this purpose. It shows the extent of development on a broad scale without providing largely unnecessary detail regarding the development status of individual small parcels.

Some ALUCs have taken the step of mapping the locations or parcels in the airport influence area where it considers the uses to be existing at the time of a compatibility plan's adoption. Alternatively, the ALUC can request an existing land use map to be submitted by affected local governments as part of the general plan consistency process.

Existing Residential Parcels

Reasonable limitations can nevertheless be set on the height of the structure. Also, where the size of the lot allows, location of the building on the least impacted portion can be encouraged.

As a practical matter, an ALUC cannot prevent construction of a dwelling on an existing residential parcel, even one located within a runway protection zone. Construction of a secondary dwelling on such parcels also typically cannot be prohibited where allowed by local zoning. (ALUCs should, however, take the potential for secondary dwelling units into account when assessing proposals for new residential development.) These points are worth stating in the compatibility plan policies.

General Plan Consistency

As discussed in Chapter 4, the locations of existing development needs to be taken into account when a general plan or specific plan is reviewed for consistency with an ALUC's compatibility plan. If a local plan merely reflects uses which already exist, the plan does not become inconsistent with the compatibility plan even if the indicated uses are not compatible with airport activities. While an ALUC may encourage the local jurisdiction to adopt more appropriate land use designations and to invite redevelopment, finding that a local plan is consistent with the ALUC plan cannot be made contingent upon the plan showing a different future land use. ALUCs should also be sensitive to the complications for existing property owners that can occur when the land use designations are changed and existing land uses become nonconforming. If it is unlikely that the existing incompatible uses will be changed, modifying the general plan designations is probably unwise.

OTHER COMPATIBILITY POLICY CONSIDERATIONS

While policies establishing criteria for development densities and intensities, height limits, and so forth are the core elements of a compatibility plan, policies addressing a variety of other issues also should be considered. Clear delineation of ALUC policies on these matters helps to minimize subsequent disputes regarding specific development proposals.

Policies for Special Situations

The following are situations which warrant special attention in determining the compatibility or incompatibility of a land use development.

Expansion, Conversion, or Redevelopment of Existing Uses

The limitation on ALUC authority over existing land uses applies only to the extent that the use remains constant. Merely because a land use exists on a property does not entitle the owner to expand the use, convert it to a different use, or otherwise redevelop the property if new or increased compatibility conflicts would result. To the extent that such land use changes require discretionary approval on the part of the county or city, they fall within the authority of the ALUC to review. Moreover, under these circumstances, it is not necessary for a proposal to involve a general plan amendment or zoning change for it to come within the ALUC's purview.

Infill Development

Another special situation which ALUCs should consider when formulating compatibility policies is how to deal with *infill* development. By definition, infill areas are locations where development does not already exist. The areas thus are subject to ALUC review authority. The chief issue with regard to infill occurs when the existing uses are, and new development would be, inconsistent with the ALUC's compatibility criteria. The question which ALUCs need to address is whether it is realistic to attempt to prevent technically incompatible development of a small area surrounded by similar existing development.

ALUCs are not obligated to allow infill development. Nevertheless, infill is a topic which should be discussed with local jurisdictions when compatibility plan policies are being drafted.

ALUCs clearly can determine nonconforming infill uses to be inconsistent with their adopted compatibility plan. However, local governments are particularly likely to disagree with such determinations and potentially to overrule them. From a broader community planning perspective, creating incompatibility with airport activities may be judged as less of a concern than causing incompatibility between adjacent land uses—for example, by placing commercial or industrial uses in the midst of a residential area.

In these circumstances, a pragmatic approach may be for ALUCs to allow infill in locations not highly critical to airport activities and require local plans to designate compatible uses in the most important areas closest to the runways. Criteria outlining the conditions which qualify a parcel for infill development should be established. These criteria should address such factors as:

- The portions of the airport influence area within which infill is to be permitted (infill within the runway protection zone might be prohibited, for example);
- The maximum size of a parcel or parcels on which infill is to be allowed;
- The extent to which the site must be bounded by similar uses (and not extend the perimeter of incompatible uses);
- The density and/or intensity of development allowed relative to that of the surrounding uses and the otherwise applicable compatibility criteria; and
- Other applicable development conditions (such as easement dedication requirements or special structural noise level attenuation criteria) which must be met.

As discussed in the next section, easement dedication and acoustical treatment of structures are particularly important factors with regard to infill and other conditionally compatible development.

Based upon these criteria, local plans should specifically define areas where infill is acceptable. To avoid incremental extension of incompatible uses resulting from infill of some parcels allowing additional parcels subsequently to qualify as infill, the determination of infill locations should be done just once. This determination should be made either during the compatibility plan review and adoption process or in conjunction with subsequent amendment of general plans for consistency with the compatibility plan.

Reconstruction

Reconstruction of existing nonconforming land uses destroyed by fire or other calamity can be treated in a manner similar to infill development. That is, areas where it is acceptable should be defined and appropriate conditions should be set. The conditions—such as limitations on the extent of destruction which can be rebuilt or time within which reconstruction must occur—could be based upon those followed by local jurisdictions in their own plans and zoning. Policies also should indicate whether a reconstructed building must be limited to the same size and usage intensity as the original or can be slightly greater. Lastly, different policies on reconstruction may be appropriate for residential versus nonresidential land uses.

Conditional Compatibility

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Requirements for avigation easement dedication and acoustical treatment of structures often go hand in hand. If special acoustical treatment is warranted, an avigation easement should also be dedicated. Similarly, if noise impacts are a primary reason for requiring avigation easement dedication, then an acoustical analysis to determine the need for special construction measures should be required.

Under certain circumstances—such as with infill development as discussed above—ALUCs may be faced with a need to consider finding otherwise incompatible development to be acceptable. If a commission should decide to approve a proposal of this type, conditions should be attached to the approval which will, as much as is reasonably possible, mitigate the incompatibility. Two important requirements which ALUCs can set as conditions for development approval in these circumstances are avigation easement dedication and acoustical treatment of structures.

Avigation Easement Dedication

As with any type of easement on real property, *avigation easements* convey certain enumerated property rights from the property owner to the holder of the easement. In this case, the easement holder is usually the airport owner. Easements continue in place as the underlying property is bought and sold (they "run with the land"). Moreover, their existence is documented during the title search conducted at the time of a property transfer. As commonly applied in the aviation industry, avigation easements convey the set of property rights listed in the adjacent sidebar. Easements which establish only the first two of these rights, but do not restrict the height of objects, are often referred to as *overflight easements*.

Historically, many airports have acquired avigation easements—often by purchasing them—on property where noise impacts are substantial or where limitations on the height of structures and trees is essential to protection of runway approaches. Airports also have obtained easements as a condition for airport-financed installation of noise insulation in structures. These continue to be highly appropriate functions for avigation easements.

Many airport land use commissions have taken the concept a step further by requiring property owners to dedicate an avigation or overflight easement as a condition for obtaining ALUC approval for proposed development. In locations, where high noise levels and/or the need for significant restrictions on the height of objects are present, avigation easement dedication requirements are generally warranted and desirable. However, ALUCs should exercise caution in adopting policies which make dedication of an avigation or overflight easement a condition for development approval in less impacted portions of the airport influence area. In locations where easements would serve primarily as a buyer awareness tool, other mechanisms, as discussed below, are usually more suitable.

No precise standards are available by which ALUCs can decide where avigation easement dedication is or is not appropriate. Nevertheless, useful guidance can be found in both statutory and case law.

California Airport Noise Regulations (California Code of Regulations, Section 5000 et seq.), for example, explicitly support avigation easements as an important land use compatibility tool, albeit under a narrowly defined set of circumstances. Specifically, the regulations deem new development of residential and certain other land uses within the 65 dB CNEL contour of a *noise problem* airport to be incompatible unless the airport obtains an avigation easement for aircraft noise. Within this noise environment, an increase in incompatible uses without attached avigation easements would be contrary to two of the fundamental purposes of ALUCs, those being "to promote the overall goals and objectives of the California airport noise standards…and to prevent the creation of new noise and safety problems" (Public Utilities Code, Section 21670(a)(1)).

Although the state regulations explicitly apply only to those few airports deemed to have a noise problem under the regulatory definition of the term, a similar approach is appropriate for ALUCs to adopt in their own policies. That is, wherever ALUC policies indicate that residential land uses

Standard Avigation Easement Provisions

- A right-of-way for free and unobstructed passage of aircraft through the airspace over the property at any altitude above an imaginary surface specified in the easement (usually set in accordance with FAR Part 77 criteria).
- A right to subject the property to noise, vibration, fumes, dust, and fuel particle emissions associated with normal airport activity.
- A right to prohibit the erection or growth of any structure, tree, or other object that would enter the acquired airspace.
- A right-of-entry onto the property, with appropriate advance notice, for the purpose of removing, marking or lighting any structure or other object that enters the acquired airspace.
- A right to prohibit electrical interference, glare, misleading lights, visual impairments, and other hazards to aircraft flight from being created on the property.

A sample of a typical avigation easement is included in Appendix D.

are normally incompatible—whether the standard is CNEL 65 dB or a lower level—approval for such development should reasonably be conditioned upon the developer's dedication of an avigation easement to the airport.

Another way to view the issue is to consider the circumstances under which the flight of an aircraft over private property—together with the noise and other impacts generated by that overflight—could be deemed a trespass on the land. If a trespass would take place, then an avigation easement should be obtained. Federal law on the limits of air navigation is not clearly delineated, however. U.S. codes simply define *navigable airspace* as the airspace above the minimum altitudes of flight prescribed by federal regulations, including airspace needed to ensure safety in the takeoff and landing of aircraft (Title 49, Section 40102). The best, although not very precise, summary of when an aircraft overflight would be a trespass is outlined in the *Restatement of Torts*, a document heavily relied upon by lawyers and judges as a synopsis of law. Section 159(2) reads:

> "Flight by aircraft in the airspace above land of another is trespass if, but only if, (a) it enters into the immediate reaches of the airspace next to the land, and (b) it interferes substantially with the other's use and enjoyment of his land."

Requirements for avigation easement dedication which go beyond these conditions risk being deemed inverse condemnation—a violation of the U.S. Constitution's prohibition on taking of private property for public use without just compensation. See the extended discussion on inverse condemnation later in this chapter.

Applying these rules, a requirement for dedication of an avigation easements may be reasonable where any of the following conditions exist:

- Aircraft are expected to be relatively low to the ground (such as where they are below traffic pattern altitude); or
- Zoning does not adequately restrict the heights of objects in the airport's environs; or
- Aircraft noise exceeds the level established as being of local significance.

Beyond these issues, two practical matters regarding avigation easement dedication need to be recognized. First is the fundamental fact that *avigation easements do not change the noise environment*. They are legal instruments which document that a property is subject to aircraft noise, as well as other impacts. Consequently, ALUCs should not use avigation easement dedication as a principal factor in determining whether a proposed land use is compatible with airport activity. Unless no feasible alternatives exist, noise-sensitive land uses should be prohibited in high-noise locations regardless of whether an easement is dedicated.

A second practical consideration is one which arises in more limited circumstances concerning privately owned and military airports. For private airports, the normal arrangement in which the airport owner is the holder of the easement means that a government entity is requiring a transfer of property rights from one private party to another. Even for privately owned airports which are public-use facilities, the legitimacy of this outcome is open to question. For military airports, the problem is more explicit: federal law prohibits federal acceptance of dedicated avigation easements. In both of these circumstances, an alternative which may be feasible is for the county or city in which the airport is situated to be the easement holder.

Acoustical Treatment of Structures

Another requirement which ALUCs should establish as a condition for development in special circumstances is acoustical treatment of structures. State law requires that "interior noise levels attributable to exterior sources shall not exceed 45 dB in any habitable room" (California Building Code, Section 1208A). The code applies this standard only to new hotels, motels, dormitories, apartment houses, and dwellings other than single-family residential. However, many local jurisdictions—usually as a policy in the noise element of their general plan—have extended the requirement to single-family residences. ALUCs should do likewise.

See Chapter 7 for a more detailed discussion of this topic.

DEPT. OF TRANSPORTATION GUIDANCE
Any time an ALUC requires special acoustical treatment of a structure as a condition for development approval, dedication of an avigation easement should also be required.

The code indicates that an acoustical analysis is necessary anywhere the annual CNEL exceeds 60 dB. However, given the normal noise level reduction provided by present-day construction standards, special measures are usually not necessary unless the noise level exceeds 65 dB CNEL.

Buyer Awareness Measures

As indicated in the discussion of compatibility strategies at the beginning of this chapter, some aspects of airport land use compatibility go beyond direct restrictions on the manner in which airport area property is developed and used. Particularly with respect to aircraft overflight annoyance concerns, compatibility between airports and surrounding land uses also can be improved through actions intended to enhance the public's knowledge and understanding of airport impacts. These actions focus on informing prospective buyers of property within an airport vicinity about the airport's impact on the property. Collectively, they are referred to as *buyer awareness measures*.

Although variations are sometimes created, measures designed specifically for the purpose of promoting buyer awareness fit mostly into two categories:

- Recorded deed notices; and
- Real estate disclosure statements.

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs are encouraged to adopt policies regarding the use of recorded deed notices and real estate disclosure statements where appropriate within the influence area of each airport in the commissions' jurisdiction.

A third device which serves a buyer awareness function is the avigation easement. Although not appropriate strictly as a form of buyer awareness measure, avigation easements are, as discussed above, valuable tools for airport land use compatibility planning in highly impacted portions of the airport environs.

Recorded Deed Notices

A deed notice is an official statement which is recorded in county records as part of a tentative or final subdivision map prepared at the time a parcel is subdivided. As a form of buyer awareness measure, recorded deed notices have broad applicability within an airport influence area. They can be used to disclose that the property is subject to routine overflights and associated noise and other impacts by aircraft operating at a nearby airport. Because this information becomes part of the deed to each property in the subdivision, it should show up in a title report prepared when one of the parcels is being sold.

An example of a deed notice is included in Appendix D.

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs should require recording of deed notices describing airport impacts as a condition for development approval anywhere in the airport influence area where avigation easements are not obtained.

A potential shortcoming of deed notices as a buyer awareness measure is that some county recorders reportedly will not record them because they do not affect title to the land. In such cases, the information would be given to the initial purchaser of a new development, but may not be passed along to subsequent buyers (by comparison, avigation easements can always be recorded). According to the state Department of Real Estate, this problem can be overcome if the county board of supervisor adopts an ordinance indicating that such notices should be recorded.

As discussed in Chapter 5, airport proprietors also can carry out a real estate disclosure program on their own.

In one sense, deed notices are similar to avigation easements in that they become part of the title to a property and thus are a permanent form of buyer awareness. The distinguishing difference between deed notices and avigation easements is that deed notices only serve as a disclosure of potential overflights (and the fact that the property is located within an airport influence area), whereas avigation easements convey an identified set of property rights. In locations where height limitations or other land use restrictions are unnecessary, deed notices have the advantage of being less cumbersome to define and establish. Also, they give less appearance of having a negative effect on the value of the property. An ideal application of deed notices is as a condition of approval for development of residential land uses in airport-vicinity locations where neither noise nor safety are major concerns, but frequent aircraft overflights might be annoying to some people.

Real Estate Disclosure Statements

Another important form of buyer awareness measures represented in ALUC policies are real estate disclosure statements. California state real estate law requires that sellers of real property disclose "any fact materially affecting the value and desirability of the property" (California Civil Code, Section 1102.1(a)). While this general requirement leaves to the property seller the decision as to whether airport-related information constitutes a fact warranting disclosure, other sections of state disclosure law specifically mention airports.

Section 1102.17 of the Civil Code says that: "The seller of residential real property subject to this article who has actual knowledge that the property is affected by or zoned to allow industrial use described in Section 731a of the Code of Civil Procedure shall give written notice of that knowledge as soon as practicable before transfer of title."

Section 731a of the Code of Civil Procedure then specifies: "Whenever any city, city and county, or county shall have established zones or districts under authority of law wherein certain manufacturing or commercial or *airport* uses are expressly permitted, except in an action to abate a public nuisance brought in the name of the people of the State of California, no person or persons, firm or corporation shall be enjoined or restrained by the injunctive process from reasonable and necessary operation in any such industrial or commercial zone or *airport* of any use expressly permitted therein, nor shall such use be deemed a nuisance without evidence of the employment of unnecessary and injurious methods of operation…." [*emphasis added*]

The interpretation of the Department of Transportation Legal Division is that these sections of the law establish a requirement for disclosure of information regarding the effects of airports on nearby property provided that the seller has "actual knowledge" of such effects. ALUCs have particular expertise in defining where airports have effects on surrounding lands. ALUCs thus can give authority to this disclosure requirement by establishing a policy indicating the geographic boundaries of the lands deemed to be affected by airport activity. In most cases, this boundary will coincide with commission's planning boundary for an airport (the airport area of influence). Furthermore, ALUCs should disseminate information regarding their disclosure policy and its significance by formally mailing copies to local real estate brokers and title companies. Having received this information, the brokers would be obligated to tell sellers that the facts should be disclosed to prospective buyers.

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs are encouraged to adopt policies defining the area within which information regarding airport noise impacts should be disclosed as part of real estate transactions.

The sole purpose for ALUC adoption of a policy such as this is to help to ensure that information regarding airport impacts will be disclosed as a normal part of real estate transactions. ALUCs have no authority to mandate disclosure of airport-related information, let alone to monitor whether such disclosures occur. To this extent, any ALUC policies regarding disclosure are merely advisory. This status applies not only to individual sellers of real property, but to local land use jurisdictions. ALUCs can encourage counties and cities to adopt similar policies, but cannot require them to do so. These jurisdictions do not need to include an airport-related real estate disclosure policy in their general plans for those plans to be considered consistent with an ALUC compatibility plan which contains a disclosure policy.

Although achievement of buyer awareness objectives are less certain with real estate disclosure policies than with avigation easement dedication or recorded deed notices, an advantage of disclosure is that it is more all-encompassing. Real estate disclosure policies are the only form of buyer awareness measure available to ALUCs which apply to previously existing land uses as well as to new development.

Limits on Land Use Restrictions

While having an airport environs be totally devoid of development may be ideal from a land use compatibility perspective, it seldom is a realistic objective. For one, existing development already makes such sterility impossible to achieve at most airports. Moreover, even in sparsely populated areas, tradeoffs generally must be made between an ideal degree of land use compatibility and the community needs for land use development. This section explores some of the legal and practical limitations on the restrictiveness of land use compatibility measures.

Inverse Condemnation

A concern sometimes raised (especially by landowners) with regard to establishment of airport land use restrictions is that the restrictions might constitute inverse condemnation—a *taking* of private property without just compensation. This is not a new concern. The criteria for compensable takings have long been debated in legal literature. Also, many court cases, including some specifically dealing with airports, have delineated when a taking has or has not occurred. Even as far back as 1952, the report of the President's Airport Commission, *The Airport and Its Neighbors* (the Doolittle Commission report, discussed more fully in Chapter 8), devoted several pages to the topic.

The material presented in this section is written from a professional planning perspective. It is not a legal opinion.

Inverse condemnation is a highly complex subject. It is not possible for this *Handbook* to delve into it at length—entire books can and have been written on the topic. Rather, this section is merely a brief summary of the issue as it applies to airport land use compatibility planning. The emphasis is on the implications for ALUCs.

State law does not give ALUCs direct authority over land use. Implementation of an ALUC's policies is accomplished by the county and affected cities through the process of making their general plans, specific plans, and applicable ordinances consistent with the ALUC's compatibility plan. Therefore, a legitimate question is whether it is possible for an ALUC policy to result in a taking through inverse condemnation. Without doubt, a property owner who feels aggrieved might sue the ALUC along with other local entities. What the outcome of any such lawsuit might be is uncertain. One view is that, because an ALUC has no assets or taxing powers of its own, either the airport owner or the local agency which implements the compatibility policies is more likely than the ALUC to bear the brunt of any such lawsuit. Regardless of whether this assessment is valid, the question of which local agency could more readily be successfully sued is not directly of interest. The issue here concerns the limitations which the potential for inverse condemnation presents in implementation of airport land use compatibility measures. Therefore, more to the point is the issue of what forms and degrees of land use restrictions for airport compatibility purposes are legally sound.

Legal Basis for Regulation

The legal basis for local government regulation of land use is well defined by both statutory and case law. Generally, such regulations are founded upon the basic power of the state to enact legislation protecting the public health, safety, morals, and general welfare of its citizens. This authority is typically passed along to municipalities by state enabling legislation. The principal form of land use regulation in most municipalities is zoning. The constitutionality of zoning was upheld in a landmark case decided by the U.S. Supreme Court in 1926 [*Village of Euclid v. Ambler Realty Company*].

In California, the ability of local governments to regulate land use is an exercise of the police power granted by Article XI of the California Constitution. The authority for airport land use commissions to establish land use regulations is provided by Section 21675(a) of the Public Utilities Code. This section states that "in formulating a land use plan, the commission may develop height restrictions on buildings, specify use of land, and determine building standards, including soundproofing…" (An earlier reference for ALUCs "to achieve by zoning" the purposes of the statutes was deleted from the law in 1982.)

Limits to Land Use Regulation

The fundamental limitation on governments' power to take property is set forth by the Fifth Amendment to the United States Constitution which states: "…nor shall private property be taken for public use, without just compensation." The most direct application of this principle requires the government to pay fair value for property which it condemns for public use by means of *eminent domain* proceedings. It is not necessary, how ever, for government to dispossess the owner or physically occupy the property in order to have effectively created a taking. A taking can also result through overly restrictive land use regulations.

The legal interpretation of when a government regulation of land use becomes a taking has continually been refined—and, occasionally, modified—as the courts have heard new cases. Although the basic principles have been in effect for some time, their application to a specific set of circumstances is often not a simple task. Even the U.S. Supreme Court has admitted that it has never been able to develop a "'set formula' to determine when 'justice and fairness' require that economic injuries caused by public action be compensated by the government…" [*Penn Central Transportation Co. v. New York City*, 438 U.S. 104, 124 (1978)].

A succinct statement of the basic principles is found in the U.S. Supreme Court's opinion in *Agins v. City of Tiburon* [447 U.S. 255 (1980)]. In that case, the court declared that for a land use regulation to avoid constituting a taking, it must pass two tests:

- It must "substantially advance legitimate state interests" and
- It must not deny the property owner of "all economically viable use of his land."

The following two sections elaborate upon these criteria.

Defining Legitimate Government Purposes

The terms "substantially advance" and "legitimate state interests" as used in the first of these two tests have never been precisely defined by the courts. Over the years, though, many court cases have shed light on the nuances of their meaning. Mostly this has occurred through various rulings regarding the legitimacy of specific regulations which have been challenged.

It is generally easier for courts to find a legitimate public purpose when a land use regulation "prevents a harm" rather than "confers a benefit." One case noted that the purpose of a regulation must be taken into account: "the nature of the State's interest in the regulation is a critical factor in determining whether a taking has occurred…" [*Pennsylvania Coal Co. v. Mahon*, 260 U.S. 393 (1922)]. An important, more recent, case on this subject [*Nollan v. California Coastal Commission*, 483 U.S. 825 (1987)] placed focus on the concept that there must be a *nexus* or connection between the public policy being invoked by the regulatory agency and the conditions or restrictions placed on that development to implement the policy. Such restrictions must clearly and directly serve to mitigate the burden. In later case [*Dolan v. City of Tigard*, 512 U.S. 374 (1994)], the court went on to require that such conditions be "roughly proportional" to the burden on the community created by the proposed private development.

Regulation of land around airports to assure compatibility with the airport is widely held to be a legitimate public purpose. The purpose of all land use regulations, after all, is the reduction of incompatibilities among different types of land uses. The state enabling legislation for airport land use commissions clearly defines the purpose of the statute as being "to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports…"

There is, however, a body of legal opinion which suggests that, at some point, measures to protect airports from incompatible land uses become a transfer of rights from one private party to other private parties. That is, owners of land adjacent to an airport give up certain rights (for example, the ability to build structures which would penetrate FAR Part 77 surfaces) which are then given to the users of the airport. In this legal view, no legitimate public purpose is being served and the action is not a valid exercise of the police power. Compensation would be necessary for any such taking unless the property owner has waived this right by failing to take timely action (in California, within five years of the event).

The nexus issue is another takings-related concern that has sometimes arisen in the context of airport land use planning. In instances where proposed land uses are marginally incompatible with airport activities, it is the policy of many ALUCs to require the land owner to dedicate an avigation easement to the airport as a condition for finding the proposed development consistent with the commission's compatibility plan. The issue raised is whether there is sufficient nexus between the negative effect of the development on the community (specifically, the community's airport) and the condition imposed on the development. To establish this connection, the development must be shown to have the potential for causing harm to the community and the imposed condition must mitigate that harm.

The issue of legal soundness notwithstanding, the most appropriate application of avigation easement dedication is with respect to property where noise impacts and height limitations are significant factors. This topic is discussed in an earlier section of this chapter.

For example, because the developer is asking the land use regulator to permit a basically incompatible land use to be put in place, a good case can be made for the required avigation easement dedication in situations involving rezoning of land from an agricultural or other airport-compatible use to an incompatible use such as a residential subdivision. Such a change would have the negative effect on the community of creating a new constraint on the use of the airport—a public facility—and thus would likely constitute a sufficient nexus to warrant imposing the avigation easement as a development condition. On the other hand, the appropriateness of adding an avigation easement dedication condition to land already zoned residential might be difficult to demonstrate unless the ALUC had previously established this requirement as a condition for finding the general plan consistent with the commission's plan.

Determining Reasonable Use of Land

By their very nature, government regulations have direct or indirect effects on property values. In examining whether a taking has occurred in a particular instance, the courts sometimes consider the extent of the resulting change in value of the property. However, when following this approach, the courts look to the value remaining in the property, *not* the value that might have resulted had the land been permitted a higher use. Local land use regulations that have resulted in more than a 90% reduction in the value of an individual's land have been upheld as not a taking because sufficient "economically viable" use of the land still remained. Generally though, the greater the range of remaining permitted uses, the easier it is for government to avoid a successful inverse condemnation suit.

Local governments are largely free to change land use designations and zoning at their discretion. Landowners are not entitled to reimbursement for hypothetical losses due to changes in zoning, nor do they have any right to anticipate a change in zoning. Zoning decisions are generally held to be legislative acts and courts will not substitute their judgment for those of elected officials. However, as described earlier in this chapter with respect to defining existing land uses, a point is reached in the development process when the developer has secured *vested rights* to proceed with the project.

In applying these principles to the work of airport land use commissions, a couple of points are noteworthy. One point, previously mentioned in Chapter 1, is that ALUCs can (to paraphrase the Supreme Court in *Penn-Central*) only go so far in restricting land uses for airport compatibility purposes. In locations close to the ends of runways, extreme noise levels, high accident potential, and significant limitations on the height of objects may restrict the choice of land uses to a few types of open space or agricultural functions. None of these land uses may be economically viable in urban areas. In these instances, acquisition of the property may be the only appropriate choice. This is an action which only the airport owner can take—ALUCs do not have this authority to acquire land or to require that the airport do so.

The vested rights issue is pertinent to ALUCs in that it helps to define when a proposed land use becomes existing and thus no longer subject to the commission's review. It is important, therefore, that ALUCs have the opportunity to review land use proposals at an early stage—preferably as a general plan or specific plan action—before they become vested. In some situations, financial commitments or other factors can result in vesting occurring quite early in the development process.

Remedies for Excessive Land Use Regulation

As long interpreted by California courts, the principal remedy in situations where an excessive land use regulation was found to constitute a taking had been for the court to invalidate the regulation. However, a 1987 U.S. Supreme Court decision [*First English Evangelical Lutheran Church of Glendale v. County of Los Angeles*, 482 U.S. 304, 107 S. Ct. 2378 (1987)] overturned the California rule. In this case, the Court held that the U.S. Constitution also requires that the landowner be compensated for a "temporary taking" which occurred while the regulation was in effect. A simple invalidation of the regulation would not be a sufficient remedy for the resulting damages incurred by the landowner.

A separate issue—one that is beyond the scope of the discussion here—is how the amount of monetary damages is to be calculated. The current status might nevertheless be summarized by saying that, much like with the overall issue of determining when a regulatory taking has occurred, the courts have adhered to a case-by-case approach when reviewing the factors affecting the calculation of appropriate damages. Future court decisions will undoubtedly continue to refine how various factors are to be included in the equation.

Practical Considerations

The sole responsibility of ALUCs is to prevent incompatible land use development and thereby both protect the public from noise and risks and preserve the utility of airports. In carrying out this responsibility, ALUCs should be guided by objective analyses of airport land use compatibility concerns.

This focus notwithstanding, ALUCs also need to be practical in their actions. Although ALUCs should not be driven by political, economic, or other non-compatibility-related factors, they should at least be cognizant of them. They should be aware of the effects that their plans and compatibility determinations will have on local land use jurisdictions and the possible reactions which these jurisdictions may have to these matters. When making land use decisions, counties and cities have other issues to contend with besides airport compatibility. Although overruling an ALUC decision requires special steps, local jurisdictions sometimes will make this effort if they feel it is in their community's best interest to do so. Many overrulings do not meet the requirements of the law. Others, however, may be legitimate, particularly if ALUCs have not established a solid foundation for their decisions.

The bottom line is that the most desirable outcome of the airport land use compatibility planning process is for counties and cities to support and take the necessary measures to implement the compatibility policies adopted by ALUCs. If ALUCs can maintain the integrity of the compatibility planning objectives set forth in the Aeronautics Act while still accommodating the needs of local jurisdictions, then they should give careful consideration to any such alternatives.

COMPATIBILITY PLANNING FOR SPECIFIC AIRPORT TYPES

The State Aeronautics Act requires—or, in the case of military airfields, allows—compatibility plans for various types of airports. While each airport presents a distinct combination of characteristics, both operationally and in terms of surrounding land uses, even broader differences are apparent among the various airport categories. The relative extensiveness of noise versus safety concerns varies between a typical air carrier airport and a typical general aviation facility, for example. The availability of data from which to develop a compatibility plan also tends to differ from one airport type to another. The discussion in this section focuses on the distinctive compatibility planning concerns and approaches common to each category:

- Air carrier airports;
- General aviation airports;
- Converted military airports;
- Military airports; and
- Heliports.

Air Carrier Airports

Several factors distinguish compatibility planning for air carrier airports from that for most other facilities. Some of these factors pertain to the substance of the compatibility policies; others involve the resources available for preparation of a compatibility plan.

From a land use compatibility standpoint, noise is usually the dominant concern. The 65-dB CNEL contour for a major air carrier airport can extend far beyond the runway ends. Lower-noise-level impacts can encompass several square miles of the airport environs.

As a practical matter, though, the ability of airport land use commissions to address compatibility matters around air carrier airports is often limited. Most air carrier airports in California are situated in existing, highly urbanized communities. Except for infill or redevelopment, there are few opportunities for new development and thus few proposed land use actions for the ALUCs to review. Where new development is allowed, noise insulation programs and the requirement for avigation easements are a major component of land use compatibility policies both for the airport land use commission and the airport itself.

The second distinct factor about compatibility planning for air carrier airports is that data and other resources needed for plan preparation are typically more readily available than for other airports. To start with, these facilities typically have full-time staff specifically assigned to dealing with noise, land use compatibility, and other issues affecting the surrounding communities. Recent calculations of current noise contours and up-to-date projections of future activity levels and noise impacts are commonly available. Moreover, noise monitoring and radar flight track data may be available to increase the precision of both current and projected noise contours. For planning purposes, however, the predictions for the noise environment in the distant future (20+ years) are more important than the measurements of noise in the past.

General Aviation Airports

The characteristics of general aviation airports and their environs vary widely. They range from very busy "reliever" airports in metropolitan areas to minimally used facilities in rural locations. The extent of compatibility issues and the availability of data from which to create a compatibility plan also run the full gamut.

For an average general aviation airport, noise, safety, airspace protection, and overflight compatibility concerns are all important issues to be addressed in compatibility plans. Moreover, because many general aviation airports are located on the fringes of urban areas, both the threat of new incompatible development and the opportunity for ALUCs to help preserve a compatible airport land use relationship are great.

See Chapters 6 and 7 for discussion of noise data sources and compatibility criteria. Chapters 8 and 9 contain valuable data with which to address safety-related issues.

Available activity level, noise impact, and other data needed for compatibility planning is not normally as extensive as for air carrier airports. Essential information often must be gathered from a variety of sources ranging from airport master plans to interviews with airport staff and others familiar with operation of the airport. Obtaining data on the locations of principal flight routes can be particularly difficult, yet of key importance at moderately busy facilities. Again, planning for the distant future is highly important.

Converted Military Airports

A series of federal Base Realignment and Closure (BRAC) Acts since the 1980s has led to closure of numerous military bases across the country. In California, many of the closed bases have included airfields which have subsequently been or yet could be converted to civilian use. Most of these airports are major facilities with long runways capable of accommodating almost any type of aircraft. Because of the wide range of future operational scenarios possible for converted military airports and their lack of history as civilian facilities, preparation of compatibility plans for them can be particularly challenging. In this regard, there are two key issues which ALUCs need to address.

Timing of ALUC Involvement in Conversion Process

Typical Base Conversion Process

1. Department of Defense begins preparation of a Final Disposal Plan.
2. Local Reuse Authority (LRA) created with responsibility for planning reuse of all surplus base property. The LRA may or may not become the airport sponsor (owner or operator).
3. LRA applies for funds from Department of Defense/Office of Economic Adjustment to prepare a base reuse plan.
4. Application is made by LRA for Airport Improvement Grant (AIP) funds to prepare an airport master plan for the new civilian airport. (This is not a required step, but is a useful one. As an initial step, grant funds sometimes are sought to prepare a feasibility plan to determine if a civilian airport is needed and would be financially viable. If a formal master plan is not prepared, the general

Conversion of a military base to civilian use entails a lengthy series of steps. In practice, the process entails four distinct sub-processes:

- The military's property disposal process;
- The community reuse planning process;
- The environmental review process; and
- The environmental clean-up process.

These processes are not sequential. Rather, there are many overlaps and interconnections among them. The individual processes may be delayed, halted, and then started again and they do not necessarily span the same period of time.

After the decision to close a military base has been made, other federal agencies have first option to obtain all or part of the property. Any property deemed surplus to federal needs is made available to local government entities and certain community organizations in accordance with the community's reuse plan. Major steps in the reuse and environmental review processes are summarized in the adjacent sidebar.

ALUCs can get involved in the conversion process at any time. The State Aeronautics Act does not specifically mention military base conversions or when ALUCs should become involved. The only statutory requirement for

ALUC involvement stems from the commissions' responsibility to review proposed airport construction plans prior to their adoption by the local reuse authority or a successor entity chosen to operate the airport (as required by the PUC Section 21661.5). Most often, this step does not occur until relatively late in the conversion process, after many key decisions have been made. Given these circumstances, it is usually wise for an ALUC to become involved at the very beginning, albeit at a very modest level initially. A graduated approach is recommended.

Conversion of military bases typically involves allocation of land and facilities among many competing uses. Early in the conversion process, ALUCs should make sure that decision-makers are aware that enough land needs to be retained to afford maximum compatibility with the eventual civilian aviation use. Initially, it should be sufficient to note that, while the areas beyond the runway ends are the most sensitive, all areas which will be routinely overflown have potential compatibility concerns. These compatibility concerns will likely involve land both on the base and in its environs. The next point at which an ALUC can be of service is during the development and analysis of alternative uses. ALUCs should seek to ensure that every alternative involving an aviation use includes appropriate compatibility measures. Existing ALUC policies can be used to formulate preliminary compatibility zone boundaries for each alternative.

Once a preferred alternative is selected, the ALUC needs to be satisfied that the environmental documents (under CEQA and NEPA) include consideration of the full range of compatibility concerns. Limiting consideration to noise contours associated with future civilian aviation uses is not sufficient. Safety and overflight impacts must also be considered. This is also the time to make certain that off-base land use designations support the civilian airport use. There may be pressures to permit residential uses (as well as schools, etc.) closer to the civilian airport than was permitted when used by the military.

description of the role and activity levels contained in the reuse plan will provide basic guidance on future use of the new civilian airport.)

5. LRA receives a grant and begins preparation of a base reuse plan. The plan will define, at least in general terms, how all of the surplus base property—including both aviation and/or nonaviation components—will be used.
6. If an airport master plan is funded, preparation begins.
7. Community reuse plan (possibly including an airport master plan) is completed.
8. Environmental impact statement (EIS) and environmental impact report (EIR) are prepared under the requirements of the National Environmental Policy Act and California Environmental Quality Act, respectively. The community reuse plan is typically the "preferred alternative" in these environmental documents.
9. Department of Defense issues Notice of Determination on EIS and adopts Final Disposal Plan.
10. LRA adopts reuse plan, airport master plan (if prepared), and associated EIR.

Assumptions Regarding Future Airport Configuration and Use

A base reuse plan and/or airport master plan together with their associated environmental documents will typically contain most of the elements necessary to prepare a compatibility plan:

- A physical plan for the airfield showing the location and dimensions of runways and types of instrument approaches, both current and future;
- A description of the future roles of the airport including the mix of aircraft types;
- Forecasts of aircraft activity; and
- Noise contours associated with the forecast level of activity.

A potential shortcoming of these plans is that the forecasts may not extend far enough into the future to adequately serve the purposes of airport land use compatibility planning. As discussed in Chapter 2, noise impacts associated with an airport-capacity level of activity may warrant evaluation.

Inherently, the base conversion process requires greater speculation about future civilian aviation uses than would a master plan for an existing civilian airport. First, there is typically no history of civilian aeronautical use or only very specialized civilian use. Secondly, there is commonly an explicit marketing or promotional aspect to conversion plans. The first factor in creases the uncertainty, while the second tends to inflate the magnitude and scope of future activities.

Since land uses tend to endure for long periods of time, it is appropriate for aviation forecasts to anticipate activity levels at the high end of the range of plausible levels. Forecasts that are somewhat high will help preserve an envelope within which future aviation activities can take place in harmony with nearby land uses.

ALUCs are not empowered to determine what the future airfield configuration, airport role, or activity levels will be. State statutes direct that a compatibility plan must be based upon an airport master plan. A base reuse plan can be expected to contain the elements of an airport master plan. However, if an ALUC is presented with a reuse plan that is so visionary that the anticipated civilian aviation use strains the bounds of credibility, it is faced with a dilemma.

State law anticipates that ALUCs will devise compatibility plans to support the future aviation uses selected by the airports' owners. If an airport's owner has selected a future airfield configuration, role, or activity level that an ALUC considers unrealistic or inappropriate, the ALUC has few options. The most that ALUCs can do is negotiate with the airport owner in an effort to have the airport plan modified to be more realistic or appropriate. Ultimately, state law forces ALUCs to accept plans adopted by airport owners, even if the ALUC considers the plans unrealistically grandiose or too modest.

Military Airports

Adoption of compatibility plans for military airports is optional under the State Aeronautics Act (PUC Section 21675(b)). Nevertheless, many ALUCs have included these facilities in their plans. Several factors make compatibility planning for military facilities distinct from that for civilian airports.

Most of the remaining military airports in California are part of large bases covering extensive land areas. Even the bases located near urban areas tend to have substantial amounts of open land near the runways. These buffer areas are valuable in terms of land use compatibility, especially with regard to safety. The noise impacts of military airports, however, can still extend far beyond the base boundaries due in large part to high noise levels generated by many military aircraft.

A particularly unique aspect of compatibility planning for military airports is that aircraft activity forecasts of the sort done for civilian airports are not very meaningful. Military airport activity levels depend almost exclusively on the mission of the base and on national or international events involving military participation. A typical planning approach thus is to postulate a "maximum mission" for the base. ALUCs wishing to anticipate the potential for yet greater aircraft operations impacts sometimes base their planning on a multiple of the maximum mission activity levels (a multiplier of 1.5 or 2, for example).

The best source of data from which ALUCs can develop a compatibility plan for a military airport normally is the *Air Installation Compatible Use Zone* (AICUZ) study which the Department of Defense requires for each base. AICUZ studies contain analyses of noise, accident potential, and height restrictions impacts of aircraft operations. For each of these impacts, a set of land use compatibility criteria are indicated. These criteria are merely recommendations to local land use jurisdictions—other than through acquisition of property, the military has no powers to enforce them. AICUZ compatibility criteria tend to be minimal in terms of the degree of protection from incompatible land uses which they afford. ALUCs and local jurisdictions can and should consider setting higher standards in their own respective compatibility planning. Ensuring a high degree of land use compatibility around military airports is particularly prudent given the economic importance which major bases have to the surrounding communities and the fact that land use compatibility is one of the factors considered in the government's assessment of which bases to maintain in operation.

Heliports

Compatibility planning for heliports presents another uncommon set of circumstances for ALUCs. As discussed in Chapter 2, the first consideration is to decide which heliports should have compatibility plans. At least in theory, any heliport which must have a permit from the state should have a compatibility plan. The Aeronautics Act requires all public-use heliports not located on an airport and all special-use heliports to obtain a Heliport Permit. Notable among the heliports in the latter category are those at hospitals. This ostensible requirement notwithstanding, very few ALUCs have adopted compatibility plans for heliports.

Any compatibility plan prepared for a heliport needs to take into account the unique operational characteristics of helicopters. Because of the steep approach and departure profiles which helicopters normally fly, they are effectively operating in an en route manner once beyond a short distance from the heliport (FAR Part 77 airspace surfaces extend just 4,000 feet from the landing pad). Within the immediate vicinity of a heliport, helicopter noise impacts can be relatively intensive on a single-event scale. However, except for the few heliports which experience a high volume of operations, cumulative noise impact contours are very small. Also, the limited accident data available for helicopters suggests that significant safety concerns are generally confined to within a few hundred feet of the landing pad. Perhaps most important with respect to safety is the necessity of keeping established approach/departure corridors clear of obstructions.

Given this combination of factors, some restrictions on land use development is appropriate within the immediate vicinity of public-use and special-use heliports. However, except where warranted by high activity levels, more extensive restrictions are normally unnecessary.

CHAPTER **4**

ALUC Review of Local Actions

OVERVIEW

Review of local agencies' land use plans and airport plans and certain other land use projects and actions is one of the two specific duties of airport land use commissions (preparation of compatibility plans being the other). The process which should be followed in this review depends upon three factors:

- The type of local action involved;
- Whether the ALUC has adopted a compatibility plan; and
- What action the local agency has taken with regard to making its general plan consistent with the ALUC's plan.

This chapter examines:
- ➤ The types of local actions subject to ALUC review;
- ➤ The process to be used by ALUCs in conducting compatibility reviews;
- ➤ The types of compatibility factors to be examined in the reviews; and
- ➤ Judicial remedies available in the event of a legal dispute over an ALUC decision.

This chapter discusses the requirements for ALUC reviews of local actions, the procedures to be followed, and the substance of the reviews. Figures 4A and 4B depict flow charts identifying the steps involved in the ALUC review process for land use actions and airport plans, respectively.

ALUC REVIEW REQUIREMENTS

One of the fundamental responsibilities assigned to airport land use commissions by the Aeronautics Act is to review particular types of local actions for compliance with the criteria and policies set forth in the commissions' adopted compatibility plans.

The law specifies that local jurisdictions must refer certain actions to the ALUC for review. Land use actions included in this category are proposed adoption or amendment of general plans, specific plans, zoning ordinances, and building regulations affecting land within an airport influence area. Also required to be submitted for ALUC review are several types of airport development plans. Referral of other local actions—primarily individual development projects—is required in some instances, but voluntary in others. The following discussion outlines the ALUC review requirements and options for each of these action types.

The question of how an ALUC should go about reviewing each of these types is examined later in this chapter.

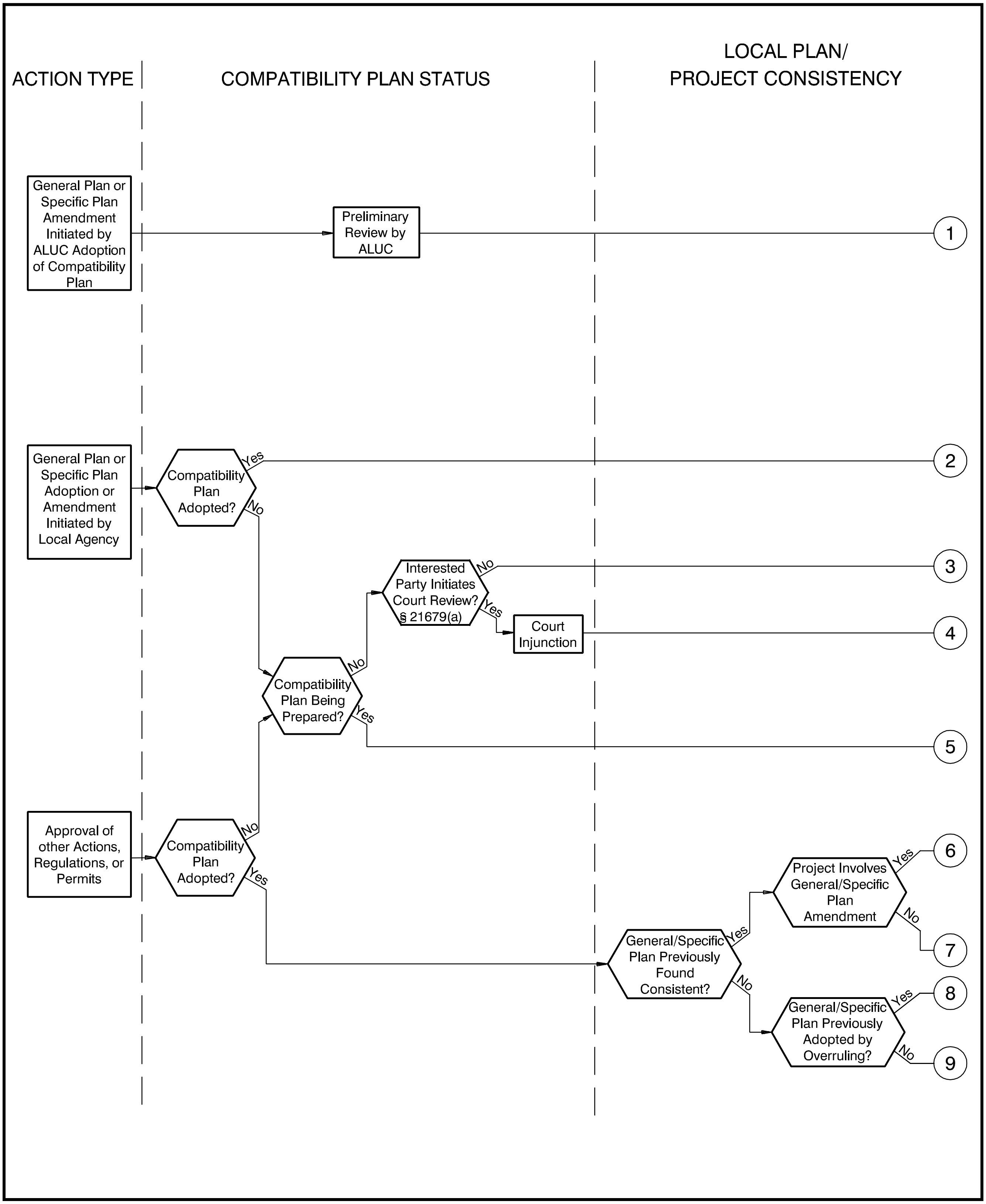


FIGURE 4A

ALUC Review Process for Land Use Actions

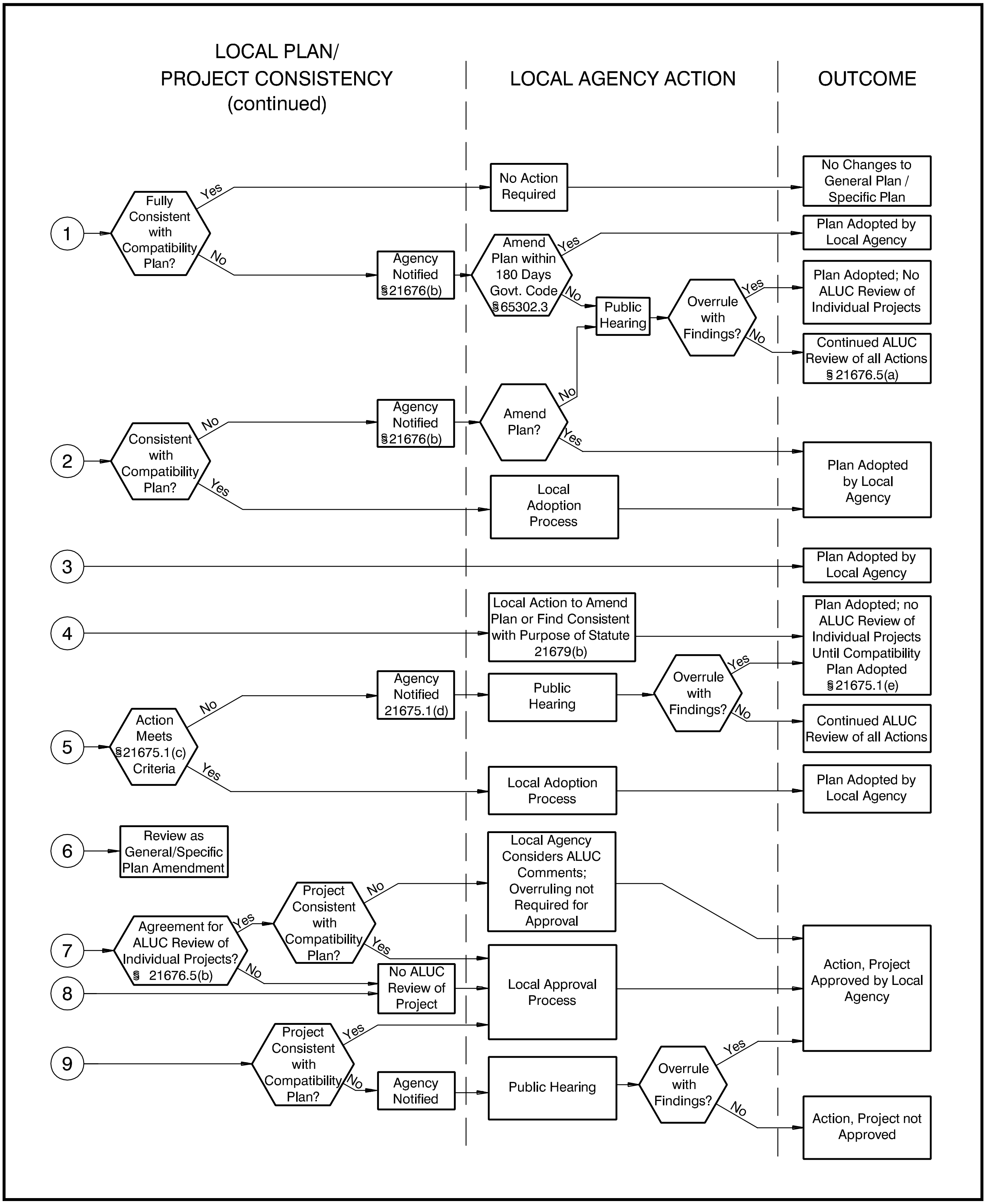


FIGURE 4A *CONTINUED*

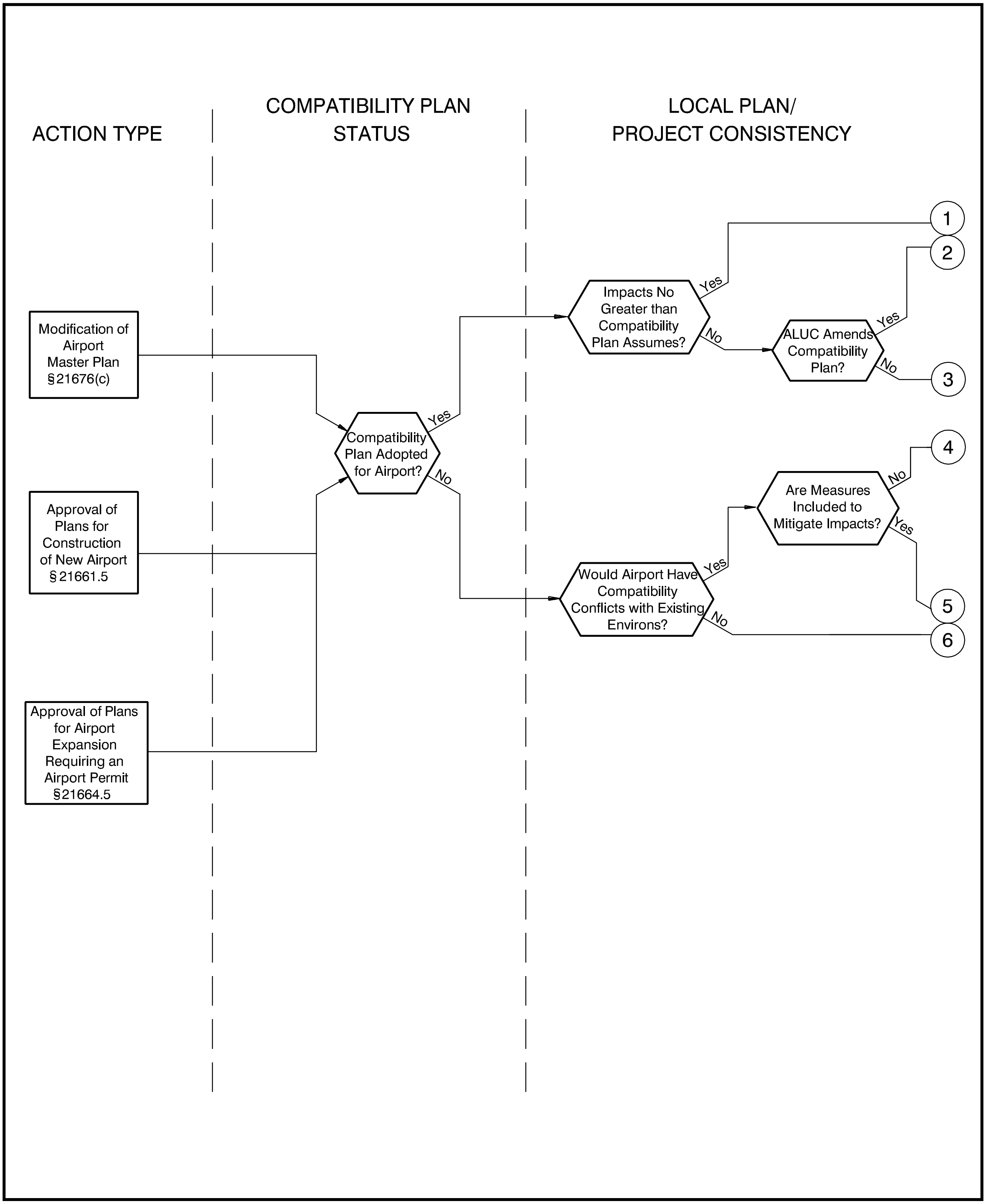


FIGURE 4B

ALUC Review Process for Airport Plans

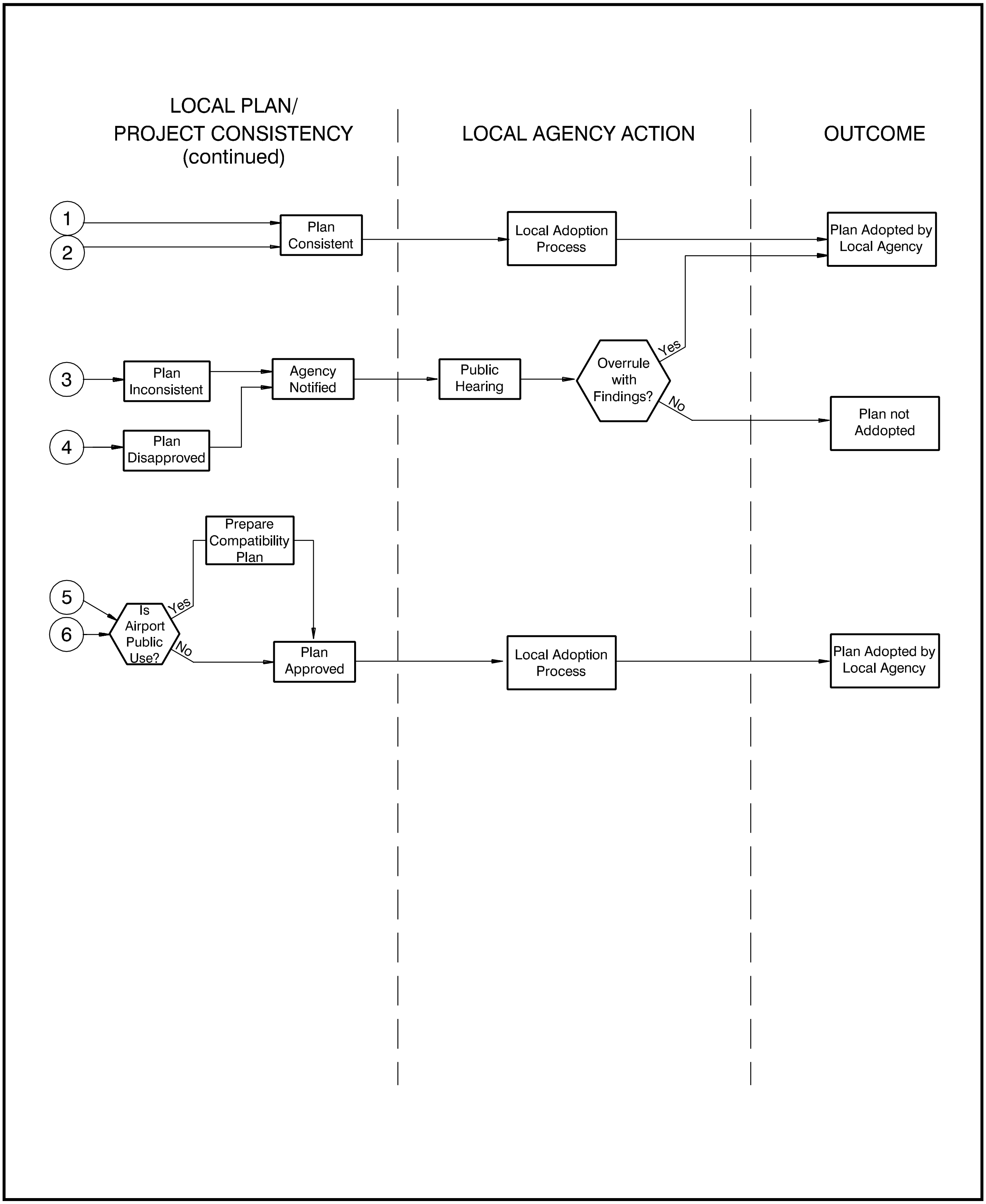


FIGURE 4B *CONTINUED*

Actions for which ALUC Review is Mandatory

General Plans and Specific Plans

Any proposal by a county or city to adopt a general plan or specific plan must be referred to the ALUC for review if the boundaries of the plan encompass the influence area of a public-use airport. Amendments to such plans also must be referred to the ALUC if the change affects locations within an airport influence area. Referral to the ALUC must take place prior to the local jurisdiction's action to adopt or amend the plan (Section 21676(b)).

The impetus for referral of a general plan or specific plan to the ALUC may come from either of two situations:

- A proposal initiated by the local jurisdiction to adopt or amend an affected plan; or
- The requirement for the local jurisdiction's plans to be reviewed for consistency with an ALUC's newly adopted or amended compatibility plan.

The requirement for submittal of general plans and specific plans exists regardless of whether the ALUC has adopted a compatibility plan for the airport. If a compatibility plan has not been adopted, then the airport "vicinity" is defined to mean the study area for such plan or the land within two miles of the airport boundary (Section 21675.1(b)). Once a compatibility plan has been adopted, the airport influence area as defined therein determines the locations which comprise the airport vicinity.

Two special considerations apply to the situations where ALUC adoption or amendment of a compatibility plan is the impetus for the local plan review. First is that, under these circumstances, ALUCs should take the initial step to identify where additions or changes to the local jurisdictions' plans will be necessary. The need for taking this step is a primarily a matter of practicality.

- Local jurisdictions may be less inclined to oppose a compatibility plan if they understand the implications that its adoption will have on their plans and policies.
- Most ALUCs and their staffs have more expertise with which to point out inconsistencies than do local agencies.
- Proposed amendments to general plans and specific plans are more likely to be complete in terms of meeting the requirements of being consistent with the compatibility plan (conflicts will be eliminated and important procedural matters addressed).
- The amendment process can be accomplished more quickly.

As noted in Chapter 5, ALUCs should recognize that the 180-day schedule can be difficult for local jurisdictions to achieve, especially if extensive modifications to their plans are necessary. Although ALUCs do not have the authority to change the 180-time limit, they can indicate that they will not bring any action against a local government for taking extra time. As a practical matter, many ALUCs consider the 180-day time limit to begin as of when printed copies of the compatibility plan or amendment thereto are formally distributed to the affected jurisdictions.

The last of the above factors is significant because of the second special consideration. State law requires not only that local jurisdictions either amend their general plans and any affected specific plan to be consistent with the ALUC's plan or take the steps necessary to overrule the ALUC, but also that this action be taken within 180 days of when the ALUC adopted or amended its plan (Government Code, Section 65302.3). Preliminary ALUC review of the affected plans enable the 180-day time limit to more easily be met because part of the review process takes place before the clock begins running. Note, though, that even when the ALUC conducts a preliminary review, the specific county or city proposals for general plan and specific plan modifications still must be submitted to the ALUC for formal review.

Ordinances and Regulations

ALUC review of county or city proposals to adopt or amend zoning, building, and other land use ordinances and regulations is required in instances where those ordinances and regulations have implications for airport land use noise or safety compatibility. Despite the potential importance of zoning, building, and other land use ordinances and regulations to compatibility planning objectives, the review requirement is undoubtedly overlooked more often than not.

As discussed later in this chapter, careful ALUC review of the relevant ordinances and regulations in conjunction with the assessment of general plans and specific plans for consistency with the compatibility plan is essential.

The State Aeronautics Act explicitly requires ALUC review of these policy instruments during the period prior to when the general plan or specific plan has been made consistent with the commission's compatibility plan or has been adopted by overruling the commission (Section 21676(b)). Subsequent to when a county or city has taken action to amend its general plan and specific plans, review of proposed new or revised zoning ordinances and building regulations remains mandatory because of their direct linkage to the general plan and specific plans. Components of zoning ordinances and building regulations are normally essential to implementation of compatibility criteria and thus to the achievement of consistency between the local plans and the ALUC's plan. In effect, these instruments become extensions of the local plans and, with respect to ALUC review requirements, must be treated in the same manner.

This review requirement especially applies when a proposed new or revised zoning ordinance or building regulation would have general applicability throughout the community or at least to lands within the airport influence area. ALUC reviews of parcel-specific changes to zoning or other regulations are also required when the parcels are within the airport influence area. This is true even when a general plan amendment is not involved. Again, the rationale for reviews being mandatory is that a determination that a general plan is consistent with the compatibility plan almost always depends upon the details, including parcel-specific details, found in implementing zoning ordinances and building regulations.

Airport Plans

ALUC review of three categories of airport plans is mandatory in accordance with state law. This review requirement is not affected by any previous action by the local agency regarding its general plan or specific plan.

Also sometimes subject to ALUC review are proposals for nonaviation development of airport property. See the discussion in the following section.

➤ **Airport Master Plans**—Section 21676(c) mandates that "each public agency owning any airport within the boundaries of an airport land use commission plan shall, prior to modification of its airport master plan, refer such proposed change to the airport land use commission." The commission must then determine whether the proposed master plan is consistent or inconsistent with the adopted compatibility plan for that airport.

As used in this section of the law and in the section (discussed below) applying to airport expansion, construction plans should be thought of as construction proposals. These sections are not intended to require that ALUCs review the actual engineering construction drawings, only the overall layout plan.

➤ **Construction Plans for New Airports**—The requirement for review of construction plans for new airports arises not out of the airport land use commission portion of the State Aeronautics Act (Chapter 4, Article 3.5), but from the regulation of airports portion of the law (Chapter 4, Article 3). Section 21661.5 of this article states that no application for the construction of a *new* airport may be submitted to any local, regional, state, or federal agency unless that plan has been both:
- Approved by the board of supervisors of the county, or the city council of the city, in which the airport is to be located; and
- Submitted to and acted upon by the appropriate airport land use commission.

State permits are required only for public-use or special-use facilities. Agricultural and certain other essentially restricted-use airports are exempt. Also, in the context of the aeronautics law, a heliport is considered to be a type of airport. Plans for construction of new heliports, including hospital heliports (a type of special-use facility) are therefore subject to ALUC review.

➤ **Airport Expansion Plans**—Section 21664.5 of the Aeronautics Act applies the above review requirements to any airport *expansion* project which entails amendment of the Airport Permit issued by the California Department of Transportation. *Airport expansion* is defined to include:
- The construction of a new runway;
- The extension or realignment of an existing runway; and
- The acquisition of runway protection zones or any interest in land for the purpose of the above.

Other Actions Potentially Subject to ALUC Review

Individual Land Use Development Projects

In the early years of ALUCs' existence, state law required that all local plans, projects, and other actions affecting the vicinity of an airport be submitted to the responsible commission for review. For airports located in growing areas, this process proved to be burdensome. The law was therefore amended to place emphasis on general plans and specific plans as the levels of local planning at which compatibility between airports and their surroundings should primarily be addressed. The current law greatly limits the need for ALUC review of local actions once the ALUC has adopted a compatibility plan and local general plans and specific plans have been made consistent with it.

Airport land use commissions can require the review of "all actions, regulations, and permits" involving the vicinity of a public airport under only two circumstances:
- Prior to ALUC adoption of a compatibility plan for the airport all such actions shall be submitted for review (Section 21675.1(b)); and
- When a local agency has neither revised its general plan or specific plan to be consistent with the commission's compatibility plan nor overruled the commission with regard to these plans the ALUC may require the local agency to submit all such actions for review (Section 21676.5(a)).

Beyond these two circumstances, the need for submittal of individual development proposals (if they do not involve general plan, specific plan, or zoning changes) is subject to mutual agreement between the ALUC and the affected jurisdiction (Section 21676.5(b)). Many ALUCs request that certain major land use actions continue to be submitted for review. Such actions might include very large developments where site design (the distribution of dwellings, areas of intensive use, open lands, etc.) and other factors such as building height have potential compatibility implications even when the overall development is basically acceptable. A full list of these types of development actions should be included in the compatibility plan, the local general plan, or in some other policy document agreed upon by both entities.

Even when a jurisdiction agrees to continue to submit major land use actions, ALUC review of a project is normally not necessary if a related general plan or zoning changes has previously been reviewed. Exceptions to this limitation on subsequent reviews might apply if sufficient details regarding the project were not available at the of the general plan or zoning action was reviewed or if the project changes significantly.

Three very important points need to be emphasized with regard to the review of individual land use development proposals whether by the ALUC or the local jurisdiction.

- **ALUC Reviews Are Voluntary Only if General Plan Is Fully Consistent with Compatibility Plan**—If individual development projects are not to be submitted to the ALUC for review, then these projects must be reviewed by the responsible county or city. The general plan or other supporting policies therefore must contain sufficient detail regarding compatibility criteria and review procedures to assure compliance with policies which the ALUC sets forth in its compatibility plan. If this is not done, then the general plan is not fully consistent with the compatibility plan and submittal of individual development projects for ALUC review would continue to be mandatory.

See the discussion later in this chapter concerning review of general plans.

- **Local Agency Reviews Must Be Based on ALUC Criteria**—The failure of a local agency's general plan to restate or reference ALUC criteria and procedures—even if that plan has been found consistent with the ALUC plan—does not relieve the agency of the obligation to require individual development proposals to meet the ALUC standards. Any exceptions require that the local agency take the special steps necessary to overrule the ALUC. A local agency's silence on these matters can be taken to indicate its acquiescence to the standards set by the compatibility plan. If a land use development project were to be challenged under these circumstances, a court could be expected to hold the project to the ALUC's standards.

- **Nonmandatory ALUC Project Reviews Are Advisory**—Under the circumstances when a general plan has been made *fully* consistent with the ALUC's compatibility plan, not only is submittal of most land use development proposals for ALUC review voluntary, but, when submitted, the reviews become advisory. Moreover, when—but *only* when—an ALUC review is advisory, the local jurisdiction does not need to take the special steps necessary to overrule the commission if it disagrees with the outcome of a review. (While the advisory nature of ALUC reviews under these circumstances is not spelled out in the Aeronautics Act, it is clear that, if this were not the case, then the local agency could simply cancel the review agreement and proceed without any ALUC involvement.)

ALUC reviews are *not* advisory when the local jurisdiction elects to continue to submit all development projects to the commission rather than to incorporate the necessary criteria and review procedures into its own plans and policies.

Ministerial Actions

A question which sometimes arises, primarily with regard to the review of individual development projects, concerns the appropriateness of ALUC review of projects for which local government approval is ministerial (administrative) as opposed to discretionary. In essence, the question is why should an ALUC review a project if the local agency has no power to deny its approval?

The important factor to remember in these cases is that, even though the local agency may not be able to deny the project, it can set design conditions. In terms of airport compatibility, such conditions might include site layout, height limits, noise insulation, etc.

Public Utilities Code Section 21675.1(g) implicitly indicates that ministerial permits are subject to ALUC review prior to the adoption of a compatibility plan. This section allows ALUCs to exempt ministerial permits for single-family dwellings from review except where 25 percent or more of the parcels in a subdivision are undeveloped. After adopting a compatibility plan, a commission has the option of what types of ministerial actions, if any, it wishes to review. Subsequent to local agency action to make its general plan or specific plans fully consistent with the compatibility plan, ALUCs only review ministerial permits if the local agency agrees to submit them.

Subsequent Review of Related Projects

When a local agency and the ALUC have agreed that selected land use actions will continue to be reviewed, efforts should be made to avoid duplicative reviews. For example, if a specific plan has been prepared primarily to provide guidance for a major land use development proposal and the plan contains substantial detail regarding the development, subsequent review of the proposal itself should not ordinarily be necessary. Similarly, if the ALUC reviews a proposed zone change related to a particular development project, then later review of the project itself can be avoided if site design and other significant information is provided with the initial review.

CEQA Documents

When a California Environmental Quality Act (CEQA) document such as a negative declaration, mitigated negative declaration, or an environmental impact report has been prepared in conjunction with an action submitted for ALUC review, a copy should be provided to the commission along with other information on the project. ALUC staff can then excerpt portions which might be relevant to a compatibility determination by the commission.

Any person or entity other than a responsible agency may submit comments to a lead agency concerning any environmental effects of a project being considered by the lead agency (CEQA Guidelines, Section 15044).

ALUCs are not responsible agencies for the purposes of CEQA and thus are not legally required to respond to the CEQA document. ALUCs' sole legal responsibility is to make a compatibility determination regarding the project itself. However, ALUCs have the right, and authority, to provide comments to the lead agency. Under state law, ALUCs have the required "special expertise" concerning compatibility planning to provide comments on projects in proximity to an airport.

ALUCs should ask to be placed on the CEQA notification lists of all local agencies within the ALUCs' planning jurisdiction to ensure that they are notified of projects in the vicinity of airports. Public agencies should compile listings of other agencies, particularly local agencies, which have jurisdiction by law and/or special expertise with respect to various projects and project locations. Such listings should be a guide in determining which agencies should be consulted with regard to a particular project.

CEQA documents circulated to ALUCs when a compatibility determination is not required should be considered the same as other voluntary referrals. They provide an opportunity for ALUCs to offer guidance to ensure the highest level of compatibility. In these circumstances, ALUCs are free to offer comments on the CEQA document, but have no authority to disapprove the project.

DEPT. OF TRANSPORTATION
GUIDANCE
ALUCs are encouraged to comment on projects that might effect compatibility with airports even when projects are not required to be referred to the ALUC for a compatibility determination.

Nonaviation Development of Airport Property

State law does not specify whether ALUCs have authority to review projects involving nonaviation development on airport property. While the statutes give ALUCs the responsibility of reviewing airport master plans and certain other airport development plans for consistency with the commission's plan, ALUCs are also explicitly precluded from having authority over operation of any airport. A suggested perspective on this issue—one asserted by at least some ALUCs—is that they have the authority to review this type of development proposal in that it does not involve the "operation" of the airport. For public relations purposes if nothing else, airports probably should concede this point—it would be difficult to argue that certain nonaviation development should be allowed to occur on airport property when the same development in the same location would be judged incompatible if the property was privately owned.

The need for ALUC review of these projects should be treated much the same as with respect to individual development projects in the airport environs. That is, just as the focus for most off-airport development review is on general plans and specific plans, reviews of on-airport projects should primarily take place at the time the airport master plan is reviewed. Only when important details regarding a proposed development have changes or were not available at the time of the initial review would subsequent review be necessary.

PROCEDURAL CONSIDERATIONS

Information Required for Project Reviews

Most county and city planning departments have a form and/or a defined list of information which a project applicant must submit when requesting zoning variances or other types of local development approvals. ALUCs should have a similar form or list of information to be included when a project is submitted for commission review.

Without adequate information, the commission cannot fully assess whether a proposed land use action will be consistent with the commission's compatibility plan. Missing information also can result in the ALUC review being delayed if questions arise during a public meeting. The importance of having complete project data is emphasized in the ALUC statutes (Section 21675.2(c)):

The text of these sections of the Government Code is included in Appendix A.

> "Failure of an applicant to submit complete or adequate information pursuant to Sections 65943 to 65946, inclusive, of the Government Code may constitute grounds for disapproval of actions, regulations, or permits."

Although this particular section applies to ALUC review of actions prior to the adoption of a compatibility plan, the results can be the same with regard to actions submitted for a consistency review.

ALUC staffs should conduct a preliminary review of the information submitted on a project to assess whether the project is subject to ALUC review and, if so, whether the information is sufficiently complete to enable a consistency determination to be made. If additional information is needed, the project proponent should be so notified without undue delay. Staff also should determine whether the applicant has already requested reviews by other agencies (for example, an aeronautical hazard review conducted by the Federal Aviation Administration in accordance with Part 77 of the Federal Aviation Regulations). If at all possible, a situation to be avoided is a delay in ALUC action on a project because insufficient information is available at the time of the commission meeting.

Time Factors

Time is a factor with regard to the project review process in two ways:

At least one ALUC encourages proponents of individual development projects to submit information on their proposals directly to the commission. These items are then placed on the commission agenda for "discussion purposes only." This process allows many compatibility issues to be resolved before the project is even submitted to the county or city for processing.

➤ **Timing of Project Submittal**—In order to avoid unnecessary delays in the overall processing of a plan or project, the timing of when a plan or project is submitted to an ALUC for review is an important consideration. In general, plans and projects should be referred to the ALUC at the earliest reasonable point in time so that the commission's review can be duly considered by the local jurisdiction prior to formalizing its actions. Depending upon the type of plan or project and the normal scheduling of meetings, ALUC review can be done before, after, or concurrently with review by the local planning commission and other advisory bodies, but must be accomplished before final action by the board of supervisors, city council, or, in the case of some airport projects, the airport district board.

The statutes do not specify a response time limit for actions submitted to ALUCs on the basis of mutual agreement with affected jurisdictions. Such time limits should be indicated in the agreement, but 60 days is generally a reasonable duration.

➤ **Response Time Requirement**—An airport land use commission must respond within 60 days of referral to local agency requests for a consistency determination on plans or projects for which submittal is mandatory. However, this response period does not begin until such time as all information necessary for accomplishment of the project review has been submitted to the commission. The 60-day response time is specified in Sections 21675.2(a) and 21676(d) of the State Aeronautics Act.

The consequence of the commission not acting within this time limit depends upon whether the commission has adopted a compatibility plan:

- If the commission *has not* adopted a compatibility plan, the proponent of a land use action, regulation, or permit may petition the court to compel the commission to act on the proposal (Section 21675.2(a)).
- If the commission *has* adopted a compatibility plan and the land use proposal involves a general plan, specific plan, zoning ordinance, or building regulation or is a proposed airport master plan, then the proposal is deemed consistent with the commission's plan (Section 21676(d)).

Review Fees

A 1989 amendment to the State Aeronautics Act granted ALUCs the authority to charge fees for review of land use proposals and airport plans (Section 21671.5(f)). However, a commission is only permitted to charge fees if it has adopted a compatibility plan for the airport involved. The fees charged cannot exceed the estimated reasonable cost of providing the review.

Responses to a late 1999 survey of ALUCs found that almost half (of the 19 responding to the survey) indicated that they charge fees. Some commissions charge a flat amount for any type of review. Others distinguish between different types of actions—for example, actions initiated by a public agency (e.g., a new general plan) versus ones which are privately initiated (e.g., individual development projects).

The fees charged for project reviews vary substantially from one ALUC to another. Some commissions charge small amounts which basically cover only the paperwork and other direct expenses. Other commissions base their fees on the typical number of staff hours involved in a project review and attempt to cover the full cost of the staff time.

ALUC Action Choices

Land Use Plans and Projects

An ALUC's choices of action on a land use plan or project submitted for review depends upon whether a compatibility plan has or has not been adopted. In either case, the commission has just two basic choices of action available.

➤ **Prior to Adoption of a Compatibility Plan**—If a commission has not yet adopted a compatibility plan, its choices of action are to *approve* or *disapprove* the matter submitted for review. This choice applies to any type of land use action, regulation, or permit, including general plans, specific plans, zoning ordinances, building regulations, and individual development projects. Absent having an adopted compatibility plan, the commission's authority to approve a land use action, regulation, or permit is limited by the law (Section 21675.1(c)). Approval requires that the commission find, based on substantial evidence in the record, that *all* of the following conditions exist:

- "The commission is making substantial progress toward completion of the plan."
- "There is a reasonable probability that the action, regulation, or permit will be consistent with the plan being prepared by the commission."
- "There is little or no probability of substantial detriment to or interference with the future adopted plan if the action, regulation, or permit is ultimately inconsistent with the plan."

If all of these tests are not met, the commission legally cannot approve the proposal. However, only the first of these conditions is a significant procedural hurdle and very little is necessary to minimally satisfy it. ALUC adoption of a resolution setting an intended schedule for preparation of a compatibility plan should suffice for this purpose. Adoption of preliminary compatibility criteria for the specific airport is not necessary, although the commission's resolution should at least refer to any generalized criteria it may have adopted or to this *Handbook* as the interim basis for project review. Once this test has been met, the characteristics of the project will determine whether the proposed action should be approved or disapproved.

If the ALUC concludes that it cannot take action because it does not have a compatibility plan and is not making progress toward preparation of one, then approval of the land use proposal would be subject only to action by the local agency unless court proceedings are initiated by an interested party (in accordance with Section 21679) as discussed later in this chapter.

➤ **After Adoption of a Compatibility Plan**—After the commission has adopted a compatibility plan for an airport, the nature of its review of land use matters changes. It now has—or should have—a set of policies and criteria by which to evaluate the proposal. The question then becomes one of determining whether the proposal is consistent or inconsistent with the compatibility plan.

The Aeronautics Act (Sections 21676(a) and 21676.5(a)) mentions only these two choices of action. No mention is made about finding a proposal *consistent with conditions attached*. Nevertheless, some ALUCs have found this to be an acceptable action choice. It is reasoned that such an action saves the applicant the step of returning to the commission with a revised proposal incorporating the commission's conditions for approval. When a finding of consistency is made contingent upon certain conditions, the conditions should be limited in scope and de scribed in a manner which allows compliance to be clearly assessed (e.g., the height of a structure). Also, regardless of which set of action choices an individual ALUC allows for itself, the compatibility plan's policies should indicate what the action choices are.

Airport Plans

When an ALUC reviews an airport master plan, a plan for construction of a new airport (or heliport), or expansion of an existing airport, its basic choices of action are once again to determine whether the proposal is *consistent* or *inconsistent* with the commission's plan. However, there are also associated actions which the commission may wish to take in conjunction with this determination.

- **Airport Master Plans**—When an inconsistency exists between a proposed airport master plan and an adopted compatibility plan, the commission has the option of first modifying its plan to reflect the assumptions and proposals of the master plan. Any such amendment to the compatibility plan is limited to once per calendar year and must follow the procedures outlined in Chapter 2 of this *Handbook*.

- **Plans for New Airports**—Unless a master plan was previously prepared—which typically occurs only when the facility will be publicly owned—the ALUC will not have an adopted compatibility plan for a proposed airport or heliport. As discussed later in this chapter, the consistency determination must therefore be based upon underlying noise and safety compatibility considerations. If the commission concludes that the plan for the proposed facility is consistent with these compatibility factors, it should then decide whether to prepare a compatibility plan for that facility to help protect it from incompatible land use development. If the proposed new airport or heliport will serve the general public (that is, if a State Airport Permit or Heliport Permit is required), then a compatibility plan for the facility should be adopted.

Also see discussion in Chapter 2 regarding the types of airports for which compatibility plans are needed.

- **Airport Expansion Plans**—Plans for expansion of the runway system at a publicly owned airport normally will be based upon a long-range airport master plan previously reviewed by the commission. The consistency review thus need involve little more than a comparison of the proposed expansion project with the airport's master plan. In cases where a master plan does not exist or the expansion project is not included in it, the consistency determination should be based upon factors similar to those for review of plans for new airports.

SUBSTANCE OF REVIEWS

If the adopted compatibility plan for an airport is thorough, the review of proposed local land use actions becomes relatively simple. Some degree of judgment is nonetheless almost always necessary, especially when the compatibility plan relies upon performance criteria rather than a format which specifically indicates the compatibility or incompatibility of individual classes of land uses.

Discussed below are some of the types of factors which an ALUC and its staff should examine in order to determine whether a proposed action is consistent with the commission's compatibility plan. The list is undoubtedly not totally inclusive. Almost any complex proposal will involve unique details which will need to be considered on a case-by-case basis.

If an ALUC elects to provide comments on an environmental document associated with a project it is reviewing, the focus of the comments should be on matters for which ALUCs have review authority under aeronautics law. Factors such as those listed here are suitable topics for comment.

General Plan and Specific Plan Consistency Reviews

Of all the types of land use actions which an ALUC reviews, general plans and specific plans require the most careful scrutiny.

When ALUCs evaluate county and city general plans and specific plans for consistency with the compatibility plan, a thorough review is essential for two reasons. One reason is that these local plans are often large and complex. Policies and other matters which may be significant with regard to airport compatibility are usually scattered throughout many sections of the plan—land use, housing, transportation, noise, safety, and open space elements, as well as the land use map, being among the likely candidates. The second, and perhaps most critical, reason is that once the ALUC has deemed the general plan or specific plan consistent with the compatibility plan, most subsequent land use actions and development proposals will not be reviewed by the commission unless the local agency agrees to submit them.

Concept of Consistency

A dictionary defines *consistency* as "agreement or harmony of parts or features to one another or a whole." Legal definitions of the term depend upon the context in which it is used and have been the subject of numerous court cases. It is not a purpose of this *Handbook* to attempt to establish a legal definition for the term. Rather the intent here is to describe what *consistency* generally means with respect to airport land use compatibility planning.

Most importantly, a general plan or specific plan does not have to be *identical* to an ALUC compatibility plan in order to be *consistent* with it. The fundamental objective is that these local plans, together with any implementing policies contained in ordinances or regulations, must be capable of ensuring that future land use development will not conflict with compatibility plan criteria. The two specific tests which a general plan must meet to be considered *fully* consistent with the compatibility plan are:

- Elimination of any direct conflicts between the two plans; and
- Delineation of a mechanism or process for ensuring that individual land use development proposals comply with the ALUC's adopted compatibility criteria.

Elimination of Direct Conflicts

See Chapter 3 for an extended discussion of the implications of existing land uses upon reviews of general plans and specific plans. Also addressed in Chapter 3 are other compatibility concerns such as redevelopment, reconstruction, and infill.

Direct conflicts primarily involve general plan land use designations which do not meet the density (for residential uses) or intensity (for nonresidential uses) criteria specified in the compatibility plan, although conflicts with regard to other policies also may exist. Note, however, that a general plan cannot be found inconsistent with the compatibility plan because of land use designations which reflect existing land uses even if those designations conflict with the ALUC's compatibility criteria. Because ALUCs have no authority over existing land uses, general plan land use designations which merely reflect the existing uses for such parcels are, in effect, excluded from requirements for general plan consistency with the ALUC plan.

Assurance of Compliance with Compatibility Criteria

Elimination of direct conflicts between a county's or city's general plan and the ALUC's compatibility plan is not enough to guarantee that future land use development will adhere to the compatibility criteria set forth in the compatibility plan. An implementation process must also be defined either directly in the general plan or specific plan or by reference to a separately adopted ordinance, regulation, or other policy document. In many respects this implementation process is equivalent to a mitigation monitoring program established as a means of achieving compliance with provisions set forth in a CEQA document.

There are three facets to the process of ensuring compliance with airport land use compatibility criteria:

- **Delineation of Compatibility Criteria**—Airport land use compatibility criteria must be defined either in a policy document adopted by the county or city or through adoption of or reference to the ALUC's compatibility plan itself.
- **Identification of Mechanisms for Compliance**—The mechanisms by which applicable compatibility criteria will be tied to an individual development and continue to be enforced must be identified. A conditional use permit or a development agreement are two possibilities.
- **Indication of Review and Approval Procedures**—Lastly, the procedures for review and approval of individual development proposals must be defined. A what level within a county or city are compatibility approvals made: staff, planning commission, or governing body? The types of actions which are to be submitted to the ALUC for review and the timing of such submittals relative to the internal review and approval process also must be indicated.

DEPT. OF TRANSPORTATION GUIDANCE
Before finding a general plan to be fully consistent with the compatibility plan, ALUCs should check that all applicable topics listed in Table 5A are addressed either in the general plan itself or in other implementing policy documents. Alternatively, as mentioned earlier in this chapter and further addressed in Chapter 5, local jurisdictions can elect to continue to refer all proposed land use actions within an airport influence area to the ALUC for review.

Further details regarding each of these essential steps to making general plans and specific plans consistent with an ALUC compatibility plan are discussed in Chapter 5. A checklist of general plan consistency requirements is included in Table 5A. The list is not necessarily exhaustive, nor will every item will be applicable to every compatibility plan or every general plan. Rather, it is intended to provide basic guidance both to ALUCs in reviewing general plans and to counties and cities in preparing the necessary amendments and implementing actions.

Review of Zoning Ordinances and Building Regulations

ALUC review of zoning ordinances, building regulations, site design standards, and other implementing actions is particularly important because general plans often do not contain all of the policies necessary to be fully consistent with a compatibility plan. Instead, zoning ordinances, building regulations, and other local policies become the mechanisms for specific implementation of airport land use compatibility policies and procedures.

When reviewing these policy instruments, the same topics outlined in Table 4A should be considered. The significant difference is that land use ordinances and regulations usually include criteria, standards, and other details which can be quantitatively compared with related criteria in the compatibility plan. It is important, however, that the ALUC avoid becoming preoccupied with details which do not relate to airport compatibility concerns.

Review of Individual Development Projects

As previously noted, with some exceptions, ALUCs review individual development proposals only when they involve general plan or zoning changes or when the local jurisdiction agrees to submit these projects for review.

The type and scope of an individual development proposal significantly affects the nature of the review. Many small details play a part in the consistency determination. Among these are:

- **Residential Density**—The proposed number of dwelling units per acre should be assessed for compliance with compatibility plan criteria. This is usually a straightforward determination, although differences between gross and net acreage and the potential for secondary dwelling units must be taken into account. When using gross acreage as the basis for calculating densities, care must however be taken that portions of roads or open space on the edges of the development are not also included in the density or intensity calculations for an adjacent development.
- **Nonresidential Usage Intensity**—The potential number of people per acre who could occupy a nonresidential land use needs to be evaluated relative to the applicable limits. This number may not be clear from the proposal and can be particularly uncertain for speculative development projects (ones where the tenant has not been determined in advance of the construction). However, an estimate can usually be made using data such as: the number of parking spaces required for the use; maximum occupancy levels prescribed by building and fire codes; and surveys of similar existing uses. Assurance needs to be provided by means of the use permit, building permit, or other local approval that the intensity limits will not be exceeded if a different tenant and/or different use occupy the facility at a later date.
- **Site Plan**—The site plan for a proposed development is essential to review, particularly when a large project site straddles more than one ALUC compatibility zone. Whether variations in noise impacts and risk levels on different parts of a large site have been taken into account should be examined. Also, the size, location, and design of open land areas should be examined if ALUC policies require these features.
- **Height Limits**—The planned height of buildings, antennas, and other objects should be checked with respect to Federal Aviation Regulations Part 77 criteria if the development is close to the airport, situated within the runway approach corridors, or on land higher more than 150 feet above the airport elevation. The potential height of trees also may be a factor. Shielding provided by terrain or existing structures should be considered when determining acceptable heights, however.

Airport Plan Reviews

The substance of the review of airport plans—master plans, construction plans for new airports (and heliports), and expansion plans for existing airports—differs depending upon whether the commission has already prepared a compatibility plan for the facility. Consistency is easier to evaluate when a plan for the specific airport has already been created.

Plans for Existing or New Airports Having Adopted Compatibility Plans

The review of a master plan, construction plan, or expansion plan for an airport for which a compatibility plan has already been prepared should focus on differences between the plans. *Fundamentally, the question to be examined is whether any components of the airport plan would result in greater noise and safety impacts on surrounding land uses than are assumed in the adopted compatibility plan.* This concept implies that the airport plan does not have to be identical with the compatibility plan as long as the impacts are not increased or moved to previously less-impacted areas.

An airport development plan can indicate that impacts will be *less* than assumed in the compatibility plan and still be consistent with the compatibility plan. However, in cases where the differences are the result of new airport-owner policies regarding the future airfield configuration or use (elimination of a previously planned new runway, for example), the ALUC should update its plan accordingly.

The airport plan review should focus on components of the plan which are associated with aircraft operations and which have off-airport impact implications. These components and the questions which should be asked about them include:

- **Forecasts**—Are the activity forecasts substantially higher than those in the compatibility plan or do they include a higher proportion of larger or noisier aircraft, including helicopters?
- **Runway Layout**—Are any new runways or helicopter takeoff and landing areas proposed? Are changes in runway length, landing threshold locations, or type of approach procedures planned? Where will pre-flight run-ups be conducted?
- **Flight Tracks**—Will new or modified facilities or aircraft operating procedures result in different aircraft traffic patterns or other changes in where or how high aircraft typically fly when approaching, departing, or flying near the airport?
- **Noise Impacts**—Will changes in any of the above items result in significantly increased noise impacts on surrounding lands?

As noted earlier in this chapter, an additional component of airport plans which ALUCs should review is proposed nonaviation development of airport property. Such uses include office buildings, industrial facilities, hotels, and other such uses that do not have a direct aeronautical function (see Glossary for definition of aviation-related use). The criteria against which such uses should be evaluated are the same as if the use were located on adjacent private property.

Plans for any other airport facilities or activities associated with aircraft operations also can be considered in the ALUC review. Proposals for new taxiways or aircraft parking facilities near noise-sensitive land uses, for example, may warrant examination. In most cases, however, these facilities and their use pose no significant off-airport implications.

See Chapters 8 and 9 for further discussion of these types of noise issues.

Noise associated with aircraft engine maintenance and testing is not an ALUC concern. These functions are not activities essential to the operation of aircraft at a particular airport. Rather, they are industrial activities and, as such, should be addressed by the local land use jurisdiction in the same manner as other industrial noise sources.

Construction or Expansion Plans for Airports without Previous Compatibility Plans

When an ALUC reviews a plan for a new airport or heliport—or the expansion of an existing airport or heliport—in an existing land use setting, the basic issue is how will the airport fit into that setting. One way of looking at this issue is to ask: *would the existing or planned land uses be considered compatible with the airport or heliport if the latter were already in existence?* If not, what features or mitigation measures are included in the airport or heliport proposal to mitigate the noise and safety impacts on surrounding land uses? Specific questions for ALUCs to consider might include:

- ➤ **Runway Layout**—Does the proposed layout of aircraft landing areas attempt to limit impacts on surrounding land uses to the extent practical?
- ➤ **Flight Tracks**—Will the aircraft traffic pattern be limited to a single side of the runway because of land use compatibility or other factors? Are any other flight track or operational restrictions proposed to minimize off-airport impacts?
- ➤ **Aircraft Activity Characteristics**—What type and volume of aircraft activity is projected for the facility over the next 20 years or more? Are these characteristics compatible with surrounding land uses?
- ➤ **Property Acquisition**—Will fee title and/or easements be acquired on highly impacted property?

When reviewing the plans for a new airport or airport expansion, it is important that ALUCs evaluate the adequacy of the facility design (in terms of federal and state standards) only to the extent that the design affects surrounding land use. Also, commissions must base their review on the proposed design. ALUCs do not have the authority to require alterations to the airport plan or to make different assumptions regarding the future airport role and airfield configuration than are indicated in the airport's plan.

JUDICIAL ACTION

Provisions under Aeronautics Law

The State Aeronautics Act (Section 21679) explicitly provides for judicial action on ALUC matters only under very limited circumstances. Specifically, all of the following must apply:

- No compatibility plan has been adopted for the airport by an ALUC (Section 21679(a));
- The local general plan or any applicable specific plan does not accomplish the purposes of a compatibility plan (Section 21679(c));
- The local agency action in question must be a zoning change, a zoning variance, the issuance of a permit, or the adoption of regulation (Section 21679(a));

- The local action must affect the use of land within one mile of the boundary of a public airport in the county (Section 21679(a));
- The court proceedings must be initiated by an owner of land within two miles of the airport boundary or an organization with "a demonstrated interest in airport safety and efficiency" (Section 21679(f)); and
- The proceedings must be commenced within 30 days of the local agency action or as otherwise provided in state laws (Section 21679(d)).

If all of these conditions prevail, the court may issue an injunction to postpone the effective date of the local agency action. The postponement remains in effect until the local agency does one of the following:

- Adopts a resolution finding that the action is consistent with the purposes of the ALUC statutes;
- Amends the action to make it consistent with the purposes of the article; or
- Rescinds the action.

Despite the explicitness of this section of the Aeronautics Act, it is generally not regarded as precluding judicial actions on ALUC matters involving other sets of circumstances. ALUCs theoretically could initiate court proceedings to seek to enforce local agency compliance with provisions of the ALUC statutes. Whether most commissions have the means to do so is another matter. More common has been for such actions to be brought by pilots' groups or other private parties having an interest in protecting the airport from incompatible development.

Mediation Process

Another mechanism which potentially could be used to address legal disputes on airport land use compatibility matters is a *mediation process*. State law (Government Code, Sections 66030-66031) provides for use of mediation as a method of resolving certain types of land use disputes. Included among listed circumstances is the "validity of any decision made pursuant to [ALUC statutes]." The law explicitly notes that "in establishing these mediation processes, it is not the intent of the Legislature to interfere with the ability of litigants to pursue remedies through the courts."

Another section of state law (Code of Civil Procedures, Section 1730(a)) expands upon the mediation process by establishing a "pilot program" in the superior courts of four counties (Contra Costa, Fresno, San Diego, and Sonoma) "to assess the benefits of early mediation of civil cases." Mediation is defined as "a process in which a neutral person or persons facilitate communication between disputants to assist them in reaching a mutually acceptable agreement" (Code of Civil Procedures, Section 1731(c)). With certain exceptions—notably, petitions for a writ of mandate or prohibition—all civil cases within the four counties are included in the program. The law became effective in January 2000 and the test period is to continue until January 2003.

The law requires that, between 90 and 150 days of the filing of a civil complaint, the court is to hold a status conference with the affected parties. The use of mediation as an alternative dispute resolution process is to be addressed at this conference. In two of the test counties (Fresno and Contra Costa), the court can order mandatory mediation. In the other two, the parties' acceptance of mediation is voluntary. The costs of the mediator, if selected from a court-appointed list, are borne by the court.

CHAPTER 5

Responsibilities of Local Agencies

OVERVIEW

This chapter focuses on the obligations and responsibilities of local land use jurisdictions and airport operators with regard to airport land use compatibility. Topics covered include:

- Making local plans consistent with ALUC plans;
- Requirements for submitting local land use actions for ALUC review;
- Compatibility planning in counties that do not have an ALUC;
- Steps which a local agency must take if it elects to overrule an ALUC action;
- The role of airport proprietors in airport land use compatibility planning.

Effective airport land use compatibility planning is not and cannot be solely a function of airport land use commissions. Indeed, as outlined in Chapter 1, state law specifically limits ALUC authority over various actions which directly affect compatibility. Much of the responsibility for airport land use compatibility clearly remains with local agencies whether in the role of controlling land use or operating an airport.

This local agency responsibility for airport land use compatibility planning is particularly critical in counties which have chosen to utilize the alternative process. As indicated in Chapter 1, establishment of the alternative process in a county only eliminates the requirement for formation of an airport land use commission. The obligation for preparation, adoption, and implementation of an airport land use compatibility plan still remains and, if anything, rests more fully upon local jurisdictions than when an ALUC exists.

LOCAL PLANS CONSISTENCY WITH COMPATIBILITY PLAN

State statutes require that, once an airport land use commission has adopted or amended an airport land use compatibility plan, the county—where it has land use jurisdiction within the airport influence area—and any affected cities must update their general plans and any applicable specific plans to be consistent with the ALUC's plan (Government Code, Section 65302.3). Alternatively, local jurisdictions have the option of taking the special steps necessary to overrule all or part of the ALUC's plan. If a county or city fails to take either action, then it is required to submit all land use development actions involving property within the airport influence area to the ALUC for review (Public Utilities Code, Section 21676.5(a)).

This section addresses the options available to local jurisdictions for bringing their plans into consistency with the compatibility plan. The latter two topics—requirements for overruling of the ALUC and for submitting actions for ALUC review—are examined later in this chapter.

General Plan Review and Amendment Process

Two key facets of the process by which a county or city modifies its general plan and any specific plans for consistency with the compatibility plan are important to highlight.

Preliminary Review by ALUC

See discussion in Chapter 4.

In conjunction with an action to prepare or amend a compatibility plan, ALUCs should conduct a preliminary review of affected local plans. The ALUC reviews should identify any obvious direct conflicts between the plans. Equally important to note are significant omissions from the local plans with respect to compatibility criteria and review procedures. While these preliminary reviews are not dictated by state law, practicality and fairness suggests that they be done. With this information in hand, local jurisdictions can better understand the implications that a proposed compatibility plan will have on their own plans. Furthermore, the preliminary review will enable local jurisdictions to be more focused in their efforts to modify their plans. The process of making the necessary changes to general plans and specific plans can thus be eased.

It is important for all parties to recognize, however, that any such reviews are preliminary. Local jurisdictions still must go through the steps of submitting the specific policy language, maps, and other plan components to the ALUC for formal review and approval.

180-Day Time Limit

DEPT. OF TRANSPORTATION GUIDANCE
The 180-time limit is a statutory deadline which ALUCs have no authority to modify. ALUCs, though, can agree not to bring action against local governments for taking extra time to amend their affected plans. Any such agreement should be predicated upon those agencies making substantial progress toward the necessary plan changes and not simply ignoring the need to act. ALUCs should recognize that forcing jurisdictions to hold to the 180-day schedule could merely lead those jurisdictions to overrule the ALUC since that process can more easily be accomplished within the time limit.

State law says that a local agency's action to either modify its general plan and applicable specific plans or to take the steps necessary to overrule the ALUC must be taken within 180 days of when an ALUC adopts or amends its compatibility plan (Government Code, Section 65302.3). As a practical matter, this time limit can be difficult to accomplish. Unless the necessary changes to the general and/or specific plan are minor, the time required to draft, circulate, and adopt the modifications together with essential environmental review can easily exceed 180 days. This fact notwithstanding, it is incumbent upon local jurisdictions to move forward as expeditiously as possible to meet the deadline.

The chief consequence of not meeting this deadline is that the ALUC can begin requiring—if it is not already doing so—that all of the jurisdiction's land use actions, regulations, and permits be submitted to the commission for review (Section 21676.5(a)). This requirement can continue until such time as the jurisdiction amends its plans or overrules the ALUC with regard to the local plan's consistency with the commission's compatibility plan.

Means of Achieving Consistency

As indicated in Chapter 4, making a general plan consistent with the ALUC's compatibility plan involves more than elimination of direct conflicts. Other aspects of compatibility planning also must be addressed. In particular, counties and cities must establish procedures which implement and ensure compliance with compatibility policies. To do this, local plans and/or policies must:

- Delineate the compatibility criteria to be applied to individual development actions;
- Identify the mechanisms to be used to tie the applicable criteria to a particular development; and
- Indicate the procedures to be followed in review and approval of development actions affecting lands within the airport influence area.

DEPT. OF TRANSPORTATION GUIDANCE As widely applied in airport land use planning, consistency does not require being identical. It means only that the concepts, standards, physical characteristics, and resulting consequences of a proposed action must not conflict with the intent of the law or the compatibility plan to which the comparison is being made.

An expanded list of the various factors to be considered by local jurisdictions when modifying their plans and policies is included in Table 5A. This checklist is not necessarily all-encompassing. Depending upon the nature of the policies adopted by the ALUC, other factors may need to be addressed and some of those listed may not be applicable.

The primary purpose of the checklist provided in Table 5A is to assist local jurisdictions with necessary modifications and additions to their plans and policies. The checklist is also designed to facilitate ALUC reviews of local plans. The list will need to be modified to reflect the policies of each individual ALUC and is not intended as a state requirement.

Local plans can be made consistent with an ALUC's compatibility plan through various means. Which ones are most suitable to a particular county or city depends in part upon the manner in which the compatibility plan criteria and maps are formatted, but even more upon choices to be made by each individual jurisdiction. As discussed in Chapter 3, some compatibility plans rely primarily upon composite, performance-type, criteria while others use list-oriented criteria or detailed land use mapping. The key decision to be made by each affected jurisdiction is whether to fully incorporate compatibility criteria and procedures into their land use plans, ordinances, and regulations and thus mostly internalize the project review process or to defer review of major land use actions to the ALUC.

See the discussions later in this chapter and in Chapter 4 regarding the implications for project reviews when local plans have not been made fully consistent with the ALUC plan.

Five general strategies for fully achieving consistency are outlined below.

➤ **Incorporate Policies into Existing General Plan Elements**—One method of achieving the necessary planning consistency is to modify existing general plan elements. For example, airport land use noise compatibility policies could be inserted into the noise element, safety policies could be placed into a safety element, and the primary compatibility criteria and associated maps plus the procedural policies might fit into the land use element. With this approach, direct conflicts would be eliminated and the majority of mechanisms and procedures to ensure compliance with compatibility criteria could be fully incorporated into a local jurisdiction's general plan.

DEPT. OF TRANSPORTATION GUIDANCE Local jurisdictions cannot simply ignore the need to respond to an ALUC's adoption of a compatibility plan. If a county or city neither amends its plans as necessary or overrules the ALUC, it must cooperate with any commission request that all or selected land use actions, regulations, and permits affecting the airport influence area be submitted for review. Furthermore, as noted in Chapter 4, a local jurisdiction's silence on the issue can be interpreted as acceptance of the compatibility criteria which the ALUC has set forth.

➤ **Adopt a General Plan Airport Element**—Another approach is to prepare a separate airport element of the general plan. Such a format may be advantageous when a community's general plan also needs to address on-airport development and operational issues. Modification of other plan elements to provide cross referencing and eliminate conflicts would still be necessary.

- **Adopt Compatibility Plan as a Specific Plan**—As mentioned in Chapter 2, some compatibility plans are prepared not as independent ALUC documents or as part of an airport master plan, but jointly with a specific plan for the airport vicinity. Assuming that a plan prepared in this manner addresses all of the important compatibility concerns, it can be adopted in its entirety both by the ALUC as a compatibility plan and the local agency as a specific plan. This option is basically the same as adoption of a general plan airport element.

- **Adopt Compatibility Plan as Stand-Alone Document**—Jurisdictions selecting this option could simply adopt as a local policy document the relevant portions of the compatibility plan. Changes to the community's existing general plan would be minimal. Policy reference to the separate compatibility plan document would need to be added and any direct land use or other conflicts with compatibility planning criteria would have to be removed. Limited discussion of compatibility planning issues could be included in the general plan, but the substance of most compatibility policies would appear only in the stand-alone compatibility plan.

This strategy is discussed more extensively in the following section of this chapter.

- **Adopt Airport Combining District or Overlay Zoning Ordinance**—Local government adoption of an airport combining district or overlay zoning ordinance is a way of codifying airport compatibility criteria identified only in concept in the general plan or specific plan. Other than where direct conflicts need to be eliminated from the local plans, implementation of the compatibility policies would essentially be accomplished solely through the zoning ordinance. Policy reference to airport compatibility in the general plan could be as simple as mentioning support for the airport land use commission and stating that policy implementation is by means of the combining zone.

Land Use Compatibility Strategies

If airport land use compatibility objectives are to be obtained, counties and cities must take direct actions such as those described here.

Beyond the issue of achieving mandated consistency between local plans and an ALUC's compatibility plan is the broader question of what local governments can do to preserve and enhance compatibility between airport activities and the land uses around the airport. Several strategies are available which can help attain this objective. If the local agency takes land use actions such as the ones discussed here, any inconsistencies between its general plan or specific plan and the ALUC's compatibility plan are likely to be few. These strategies also are appropriate for jurisdictions in counties using the alternative compatibility planning process.

Land Use Designations

If compatibility between an airport and its surroundings is to be achieved, designation of appropriate land uses—in general plans and specific plans and also in land use zoning ordinances—is essential. This is particularly

This checklist is intended to assist counties and cities with modifications necessary to make their general plans and other local policies consistent with the ALUC's compatibility plan. It is also designed to facilitate ALUC reviews of these local plans and policies. *The list will need to be modified to reflect the policies of each individual ALUC and is not intended as a state requirement.*

For additional guidance see:

COMPATIBILITY CRITERIA

General Plan Document

The following items typically appear directly in a general plan document. Amendment of the general plan will be required if there are any conflicts with the compatibility plan

Page 4-16

➤ **Land Use Map**—No direct conflicts should exist between proposed new land uses indicated on a general plan land use map and the ALUC land use compatibility criteria.
- Residential densities (dwelling units per acre) should not exceed the set limits. Differences between gross and net densities and the potential for secondary dwellings on single parcels (see below) may need to be taken into account.
- Proposed nonresidential development needs to be assessed with respect to applicable intensity limits (see below).
- No new land uses of a type listed as specifically prohibited should be shown within affected areas.

Pages 3-3, 7-23

➤ **Noise Element**—General plan noise elements typically include criteria indicating the maximum noise exposure for which residential development is normally acceptable. This limit must be made consistent with the equivalent compatibility plan criteria. Note, however, that a general plan may establish a different limit with respect to aviation-related noise than for noise from other sources (this may be appropriate in that aviation-related noise is often judged to be more objectionable than other types of equally loud noises).

Zoning or Other Policy Documents

The following items need to be reflected either in the general plan or in a separate policy document such as a combining zone ordinance. If a separate policy document is adopted, modification of the general plan to achieve consistency with the compatibility plan may not be required. Modifications would normally be needed only to eliminate any conflicting language which may be present and to make reference to the separate policy document.

Page 3-20

➤ **Secondary Dwellings**—Detached secondary dwellings on the same parcel should be counted as additional dwellings for the purposes of density calculations. This factor needs to be reflected in local policies either by adjusting the maximum allowable densities or by prohibiting secondary dwellings where their presence would conflict with the compatibility criteria.

Page 9-51, Appendix C

➤ **Intensity Limitations on Nonresidential Uses**—Local policies must be established to limit the usage intensities of commercial, industrial, and other nonresidential land uses. This can be done by duplication of the performance-oriented criteria—specifically, the number of people per acre—indicated in the compatibility plan. Alternatively, local jurisdictions may create a detailed list of land uses which are allowable and/or not allowable within each compatibility zone. For certain land uses, such a list may need to include limits on building sizes, floor area ratios, habitable floors, and/or other design parameters which are equivalent to the usage intensity criteria.

Page 3-6
Table 9B, page 9-4

➤ **Identification of Prohibited Uses**—Compatibility plans may prohibit day care centers, hospitals, and certain other uses within much of each airport's influence area. The facilities often are permitted or conditionally permitted uses within many commercial or industrial land use designations. Policies need to be established which preclude these uses in accordance with the compatibility criteria.

TABLE 5A

General Plan Consistency Checklist

For additional guidance see:

Page 9-54

➤ **Open Land Requirements**—Compatibility plan requirements, if any, for assuring that a minimum amount of open land is preserved in the airport vicinity must be reflected in local policies. Normally, the locations which are intended to be maintained as open land would be identified on a map with the total acreage within each compatibility zone indicated. If some of the area included as open land is private property, then policies must be established which assure that the open land will continue to exist as the property develops. Policies specifying the required characteristics of eligible open land also must be established.

Page 3-21

➤ **Infill Development**—If a compatibility plan contains infill policies and a jurisdiction wishes to take advantage of them, the lands which meet the qualifications must be shown on a map.

Page 9-54

➤ **Height Limitations and Other Hazards to Flight**—To protect the airport airspace, limitations must be set on the height of structures and other objects near airports. These limitations are to be based upon Part 77 of the Federal Aviation Regulations, but may include exceptions for objects on high terrain if provided for in the compatibility plan. Restrictions also must be established on other land use characteristics which can cause hazards to flight (specifically, visual or electronic interference with navigation and uses which attract birds). Note that many jurisdictions have al ready adopted an airport-related hazard and height limit zoning ordinance which, if up to date, will satisfy this consistency requirement.

Pages 3-3, 7-34

➤ **Noise Insulation Requirements**—Some compatibility plans call for certain buildings proposed for construction within high noise-impact areas to demonstrate that they will contain sufficient sound insulation to reduce aircraft-related noise to an acceptable level. These criteria apply to new residences, schools, and certain other buildings containing noise-sensitive uses. Local policies must include parallel criteria.

Pages 3-4, 7-38

➤ **Buyer Awareness Measures**—As a condition for approval of development within certain compatibility zones, some compatibility plans require either dedication of an avigation easement to the airport proprietor or placement on deeds of a notice regarding airport impacts. If so, local jurisdiction policies must contain similar requirements. Compatibility plans also may encourage, but should not require, local jurisdictions to adopt a policy stating that airport proximity and the potential for aircraft overflights be disclosed as part of real estate transactions regarding property in the airport influence area.

Page 3-21

➤ **Nonconforming Uses and Reconstruction**—Local jurisdiction policies regarding nonconforming uses and reconstruction must be equivalent to or more restrictive than those in the compatibility plan, if any.

TABLE 5A, *CONTINUED*

For additional guidance see:	
	REVIEW PROCEDURES
	In addition to incorporation of ALUC compatibility criteria, local jurisdiction implementing documents must specify the manner in which development proposals will be reviewed for consistency with the compatibility criteria.
Page 4-6	➤ **Actions Always Required to be Submitted for ALUC Review**—State law specifies which types of development actions must be submitted for airport land use commission review. Local policies should either list these actions or, at a minimum, note the jurisdiction's intent to comply with the state statute.
Page 4-8	➤ **Other Land Use Actions Potentially Subject to ALUC Review**—In addition to the above actions, compatibility plan may identify certain major land use actions for which referral to the ALUC is dependent upon agreement between the jurisdiction and the ALUC. If the jurisdiction fully complies with all of the items in this general plan consistency check list or has taken the necessary steps to overrule the ALUC, then referral of the additional actions is voluntary. On the other hand, a jurisdiction may elect not to incorporate all of the necessary compatibility criteria and review procedures into its own policies. In this case, referral of major land use actions to the ALUC is mandatory. Local policies should indicate the jurisdiction's intentions in this regard.
Pages 4-8, 5-10	➤ **Process for Compatibility Reviews by Local Jurisdictions**—If a jurisdiction chooses to submit only the mandatory actions for ALUC review, then it must establish a policy indicating the procedures which will be used to assure that airport compatibility criteria are addressed during review of other projects. Possibilities include: a standard review procedure checklist which includes reference to compatibility criteria; use of a geographic information system to identify all parcels within the airport influence area; etc.
Page 4-7	➤ **Variance Procedures**—Local procedures for granting of variances to the zoning ordinance must make certain that any such variances do not result in a conflict with the compatibility criteria. Any variance which involves issues of noise, safety, airspace protection, or overflight compatibility as addressed in the compatibility plan must be referred to the ALUC for review.
Page 5-8	➤ **Enforcement**—Policies must be established to assure compliance with compatibility criteria during the lifetime of the development. Enforcement procedures are especially necessary with regard to limitations on usage intensities and the heights of trees. An airport combining district zoning ordinance is one means of implementing enforcement requirements.

TABLE 5A, *CONTINUED*

true in developing areas—good planning today can avoid significant conflicts later. The value of designating compatible land uses in built-up areas should not be overlooked, however. Appropriate designations can serve to identify already incompatible uses as nonconforming and thus limit the potential for expansion or modification of the uses to worsen the incompatibility. Designating compatible uses also can encourage eventual change of currently incompatible uses to ones which are better suited to the environs of an airport.

Overlay Zones or Combining Districts

For the purposes of airport land use compatibility planning, land use plan and zoning designations as commonly adopted by counties and cities have a notable shortcoming. Seldom do they have an aviation orientation or address the specific issues of compatibility with aviation activities (i.e., noise and safety). The Table 5A checklist of factors essential to making a local general plan or specific plan consistent with a compatibility plan highlights many of the reasons why consistency is seldom achieved without explicit consideration of aviation issues.

Possible components of an airport compatibility combining zoning ordinance are listed in Table 5B. The compatibility concerns which form the basis for these components are described as well.

One way local governments can overcome the lack of aviation orientation of basic land use designations is to adopt an airport compatibility overlay zone or combining district ordinance. A combining district can supplement local land use designations by adding specific noise and, often more importantly, safety criteria (e.g., maximum number of people permitted on the site, site design and open space criteria, height restrictions, etc.) applicable to future development in the airport vicinity. Project review procedures and other implementation mechanisms can also be defined. Geographically, the combining district should cover at least the entire airport influence area as defined by the ALUC in its compatibility plan.

An airport overlay zoning ordinance has several important benefits. Most importantly, it permits the continued utilization of the majority of the design and use guidelines contained in the existing general plan and zoning ordinance. At the same time, it provides a mechanism for implementation of restrictions and conditions that may apply to only a few types of land uses within a given land use category or zoning district. This avoids the need for a large number of discrete zoning districts. It also enables general plans and specific plans to attain consistency with a compatibility plan through reference to basic compatibility criteria rather than through redefinition of existing land use designations.

Buyer Awareness Measures

Buyer awareness measures serve to alert prospective airport vicinity residents about the airport and its impacts. Three basic forms of buyer awareness measures are most common in airport land use compatibility practice:

- Avigation easements;
- Recorded deed notices; and
- Real estate disclosure statements.

An airport compatibility combining zoning ordinance might include some or all of the following components:

- **Airspace Protection**—A combining district can establish restrictions on the height of buildings, antennas, trees, and other objects as necessary to protect the airspace needed for operation of the airport. These restrictions should be based upon the current version of Federal Aviation Regulations (FAR) Part 77, Objects Affecting Navigable Airspace, Subpart C. Additions or adjustment to take into account instrument approach (TERPS) surfaces should be made as necessary. Provisions prohibiting smoke, glare, bird attractions, and other hazards to flight should also be included.
- **FAA Notification Requirements**—Combining districts also can be used to ensure that project developers are informed about the need for compliance with the notification requirements of FAR Part 77. Subpart B of the regulations requires that the proponent of any project which exceeds a specified set of height criteria submit a Notice of Proposed Construction or Alteration (Form 7460-1) to the Federal Aviation Administration prior to commencement of construction. The height criteria associated with this notification requirement are lower than those spelled out in Part 77, Subpart C, which define airspace obstructions. The purpose of the notification is to determine if the proposed construction would constitute a potential hazard or obstruction to flight. Notification is not required for proposed structures that would be shielded by existing structures or by natural terrain of equal or greater height, where it is obvious that the proposal would not adversely affect air safety.
- **State Regulation of Obstructions**—State law prohibits anyone from constructing or altering a structure or permitting an object of natural growth to exceed the heights established by FAR Part 77, Subpart C, unless the FAA has determined the object would not or does not constitute a hazard to air navigation (Public Utilities Code, Section 21659). Additionally, a permit from the Department of Transportation is required for any structure taller than 500 feet above the ground unless the height is reviewed and approved by the Federal Communications Commission or the FAA (Section 21656).
- **Designation of High Noise-Impact Areas**—California state statutes require that multi-family residential structures in high-noise exposure areas be constructed so as to limit the interior noise to a Community Noise Equivalent Level of no more than 45 dB. A combining district could be used to indicate the locations where special construction techniques may be necessary in order to ensure compliance with this requirement. The combining district also could extend this criterion to single-family dwellings.
- **Maximum Densities/Intensities**—Airport noise and safety compatibility criteria are frequently expressed in terms of dwelling units per acre for residential uses and people per acre for other land uses. These standards can either be directly included in a combining zone or used to modify the underlying land use designations. For residential land uses, the correlation between the compatibility criteria and land use designations is direct. For other land uses, the method of calculating the intensity limitations needs to be defined. Alternatively, a matrix can be established indicating whether each specific type of land use is compatible with each compatibility zone. To be useful, the land use categories need to be more detailed than typically provided by general plan or zoning ordinance land use designations.
- **Open Areas for Emergency Landing of Aircraft**—In most circumstances in which an accident involving a small aircraft occurs near an airport, the aircraft is under control as it descends. When forced to make an off-airport emergency landing, pilots will usually attempt to do so in the most open area readily available. To enhance safety both for people on the ground and the occupants of aircraft, airport compatibility plans often contain criteria requiring a certain amount of open land near airports. These criteria are most effectively carried out by planning at the general or specific plan level, but may also need to be included in a combining district so that they will be applied to development of large parcels. Adequate open areas can often be provided by clustering of development on adjacent land.
- **Areas of Special Compatibility Concern**—A significant drawback of standard general plan and zoning ordinance land use designations is that they can be changed. Uses that are currently compatible are not assured of staying that way in the future. Designation of areas of special compatibility concern would serve as a reminder that airport impacts should be carefully considered in any decision to change the existing land use designation. [A legal consideration which supports the value of this concept is that down-zoning of a property to a less intensive use is becoming more difficult. It is much better not to have inappropriately up-zoned the property in the first place.]
- **Real Estate Disclosure Policies**—The geographic extent and specific language of recommended real estate disclosure statements can be described in an airport combining zone ordinance.

TABLE 5B

Possible Airport Combining Zone Components

While ALUCs may define policies establishing how and where each of these measures should be used, the effectiveness of each is enhanced by actions which local governments can take. Chapter 3 contains a discussion of the applicability of each of these measures to accomplishment of airport land use compatibility planning objectives.

SUBMITTING PROJECTS FOR REVIEW

Reviews by Airport Land Use Commissions

Also see Chapter 4 for a discussion of this topic from the perspective of ALUCs. Note that local agencies which are airport proprietors also are obligated to submit certain airport plans for ALUC review.

In counties where an airport land use commission exists, the obligations of counties and cities with regard to submitting land use projects and other actions for the commission's review are well defined in the state law. Local jurisdictions cannot legally ignore these requirements. If they do, ALUCs can initiate the review process on their own and seek a writ of mandate to force the local jurisdiction to provide the necessary project information.

The types of land use projects to be submitted depends upon:

- Whether a compatibility plan has been adopted by the ALUC;
- What action the county or city has taken with regard to making its general plan or specific plan consistent with the compatibility plan;
- Whether the project requires an amendment to the local general plan, specific plan, or zoning ordinance; and
- Whether voluntary agreements for the review of projects have been established.

Any environmental documents prepared in conjunction with these actions also should be submitted for ALUC review.

The requirements for project review can be summarized as follows:

➤ **General Plans and Specific Plans**—As discussed in the preceding chapter, counties and cities must refer any proposal to adopt or amend a general plan or specific plan to the ALUC for review if the proposal involves land within an airport influence area defined by the ALUC (Section 21676(b)). This requirement applies regardless of whether the proposal has community-wide applicability or affects only a single parcel (unless the parcel is not in the airport influence area). It also applies both to actions initiated by the local agency or a property owner and to amendments proposed for the purpose of making a general plan or specific plan consistent with an ALUC's compatibility plan.

For example, proposed ordinances or regulations involving allowable land uses, densities, structure heights, or sound insulation must be submitted for ALUC review. Architectural standards, sign regulations, and other such matters which clearly do not have airport land use implications need not be submitted.

➤ **Ordinances and Regulations**—Proposed zoning ordinances and building regulations also must be submitted for ALUC review before being acted upon by the local agency if they affect the compatibility of land uses located within an airport influence area (Section 21676(b)).

➤ **Individual Development Projects**—Once an ALUC has adopted a compatibility plan, requirements for local jurisdictions to submit individual development proposals for review depends upon whether the county or city has acted to make its plans consistent with the ALUC's plan or to overrule the commission. Prior to when the local jurisdiction takes a consistency or overruling action, all individual development projects must be submitted for review (Section 21676.5(a)). This requirement includes referral of actions which are ministerial unless the ALUC has indicated it does not want to receive them (see discussion in Chapter 4). Referral of all project proposals also continues to be mandatory if the local jurisdiction has opted not to fully incorporate essential compatibility criteria and procedures into local plans and policies, but has merely eliminated the direct conflicts with the compatibility plan.

Submittal of individual development projects becomes voluntary only when: the local plans have been made fully consistent with the ALUC's plan or the local jurisdiction has overruled the ALUC; and the action does not involve a general plan, specific plan, or zoning amendment previously reviewed by the ALUC. Even in these circumstances, however, local agencies are encouraged to form an agreement with the airport land use commission for review of major land use development project proposals—those which could have airport land use compatibility implications. A factor to be borne in mind with voluntary project-review agreements is that the ALUC's review is advisory only. The overruling procedures which must be followed with respect to mandatory reviews are not in effect.

➤ **Airport Plans**—Proposed airport master plans, expansion of an existing airport, and plans for construction of a new airport (or heliport) must be submitted to the ALUC for review in accordance with Sections 21676(c), 21664.5, and 21661.5, respectively. This referral requirement is independent of whether the ALUC has previously adopted a compatibility plan or the county or city has taken action with regard to the consistency of its general plan or specific plan.

Reviews by Other Agencies

In addition to being reviewed by the airport land use commission, certain airport-vicinity development actions also must be submitted to other agencies for review. Counties and cities should be aware of the extent to which these review requirements apply within their jurisdictions and inform project proponents accordingly.

Federal Aviation Administration

The FAA's involvement in the review of local projects derives both from its authority over navigable airspace and its function as a funding agency for airport planning studies and airport improvement projects.

➤ **Aeronautical Studies**—As noted earlier in this chapter, Federal Aviation Regulations Part 77 requires that anyone proposing to construct an object which could affect the navigable airspace around an airport submit information about the proposed construction to the FAA. The FAA then conducts an aeronautical study, the outcome of which is a determination as to whether the object would be a potential hazard to air navigation. If the proposed object is concluded to pose a hazard, the FAA may object to its

The FAA's review does not consider the type of land use involved. Neither does the FAA approve or disapprove the proposal; it merely evaluates and recommends.

construction, examine possible revisions of the proposal to eliminate the problem, require that the object be appropriately marked and lighted as an airspace obstruction, and/or initiate changes to the aircraft flight procedures for the airport so as to account for the object.

- **Airport Improvement Program Grants**—Through its Airport Improvement Program (AIP) grants, the FAA currently funds 90% of the cost of most planning studies and eligible improvement projects at airports in California. As a condition for receipt of a grant, an airport project sponsor must assure the FAA that it will take appropriate actions "to restrict the use of 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 aircraft." The FAA does not routinely review land use development near an airport with respect to this grant assurance obligation; it only becomes involved when a problem is brought to its attention. The FAA does, however, review airport layout plans and plans for federally funded construction to ensure compliance with Federal Aviation Regulations and airport design standards.

California Department of Transportation

Through its Division of Aeronautics, the California Department of Transportation has review and, in certain cases, permitting authority with respect to several types of airport and airport-related land use actions. These include:

- **Airport Permits**—The Department of Transportation has authority under the State Aeronautics Act to issue permits for the approval of airport sites and the operation of airports (Section 21662). Moreover, other than for a few limited exceptions (a private-use facility, for example), it is unlawful for any political subdivision or any person to operate an airport unless the airport has a valid state permit (Section 21663). The law spells out the conditions for issuance or amendment of an airport permit.
- **Regulation of Obstructions**—A state permit is also required for construction of objects that would affect the navigable airspace. These objects include:
  - Any structure taller than 500 feet above ground level, unless the height of the structure is required to be approved by the Federal Communications Commission or the Federal Aviation Administration (Section 21656).
  - Any structure or object of natural growth which would exceed the height limits specified in Federal Aviation Regulations Part 77, Subpart C, unless the FAA has determined that the object's construction, alteration, or growth would not constitute a hazard to air navigation or otherwise create conditions unsafe for air navigation (Section 21659).

The contents of the Education Code sections are included in Appendix A.

- **School Site Reviews**—Two sections of the Education Code (17215 and 81033) require that the Department of Transportation investigate and make recommendations regarding acquisition of property for school and community college sites near airports. Specifically, before a district can acquire property for a school or community college site that would be within two miles of an airport runway or potential runway included in an airport master plan, the Department must investigate and submit a report of its findings regarding that acquisition. This requirement also applies to additions to an existing site. The primary factors considered in the analysis of a site by the Department's Division of Aeronautics are aircraft accident exposure and aircraft noise. Division staff will review the airport compatibility plan, if one exists, and will ask for comments from the appropriate ALUC as a part of its investigation. Input from an ALUC and compatibility criteria established in an adopted plan weigh heavily in the Department's final report and recommendation about the suitability of the proposed acquisition for use as a school or community college.

➤ **Building Site Reviews**—A review process similar to that for school sites is established by a section of the Aeronautics Act (Public Utilities Code, Section 21655). This section requires that the Department of Transportation be notified of any state agency proposal to acquire a site for a state building if such site is within two miles of an airport runway. The Department of Transportation, Division of Aeronautics then investigates the site and reports its recommendations to the agency.

➤ **California Environmental Quality Act Reviews**—Another avenue through which the Division of Aeronautics becomes involved in local projects is through the California Environmental Quality Act (CEQA). As a responsible agency having permitting authority for airports, the Division of Aeronautics reviews and comments upon environmental impact documents prepared for airport master plans and airport improvement projects. The Division of Aeronautics also frequently comments upon environmental documents associated with local general plans, specific plans, and individual development projects near airports.

Legislation enacted in 1994 requires lead agencies to use the *Airport Land Use Planning Handbook* as a "technical resource" when assessing the airport-related noise and safety impacts of projects in the vicinity of airports (Public Resources Code, Section 21096).

Regional Planning Agencies

Most of the single- or multi-county regional planning agencies in the state have responsibilities for reviewing grant applications and setting regional priorities for the use of federal and state grant funds. These agencies also frequently review and comment upon airport master plans and environmental documents for airport plans and improvements.

DEPT. OF TRANSPORTATION GUIDANCE

Proponents of major development projects and the local agencies which have land use jurisdiction over airport environs are urged to seek the input of airport management when preparing community plans and plans for development.

Airport Proprietors

No state laws require the participation of airport proprietors in the review of proposed land use development in the airport vicinity. These agencies are nevertheless often the most knowledgeable about the effects which nearby development would have upon the operation of their airports.

COMPATIBILITY PLANNING IN COUNTIES WITHOUT ALUCS

As a result of either a special exemption or through establishment of the alternative process, several counties in the state do not have an airport land use commission. As emphasized in Chapter 1, however, the lack of an ALUC does not eliminate the responsibilities of counties and cities to engage in airport land use compatibility planning. If anything, not having an ALUC increases the obligations of local agencies in this regard. These obligations extend both to preparation of compatibility plans and to the subsequent review of individual development proposals.

DEPT. OF TRANSPORTATION
GUIDANCE
Under the law, the Division of Aeronautics has the responsibility for reviewing and approving the processes by which a county and each affected city in the county establish and implement compatibility planning under the alternative process. To be acceptable, an alternative process must, at a minimum, address all of the topics associated with making local plans consistent with an ALUC plan. Additional procedures special to the alternative process also must be defined as indicated here.

In accordance with state law (Section 21670.1(c)(2)), establishment of the alternative process in a county requires the county and "the appropriate affected cities having jurisdiction over an airport" to adopt processes which provide for:

- Preparation, adoption, and amendment of a compatibility plan for each public-use airport in the county and designation of an agency responsible for these actions;
- Public and agency notification regarding compatibility plan preparation, adoption, or amendment;
- Mediation of disputes regarding preparation, adoption, or amendment of compatibility plans;
- Amendment of general plans and specific plans to be consistent with the compatibility plans.

Compatibility Policies

Irrespective of requirements of the Aeronautics Act, state general plan requirements for noise and safety elements arguably require some level of airport compatibility planning by counties and cities.

Jurisdictions within counties without ALUCs (other than counties which are exempt) still must adopt airport land use compatibility plans or policies for the portion of any public-use airport's environs which lies within their borders. Compatibility planning for private-use airports is not required. Compatibility policies can be adopted as separate documents equivalent to ones adopted by ALUCs. Alternatively, compatibility planning policies can be folded into the general plan or other local policy documents as outlined earlier in this chapter with respect to making a general plan consistent with a compatibility plan.

Whichever option is chosen, the same concerns as would be found in a compatibility plan adopted by an ALUC must be explicitly addressed. Compatibility criteria must be established and any internal conflicts between the criteria and land use designations or other elements of the general plan must be resolved.

Project Reviews

In addition to adoption of compatibility criteria and designation of appropriate land uses for the environs of each airport, jurisdictions in counties without ALUCs must adopt project review procedures and mechanisms necessary for ensuring compliance with the compatibility criteria. Specific attention should be given to the following:

➤ **Special Review Process**—Proposals for major land use development within the airport influence area should specifically be reviewed for consistency with the airport land use compatibility criteria. A list of the types of projects subject to this review should be established. When action on the proposal involves discretionary approval by the county or city, specific *findings* should be made that either (1) the proposal is consistent with the compatibility criteria or (2) other overriding land use factors are of higher priority to the community.

➤ **Interagency Communication and Cooperation**—Among the functions provided by ALUCs, a particularly important one is to facilitate coordination of planning between agencies having land use jurisdiction around airports and agencies which own the airports. This function still needs to be accomplished when an ALUC does not exist. Formal interagency agreements should be established between the affected entities for each airport. These agreements should refer to the compatibility plan and the project review process, as well as to any adopted airport plans. Information on land use development in the vicinity of an airport should be provided to the agency (or private party) owning the airport for review and comment. Also, airport operators should inform surrounding jurisdictions about any proposed changes in airport development or operation which could affect surrounding land. Methods for resolving conflicts also must be identified.

OVERRULING ALUC DECISIONS

Various sections of the airport land use commission statutes provide for local agencies to overrule ALUC decisions on land use matters and airport master plans. The overruling process involves three mandatory steps:

- The holding of a public hearing (except when a the ALUC disapproves a county or city action prior to having adopted a compatibility plan);
- The making of specific findings that the action proposed is consistent with the purposes of the ALUC statute; and
- Approval of the proposed action by a two-thirds vote of the agency's governing body.

The Aeronautics Act primarily refers to the term "overrule," although "override" is used in some sections. In common practice, the two terms are often used interchangeably. The critical point is that any local agency overruling of an ALUC must include the three steps listed here.

Note that a 1992 opinion of the State Attorney General concluded that a two-thirds vote of the entire membership of a city council or board of supervisors is not necessary for an overruling; a two-thirds vote of the members constituting a quorum is sufficient.

Two particular aspects of the overruling process warrant further examination. One is the issue of what constitutes valid findings under the provisions of the law. The other involves the subsequent implications of an overruling action.

Findings

A requirement for a local agency to make specific findings in conjunction with a decision to overrule an airport land use commission action is included in six separate sections of the ALUC statutes. In each case, the law provides that the findings must show that the proposed local agency action "is consistent with the purposes of this article stated in Section 21670." A county or city cannot simply overrule an ALUC decision without first documenting the basis for the overruling action and relating that basis directly to the purposes for which the ALUC statutes were adopted. The purpose of findings is to assure compliance with state law.

The Concept of Findings

A document prepared by the Governor's Office of Planning and Research (OPR), *Bridging the Gap: Using Findings in Local Land Use Decisions* (the 1989 version remains current as of late 2001), examines the subject of findings at length. The purpose here is only to highlight key factors, particularly as they apply to local agency overruling of ALUC decisions.

These comments do not constitute a legal opinion regarding the requirements for use or adequacy of findings. Local agencies should consult with their respective legal counsels on these matters.

Requirements for a government entity to make findings of fact when taking certain actions appear in many parts of state law. Also numerous court cases have dealt with the issues of findings and their adoption. The most important case regarding the use of findings in local land use decisions was *Topanga Association for a Scenic Community v. County of Los Angeles* [(1974) 11 Cal. 3d 506]. In its ruling on this case, the Court defined findings, explained their purposes, and outlined when findings are needed in making local land use decisions.

Findings were defined in the decision as legally relevant conclusions that explain the decision-making agency's method of analyzing facts, regulations, and policies and the rationale for making the decisions based on the facts involved. Findings are used to show how local decision-makers arrived at their decision based on facts and established policies.

The *Topanga* court also outlined five purposes for making findings. Findings should:

- Provide a framework for making principled decisions, enhancing the integrity of the administrative process;
- Help make analysis orderly and reduce the likelihood that the agency will randomly leap from evidence to the conclusions;
- Enable the parties to determine whether and on what basis they may seek judicial review and remedy;
- Apprise a reviewing court of the basis for the agency's action; and
- Serve a public relations function by helping to persuade the parties that administrative decision making is careful, reasoned, and equitable.

The necessity for adequate findings to accompany a local agency's overruling of an ALUC was affirmed in a 1992 court case, *California Aviation Council v. City of Ceres*. In this case the court found that the Ceres city council had merely referred to the ALUC statutes and then concluded that the proposed land uses minimized public exposure to excessive noise and safety hazards in the airport area. The findings did not document the critical links between the proposal, the finding, and the facts.

In its review of findings requirements, OPR offers several guidelines regarding what constitutes sound, legally sufficient findings. Perhaps most basic among these guidelines is that *findings must be substantive*, not just bare conclusions or recitations of the law: "Generally, findings are not sufficient if they merely recite the very language of the local ordinance or state statute that requires them." In other words, findings must "bridge the analytical gap between raw data and ultimate decision." Findings made by a local commission composed of laymen can be informal, however. They are not required to meet the standards of judicial findings of fact.

Findings Accompanying an Overruling of an ALUC Decision

In general, California law does not clearly distinguish between situations which require findings and those which do not. However, with respect to a local agency's action to overrule an ALUC decision, the law is quite specific. Any such action—whether it involves a general plan, an individual development proposal, an airport master plan, or other local project reviewed by the ALUC—must be accompanied by specific findings of fact supported by substantial evidence.

The essential substance of the findings which accompany a local agency overruling of an ALUC decision is indicated in the ALUC statutes. The findings must demonstrate that the proposed action "is consistent with the purposes…" of the statutes as set forth in Section 21670. Examination of Section 21670(a) indicates that five separate purposes for the legislation are stated:

See Appendix A of this *Handbook* for the complete text of Section 21670(a).

- "…to provide for the orderly development of each public use airport in this state…"
- "…to provide for the orderly development of…the area surrounding these airports so as to promote the overall goals and objectives of the California airport noise standards…"
- "…to provide for the orderly development of…the area surrounding these airports so as…to prevent the creation of new noise and safety problems."
- "…to protect the public health, safety, and welfare by ensuring the orderly expansion of airports…"
- "…to protect the public health, safety, and welfare by…the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses."

Although findings do not need to address each of these purposes point by point, it is essential that, collectively, all of the purposes be addressed. The following paragraphs outline possible approaches to demonstrating a proposed action would indeed be consistent with these purposes.

➤ **Providing for Orderly Development of the Airport**—The findings should document:
- How the local agency has considered any adopted long-range development plans that may exist for the airport;
- How the local agency plans support development of the airport over at least the next 20 years; and
- How local land use planning and zoning actions would serve to protect the approaches to the airport runways.

When a master plan has been adopted for an airport, the local agency's analysis should focus on the relationship between the proposed local action and the airport's plan. In instances where a master plan for the airport does not exist (or was never adopted), the ALUC is required to have obtained Division of Aeronautics approval to use an airport layout plan as the basis for preparation of the commission's compatibility plan. Under those circumstances, the state-approved plan should be the basis for the local agency's analysis.

➤ **Relationship to California Airport Noise Standards**—The state airport noise standards are set forth in Title 21 of the California Code of Regulations. These standards are "designed to cause the airport proprietor, aircraft operator, local governments, pilots, and the [Department of Transportation] to work cooperatively to diminish noise problems."

In addressing the question of consistency of the proposed action with the state noise standards, the local agency should refer specifically to the content of the noise element of its own general plan. Section 65302(g) of the Government Code requires community general plans to include a noise element. This element is required to describe the community noise environment in terms of both near and long-term noise exposure contours for various noise sources. Airports are among the noise sources that should be considered in the noise element. The findings should:

- Document any inconsistencies between noise element policies and noise compatibility criteria in the ALUC compatibility plan and attempt to resolve why the differences exist;
- Show how noise element policies will assure conformance with the state noise airport standards; and
- Identify any measures to be incorporated into local development to mitigate existing and foreseeable airport noise problems.

➤ **Preventing Creation of New Noise and Safety Problems**—The preceding item covers the topic of noise. With respect to safety, reference should be made to both the land use and the safety elements of the general plan. Aircraft accident location data and analyses presented in Chapters 8 and 9 of this *Handbook* also can provide factual support for the findings. The findings should:

- Document any inconsistencies between the proposed land use action and safety compatibility criteria in the ALUC compatibility plan;
- Describe the measures taken to assure that risks—both to people and property on the ground and to the occupants of aircraft—associated with the land use proposal are held to a minimum; and
- Indicate that the proposed land use action falls within a level of acceptable risk considered to be a community norm.

➤ **Protecting Public Health, Safety, and Welfare by Ensuring Orderly Expansion of the Airport**—This purpose is essentially the same as the first one listed above.

➤ **Minimizing the Public's Exposure to Excessive Noise and Safety Hazards**—Key words in this component of the law's purpose are *minimize* and *excessive*. The phrase "to the extent such areas are not already devoted to incompatible uses" is significant as well.

The language used in the statute implies a quantitative assessment of noise exposure and safety hazards. The purpose of the statute is not merely to reduce the public's exposure to noise and safety hazards, but to minimize exposure in areas with excessive noise or safety concerns. To adopt a finding demonstrating consistency with this purpose, the local agency first must determine whether the existing noise exposure or safety hazards are excessive.

- If existing noise and safety hazards are not excessive, then the actions taken by the local agency must "prevent the creation of new noise and safety problems" (see the third bullet above).
- If the existing exposure is excessive, the local agency would have to show how its action in overruling an ALUC determination of inconsis-

tency nonetheless *minimizes* additional exposure to those noise and safety concerns that have been identified.

- Finally, the local agency needs to show the extent to which land uses in the area in question are already incompatible with airport operations, and how an action to overrule would not create a new incompatible use, or would not expose additional persons or property to noise and safety hazards associated with existing compatible uses.

Implications of Local Agency Overruling

The state law indicates several implications of a local agency's decision to overrule an ALUC determination:

➤ **Action Approved**—The most obvious outcome of a local agency's overruling is that the proposed action—approval of a plan, ordinance, project, or whatever—takes effect just as if the ALUC had approved it or found it consistent with the compatibility plan.

➤ **Subsequent Reviews**—If a local agency adopts or amends a general plan or specific plan for the airport area by overruling the ALUC, then subsequent ALUC review of individual development projects related to that overruling become voluntary (Section 21676.5(b)).

➤ **Airport Proprietor's Immunity**—Two sections of the law establish that, if a county or city overrules an airport land use commission with respect to a publicly owned airport not operated by that county or city, the agency operating the airport "shall be immune from liability for damages to property or personal injury caused by or resulting directly or indirectly from the public agency's decision to override the commission's action or recommendation" (Sections 21678 and, with slightly different wording, 21675.1(f)). The law does not indicate who will become liable under these circumstances.

It is perhaps of significance to note that the immunity provision of the state law has not been tested in court.

➤ **Lack of Notification to ALUC**—Another common situation which occurs when a county or city is contemplating overruling an ALUC is the lack of notification to the commission. From the perspective of ALUCs and airport managers, one of the significant shortcomings of the state law is that it does not require a local agency to notify the commission of a pending overruling action. Frequently, the ALUC and its staff do not become aware that an overruling has occurred until after the fact, if at all. Giving the commission an opportunity to state its case at a public hearing and challenge unsupported findings would potentially avoid some of the resulting incompatibilities and would further the objectives of the statutes.

ROLE OF AIRPORT PROPRIETORS

Apart from their obligation to submit airport master plans, construction plans of new airports, and plans for airport expansion (when an amended airport permit is required) for airport land use commission review, airport proprietors also have a more basic role in airport land use compatibility matters. There are three facets to this role. One arises because of the relationship between the airport proprietor's actions and the substance of the ALUC compatibility plan for the airport. A second is the airport proprietor's direct responsibility for fostering compatibility between the airport and its environs. Lastly, airport proprietors have a community relations role which can have implications on land use compatibility issues.

Influence on ALUC Compatibility Plan

By law, an airport land use commission cannot establish policies governing the operation of any airport. Nevertheless, because an ALUC's compatibility plan for an airport must be based upon the long-range plans for that airport, the manner in which the airport is or will be constructed and operated clearly has a major bearing on the compatibility plan. The airport's ability to affect the location and magnitude of airport impacts can make development compatible in places where it would otherwise not be acceptable.

Some examples of this relationship are obvious. The configuration of the existing and proposed airport runways is a major determinant of noise and safety compatibility zone locations. Other influences on the compatibility plan are usually more subtle and may or may not be taken into account in the ALUC's formulation of the compatibility plan. As mentioned in Chapter 3, one airport operational procedure which can have an important influence on a compatibility plan is the location of traffic patterns. If a traffic pattern exists only on one side of a runway, whether for compatibility purposes or other reasons, fewer restrictions on land uses may be necessary on the non-traffic-pattern side.

Actions to Enhance Land Use Compatibility

Most airport proprietors understand that they too have a responsibility for promoting airport land use compatibility. They cannot rely solely upon actions taken by the airport land use commission or the agency having jurisdiction over local land uses. In locations where the need for compatible land uses is particularly critical, airports should take direct action to prevent or mitigate problems.

Airports need direct control over lands critical to airport operations because of the limitations of land use planning and zoning measures for airport land use compatibility purposes. As essential as the designation of appropriate land uses is to airport land use compatibility, reliance on the normal form of these documents does not provide adequate long-term compatibility assurance. Among the important limitations which need to be recognized are:

➤ **Ease of Change**—Nothing permanently locks in a land use designation. Future local legislative bodies can change the established designations—by overruling the ALUC, if necessary. Such changes especially can occur if the land changes jurisdiction (e.g., as a result of annexation).

- **Restrictiveness**—Land use designations are limited as to how restrictive they can be. If they are deemed to eliminate all reasonable economic use of private property, they can be considered an unfair taking and result in inverse condemnation. Especially in areas near ends of runways, the restrictions may need to be more extensive or demanding than can be accomplished by land use designations.

For additional discussion of inverse condemnation, see Chapter 3.

- **Lack of Retroactiveness**—Designating an area for a different use than the one already existing may encourage change over the long run, but it does not directly eliminate existing incompatible uses.

Given these limitations of land use planning and zoning measures, the only certain means available to airport proprietors for protecting against incompatible development in the airport vicinity is to directly control the property most critical to compatibility. In most instances, this means acquiring the property. The acquisition can be outright, fee simple title acquisition or the acquisition of an easement granting specified rights to the airport.

Among the assurances that an airport proprietor must give to the FAA before receiving a project grant is to take appropriate action "to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations." When the agency owning the airport also has jurisdiction over surrounding land uses, zoning may suffice, especially for lands outside the runway protection zones. However, when the jurisdictions are different or where unprotected land is within a runway protection zone, direct acquisition may be the only effective means of carrying out the grant assurances.

From the airport's perspective, the chief advantage of property acquisition is to provide long-term assurance of land use compatibility. If the airport owns the property or an easement, maintenance of compatibility is not dependent upon the success of ALUC actions or the understanding and cooperation of the local jurisdiction having land use powers. There are also disadvantages, however; cost being the major one.

Airport property ownership is most critical for the runway protection zones. These areas immediately beyond the runway ends should be clear of structures and be used only for agricultural or other low-intensity use. As discussed in Chapter 3, airport land use commissions are limited as to how far they can go to restrict land uses without the restriction being legally deemed to be a taking. The zoning authority of local agencies is similarly constrained.

In noise- and/or safety-impacted locations beyond the runway protection zones, property acquisition may also be the only effective means of land use control. This can be particularly true in situations where the local government having authority over land uses is not the same one that owns the airport. In such cases, the interests and objectives of the land use jurisdiction often differ from those of the airport agency.

Acquisition of Fee Simple Title

Airport acquisition of fee simple title is not only the most absolute means of controlling a property's use, it is the only type of action that ensures the conversion of existing legal, but incompatible, land uses to uses more compatible with airport activities.

Acquisition of property for approach protection purposes is eligible for federal grants under the Federal Aviation Administration Airport Improvement Program. FAA guidelines state that:

> "…land interest is eligible which is necessary to restrict the use of land in the approach and the transitional zones (the dimensions as cited in

the applicable Advisory Circulars) to activities and purposes compatible with normal airport operations as well as to meet current and anticipated development at the airport." (FAA–1989a)

The FAA's *Airport Design* Advisory Circular indicates that airports should own areas necessary to mitigate potential incompatible land uses where adequate control cannot be provided by zoning, easements, or other means. At a minimum, runway protection zones and areas adjacent to the runway (locations where the Federal Aviation Regulations Part 77 transitional surface is less than 35 feet above the adjacent runway surface elevation) should be on airport property.

Depending upon the urgency, fee title acquisition can take one of these forms:

- **Condemnation**—Public agencies have the authority to use eminent domain proceedings to condemn property needed for public purposes. For airport compatibility reasons, condemnation is usually reserved for situations in which a significant compatibility conflict exists or is expected to soon occur if action is not taken.
- **Purchase when on Market**—A less adversarial approach to fee title acquisition is for the airport to determine which properties it is interested in buying, then purchase them when the owners place them on the market. A potential difficulty of this approach is that the airport may not have or be able to obtain the necessary funding in a timely manner. (Unlike with construction projects, however, FAA grant funding for property acquisition can be obtained retroactively.) It is also possible that another buyer could offer more money than the airport could pay.
- **Purchase Assurance**—A variation of purchasing property when it comes on the market is for the airport to establish a purchase assurance agreement with the owners of the property it wishes to buy. This agreement would give the landowner assurance of a buyer when the owner chooses to sell and, simultaneously, would give the airport the option of whether or not to make the acquisition (a *right of first refusal*).

Acquisition of Easements

Also see the discussion of the appropriateness of avigation easements as buyer awareness measures earlier in this chapter and in Chapter 3.

Standard Avigation Easement Rights
As described in Chapter 3, a standard avigation easement conveys the following property rights from the property owner to another entity, usually the airport owner:

- A right-of-way for free and unobstructed passage of aircraft through the airspace over the property at any altitude above an imaginary surface specified in the easement (usually set in accordance with FAR Part 77 criteria).

Easements in general are a less-than-fee form of property ownership. They convey specified rights from the owner of the underlying parcel to the party which owns the easement. Two related, but different, types of easements are sometimes acquired by airports as means of controlling certain types of land use activities. One form, an avigation easement, is relatively common. The other, approach protection easements, have only recently begun to be acquired and are still relatively rare.

- **Avigation Easements**—Avigation easements have historically been used to establish height limitations, prevent other flight hazards, and permit noise impacts and other impacts related to the overflight of aircraft. Airport acquisition of an avigation easement is sometimes an alternative to fee simple title acquisition of property within or near the runway protection zones, especially when outright acquisition is not affordable or otherwise practical. In these instances, the property involved is usually already developed. Airport proprietors often require property owners to dedicate an avigation easement to the airport in exchange for installation of noise insulation paid for by the airport (usually at least in part with the assistance of the FAA).

A standard avigation easement usually involves conveyance of the property rights listed in the adjacent sidebar. Sometimes, though, only part of these rights are obtained. Most common is an Overflight Easement addressing the noise and other impacts of aircraft passage over a property, but not restricting the height of objects on the property.

- **Approach Protection Easements**—A significant shortcoming of standard avigation easements as a means of assuring airport land use compatibility is that they do not specifically regulate the types of land uses allowed on the property. As long as the height limits and other conditions are adhered to, any land use is permitted. Approach protection easements go a step farther by combining standard avigation easement provisions with the acquisition of specific development rights to the property.

Approach protection easement acquisition is particularly suitable for areas which: (1) are not so highly impacted that fee simple title acquisition is necessary; (2) are currently in agricultural or other compatible use; and (3) would be a significant problem if converted to an incompatible use. Future uses of the property would be restricted to specified types of agriculture or other compatible land uses. New residential development would be excluded.

Because the rights to ownership and limited use of the property remain with the landowner, the cost of acquiring approach protection easements is usually less than that of fee title. Airports can obtain approach protection easements either through direct acquisition or, when necessary, by acquiring fee title then reselling the property while retaining the easement.

Community Relations

Among the most effective means airports have available with which to minimize airport/community conflicts is to reach out to local residents by means of a public relations program. Generally, the more informed that people are about an airport and its activities, the less likely they are to complain about it. Possible elements of a communication program might include:

- Creation of a telephone hot line.
- Periodic publication of a newsletter about the airport.
- Talks to local civic groups.
- Offering tours of the airport.
- Establishment of an airport/community advisory committee.

Additionally, a real estate disclosure program could be implemented, at least in an informal manner, by the airport proprietor. An airport cannot, on its own, include such a program as part of an overlay zoning ordinance

- A right to subject the property to noise, vibration, fumes, dust, and fuel particle emissions associated with normal airport activity.
- A right to prohibit the erection or growth of any structure, tree, or other object that would enter the acquired airspace.
- A right-of-entry onto the property, with appropriate advance notice, for the purpose of removing, marking or lighting any structure or other object that enters the acquired airspace.
- A right to prohibit electrical interference, glare, misleading lights, visual impairments, and other hazards to aircraft flight from being created on the property.

A sample of a typical avigation easement is included in Appendix D.

The concept of *approach protection easements* is very similar to that of *conservation easements* used for the purpose of preserving agricultural land.

affecting surrounding land use jurisdictions. Nevertheless, airport proprietors can assemble information about the airport, its activity levels and traffic patterns, and any other factors which may influence land use compatibility. This information could then be distributed to local real estate agents and be made available to airport area residents.

CHAPTER 6

Measuring Airport Noise

OVERVIEW

By one common definition, noise is simply *unwanted* sound. *Sound* is something which can be precisely defined and physically measured. *Noise*, on the other hand, is highly subjective. Sounds which may be pleasant and desirable to one person may be noise to someone else. Moreover, even when people agree that a sound constitutes noise, their reactions to that noise may vary substantially.

The subjective and highly complex nature of noise is implicit even in the measurement of noise. These characteristics are particularly evident with respect to measurement of airport noise. As discussed in this chapter, airport noise differs in many respects from other sources of noise, including other transportation noise. Also discussed are the efforts which have been and continue to be made to devise ways of describing and quantifying airport noise. Lastly, issues involved with measuring noise levels for a particular airport and projecting potential future noise impacts are addressed.

This chapter examines the various factors involved in measurement of airport noise. The discussion covers:

- Characteristics of airport noise
- Airport noise metrics
- Calculation of airport noise contours

The chapter which follows addresses the issue of setting land use compatibility policies on the basis of airport noise data.

CHARACTERISTICS OF AIRPORT NOISE

Noise is often perceived to be the most significant of the adverse impacts associated with airport activity. To better understand airport noise impacts, it is important to recognize the variables involved with regard to different types of aircraft, aircraft flight routes, and other factors such as pilot technique.

As background to the topics which follow, an understanding of the fundamental characteristics of sound is valuable. Tables 6A and 6B provide some basic information on sound measurement and sound attenuation, respectively. Figure 6A lists typical sound levels of common indoor and outdoor sound sources.

Types of Aircraft

As experienced on the ground, the noise emitted by different types of aircraft has distinct differences in terms of both the overall sound level and other properties. The extent of the differences in sound levels generated by a selection of general aviation, air carrier, and military aircraft can be seen in Figure 6B. The illustrations depict the typical noise "footprint" created by

Sound

Sound is transmitted in the form of pressure waves. These waves are created by oscillation of particles of air—that is, air particles being displaced from and returning to an equilibrium position. As the particles are displaced, they bump into surrounding particles which bump into others and so on. In this manner, sound is transmitted through the atmosphere. Sounds are heard when the pressure waves of displaced air particles strike the eardrum, causing it to vibrate.

The physical properties of a sound can be measured in terms of three basic components: *magnitude, frequency,* and *duration*. Although these components can be directly measured, useful measures of sound are complicated both by environmental variables and the way in which people hear sound.

Magnitude

The magnitude or strength of a sound is determined by how much the air particles are displaced from equilibrium by the sound pressure waves. The greater the amplitude of the pressure fluctuation, the more acoustic energy the sound wave carries. Simply measuring the magnitude of sound on a linear scale is not practical, however, because the range of sound pressures which the human ear can detect is enormous—a ratio of 1 to approximately 10^{14} (1 followed by 14 zeros). By converting this ratio to a logarithmic scale, the range can be reduced to 14 units. The unit of sound level measurement on this scale is the bel (in honor of Alexander Graham Bell). Normally, though, these units are divided into tenths—that is, *decibels*. The range of human hearing thus extends from 0 decibels, corresponding to the faintest sound level that the healthy, unimpaired human ear can detect, to more than 140 decibels. (Sound levels of nearly 200 decibels are possible—such as inside a rocket engine—but are greater than the unprotected human ear can withstand.)

The use of a logarithmic scale for measurement of the magnitude of sound is often the cause for confusion because it does not directly correspond to the way in which people perceive the relative *loudness* of different sound levels. People tend to think that, if two equal sounds are combined, the result will seem twice as loud. In reality, however, combining two equal sounds—although it doubles the sound energy—produces only a 3 dB increase in magnitude, an amount which is bare perceptible. For one sound to be judged twice as loud as another, it actually must be 10 dB higher (meaning that the acoustic energy must increase 10-fold). Because we perceive the loudness of sounds in relative rather than absolute terms, the relationship of 10 dB per doubling of loudness applies to any 10 dB increase—sound level increases from 40 dB to 50 dB or from 80 dB to 90 dB are both perceived as representing a doubling of loudness.

Frequency

The frequency of a sound—its *tonal quality*—depends upon the relative rapidity of the air pressure oscillation. In a low-pitched tone, the sound waves are relatively far apart (that is, the wavelength is relatively long), while in a high-pitched tone they are squeezed much closer together. Frequency is measured in cycles per second (also called *hertz* or Hz). Although some *pure* tone sounds contain only one frequency, more often sound is a mixture of different frequencies.

The response of the human ear to different sounds is significantly affected by the frequency of those sounds. Although people can hear sound frequencies as low as 20 Hz and as high as 20,000 Hz, they do not hear all frequencies in this range equally well. Very low and very high frequency sounds are perceived to be less loud than mid-range sounds.

Most environmental sound measurements consequently are weighted to simulate the varying frequency sensitivity of the human ear. A widely used weighting for general environmental sounds (as opposed to large-amplitude impulse sounds such as sonic booms) is the A-weighted sound level expressed in decibels (abbreviated as "dBA").

Duration

The third component of sound is the length of time over which it occurs. Many sounds have a distinct beginning and ending; others, such as from aircraft overflights, gradually increase and decrease without a sharp definition of when they start or stop. In the latter case, the duration of the sound is usually measured in terms of the time period over which the sound level exceeds a specified threshold.

Because sound levels vary from one moment to the next, it is not possible to say that a given noise was "so many decibels" except when referring to an instantaneous measurement or by averaging the sound level over time. As discussed elsewhere in this chapter, numerous methods have been developed which seek to measure the overall *exposure* produced by a noise event or events within a defined period of time.

TABLE 6A

Measurement of Sound

Sound Attenuation in the Outdoor Environment

Among the basic characteristics of sound which are of particular interest in the discussion of aircraft-generated noise are sound attenuation or reduction over distance. Part of the reduction occurs because sound energy is spread over a three-dimensional, geometrically increasing area as the distance from the source increases. At sufficient distances from the source, geometric spreading alone results in a 6 dB loss per doubling of distance. Actual attenuation of sound is greater than this as a result of factors such as absorption by the atmosphere. Also, atmospheric attenuation is greater for high-frequency sound than for sound with a low frequency.

Other factors also influence the extent to which sound is attenuated in the environment. Sound propagation through the air is affected by meteorological conditions including air temperature, temperature inversions, humidity, wind speed, and air turbulence. Sound traveling along a hard ground surface is attenuated by approximately an additional 2.5 dB in 1,000 feet (compared to the attenuation in air alone) and tall grasses or shrubs can double this figure. Structures, terrain, or other barriers can provide significant attenuation for ground-to-ground sound as well.

Ground cover and objects on the ground, however, have little effect on reducing air-to-ground sound such as that from aircraft. Moreover, buildings and other such objects can cause reflections which may even *increase* the localized sound level.

Sound Attenuation Provided by Buildings

For indoor activities, another significant factor affecting the level of aircraft-generated noise to which people are exposed is the amount of sound attenuation provided by the building. The sound insulation capabilities of buildings are measured in several ways.

One measure commonly associated with the individual structural components of a building is the *Sound Transmission Class* (STC). The STC rating of a component is expressed as a single number, in decibels, and is calculated in laboratory testing of the component. STC ratings are often used in construction specifications to indicate a required sound insulation capability. The original application of STC ratings was with regard to interior partitions, but it can also give some indication of the sound attenuation provided by exterior walls, windows, and doors.

Caution must be used, however, when attempting to evaluate the exterior-to-interior sound level attenuation of a building by means of STC ratings. First, as a single number, the STC of a structural component may not adequately reflect differences in the component's relative abilities to block sounds of different frequencies. Secondly, the overall sound attenuation provided by most buildings cannot be calculated from STC ratings. The various components of a building each have different noise insulation qualities. Moreover, sound tends to enter an interior space not so much through individual components, but by way of openings and gaps such as vents, door jambs, and so forth. Interior noise levels from exterior sources thus are substantially determined by the weak link in the overall construction.

A more general measure of a building's sound attenuation attributes is its *Noise Level Reduction* (NLR). Like STC, NLR is a single-number value measured in decibels and as such may disguise a building's varying response to different sound frequencies. Unlike STC, though, NLR is measured in field testing of actual structures. It thus takes into account the fact that buildings are made up of numerous components.

(See Chapter 7 for a discussion of interior noise level standards and sound insulation programs.)

TABLE 6B

Sound Attenuation

In several respects, aircraft noise is intrinsically different from other types of transportation noise.

- *Directionality:* Few other noises routinely come from overhead.
- *Intermittent Occurrence:* Unlike the often constant drone common from highway noise, aircraft noise is usually composed of discrete events.
- *Vibration:* Blade slap noise from helicopters and the low- frequency rumble created behind jet aircraft as they take off often cause perceptible vibration in structures.
- *Fear:* In part because the source is from overhead, there is sometimes a sense of fear attached to how people perceive aircraft noise that is seldom evident with noise from highways and railroads.

As discussed later in this chapter and in the chapter which follows, these characteristics often necessitate different approaches to airport noise impact mitigation than are used with respect to other noise sources.

a single landing and takeoff of each aircraft. Each of the footprints is broadly representative of those produced by other aircraft similar to the ones included. However, the actual sound level produced by any single aircraft takeoff or landing will vary not only among specific makes and models of aircraft, but also from one operation to another of identical aircraft.

Jet Airplanes

Both the character and the sound level (magnitude) of jet airplane noise has changed over time as new engine technologies have been developed and introduced into the airline and business jet aircraft fleets. The old, pure-jet engines produce noise that is both very loud and at the high end of the frequency spectrum. Newer generation, fan-jet engines—in which a substantial volume of the air entering the engine bypasses the combustion chamber—create noise that is comparatively lower both in magnitude and frequency. Even among fan-jet engines, noise levels have been considerably reduced with the most recent models compared to the earliest types.

Most of the overall noise level improvements experienced in recent years at airports having jet activity have resulted from retirement of the older, louder jet aircraft. As of January 1, 2000, the older-model, so-called Stage 2, fan-jet aircraft have been phased out of the nation's airline fleet in accordance with federal law. In many cases, though, compliance with the current Stage 3 phase-out standards has been accomplished not by retirement of the entire aircraft, but by replacement or modification of the engines. Although aircraft retrofitted with "hush kits" meet the present standards, they remain comparatively more noisy than newer-technology aircraft. Additionally, the Stage 3 standards apply only to aircraft weighing more than 75,000 pounds. The many Stage 2 business jet aircraft which weigh less than this amount are still allowed to operate. Such aircraft can produce a significant proportion of the noise impacts at general aviation airports.

Furthermore, the effect of the technological improvements on aircraft noise levels differs between takeoffs (departures) and landings (approaches). Decreased engine exhaust noise together with improved climb-out performance (aircraft reach a higher altitude more quickly) have enabled major reductions in departure noise levels. Approach noise has also recently become a more prominent issue. Greater noise emissions from the fans and compressors in high-bypass engines have increased the comparative importance—and sometimes the actual noise levels—of aircraft approaches. One further concern to be addressed is sideline noise produced by the reverse thrust applied as aircraft land. This noise, particularly evident lateral to runways, can be the subject of complaints, but usually has little effect on overall noise contours because of the dominance of takeoff noise.

With regard to aircraft noise emissions standards, see the discussion of federal laws and regulations in Chapter 7.

The extent to which jet aircraft noise will be further reduced in the future depends upon several factors. Continued technological advancements appear capable of reducing noise emissions to levels below those of the newest aircraft now in production. The question then becomes one of how quickly such technologies will be introduced into the national and world-

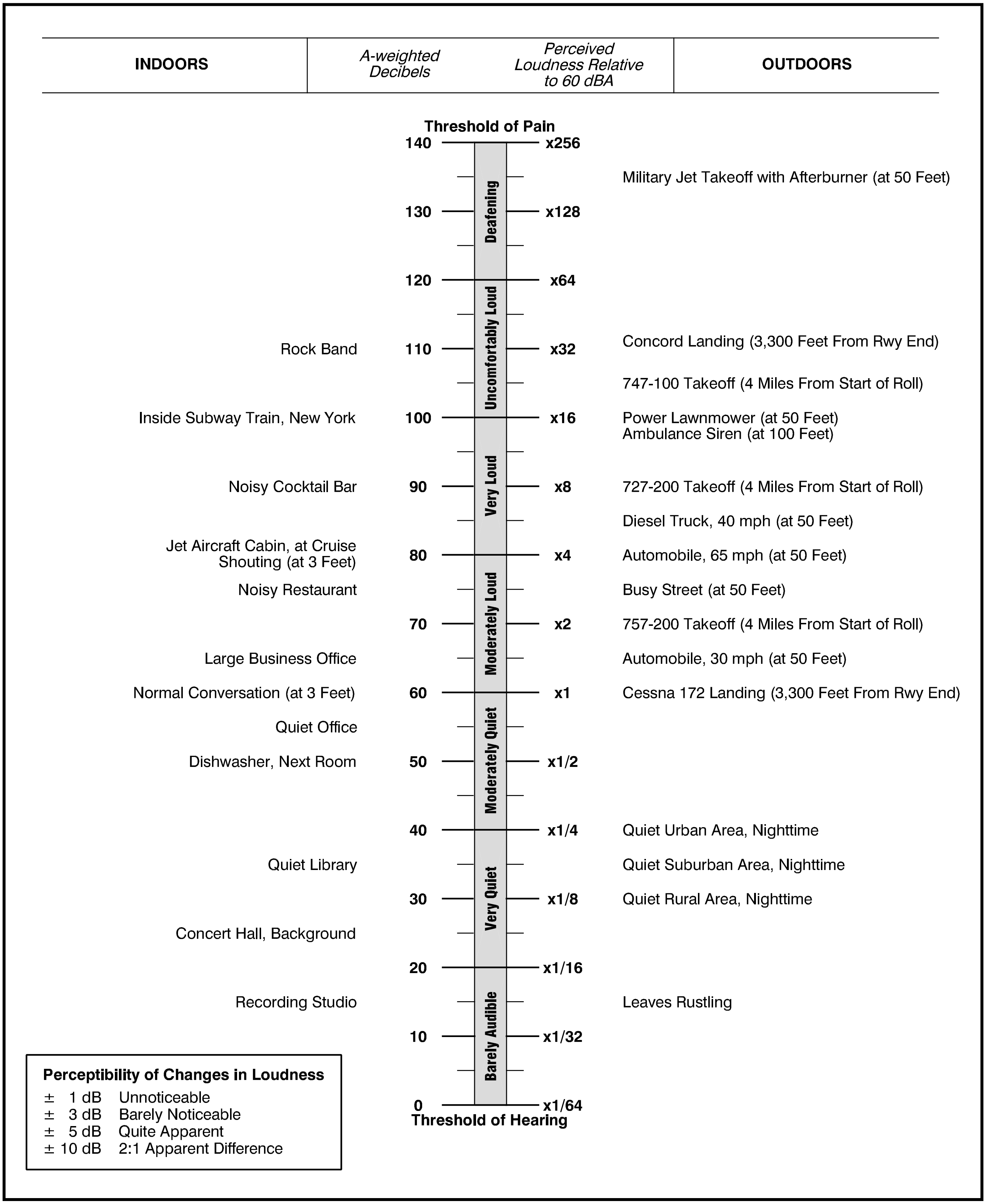
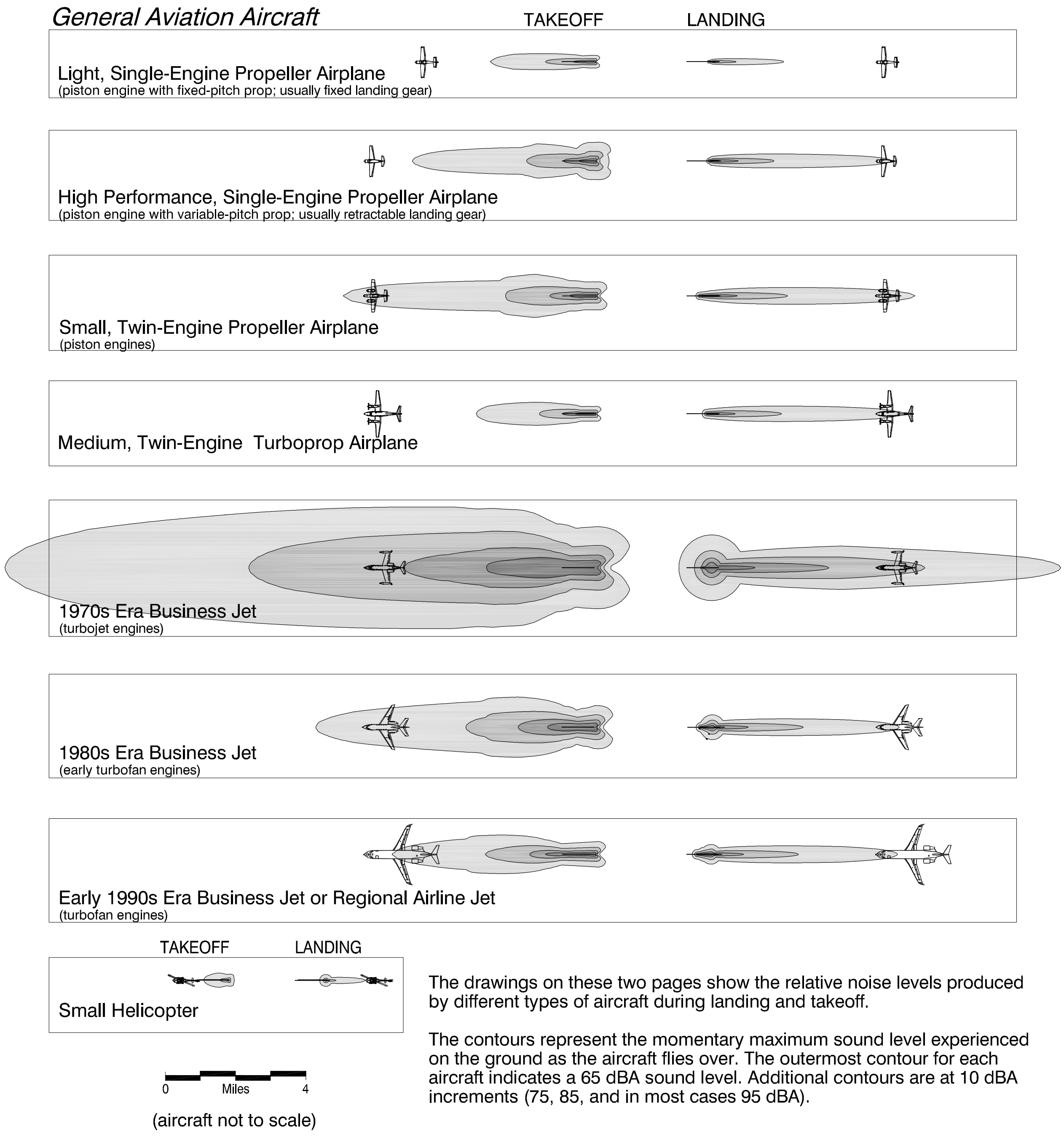


FIGURE 6A

Typical Decibel Level of Common Sounds



The drawings on these two pages show the relative noise levels produced by different types of aircraft during landing and takeoff.

The contours represent the momentary maximum sound level experienced on the ground as the aircraft flies over. The outermost contour for each aircraft indicates a 65 dBA sound level. Additional contours are at 10 dBA increments (75, 85, and in most cases 95 dBA).

FIGURE 6B

Noise Footprints of Selected Aircraft

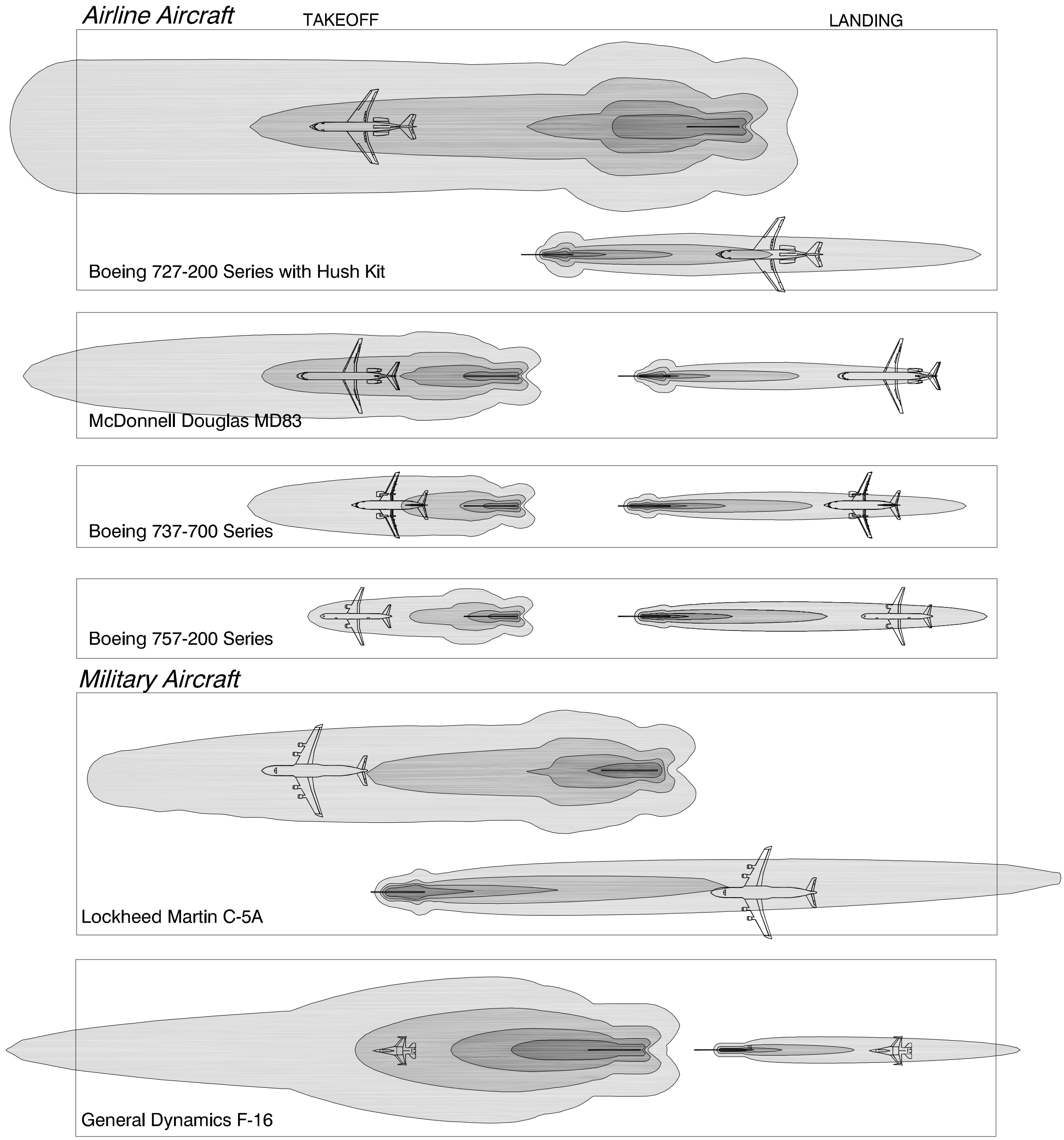


FIGURE 6B *CONTINUED*

wide aircraft fleets. Also an important consideration is the rate at which older, noisier aircraft will be phased out of operation. Lastly, in terms of cumulative noise impacts, a key factor is the volume of future aircraft operations. Even with improved technologies, the potential exists for the overall noise level at airports to increase along with growth in the number of aircraft operations.

Propeller Airplanes

The dominant noise from most propeller airplanes, whether they are driven by piston or turbine engines, is from the propeller itself. Propeller airplane noise varies depending upon the number of engines, the rotational speed of the propellers, the number of blades on each propeller, and the pitch of the blades, as well as, to some extent, the type of engine.

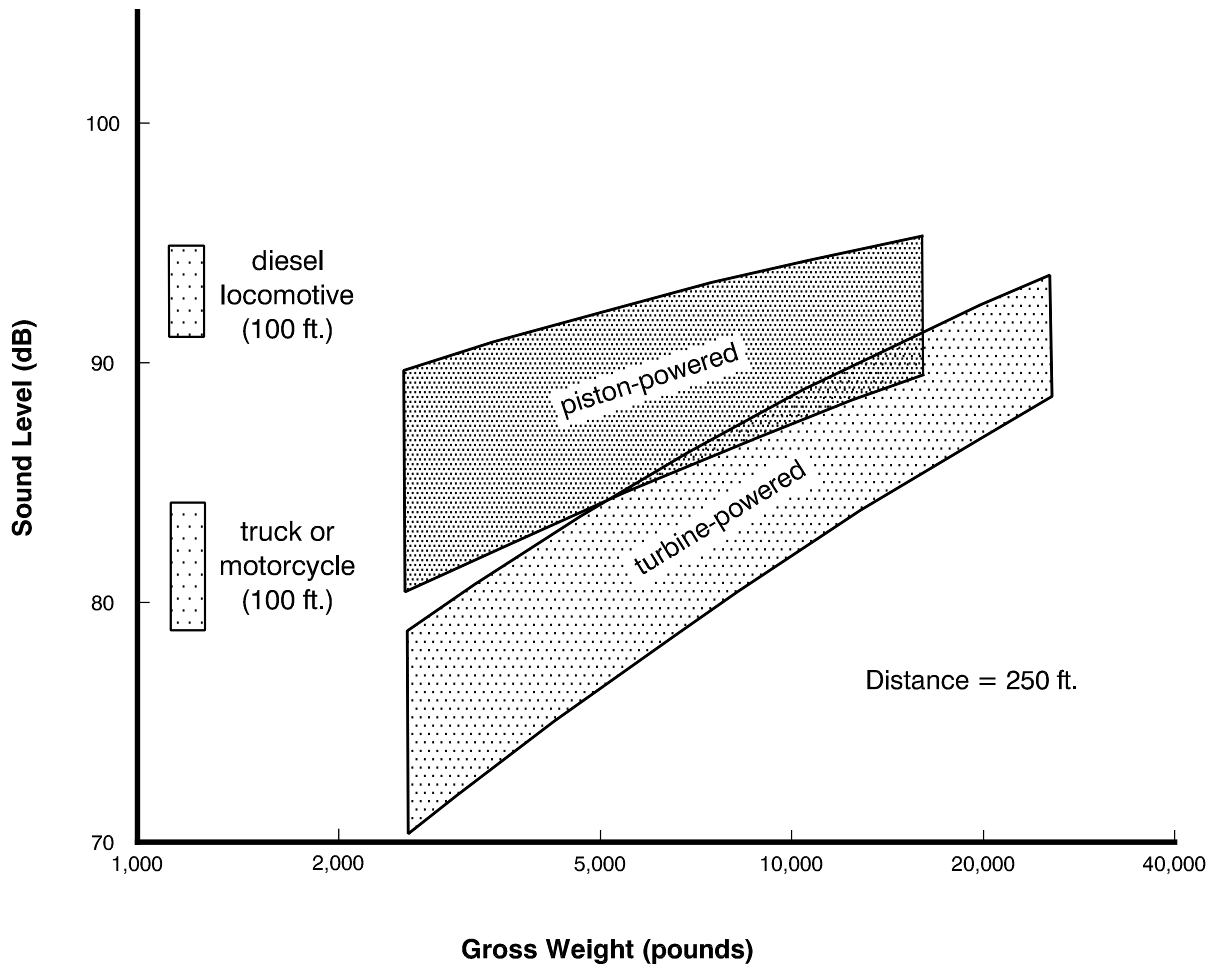
A common perception is that propeller airplanes typically emit significantly less noise than jet airplanes. Early-technology (and most tactical military) jet aircraft clearly are very noisy—more so than most propeller airplanes. With current model jets, however, the distinction is much less. Indeed, aircraft weight accounts for much of the difference. Most propeller airplanes flying today are substantially smaller and lighter than jet airplanes. For aircraft of similar weight, the noise levels of aircraft that are propeller driven and those that have new-technology, fan-jet engines are not greatly different. Another factor affecting the relative noise levels generated by the two aircraft types is the takeoff climb profile. Because jets climb much more rapidly than typical propeller airplanes, the noise levels measured on the ground diminish rapidly with increased distance from the runway. Consequently, at points sufficiently far from the runway end, the higher altitude attained by jets may make them effectively quieter than propeller airplanes. This phenomenon can be seen from comparisons among the aircraft noise footprints depicted in Figure 6B.

Unlike jet aircraft, the noise levels produced by average, propeller-driven, small airplanes found at general aviation airports has not changed appreciably over the years. The potential for future technological improvements is limited. Moreover, small, private airplanes tend not to be replaced with newer models at anywhere near the rate common to airline aircraft. Thus, for many years to come, the noise impacts of typical propeller airplanes are likely to remain little different from what they are now.

Helicopters

Figure 6C depicts the normal sound level range of helicopter operations, measured at a distance of 250 feet.

Helicopter noise has a character all its own. Although a portion of the noise emanates from the engines themselves, the uniqueness of helicopter noise is mostly due to the modulation of sound created by the relatively slow-turning main rotor. This sound modulation is referred to as *blade slap*. Blade slap is most pronounced during low-speed descents and high- speed cruise. To a listener on the ground, it is most audible as the aircraft approaches. Helicopters are also notable for creating vibration or rattle in structures.



Source: Helicopter Association International (1993)

FIGURE 6C

Helicopter Noise Levels

Research into methods of reducing helicopter noise is on-going. Remaining to be seen is how successful and cost-effective the results will be.

Common Aircraft Flight Routes

The discussion in this section concerns the flight routes and procedures used by aircraft under normal flying conditions. Chapter 8 contains information regarding how pilots and aircraft react under emergency circumstances.

An essential point to emphasize in this discussion of aircraft flight routes is that airport land use commissions have no authority to regulate where aircraft fly. That responsibility rests with the FAA and, to a lesser degree, with airport proprietors.

In general, the most significant noise impacts created by aircraft are concentrated near the ends of airport runways. The locations of aircraft flight routes to, from, and around an airport, however, are also a major determinant of where noise impacts occur. This section describes the major factors which determine the type and location of aircraft flight routes near airports.

Types of Flight Rules

Aircraft fly to and from airports under two different sets of operating procedures defined by Federal Aviation Regulations:

- **Visual Flight Rules (VFR)**—VFR operating procedures apply at airports when weather conditions (specifically, the horizontal visibility and the cloud ceiling height) permit pilots sufficient time to see a runway for landing as well as to see and avoid other aircraft in flight and obstacles on the ground. These minimums are set by Federal Aviation Regulations Part 91. Within controlled airspace around airports the minimum visibility requirement for VFR flight is basically 3 statute miles. By requesting a special VFR clearance, pilots can obtain minimums as low as 1 statute mile. Minimums of 1 statute mile also are permitted in uncontrolled airspace.
- **Instrument Flight Rules (IFR)**—Under IFR procedures, pilots must rely on the aircraft's cockpit instrumentation, ground- or satellite-based navigational aids, and (where available) air traffic control services. IFR procedures are required when the weather conditions are below the minimums for VFR operations.

  Airport instrument procedures fall into two basic categories: *approach procedures* and *departure procedures*. Published procedures for individual airports are formally defined in accordance with federal guidelines and must be approved by the FAA. Airports may have one or more of each type of procedure based upon different navigational aids and applicable to different runway ends.

A mixture of VFR and IFR procedures are frequently used for aircraft operations at airports. IFR procedures can be followed during VFR conditions. This is the standard practice for airline aircraft, is often used by corporate aircraft, and also occurs during instrument flight training. Additionally, VFR procedures are often used at the termination of an IFR flight once the pilot has the airport in sight.

Airplane VFR Traffic Patterns

Federal Aviation Administration guidelines establish the standard traffic pattern flown by airplanes approaching and departing airports under VFR conditions. Airplane traffic patterns are defined in terms of a generalized *routing* and an *altitude* (or height above the airport).

The generalized routing is in the form of a racetrack-shaped path leading to and from the runway in use (Figure 6D). FAA guidelines specify only the shape of the pattern, not its size. Unless precluded by local conditions, traffic patterns use left-hand turns. The direction of flow within a traffic pattern depends mostly upon wind conditions. When winds are moderate to strong, aircraft will almost always take off and land facing as closely into the wind as the choice of runway alignment permits. When winds are calm or mild, other factors such as attaining the most efficient flow of traffic or minimizing noise impacts may influence which runway direction is used.

It is important to realize that, although most pilots normally fly a standard pattern at a nontowered airport, use of such a pattern is not mandatory. Depending upon the direction from which the flight is coming, a pilot may choose to make a *base entry* or *straight in* approach to landing. Also, after takeoff, an aircraft may depart the pattern at various points.

Traffic patterns at airports where an airport traffic control tower is operating are more regulated, but often more variable, than at airports without towers. Pilots commonly request the type of entry or departure which will be most convenient to them. Controllers usually grant such requests if conditions allow. However, when traffic is heavy, controllers may tell pilots which aircraft to follow and when to make turns. Atypical flight tracks can sometimes result.

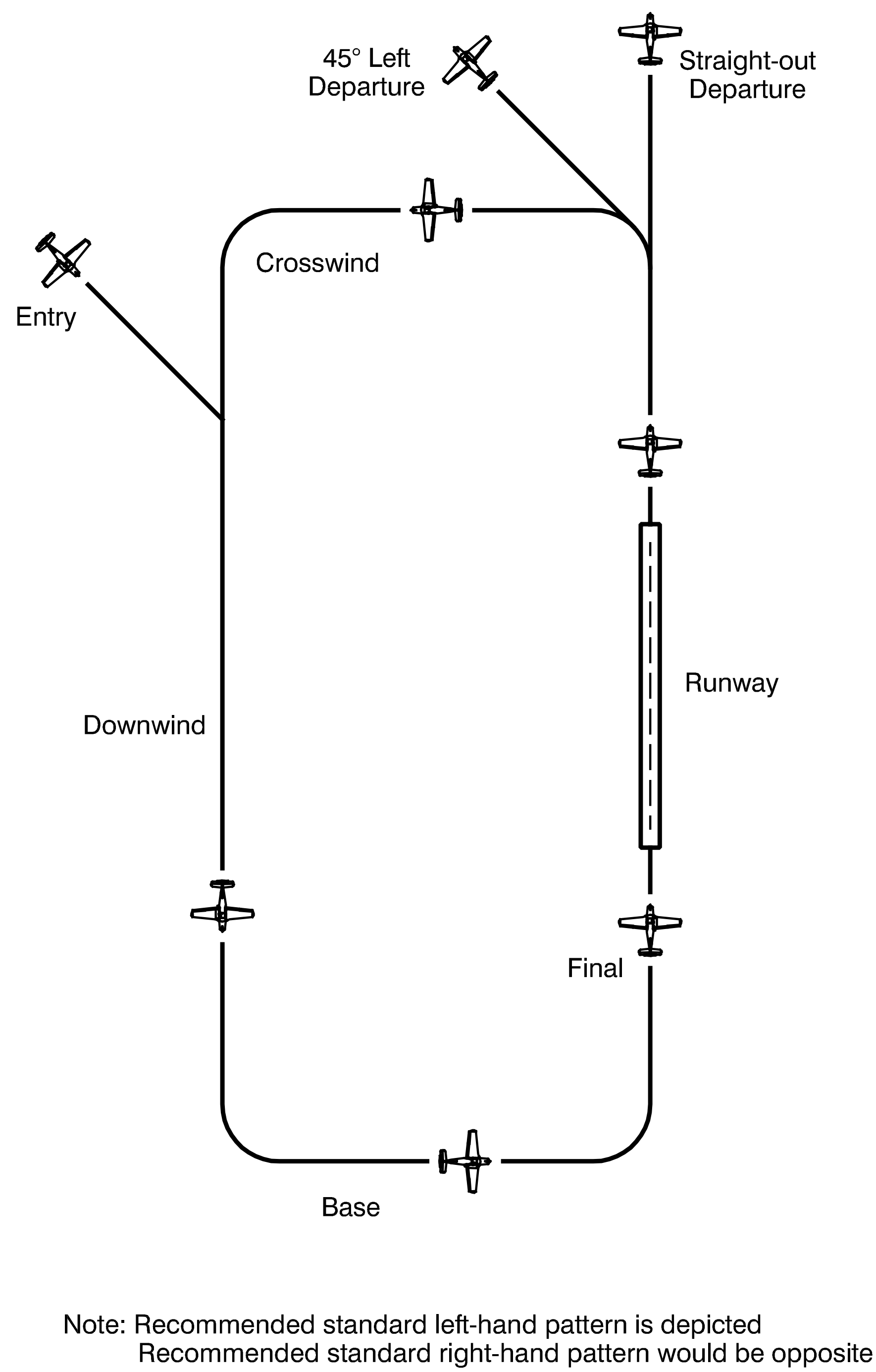
The existence of standard patterns tends to give people who are not pilots the impression that aircraft follow well-defined *highways in the sky*. The reality is that considerable variation occurs in how pilots fly traffic patterns. This variation is expected and normal.

- **Landings**—For landings, pilots of average single-engine airplanes usually fly the downwind leg (see Figure 6D) anywhere from ¼ to 1 nautical mile (1,500 to 6,000 feet) laterally from the runway. The base leg may extend even farther from the airport, particularly when other aircraft are in the traffic pattern. There is a tendency by many pilots to fly a relatively wide pattern at airports with a long, wide runway even when no other aircraft are present. Also, terrain and other local conditions can affect how traffic patterns are commonly flown at any given airport. When larger and faster airplanes fly a traffic pattern, the pattern is not only typically higher, but also farther out than one flown by smaller airplanes.
- **Takeoffs**—On takeoff, the normal procedure for small airplanes is to fly straight ahead until reaching an altitude of at least 400 feet above the airport. Depending upon runway length, aircraft type, air temperature, and pilot technique, this altitude may be reached over the end of the runway or not until nearly a mile beyond the runway end. Some pilots (especially those of agricultural aircraft) begin a turn at a lower altitude. Jets and other large airplanes normally climb straight ahead until reaching an altitude of at least 1,500 feet.

At most airports, the traffic pattern altitude for small airplanes is set at 800

Figure 6E depicts the actual flight tracks at an airport having both airline and general aviation operations, recorded from FAA radar over two six-hour periods. Although certain primary traffic corridors can be seen, the significant diversity in flight track locations is also apparent. Additionally, even for aircraft following nearly identical tracks, performance differences and the need to avoid conflicts with other aircraft results in wide variations in aircraft altitudes at any given point along a track.

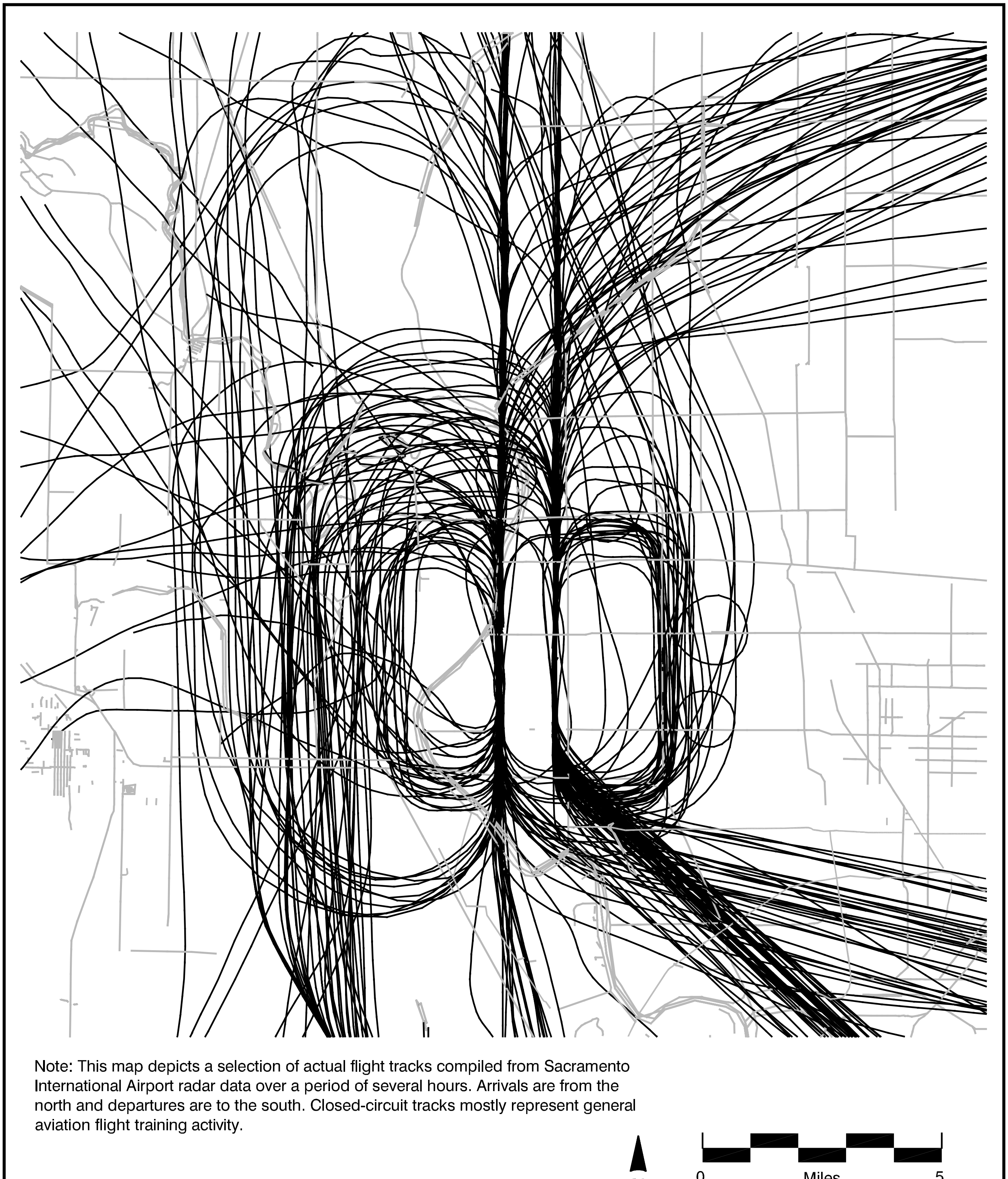
These variations in flight paths and altitudes may be somewhat reduced in the future. At least near major airline airports, newly emerging technologies are expected to enable aircraft to closely follow precisely defined flight paths. The potential for creation of enhanced noise abatement flight procedures is yet to be explored.



Source: Aeronautical Information Manual (Section 4-3)

FIGURE 6D

Standard Traffic Pattern



Source: Sacramento County Airport System Noise Office

FIGURE 6E

Sample Plot of Actual Flight Tracks

to 1,000 feet above the airport elevation. Higher altitudes are sometimes established for large aircraft. These altitudes, however, apply only to a portion of the traffic pattern (mostly the *downwind* leg). Elsewhere in the pattern, aircraft are descending toward a landing or climbing after takeoff. FAA regulations regarding minimum en route altitudes (in populated areas, 1,000 feet above the highest obstacle within 2,000 feet of the aircraft) do not apply while an aircraft is landing at or taking off from an airport. The actual altitude of an aircraft at any particular point along the traffic pattern is largely dependent upon its performance capabilities plus, on landing, any visual glide slope guidance which may be installed at the airport.

Instrument Approach Procedures

Instrument approach procedures are classified as either *precision* or *nonprecision*.

The FAA has recently created a third category of instrument approach procedures: *approach procedure with vertical guidance (APV)*. These procedures are similar to precision approach procedures in that they provide vertical guidance. However, for any of several reasons, they do not fully conform to international standards for precision approach procedures.

- **Precision Approach Procedures**—Precision approach procedures provide both vertical and horizontal guidance to the aircraft. Current procedures all rely upon using navigational aids located at the airport and elsewhere on the ground nearby. In the future, the satellite-based Global Positioning System (GPS) is expected to enable precision approaches without the need for navigational equipment on the ground.
- **Nonprecision Approach Procedures**—Nonprecision approach procedures give only horizontal guidance. Pilots must rely upon other means (other navigation aids on or off the airport and/or radar control) to determine when to descend to a lower altitude along the approach course. Historically, nonprecision approaches required installation of navigational equipment on the ground at the airport or in the vicinity. More recently, stand-alone GPS-based nonprecision approaches have come into use.

Precision approach procedures typically allow lower approach minimums than do nonprecision approach procedures. Most precision approach procedures allow aircraft to land with weather conditions as low as a 200-foot cloud ceiling and a ½-mile visibility. Some major airline airports have navigational aids which enable suitably equipped aircraft to land with *zero-zero* conditions. Good minimums for nonprecision approach procedures are generally double those typical of a precision approach procedure.

Circle-to-land procedures can result in aircraft overflights of areas adjacent to and near the ends of runways which are seldom overflown under regular visual flight conditions. Also, these overflights may be at altitudes well below the normal traffic pattern altitude. The noise and safety implications of circle-to-land maneuvers may be worth special consideration in land use planning around airports where such procedures are common.

Instrument approach procedures are divided into as many as four segments: *initial*, *intermediate*, *final*, and *missed*. The initial and intermediate approach segments serve to guide the aircraft from major air routes to the airport vicinity. Once an aircraft is established on the final approach course, it generally is aligned with the runway and is at a precise altitude. Aircraft fly the final approach segment until reaching the specified minimum altitude at which point, if the runway is visible, the aircraft either proceeds straight ahead to the runway or circles to land on another runway. The missed approach segment of the procedure is utilized if the runway is not visible when the aircraft reaches a predetermined position (indicated by navigational aids or timing) and minimum altitude or the pilot elects to abandon the approach earlier. Missed approach procedures enable the aircraft to climb back to a safe altitude and then either wait for weather conditions to improve or proceed to another airport.

Until the mid 1990s, all instrument approach procedures relied upon ground-based navigational aids. Since that time, procedures utilizing GPS have come increasingly into use. Initially, all GPS procedures were "overlays"—near duplicates of already existing ground-based procedures. More recently, procedures based solely upon GPS have been established. To date, all GPS procedures are nonprecision (providing horizontal guidance only). Ultimately, GPS has the potential to allow establishment of new instrument approach procedures with lower minimums or even curved approach paths. Another key advantage of GPS approach procedures is that they do not require installation of on-ground navigational aids. Runways for which ground-based procedures are not technically practical or cost-effective (because of relatively low activity levels) thus may be capable of accommodating a GPS-based approach.

Despite this potential, it should be realized that, even with GPS, every runway will not become an instrument runway, let alone a precision instrument runway. The FAA has adopted minimum design criteria for runways to support various categories of instrument approach procedures (whether GPS or otherwise). For example, the minimum runway length requirement (as of late 2001) is 3,200 feet for a nonprecision approach. Additionally, lateral setback distances from the runway and the presence of obstacles in the approach and missed approach path are major determinants of the visibility and descent minimums that an approach can have.

DEPT. OF TRANSPORTATION GUIDANCE

Even though GPS may enable many runways currently without an instrument approach procedure to have one in the future, ALUCs cannot necessarily assume this will occur for any particular runway. ALUCs are limited by state law to basing their compatibility plans on master plans or layout plans adopted by airport proprietors. Therefore, unless the adopted plan indicates a runway to be a future instrument runway or the instrument procedure already exists, ALUCs should not base their plans on the possibility that a procedure will be created.

Instrument Departure Procedures

All airports with instrument approach capabilities also have published instrument departure procedures. These procedures enable aircraft to depart an airport and climb to en route airspace. Departure procedures are usually less complex than approach procedures and often do not depend upon on-airport navigational aids. For airline and charter aircraft operations, certain minimum visibility conditions must be met before the aircraft can take off. No minimums are set for operations by private aircraft operating under Federal Aviation Regulations Part 91. Also, instrument departures are permitted from any airport, even those without an instrument approach procedure.

Airport-Related Factors

Adjustments to standard traffic patterns frequently are made to reflect specific conditions at individual airports. Airports where multiple runways are simultaneously used may limit the pattern locations of individual runways in order to avoid air traffic conflicts. Similarly, when two or more airports are situated close together, limitations on their traffic pattern locations may be necessary.

High terrain on one side of an airport is another local condition which may dictate establishment of a right-hand pattern to a runway. Finally, the locations of traffic patterns and flight routes to and from an airport are sometimes defined so as to minimize aircraft overflight of residential or other noise-sensitive land uses.

Specialized Aircraft Flight Routes

In addition to the common arrival and departure flight routes flown by most aircraft, some airports have activity by specialized aircraft which may have their own particular routes.

Helicopter Flight Patterns

Normal flight patterns for helicopters are the same as those for airplanes in certain ways and are different in others. Most of the differences result from the distinct operating characteristics of helicopters.

- **Visual Flight Rules**—Helicopter flight under VFR conditions involves significant differences from airplane flight. For example, en route altitude is generally lower for helicopter flights than it is for airplanes. Federal Aviation Regulations Part 91 establishes the minimum en route altitude for all aircraft at 1,000 feet over urban areas and generally 500 feet over less populated locations. Helicopters, however, may be operated at less than these minimums if "the operation is conducted without hazard to persons or property on the surface."

  The FAA has not established a standard airport traffic pattern for helicopters comparable to that for airplanes. FAR Part 91 dictates only that helicopters should "avoid the flow of fixed-wing traffic." This is often accomplished by flying both at a lower altitude than the airplane traffic pattern and along different routes. Also, many airports and heliports have adopted official or unofficial helicopter approach and departure routes.

  Because helicopters require little or no landing or takeoff roll along the ground the way airplanes do, they can approach or depart a landing/takeoff site from virtually any direction when not limited by obstacles, established procedures, or other factors. Given the choice, helicopters, like airplanes, will land and take off as closely into the direction of the wind as possible. Helicopter landing approach and takeoff climb angles are comparatively steeper, however. Also, the length of these segments can be much shorter than needed for airplanes.

- **Instrument Flight Rules**—Under instrument weather conditions, helicopters mostly follow the same flight rules as airplanes. At airports, for example, properly equipped helicopters can use the same instrument approach and departure procedures as those flown by airplanes. Some helicopter facilities, however, may have instrument procedures exclusively for helicopter use.

Fire Attack Aircraft

Fire attack aircraft operated at many airports in California often utilize special flight tracks not normally followed by other types of aircraft. For example, fire attack aircraft sometimes will make a low pass over the runway prior to landing (primarily at a nontowered airport) or will circle back over the airport to gain altitude on departure. Another common procedure is for these aircraft to take off and land in opposite directions on the same runway. This is particularly common when the fire attack reload base is at one end of the runway or if dictated by terrain or land use considerations.

Agricultural Aircraft

In agricultural locations, agricultural *crop duster* aircraft often are the principal contributors to an airport's overall noise impact. Agricultural aircraft noise differs from that of other aircraft and is difficult to accurately portray in airport noise contours. A key factor is that these aircraft seldom climb to normal traffic pattern altitudes and they often make turns at low altitudes close to the runway.

Other Factors Affecting Airport Noise Levels

Although aircraft characteristics and flight routes are the principal determinants of airport noise impacts, other factors have noteworthy contributing roles.

Ground Operations

Although airborne aircraft operations are the primary source of aircraft noise in the vicinity of an airport, ground operations can also produce significant impacts under certain circumstances. Particular locations of ground operation noise include:

- **On the Runway**—Significant noise levels are generated behind an aircraft, especially a jet aircraft, as full engine thrust is produced during acceleration to takeoff. (More specifically, the highest noise levels are experienced at a 15 to 45 angle from the aircraft path; directly behind the aircraft is a zone of relative quiet.) On landing roll-out, power settings on most aircraft are low and the noise is comparatively minimal. The one significant exception is when jet aircraft use reverse thrust to decelerate after landing. This action can produce high noise levels in front and to the sides of the aircraft. (Note: reverse thrust noise is included in standard Integrated Noise Model computations.)
- **Taxiing**—Aircraft mostly use low power settings when taxiing between parking locations and a runway. For most aircraft, the resulting noise levels are minimal and not a factor off the airport property. There are exceptions, however. For example, aircraft require added power to begin moving when stopped. Also, large aircraft need to apply moderate power to engines on one side in order to turn while taxiing at low speeds. With propeller airplanes, moderately high engine power is briefly necessary to start the engine. Noise levels increase correspondingly for these few moments.
- **At Runway Holding Bays**—Pre-flight engine run-ups by piston aircraft are usually conducted at holding bays or other locations near the ends of run-

Airport land use commissions seldom adopt land use compatibility criteria which specifically consider noise from aircraft ground operations not on the runway. Nevertheless, these noise sources can be significant in locations immediately adjacent to an airport. INM now allows analysis of aircraft run-up noise.

ways. Many people perceive the noise from pre-flight run-ups of propeller-aircraft engines to be more annoying than the noise from overflights, even if the sounds have equal loudness. Part of the reason for this greater annoyance is that run-up noise is thought to be (although it is not) less necessary and more under the control of the aircraft operator. For land uses near the end of a runway, run-up noise can be louder and more prolonged than overflight noise. This is especially true when a runway is used predominantly in one direction. The runway end which is used for landings—when aircraft are typically the quietest—is also the end at which pre-flight engine run-ups are normally conducted.

➤ **At Airline Terminals**—Activity around airline terminals can be a noticeable source of noise. Auxiliary power units on board jet aircraft (used for cabin temperature control, to operate electrical equipment, etc.) are one such source. These noise sources can be bothersome at airports where terminal areas are situated close to noise-sensitive land uses.

➤ **Aircraft Maintenance Facilities**—Maintenance testing of aircraft engines requires the use of high power settings and resulting noise levels. This activity may occur in or near airline or fixed base operations maintenance hangars or sometimes at other locations on an airport. At airports where frequent engine testing creates significant noise impacts on nearby land uses, construction of noise barriers or testing enclosures (sometimes called "hush houses") has become necessary.

Other Variables

It should be noted that the cumulative noise level contours which ALUCs use for land use compatibility planning purposes normally do not take into account variables such as these. Unless special steps are taken to calibrate the noise contours for a particular airport with actual noise measurements taken at that airport, the contours will reflect conditions considered average for all airports.

The noise levels experienced on the ground as an aircraft flies over are primarily dependent upon the inherent loudness of the aircraft, the aircraft's altitude, and the horizontal distance between the measuring site and the aircraft flight track. Other variables are also important, however.

➤ **Pilot Technique**—An important variable in aircraft noise is the pilot. Depending upon the techniques that the pilot employs, the same aircraft can generate significantly different noise levels. Conditions which produce some of the greatest noise variations include:

- The angle of climb while on takeoff (also affected by aircraft payload, air temperature, and wind);
- Power adjustments during takeoff;
- The propeller pitch setting on airplanes with variable pitch propellers, especially at high takeoff power settings;
- Flap settings (especially during landings by large aircraft); and
- The airspeed and descent rate relationships that determine the extent of helicopter blade slap during landing operations.

Pilot awareness of the aircraft configurations that create abnormally high noise levels can be a significant factor in helping to reduce actual airport noise impacts.

➤ **Air Temperature**—Aircraft engines, both piston and turbine, operate less efficiently when temperatures are high. The lower power results in reduced climb rates. For propeller airplanes, somewhat higher noise levels may result. However, for jets, the lower power also results in lower noise emissions, thus essentially cancelling out the effect of reduced climb rates.

➤ **Sound Wave Reflection**—The presence of nearby structures or steep terrain can cause sound wave reflections which may locally increase noise levels. Water or hard ground surfaces can particularly contribute to such occurrences. Certain meteorological conditions—such as a temperature inversion layer—also can reflect sound back to the ground, resulting in higher noise levels.

➤ **Height of Terrain**—Rising or falling terrain changes the distance between an aircraft and people on the ground relative to the flat ground assumed in standard INM calculations. These changes in turn increase or reduce the actual sound levels experienced on the ground compared to the levels calculated by the noise model.

The FAA's Integrated Noise Model version 6.0 allows assessment of the effects of elevation variations.

AIRPORT NOISE METRICS

Measurement of sound is a relatively straightforward and objective process. Environmental noise, however, is comprised of a multitude of varying sounds having different magnitudes, frequencies, and durations, and stemming from different sources. Moreover, to be useful, measures of environmental noise must take into account the ways in which noise affects people.

Metric: A standard or scale of measurement.

In many communities, particularly urban communities, aircraft and other modes of transportation constitute the most predominant sources of noise. Over the years, a variety of noise metrics have been devised in order to assess these forms of noise. Some of these metrics are general-purpose and can be applied to almost any noise source. Others are intended more specifically for measuring aircraft noise and particularly noise associated with aircraft operations to and from airports. These noise metrics can be grouped according to whether they measure the sound level of a single event or are cumulative measures of many events. Essentially all noise description metrics employ a logarithmic scale and the measurement units are expressed in decibels (dB). An A-weighted decibel scale (see Table 6A) is generally used.

Each of these metrics has notable advantages and disadvantages which differ depending upon the purpose of the noise measurement. These tradeoffs are discussed in Chapter 7. The emphasis in the discussion here is on describing the various metrics available to airports and land use planners.

Single-Event Metrics

The sound level associated with an individual aircraft flying nearby (see Figure 6F) can be characterized as:

- Beginning at some point when the sound can be distinguished above a threshold or ambient sound level;
- Reaching a maximum level; then
- Diminishing until it is no longer distinct.

Ambient Noise Level: The background noise level absent any readily distinguishable sounds.

Instantaneous Sound Levels

Sound levels can be measured on a continuous basis for each instant during this cycle. A significant point is the maximum sound level attained (L_{max}). L_{max} is an important determinant of whether speech interference may occur.

Single Event Energy

The *SENEL* metric used in California is virtually identical to the *Sound Exposure Level* (SEL) metric used by the Federal Aviation Administration and other federal agencies.

The limitation of an instantaneous sound level measurement is that it provides no information regarding the duration of a sound. Two different aircraft overflights thus can produce vastly different total amounts of sound energy at a given point on the ground depending upon how quickly the aircraft pass by. To compare the total sound produced by individual aircraft flyovers, a reference time of one second is used. In other words, this measurement method indicates the level of a continuous one-second sound which contains the same amount of energy as the complete noise event. The resulting noise metric is called *Single Event Noise Exposure Level* (SENEL).

Figure 6F illustrates the relationship between L_{max} and SENEL for a typical aircraft noise event. Because aircraft noise events last more than one second, SENEL values are higher than the L_{max} recorded for any individual event. The relationship between SENEL and L_{max} is not constant, however. For most aircraft noise events, SENEL is about 5 to 10 dB higher than L_{max}; the shorter the noise event is, the closer the two numbers will be.

Cumulative Noise Metrics

Various other cumulative noise metrics exist in addition to the ones mentioned here. Some are used for measuring other aspects of noise (the amount of time noise exceeds a certain level, for example) or noise from sources other than airports. Others were created as communications tools rather than for policy making purposes. Still others are found primarily in other countries. None of these metrics are considered applicable to airport land use compatibility planning in California.

In order to provide a single measure of continuous or multiple noise events over an extended period of time, a variety of cumulative noise level metrics have been devised. Most of these metrics result in a weighted average measurement of noise over time.

Equivalent Sound Level

A standard measure of sound level averaged over a specified period of time is the *Equivalent Sound Level* (abbreviated L_{eq}). This metric indicates the constant sound level in decibels which would produce the same amount of sound energy as a series of events having fluctuating sound levels. The more closely spaced the noise events over the entire measurement period, the closer L_{eq} will come to L_{max}. This is the case for noise from a busy highway, for example. For infrequent noise events, such as at a low-activity general aviation airport, L_{eq} may not be much higher than the ambient noise level.

Time-Weighted Cumulative Noise Metrics

The remainder of this *Handbook* primarily refers to cumulative noise metrics in term of CNEL rather than DNL in that the former is the metric used in most California state noise regulations including those for airports.

Undoubtedly the most widely used metrics for assessment of airport noise levels are time-weighted cumulative noise metrics. These types of metrics include the *Community Noise Equivalent Level* (CNEL) used in California and the *Day-Night Average Sound Level* (abbreviated as DNL, but symbolized in formulas as L_{dn}) adopted by the Environmental Protection Agency and the Federal Aviation Administration and used elsewhere in the United States.

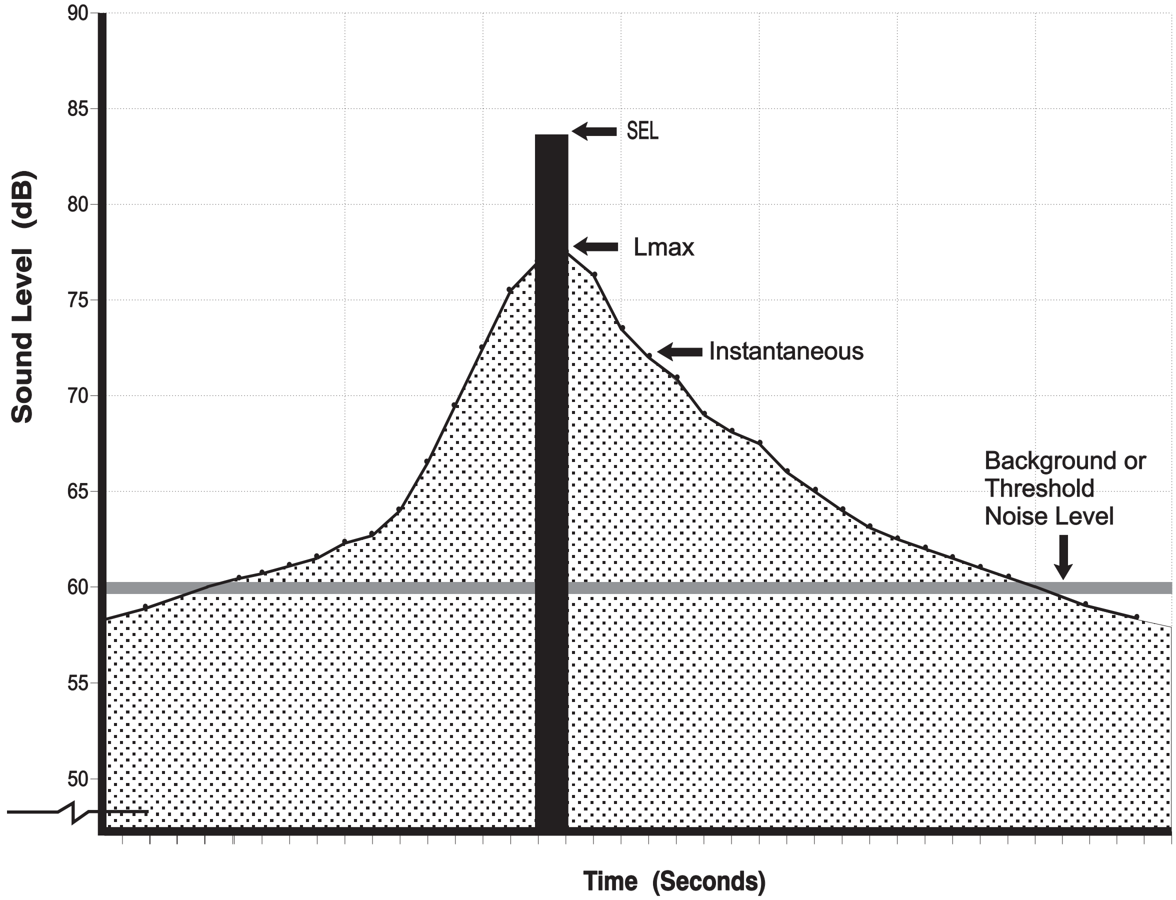


FIGURE 6F

Typical Aircraft Noise Event

Both metrics are similar to the Equivalent Sound Level (Leq) except that they compensate for the widely assumed increase in people's sensitivity to noise during nighttime hours. Each aircraft operation occurring between 10:00 p.m. and 7:00 a.m. is treated as if it were 10 operations. Similarly, CNEL (but not DNL) includes a penalty weighting for operations taking place between 7:00 and 10:00 p.m. in the evening. Each aircraft operation during these hours is counted as if it were three operations. Logarithmically, these multipliers are the equivalent of adding 10 dB to the noise level of each nighttime operation and 4.77 dB to the noise level of each evening operation. These noise level penalties are intended to correspond to the drop in background noise level which studies have found takes place from daytime to evening and nighttime in a typical community. The evening and nighttime decrease in ambient sound levels—from both outdoor and indoor sources—is commonly considered to be the principal explanation for people's heightened sensitivity to noises during these periods.

CNEL values are normally depicted by a series of contours representing points of equal noise exposure in 5 dB increments (see example in Figure 6G). Specialized computer programs—as described in the next section—are normally used for calculation of noise contours.

CALCULATION OF AIRPORT NOISE CONTOURS

When developing or updating compatibility plans, ALUCs (or their staff or consultants) sometimes need to prepare airport noise contours. Even when creation of noise contours is not necessary as part of a compatibility planning process, it is important that ALUCs and their staffs understand the factors involved.

Just as the metrics created for describing airport noise have evolved over the years, so have the means available for calculating current and future noise levels around airports. Today, highly sophisticated computer models are commonly used to carry out the noise calculations. Still, as precise as these models can be, they depend upon the accuracy of the data entered into them. These topics are discussed in the text which follows.

Aircraft Noise Models

Integrated Noise Model

Anyone can obtain the INM software through the FAA. However, most airports and ALUCs retain consultants to prepare noise analyses. Major airports commonly have their own staff trained in use of the program.

In the U.S., by far the most commonly used aircraft noise model is the Federal Aviation Administration's Integrated Noise Model (INM) computer program. INM was developed by the FAA as a means of standardizing the assessment of aircraft noise levels in the vicinity of airports. The original INM program dates back to 1978. As of late 2001, the most recent version is 6.0 which was introduced in 1999. Each iteration of the program has added to its sophistication, allowing noise contours to be computed more efficiently and more accurately. However, one effect of the upgrading of the noise calculation algorithms at the core of the program has been that identical input data may result in slightly different output contours than produced by earlier versions.

The INM is capable of providing output in a variety of formats and metrics. Noise contours can be produced using CNEL, DNL, or any of several other cumulative noise metrics. Single-event contours can also be run. Finally, detailed data for a point or grid of points can be produced.

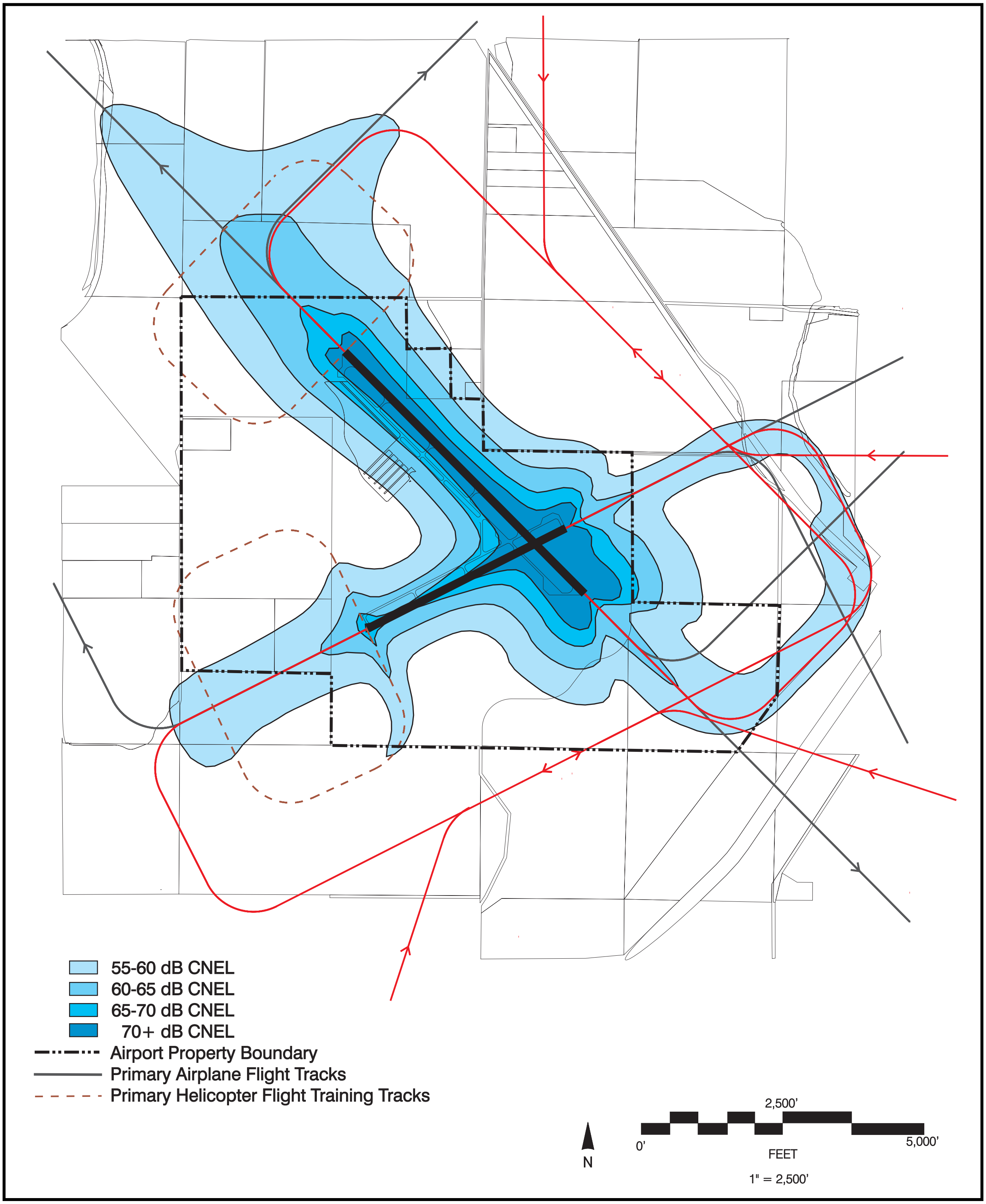


FIGURE 6G

Example of Airport Noise Contours

Other Noise Models

While INM has widespread general utility, two other noise models have been created for use in more specialized circumstances. (Also, other countries have developed their own variations of noise models.)

➤ **Helicopter Noise Model**—For calculation of noise contours at heliports, the FAA has developed a separate program—the *Helicopter Noise Model* (HNM). This model, last updated in 1994, includes data for 16 types of helicopters. However, its lack of static mode flight data for most of the helicopters in the database limits HNM's usefulness in modeling hover noise levels which are critical to evaluation of noise exposures close to heliports and helipads. Also, HNM does not allow user modifications to the database.

Because NOISEMAP includes data for military helicopters similar to ones in civilian use, the program serves as an alternative method for modeling heliport noise impacts.

➤ **NOISEMAP**—The current U.S. Air Force NOISEMAP model has capabilities similar to the latest version of INM, but is designed for use at military aviation facilities or civil airports with a substantial amount of military aircraft operations. The aircraft noise database in NOISEMAP consists solely of military aircraft, but civil aircraft can be added using the INM database. The noise computation algorithms are slightly different between the two models, but the output noise contours are very similar.

Sources of Aircraft Noise Model Input Data

In order to calculate noise contours or other noise impact information, INM and the other noise models require several types of data. Some of the data is built into the model database, although (except for HNM) it can be modified by the user. Other data must be entered for each individual noise study. Still other types of data can be entered to refine the analyses, but are not required.

Built-In Data

The database built into INM consists primarily of aircraft-related data. Information is included on over 100 different types of airplanes. The emphasis, though, is on airline and military aircraft. General aviation is comparatively less represented, especially with regard to relatively new aircraft models. For each of the aircraft in the database, standardized data is provided for:

- Performance characteristics (takeoff distance, climb rates, etc.);
- Power settings used at various stages of landing or takeoff; and
- For each power setting, the amount of noise measured at various distances from the aircraft.

Table 6C provides additional background information about aircraft noise and operations monitoring systems.

The database reflects average operating conditions for each aircraft type. In most cases this data is used directly when calculating noise contours. INM also has the capability of accepting user input data to better fit known variations for a particular aircraft or airport. For example, adjustments or "calibration" of the standard aircraft parameters can be done based upon data obtained from noise monitoring systems. Production of noise contours does not require use of noise monitors, however.

History

Airport noise and operations monitoring systems have been installed at California airports since the 1970s. The earliest systems measured aircraft noise levels at fixed positions, separating aircraft noise events from other noise sources primarily by their isolation from such sources, and the use of threshold values for noise levels and event duration. Other noise event parameters were evaluated during data analysis to improve discrimination of aircraft noise events. Later systems relied on airport staff input of FAA flight strips (which the FAA did not make available until at least 14 days after the flights). Using a computer, sequential noise events were then matched to the reported FAA takeoff release times. In this manner, aircraft noise events were reasonably well separated from other noise sources and it was possible to determine the noise levels produced by individual aircraft.

Over time, noise and operations monitoring systems have taken advantage of better computers and of access to aircraft flight data directly from FAA data disks and computer downloads, use of passive radar systems to gather data without the need for FAA cooperation (except the flight strips), and most recently, direct connection to the FAA TRACON radar system using an FAA-approved "gateway."

Present-Day Systems

Today, several major California airports have fully integrated noise and operations data collection and analysis systems which allow rapid matching of aircraft noise events, specific flights, and their flight paths. Other, typically less busy, airports have systems which monitor noise levels, without access to FAA radar data. In such systems, recordings of radio transmissions by the FAA Tower and the aircraft are used to correlate noise events to specific flights.

Permanent aircraft noise and operations monitoring systems provide a highly credible database of noise level and operational data including:

- Long-term measurements of cumulative noise levels
- Statistically valid distributions of measured single-event noise levels by aircraft type and operator
- Precise definition of flight tracks and areas of aircraft overflights
- Census of aircraft types and operations
- Flight profiles
- Adherence to established flight procedures
- Variations in noise levels and operational procedures over time
- Changes in noise levels due to changes in operations
- Identification of aircraft flights and noise levels associated with complaints and political concerns
- Accurate input data for the INM
- Validation of INM-predicted CNEL contours

Although each system has distinct capabilities, noise and operations monitoring systems will typically be capable of producing a wide range of standard or customized statistical analyses and maps. Most systems either utilize or can be integrated with geographic information system (GIS) databases. All of these systems enable precise judging of changes in noise levels and compliance with the established noise emissions criteria. Additionally, by accurately defining aircraft noise exposures, they facilitate justification and implementation of noise mitigation programs such as sound insulation or property acquisition.

Although permanent noise and operations monitoring systems are unsurpassed as an objective method of providing current airport noise data, a major limitation is their cost. Systems such as these can range from about $500,000 to as much as $2.0 million.

The high costs limit the practicality of permanent systems for smaller airports. At these facilities, noise measurements can be made using portable monitoring units set to discriminate between aircraft and nonaircraft noise levels in the same manner as the earliest systems. Noise sampling techniques may be used to provide reasonable estimates of cumulative noise exposures over longer periods and single-event data can be collected for comparison to noise levels predicted using the INM. In addition, short-term radar data, or observations of aircraft flight paths in the field or at the radar scope, can be used to develop reasonable assumptions for standard aircraft flight tracks.

While not as sophisticated as the permanent systems, even the portable units can serve an important function of all monitoring systems. They serve as an essential source of information with which to respond to public queries and concerns over airport noise.

TABLE 6C

Noise and Operations Monitoring Systems

User-Provided Data

The user-provided data critical to operation of INM consists of defining where aircraft fly and how often. An extensive amount of data is usually available for major airline airports and other airports situated in the surrounding metropolitan area. For airports in outlying or rural areas, solid data may be scarce and use of estimates may become necessary.

Inputs to CNEL noise contour calculation include:
- Runway system configuration and runway lengths.
- The geometry of common aircraft flight tracks.
- The standard approach slope used for each runway.
- The number of operations by aircraft type or group.
- Runway utilization distribution by aircraft type and time of day.
- The distribution of operations by time of day for each type of aircraft.
- The distribution of operations for each flight track.

Specific types of data needed by INM are listed in the adjacent sidebar. Potential sources for this data include the following:

- **Radar Flight Track Data**—For airports covered by FAA terminal radar control (TRACON) facilities, recorded flight track data is an ideal source of information on where aircraft fly. Not only the path of the aircraft along the ground, but also the altitude and the type of aircraft can be identified. Noise models, however, are not capable of working with an indefinite number of flight tracks. In practice, past versions of INM required simplification of the radar data into a relatively limited number of tracks. Recent versions of the software allow for some refinement of this process—a set of dispersed subtracks offset horizontally (but not in altitude) from the primary tracks can now be modeled.
- **Control Tower Counts of Aircraft Operations**—At airports having functioning traffic control towers, tower personnel maintain complete data on the number of aircraft operations. This data categorizes the operations as to whether they were conducted by air carrier, air taxi, general aviation, or military aircraft (a note of caution here: air carrier and air taxi counts may include operations other than by scheduled airlines). Also counted are itinerant (headed to or from other airports) versus local (consisting mostly of flight training "touch-and-go") operations. Tower count data can usually be obtained from airport management or directly from the FAA and is also available via the Internet.
- **Automated Aircraft Operations Counter Data**—Because only the busiest airports have control towers, the Division of Aeronautics has established a program for obtaining activity data for other facilities using automated aircraft operations counters. Present counters work acoustically by counting the number of noise events (usually on an hourly basis) which exceed a set threshold sound level. By placing the microphone at a point close to where aircraft take off, the threshold level can be set such that aircraft takeoffs are the only noise sources to trigger the counter. A limitation of counter data is that it typically is gathered on a sampling rather than complete count basis. Annual data must be inferred from the samples. To increase the accuracy, counts are normally done during several times of the year.
- **Airport Management Records**—Neither control tower nor automated counter data fully identify the types of aircraft operations. Additional data needs to be obtained from other sources. Information on numbers of scheduled airline flights, air cargo aircraft operations, fire attack aircraft missions, and other distinct forms of aircraft activity are often maintained

by airport management, particularly if landing fees are collected from these users. Airport management also may have information on the types of aircraft based at the airport which can be used to help estimate the mix of aircraft operations.

- **Wind Data**—Wind direction data gathered at the airport in question or at a nearby location can be useful in estimating the percentage of usage of each of the airport's runways.
- **Interviews with Airport Personnel**—Individuals who regularly operate or observe aircraft at the airport comprise a final source of valuable, although qualitative, information on aircraft types, runway usage, flight tracks, time of day distribution, and other inputs to noise modeling. Interviews with control tower staff, flight instructors, and others can help fill the gaps in quantitative data.
- **Projected Activity**—The data sources listed above are all potentially useful in preparation of noise contours representing current airport activity. To develop contours depicting projected future noise impacts, forecasts of future activity are necessary. Additionally, assumptions must be made regarding future changes in the aircraft fleet mix, runway utilization, and other noise model input data.

Chapter 7 contains a discussion of forecasts and other factors to consider in development of projected noise impact contours.

Optional Data

To refine the precision of noise contours, the latest versions of INM allow entry of terrain data. Whereas earlier versions assumed that the airport and surrounding areas were all on level ground, this capability enables the effects of increased or decreased distances between the aircraft and the ground to be calculated. (The effects of shielding or reverberation produced by the terrain are not taken into account, however.)

Another form of data which can be entered into the program on an optional basis is census data. Although this information has no effect on the contours, its entry can facilitate evaluation of the numbers of people impacted by various noise levels or aircraft operational scenarios.

Limitations of Airport Noise Contour Modeling

Despite the increasing sophistication and accuracy of airport noise models, several limitations are important to note.

- **Aircraft Database Limitations**—Even though additional aircraft have been added to the database with each version of the program, INM (as well as the other noise models) tend to be slow in including the newest models of aircraft. This is particularly the case with regard to late model general aviation jet aircraft. Often it is necessary to substitute similar aircraft. The INM database also lacks information on helicopters and specialized aircraft such as agricultural aircraft. Lastly, all of the databases include only existing aircraft. When modeling projections of noise impacts more than five or so years in the future, the quietest existing aircraft are typically assumed to be representative of average future aircraft.

- **Flight Tracks**—Close to the ends of runways, nearly all aircraft flight tracks are aligned with the runway, especially on arrivals or on departures from a short runway. The greater the distance from the runway ends, the more the tracks disperse. The accuracy of noise contours in these areas depends greatly upon the number and location of flight tracks entered into the noise model. If too few flight tracks are defined, the noise contours will tend to take on a spiky rather than usually more realistic bulbous shape. This is particularly the case with general aviation aircraft in that their flight tracks ordinarily vary quite widely. Even airline aircraft following instrument procedures have a noticeable divergence in their flight tracks, although certain flight corridors are normally evident. On the other hand, attempts to model a large number of flight tracks can be difficult and, if little is know as to their precise location or frequency of use, not necessarily more accurate. The recent enhancement of INM allowing modeling of dispersed subtracks adjacent to the primary tracks can help improve the realism of noise contours.
- **Helicopter Noise**—Because of their separate flight tracks, different operating characteristics, and typically low activity volumes, helicopter operations are often not included in noise contour calculations. However, a simulation of helicopter noise can be included in Integrated Noise Model calculations. Also, the noise impacts of some types of helicopters can be modeled with the separate FAA Helicopter Noise Model (HNM) or the U.S. Air Force NOISEMAP model and the impacts then manually added to airplane impacts calculated with INM.
- **Ground Operations**—As noted previously, various types of aircraft ground operations can be significant noise sources at some airports. Although recent versions of INM allow some of this activity to be modeled (specifically, run-up operations), this is seldom done unless a problem with noise from this source is known to exist.
- **Local Environmental Conditions**—The noise calculation algorithms built into the model assume an average set of physical and atmospheric conditions in the area surrounding an airport. Thus, localized factors such as reflection or diffraction of sound off of or around terrain or buildings are not considered. Similarly, local atmospheric conditions—such as temperature, humidity, wind, and cloud cover—may result in day-to-day variations from the predicted annual average noise levels.
- **Precision**—Because of the many variables and assumptions associated with their computation, cumulative noise contours representing existing airport activity are often considered to have a precision of approximately ±3 dB. Greater precision (within ±1 dB) can be obtained at airports where flight track data is available from radar and/or a permanent noise monitoring system is installed. In any case, precision is greatest close to the runway and decreases beyond where flight tracks diverge.

- **Projections of Future Noise Impacts**—As imprecise as modeling of current noise contours can sometimes be, contours representing projections of future noise impacts are inherently even less precise. Uncertainty regarding future aircraft technologies and the timing of when current aircraft models will be phased out of use is one source of imprecision. Perhaps even more unknown is the future number of operations of various aircraft types likely to occur at any particular airport.

CHAPTER **7**

Establishing Airport Noise Compatibility Policies

Overview

This chapter examines the manner in which airport noise data—measured by means of the metrics and techniques discussed in Chapter 6—can be applied to establishment of land use compatibility policies. The guidance offered here places heavy reliance upon cumulative noise exposure metrics—specifically, the Cumulative Noise Exposure Level (CNEL)—as the principal gauge against which to assess the noise compatibility of land uses near airports. With regard to setting the specific criteria for compatibility, established federal and state regulations and guidelines provide the policy foundations. Also explicitly recognized, though, is the need to take into account the characteristics of individual airports and the communities which surround them when setting local noise compatibility policies. In particular, strong support is given to the concept of *normalization* as guidance for the policy-setting process.

Specific topics addressed in this chapter include:

- Federal and state noise policies;
- The effects of noise on people;
- Preparation of noise contours for compatibility planning purposes;
- Determining acceptable cumulative noise exposure levels;
- The relevance of single-event noise levels; and
- Other measures of noise compatibility

Noise Policy Foundations

Statutes enacted by the U.S. Congress and the California State Legislature typically set general requirements and the authority for administrative adoption of more detailed regulations and policies. With respect to airports, most of the administrative actions are taken by the Federal Aviation Administration and the California Department of Transportation, Division of Aeronautics. These statutes and regulations establish the basis for local development of airport plans, analyses of airport impacts, and enactment of compatibility policies. Brief descriptions of selected statutes, regulations, and policies having particular significance to noise issues are provided in the paragraphs which follow.

Federal Statutes and Regulations

Statutes

- **Aviation Safety and Noise Abatement Act of 1979 (ASNA)**—Among the stated purposes of this act is "to provide assistance to airport operators to prepare and carry out noise compatibility programs." The law establishes funding for noise compatibility planning and sets the requirements by which airport operators can apply for funding. The law does not require any airport to develop a noise compatibility program—the decision to do so is the choice of each individual airport proprietor. Regulations implementing the act are set forth in Federal Aviation Regulations Part 150.
- **Airport and Airway Improvement Act of 1982 (AAIA)**—This act established the Airport Improvement Program (AIP) through which federal funds are made available for airport improvements and noise compatibility planning. The act has been amended several times, but remains in effect as of late 2001.
- **Airport Noise and Capacity Act of 1990 (ANCA)**—In adopting this legislation, Congress' stated intention was to try to balance local needs for airport noise abatement with national needs for an effective air transportation system. To accomplish this objective, the act did two things: (1) it directed the FAA to establish a national program to review noise and access restrictions on aircraft operations imposed by airport proprietors; and (2) it established requirements for the phase-out of older model, comparatively louder, "Stage 2" aircraft from the nation's airline fleet by January 2000. These two requirements are implemented by Federal Aviation Regulations Part 161 and 91, respectively.

Federal Aviation Administration Regulations and Policies

In July 2000, the Federal Aviation Administration published a draft update of the 1976 policy. The proposed policy "reaffirms and incorporates the major tenets" of the 1976 policy. The policy continues to define areas of "significant noise exposure" as locations where noise levels are DNL 65 dB or higher. However, the policy goes on to indicate that the FAA will support local efforts to establish noise buffers outside this boundary of significance. As of late 2001, the draft policy remains under review.

- **U.S. Department of Transportation Aviation Noise Abatement Policy**—Adopted in 1976, this policy sets forth the noise abatement authority and responsibilities of the federal government, airport proprietors, state and local governments, the air carriers, air travelers and shippers, and airport area residents and prospective residents. The basic thrust of the policy is that the FAA's role is primarily one of regulating noise at its source (the aircraft) plus supporting local efforts to develop airport noise abatement plans. The FAA will give high priority in the allocation of Airport Improvement Program funds to projects designed to ensure compatible use of land near airports. However, it is the role of state and local governments and airport proprietors to undertake the land use and operational actions necessary to promote compatibility.
- **Federal Aviation Regulations Part 36, Noise Standards: Aircraft Type and Airworthiness Certification**—This part of the Federal Aviation Regulations sets the noise limits which all newly produced aircraft must meet as part of their airworthiness certification. The methods by which aircraft noise levels are to be measured are specified as well. The regulations catego-

rize aircraft (except small, propeller-driven airplanes) into three groups—referred to as Stage 1, 2, and 3—according to the noise levels they produce. Comparable aircraft (those having similar gross weights and numbers of engines) meeting the Stage 3 standards are quieter than equivalent Stage 2 aircraft. However, a heavy Stage 3 aircraft may be noisier than a light Stage 2 aircraft. Also, Stage 3 technology provides only limited improvements over Stage 2 with respect to low-frequency noise.

The Part 36 regulations make no determination that new aircraft are acceptably quiet for operation at any given airport. Rather, the regulations are intended to establish national maximum aircraft noise-emission levels.

- **Federal Aviation Regulations Part 91, General Operating and Flight Rules**—This part of the Federal Aviation Regulations sets many of the rules by which aircraft flights within the United States are to be conducted. Rules governing noise limits are set forth in Subpart I. Within this subpart is a provision which mandated that all Stage 2 civil subsonic aircraft having a maximum gross weight of more than 75,000 pounds be phased out of operation within the United States by January 1, 2000. This provision implements the requirement set forth in the Airport Noise and Capacity Act of 1990.

- **Federal Aviation Regulations Part 150, Airport Noise Compatibility Planning**—As a means of implementing the Aviation Safety and Noise Abatement Act of 1979, the Federal Aviation Administration adopted these regulations establishing a voluntary program which airports can utilize to conduct airport noise compatibility planning. "This part prescribes the procedures, standards, and methodology governing the development, submission, and review of airport noise exposure maps and airport noise compatibility programs, including the process for evaluating and approving or disapproving these programs." Part 150 also prescribes a system for measuring airport noise impacts and presents guidelines for identifying incompatible land uses. Airports which choose to undertake a Part 150 study are eligible for federal funding both for the study itself and for implementation of approved components of the local program.

  The noise exposure maps are to be depicted in terms of average annual Day-Night Average Sound Level (DNL) contours around the airport. For the purposes of federal regulations, all land uses are considered compatible with noise levels of less than DNL 65 dB. At higher noise exposures, selected land uses are also deemed acceptable, depending upon the nature of the use and the degree of structural noise attenuation provided.

  The FAA allows use of Community Noise Equivalent Level (CNEL) contours for airports in California.

  In setting the various compatibility guidelines, however, the regulations state that the designations:

  > "…do not constitute a Federal determination that any use of land covered by the [noise compatibility] program is acceptable or unacceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local

authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses."

As of this writing, several FAR Part 161 studies are under way, but only a few have been completed, and none are yet approved by the FAA.

- **Federal Aviation Regulations Part 161, Notice and Approval of Airport Noise and Access Restrictions**—This part of the federal regulations implements the Airport Noise and Capacity Act of 1990. It codifies the analysis and notification requirements for airport proprietors proposing aircraft noise and access restrictions on Stage 2 or Stage 3 aircraft weighing 75,000 pounds or more. Among other things, an extensive cost-benefit analysis of proposed restrictions is required. The analysis requirements are closely tied to the process set forth in FAR Part 150 and are more stringent with respect to the quieter, Stage 3 aircraft than for Stage 2.

Regulations and Guidelines of Other Federal Agencies

- **U.S. Environmental Protection Agency (EPA)**—A report published in 1974 by the EPA Office of Noise Abatement and Control continues to be a source of useful background information. Entitled *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, this report is better known as the "Levels Document." The document does not constitute EPA regulations or standards. Rather, it is intended to "provide state and local governments as well as the federal government and the private sector with an informational point of departure for the purposes of decision-making." Using Yearly Day-Night Average Sound Level (DNL) as a measure of noise acceptability, the document states that "undue interference with activity and annoyance" will not occur if *outdoor* noise levels in residential areas are below DNL 55 dB and *indoor* levels are below DNL 45 dB. These thresholds include an "adequate margin of safety" as the document title indicates.

- **Federal Interagency Committee on Urban Noise (FICUN)**—The product of this committee was a 1980 report entitled *Guidelines for Considering Noise in Land Use Planning and Control*. These guidelines were not intended to substitute for those of individual federal agencies, but rather serve to establish a common basis upon which agency standards can be developed. The report features a table indicating the compatibility or incompatibility of various land uses listed according to their standard land use code (SLUC). All land uses are considered compatible with noise levels less than DNL 65 dB. Beginning at that level, residential and certain other land uses are judged compatible only if adequate noise level reduction is provided by the structure.

- **Department of Housing and Urban Development (HUD)**—HUD guidelines for the acceptability of residential land use are set forth in the Code of Federal Regulations Title 24, Part 51, "Environmental Criteria and Standards." These guidelines parallel those suggested in the FICUN report: noise exposure of DNL 65 dB or less is acceptable; between 65 and 75 dB is normally acceptable if appropriate sound attenuation is provided; and above DNL 75 dB is unacceptable. The goal for interior noise levels is DNL 45 dB. These guidelines apply only to new construction supported by HUD grants and are not binding upon local communities.

➤ **Department of Defense Air Installations Compatible Use Zones (AICUZ) Program**—The AICUZ program was established by the Department of Defense in 1973 as an effort to protect the federal government's investment in military airfields. The current noise compatibility criteria (as set forth in the Code of Federal Regulations Title 32, Part 256) are basically the same as those indicated in the FICUN report and the FAA's Part 150 program. AICUZ plans prepared for individual airfields are primarily intended as recommendations to local communities regarding the importance of maintaining land uses which are compatible with the noise and safety impacts of military aircraft operations.

➤ **Federal Interagency Committee on Noise (FICON)**—Established in 1991, this committee's task was to review technical and policy issues related to airport noise impacts. A final report, issued the following year, addressed such topics as:

- "The manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts;
- "The manner in which noise impacts are described;
- "The extent of impacts outside of Day-Night Average A-Weighted Sound Level (DNL) 65 decibels (dB) that should be reviewed in a National Environmental Policy Act (NEPA) document;
- "The range of Federal Aviation Administration (FAA)-controlled mitigation options (noise abatement and flight track procedures) analyzed; and
- "The relationship of the FAA Federal Aviation Regulations (FAR) Part 150 process to the NEPA process; including ramifications of the NEPA process if they are separate, and exploration of the means by which the two processes can be handled to maximize benefits."

One of the FICON conclusions was that there are no new noise descriptors or metrics of sufficient scientific standing to substitute for the DNL cumulative noise exposure metric. However, FICON acknowledged that there may be instances in which supplemental noise analyses using other metrics may be appropriate.

➤ **Federal Interagency Committee on Aviation Noise (FICAN)**—FICAN was formed in 1993 as a result of a FICON recommendation that a standing interagency committee be created for the purpose of facilitating research into aviation noise issues. Toward this end, the committee functions as a clearinghouse for federal noise research and development efforts. It also has produced several position papers and conducted various public workshops on specific aviation noise topics. FICAN itself does not conduct or fund noise research; neither does it establish policies of its own.

See the FICAN Internet web site (www.fican.org) for more information about the committee's activities.

FICAN member agencies include:

- U.S. Air Force
- U.S. Army
- U.S. Navy
- Federal Aviation Administration
- National Aeronautics and Space Administration
- National Parks Service
- U.S. Environmental Protection Agency
- Department of Housing and Urban Development
- Centers for Disease Control and Prevention.

State of California Laws, Regulations, and Guidelines

➤ **State Aeronautics Act**—Chapter 4, Article 3, Section 21669 of the State Aeronautics Act (Division 9, Part 1 of the California Public Utilities Code) requires the State Department of Transportation to adopt—to an extent not prohibited by federal law—noise standards applicable to all airports operating under a state permit.

➤ **California Airport Noise Regulations**—The airport noise standards promulgated in accordance with the State Aeronautics Act are set forth in Section 5000 et seq. of the California Code of Regulations (Title 21, Division 2.5, Chapter 6). The current version of the regulations became effective in March 1990.

An important factor to recognize about the Airport Noise Regulations is that their compatibility criterion is mandated for only a few (less than a dozen) airports which are declared to have a "noise problem." The regulations do not establish a mandatory criterion for evaluating the compatibility of proposed land use development around other airports. Section 5004 of the regulations specifically notes that: "It is not the intent of these regulations to preempt the field of aircraft noise limitation in the state. The noise limits specified herein are not intended to prevent any local government, to the extent not prohibited by federal law, or any airport proprietor from setting more stringent standards." As discussed later in this chapter, setting the threshold for land use compatibility lower than CNEL 65 dB is appropriate at many airports.

In Section 5006, the regulations state that:

> "The level of noise acceptable to a reasonable person residing in the vicinity of an airport is established as a community noise equivalent level (CNEL) value of 65 dB for purposes of these regulations. This criterion level has been chosen for reasonable persons residing in urban residential areas where houses are of typical California construction and may have windows partially open. It has been selected with reference to speech, sleep and community reaction."

In accordance with procedures listed in Section 5020, the county board of supervisors can declare an airport to have a "noise problem." As specified in Section 5012, no such airport shall operate "with a noise impact area based on the standard of 65 dB CNEL unless the operator has applied for or received a variance as prescribed in…" the regulations.

For designated noise problem airports, the "noise impact area" is the area within the airport's 65 dB CNEL contour that is composed of *incompatible* land uses. Four types of land uses are defined as incompatible:

- Residences of all types;
- Public and private schools;
- Hospitals and convalescent homes; and
- Churches, synagogues, temples, and other places of worship.

However, these uses are not deemed incompatible if any of several mitigative actions has been taken as spelled out in Section 5014. Among these measures are airport acquisition of an avigation easement for aircraft noise and, except for some residential uses, acoustical insulation adequate to ensure that the interior CNEL due to aircraft noise is 45 dB or less in all habitable rooms.

➤ **California Building Code**—California Code of Regulations, Title 24—known as the California Building Code—contains standards for allowable interior noise levels associated with exterior noise sources (*California Building Code*, 1998 edition, Volume 1, Appendix Chapter 12, Section 1208A). The standards apply to new hotels, motels, dormitories, apartment houses, and dwellings other than detached single-family residences.

The standards state that:

> "Interior noise levels attributable to exterior sources shall not exceed 45 dB in any habitable room. The noise metric shall be either the Day-Night Average Sound Level (L_{dn}) or the Community Noise Equivalent Level (CNEL), consistent with the noise element of the local general plan. Worst-case noise levels, either existing or future, shall be used as the basis for determining compliance with [these standards]. Future noise levels shall be predicted for a period of at least 10 years from the time of building permit application."

With regard to airport noise sources, the code goes on to indicate that:

> "Residential structures to be located where the annual L_{dn} or CNEL exceeds 60 dB shall require an acoustical analysis showing that the proposed design will achieve the prescribed allowable interior level. For public use airports or heliports, the L_{dn} or CNEL shall be determined from the airport land use plan prepared by the county wherein the airport is located. For military bases, the L_{dn} shall be determined from the facility Air Installation Compatible Use Zone (AICUZ) plan. For all other airports or heliports, or public use airports or heliports for which a land use plan has not been developed, the L_{dn} or CNEL shall be determined from the noise element of the general plan of the local jurisdiction.
>
> "When aircraft noise is not the only significant source, noise levels from all sources shall be added to determine the composite site noise level."

➤ **General Plan Guidelines**—Section 65302(f) of the California Government Code (Title 7, Division 1, Chapter 3, Article 5), requires that a noise element be included as part of local general plans. Airports and heliports are among the noise sources specifically to be analyzed. To the extent practical, both current and future noise contours (expressed in terms of either CNEL or DNL) are to be included. The noise contours are to be "used as a guide for establishing a pattern of land uses…that minimizes the exposure of community residents to excessive noise."

Guidance on the preparation and content of general plan noise elements is provided by the Office of Planning and Research in its *General Plan Guidelines* publication (last revised in 1998). This guidance represents an updated version of guidelines originally published by the State Department of Health Services in 1976. Included in the document is a table

DEPT. OF TRANSPORTATION GUIDANCE

Although the building code does not apply the CNEL 45 dB interior noise level standard to detached single-family residences, the Division of Aeronautics encourages communities to adopt this standard (or lower) for these uses. Many communities have done so as part of their general plan noise element policies.

This second table appears later in this chapter as Table 7B.

indicating noise compatibility criteria for a variety of land use categories. Another table outlines a set of adjustment or "normalization" factors that "may be used in order to arrive at noise acceptability standards which reflect the noise control goals of the community, the particular community's sensitivity to noise…, and their assessment of the relative importance of noise pollution."

EFFECTS OF NOISE ON PEOPLE

A central consideration in setting noise compatibility policies is to understand the ways in which noise affects people.

Types of Effects

Noise, especially aircraft noise, affects people and their activities in varied and complex ways. Three principal types of effects can be identified: *physiological*, *behavioral*, and *subjective*.

➤ **Physiological Effects**—Physiological effects can be either temporary or permanent. Among the temporary effects are startle reactions and the effects of sustained sleep interference. Hearing loss is the most obvious permanent effect of noise. Research indicates that off-airport aircraft noise, even from the loudest aircraft, is not severe enough to produce permanent or even sustained (after the noise ceases) effects on hearing. Less is known about the nonauditory health effects of aircraft noise. Despite new research conducted over the last two decades, a U.S. Environmental Protection Agency conclusion in 1982 remains valid today:

  "Research implicates noise as one of several factors producing stress-related health effects such as heart disease, high blood pressure and stroke, ulcers and other digestive disorders. The relationship between noise and these effects has not yet been quantified."

➤ **Behavioral Effects**—Behavioral effects are usually measured in terms of interference with human activities. Speech interference and interference with the enjoyment of radio or television are the most often cited examples. Interference with concentration on mental activities and disruption of sleep are two others. Most of the readily identifiable aircraft noise effects fall into this category.

➤ **Subjective Effects**—By their very nature, subjective effects are unique to each individual and, therefore, difficult to quantify. Subjective effects of noise are commonly described in terms of *annoyance* or other similar terms. Because of the great variability in the ways people perceive and react to the unpleasant aspects of noise, prediction of how any one individual will react is nearly impossible. Most research consequently focuses on identifying predictable results among a group or community of people.

The latter two categories are examined more closely in the following discussion.

Effects of Noise on Human Activities

Speech Communication

Scientific research has found that the maximum continuous sound level that will permit relaxed conversation with 100% intelligibility throughout a typical residential living room (talker/listener separation greater than approximately 3.5 feet) is 45 dB (L_{eq} = 45 dB). A 95% intelligibility—considered to be "satisfactory conversation"—can be obtained with a steady sound level of up to 64 dB. When the noise level approaches 80 dB, intelligibility drops to near zero even when a loud voice is used (EPA–1974). Interference with communication may result from masking of the speaker's words or by causing the speaker to pause.

Figure 7A illustrates the relationships between speech intelligibility, sound level, and distance.

Outdoors, because of the absence of reflecting walls to provide the reverberation found indoors, the sound level of speech as it reaches the ear decreases comparatively more rapidly with increasing distance between the talker and listener. In a steady background noise, there comes a point—as the talker and listener increase their separation where speech can no longer be understood because it is masked by the noise.

Almost all fluctuating sound levels found in the everyday environment will, if averaged over a long time period, have less impact on speech intelligibility than a steady sound which has the same Equivalent Sound Level (L_{eq}). This occurs because most of the time the background noise level is less than the Equivalent Sound Level (because of the logarithmic base of sound intensity measurement, a loud sound need have only a relatively short duration to raise the L_{eq} substantially). In circumstances where assessment of speech interference is particularly important, measurement of the amount of time during which noise levels exceed a level for acceptable communication can be informative.

Effects on Learning

Closely related to speech interference are the effects of noise on learning and, more broadly, on cognitive tasks. Recent studies have shown a strong relationship between noise and children's reading ability (FICAN–2000). Children's attention spans also appear to be adversely affected by noise. Adults are affected as well. Some studies indicate that, in a noisy environment, adults have increased difficulty accomplishing complex tasks.

The current status and future needs for research into the effects of aircraft noise on classroom learning was a topic addressed by FICAN in 2000.

One of the issues associated with assessment of these effects is which noise metric correlates most closely with the impacts. For example, DNL, with its nighttime weighting, may not be the best measure of noise impacts on schools. Also, DNL and L_{eq} were developed primarily to address annoyance issues, not effects on learning or health-related matters. Future research into this issue also may help in assessment of the manner in which the effects of loud, intermittent noise events such as aircraft overflights differ from lower volume, but relatively constant, noise sources such as highways.

The FAA has established L_{eq} 45 dB for noise resulting from aircraft operations during normal school hours as the design objective for school sound insulation projects (FAA Order 5100.38A, Section 712.c).

Sleep Disturbance

The extent to which environmental noise disturbs human sleep patterns varies greatly from individual to individual as well as from one time to another for any particular individual. Whether an individual is aroused by a noise depends upon the individual's sleep state and sleep habits, the loudness or suddenness of the noise, the information value of the noise (a child crying, for example), and other factors. Also, most people adapt over time to increased levels of noise during sleep.

When the noise source emanates from outdoors—as is the case with aircraft noise—additional factors affect the loudness of the noise as heard indoors. The noise level reduction provided by the type of construction is one of these determinants. A greater variable, though, is whether windows are open or closed.

Early studies of the effects of noise on sleep disturbance produced varying results. A major factor in these differences, though, is whether the study evaluated people sleeping in a laboratory or in their own homes. Generally, laboratory studies have shown considerably more sleep disturbance than is evident in field studies. More recent studies, all conducted in the field, have produced relatively consistent results. These studies have included:

- A 1990 British study;
- A 1992 U.S. Air Force study of residents near Castle Air Force Base and Los Angeles International Airport; and
- A 1995 study comparing the effects of the closure of Stapleton International Airport with the opening of Denver International Airport.

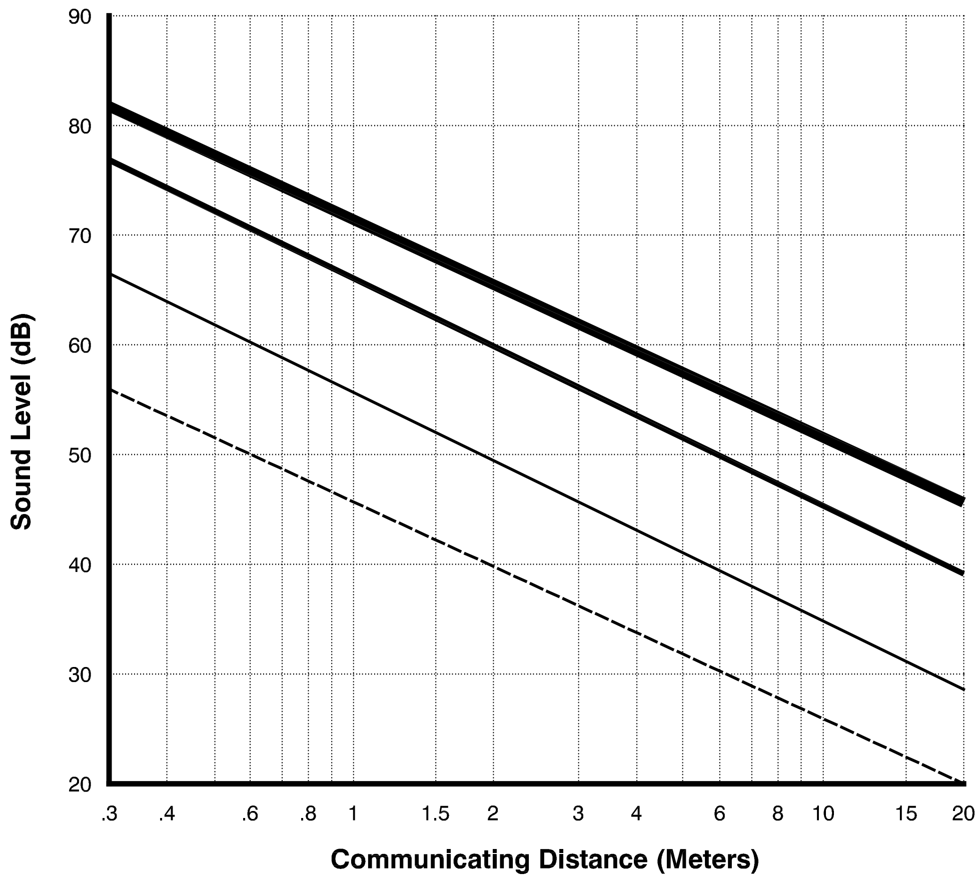
In 1997, the Federal Interagency Committee on Aviation Noise (FICAN) sought to put the subject to rest with publication of a recommended new dose-response curve predicting awakening. This curve (Figure 7B) was calculated using data from the above three studies, among others. The 1997 FICAN curve represents the upper limit of the observed field data and should be interpreted as predicting the maximum percent of the exposed population expected to be behaviorally awakened.

FICAN found a much lower likelihood of awakenings from noise than had been indicated in earlier studies, including the 1992 FICON report. For example, at an indoor sound exposure of SEL 80 dB, the FICAN curve predicts 10% awakenings. By comparison, FICON predicted over 30%. FICAN, however, notes two particular caveats to the prediction curve: (1) it applies only to long-term residents; and (2) it cannot be generalized to apply to children in that only adults were included in the studies.

Subjective Reactions to Noise

Factors Influencing Individuals' Annoyance at Noise

Numerous studies have been conducted which attempt to identify the types of factors which contribute to an individual's annoyance at noise. Annoyance as assessed in most of these studies is not limited to reactions separate



Maximum distance outdoors over which conversation is considered to be satisfactory; intelligible in steady noise.

- Raised voice satisfactory conversation (sentence intelligibility 95%)
- Normal voice satisfactory conversation (sentence intelligibility 95%)
- Relaxed conversation (sentence intelligibility 99%)
- Relaxed conversation (sentence intelligibility 100%)

Source: U.S. Environmental Protection Agency (1974)

FIGURE 7A

Relationship Between Noise Levels and Conversation

Annoyance Factors

- Demographic characteristics of the individual (age, sex, economic status, etc.).
- Residential dwelling characteristics (single versus multi-family; owner-occupied versus rental).
- The loudness, tonal qualities, and other inherent unpleasant characteristics of the noise itself.
- How often the noise occurs.
- The duration of the noise.
- The predictability of the noise.
- Experience and expectations regarding noise levels in the community (is the noise likely to get better or worse in the future?).
- Personal sensitivity to noise.
- Beliefs regarding the preventability of the noise.
- Attitudes regarding the importance of the activity associated with the noise.
- Perceptions concerning the extent to which efforts have been made to minimize the noise levels.
- The activity in which the individual is engaged at the time of the noise.
- Beliefs regarding the health effects of noise.
- Feelings of fear or anxiety associated with the noise.

from interference with speech communication, disturbance to sleep, and other such behavioral effects. Rather, annoyance is a complex reaction to many physical and emotional factors, including adverse effects on behavior.

Listed in the adjacent box, in no particular order, are many of the factors which have been demonstrated to influence the extent of an individual's annoyance at noise. As can be seen, some of these factors are objective, measurable influences, but many are highly subjective. The significance of these subjective factors varies widely from individual to individual and, even for a given individual, from one set of circumstances to another.

The last factor in the adjacent list suggests that annoyance is not strictly a noise-derived phenomenon, but one which also involves a safety component. This factor is particularly important with respect to annoyance at aircraft overflights. Although people may not fear the aircraft noise itself, they may be apprehensive of the prospect that an aircraft could crash onto their property and it is the noise that mostly creates their awareness of the aircraft's presence. The altitude of the aircraft and individuals' understanding of how aircraft fly thus are additional factors in the airport-related annoyance equation.

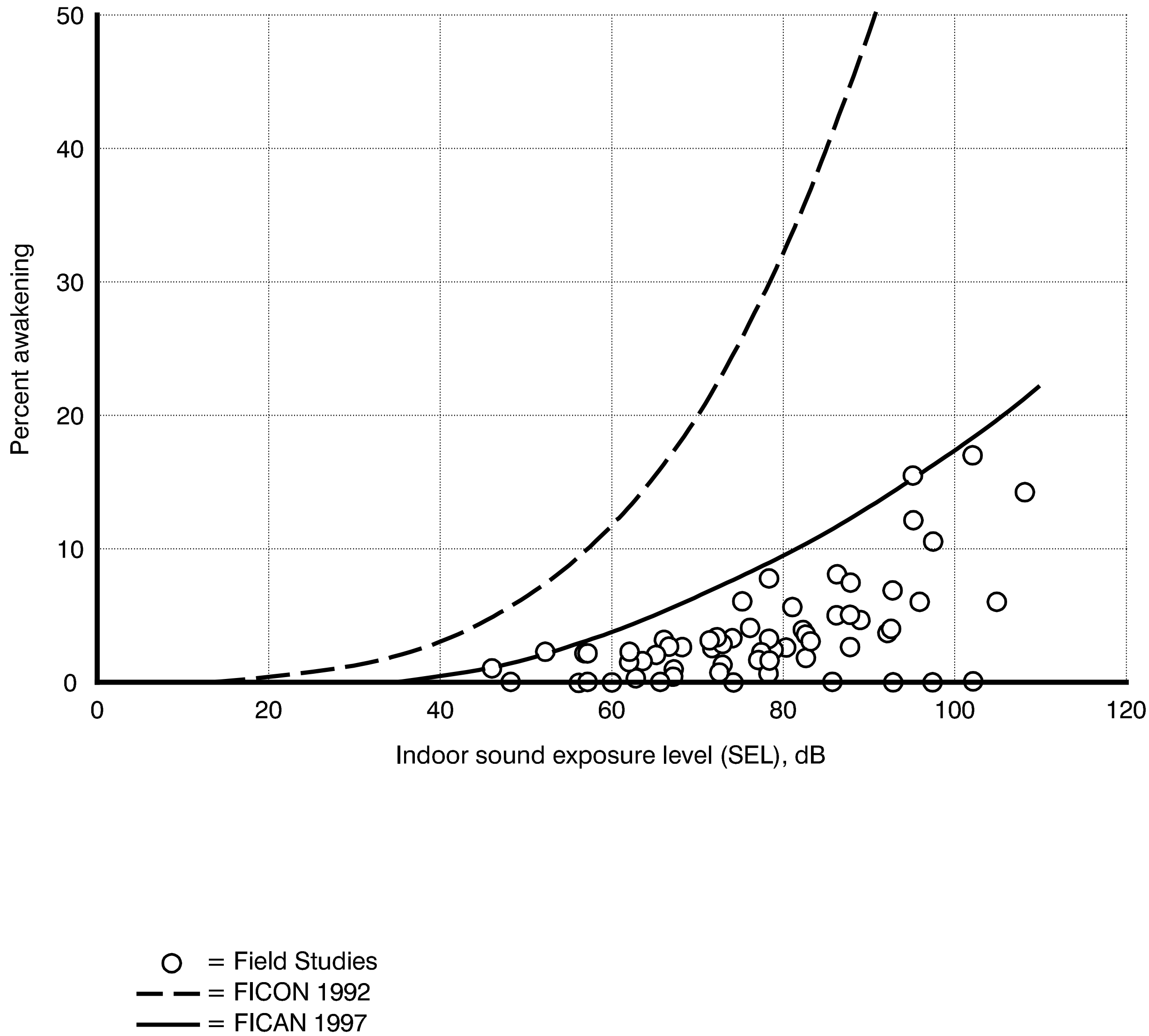
Rates of Annoyance

Even though studies have been able to identify most of the factors affecting an individual's annoyance at noise, predicting how any one individual will react to typical environmental noises has proved virtually impossible. Consequently, most studies seek instead to assess the rate of annoyance within broad segments of the population.

Perhaps the most comprehensive and widely accepted evaluation of the relationship between transportation noise exposure (not exclusively aviation noise) and the extent of annoyance was one originally developed by Schultz (1978) and later updated by the U.S. Air Force (Finegold–1992). This relationship—known as the Schultz curve (Figure 7C)—indicates the percent of people found to be *highly annoyed* (%HA) at various levels of noise exposure measured in terms of the DNL metric. Both of these studies represent compilations of findings from a number of social surveys conducted by other researchers.

A summary of the effects of noise on people, including the reactions of average communities is presented in the FICON report. This summary is reproduced here as Table 7A.

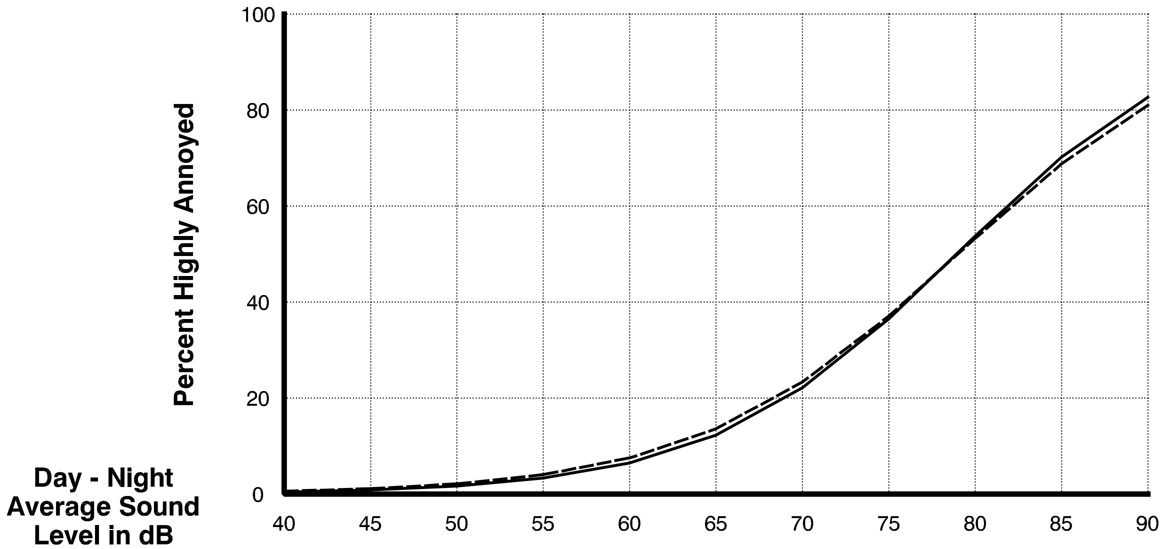
The Schultz curve indicates that approximately 13% of the population is highly annoyed at a DNL of 65 decibels. It also indicates that the percent of people describing themselves as being highly annoyed (%HA) accelerates smoothly between a DNL of 55 dB and a DNL of 70 dB. A DNL of 65 dB is a commonly referenced dividing point between lower and higher rates of people describing themselves as being highly annoyed. The Federal Aviation Administration selected the DNL of 65 dB as the dividing point between normally *compatible* and normally *incompatible* residential land



Source: Federal Interagency Committee on Airport Noise (1997)

FIGURE 7B

Sleep Disturbance Dose-Response Relationship



Calculated % HA Points

USAF	0.41	0.83	1.66	3.31	6.48	12.29	22.10	36.47	53.74	70.16	82.65
Schultz	0.58	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81.00

——— USAF (Finegold et al. 1992) data: 400 points
%HA = 100/(1 + EXP (11.13 - .141 LDN))

– – – – Schultz data: 161 points
%HA = 100/(1 + EXP(10.43 - .132 LDN))

Comparison of logistic fits to original 161 data points of Schultz (1978) and USAF analysis with 400 points (data provided by USAF Armstrong Laboratory)

Source: Federal Interagency Committee on Noise (1992)

FIGURE 7C

Relationship Between Noise Levels and Annoyance

(Schultz Curve)

Day-Night Average Sound Level *(Decibels)*	**Effects[1]**			
	Hearing Loss *(Qualitative Description)*	**Annoyance[2]** *(Percentage of Population Highly Annoyed)[3]*	**Average Community Reaction[4]**	**General Community Attitude Toward Area**
≥75	May begin to occur	37%	Very severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will not likely occur	22%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will not occur	12%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will not occur	7%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
≤55	Will not occur	3%		Noise considered no more important than various other environmental factors.

[1] All data is drawn from National Academy of Science 1977 report *Guidelines for Preparing Environmental Impact Statements on Noise*, Report of Working Group 69 on Evaluation of Environmental Impact of Noise.

[2] A summary measure of the general adverse reaction of people to living in noisy environments that cause speech interference; sleep disturbance; desire for tranquil environment; and the inability to use the telephone, radio or television satisfactorily.

[3] The percentage of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time. USAF Update with 400 points (Finegold et al. 1992)

[4] Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE:
Research implicates noise as a factor producing stress-related health effects such as heart disease, high blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been conclusively demonstrated. (Thompson 1981; Thompson et al. 1989; CHABA 1981; CHABA 1982; Hattis et al. 1980; and U.S. EPA 1981)

Source: Federal Interagency Committee on Noise (1992)

TABLE 7A

Summary of Effects of Noise on People

use (see discussion later in this chapter). The extremes of the curve are also worth noting. At the low end, the data reflect the findings of social surveys that a few people will be highly annoyed regardless of how minimal the noise level is (about 0.6% at a DNL of 40 dB). Oppositely, nearly 20% of the population is apparently not highly annoyed even at a DNL of 90 dB.

Two factors should be recognized with respect to applying the Schultz curve to establishment of airport noise compatibility policies:

➤**Differences between Sources of Noise**—The Schultz curve is based upon the findings of research on all types of transportation noise. Some studies have suggested that aircraft noise is more annoying than highway noise at the same DNL exposure. Other studies have found similar responses regardless of the source of noise. There are many factors that could not be standardized in the studies analyzed by Schultz. These include weather, design of residential structure, types of thermal or acoustic insulation included in structures, types of windows, etc.

➤**Significance of Background Noise Levels**—The studies forming the basis of the Schultz curve were primarily conducted in urban or other relatively noisy environments. A variable discussed by Schultz in his assessment of annoyance is the effect of background or ambient noise in a community. Unfortunately, the data available to Schultz did not provide a basis for determining this effect. Background noise levels are one of the factors taken into account in the concept of normalization described later in this chapter.

Complaints

One manner in which annoyance at noise is sometimes exhibited is through complaints. Many airports maintain logs of noise complaints received. In addition to providing an avenue for people to express their concerns, noise complaint phone lines can help in identifying the nature and location of particular airport noise problems.

Complaints, however, cannot necessarily be equated to annoyance rates within a community. Annoyance can exist without resulting in complaints and complaints may occur even without a high rate of annoyance. Moreover, there is not necessarily a correlation between complaints and noise exposure. At many airports, residential areas subjected to the highest noise levels produce relatively few complaints perhaps because of the predictability of the events. More common is for the majority of complaints to originate from locations outside the defined noise contours. Most complaints tend to be associated with:

- Exceptionally loud, large, or low-flying aircraft which are not normal for the airport;
- Changes in flight patterns which cause increased noise impacts; or
- A small number of people who frequently complain about airport activities.

Other Variables in Airport-Related Noise Annoyance

Several other inter-related variables appear to influence the extent of airport-related annoyance within a community. For some of these, relatively little research has been conducted. The apparent significance is thus more qualitative than quantified.

➤ **Differences among Airport Types**—Virtually all research on airport noise has been conducted at major airline airports, most of which are located in urban areas. The aircraft activity at these airports generates relatively predictable, frequent, loud noise events. In contrast, most general aviation airports have relatively few loud noise events and the total number of aircraft operations may vary substantially from day to day. Also, many general aviation airports are located in relatively quiet, suburban or rural settings where aircraft noise may be perceived as more intrusive than in noisier communities.

➤ **Significance of Overflight Frequency versus Noise Event Loudness**—Cumulative noise exposure metrics reflect a combination of both the frequency with which overflights occur and the loudness of those events. Any given noise exposure level can be the result of either a small number of noisy overflights or a high incidence of just moderately noisy events. A basic assumption in use of cumulative noise contours for compatibility planning is that community reactions will be the same under each of these circumstances.

➤ **Time of Day Weighting**—Some evidence suggests that, because people are more likely to be home during the evening (7:00 p.m. to 10:00 p.m.) and nighttime (10:00 p.m. to 7:00 a.m.) than in the day, the same noise exposure produces more annoyance during those hours. This consideration is reflected in the CNEL metric by inclusion of a penalty factor on evening and nighttime aircraft operations.

Communication of Airport Noise Data

In seeking to measure or predict the effects of noise on people and to establish appropriate noise level criteria, most noise research and airport-specific noise studies have relied upon cumulative noise exposure metrics as the basis for describing noise levels. Cumulative noise exposure metrics are usually very well-suited to this task. Sometimes, though, the need is not to *assess* how noise affects people, but to *explain* noise information to people. This need often arises in the preparation of environmental impact analyses of airport improvement projects.

For noise communication purposes, metrics such as CNEL and DNL may not provide all of the information desired. The general public often finds it difficult, if not impossible, to understand the relationship between cumulative noise exposure contours and the airport noise they experience or will experience. Rather, people tend to focus on where aircraft are flying, how often they fly, and the extent to which the noise is or will be intrusive or annoying. To

A point to emphasize here is that use of supplemental noise metrics as a means of improving airport noise data communication does not diminish the importance and viability of cumulative noise exposure metrics as analytical and compatibility planning tools.

better communicate airport noise data in everyday terminology to which the public can more readily relate, supplemental noise metrics may be helpful. A variety of such metrics have been used in the U.S. and abroad. Few, though, have attained widespread application or general consensus as to their merit.

Noise Contours for Compatibility Planning

Although supplemental metrics may be useful for certain purposes, cumulative noise exposure metrics and the noise contours associated with these metrics continue to represent the best available tools for the purposes of airport land use compatibility planning. The previous chapter described some of the basic input data required for preparation of current airport noise contours. The focus in the following discussion is on issues to be considered in projecting future noise impacts and in selecting contours for land use compatibility planning purposes.

Noise Analysis Time Frame

See the discussion in Chapter 2 regarding preparation or updating of aviation activity forecasts for airport land use compatibility planning purposes.

State statutes specify that airport land use compatibility plans must be based upon an airport development plan "that reflects the anticipated growth of the airport during at least the next 20 years." Forecasts having the required 20-year time horizon are normally included in airport master plans. The FAA, the Division of Aeronautics, and some regional planning agencies also prepare individual airport forecasts, some extending to 20 years.

DEPT. OF TRANSPORTATION GUIDANCE
The "at least" phrase in the statutory guidelines deserves emphasis. The 20-year time frame should be considered a *minimum* for compatibility plans. Noise impacts (as well as other compatibility concerns) should be viewed from the longest practical time perspective.

For the purposes of compatibility planning, however, 20 years may be shortsighted. For most airports, a lifespan of more than 20 years can reasonably be presumed. Moreover, the need to avoid incompatible land use development will exist for as long as an airport exists. Once development occurs near an airport, it is virtually impossible—or at least very costly and time consuming—to change the land uses to ones which would be more compatible with airport activities.

In conducting noise analyses for compatibility plans, the long-range time frame is almost always of greatest significance. Barring vast improvements in aircraft noise reduction technology, the growth in aircraft operations expected at most airports will result in larger noise contours. A possible exception to this trend is that, at some airports, planned changes in runway configuration or approach procedures could result in reduction of noise impacts in some portions of the airport environs. In these instances, a combination of current and future noise contours may be the appropriate basis for compatibility planning.

Past improvements in aircraft noise reduction technology—or, more to the point, the elimination of older, noisier aircraft from the fleet—have caused noise contours at some airports to shrink. One result of shrinking contour sizes during the late 1990s was pressure to allow residential and other noise-sensitive development closer to airports. Allowing such development might be reasonable in situations where no potential exists for the contours to expand back to their former size (for example, where policies to limit contour sizes have been adopted). However, whether future technology will again enable significant reduction in noise impacts is uncertain. Thus, looking to the long-range future, the scenario which has the greatest land use planning implications for most airports is that anticipated future growth in airport activity will result in expansion of noise contours.

Other Factors in Noise Contour Selection

In addition to time frame and forecasting issues, several other factors warrant consideration in selection of noise contours for compatibility planning functions.

Lowest Noise Contour Level

Calculating at least one 5-dB CNEL contour interval below the threshold level can provide valuable supplemental information for land use planning. Aircraft noise does not become suddenly unnoticeable just beyond the CNEL contour that delineates the threshold for determining compatible versus incompatible land uses. The additional contour(s) can show where noise levels are below the level at which residential and certain other noise-sensitive land uses may need to be prohibited or substantially restricted, yet still may be noticeable and may warrant some form of land use compatibility measure. When applying this concept, it is important to recognize that CNEL contours become less precise the further they are from the airport.

Supplemental Forecast Scenarios

At some airports, the distribution of activity throughout the year or among aircraft types is such that an annual average forecast is insufficient for full assessment of noise impacts.

For instance, an airport may have distinct seasonal or even daily variations in its activity. Such circumstances may warrant examination of noise contours reflecting these shorter periods in addition to the annual average impacts. These variations are particularly interesting when activity by the noisiest aircraft are concentrated into one part of the year. The predominantly summertime operations of fire attack aircraft is one common example.

Another situation in which supplemental forecast scenarios may be needed is when there is substantial uncertainty regarding a major component of the airport activity. Examples include: possible changes in airline aircraft fleet mix and/or volume of operations; potential addition or elimination of particularly noisy based aircraft; and/or uncertainties in activity levels by aircraft which follow unique flight tracks (such as helicopters or agricultural applicator aircraft).

As long as the assumptions used in these supplemental forecast scenarios are consistent with the defined role of the airport, it is within reason for ALUCs to consider them.

Special Noise Sources

As noted in Chapter 6, most noise contour calculations only take into account the noise from approaches/landings, takeoffs/departures, and closed traffic pattern (touch-and-go) activity of typical airplanes. In some circumstances, other sources of aircraft noise may also need to be considered. These include:

Including helicopter operations in noise contour calculations generally will not have much effect on the size or shape of noise contours unless the traffic volumes are quite high. In these instances, the location of common helicopter flight tracks and the single-event noise levels of helicopter overflights may be appropriate to consider in compatibility planning.

- **Helicopters**—Because of helicopters distinct noise characteristics and the fact that they usually follow different flight tracks than used by airplanes, their noise can be particularly noticeable. Inclusion of helicopter noise in computation of airport noise contours is desirable, especially at airports having moderate or high levels of helicopter activity.
- **Agricultural Aircraft**—Another group of aircraft having unique noise characteristics is agricultural "crop duster" aircraft. From a noise contour standpoint, one characteristic is that, unless numerous flight tracks are modeled, the calculated contours tend to maintain a constant width along the flight tracks and never reach a closure point.
- **Ground Operations**—For most airports, the various sources of aircraft ground operations described in Chapter 6 are not a significant source of noise. Noise from engine run-ups can be included in INM calculations, however. At airports where this activity is a noise factor, the capability of INM to include it in the noise contours should be utilized. If included, some reference to the fact should be noted in the description of the contours.

Sources of Noise Contours

The preceding discussion focuses on issues involved in development of noise contours suitable for compatibility planning. However, it may not be necessary for ALUCs to develop new contours. Noise contours are available from a variety of sources. Some of these are potentially useful for airport land use compatibility planning purposes, others are of limited value.

Potential sources and applicability of noise contours can be summarized as follows:

- **Airport Master Plans**—As indicated above, an adopted airport master plan is one of the preferred sources for airport activity forecasts and noise contours. Even when the forecasts and contours in a master plan no longer extend at least 20 years into the future, information contained about the intended role and future physical characteristics of the airport is needed for compatibility planning.
- **Noise Elements of Community General Plans**—The status of noise contours depicted in general plans is similar to that of noise contours from airport master plans in that they represent adopted local policy. As for utility in compatibility planning, again the principal concern is currentness. More often than not, noise contours included in general plans are copies of ones from the most recent airport master plan.
- **Environmental Documents**—State environmental impact reports and/or federal environmental assessments and environmental impact statements conducted for major airport improvements normally will contain newly prepared noise contours having a 20-year time horizon. Depending upon the timing of the project, these contours may be more recent than ones in an airport master plan.
- **FAR Part 150 Studies**—Most of the airline and busier general aviation airports in the state have conducted FAR Part 150 noise compatibility studies. These studies contain current and five-year projected noise contours. At airports where noise impacts are expected to decrease in the future, the Part 150 noise exposure maps are appropriate for land use compatibility

planning purposes. If the noise exposure is expected to expand beyond the five-year time frame, then noise contours do not provide a sufficiently long time horizon and generally should not be used for policy purposes. Even in this latter case, though, the contours can be useful in illustrating anticipated noise impact trends and the noise model input data can be valuable in preparation of longer range noise contours.

➤ **AICUZ Studies**—Often the only sources of noise contours for military airfields are the Air Installation Compatible Use Zone studies conducted by the Department of Defense. Because aircraft activity levels at most military facilities is highly dependent upon international events, the contours usually represent current conditions and long-range projections are seldom done. Often, though, a "maximum mission" scenario will be analyzed which can be useful for compatibility planning.

ESTABLISHING CUMULATIVE NOISE EXPOSURE CRITERIA

Just as there are no absolute determinants of the noise level at which an individual person will be highly annoyed, there are no absolute scientific measures for establishing which land uses and noise exposures are or are not compatible with each other. The best that can be hoped for is that compatibility criteria will reflect what is *appropriate* for the communities involved. The Schultz curve depiction of the percentages of people highly annoyed by various noise levels is a cornerstone for the task of establishing noise criteria for land use planning purposes. It is important to remember, however, that what may be considered an *acceptable* level of noise to a reasonable person will not satisfy 100% of the public.

The Context of Acceptability

The level of noise acceptable to an individual depends greatly upon the context of the noise and the perspective of the listener—noise to one person may be music to another. Similarly, context is important in determining the level of noise acceptable to a community. The level selected depends upon whether the function of the standards is control and abatement of noise sources or making land uses compatible with those sources.

Methods of Limiting Airport Noise Impacts

Methods of limiting airport noise impacts can be divided into four basic groups. All four categories have significant roles to play if the goal of quieter communities is to be attained. Importantly, the authority for implementation of each method differs.

➤ **Source Noise Reduction**—From the perspective of most communities, the ideal method of limiting airport noise impacts is to reduce aircraft noise at its source. However, local entities—including airports, local land use jurisdictions, and ALUCs—have no control over this technique. Responsibility for source noise reduction actions rests with the federal government (which sets standards and conducts research), aircraft manufacturers (which design and build new technology aircraft), and aircraft owners (which place the new aircraft in their fleets). A basic difficulty with implementation of this process is that it takes time between when new technologies are created and when they are put into use.

- **Operational Limitations**—Operational methods to reduce noise include a variety of measures affecting how, where, and when aircraft are flown. The principal authority over these actions rests with the federal government and the pilots of aircraft. Airport proprietors have some regulatory powers (setting restrictions on aircraft types, hours of operation, or flight track locations, for example) to the extent that the actions do not adversely affect safety and are implemented in a manner which is reasonable, nonarbitrary, and nondiscriminatory. Airport proprietors also can affect where aircraft fly by modifying the configuration of airport runways. Other than when they are also the airport proprietor, local governments have no authority over aircraft operations. Airport land use commissions are explicitly denied this power.

Among the four categories of noise impact reduction methods, preventative measures are the only category in which ALUCs have any authority.

- **Preventative Measures**—Falling into this category are the wide variety of land use planning measures designed to avoid encroachment of incompatible development into airport environs. These measures include general plans, specific plans, and zoning ordinances adopted by local governments. Compatibility plans adopted by ALUCs are another example.

Avigation easements, although they provide a legal means of complying with state Airport Noise Regulations, are not truly remedial actions in that they do not physically change the noise environment.

- **Remedial Actions**—This group of actions are ones designed to mitigate current and future noise impacts on established land uses around airports through modification of the land uses. The objective is to change existing incompatible land uses into ones which are compatible or at least more acceptable. Property redevelopment and reuse are examples of remedial actions which can be fostered by local governments and taken by property owners. Airport proprietors can effect remedial action through programs such as property acquisition and soundproofing of existing structures.

Functions of Noise Impact Criteria

Not only does the authority to implement each of the preceding noise impact reduction methods differ, the standards which the methods seek to achieve may vary as well. Indeed, in the case of source noise reduction, even the metric used to measure compliance differs. It is a single-event metric, whereas the other methods are primarily evaluated in terms of cumulative noise level metrics. Particularly important with respect to the methods over which ALUCs and local land use jurisdictions have authority are differences in objectives for preventative measures versus remedial actions. The noise levels considered *appropriate*—as opposed to *optimum* or *ideal*—under each of these two contexts may not be the same.

Yet another matter is the issue of noise increases resulting from airport development or operational changes. This issue is explored in the final section of this chapter.

In each case, setting appropriate noise level criteria for a community implies that an element of feasibility or cost-effectiveness is being taken into account. For example, within the limits of powers available to local governments, it is usually more feasible to avoid creation of new incompatible land uses than it is to reduce existing noise impacts through land use changes. Moreover, while the benefits or effectiveness may be the same in each case, the cost of eliminating or mitigating existing land use incompatibilities is usually far greater than avoiding it in the first place. *Thus, noise level criteria might justifiably be set lower for new land use development than for triggering action to mitigate existing impacts*.

Even for new development, competing community needs can influence the level deemed to constitute acceptable noise. As examined in Chapter 3, various practical considerations can shift the line of demarcation between acceptable and unacceptable noise exposure. ALUCs need to reflect upon such factors when establishing noise compatibility criteria. In so doing, however, commissions should also remember that their primary responsibility is toward promoting compatibility between airports and proposed land use development in the airport vicinity. Local elected officials can weigh the importance of other factors if they so choose (in so doing, though, they must understand that any action to overrule a decision of an ALUC must adhere to the procedural requirements set forth in state law).

Variables Affecting Cumulative Noise Level Criteria

As noted in the review at the outset of this chapter, most federal and state of California regulations and policies set DNL/CNEL 65 dB as the basic limit of acceptable noise exposure for residential and other noise-sensitive land uses. Often overlooked, though, is that this standard has been set with respect to relatively noisy urban areas. For quieter settings and many—if not most—airports in California, CNEL 65 dB is too high of a noise level to be appropriate as a standard for land use compatibility planning. This view is particularly evident with respect to evaluation of proposed new land use development. Even FAA policy has evolved to where the agency now will "respect and support" local establishment of a lower threshold of noise exposure acceptability. On the other hand, special situations continue to exist in which noise exposures above CNEL 65 dB may be regarded as appropriate.

As discussed elsewhere, DNL is the only metric for which there is a substantial body of research data defining the relationship between noise exposure and people's reactions (as noted in Chapter 6, the CNEL metric used in California is essentially the same as DNL). Furthermore, cumulative noise exposure metrics remain the only metrics suited to establishment of policies defining the noise levels considered acceptable or compatible with various land uses.

Clearly, the level of noise deemed acceptable in one community is not necessarily the same in another. The issue which therefore needs to be examined is what factors influence setting of appropriate noise level criteria.

The Concept of Normalization

A long-standing method of adjusting noise levels in a community is the concept of "normalization." The normalization concept has its origin in research done for the U. S. Air Force in the 1950s. The purpose of the research was to establish a method for adjusting aircraft noise levels used for determining and predicting expected community reactions. The adjustments take into account local conditions as described below. National recognition and support of normalization appeared in the U. S. Environmental Protection Agency's (EPA) *Community Noise* (1971) and "Levels" (1974) documents. The California Department of Transportation also used the normalization process in its development of Noise Standards for California airports, and the California Office of Planning and Research continues to include the normalization procedure in its *Guidelines for Development of General Plans*.

The normalization procedure was originally designed to adjust or "normalize" actual measured noise levels so that the effects of different noises on different communities could be compared more reliably. Over the years, planners have also found normalization to be a valuable tool for establishing appropriate noise level limits for new noise-sensitive development in the vicinity of an airport. This latter application of normalization is particularly well-suited to airport land use planning.

The normalization procedure takes into account four categories of adjustment factors associated with the noise source and the characteristics of the affected community:

- Seasonal characteristics of the noise;
- The background noise level in the community, absent distinct noise events;
- The community's previous exposure to, and attitudes toward the noise; and
- Whether the noise includes pure tones or impulse characteristics.

Figure 7D shows the common background noise levels, measured in terms of Community Noise Equivalent Level, assumed to occur in the various community settings identified in Table 7B.

Table 7B lists the complete set of normalization factors and recommended adjustments to measured noise levels. To use this table for the purpose of setting a land use compatibility noise-level criterion, the values must first be reversed (positive for negative and vice versa). The results can then be applied to adjust a baseline noise-level criterion. In California, a commonly used baseline criterion is a CNEL of 65 dB. As discussed earlier, this criterion is indicated in the Noise Standards for California airports, in FAA guidelines, and elsewhere. It is the cumulative noise level defined as being acceptable to a reasonable person (a person whose sensitivity to aircraft noise is near the middle of public response) residing in an urban setting in the vicinity of an airport.

The two examples on the top of the following page illustrate the use of normalization in airport land use compatibility planning.

DEPT. OF TRANSPORTATION GUIDANCE
ALUCs are encouraged to consider the normalization factors listed in Table 7B when setting noise level limits for new noise-sensitive development in the vicinity of an airport.

ALUCs are encouraged to consider the normalization factors listed in Table 7B when setting noise level limits for new noise-sensitive development in the vicinity of an airport. However, caution should be exercised in the event that the normalization procedure indicates a planning criterion greater than a CNEL of 65 dB. With few exceptions, new noise-sensitive land uses should not be allowed where current or projected airport related noise exceeds a CNEL of 65 dB. To do so would be inconsistent with the overall goals and objectives of the Noise Standards for California airports.

It should also be noted that normalization is not applicable to implementation of the Noise Standards for California airports. The Noise Standards are formal regulations that have their own requirements separate from land use planning guidelines.

Examples of Using Normalization in Airport Land Use Compatibility Planning

Example 1: An urban residential community near a major air carrier airport.

Factor	*Characteristics Present in Community*	*Correction*
Seasonal Character of Noise:	Year-round operation	0
Community Setting:	Typical urban residential background noise levels	0
Previous Community Exposure to Noise:	Some exposure, but no control of noise	0
Noise Qualities:	No pure tones or impulse characteristics	0

Under these conditions, no corrections would be made to the basic CNEL 65 dB criterion as the design guideline.

Example 2: A small airport in a quiet location.

Factor	*Characteristics Present in Community*	*Correction*
Seasonal Character of Noise:	Year-round operation	0
Community Setting:	Quiet suburban area	-10 dB
Previous Community Exposure to Noise:	Some exposure, but no control of noise	0
Noise Qualities:	No pure tones or impulse characteristics	0

Under these assumptions, a total correction of minus 10 dB would be applied to the basic criterion of CNEL 65 dB. A community fitting these conditions therefore may find that a criterion of CNEL 55 dB should be set as the maximum acceptable noise exposure for new residential and other noise-sensitive land use development.

At the present time, normalization is the best method available for quantitatively adjusting noise levels to account for local conditions in an effort to establish appropriate noise limits for noise-sensitive land uses near airports. Its applicability is perhaps greatest in relatively quiet suburban or rural communities. The normalization procedure has also proven to be capable of predicting controversial airport noise situations such as around the new Denver International Airport, the reorganization of airspace along the eastern U. S. coast (Expanded East Coast Plan), and sightseeing flights over the Grand Canyon.

Varying Noise Sensitivity of Different Land Uses

Noise compatibility standards, such as those summarized at the beginning of this chapter, typically place primary emphasis on residential areas. Residential development is not only one of the most noise-sensitive land uses, it usually covers the greatest proportion of urban land. Several factors contribute to this sensitivity:

- Normal residential construction usually provides less sound attenuation than typical commercial construction and windows are more likely to be open;
- Outdoor activity is a significant aspect of residential land use; and
- People are particularly sensitive to noise at night when they are trying to sleep.

DEPT. OF TRANSPORTATION GUIDANCE
For the purposes of airport land use compatibility planning, the Department's advice is that CNEL 65 dB is not an appropriate criterion for new noise-sensitive development around most airports. At a minimum, communities should assess the suitability and feasibility of setting a lower standard for new residential and other noise-sensitive development.

The three Community Noise Exposure Levels commonly used as the limit for acceptable residential noise exposure are: CNEL 65 dB, 60 dB, or 55 dB. The choices and the rationale for each are listed in Table 7C.

Type of Correction	Description	Amount of Correction to be Added to Measured CNEL in dB *
Seasonal Correction	Summer (or year-round operation).	0
	Winter only (or windows always closed).	– 5
Correction for Outdoor Noise Level Measured in Absence of Intruding Noise	Quiet suburban or rural community (remote from large cities and from industrial activity and trucking).	+ 10
	Normal suburban community (not located near industrial activity).	+ 5
	Urban residential community (not immediately adjacent to heavily-traveled roads and industrial areas).	0
	Noisy urban residential community (near relatively busy roads or industrial areas).	– 5
	Very noisy urban residential community.	– 10
Correction for Previous Exposure & Community Attitudes	No prior experience with the intruding noise.	+ 5
	Community has had some previous exposure to intruding noise but little effort is being made to control the noise. This correction may also be applied in a situation where the community has not been exposed to the noise previously, but the people are aware that bona fide efforts are being made to control the noise.	0
	Community has had considerable previous exposure to the intruding noise and the noise maker's relations with the community are good.	– 5
	Community aware that operation causing noise is very necessary and it will not continue indefinitely. This correction can be applied for an operation of limited duration and under emergency circumstances.	– 10
Pure Tone or Impulse	No pure tone or impulsive character.	0
	Pure tone or impulsive character present.	+ 5

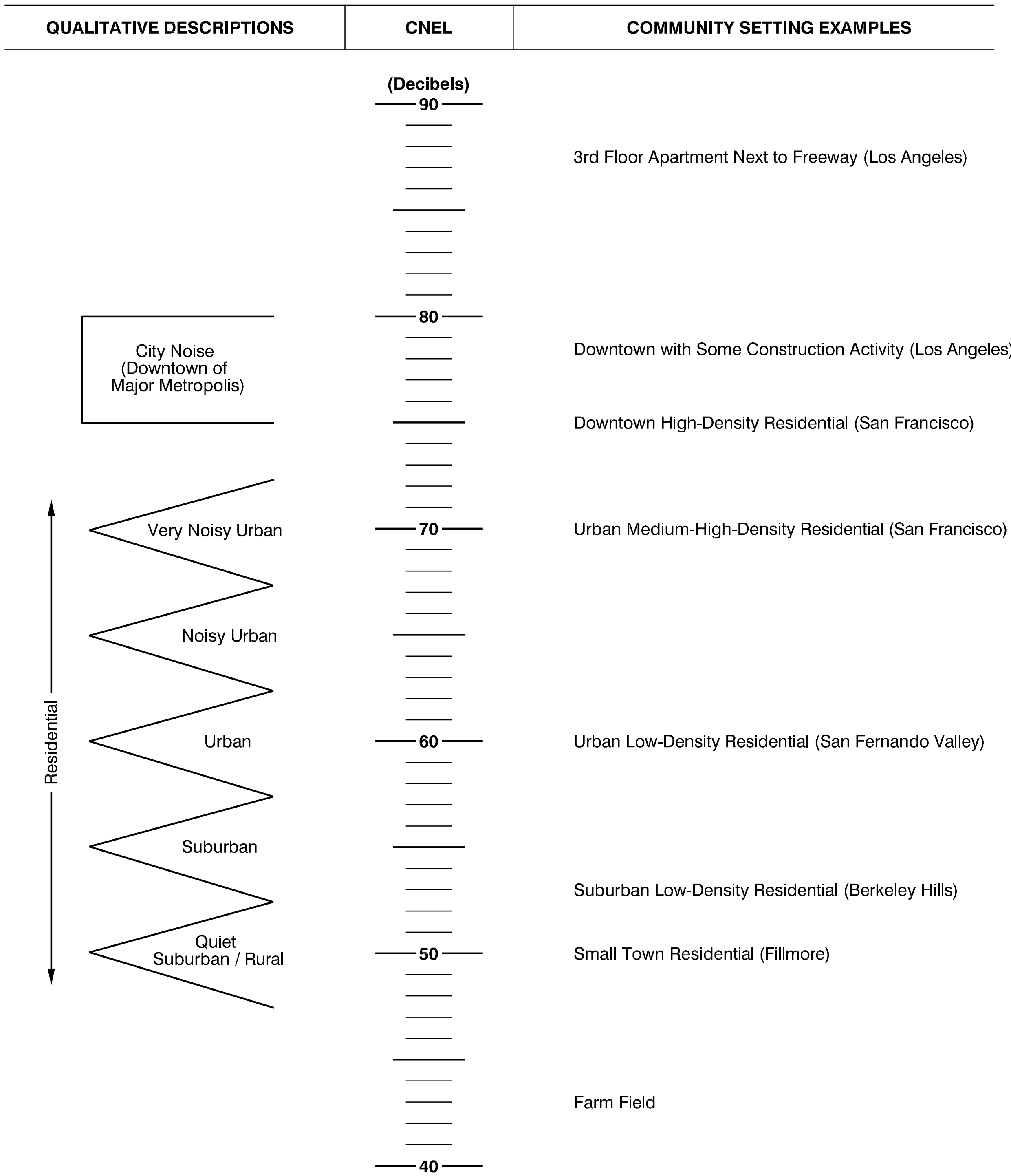
* *Notes:*

- Source document uses the equivalent DNL metric.
- See text for guidance on application of these factors to setting maximum noise level criteria for new land use development near airports.

Source: U.S. Environmental Protection Agency (1974)

TABLE 7B

Adjustment Factors for Obtaining Normalized CNEL



Source: Based upon diagram in Office of Planning and Research (1998)

FIGURE 7D

Typical Noise Levels in Various Communities

Data on acceptable noise exposure for other land uses is not as extensive as for residential uses. Some guidelines exist in the various regulations and documents cited earlier in this chapter. In general, once a criterion has been set for residential uses, the criteria for other land uses can be established by considering the comparative extent to which human activities associated with that land use would be disrupted by noise, as well as the degree of structural sound attenuation which typically is provided.

Characteristics of Cumulative Noise Exposure Metrics

Because of these characteristics, supplemental noise metrics can be helpful as means of adding to public understanding of the complexities of airport noise. For example, as discussed later in this chapter, single-event noise exposure metrics can provide relevant information for some purposes.

As noted earlier in this chapter, various studies—the Schultz curve in particular—have demonstrated a strong correlation between cumulative noise exposure metrics such as CNEL and public annoyance. This correlation, together with the lack of comparable data for any alternatives, makes these metrics essential in defining noise-related land use compatibility policies. To make appropriate use of cumulative noise exposure metrics, though, an understanding of some of their particular characteristics is important.

Logarithmic Scale

The logarithmic scale is used to provide meaningful numbers (0 to 140) in describing sound pressures for which the audible range varies enormously (a ratio of over 1,000,000:1).

A fundamental characteristic of cumulative noise exposure metrics is that they measure noise exposure in decibels which are in turn based on a logarithmic scale. These metrics are not widely understood by the general public. Consequently, some explanation of the manner in which individual aircraft noise levels and frequency of operations contribute to the contours is useful.

- **Effect of Occasional Loud Events**—Because of the logarithmic scale, a relatively few operations by aircraft which generate noise levels well above the average for an airport can greatly influence the size of the noise contours. This is particularly true if these operations occur at night or at airports with low volumes of activity.

Figure 7E depicts the relationships between the number of noise events, their loudness (in SENEL), and the resulting CNEL.

- **Effect of Frequency of Operations**—If the distribution of operations by aircraft type, time of day, and so on is held constant, a doubling of the number of operations will increase the CNEL values by approximately 3 dB. The seemingly small size of this change is a result of the logarithmic scale upon which the decibel unit is measured.

Relationship to Peak Noise Levels

Although the logarithmic scale gives added weight to the loudest noise events, the cumulative basis of CNEL metric does not directly depict information regarding peak noise levels. Specifically:

- **Sound Level Averaging**—Cumulative noise exposure metrics represent a logarithmic average of the penalty-weighted hourly noise levels attributable to individual aircraft noise events. The results are equivalent to a constant noise level of the same magnitude, but with penalties added for evening and nighttime noise. Noise measurements on this type of scale correlate well with overall human responses and acceptance. Nevertheless, even when the cumulative noise exposure level is judged accept-

	CNEL = 65 dB	CNEL = 60 dB	CNEL = 55 dB
Criteria	▪ Set by the FAA and other federal agencies as level above which residential land uses may be incompatible if not acoustically treated. ▪ Established by California state regulations as the maximum normally acceptable for residential and certain other land uses at county-designated noise-problem airports. ▪ Schultz curve predicts that about 13% of the population will be highly annoyed at this noise exposure.	▪ The contour within which California Building Code (Section 1208A) requires an acoustical analysis of proposed residential structures, other than detached single-family dwellings. ▪ Suggested by the California Office of Planning and Research *General Plan Guidelines* as the maximum "normally acceptable" noise exposure for residential areas. ▪ Individual noise events will occasionally cause significant interference with residential land use activities, particularly outdoor activities, in quiet suburban/rural communities. ▪ Schultz curve indicates about 7% of population highly annoyed.	▪ Identified by the U.S. Environmental Protection Agency as the level below which "undue interference with activity and annoyance" will not occur. ▪ Individual noise events will seldom significantly interfere with residential land use activities (e.g., interference with speech). ▪ Schultz curve shows about 4% of population highly annoyed at this noise level. ▪ In urban areas, aircraft contribution to this noise level may be less than that of other noise sources.
Suggested Applicability	▪ Generally not appropriate for most new development. ▪ May be acceptable in noisy urban locations and/or in hot climates where most buildings are air conditioned.	▪ Suitable for new development around most airports. ▪ Particularly appropriate in mild climates where windows are often open.	▪ Suitable for airports in quiet, rural locations.

Note: When setting criteria for a specific airport, other characteristics of the airport and its environs also need to be considered. See Table 7B for normalization factors.

TABLE 7C

Noise Compatibility Criteria Alternatives

New Residential Land Uses

DEPT. OF TRANSPORTATION GUIDANCE
Calculation of CNEL contours for time periods other than an annual average day deserves ALUC consideration at airports which have notable seasonal variations in activity.

able, the peak noise levels of some individual events may be considered intrusive for several seconds.

➤ **Seasonal Variations**—CNEL contours are usually calculated in terms of an average day of the year. Occasionally, shorter time periods are evaluated. Shorter time frames are primarily assessed for airports which have substantial variations in operating characteristics (total volume of operations, type of aircraft, or patterns of runway use) from one season to another. Seasonal variations in noise exposure can be particularly significant at airports where the highest activity levels occur in the summer when outdoor residential living and open windows in dwellings are most common.

Differences Between High- and Low-Activity Airports

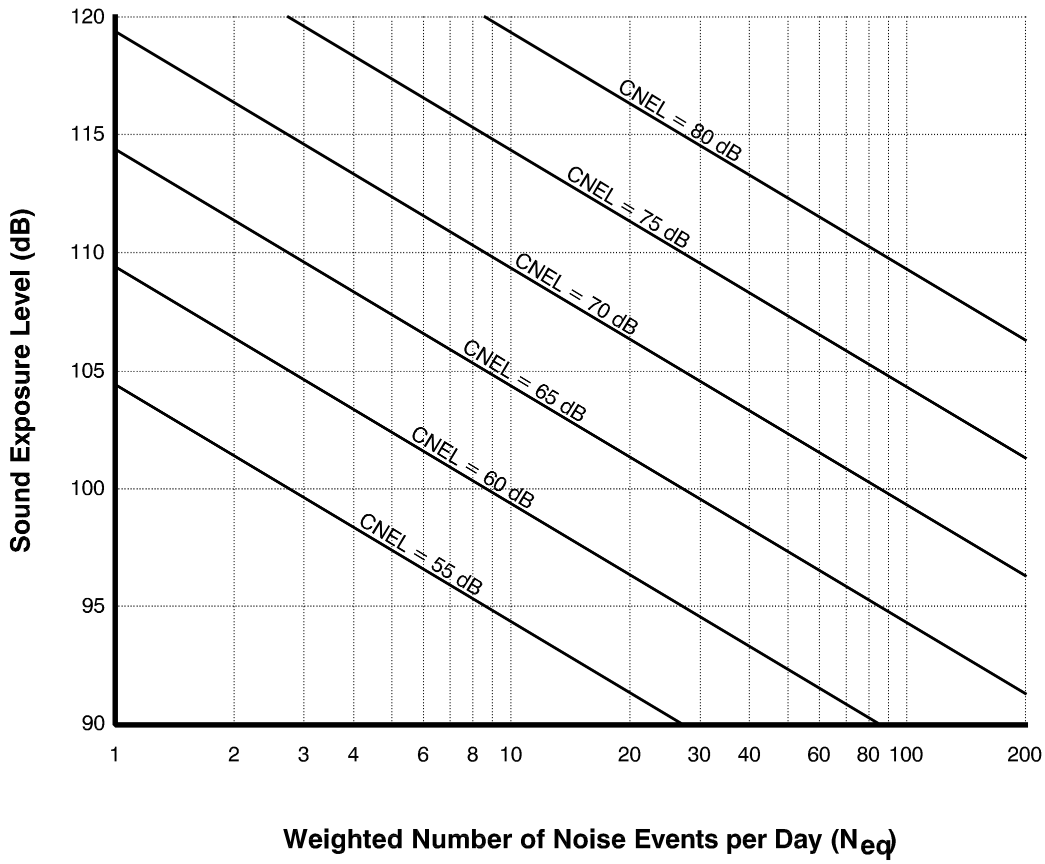
Although cumulative noise exposure metrics have been shown to correlate closely with public annoyance over a wide range of noise exposure levels, there probably are limits beyond which these metrics do not adequately describe potential public reaction. For communities near larger airports with relatively many operations (like air carrier airports), CNEL is well suited to describing anticipated public reaction to aircraft noise. However, at the extreme conditions, where there are either very many relatively quiet events or a small number of very loud events, public reaction is probably more difficult to gauge, and may not be well described.

To illustrate this point, consider two situations in which the CNEL is the same, but the circumstances are quite different. A CNEL of 65 dB due to a single Boeing 727 departure at 2 a.m. would probably have a different effect on people than a CNEL of 65 dB due to one hundred operations of small airplanes during daytime hours. In the first instance, sleep disturbance would be the primary issue; while, in the second case, the issue could well be speech interference. Additionally, the first example would yield one very intrusive event, with quiet prevailing for the rest of the day. The second case would result in a nearly continuously noisy situation, with an aircraft in the air every few minutes. Whether these situations would be equivalent in terms of annoyance is uncertain.

RELEVANCE OF SINGLE-EVENT NOISE LEVELS

When people express their annoyance at airport noise, they often indicate that they are particularly disturbed by the loudest aircraft, ones which use the airport on just an occasional basis. In response to reactions such as this, suggestions have been made that single-event noise level standards should be established. Any thoughts in this regard, however, must draw the distinction between standards applying to aircraft operations and standards directed toward land use compatibility planning. In both respects, there are significant limitations.

Neither ALUCs nor local land use jurisdictions have the authority to regulate the amount of noise individual aircraft generate. Federal laws greatly



N_{eq} = Nd + 3 x Ne + 10 x Nn

Legend: N_{eq} Weighted number of noise events per 24 hours
Nd Number of daytime events (7 a.m. to 7 p.m.)
Ne Number of evening events (7 p.m. to 10 p.m.)
Nn Number of nighttime events (10 p.m. to 7 a.m.)

Note: The above relationship assumes all events are by the same aircraft type (or by aircraft having the same sound exposure level)

FIGURE 7E

Relationship Between CNEL and Sound Exposure Level

constrain even airport proprietors from regulating how, when, and where aircraft operate. However, with respect to land use compatibility planning, nothing in federal or state laws prevents ALUCs from setting standards which rely upon single-event noise level data as a factor in evaluating proposed land use development. There are nonetheless important practical factors which limit the viability of this concept.

Federal Constraints on Single-Event Noise Standards

A fundamental constraint on any local regulation of noise emissions is that the federal government has a preemptive right to set noise level standards for individual aircraft. California, for example, originally included single-event noise emission standards in its Airport Noise Regulations, only to have them later deleted as a result of a successful legal challenge on the basis of federal preemption. As previously indicated, federal law currently prohibits airports from setting single-event noise standards which restrict the operations of federally authorized aircraft over 75,000 pounds takeoff weight unless an extensive cost-benefit analysis is prepared (under FAR Part 161) and subsequently approved by the FAA.

Some airport proprietors have succeeded in adopting single-event noise level standards. Such standards, however, have been limited to specific measurement locations (usually those specified in FAR Part 36 or where noise monitors have been installed). Also, they must have been shown to be nondiscriminatory and to have no deleterious effect on interstate commerce. Furthermore, most have been in place since prior to the 1990 adoption of the current federal legislation (the Airport Noise and Capacity Act) and thus have a grandfathered status. Short of undertaking the FAR Part 161 process, the only other option available to airports for limiting single-event noise levels is through negotiated agreements with airlines and other aircraft operators.

Single-Event Noise Criteria in Compatibility Planning

In each of the above instances, the objective of the single-event noise level policies has been to control noise through restrictions on aircraft operations. The federal constraints on locally established single-event noise standards for *aircraft operations* do not, however, preclude communities and airport land use commissions from adopting *land use* restrictions based upon single-event noise levels. These local entities can adopt land use policies to ensure that single-event noise levels experienced in proposed noise-sensitive land uses will be within acceptable limits. Such policies can help minimize noise intrusions, as well as avoid public reactions that can lead to demands for restrictions on airport operations.

Setting land use restrictions based upon single-event noise levels is not a simple proposition, however. The task is rendered difficult for several reasons: availability of single-event aircraft noise data; criteria selection; and applying the criteria.

Data Availability

A basic difficulty in development of single-event noise level criteria applicable to land use compatibility assessment lies in obtaining suitable aircraft noise data. Three possible sources exist, although each has its limitations.

- **Recorded Data**—Recorded data on actual aircraft overflight noise levels has increasingly become available through noise monitoring systems installed at most major airline airports as well as many busy, urban general aviation facilities. Data for smaller general aviation airports, however, is rarely available unless a special study has been conducted for a particular purpose. Monitoring data is valuable in that it provides an indication of the range of noise levels from various aircraft or even the same type of aircraft.
- **FAR Part 36 Data**—The data resulting from FAR Part 36 is of value only in distinguishing the relative loudness of different types of aircraft. For most airports, especially at general aviation airports, the actual points established by the regulations for measurement of noise levels are too far from the runway to be of much significance in land use planning. Also, the noise levels are measured under very specific conditions which may not represent the manner in which aircraft are actually flown.
- **INM Database**—The only other readily available source of data relating aircraft types to the single-event noise levels at various locations on the ground is the database for the Federal Aviation Administration's Integrated Noise Model (INM). This database provides the typical noise levels for a variety of aircraft types, but does not contain data on the full range of aircraft (airline aircraft are much better represented than general aviation aircraft). Also, unlike monitoring data, the database does not reflect how specific aircraft are operated at a particular airport.

Criterion Selection

Selection of a criterion value is difficult because there has been no widely accepted policy guidance for single-event noise levels. To the extent that there is any guidance regarding acceptable single-event noise levels, the emphasis has been on physiological effects, not on land use planning. For example, the FAA has suggested that the threshold of speech interference is 60 dBA. While this datum is informative, the FAA has not provided guidance indicating what number or duration of events exceeding this threshold should be considered significant. Similarly, FICON and FICAN have provided estimates of the percentage of people expected to be awakened when exposed to specific single-event noise levels inside a home. However, no one has suggested what frequency of awakening is acceptable.

Criterion Application

Assuming that a community has selected a criterion value for maximum single-event noise levels on the basis of some objective analysis, the problem of applying the criterion remains. None of the general single-event noise level data sources cited above may be very useful in evaluating the acceptability of a proposed land use at a specific location near an airport. Noise monitoring at the actual project site could well be necessary. Moreover, such monitoring would need to be conducted over a long enough period to ensure that a full range of aircraft types, flight patterns, and weather conditions are represented.

Conclusions

Perhaps the most salient point which can be made with regard to single-event noise level criteria for land use compatibility planning is that no definitive, widely recognized, single-event noise level guidelines currently exist. The single-event noise research which has been conducted has primarily focused on specific human reactions such as sleep disturbance. The means of applying such research to land use decisions is not yet clear.

DEPT. OF TRANSPORTATION GUIDANCE
ALUC use of single-event noise level data for land use compatibility planning should be narrowly limited.

Until single-event noise level guidelines evolve—if they eventually do—ALUCs have no solid grounds on which to define compatibility criteria relative to specific single-event noise levels. Use of single-event noise level data should be limited to three circumstances:

- In supplemental evaluation of special, highly noise-sensitive, land uses such as schools and outdoor theaters;
- As considerations in the design of acoustical treatments of buildings (if ALUC policies or project reviews go into that level of detail); and
- As one of the factors to be considered in determining the geographic extent of the area within which annoyance at aircraft overflight is a compatibility concern.

Overflight Altitude

Single-event noise levels are often promoted as useful in identifying the existence of noise concerns in locations beyond those typically outlined by cumulative noise exposure contours. A less problematic alternative is to use the altitude of aircraft overflights (their height above ground level) as a means of defining the limits of these additional concerns. At least for general aviation airports, experience suggests a correlation between frequent, low-altitude aircraft overflights and noise-related annoyance.

OTHER NOISE COMPATIBILITY MEASURES

Although not applicable as the primary basis for formulation of noise compatibility policies, certain other noise compatibility measures can play important secondary roles in the determination of noise level acceptability.

Interior Noise Levels

For many land uses, interior noise levels resulting from exterior noise sources are equally, if not more, important than exterior noise levels as a determinant of acceptability. Furthermore, interior noise level criteria together with data and assumptions regarding the noise level reduction (NLR) provided by the structure can be combined to indirectly indicate a maximum acceptable level of exterior noise.

Factors Affecting Interior Noise Level Criteria

Various human factors play a part in determining acceptable interior noise levels. For residences, the most important are usually considered to be speech interference and sleep disruption. As noted earlier in this chapter, speech interference begins to become a problem when steady noise levels reach approximately 60 to 65 dBA. For sleep disruption, the threshold of significance is less absolute in that there is more variability from one person to another. Nevertheless, the indication from several studies is that the noise threshold for significant occurrence of sleep disruption is higher than for speech interference (only 10% of people are awakened at SEL 80 dB).

One of the choices involved with setting interior noise level criteria is deciding the appropriate noise metric to apply. As apparent from the preceding paragraph, speech interference and sleep disruption are usually measured in terms of either constant or single-event noise metrics. However, for the purposes of land use or building design criteria, cumulative noise exposure metrics are the easiest to implement in that exterior noise is most often measured in these terms. Additionally, once any two of the variables—interior noise level, exterior noise level, or the NLR value of the structure—are known, the third can be directly calculated through simple addition or subtraction. The problem which arises is that, although there is a general relationship between single-event and cumulative noise metrics, it is not constant from one airport to another.

Some airport land use commissions have adopted peak noise level criteria for *intermittent* noises. However, as with any single-event metrics, application of these criteria poses questions in defining the number of events considered to be significant.

Regardless of these issues, cumulative noise exposure metrics are the most commonly used for interior noise level standards, at least for residential uses. In particular, an interior noise level standard of CNEL 45 dB is typical. Allowing for at least 20 dB of noise level reduction from the structure with windows closed, this standard equates to an exterior noise level of CNEL 65 dB. Of particular significance within California, the previously cited California Building Code sets a CNEL of 45 dB as the maximum acceptable interior noise level for residential uses (other than detached single-family dwellings). Although guidelines for other uses exist, there are no other federal or state interior noise level regulations.

Problems arise with developing interior standards for other building uses because some are used only occasionally and others (such as concert halls) are especially sensitive to peak noises. Once again, the issue is whether a cumulative noise exposure metric is the most appropriate basis for compatibility standards.

As noted previously, one such guideline is a L_{eq} 45-dB noise level which the FAA considers as the "usual design objective" for sound insulation of schools. (FAA Order 5100.38A)

Sound Insulation Requirements

Once interior noise level criteria have been established and the exterior noise levels at a particular location are known, the variable which remains is the amount of noise level reduction which the structure needs to provide. Ideally,

Table 7D is offered here as a very general guide to the overall Noise Level Reduction afforded by average types of building construction. Table 7E provides some additional information regarding sound insulation programs for airport area land uses.

land uses should not be situated where special measures to insulate the building interior from outside noise would be required. Frequently, though, attainment of this ideal is not realistic either because the development already exists or because the need for development warrants the special measures.

The objectives of sound insulation programs are to provide a meaningful reduction in aircraft noise inside homes and schools and to satisfy the interior noise standard of CNEL 45 dB. For schools, the interior noise standard is usually assumed to be an hourly L_{eq} of 45 dB during the peak period of aircraft operations during school hours. It is also usually assumed that a meaningful degree of noise reduction is attained when the interior noise level is reduced by 5 dB more than otherwise provided by the structure. These standards are consistent with FAA guidelines which apply when federal funds are used for the sound insulation program.

Given the noise level reduction provided by standard residential construction, interior noise level standards can generally be satisfied without the need for special sound insulation measures in locations where the exterior noise exposure is less than CNEL 60-65 dB.

Older homes in good repair may be expected to provide aircraft noise reduction of about 20 to 30 dB with the windows and doors closed. Newer homes constructed to meet current energy-conserving building codes can provide 25 to 30 dB aircraft noise reduction. This means that many homes will meet the CNEL 45 dB interior noise standard in an aircraft noise environment up to CNEL 65 dB without additional acoustical treatment, assuming that windows and doors are closed. (As indicated above, this factor is one of the bases for the selection of the CNEL 65 dB exterior noise standard.) If the windows are partially opened, most homes will provide no more than 15 to 20 dB noise level reduction, regardless of age or construction practices.

DEPT. OF TRANSPORTATION GUIDANCE
Rather than accepting the use of sound insulation as a mitigation action, ALUCs primary objective should be to prevent development of land uses which are basically incompatible with the noise conditions.

Interior Noise Level Criteria in Land Use Compatibility Planning

Installation of special sound insulation in structures is often thought to be broadly suitable as a land use compatibility measure for highly noise-impacted locations. It should not be viewed that way, however.

As indicated in Chapter 3, installation of sound insulation—whether funded by airports as mitigation for noise impacts or set by ALUCs as a condition for approval of new development—should be accompanied by dedication of an avigation easement to the airport.

The most appropriate application for structural sound insulation is for existing land uses. It is a method of improving existing incompatible conditions when changing the land use to something less noise sensitive is not practical. Even then, though, there are limitations. Sound insulation is not effective for land uses in which noise-sensitive activities take place outdoors. Unlike the case with ground-based noise sources, sound walls and other such devices do nothing to block noise from aircraft while they are in the air.

Also important to remember is that, even where sound insulation may make a high level of noise exposure acceptable, high-intensity land uses may be unacceptable because of safety factors. This topic is addressed in Chapters 8 and 9.

With regard to new development, sound insulation should be regarded as a measure of last resort. It is not a substitute for good land use compatibility planning in the first place. Exterior noise levels should generally be the primary consideration in evaluation of proposed land uses, especially residential development and other land uses where noise-sensitive outdoor activities are normal and important features.

For those airports where noise exposure levels and the demands for land use development dictate the use of sound insulation, airport land use commissions have the authority to establish definitive policies. State airport land use commission statutes (Public Utilities Code, Section 21675(a)) specifically

Construction Type	Typical Occupancy	General Description[a]	Noise Level Reduction (NLR)[b] in dB
1	Residential, Commercial, Schools	Wood framing. Exterior stucco or wood sheathing. Interior drywall or plaster. Sliding glass windows. Windows partially open.	15–20
2	Same as 1 above	Same as 1 above, but windows closed.	25–30[c]
3	Commercial, Schools	Same as 1 above, but windows are fixed ¼-inch plate glass.	30–35
4	Commercial	Steel or concrete framing. Curtain-wall or masonry exterior wall. Fixed ¼-inch plate glass windows.	30–40

Notes:
[a] Construction methods assume no special control provisions.
[b] The NLR range depends upon the amount that windows are open, the degree of seal, and the window area involved.
[c] For older homes in good repair, the NLR is typically 20–30 dB with windows and doors closed.

Source: Paul S. Veneklasen & Associates (1973)
Supplemental notes added

TABLE 7D

Noise Reduction Afforded by Common Building Construction

The California requirements for, and FAA funding of, sound insulation programs apply only to civilian airports. Although similar measures might be appropriate with respect to military airfields, the U.S. military does not have legal authority to insulate civilian structures.

note that ALUCs may "determine building standards, including soundproofing" when developing airport land use compatibility plans. ALUCs have mostly steered clear of setting detailed building standards, however.

Those that deal with the question of acceptable indoor noise levels typically use one of two approaches. One method is to indicate the noise level standards for various indoor building uses and require project proponents to show how those standards will be met. Another common approach is for the ALUC to establish criteria specifying the amount of Noise Level Reduction a building in a particular noise environment must provide. Again, the details of how the criterion is met are left to the proponent.

In light of these factors, ALUCs contemplating establishment of interior noise level criteria are advised to:

- Consider whether such criteria are necessary (in general, standard construction will provide adequate noise level reduction in areas where exterior noise levels are below CNEL 60 to 65 dB);
- Limit the applicability to residences, schools, and other equally noise-sensitive land uses; and
- Base the criteria on the CNEL metric unless data to support other measures can be documented.

Buyer Awareness Measures

In a pure sense, the acceptability of a given noise level with respect to a particular type of land use should solely be a function of the noise level and the land use. In practice, however, judgments of acceptability are easier to make at high noise exposure levels than at lower ones. At high noise levels, clear evidence exists that human activities associated with certain land uses will be disrupted and many people will be highly annoyed. Accordingly, community policies can be adopted to preclude these land uses under most circumstances.

At lower noise levels, the variability in how people react becomes more of a factor. In these lower noise environments—whether the threshold is at CNEL 65, 60, or even 55 dB—relatively few people are expected to be highly annoyed and the majority will probably not be even moderately annoyed. Total prohibition of certain types of land uses, especially residential land uses, consequently may not be necessary. More important is to give people who may be annoyed by airport noise timely information with which to assess how living in an airport vicinity would affect them. For these situations, buyer awareness measures such as those described in Chapter 3 can be effective strategies.

Noise and Assessment of Airport Development Impacts

In most of the circumstances previously discussed in this chapter the intent is to determine land use compatibility relative to known or projected airport noise levels. A much different context within which local assessment of airport noise impact acceptability also occurs is when airport facility improvements

Typical Insulation Measures

The primary path of aircraft noise into buildings is usually through the windows, so the acoustical performance of buildings is strongly dependent upon the type, location, and size of windows. If the windows are acoustically treated, then other building components become acoustically significant. For this reason, sound insulation programs almost always include replacement of standard windows and doors with acoustically-rated assemblies. In addition, most programs include insulation of attic spaces, and sealing or baffling of openings and vents to limit the effects of other common building elements on the interior noise levels. Fireplaces may also be treated with chimney cap dampers or glass doors. The use of these measures can provide up to 35dB aircraft noise reduction.

Note that the use of acoustically-rated windows and doors assumes that the windows and doors can be maintained in a closed configuration, which presumes that some means of providing adequate fresh air exchange is provided to meet the requirements of the Uniform Building Code. For this reason, most aircraft sound insulation programs include modifications of the ventilation system to ensure fresh air circulation. In some cases, air conditioning will be required, though it is not usually possible to obtain federal funding to provide that feature.

Practical factors usually limit sound insulation programs to the above measures, though the presence of acoustically weak building elements may still preclude satisfying the interior noise standards under extreme conditions.

For example, exterior walls of wood siding may allow more aircraft noise to pass through them than will pass through acoustically-rated windows, a function of both the transmission loss characteristics of the wall materials and the total surface area of the walls as compared to the windows. The only practical means of significantly increasing the transmission loss of wood siding walls is to mount the interior wall surfaces on resilient channels, which requires removing all of the affected wall surfaces. This is obviously impractical so, in this case, the wood siding exterior wall becomes the limiting factor in the acoustical performance of the building facades. For all homes, there is no practical value to increasing the acoustical ratings of windows beyond the rating of the wall assembly.

In some homes, the roof/ceiling assembly may be a single composite layer, with no attic space. Such an assembly is typically weak from an acoustical standpoint, and may be the dominant source of aircraft noise transmission into the room. Practical treatment of this assembly is also limited to removing the ceiling panels and re-mounting them on resilient channels, provided that there is an air space of about 2 to 4 inches available between the ceiling and the roof panels. This measure is usually impractical, so the roof/ceiling design may also limit the effectiveness of other acoustical treatments.

Testing and Implementation

If federal funds are used for sound insulation programs, acoustical testing is required to ensure that the program objectives have been satisfied. FAA guidelines require that at least 10% of homes be acoustically tested before and after the acoustical treatment program to demonstrate that the desired noise reduction values have been achieved. The noise measurements are usually performed on a single-event basis during actual aircraft overflights, though simulated aircraft noise is sometimes played from loudspeakers through building facades in areas where it is difficult to arrange testing during overflights. The disadvantage of using simulations is that it is usually not possible to acoustically excite the entire building as would occur during an aircraft overflight.

Because of the scope of sound insulation projects, which include public relations, program management, construction management, architectural design, and acoustical testing, many airports retain a design and implementation team. Program management is sometimes provided by the airport, but the architectural and acoustical services are usually assigned to outside consultants. Total program costs can be very high, as the treatment costs per home can range from about $5,000 to $25,000, depending upon the treatments required, and the value of the home.

TABLE 7E

Sound Insulation Programs

On this topic, two things are important to note:

- Not all airport development necessarily results in increased noise impacts; and
- Noise can increase as a result of additional aircraft operations even in the absence of new airport development.

As discussed in Chapter 4, state law requires that ALUCs review certain types of airport development plans. This requirement also applies to development plans for public or special-use heliports such as those located at hospitals.

or changes in airport usage patterns are proposed. Unlike the assessment of land use development proposals where the concern is with incompatible uses encroaching on the airport, this situation involves concerns that airport construction or other changes could adversely impact existing land uses.

In general, the noise impacts of airport development can be evaluated against the same criteria as applies to land use development. A question which might be asked is: are there nearby existing or planned land uses which would be considered incompatible with the airport if the latter were already in existence? If so, then actions to mitigate the impacts of the airport development are appropriate.

Another factor with regard to assessment of airport development is that consideration needs to be given not just to the absolute level of noise, but also the amount of noise increase resulting from the project. As a guideline for considering when noise level changes might be significant and thus require thorough environmental impact review, the FAA has established a screening criterion. In noise-sensitive locations where the DNL/CNEL already exceeds 65 dB, an increase of 1.5 dB is deemed the threshold of potential significance (FAA–1986). (Although it can be argued that *any* increase in locations already subject to more than DNL/CNEL 65 dB should be considered unacceptable, the fact of the matter is that a change of 1.5 dB is not perceptible outside of a laboratory setting. Also, 1.5 dB is within both the daily fluctuation and typical degree of accuracy of most noise contours.) The FICON report expands upon this screening concept by recommending that a projected increase of 3.0 dB within an area exposed to a DNL/CNEL of 60 to 65 dB also be subject to analysis and possible mitigation.

Not reflected in these screening criteria is that noise increases of several decibels may also be significant in quieter environments (ones below DNL/CNEL 60 dB). This outcome has become apparent in many parts of the country when the FAA has implemented flight track changes affecting communities which previously had not routinely been subjected to a high volume of aircraft overflights. Substantial community reaction has resulted even though the changes only affected air traffic patterns at altitudes above 3,000 feet and the resulting noise levels were still well below normally acceptable DNL/CNEL levels. (Reactions such as this lend further credibility to the concept of normalization described earlier.)

A final consideration with respect to reviews of airport development proposals is that the issue involves not only a matter of policy (how much noise is acceptable?), but also, as previously noted, communication of the information in a form that the general public can comprehend. Consequently, environmental impact documents prepared for airport-related projects may need to make use of supplemental noise metrics to explain the impacts even though the determination of significance relies upon criteria related to cumulative noise metrics.

CHAPTER **8**

Aircraft Accident Characteristics

OVERVIEW

There has long been a general consensus within the airport industry that some degree of safety concern exists beyond the typical boundaries of an airport and its runway protection zones. This is particularly true with regard to general aviation airports which, compared to major airline facilities, typically control less land beyond the runway ends and have higher rates of aircraft accidents. Also, land use compatibility planning at most general aviation airports is not dominated by the extensive noise exposure areas common to airline (and military) airports.

This chapter summarizes a variety of data regarding the characteristics of aircraft accidents including:

- Aircraft and pilot performance factors affecting aircraft accidents;
- The location of aircraft accidents near airports; and
- The nature of aircraft accident impacts.

A major element of the 1993 edition of the *Airport Land Use Planning Handbook* was the development of a geographic database for general aviation aircraft accidents. Until the 1993 *Handbook* was published, airport and land use planners lacked a source of data to utilize when attempting to develop safety compatibility criteria for the vicinity of airports. For the first time, the locations of general aviation aircraft accidents relative to the runway used was known.

The work of compiling the accident data was conducted by the Institute of Transportation Studies at the University of California, Berkeley. The major findings of this research are incorporated into the discussion here.

Neither the National Transportation Safety Board (NTSB), which is the primary repository of aviation accident data in the U.S., nor the Federal Aviation Administration routinely compile data in this manner. For both agencies, accidents are investigated for aeronautical purposes to determine ways of improving the design and operation of aircraft and airports and to foster better pilot skills and techniques. If land use factors are examined at all, it is done only in a manner incidental to the primary purpose of the investigation.

Aircraft *accidents* are defined as events associated with flight which result either in fatal or serious injury to a person (either on board the aircraft or on the ground) or in substantial damage to the aircraft. Events with less serious outcomes are classified as *incidents*. Taken together, accidents and incidents are referred to as *mishaps*.

As part of this 2002 edition of the *Handbook*, the accident location database was expanded. The total number of data points was increased from 400 to 873. A statistical analysis of the expanded accident database is summarized in this chapter. Also included here is information describing other characteristics of aircraft operations and accidents. This update also significantly expands the documentation of commercial airline aircraft accidents. Chapter 9 then evaluates this data in the specific context of airport land use commissions and safety compatibility planning issues.

Aircraft Limitations and Pilot Actions

The emphasis in this discussion is on emergency conditions in which the aircraft can be maintained under at least some measure of pilot control. Most of the performance characteristics described here are not applicable in situations where the aircraft is incapable of being controlled (because of mechanical failure or damage resulting from collisions with obstacles or other aircraft, for example). For a discussion of normal, nonemergency, aircraft operational characteristics and flight procedures, see Chapter 6.

Chapter 6 outlined the parameters of normal operation of aircraft in the vicinity of airports. That discussion, presented in the context of airport noise, is also pertinent to safety compatibility issues in that it addresses where aircraft regularly fly. The additional factors of importance to the topic of safety are the performance limitations of aircraft and the actions of pilots which can cause or contribute to emergency situations. A review of these factors helps to provide some understanding of why aircraft accidents occur where they do.

Airplane Emergencies

Broadly speaking, aircraft operations emergencies can be divided into two groups: situations in which the pilot's control of the aircraft directly creates the emergency and situations in which some other condition causes an emergency to which the pilot must react. Among airport-vicinity, general aviation airplane accidents in the first of these groups, the most common is pilot failure to maintain sufficient flying speed. This usually results in a stall, and potentially a spin and uncontrolled descent. In the second group, common accident factors include adverse wind and weather conditions and loss of power (complete or partial engine failure for either mechanical reasons or due to lack of fuel).

Airplane Performance Limitations

When not prevented by mechanical or structural damage, the capability of an airplane to remain under pilot control while flying is largely dependent upon the plane's airspeed. Even in situations where a complete engine failure has occurred, a plane will not go out of control and drop from the sky if sufficient speed is maintained and enough altitude is available to give the pilot a chance to react. Even large, air carrier jet aircraft have been landed without functioning engines.

Most light airplanes are capable of gliding 500 to 1,000 feet for every 100 feet of altitude (altitude is lost more quickly in turns than when gliding straight ahead, however). At a 1,000-foot traffic pattern altitude, for example, a light airplanes could travel one to two miles before reaching the ground.

One major difference among airplanes is between single-engine and multi-engine types. An obvious, but very important, distinction between the two is that a multi-engine aircraft can experience an engine failure without having a complete loss of power. Although the asymmetrical thrust plus drag from an inoperative engine(s) reduce performance, most multi-engine aircraft can hold altitude or even continue to climb if one engine fails. For smaller piston twins with less power, the functioning engine may do no more than extend the glide distance, provided that the pilot keeps the aircraft under control.

For a single-engine plane, the critical airspeed is its *stall speed.* A multi-engine plane has two additional milestone speeds: *minimum control speed* and *best single-engine rate of climb speed*. These critical airspeeds are significant regardless of the flight mode of the aircraft: taking off, landing, or maneuvering at low speeds. As noted, however, these speeds are particularly important for a pilot to watch when an engine failure occurs, especially on takeoff.

- **Stall Speed (V_s)**—This is the minimum steady flight speed at which an airplane, either single- or multi-engine, can fly. At lower speeds, the flow of air over the wing does not generate enough lift to match the aircraft's weight. If an engine failure occurs before this speed is reached during the takeoff run, the airplane would remain on the ground and maximum braking would need to be applied to bring the plane to a stop. If the engine failure occurs while the airplane is airborne, it is essential for the pilot to keep the aircraft above stall speed. The airplane's speed can be controlled by adjusting its pitch and, on a multi-engine aircraft, by use of the remaining engine(s). By staying above stall speed, an airplane can potentially be guided to a successful emergency landing. A significant factor to note is that an airplane's stall speed is higher during a turn (that is, the airplane can stall more readily) than it is in straight flight.
- **Minimum Control Speed (V_{mc})**—Below this speed, a multi-engine airplane cannot be controlled with full power on the remaining engine(s) with the critical engine inoperative. Airflow across the rudder does not generate enough yawing force to overcome the asymmetrical thrust of the remaining engine(s) operating away from the aircraft centerline. Engine failure below this speed requires a reduction in power on the good engine(s) in order to maintain directional control.

  V_{mc} is typically attained while the aircraft is either still on the runway or only a few feet above it. During a takeoff, the aircraft would either remain on the ground or would, if properly handled, return immediately to the ground in a controlled manner. Maximum braking would then be applied.
- **Single-Engine Climb Speed (V_{yse})**—V_{yse} is the speed at which a twin-engine airplane operating on one engine can attain the best rate of climb (or, for some aircraft, the slowest rate of descent). If an engine fails below this speed, it is possible to stretch a controlled descent as long as a speed of V_{mc} or better is maintained. The aircraft will quickly return to the ground, however. Engine failure at a speed above V_{yse} may not necessitate a forced landing because many twin-engine airplanes are capable of using the remaining engine to climb to an altitude from which a return to the airport for a safe emergency landing can be made.

Pilot Actions

As alluded to above, pilot actions under emergency circumstances are a major determinant of whether an accident will result and, if so, how severe it will be. Pilots are taught a set of procedures to follow if, for example, an engine stops running. Most critical is to keep the aircraft under control. Next, time permitting, is to attempt to determine the problem and, if possible, restart the engine. If an emergency landing becomes inevitable, the pilot should then try to find a reasonable spot to put the aircraft down.

When an engine failure occurs while approaching or departing an airport, the initial reaction of most pilots is to attempt to land on the runway. For small aircraft, a runway landing should be possible if a landing traffic pattern is flown at a normal altitude and distance from the runway. If larger, multi-engine aircraft lose an engine, most are capable of continuing the flight to a normal landing. Of course, on takeoff, the aircraft is headed away from the runway. For single-engine aircraft, and some piston twins, a runway landing becomes difficult or, at low altitudes, impossible. As mentioned above, an airplane's descent rate and stall speed both increase while turning. This characteristic is the reason why attempting to return to the runway with a single-engine aircraft following an engine failure while on takeoff can have disastrous consequences.

In certain respects, maintaining control of a multi-engine airplane, especially a twin-engine airplane, is more difficult following an engine failure than it is with a single-engine airplane. With the latter, a complete engine failure unavoidably results in descent (assuming the engine cannot be restarted) and the pilot has no choice but to respond accordingly. With a twin-engine aircraft, however, many pilots think that they can keep the aircraft in the air even when an engine failure occurs on takeoff at low altitude. Many light twins, though, do not have enough power to continue to remain airborne on one engine. Moreover, because of a twin-engine airplane's asymmetrical thrust characteristics, lack of immediate and proper pilot response during an engine failure on takeoff is more likely to lead to an uncontrolled accident than is the case with a single-engine plane. For many small, twin-engine airplanes, the prudent course of action if an engine fails at low altitude on takeoff is to reduce or shut off power to the good engine and glide back to the ground just like would be done in a single-engine plane. For larger twins and multi-engine aircraft, there is typically sufficient power available from the remaining engine(s) and sufficient control authority to continue the flight.

In the few moments that a pilot may have available in which to select an off-airport emergency landing site, there is no certainty that the best site can be spotted—particularly at night or under IFR weather conditions—or that it can be reached. A large, flat, open area is preferable; but, if one cannot be found, a small open space or a street or parking lot are often the best candidates. Usually, an effort will be made to avoid people, buildings, large trees, and other such objects. Smaller objects, such as ditches and wires, may not be obvious until it is too late to avoid them. Luck consequently plays a significant role in such circumstances.

Helicopter Emergencies

As with airplanes, airspeed and altitude are also critical determinants of whether a pilot can maintain control of a helicopter in the event of an emergency involving an engine failure. Although helicopters cannot glide as far as airplanes can (a typical glide ratio at optimum airspeed is 300 to 500 feet horizontally per 100 feet of altitude lost), neither do they necessarily crash if an engine should fail while in flight. Indeed, because helicopters can safely descend much more steeply than airplanes, the area needed for an emergency off-airport landing can be much smaller. Also many of the newer, moderate-size helicopters—especially turbine-powered ones—have twin engines driving the main rotor.

The procedure used for emergency helicopter landings following an engine failure is known as *autorotation*. In simple terms, autorotation involves disengaging the main rotor from the engine drive system, thus enabling the blades to rotate freely. Air traveling upward through the blades causes them to continue rotating and producing lift to slow the descent. Also, the rotation of the main rotor drives the tail rotor to allow directional control to be maintained.

The altitude from which an emergency autorotation descent can successfully be conducted is dependent upon several factors with airspeed generally being the most significant. From near cruising speeds, most helicopters can perform an autorotation from an altitude of 100 feet or even slightly less. However, when hovering at zero airspeed, 500 feet of altitude may be needed. In effect, the altitude must be traded for forward speed before successful autorotation can be accomplished.

AVAILABILITY OF ACCIDENT LOCATION DATA

Historical Data

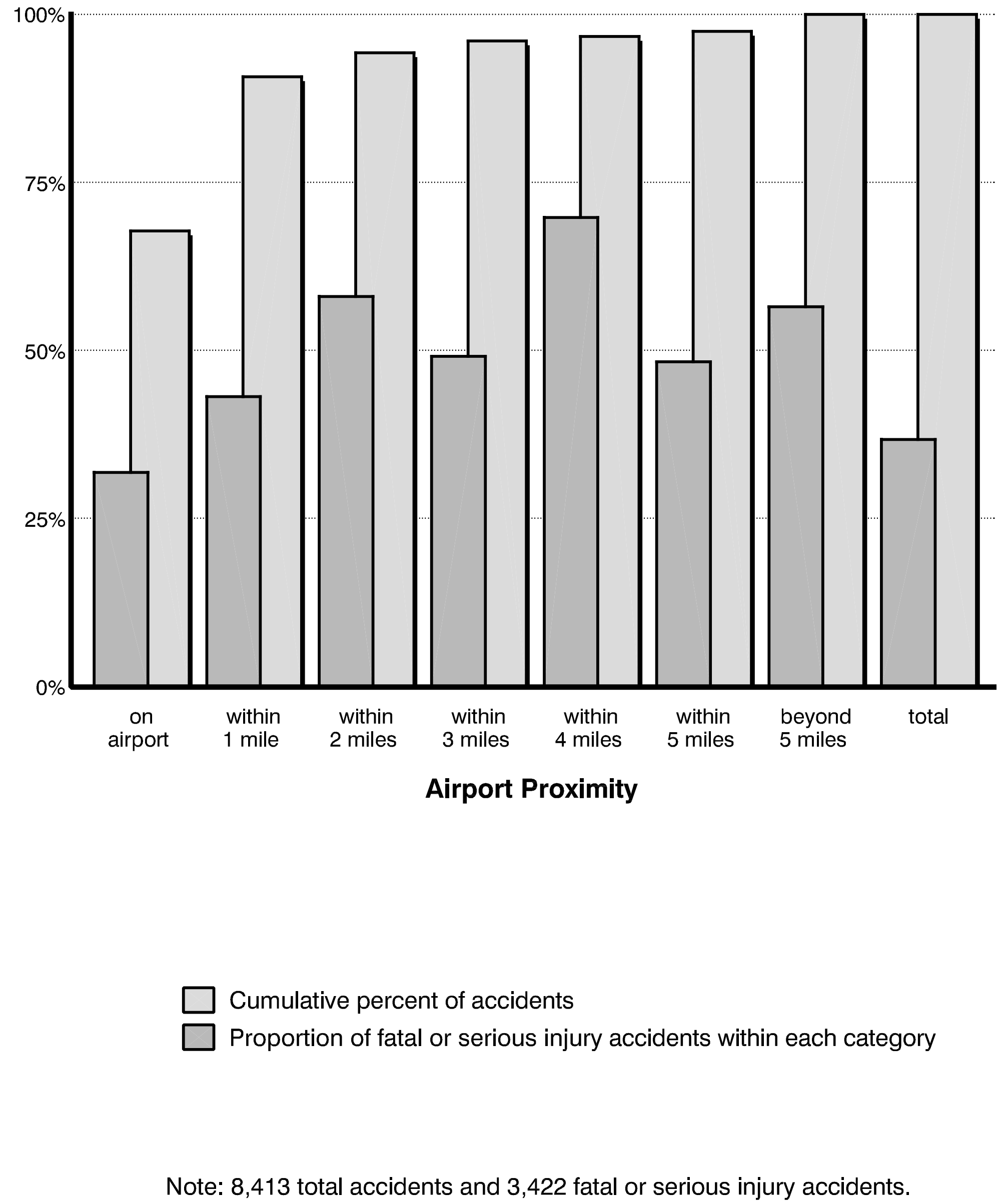
A vast amount of data on aircraft accidents is available from the National Transportation Safety Board, the primary repository of aircraft accident data in the U.S., and from the Federal Aviation Administration. As noted at the beginning of this chapter, however, data regarding the location of aircraft accidents is scarce.

Approximate Location Data

For each accident which the National Transportation Safety Board investigates, a *Factual Report* (NTSB Form 6120.4) is completed. Included in the report are data entries for *distance from airport center* and *direction from airport*. This information could be valuable for land use compatibility planning purposes if it were precisely documented. Its usefulness is limited, however, because the accident investigation form requires only that the data be given to the nearest statute mile.

A compilation of the NTSB accident proximity data for the years 1990 through 2000 for general aviation accidents is shown in Figure 8A. Figure 8B shows similar data for commercial aircraft.

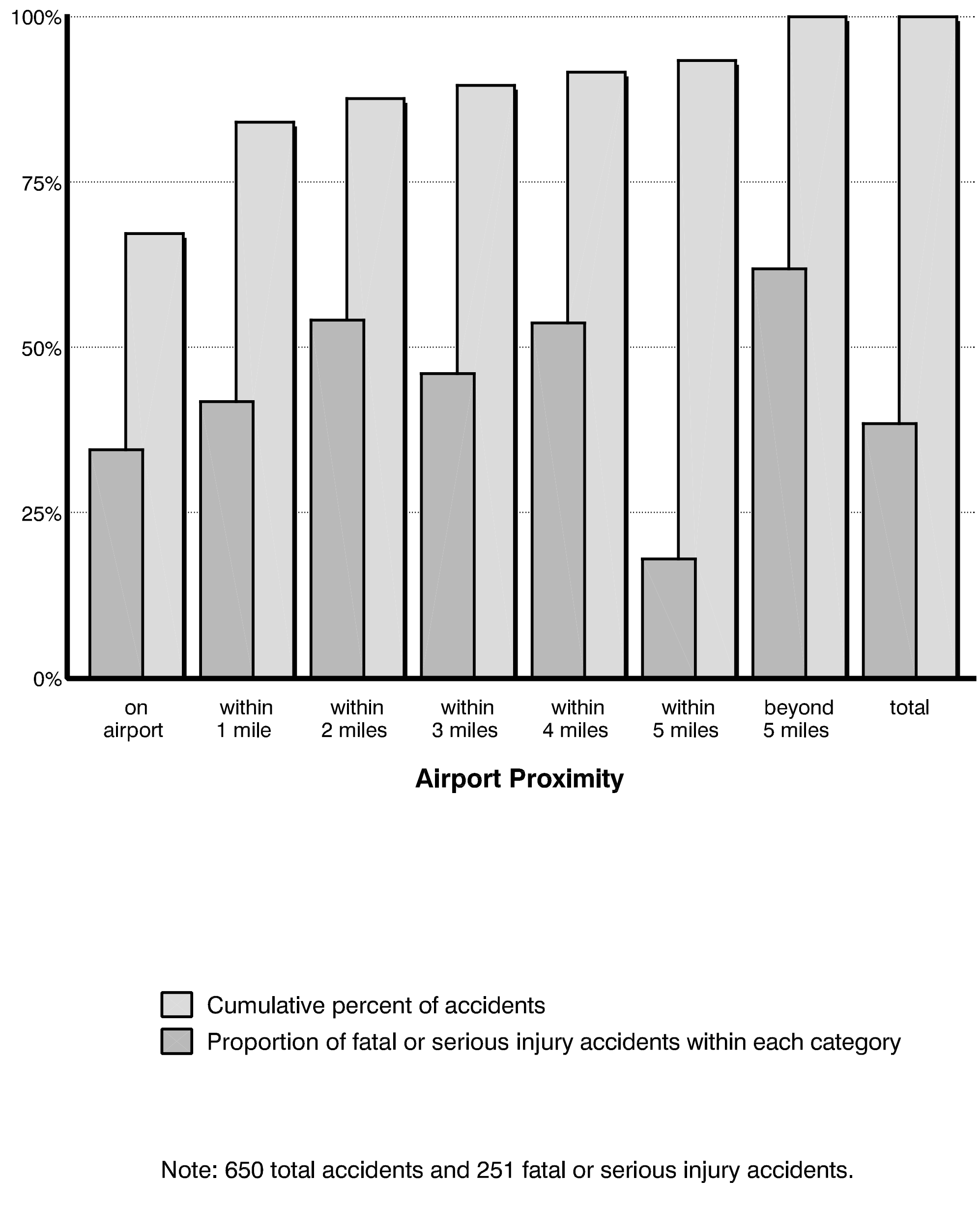
The NTSB has not published this in formation for later years in its *Annual Review of Aircraft Accident Data*. Nevertheless, the consistency of the numbers for the years examined suggests that the average remains basically valid today.



Source: Data compiled from NTSB Aviation Accident Database: General Aviation—Calendar years 1990–2000

FIGURE 8A

Proximity of General Aviation Accidents to Nearest Airport



Source: Data compiled from NTSB Aviation Accident Database: Air Carrier—Calendar years 1990–2000

FIGURE 8B

Proximity of Air Carrier Accidents to Nearest Airport

The data reveals that over two-thirds of both general aviation (68%) and commercial (67%) aircraft accidents take place on an airport. Another 3% of general aviation and 7% of commercial aviation are en route accidents—defined here as ones occurring more than 5 miles from an airport. This leaves 29% of general aviation and 26% of commercial aviation accidents which can be classified as airport-vicinity accidents, potentially including some en route accidents which happened to take place within 5 miles of an airport.

A somewhat more detailed set of data on commercial aircraft accident locations is one recently gathered by researchers in the United Kingdom (NATS–1997). Separate graphs show runway proximity of landing and take-off accidents in two dimensions: distance from the runway end and distance from the extended runway centerline (see Figure 8C).

Precise Location Data

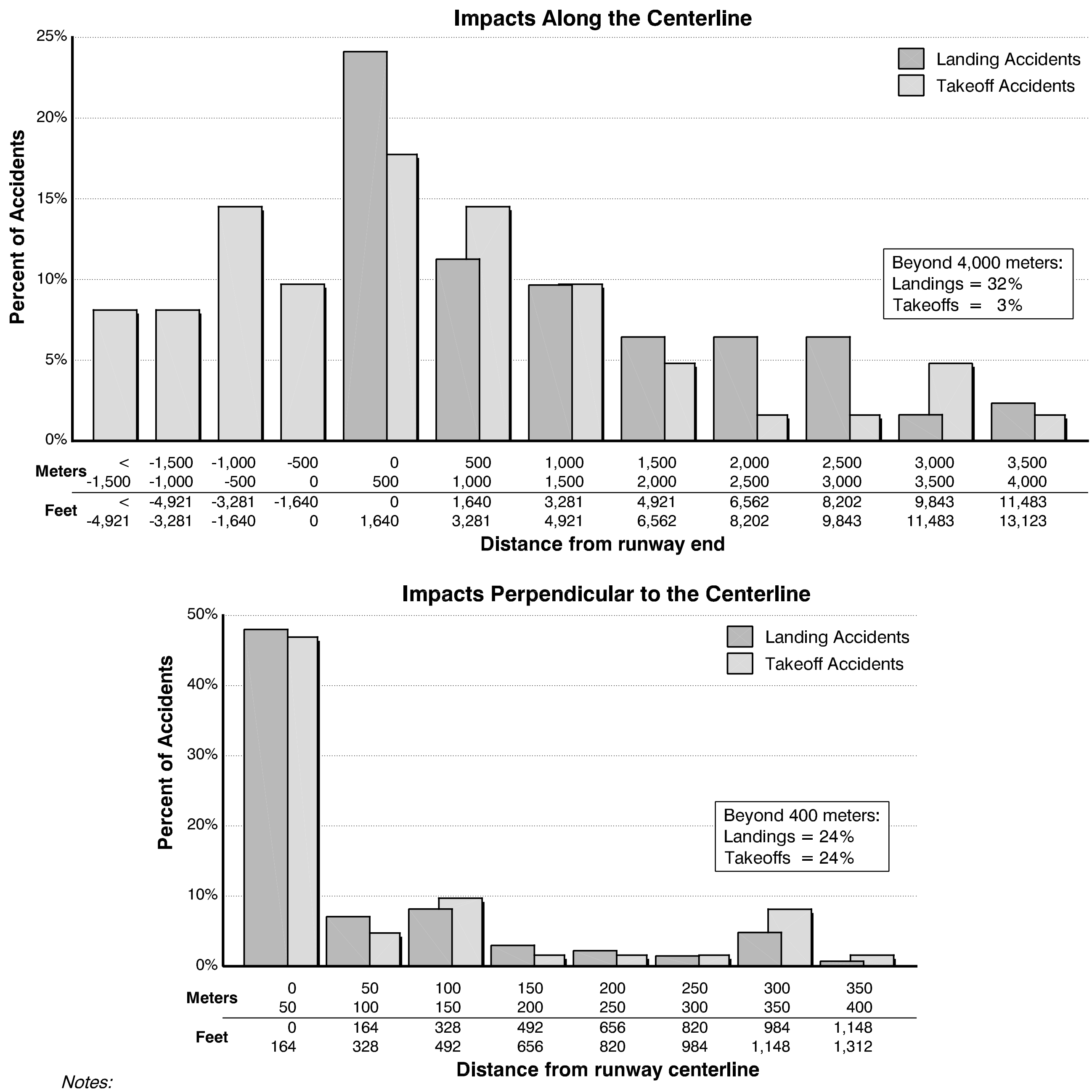
Several previous research efforts endeavored to document the type of precise aircraft accident location data which would be pertinent to airport land use compatibility planning. Although each of the studies provides significant information, all are limited in scope.

- **Report of the President's Airport Commission**—This commission, best known as the Doolittle Commission in honor of its chairman, James Doolittle, conducted one of the first comprehensive studies of the noise and safety relationships between airports and surrounding communities. The commission's 1952 report is valuable today for the historical perspective it gives to current airport compatibility issues. Among other things, the commission plotted the location of over 30 off-airport commercial and military aircraft crashes which caused death or injury to persons on the ground (there is no indication in the report that any data was gathered regarding non-injury accidents). Despite the rather limited database, the commission's report lead to the establishment of what became known as clear zones and are now called runway protection zones at the ends of airport runways.

See Chapter 9 for a description of APZs.

- **Department of Defense Air Installation Compatible Use Zone (AICUZ) Program**—The AICUZ program was established in 1973 as a joint effort of the several branches of the military. An element of the study leading to the creation of the program entailed assembly and analysis of data regarding the locations of military aircraft accidents around air bases. The data covered the period from 1968 through 1972 and included more than 300 major airfield-related accidents which occurred within 10 nautical miles of the runway. The study served to define areas of significant military aircraft accident potential, known as *Accident Potential Zones (APZs)*.

- **FAA Commercial Aircraft Accident Study**—A 1990 FAA study (*Location of Aircraft Accidents/Incidents Relative to Runways*) compiled data regarding the location of commercial aircraft accidents relative to the runway involved. Data was gathered by review of National Transportation Safety Board dockets containing the complete record of the board's investiga-



Notes:

- Data represents accidents involving commercial air carrier aircraft having a maximum authorized total weight of 4.0 metric tons or more. Locations are international and cover the period between 1970 and 1995.
- Takeoff and landing overrun accidents are excluded from this data.
- Landing percentages are based on 125 landing accidents occuring prior to the landing threshold; 55 landing accidents occurring beyond the threshold are excluded.
- Takeoff percentages are based on 62 takeoffs accidents; locations indicated are relative to the far (departure) end of the runway.

Source: National Air Traffic Services Limited, London; Third Party Risk Near Airports and Public Safety Zone Policy (1997)

FIGURE 8C

Runway Proximity of Air Carrier Accidents

International

tion of each accident. A total of 246 accidents and incidents occurring over a 10-year period (1978-1987) were included in the analysis. Of these, the majority (141) were limited to the immediate vicinity of the runway. Some 87 were classified as being either: a landing accident/incident in which the aircraft impacted with the ground more than 2,000 feet from the runway threshold; or a takeoff crash after the aircraft became airborne, but before it reached the first power reduction or VFR pattern altitude. Another 18 entries were landing undershoots occurring within 2,000 feet of the runway end. Figure 8D depicts the locations of the 16 landing (including 4 undershoots of more then 500 feet) and 23 takeoff accidents/incidents for which adequate locational data was available.

Theoretical Areas of High Accident Probability

Particularly useful in this regard is data on the phase of operation of aircraft at the time of an accident. Table 8A contains a summary of published NTSB data on this subject.

By examining the available data on types and locations of accidents in conjunction with information on airplane operational parameters as discussed earlier, it is possible to ascertain where accidents can theoretically be expected to occur most often.

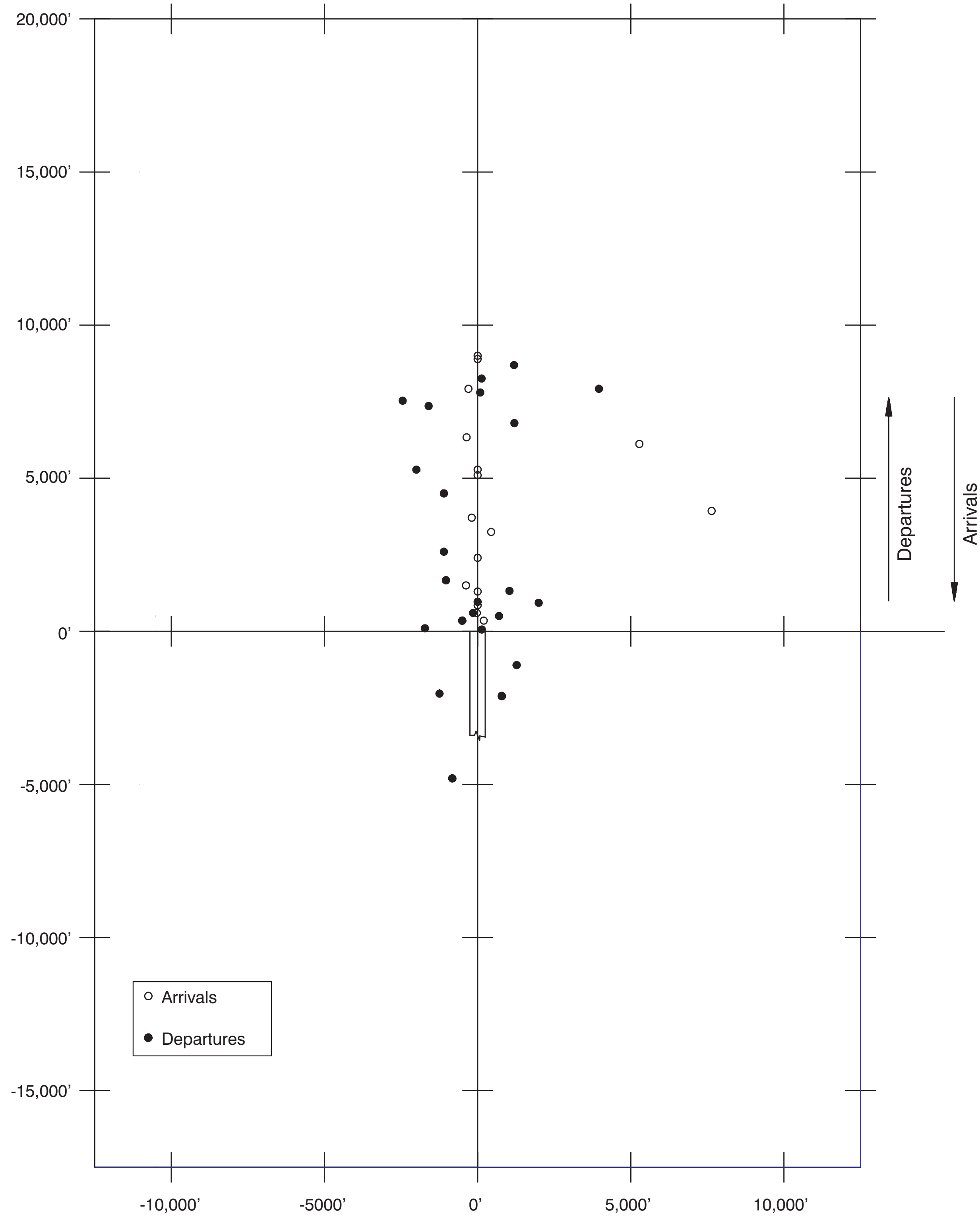
Approach/Landing Accidents

The great majority of general aviation aircraft landing accidents take place on or immediately adjacent to the runway. Indeed, NTSB data for the 1990 to 2000 period indicates that some three-fourths (77%) of all general aviation landing accidents occur during touchdown or roll-out (usually hard or long landings, ground loops, etc.). Although frequent in occurrence, these types of accidents seldom (less than 11% of the time) result in serious or fatal injuries.

The remaining 23% of general aviation landing accidents take place in the landing pattern, on final approach, or during a go-around attempt. A common circumstance that can result in an approach accident is pilot misjudgment of the aircraft descent rate and failure to add power soon enough to keep the aircraft in the air. Poor visibility, unexpected downdrafts, or tall objects beneath the final approach course can intensify this problem. Another prospective type of landing accident can occur if a pilot overshoots a turn from base to final and inappropriately cross controls the airplane rudder and ailerons while attempting to return to the runway alignment. The result can be a stall, spin, and uncontrolled crash.

The pattern for commercial aviation is less heavily weighted to the area on or near the runway (Table 8B). Accidents on or near the runway range from 64% for air carrier operations, to 51% for commuter operations, to 58% for air taxi operations.

These types of events all will tend to place the accident site fairly close to the extended runway centerline. Also, because lower altitude decreases the chances of successful recovery from unexpected conditions, accidents can be expected to be more common closer to the runway end than at points farther away.



Source: FAA Office of Safety Oversight (1990)

FIGURE 8D

Commercial Aircraft Accident Location Pattern

Phase of Operation	Percent of Total		Proportion Fatal/Serious	
Standing	1.1		34.6	
Taxi	3.5		11.0	
Takeoff	18.2		28.9	
In Flight				
Climb		2.8		46.3
Cruise		11.8		41.5
Descent		4.9		58.9
Maneuver		12.6		58.4
Total	32.1		46.3	
Landing				
Approach		10.0		42.5
Landing		33.9		11.3
Go-Around		0.3		27.3
Total	44.2		42.5	
Other/Unknown	0.9		83.6	
All Accidents	*100.0*		*31.4*	

Note: Data includes all (20,399) U.S. general aviation accidents by all aircraft types for the period 1990–2000.

Source: NTSB Aviation Accident Database — General Aviation, 1990–2000

TABLE 8A

Accidents by Phase of Operation

U.S. General Aviation Aircraft

Phase of Operation	FAR Part 121 Operations		Scheduled FAR Part 135 Operations		Nonscheduled FAR Part 135 Operations	
	Percent of Total	Proportion Fatal/Serious	Percent of Total	Proportion Fatal/Serious	Percent of Total	Proportion Fatal/Serious
Standing	10.3	11.4	7.0	4.3	2.3	2.3
Taxi	16.2	11.4	14.6	0.0	5.1	0.0
Takeoff	12.2	25.0	14.6	8.7	21.0	15.8
In Flight						
Climb	7.4	4.5	3.8	4.3	4.7	6.8
Cruise	18.5	13.6	9.7	23.9	21.8	30.6
Descent	10.3	0.0	5.9	4.3	3.0	4.9
Maneuver	1.1	0.0	5.9	13.0	8.1	12.8
Total	37.3	18.1	25.3	45.5	37.6	55.1
Landing						
Approach	7.0	15.9	16.8	37.0	13.3	21.5
Landing	12.2	4.5	17.8	0.0	18.7	2.6
Total	19.2	20.4	34.6	37.0	32.0	24.1
Other/Unknown	4.8	11.4	3.8	4.3	1.9	2.6
All Accidents	*100.0*		*100.0*		*100.0*	

Source: NTSB Aviation Accident Database—Air Carrier, 1986–1995

TABLE 8B

Accidents by Phase of Operation

U.S. Air Carrier Aircraft

Takeoff/Departure Accidents

Unfortunately, since 1990 NTSB has not distinguished between the various phases of takeoff in presenting accident data. Therefore, the latest available data is described here.

Data from the period 1974-1989 indicates that the greatest proportion of general aviation takeoff/departure accidents (some 65%) take place during the initial climb phase. (Equivalent data for commercial aviation is not available.) This finding is consistent with two factors:

- Aircraft engines are under maximum stress during the initial climb phase and thus somewhat more susceptible to mechanical problems than at other times; and
- On average-length runways, once an aircraft has begun to climb, it is often too late to make an emergency landing and stop on the runway without overshooting the far end.

With respect to where takeoff accidents occur, a much greater dispersion of sites can be hypothesized than is the case for landings. Landings all involve aircraft descending at similar angles toward about the same point on the runway. By comparison, more variables affect the three-dimensional path of aircraft takeoffs, even under normal conditions. For one, climb rates and other takeoff performance characteristics differ substantially from one aircraft type to another. Also, even for similar types of aircraft, the flight track and the altitude above any given point along it will vary depending upon the aircraft payload, piloting techniques, and the intended direction of flight after takeoff.

The differences in performance characteristics of single-engine versus twin-engine propeller airplanes is particularly illustrative.

➤ **Single-Engine Airplanes**—For single-engine airplanes, a high percentage of accidents can be expected to occur within 7,000 to 9,000 feet of the start of takeoff roll. This distance is calculated based upon an assumed occurrence of an engine failure at an altitude of 500 feet with the aircraft then gliding back down to the ground (and also assuming the ground level to be equal to that of the runway). As previously discussed, at altitudes above 500 feet, it should be possible to return to the runway for an emergency landing and most pilots will attempt to do so rather than continue straight ahead. At lower altitudes, the most prudent pilot action is to seek a landing site as close to straight ahead as practical.

➤ **Twin-Engine Airplanes**—With a twin-engine piston airplane, an engine failure on takeoff does not necessarily mean that the aircraft will immediately glide back toward the ground. The altitude at engine failure and the manner in which the remaining engine is operated thus add more variables to where the plane can be most expected to put down. If an engine failure occurs at or below best single-engine rate of climb speed (V_{yse}), the aircraft would normally be just airborne and controllable, but sometimes unable to climb. At these low speeds, the proper pilot action should be to reduce or shut off power to the remaining engine and glide back to the ground as would a single-engine airplane. At speeds slightly above V_{yse}, twin-engines airplanes may theoretically be capable of climbing, but for a pilot to make this happen under emergency conditions is difficult. Sometimes, a pilot will try to maintain power in the functioning engine, but then lose directional control of the aircraft and crash. A relatively wide dispersal of accident sites—both in distance from the start of takeoff and to either side of the extended runway centerline—can thus be predicted in theory.

Recent Research

In order to obtain accident location data for general aviation aircraft, basic new research was conducted for the 1993 edition of this *Handbook*. After investigating several possible data sources—principally direct contact with individual airports versus review of the NTSB *Factual Reports*—the latter method was found to provide the most complete and consistent data. The research was conducted by the Institute of Transportation Studies at the University of California, Berkeley. For the 2002 edition of the *Handbook*, this database was expanded. The current database resulting from this research:

- Encompasses all 50 states (although several have no accidents represented);
- Covers a time period from 1983 into 1992;
- Contains data only on accidents, not incidents;
- Contains a total of 873 aircraft accident records (445 arrivals and 428 departures); and
- Includes all types of general aviation airplanes, but not airline air craft, helicopters, or other aircraft types (ultralights, blimps, etc.), or military aircraft.

See Appendix E for a more complete description of the data sources considered, the research methodology employed, and the specific data included in the database.

A somewhat broad definition of airport vicinity was used for the purposes of this research. Airport size was recognized as being a significant determinant of whether an accident site a certain distance beyond the runway is on or off the airport property. Consequently, all accidents not confined to the immediate vicinity of the runway or its associated safety zones are included in the database. For the outer boundary of the airport vicinity, a 5-mile radius—measured from the airport center in accordance with the NTSB data format—was selected.

Aircraft Accident Location Patterns

The following paragraphs highlight notable findings from the expanded general aviation accident database. Comparative data from other sources is indicated where applicable. Table 8C presents a numeric summary of the percentages of various categories of accidents represented in the database. Selected distance data is listed in Table 8D. Table 8E summarizes some comparative NTSB accident data for all U.S. general aviation aircraft accidents, both on-airport and off. Similar NTSB data for air carrier accidents is contained in Table 8F.

Category Accidents Involving:	All Accidents		Arrival Accidents		Departure Accidents	
Total Database	873	100.0%	445	100.0%	428	100.0%
Runway Length						
Less than 4,000 ft.	344	39.4%	153	34.4%	191	44.6%
4,000 ft. to 5,999 ft.	281	32.2%	150	33.7%	131	30.6%
6,000 ft. or more	248	28.4%	142	31.9%	106	24.8%
Unknown	0	0.0%	0	0.0%	0	0.0%
Approach Type						
Visual Approaches			343	77.1%		
Nonprecision Approaches			27	6.1%		
Precision Approaches			70	15.7%		
Unknown			5	1.1%		
Time						
Dawn	10	1.1%	7	1.6%	3	0.7%
Day	603	69.1%	262	58.9%	341	79.7%
Dusk	37	4.2%	29	6.5%	8	1.9%
Night	222	25.4%	147	33.0%	75	17.5%
Unknown	1	0.1%	0	0.0%	1	0.2%
Weather Conditions						
VFR	688	78.8%	328	73.7%	360	84.1%
IFR	182	20.8%	117	26.3%	65	15.2%
Unknown	3	0.3%	0	0.0%	3	0.7%
Aircraft Type						
Single-Engine Propeller	636	72.9%	305	68.5%	331	77.3%
Twin-Engine Propeller	235	26.9%	140	31.5%	95	22.2%
Business Jet	2	0.2%	0	0.0%	2	0.5%
Pilot Control						
Some	164	18.8%	71	16.0%	93	21.7%
None	665	76.2%	357	80.2%	308	72.0%
Unknown	44	5.0%	17	3.8%	27	6.3%
In-Flight Collision with Object						
Yes	280	32.1%	148	33.3%	132	30.8%
No	593	67.9%	297	66.7%	296	69.2%
Aircraft Damage						
Destroyed	568	65.1%	260	58.4%	308	72.0%
Substantial	303	34.7%	185	41.6%	118	27.6%
Unknown	2	0.2%	0	0.0%	2	0.5%
Consequences						
Onboard Fatalities	463	53.0%	212	47.6%	251	58.6%
Ground Fatalities	6	0.7%	2	0.4%	4	0.9%
Onboard Serious Injury	228	26.1%	104	23.4%	124	29.0%
Ground Serious Injury	6	0.7%	2	0.4%	4	0.9%
Traffic Pattern Direction						
Left	684	78.4%	353	79.3%	331	77.3%
Right	117	13.4%	59	13.3%	95	13.6%
Unknown	72	8.2%	33	7.4%	2	9.1%

Note: Numbers in each category may not add to 100% because of mathematical rounding or missing data in some records.

TABLE 8C

Accident Characteristics: Proportions

General Aviation Aircraft Accident Database

	Mean Distances (Feet)			
	All Operations	**Arrivals**	**Departures**	**Normalized Departures**
Runway Length				
All Categories	4,938	5,152	4,715	
Accident Location				
All Categories		2,801	5,514	799
Aircraft Type				
Single-Engine		2,092	4,959	669
Twin-Engine		4,347	7,446	1,320
Pilot Control				
Some		2,422	5,581	1,083
None		2,767	5,404	562
Visibility				
VFR		1,716	5,196	700
IFR		5,844	7,150	1,152
Time of Day				
Dawn/Daylight/Dusk		2,006	5,038	594
Night		4,430	7,681	1,813
Swath Length				
All Accidents	197	236	158	
Pilot Control				
Some	220	186	244	
None	183	231	130	

	Median Distances (Feet)			
	All Operations	**Arrivals**	**Departures**	**Normalized Departures**
Runway Length				
All Categories	4,600	4,997	4,300	
Accident Location				
All Categories		1,000	4,684	600
Aircraft Type				
Single-Engine		520	4,177	500
Twin-Engine		2,276	6,946	1,131
Pilot Control				
Some		1,320	4,753	779
None		788	4,561	478
Visibility				
VFR		475	4,427	500
IFR		4,200	7,051	1,738
Time of Day				
Dawn / Daylight / Dusk		500	4,417	500
Night		2,798	7,337	1,481
Swath Length				
All Accidents	100	145	75	
Pilot Control				
Some	144	135	147	
None	89	140	54	

Notes:
- All distances rounded to nearest 10 feet.
- Accident location distances calculated along runway centerline, ignoring offset to left or right. Arrival distances measured from landing threshold; departure distances measured from start of takeoff roll; normalized departure distances from departure (climb-out) end of runway.
- Information on the degree of pilot control at the time of aircraft contact with the ground is unknown for many accidents, including some for which swath length data was available. This factor accounts for the "all accidents" swath length exceeding the lengths for both "some" pilot control and "none."

TABLE 8D

Accident Characteristics: Distances

General Aviation Aircraft Accident Database

	Percent of Total Accidents	Proportion Fatal/Serious
Time of Day		
Dawn/Daylight/Dusk	85.6 [a]	28.5 [a]
Night	14.4	45.0
Weather Conditions		
VFR	55.5 [a]	26.4 [a]
IFR	45.5	46.7
Aircraft Damage		
Destroyed	25.3 [a]	
Substantial	72.5	
Minor/None	2.2	
Type of Injuries		
Fatal	19.7 [a]	
Serious	11.3	
Minor/None	69.0	
Aircraft Damage		
Single-Engine Airplanes	89.1 [b]	17.2 [b]
Twin-Engine Airplanes	8.9	29.9
Turboprop	0.5	32.0
Business Jet	8.3	15.0
Helicopter	2.8	11.5
Other	1.5	34.4

Notes:

- Comparable data not available for all years. Data shown is tabulated for the following years:
  [a] 1990–2000 [b] 1975–1997
- Data includes all general aviation accidents, both on- and off-airport.

Source: [a] *Data compiled from NTSB, Aviation Accident Database (1990–2000) and*
[b] *Annual Review of Aircraft Accident Data (1997)—General Aviation*

TABLE 8E

Selected NTSB Accident Data

U.S. General Aviation Aircraft

	Percent of Total Accidents	Proportion Fatal/Serious
Time of Day		
Dawn/Daylight/Dusk	60.7	29.7
Night	39.3	29.6
Weather Conditions		
VFR	33.4	29.4
IFR	66.6	28.3
Aircraft Damage		
Destroyed	16.7	
Substantial	42.2	
Minor/None	41.1	
Type of Injuries		
Fatal	15.6	
Serious	14.4	
Minor/None	70.7	

Notes:

- Comparable data not available for all years. Data shown is tabulated for the years 1990–2000.
- Data includes all air carrier accidents, both on- and off-airport.

Source: Data compiled from NTSB, Aviation Accident Database (1990–2000)

TABLE 8F

Selected NTSB Accident Data

U.S. Air Carrier Aircraft

The complete set of general aviation accident location pattern exhibits, including depiction of the various data subsets discussed in this section, are found in Appendix F.

The spatial distribution of general aviation aircraft arrival and departure accidents is illustrated in Figures 8E, 8F, and 8G. As described below, the departure accident location patterns are presented in two different formats.

Arrival versus Departure Difference

See Appendix E, Exhibit E-1, for the criteria used to distinguish between arrivals and departures for circumstances such as touch-and-goes and missed approaches.

The first question assessed in review of the accident location data was to determine how the pattern of aircraft landing accidents differs from the pattern for takeoff accidents. An important issue in this analysis is what point to use as a common reference within each of these accident categories.

➤ **Arrivals**—For landing accidents, this decision is easy. The landing threshold, whether it be the actual runway end or a displaced threshold, is the relevant point. Figure 8E and Exhibit F-1 illustrate the spatial distribution of all arrival accidents occurring within 25,000 feet of the runway landing threshold.

As used herein, the departure end of the runway is the end which the aircraft passes on takeoff and climb-out.

➤ **Departures**—For takeoffs, two choices of common reference point are apparent: the beginning point of the takeoff roll and the departure end of the runway. Except for touch-and-goes and intersection departures, the runway length represents the difference between the two points. Each of these choices has theoretical merits as to the utility of the information provided.

- Measuring from the start of takeoff roll recognizes the fact that, once an aircraft is airborne, the location of many accidents is independent of the runway length.
- On the other hand, circumstances resulting in an accident 2,000 feet beyond the end of a 5,000-foot runway might result in nothing more than an emergency landing on a 10,000-foot runway. *Normalizing* the data by measuring from the departure end of the runway thus takes into account the significance of runway length in many departure accidents.

Figure 8F and Exhibit F-2 plot the departure accidents relative to the start of takeoff roll. Figure 8G and Exhibit F-3 show the normalized location pattern. As can be expected, the clustering of points is much tighter when measured from the departure end of the runway.

The total number of accidents in the database is split almost equally between arrivals and departures. By comparison, NTSB data indicates that general aviation landing accidents occur about twice as often as takeoff accidents (Table 8A). The substantial number of landing accidents which take place on or near the runway accounts for most of this difference. Since these accidents do not have land use compatibility implications, they are not included in the *Handbook* database.

Effects of Runway Length

See Appendix F for these exhibits.

Another means of factoring out the runway length variable for departure accidents is to individually assess the location distributions associated with

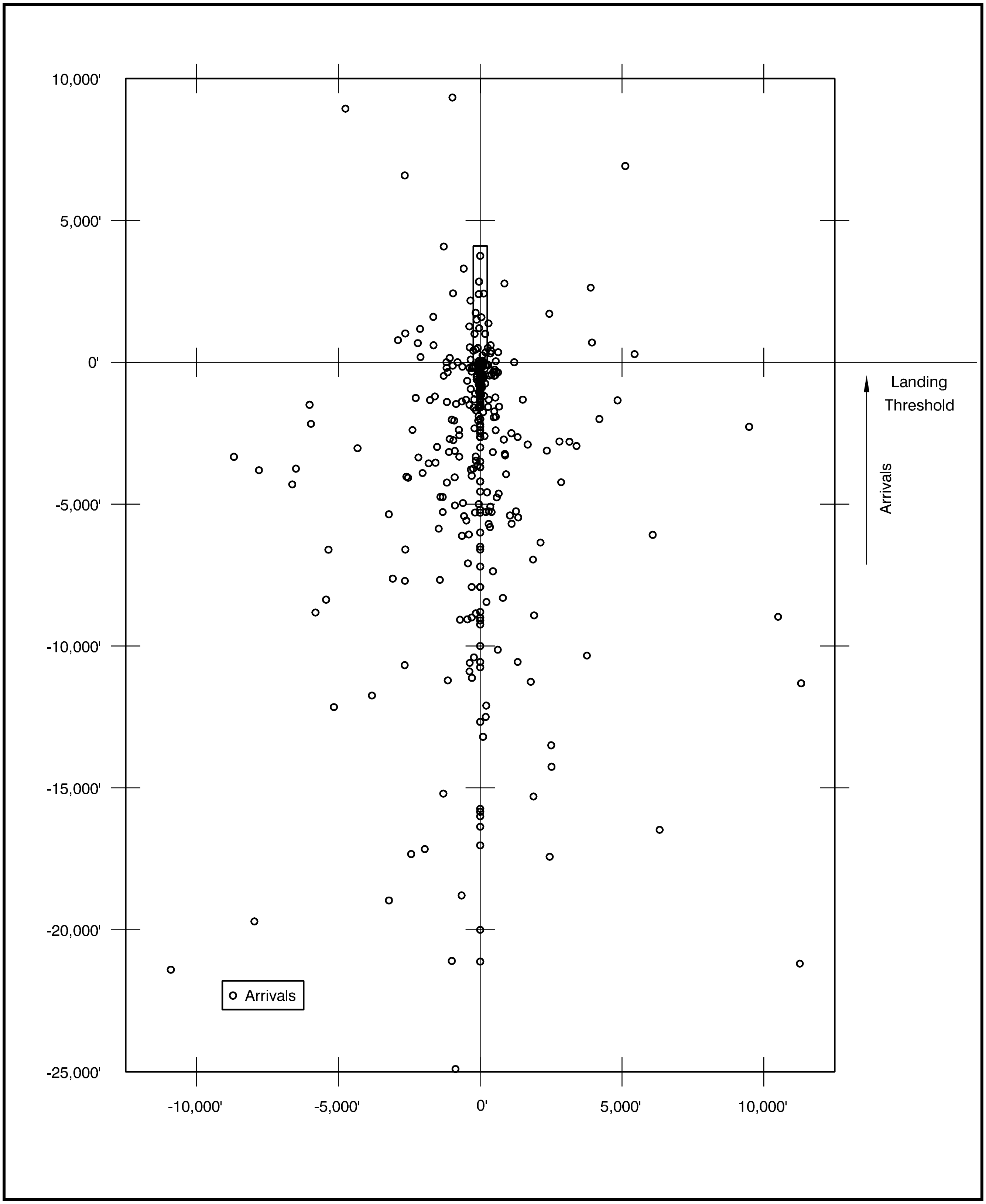


FIGURE 8E

Arrival Accidents

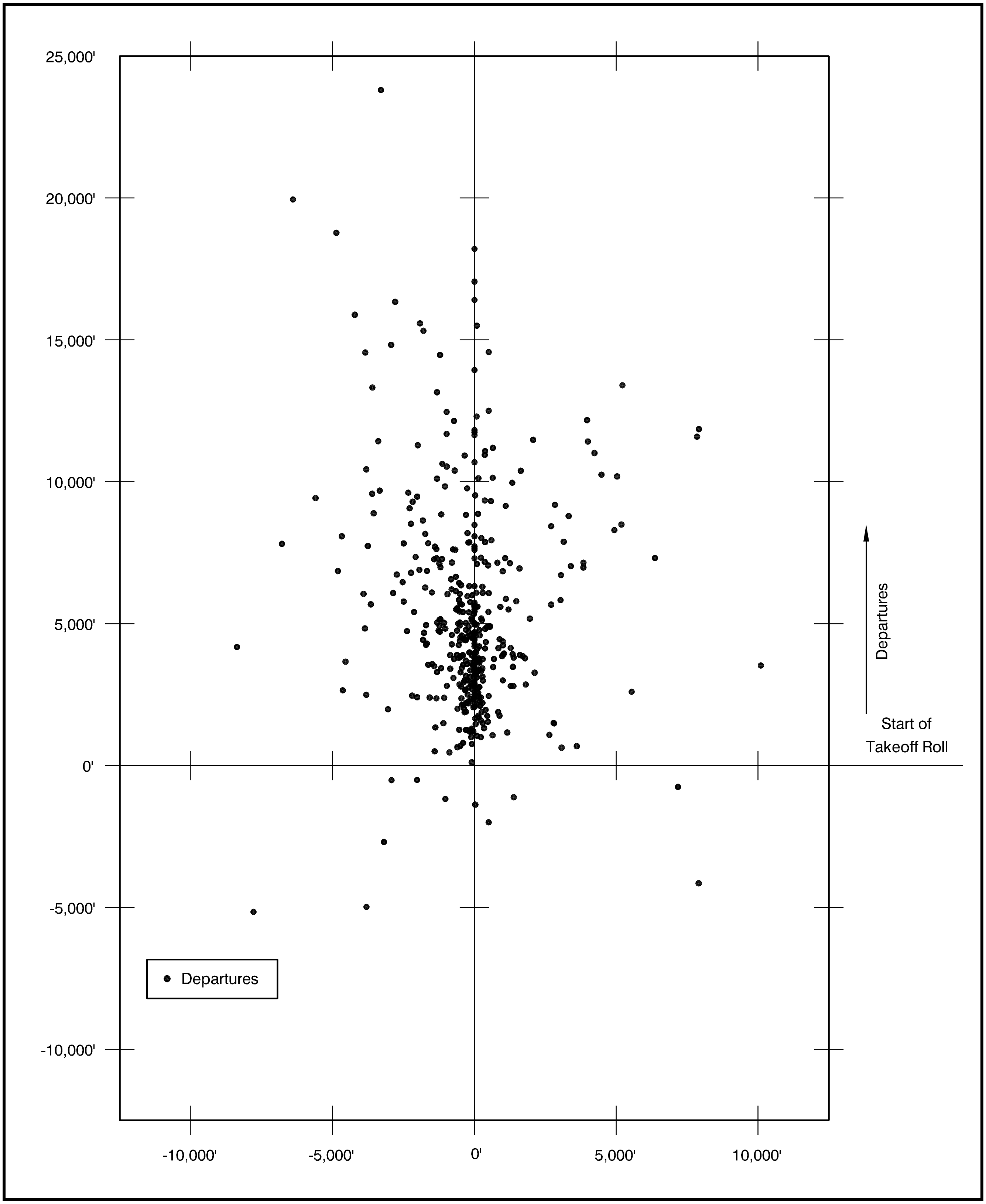


FIGURE 8F

Departure Accidents

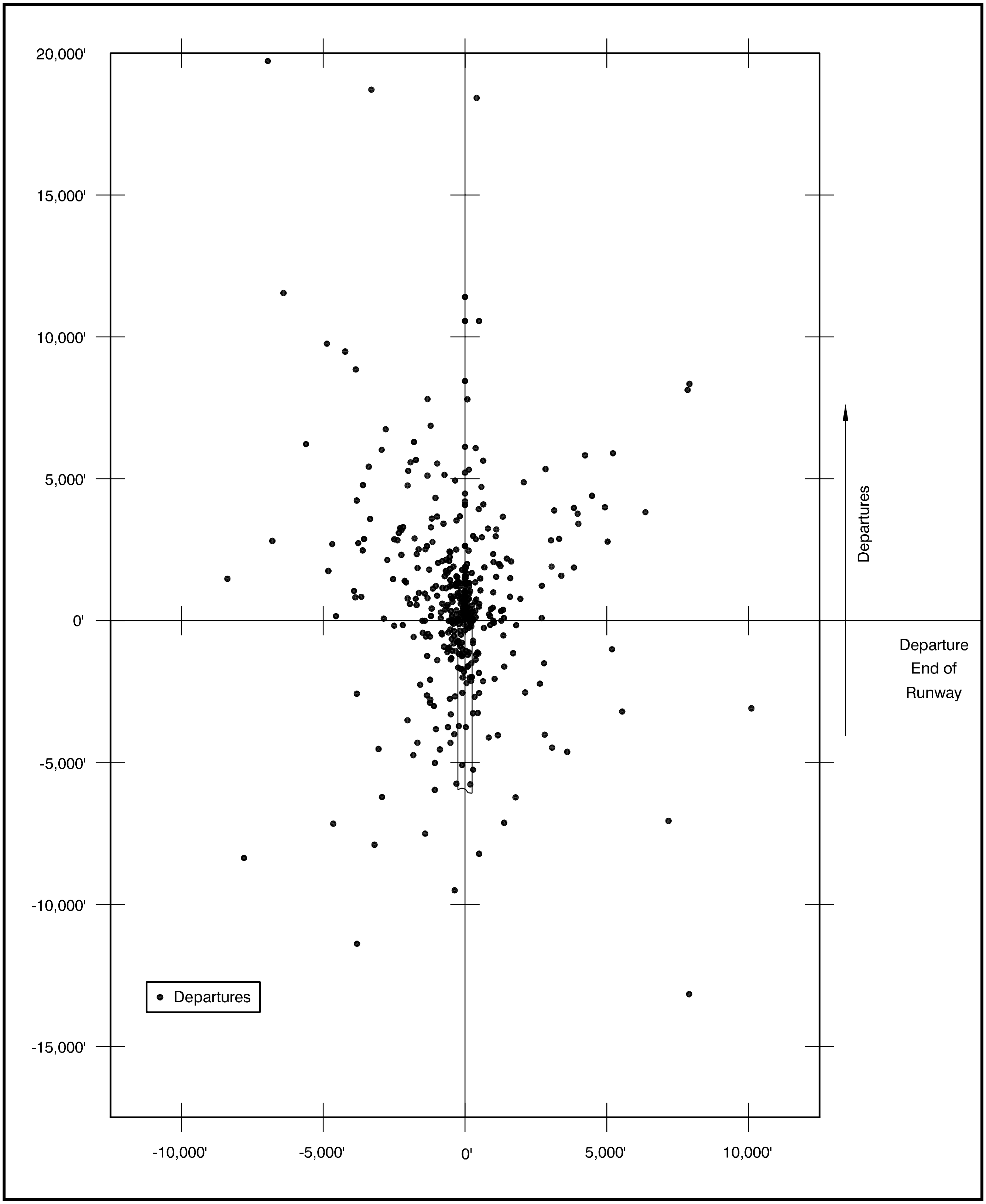


FIGURE 8G
Departure Accidents, Normalized

different length runways. Exhibits F-4, F-5, and F-6 illustrate the results for runway lengths of less than 4,000 feet, 4,000 to 5,999 feet, and 6,000 feet or more, respectively. The sites of the departure accidents are plotted with respect to the start of takeoff roll.

One finding apparent from these illustrations is that the longer the runway, the greater the spread of departure accident locations. Nevertheless, the locations tend to be most closely bunched around the end of the median length runway in each of these groups.

Another, perhaps somewhat surprising, variable revealed by the three charts is that arrival accidents also are more spread out for longer runways than for shorter ones. A review of the data suggest several possible explanations for this phenomenon:

- Almost half (49%) of all accidents on runways of 6,000 feet or more are by twin-engine aircraft compared to only 12% on runways under 4,000 feet.
- Long runways have more IFR accidents—44% for runways of 6,000 feet or more, 4% for runways of less than 4,000 feet.
- Similarly, for nighttime accidents, more occur on long runways (45%) than on short ones (16%).

Aircraft Type Variables

Single-Engine Propeller Airplanes

Not certain from the accident records is whether accident locations reported as being on the extended runway centerline might actually be several hundred feet off to the side, especially for accidents occurring some distance from the runway end. It is apparent from NTSB reports that precision in terms of accident site location was not a high-priority objective. Every effort was made in the review of the records to determine the accident location as precisely as possible, but the actual number of points truly on centerline is probably less than shown in the database.

Exhibit F-7 illustrates the pattern of off-airport landing and takeoff accidents by single-engine propeller airplanes. As hypothesized above, the accident locations tend to be clustered close to the runway ends and also relatively near the extended centerline. For approach/landing accidents, the median distance is 520 feet from the landing threshold. For takeoffs/departures, the median distance is 500 feet from the departure end of the runway and 4,177 feet from the start of takeoff roll. Also, almost 90% of the departure accident points lie within 9,000 feet of the start of takeoff roll.

Multi-Engine Airplanes

The database indicates that the accident locations for twin and other multi-engine airplanes, including jets, are comparatively more stretched out than those for single-engine airplanes. Exhibit F-8 depicts the distribution. The majority of the approach/landing accidents are within 500 feet of the extended runway centerline, but the median distance is more than 2,200 feet from the landing threshold. The takeoff/departure accidents are widely scattered as conjectured in the earlier discussion of aircraft and pilot performance during emergencies. Although the median accident site distance is some 1,100 feet from the departure end of the runway, the sites are spread about evenly in the 5,000 to 10,000-foot range measured from the start of takeoff roll.

Airline Aircraft

The project database does not include airline aircraft accidents. For an assessment of these accidents, reference should be made to the FAA commercial aircraft accident study cited earlier in this chapter.

Helicopters

Data comparable to that presented here for airplanes may exist in NTSB *Factual Records*, but has not been compiled in any published source. The most detailed assessment of helicopter accident locations currently available is one documented in two reports prepared for the Federal Aviation Administration—*Analysis of Helicopter Mishaps at Heliports, Airports, and Unimproved Sites* and *Analysis of Helicopter Accident Risk Exposure near Heliports, Airports, and Unimproved Sites* (SCT–1991 and SCT–1992). This study found that (between 1977 and 1986) some 37% of helicopter accidents took place on or within 1 mile of a landing site whether it be at an airport, a heliport, or other location. Among all types of helicopter mishaps (accidents plus incidents), 60% involved obstruction strikes—38% at the landing site and 22% within 1 mile. The majority of the latter group were wire strikes and in each case the wires were unmarked. This finding lead the authors of the study to recommend the marking of wires and other objects within a buffer zone below the standard 8:1 approach/departure surface slope of helicopter facilities.

Three additional observations are worth noting regarding helicopter accident locations:

- Because helicopter landing sites are small, a substantial proportion likely occur, or affect locations, beyond the landing site boundaries.
- Helicopters can take off and land in almost any direction from a heliport, obstacles and wind direction permitting.
- Beyond the immediate vicinity of the landing site, helicopter flight tracks may be widely divergent unless specific procedures are established for a given airport or heliport (the FAR Part 77 approach/departure surface for helicopter landing pads is 4,000 feet in length).

Pilot Control Variables

In the discussion of emergency procedures earlier in this chapter, the point was made that a pilot will, if possible, normally attempt to steer the aircraft to an open area when an emergency landing is unavoidable. A general assumption has been that most aircraft are under some control when forced down. The extent of pilot control was therefore one of the variables assessed in the review of the accident Factual Records.

The results of the research were surprising: in over three-fourths of the cases included in the database, the aircraft was not under control when it hit the ground. A probable explanation for this number being so high is that the database includes only accidents, not incidents. Thus, if a pilot makes a successful emergency landing without causing serious injuries or substantial damage, the event is classified as an incident and does not appear in NTSB records even if the landing site is not an airport runway.

Exhibits F-9 and F-10 show the location patterns for accidents in which there was some pilot control and no pilot control, respectively.

Other Variables

Weather Conditions

Exhibits F-11 and F-12 show the respective distributions of accidents which took place during visual flight rules (VFR) weather conditions versus those occurring during instrument flight rules (IFR).

A comparison of the two figures indicates that IFR arrival accidents tend to occur farther from the end of the runway than VFR accidents do—a median distance of nearly 4,200 feet from the runway approach end for IFR arrivals versus 475 feet for VFR landings.

Time of Day

NTSB data (for 1990 to 2000) reveals that approximately 86% of all general aviation accidents and 61% of commercial aircraft accidents take place during dawn, daylight, or dusk, with about 14% general aviation accidents and 39% of commercial aviation accidents occurring in hours of darkness (officially, one hour after sunset to one hour before sunrise). No definitive data is available on the percentage of aircraft takeoffs and landings made at night. A reasonable estimate is 7% to 10%, although the number varies substantially from one airport to another. The higher incidence of commercial aviation accidents at night is consistent with the expected greater number of commercial operations at night.

Of all the accidents in the *Handbook* database, approximately 25% took place at night. Moreover, nighttime accounted for over 30% of the arrival accidents in the database. If these figures are representative of all off-airport accidents, they suggest that nighttime increases the propensity for accidents to occur beyond the runway environment.

Exhibits F-13 and F-14 show the locational distributions of dawn/daylight/dusk versus nighttime accident sites. As can be seen, the nighttime accident sites are generally farther from the runway than are the daytime accident sites—the median is some 2,300 feet greater for arrivals and 980 feet more for departures.

Single-Sided Traffic Patterns

For most runways, aircraft make left-hand turns as they approach for landing or when they takeoff and remain in the traffic pattern. On some runways, any of a variety of factors may dictate a right-hand pattern. Accidents in the *Handbook* database include a mixture of both situations. A reasonable expectation is that the distribution of accident sites would look somewhat different around runways which have the traffic pattern only on one side.

Surprisingly, though, no significant difference is apparent from a comparison between Exhibit F-15 which shows accidents for runways indicated to have left-hand patterns and Exhibits F-1 and F-2 which represent all accidents.

NATURE OF IMPACT

The nature of the impact that occurs when a small aircraft comes down off airport can vary from a nearly normal landing to a catastrophic crash. When the aircraft remains under control and a reasonably open emergency landing site can be found, the impact can be relatively minor—the potential for injury to people on the ground is small and the aircraft occupants have a strong probability of surviving. The most serious accidents, in terms of risks to people on the ground as well as to the aircraft occupants, are those in which the pilot either:

- Loses control of the aircraft and, because of damage, low altitude, or improper procedures, is unable to regain control; or
- Is unable to select a reasonable forced landing spot because of darkness, fog, or the nonexistence of such a spot.

The following discussion examines available data and theoretical findings regarding the nature of the impact from an aircraft accident.

Severity

As can be expected, off-airport aircraft accidents tend to be more severe than those occurring on or near a runway. The accident database summary (Table 8C) indicates that the aircraft is destroyed in some 65% of off-airport accidents. Moreover, fatal injuries occur about half of the time—48% for arrival accidents and 59% for departure accidents. By comparison, NTSB data (Table 8E) shows that for all accident locations, the rates for destroyed aircraft and fatal injuries have been only 25% and 20%, respectively. In commercial aviation accidents, the rates are slightly lower: in 17% of accidents the aircraft is destroyed and in 16% a fatality occurs (Table 8F).

It must be remembered, however, that these figures are relative to the total number of *accidents*. No information is available regarding how often aircraft make an emergency landing on or off of an airport without incurring substantial damage or resulting in serious or fatal injuries. Nevertheless, the percentage involving severe consequences is undoubtedly much less when all mishaps (incidents as well as accidents) are taken into account.

Darkness and poor weather both adversely affect the severity of accidents. According to NTSB data, about 29% of dawn/daylight/dusk accidents involving general aviation aircraft result in serious or fatal injuries, compared to nearly 45% of the night accidents. About 30% of commercial aviation accidents during the dawn/daylight/dusk period result in fatalities or serious injuries with about the same percentage at night. Likewise, general aviation IFR accidents have serious or fatal results about half (47%) of the time, whereas only a quarter (26%) of VFR accidents have such severe consequences.

General Aviation Aircraft Accident Swath

Swath length is defined as the distance between where an aircraft first touched the ground or an object on the ground and where it subsequently came to a rest.

One of the variables examined during the review of NTSB accident re cords was the swath length associated with each accident. Adequate information with which to assess this factor was available in only about 53% of the Factual Records. Among the conclusions reached regarding the accidents represented in the database are:

- The median swath length for all general aviation accidents is only about 100 feet.
- Accidents in which the aircraft was under some pilot control typically have longer swath lengths (144 feet on average) than those where the aircraft was out of control (an average of 89 feet).

Accidents Involving Collisions with Objects

Aircraft collisions with objects on the ground can be the cause of accidents or simply a secondary factor in the consequences of the event. Historically, the NTSB's annual reviews of general aviation accident data included counts of accidents in which objects were a cause or factor. Unfortunately, the NTSB discontinued the detailed documentation of this information in 1990. Therefore, the most current data available have been used (1982-1989). Table 8G presents a summary of this data.

In evaluating the data's significance, several points should be recognized:

- The data includes accidents involving all types of aircraft helicopters, hot air balloons, etc.), not just airplanes.
- The location of the objects involved may be either on or off airport.
- The counts include accidents during all phases of aircraft opera tion—taxiing accidents, as well as those during approaches, departures, or en route.
- No distinction is made between accidents in which the objects listed were the cause versus ones in which they were only involved in a secondary manner.
- The severity of the accidents is not reflected in the data.

A particularly noteworthy finding of the data is the relative rarity of accidents involving residences or other buildings. For an 8-year period (1982–1989), the annual average was only 8.1 for residences and 9.9 per year for other buildings. These numbers represent 0.3% and 0.4% of total accidents, respectively. An earlier study by the Aircraft Owners and Pilots Association (AOPA–1985) for the years 1964–1982 showed a higher average number of collisions with residences and other buildings—a total of 29.6 per year (also summarized in Table 8E). However, more aircraft operations, as well as nearly 65% more accidents, took place annually during that period compared to the more recent data. The percentage of annual accidents involving residences and buildings thus averages only about 0.65% in both data sets.

Considering that the *Handbook* database contains only near-airport accidents and only those for which precise location data was available, the results are consistent with the NTSB data. Over the 10-year period covered

	Average Number/Year	% of Category	% of All Accidents
Accidents Involving Objects on the Ground (1982–1989) [a]			
Type of Object Involved			
Residences	8.1	1.4	0.3
Other Buildings	9.9	1.7	0.4
Fences/Walls	88.0	15.1	3.2
Poles/Towers	26.4	4.5	1.0
Wires	108.3	18.6	3.9
Trees	242.5	41.7	8.8
Other Objects	98.3	16.9	3.6
Total - All Objects	581.4	100.0	21.2
All Accident Types	2,742.0		100.0
Accidents Involving Buildings and Residences (1964–1982) [b]			
Phase of Flight			
On-Ground	9.1	30.8	0.20
Traffic Pattern	17.8	60.1	0.40
In-Flight	2.7	9.1	0.06
Total	29.6	100.0	0.66
Type of Injuries On-Board or On-Ground			
Fatal	3.7	12.5	0.08
Serious	4.4	14.9	0.10
Minor/None	21.5	72.6	0.48
Total	29.6	100.0	0.66
Type of Injuries to People On-Ground			
Fatal	0.5	27.8	0.011
Serious	0.6	33.3	0.013
Minor/None	0.7	38.9	0.016
Total	1.8	100.0	0.040
All Accident Types (1964–1982)	4,510.0		100.0
Type of Injury			
Fatal	1.8	28.7	
Serious	1.3	20.5	
Minor/None	3.3	50.8	
Total	6.4	100.0	

Source: [a] *NTSB, Annual Review of Aircraft Accident Data—General Aviation, 1982–1989*
[b] *Aircraft Owners and Pilots Association (1985)*

TABLE 8G

Accidents Involving Objects or People on the Ground

by the database, some 30 of the 873 accidents involved a collision with a residence (3.0 per year) and 18 involved other buildings (1.8 per year).

Effects of an Aircraft Collision with a Building

Data regarding the probable effects of a small aircraft colliding with a typical house or other small building is documented in a 1985 study (H&S–1985). The research entailed a search for previous studies on the subject, review of historical accident records, and interviews with building demolition experts and aircraft salvage companies. Consider-ation was also given to what effects might theoretically be predicted.

Variables

The consequences of an aircraft collision with a building were found to be affected by many variables. Among the primary ones are:

- The aircraft weight;
- The amount of fuel on board;
- The speed of the aircraft, both horizontally and vertically, at the time of the collision;
- The angle of contact with the structure (i.e., glancing or head-on);
- The aircraft attitude when the collision occurs;
- The extent of aircraft disintegration upon impact;
- The type of building construction, particularly the composition of the surface struck by the aircraft; and
- The occurrence and extent of fire after the impact.

Conclusions

The study determined that the combination of these variables is so great as to preclude definitive conclusions. The effects can only be estimated within a wide range of possibilities. To the extent that any meaningful conclusions can be reached from the data obtained, they can be summarized as follows:

➤ **Significance of Aircraft Size**—Other factors being equal (which, for any two accidents, they never are), more damage will be produced by larger, faster aircraft than by smaller and slower ones. The amount of kinetic energy produced by a small, but fully loaded, single-engine airplane flying at minimum speed is equivalent to that of a small automobile traveling at about 55 miles per hour. By comparison, a cabin-class twin would generate kinetic energy similar to that of a loaded 10-ton truck traveling 60 miles per hour (McElroy–1973).

➤ **Aircraft Design Factors**—Unlike automobiles, aircraft are not de signed to remain intact in collisions. The disintegration of the wings and fuselage of a small, general aviation aircraft as it collides with a building dissipates much of the kinetic energy that would otherwise be delivered to the structure.

➤ **Frequency of Occurrence**—As stated above, general aviation aircraft collisions with buildings of any kind, and residences in particular, happen infrequently.

- **Range of Consequences** — *When* an aircraft collides with a small building, the results can range from insignificant to catastrophic. Neither data nor analyses can predict the actual effects of a particular incident.

Non-Occupant Injuries

Injuries to people on the ground (i.e., people who are not occupants of the aircraft) as a result of general aviation aircraft accidents occur even less frequently than collisions with buildings. Most such incidents take place on-airport. National data on injuries to people in residences and other buildings over a 19-year period is summarized in the previously referenced Table 8G. Over the period examined, only 3.1 accidents per year resulted in fatal or serious injuries to people in a building.

A direct comparison with accidents in the *Handbook* database cannot be made because the database includes only off-airport accidents and does not distinguish between people in buildings and elsewhere on the ground. Nevertheless, the results show a similarly infrequent occurrence of people on the ground being seriously or fatally injured by an aircraft accident. Only 12 such accidents are in the database.

CHAPTER 9

Establishing Airport Safety Compatibility Policies

Overview

This chapter expands upon the safety and airspace protection concepts outlined in Chapter 3. It analyzes the accident data presented in Chapter 8 and assesses how this data and other factors can be applied to the development of safety compatibility policies for inclusion in compatibility plans prepared by airport land use commissions. Major sections address:

- The nature of airport land use safety compatibility concerns;
- The foundations of safety compatibility policies;
- Fundamental risk concepts;
- Geographic patterns of aircraft accidents;
- Development of safety compatibility policies for individual airports; and
- Airspace obstructions and other hazards to flight.

Compared to noise compatibility issues, the need to address the safety aspects of interactions between airports and surrounding land uses is largely a forgotten compatibility planning topic. Perhaps this is because aircraft noise is experienced daily, but off-airport accidents are rare. Except for regulations on airspace obstructions and clearance requirements in the immediate vicinity of runways, there are few formal federal or state standards addressing safety compatibility concerns. This *Handbook* provides the most comprehensive guidance known to be available.

Most of the discussion in this chapter deals with the development of safety compatibility zones and associated criteria aimed at limiting the consequences which aircraft accidents can have upon people and property near airports. The need for establishment of safety compatibility zones does not imply that airports are unsafe. Neither does it suggest that existing land uses near airports are necessarily unsafe. Indeed, aircraft accidents in the vicinity of airports are very infrequent occurrences and, historically, very few people on the ground have been seriously or fatally injured as a result of such accidents. Safety, though, is a relative concept. More can almost always be done to enhance safety. The important questions to be answered are: what is an acceptable level of safety; and what is the cost of attaining that level? Central to the assessment of these issues is the concept of risk. This topic is explored in a major section of this chapter.

Beyond the fundamental concept of risk, the specific issue addressed in this chapter is what restrictions should be placed on development of land uses near airports in response to the potential occurrence of aircraft accidents. It is not sufficient to rely solely upon Federal Aviation Administration guidance for this purpose. The focus of FAA standards is on the safe operation of aircraft, not on land use planning (the federal government has no direct authority over local land uses in any case). Also, it is misguided to argue that restrictions beyond those defined by the FAA are unnecessary given the historically infrequent occurrence of accidents resulting in serious consequences to people on the ground. To a significant extent, the good record with regard to harm that has come to people and property near airports can be attributed to the existence of compatible land uses near airports. As airport environs become more intensively urbanized, the likelihood of more severe accident consequences can only increase. Thus, if the utility of airports and the safety of the general public are both to be protected, decision makers will need to be more aware of and more responsive to safety-related compatibility concerns.

The discussion and guidance presented in this chapter is concerned with aircraft accidents, not deliberate acts.

The final sections of the chapter present guidelines which airport land use commissions, together with the counties and cities which have jurisdiction over airport area land uses, can use as the basis for establishing safety compatibility policies for areas around airports. No pretense is made that the suggested guidelines represent an ideal or absolute level of safety or land use compatibility. Rather, they are intended to represent a multi-faceted balance: a balance between the need for protection of airports and the public and the necessity for, or inevitability of, some amount of development near most airports; and also a balance between the benefits which airports provide and the risks which they present. In this regard, an assessment in the 1952 *Report of the President's Airport Commission* (the Doolittle Commission)—a document which provided the foundation for addressing airport land use safety compatibility—says it well and remains valid today:

> "Absolute safety for the individual is an ideal which has ever been sought but never attained. Because man does not have full control over his environment, the very function of living has inherent hazards which become more pronounced as the scheme of living grows more complex. Thus, since absolute safety is a theoretical concept, one can speak only of relative risk."

Safety Concerns

Safety is a factor in the interaction between airports and nearby land uses in three distinct ways:

- Protecting people and property on the ground;
- Minimizing injury to aircraft occupants; and
- Preventing creation of hazards to flight.

Each of these concerns needs to be addressed in airport land use compatibility plans. The nature of each concern can be summarized as noted here. More detailed evaluation of each concern is the objective of the remainder of this chapter.

Protecting People and Property on the Ground

Protecting people and property on the ground from the potential consequences of near-airport aircraft accidents is a fundamental land use compatibility planning objective. To accomplish this, some form of restrictions on land use are essential. Land use characteristics are the most important factors to consider in developing safety compatibility criteria. The potential severity of an off-airport aircraft accident is highly dependent upon the nature of the land use at the accident site. For the purposes of evaluating the relative risks presented by different land uses, three characteristics are most important:

Even when safety compatibility criteria are formatted in terms of a detailed list of land uses, usage intensity is generally the basic factor upon which the acceptability or unacceptability of each use is judged.

- **Intensity of Use**—The most direct means of limiting the potential consequences of an off-airport accident is to limit the intensity of use. Intensity of use is measured in terms of the number of people which the development can attract per acre. This metric serves as a common denominator among various types of nonresidential uses. Except for certain especially risk-sensitive uses, as noted below, the degree of safety compatibility is usually considered the same for any two land uses having similar usage intensities.

Even when safety compatibility criteria are formatted in terms of a detailed list of land uses, usage intensity is generally the basic factor upon which the acceptability or unacceptability of each use is judged.

- **Residential versus Nonresidential Function**—Residential land uses are typically measured in dwelling units per acre rather than people per acre. This is principally a practical measure to simplify implementation. However, residential uses are also normally afforded a comparatively higher degree of protection than nonresidential ones. That is, for a given location, higher occupancy levels are permitted for nonresidential uses than for residential uses.

- **Sensitive Uses**—Certain other types of land uses are also commonly regarded as requiring special protection from hazards such as potential aircraft accidents. These uses fall into two categories:

  - *Low Effective Mobility Occupancies:* Society normally seeks a high degree of protection for certain groups of people, especially children and the infirm. A common element among these groups is inability—either because of inexperience or physical limitations—to move out of harm's way. Among the types of land uses which are regarded as particularly risk sensitive are elementary and secondary schools, day care centers, hospitals, and nursing homes.

  - *Hazardous Materials:* Functions, such as aboveground storage of large quantities of flammable materials or other hazardous substances which could substantially contribute to the severity of an aircraft accident if they were to be involved in one.

A limit of no more than 6,000 gallons is suggested. Tanks larger than this size must meet more stringent requirements under the Uniform Fire Code as well.

Minimizing Injury to Aircraft Occupants

In accidents involving an aircraft that is out of control as it descends, the character of the land uses below are not likely to have a significant effect on the survivability of the crash. However, as noted in Chapter 8, some aircraft mishaps involve situations in which the aircraft is descending, often without power, but otherwise under control. If the aircraft has sufficient altitude, the pilot has some choice as to where to attempt an emergency landing. Under these circumstances, the pilot of a disabled aircraft will, if possible, direct the aircraft toward some form of open land when an off-airport emergency landing is inevitable.

This propensity forms the premise behind the primary form of land use control intended to minimize the severity of injury to aircraft occupants in the event of an off-airport emergency landing. Specifically, some amount of useful open land should be preserved in the vicinity of airports. This concept is largely limited to airports that serve small aircraft.

Preventing Creation of Hazards to Flight

Unlike the preceding land use characteristics which can only affect the consequences of an aircraft accident (for better or worse), hazards to flight can be the cause of an accident. Hazards to flight fall into three basic categories:

- Obstructions to the airspace required for flight to, from, and around an airport;
- Wildlife hazards; and
- Other forms of interference with safe flight, navigation, or communication.

SAFETY POLICY FOUNDATIONS

In order for ALUCs and local land use jurisdictions to address the preceding compatibility concerns, an assessment of safety standards and guidelines set by federal and state agencies is essential. Unlike the case with noise, though, few federal and state laws, regulations, or policies address the issue of safety-related land use compatibility around airports. Only the guidelines prepared by the Department of Defense for military air bases are comprehensive in their approach. This section summarizes significant criteria which federal and state agencies have developed.

Federal Aviation Administration

Property acquisition for approach protection purposes is eligible for FAA grant funding.

Land use safety compatibility guidance from the Federal Aviation Administration (FAA) is limited to the immediate vicinity of the runway, the runway protection zones at each end of the runway, and the protection of navigable airspace. The lack of FAA land use compatibility criteria for other portions of the airport environment is often cited by land use development proponents as an argument that further controls on land use are unnecessary. What must be remembered, however, is that the FAA criteria apply only to property controlled by the airport proprietor. The FAA has no authority over off-airport land uses—its role is with regard to the safety of aircraft operations. The FAA's only leverage for promoting compatible land use planning is through the grant assurances which airport proprietors must sign in order to obtain federal funding for airport improvements. State and local agencies are free to set more stringent land use compatibility policies as they see fit.

Runway Vicinity

The emphasis in FAA safety criteria is upon the runway surface and the areas immediately adjoining it. Standards are established which specify ground surface gradients for areas adjacent to runways and the acceptable location and height of aeronautical equipment placed nearby. These areas normally are encompassed within airport boundaries.

These standards are set forth in an FAA Advisory Circular entitled *Airport Design* (AC 150/5300-13).

Runway Protection Zones

Runway protection zones (RPZs) are trapezoidal-shaped areas located at ground level beyond each end of a runway. The dimensions of RPZs vary depending upon:

- The type of landing approach available at the airport (visual, non-precision, or precision); and
- Characteristics of the critical aircraft operating at the airport (weight and approach speed).

Runway protection zones (previously called clear zones) date from a recommendation in the 1952 *Report of the President's Airport Commission*. See Chapter 8 for additional information.

Ideally, each runway protection zone should be entirely clear of all objects. The FAA's *Airport Design* advisory circular strongly recommends that airports own this property outright or, when this is impractical, to obtain easements sufficient to control the land use. Acquisition of this property is eligible for FAA grants (except at some small airports which are not part of the national airport system). Even on portions of the RPZs not under airport control, the FAA recommends that churches, schools, hospitals, office buildings, shopping centers, and other places of public assembly, as well as fuel storage facilities, be prohibited. Automobile parking is considered acceptable only on the outer edges of RPZs (outside the extended object free area).

Beyond the runway protection zones, the FAA has no specific safety-related land use guidance other than airspace protection. However, additional property can also potentially be acquired with federal grants if necessary to restrict the use of the land to activities and purposes compatible with normal airport operations. In general, this property must be situated in the approach zones within a distance of 5,000 feet from the runway primary surface. Exposure to high levels of noise can also be the basis for FAA funding of property acquisition.

Airspace Protection

Part 77 of the Federal Aviation Regulations (FAR), *Objects Affecting Navigable Airspace*, establishes standards for determining obstructions to navigable airspace and the effects of such obstructions on the safe and efficient use of that airspace. The regulations require that the FAA be notified of proposed construction or alteration of objects—whether permanent, temporary, or of natural growth—if those objects would be of a height which exceeds the FAR Part 77 criteria. The height limits are defined in terms of imaginary surfaces in the airspace extending about two to three miles around airport runways and approximately 9.5 miles from the ends of runways having a precision instrument approach.

Excerpts from FAR Part 77 are contained in Appendix B.

It is essential to emphasize that FAA aeronautical studies are concerned only with airspace hazards, not with hazards to people and property on the ground. An FAA determination of "no hazard" says nothing about whether proposed construction is compatible with airport activity in terms of safety and noise.

As described below, the California State Public Utilities Code gives the Division of Aeronautics and local governments authority to prevent hazards to air navigation.

Also, under state laws, an airport's permit to operate could be restricted, suspended, or revoked because of objects deemed by the FAA to be hazards to air navigation.

When notified of a proposed construction, the FAA conducts an aeronautical study to determine whether the object would constitute an airspace hazard. Simply because an object would exceed an airport's airspace surfaces established in accordance with FAR Part 77 criteria does not mean that the object would be considered a hazard. Various factors, including the extent to which an object is shielded by nearby taller objects, are taken into account. The FAA may recommend marking and lighting of obstructions.

The FAA has no authority to remove or to prevent construction or growth of objects deemed to be obstructions. Local governments having jurisdiction over land use are typically responsible for establishing height limitation ordinances which prevent new, and enable removal of existing, obstructions to the FAR Part 77 surfaces. Federal action in response to new airspace obstructions is primarily limited to three possibilities:

- For airports with instrument approaches, an obstruction could necessitate modification to one or more of the approach procedures (particularly greater visibility and/or cloud ceiling minimums) or even require elimination of an approach procedure.
- Airfield changes such as displacement of a landing threshold could be required (especially at airports certificated for commercial air carrier service).
- The owner of an airport could be found in noncompliance with the conditions agreed to upon receipt of airport development or property acquisition grant funds and could become ineligible for future grants (or, in extreme cases, be required to repay part of a previous grant).

Additional guidelines regarding protection of airport airspace are set forth in other FAA documents. In general, these criteria specify that no use of land or water anywhere within the boundaries encompassed by FAR Part 77 should be allowed if it could endanger or interfere with the landing, take off, or maneuvering of an aircraft at an airport (FAA–1987). Specific characteristics to be avoided include:

- Creation of electrical interference with navigational signals or radio communication between the airport and aircraft;
- Lighting which is difficult to distinguish from airport lighting;
- Glare in the eyes of pilots using the airport;
- Smoke or other impairments to visibility in the airport vicinity; and
- Uses which attract birds and create bird strike hazards.

Bird strike and other forms of wildlife hazard have become a major concern internationally. In the United States and Canada, reduction and management of wildlife hazards are of particular concern. With regard to bird strike hazards, the FAA specifically considers waste disposal sites (sanitary landfills) to be incompatible land uses if located within 10,000 feet of a runway used by turbine-powered aircraft or 5,000 feet of other runways. Any waste disposal site located within five statute miles of an airport is also deemed incompatible if it results in a hazardous movement of birds across a runway or aircraft approach and departure paths. Caution should be exercised with regard to certain other land uses—including golf courses and some agricultural crops— in these locations to ensure that wildlife hazards do not result (FAA–1997). Additionally, Federal statutes (49 U.S.C. §44718(d)) now prohibit new "municipal solid waste landfills" within six miles of airports that (1) receive FAA grants and (2) primarily serve general aviation aircraft and scheduled air carrier operations using aircraft with less than 60 passenger seats. A landfill can only be built within six miles of this class of airports if the FAA concludes that it would have no adverse effect on aviation safety (FAA–2000b).

U.S. Department of Defense

Safety compatibility criteria for military air bases are set forth through the Air Installations Compatible Use Zones (AICUZ) program (DOD–1977). The objective of this program is to encourage compatible uses of public and private lands in the vicinity of military airfields through the local communities' comprehensive planning process.

With respect to safety, AICUZ standards establish three accident potential zones (APZs) beyond each end of a military airfield runway. The innermost zone— the clear zone— is either trapezoidal in shape (at Navy bases) or rectangular (at Air Force bases). Two additional zones— designated APZ I and APZ II—lie beyond the clear zone. The alignment of these zones may be altered to follow the primary flight tracks. The clear zone length is typically 3,000 feet. Other dimensions vary depending upon the type of aircraft and/or number of aircraft operations on the runway. For most military runways, though, the APZs are 3,000 feet wide and have lengths of 5,000 feet for APZ I and 7,000 feet for APZ II, for a total of 15,000 feet from the runway end.

As noted in Chapter 8, these dimensions were developed based upon a study of where military aircraft accidents have occurred in the past.

Within each zone, the compatibility or incompatibility of possible land uses is specified. For example, residential uses are considered incompatible in the clear zone and APZ I and compatible only at low densities in APZ II. Retail land uses are unacceptable in the clear zone and may or may not be compatible in APZ I and II depending upon on the intensity of use.

State of California

Statutes

As is true at the federal level, California state laws—and regulations as well— provide few specifics with respect to airport land use safety compatibility. The guidance which is available is found in two primary locations:

Note that other parts of state law— the Government Code and the Public Resources Code, in particular— establish various requirements for compatibility planning and the review of development near airports, but do not set specific compatibility criteria.

- **State Aeronautics Act**—The Aeronautics Act (Public Utilities Code, Section 21001 et seq.) provides for the right of flight over private property, unless conducted in a dangerous manner or at altitudes below those prescribed by federal authority (Section 21403(a)). No use shall be made of the airspace above a property which would interfere with the right of flight, including established approaches to a runway (Section 21402). The act also gives the State Department of Transportation and local governments the authority to protect the airspace defined by FAR Part 77 criteria. The act prohibits any person from constructing any structure or permitting any natural growth of a height which would constitute a hazard to air navigation as defined in FAR Part 77 unless the department issues a permit (Public Utilities Code, Section 21659). The permit is not required if the FAA has determined that the structure or growth does not constitute a hazard to air navigation or would not create an unsafe condition for air navigation. Typically this has been interpreted to mean that no penetrations of FAR Part 77 imaginary surfaces is permitted without a finding by the FAA that the object would not constitute a hazard to air navigation.

➤ **State Education Code**—The State Education Code (Section 17215) requires that, before acquiring title to property for a new school site situated within two miles of an airport runway, a school district must notify the Department of Education. The Department of Education then notifies the Department of Transportation which is required to investigate the site and prepare a written report. If the Department of Transportation report does not favor acquisition of the site for a school, no state or local funds can be used for site acquisition or building construction on that site.

Another section of the Education Code (Section 81033) establishes similar requirements for community college sites.

Department of Transportation Guidelines

DEPT. OF TRANSPORTATION GUIDANCE
See the Summary section for a discussion of how the "be guided by" requirement should be interpreted.

In 1994, a section was added to the Aeronautics Act to require that: "An airport land use commission that formulates, adopts or amends a comprehensive airport land use plan shall be guided by … the Airport Land Use Planning Handbook published by the Division of Aeronautics of the Department of Transportation" (Public Utilities Code, Section 21674.7).

The addition of this statute changed the role of the *Handbook* from a useful reference document to one that must be used as guidance in the development of ALUC policies. This is particularly important in the development of safety compatibility policies, because very little guidance is otherwise available for civilian airports.

RISK CONCEPTS

Maintaining a high degree of safety as lands near airports are developed is clearly an important planning objective. Frequently, planners face issues that have a potential for compromising safety and look for guidance on how best to proceed. Established federal and state regulations are among the resources often examined. However, from the preceding review, the narrow focus of official federal and state airport land use safety compatibility policies is apparent. Particularly lacking is guidance regarding protection of people and property on the ground in the event of aircraft accidents in the vicinity of airports. To adequately address this concern, ALUCs and local land use jurisdictions need to go beyond the basic policy foundations.

This task is not simple. While the basic concerns are clear, the extent to which the use of land around airports should be restricted in response to these concerns is not as evident. Defining appropriate safety compatibility policies based upon the available aircraft accident data thus represents a major challenge. To attempt this task, requires an understanding of the concepts of *risk*.

Experts in the field of risk have done extensive amounts of research on the topic in general and on certain types of risks in particular. However, very little of this research is specifically concerned with the risks to people and property on the ground in the environs of airports. Even so, there is much of relevance to airport land use compatibility issues that can be gleaned from these broader analyses. Toward that end, the first portion of this section examines risk concepts as they concern hazards in general; the latter portion then focuses on how these concepts can specifically be applied to airport land use compatibility planning.

In simple terms, risk can be defined as "the chance of injury, damage, or loss." More technically, risk is "the potential for realization of unwanted, adverse consequences to human life, health, property, or the environment" (Society for Risk Analysis). In mathematical terms, risk equals the probability of occurrence of an unwanted event times the adverse consequences. Risk can be considered as the inverse of safety; the latter being defined as "relative protection from adverse consequences."

The discussion here focuses on risks which have two common characteristics. First, the associated activities are physical in nature (as opposed to being strictly financial, for example). Secondly, the adverse consequences of concern are measured in terms of a specific event (rather than the incremental effects of prolonged exposure). These both are characteristics common to aircraft accident risks.

Risk Assessment

The assessment of risks and determination of appropriate actions to be taken in response to those risks is a complex and often imprecise process. Some elements of risk can be quantitatively measured and delineated. Risk assessment done in this way is often referred to as technical risk assessment, probabilistic risk assessment, or quantitative risk assessment. These forms of risk assessment are generally equivalent and are most useful for comparing various alternatives in a decision problem, such as, for example, which of two engineering solutions or land use plans has the lower risk.

Most risks, though, also have equally significant qualitative components. Moreover, subjective judgment plays an especially important role in formulation of responses to risks. These characteristics exist even for risks involving only one individual or a small group of people, but are particularly evident when the effects extend to large segments of a community or to society as a whole. Risk assessment that is done from a qualitative perspective is useful in determining why and how risks differ in ways that are not captured or represented by their quantitative or statistical characteristics. This type of risk assessment also helps with understanding what makes some risks appear acceptable and others unacceptable even though they do not differ appreciably in quantitative terms.

Measurement of Risk

The beginning point for any efforts to develop public policies to address most risks is to measure the extent to which a particular risk exists. Risk measurement or analysis is concerned with the question of what might happen.

As noted in the definition above, the two fundamental components of risk measurement are frequency and consequences. *Frequency* measures when or how often an adverse event might occur. The *consequences* component describes what the effects of such an event might be (in terms of fatalities, injuries, property damage, service interruption, etc.).

For most risks involving physical hazards (and certainly those related to airport area land uses), it is useful to consider a third component. Accident frequency can be thought of not just in terms of how often accidents occur, but also in terms of their *distribution*. The distribution component of risk identifies where or for whom there is an exposure to accidents (geographically or to certain segments of the population).

While the frequency and distribution components of risk are measured in quantitative (even if sometimes only relative or rank order) terms, the consequences of accidents can have important qualitative characteristics. Depending upon the perspective taken with respect to the potential consequences of accidents, the overall risk can be measured with respect to three fundamentally different metrics.

- **Accident Risk**—Most basic among these metrics is the accident risk rate (sometimes also referred to as crash or failure risk). This number simply measures the annual number of events predicted to occur within a specified unit of area. The consequences component is held constant—that is, the potential consequences are assumed to be the same regardless of where and how often the accidents might occur. The number of general aviation accidents projected to take place in the U.S. in a year is an example of accident risk. By combining the projected accident rate data with historical data on accident locations, the probability of an accident occurring in a given location can be calculated. With respect to aircraft accidents, the resulting information can be presented in the form of contours defining locations having the same probability of accident occurrence.
- **Individual Risk**—The individual risk rate changes the focus from events to people. Individual risk thus takes into account both the frequency of accidents as measured by the accident risk and the severity or consequences of the accident. Typically, only the most serious consequences to an individual are considered—the risk of death—although sometimes serious injuries are also taken into account. The risk is usually calculated on the basis of a person exposed to the hazard on a constant basis, 24 hours per day, 365 days per year.
- **Societal Risk**—The most broadly based form of risk metric is societal or collective risk. Societal risks are concerned with consequences that are wider than the the discrete effects on individuals. Repercussions of certain events go beyond the immediate casualties and damage to the extent of provoking socio-political response. The need to avoid these types of

accidents or events may thus be greater than statistical measurements would suggest. Indeed, societal risk often takes into account non-quantitative elements and can particularly be influenced by public perceptions.

Regardless of the precision to which a risk can be measured, a factor to be recognized is that even scientific measures of risk are inherently subjective in one respect. Scientists and experts typically measure risk in terms of mortality rates or probability of harm. There are many ways in which this information can be portrayed, however. This choice can affect how the data is judged. For example, in the context of transportation, the chance of someone being killed in an accident can be measured relative to total population (deaths per million population), passenger-miles for the transportation mode, or the number of trips. The way in which the data is numerically presented also makes a difference: 1 death per *x* people versus *y* deaths per million people. The point is that there is no right or wrong frame of reference—no universal set of characteristics—for measuring risk.

Risk Perceptions

While measurement of risks provides essential input to the making of public policy, it is not the only consideration. In our society, decisions about how to respond to many risks—particularly ones affecting many people or whole communities—are not the sole purview of experts. Moreover, such decisions are not based simply on technical analyses and data. The public's *perception* of risks plays a major role as well. Perception is a key component in any assessment of societal risk.

To those experts or others who evaluate risk in a strictly quantitative manner, public perceptions may seem to be irrational or even ignorant. While some component of public reaction may be attributable to these human qualities, other more definable factors are also apparent. Studies have shown that risks are usually perceived to be high when factors such as the following are prevalent:

- The general public has limited understanding of how the technology or system operates;
- After a failure in the technology or system, no one, including experts in the field, seems to know and understand the cause (as opposed to events for which the cause is clear);
- The possible consequences of the hazard evoke feelings of dread, especially concerns about death;
- The possible consequences seem unbounded (in magnitude or persistence over time) or are believed to be potentially catastrophic;
- The activity is not under one's own control (the risks are not affected by one's own skills);
- The risk exposure is not on a voluntary basis (the exposure cannot readily be reduced by changes in one's lifestyle);
- The hazard is unnatural (not an act of nature);
- The potential personal or societal benefits to be gained from the activity involved appear to be minimal or nonexistent;

- The distribution of risks and benefits among groups or geographically is inequitable;
- The groups at risk include children, elderly, the infirm, or others regarded as having comparatively little control over their own lives; and/or
- Highly negative imagery about the technology or system is widespread in the media (especially pictures on television and in newspapers).

To a significant extent, the manner in which people judge the importance of these factors depends upon our attitudes toward the underlying technology or system. Our attitudes, in turn, have their basis in social values. These judgments are inherently subjective—there are no right or wrong responses. Thus, at least from the perspective of social science, risk is not an objective concept. Danger is real, but there is no such thing as real risk—risk is socially constructed.

Because of these subjective elements, risk perceptions are frequently not consistent with statistical expectations. Risks are often misjudged, sometimes overestimated and sometimes underestimated. Moreover, judgments about the facts associated with risks may be held with unfounded confidence. As a consequence, technical risk analyses and statistics prepared by experts often do little to change people's attitudes and perceptions. Even news that studies of a potential risk are being conducted can add to public concerns. The rapidity with which information—both accurate and inaccurate—is transmitted today further adds to the challenge of placing risks in a proper perspective within society as a whole.

Another factor which affects how a risk is perceived is the scale on which the risk is measured. Experts typically measure risk in terms of fatalities. To most people, though, riskiness means more than the number of deaths per year. The manner in which the presence of the risk affects one's daily life also influences how the risk is viewed.

Even when annual fatalities is the accepted risk measure, statistically equivalent risks may be perceived differently. For example, a technology or system on which one accident with 100 fatalities has occurred is likely to be judged more risky than a system which has experienced 100 accidents having one fatality each. In effect, there is a penalty function which gives added weight to events with large consequences. On the other hand, our familiarity with particular technologies or systems can also affect how their associated risks are perceived. The apparent seriousness of an unfortunate event is determined in part by what the event signals or portends—what its potential social impact may be. An accident on an unfamiliar system, even if small in size, may be viewed as a harbinger of more catastrophic events and thus deemed to be worse than a large accident on a familiar system.

A final, not often acknowledged, element of risk perception is hindsight. Knowing that something has happened increases its perceived inevitability. What is more, not only do such occurrences seem in retrospect to have been inevitable, the judgment often is that they should have been anticipated in advance. "On the other hand, perhaps the handwriting on the wall was written in ink visible in hindsight alone" (Fischhoff–1975).

As one author summarized the topic: "…there is wisdom as well as error in public attitudes and perceptions. Lay people sometimes lack certain information about hazards. However, their basic conceptualization of risk is much richer than that of the experts and reflects legitimate concerns that are typically omitted from expert risk assessments" (Slovic–1987).

Risk Comparisons

Another approach to risk assessment is to compare a new or uncertain risk with risks which are better known and understood. Both the general public and risk experts engage in making these comparisons. Although such comparisons must be made with caution, they can be informative.

One situation in which risk comparisons can be useful is with respect to infrequently occurring events. For frequent events, risks can be measured with a great deal of precision. However, the probability of events which take place infrequently—even though they may be of high consequence—is very difficult to predict with any high degree of statistical accuracy. For many technologies, the very success of hazard reduction efforts has led to relatively few events from which to calculate the level of risk.

In general, observed data cannot lead to confident estimates of extremely rare events. The probability of events with 50-to-100-year intervals can be estimated with a reasonable degree of confidence, but not those with 10,000-year intervals. In such situations, an alternative approach is to measure risk levels in a relative rather than probabilistic manner. Experts in a particular technology often can identify the locations or circumstances which present higher-than-usual risks, even if they cannot estimate the probability of an event.

The danger of risk comparisons is that differences among risks can be oversimplified if both the quantitative and qualitative attributes are not considered. The general public may overlook important measurable factors. On the other hand, experts may gauge the acceptability of risk solely in terms of the probability of fatalities or other loss, but ignore the *context* within which the risk occurs. Context helps us to gain perspective on the size and scope of a risk and to determine what response may be appropriate.

It is because of the difference in context that comparisons between the chance of a person on the ground being injured or killed as a result of an aircraft accident and the chance of a similar result from being struck by lightening are not valid. Hazards from technological and natural events are not perceived the same.

Responding to Risks

Ultimately, the decisions we—as individuals or as a society—make in response to hazards come down to a question of our tolerance for or acceptance of the risks which are known or believed to be involved. This is not a question which can be answered in an absolute sense, however. Society's allocation of resources must be taken into account. It is always possible to reduce risk, but the cost of doing so increases as the risk becomes smaller.

One approach risk experts have taken to this question is to divide the risk spectrum into three regions separated by two key boundary lines (Figure 9A):

- The upper boundary line is the threshold of intolerable risk. Risks exceeding this threshold must be reduced below the line regardless of cost. From an individual perspective, these are risks which are not tolerable regardless of the amount of money offered in compensation.
- The lower boundary line is the threshold of acceptable risk. Risks below this level merge into the background risks of life and require no action. We generally do not concern ourselves with these risks as we go about our daily lives.

The three risk levels thus might be described as:

- Intolerable risks;
- Significant but tolerable risks; and
- Acceptable risks.

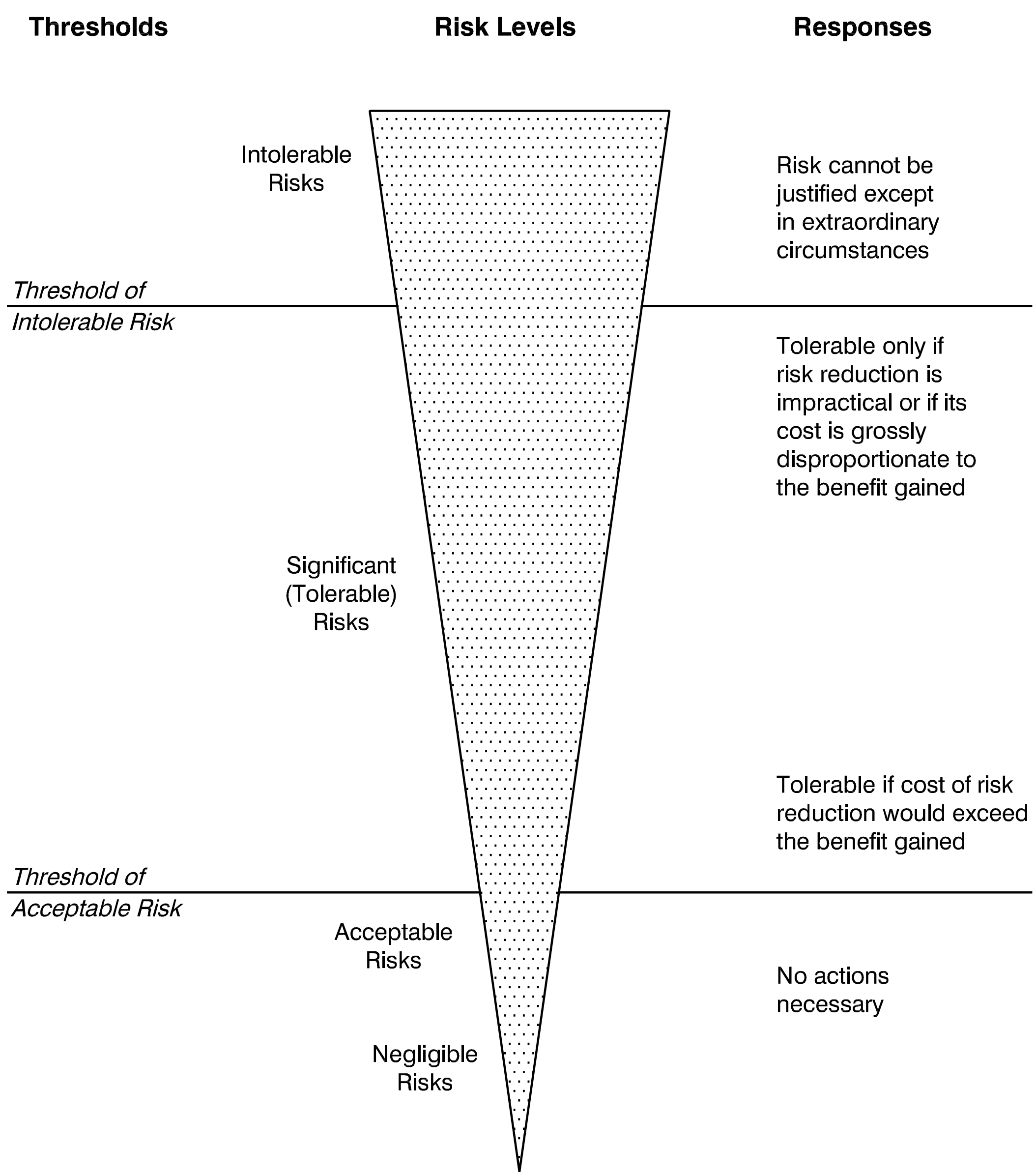
Given this categorization, the next question which might be asked is where any specific risk falls within the overall spectrum.

Judging Risk Acceptability

As indicated earlier, accident risks can be assessed as a combination of the anticipated *frequency* of occurrence at any given location and the potential magnitude of adverse *consequences*. One qualitative method of judging risk acceptability thus is to divide the full range of frequencies and consequences into discrete increments and then evaluate the implications of each possible combination of the two components. The result will be a matrix such as the one shown below. The matrix illustrates the conceptual relationship between accident frequency, potential consequences, and judgments as to the overall risk acceptability. Frequency is calculated in terms of the number of events within a specific time period and location. Consequences are typically defined in terms of injuries, particularly fatalities and serious (life-threatening) injuries. Property damage can also be included, however.

Conceptual Relationship of Risk Components

		Potential Consequences				
		Negligible	*Minor*	*Major*	*Severe*	*Disastrous*
Anticipated Frequency of Occurrence	*Frequent*					
	Occasional					
	Uncommon					
	Rare					
	Extraordinary					
Legend		Acceptable Risk		Significant Risk		Intolerable Risk



Source: Based upon diagram in National Air Traffic Services Ltd., London (1997)

FIGURE 9A

Risk Acceptability Framework

This matrix suggests a variety of possible risk responses. For example:

- Risks which have negligible consequences do not warrant specific action regardless of how frequently the events occur. Even minor consequences do not make the risk significant unless the frequency is such as to be almost predictable.
- Activities with potentially major adverse consequences generally necessitate investigation into possible risk reduction measures unless the events rarely occur.
- A combination of relatively frequent occurrence and potentially high consequences means that action to reduce the risks to a tolerable level must be taken.
- While potentially disastrous consequences are always significant and the risk reduction measures need to be evaluated, action still may not be warranted when the events are rare or extraordinary.

Several additional points regarding this matrix are worth noting. First is that it pertains only to risks for which exposure is *involuntary*. People generally accept higher risks when they engage in an activity voluntarily and have a high degree of self control over its outcome. Greater risks also are tolerated when more *benefit* is to be gained from the activity. Thus, the public tends to accept higher risks from voluntary activities (such as driving a car) than from equally beneficial involuntary risks (food preservatives, for example). Another factor in judgment of risk acceptability is public perception. As a result, for certain risks, adjustments to the matrix may be necessary to reflect the influences noted earlier as having an effect on risk perception.

One further point is that both individual and collective risks are relevant to the assessment of acceptability. For some activities or circumstances, individual risk may be low either because accidents are rare or because the likelihood of severe consequences (death or serious injury) is minimal even if more minor mishaps are comparatively common. Nevertheless, even when measurable individual risk is low, governmental regulations to prevent some harm may be warranted simply because a large number of people are exposed.

Lastly, no attempt to quantify either the frequency or consequences components of the matrix has been made here. Such a step may be possible although the ranges would vary depending upon the type of risk involved. Again, the only intent of the matrix is to illustrate the conceptual relationships among risk components and risk acceptability.

Of interest, though, is that—despite the variability in how frequency and consequences would need to be quantified depending upon the hazard involved—the combination of the two components have a quantifiably consistent relationship to acceptability regardless of the type of risk. That is, the measured level of risk which defines the boundaries between intolerable, significant, and acceptable risks has been found to remain relatively constant across a wide range of hazards. To be specific:

- The upper limit of tolerability for involuntary risks has been concluded to be on the order of one death per 10,000 people, or 10^{-4} chance of death to an individual, per year. Risks exceeding this level essentially mandate government intervention.
- Society also seems to have achieved a general consensus that governmental action to protect public health and safety is usually warranted if a hazard results in an annual death rate of more than 1:100,000 (10^{-5}).
- Risks as low as 1:1,000,000 (10^{-6}) per year are also commonly of sufficient concern to justify further investigation into possible actions.
- Lower levels of risk generally do not merit an explicit response unless the risk presents broader societal implications or is widely perceived in a manner which heightens its significance.

To emphasize the point, these numbers refer to risks to which people are exposed on an involuntary basis. As indicated above, people will accept a much greater risk when the exposure is on a voluntary basis. Indeed, risk researchers have concluded that acceptance of voluntary risks is roughly 1,000 times greater than for equally beneficial involuntary risks (Fischhoff–1979).

Weighing Responses to Risks

Risks which fall into the middle (significant) range—ones which are tolerable, but not particularly acceptable—represent the greatest challenge for determining appropriate responses. Intolerable risks must be dealt with in all cases and acceptable risks require no action. The mid-level risks, while significant, may or may not warrant a response depending upon the circumstances. In general, the objective in dealing with these risks is to make them as low as reasonably practical.

The 1952 *Report of the President's Airport Commission* comments on this topic that: "…'calculated risk' is an American concept which gives mobility to the whole social structure. The phrase simply means a willingness to embark deliberately on a course of action which offers prospective rewards outweighing its estimated dangers."

Various approaches have been devised as means of evaluating actions to be taken in response to the mid-range risks. Perhaps most common are cost-benefit analyses. The difficulty with cost-benefit analyses, though, is that they necessitate having data which is both meaningful and can be quantified. This often requires judgments—determining the value of human life, for example.

A further consideration is that a safety measure that seems appropriate on a cost-benefit basis may not be reasonable in a cost-effectiveness sense. That is, even if the benefits outweigh the costs, other measures may be available which could achieve greater benefits for the same cost or the same benefits for less cost. The range of possible safety measures thus generally also needs to be evaluated on a cost-effectiveness scale. The objective of cost-effectiveness analyses is to help set priorities among different risk reduction measures so as to achieve maximum safety for the amount spent. Cost-effectiveness analyses also can help to sort out the interactions among hazards. A risk reduction measure which may not manifest the highest benefit-cost ratio with respect to one particular hazard, may nevertheless be the most overall cost-effective measure because it can reduce multiple risks.

Another factor to be considered in cost-benefit or cost-effectiveness analyses of risk reduction measures is who bears the costs and who attains the benefits. For most risks which affect a large number of people, costs and benefits are seldom distributed equally. Governments, particularly the federal government, are usually better able to bear the costs of risk reduction measures than are private individuals or businesses, but even governments must balance the investment against the benefits. Economic feasibility has further implications where the costs are to be borne privately. When government-imposed measures are not affordable, the rules may be circumvented and enforcement can then become a problem.

Determining appropriate responses to risks associated with events which are extraordinarily rare but potentially catastrophic presents a particularly difficult test. An example of this type of hazard is a volcanic eruption. One study of this risk pondered whether anything at all should be done to protect against such an event given its extreme rarity (William Spangle and Associates–1987). On the other hand, the report notes that "the potential for a major catastrophe which could be averted begs for some kind of public response." As for where to strike the balance between acceptable risk and affordable protection, the report concludes:

> "Do what you can, politically and fiscally, to reduce the exposure and provide for effective emergency response and that becomes, by definition, acceptable risk. An official who proposes to go farther than his constituents want will find out quickly what the limits are."

Lastly, it is important to recognize that, whether accurate or not, public perceptions about risks play an influential role in determining the priorities of legislative and regulatory bodies. These entities, in turn, must exercise their own judgments about both the quantified risk data and the public perceptions of the risks. The amounts spent to reduce various types of risk can thus vary greatly and with little apparent rationality when viewed in light of the measured risks. For example, U.S. society has spent some 75 times as much to prevent each death due to environmental toxin exposure as it has to prevent each death from transportation accidents (Tengs–1994).

One risk expert sums up this tendency toward inconsistency by noting that good analysis may be insightful, but need not be conclusive. "Uncertainty about facts and values in a disorderly social world means the various decision making approaches must be viewed as tools rather than ends in themselves." Thus, perhaps "the best we can hope for is some intelligent muddling through" (Fischhoff–1979).

Putting Airport Land Use Risks into Perspective

From a risk reduction perspective, a fundamental objective of airport land use compatibility planning is to minimize the consequences of aircraft accidents when they happen.

Assessing and responding to the risks which aircraft accidents pose for land uses around airports is a difficult process. Compared to aircraft noise, there is little data from which to work—risks cannot simply be measured with a "risk level" meter. Even if better data were available, the problem would remain as to how to determine appropriate responses. Again, there is relatively little with which to compare. A variety of studies address the topic of accident-related risks. Most of these studies focus on evaluating actions which can be taken to reduce the frequency with which the accidents occur. With land use compatibility planning around airports, however, reducing the frequency of accidents is not the objective—except for airspace obstructions, land uses have little effect on whether aircraft accidents occur. Rather, the purpose is to minimize the consequences of accidents when they happen.

Measuring the Risk

Conceptually, calculation of the risks associated with potential aircraft accidents near airports is easy. The risk consists of a combination of the three earlier described components: frequency, consequences, and distribution. The difficulty, though, lies in the fact that each of these components is complex to measure particularly with regard to any single airport. Errors and inaccuracies can easily be introduced into the equation. The following are some insights into factors which affect measurement of each of these components.

➤ **Frequency of Occurrence**—While the historical number of aircraft accidents nationwide has varied to some extent from year to year, future trends can nevertheless be predicted with a fair degree of accuracy. Even with respect to specific classes of aviation (air carrier, general aviation, military) or types of aircraft (business jets, helicopters, etc.), the frequency of accident occurrence is fairly constant and predictable. The difficulty with prediction arises when the focus is on a single airport rather than nationwide data. Even for busy airports, the frequency of occurrence may be once per some multiple number of years. As discussed earlier, predictions become less certain as the number of events becomes less frequent. A further complication with measuring frequency of occurrence lies in defining the types of events that are of interest. Clearly, accidents are the most significant events for airport land use planning purposes, but lesser mishaps are also relevant. Even though aircraft sometimes successfully land off airport—and thus the event is not treated as an accident—the potential exists that any such occurrence could have more serious consequences.

➤ **Potential Consequences**—The consequences of an aircraft accident on land uses near an airport can basically be described in terms of the number of people killed or injured and the size and value of the property damaged. However, as described in Chapter 8, the consequences of any particular accident depends upon numerous variables involving the aircraft characteristics, the manner of its descent, and the nature of the terrain and land uses at the site. Because of the wide range of each of these variables, the outcome is highly uncertain. Therefore, even though the vast majority of near-airport aircraft accidents do not result in serious land use consequences, the emphasis in any analysis needs to be on the potential consequences—that is, on what could happen. Moreover, in terms of airport land use compatibility planning, the issue is what could happen if incompatible development is allowed to occur.

An important point to realize with respect to near-airport aircraft accidents is that the consequences have historically most often been minimal because of the extent of undeveloped or low-intensity uses near many airports. Allowing more intensive nearby development can only increase the frequency with which more severe consequences occur.

➤ **Spatial Distribution**—Although not huge by many standards, the aircraft accident data described in Chapter 8 is sufficient to enable the spatial distribution of accidents to be well defined for each category of airport (air carrier, general aviation, and military). This distribution is broadly applicable to most airports within each category. Nevertheless, to more accurately predict where future accidents are most likely to occur at a particular airport, the physical characteristics and usage patterns of the airport need to be considered. The risks will generally be most concentrated along the flight routes which aircraft use most frequently.

To summarize measurable airport land use risks in the context of the preceding discussion of risk concepts, near-airport aircraft accidents are events which occur infrequently, but have potentially high consequences. Moreover, despite the relative rarity of the events, the spatial distribution of aircraft accidents near airports can be delineated quite well as indicated by the data presented in Chapter 8 and the potential consequences can be directly related to the characteristics of land use in the areas of concern.

Risk Perceptions and Comparisons

Proponents of land use development near airports sometimes attempt to quantitatively assess the risks of an aircraft accident and then dismiss the risk on the basis of comparison with other types of risks. Caution should be exercised in the preparation and review of such analyses.

One factor to be recognized is that, while the spatial distribution of aircraft accidents is quite predictable close to the ends of runways, it is less so at greater distances. This is particularly true for general aviation airports because their aircraft flight tracks are comparatively more spread out than at major air carrier airports. Analyses thus need to be done with respect to relatively broad-scale areas. Otherwise, by defining a sufficiently small site of interest, the accident probability can be calculated as near zero (the probability of an accident occurring somewhere in the airport vicinity is much greater than the probability of an accident occurring on a particular one-acre site).

Several studies have sought to take the step of broadly quantifying the individual risk which aircraft accidents represent for people on the ground. The results from two of these studies (NATS–1997; Shutt Moen Associates–1999) are useful in putting airport land use risks into a context with other types of risks.

➤ The level of individual risk for a given location near an airport is dependent to a significant extent upon the number of aircraft operations and to a lesser degree upon the type of aircraft. The greater potential consequences of a large air carrier aircraft accident compared to that of a small general aviation aircraft is balanced by the fact that the larger aircraft have fewer accidents per a given number of operations.

➤ Not surprisingly, the data shows the highest level of risk occurs immediately beyond the runway ends. These risks are on the order of 1:10,000

(10^{-4}) per year and are typically contained within the limits of the an airport's runway protection zones (RPZs).

➤ The extent of risks at the 1:100,000 (10^{-5}) level is more dependent upon the volume of aircraft operations on a runway, but generally is within an area immediately surrounding the RPZs.

➤ The 1:1,000,000 (10^{-6}) risk level, although also dependent upon aircraft operations numbers, is much more extensive. Even for a moderately busy general aviation airport, risks of this magnitude can extend two miles from the runway. For major air carrier airports, the distance is greater, but the risk is more concentrated along the extended runway centerline than is the case at general aviation airports. The risk tends to be more dispersed for general aviation airports because aircraft follow more varied flight tracks than do larger aircraft.

➤ Nationwide, the annual risk of an aircraft accident causing fatal injury to an individual on the ground, but not on an airport, was found to be 1:1,700,000 (6×10^{-8}) for the 1975-85 period (Goldstein–1992).

Another consideration with regard to comparisons between airport land use and other risks is that subjective characteristics must be similar. In the context of the previously mentioned factors which influence public perceptions, the risks of off-airport aircraft accidents can be characterized as:

- Not voluntary except to the extent that people choose to live near an airport;
- Not controllable as a function of the individual's skills;
- Generally not well understood;
- Including consequences which are unpredictable;
- Not an act of nature;
- Giving no advance warning of an impending event; and
- Usually not balanced by potential personal benefits of the activity.

Because of these factors, comparisons with the chance of fatal injury as an occupant in an automobile accident or from being stuck by lightening, for example, are not directly relevant to the issue of airport land use compatibility planning.

Responding to the Risk

Regardless of the method used to assess the risks, a decision still must be made as to what the public-policy response should be. The basic question to be asked is *how much risk is acceptable?* As discussed earlier in this chapter, acceptability can be evaluated as a function of the frequency and consequences of undesirable events. The chart on page 9-14 is helpful in showing the conceptual relationship between these two components. When applying this chart to the defining of safety compatibility criteria, though, two factors should be kept in mind:

➤ To be of value to airport land use compatibility planning, the frequency scale needs to be considered primarily in terms of the relative concentration of aircraft accidents near airport runways. If the scale is set relative to the wide range of physical risks, then aviation-related risks to land uses near airports would probably all fall in the rare category.

- For most airports, the risks to nearby land uses are dominated by the consequences side of the risk equation. Even a small airplane could cause major to severe harm if it were to strike an exposed, densely populated site. Only in essentially unoccupied locations such as range lands or wilderness areas can the potential consequences to people on the ground be considered negligible or minor.

As also indicated in the earlier discussion of risk concepts, the acceptability of a risk is not the only consideration in the establishment of public policy in response to that risk. An additional question to be weighed is *how much protection can society afford to provide?* Or, to put the issue another way, *how safe is safe enough?*

To answer these questions, the benefit-cost ratio of the risk reduction measures must be taken into account. When an airport is situated in a rural area, well away from development pressures, the cost—to the landowner, the community, and the airport—for a high degree of protection may be low. Important land use development can usually be redirected toward areas where the prospects of an aircraft accident are minimal. At the other end of the spectrum, the need for developable land around urban area airports typically is such that avoidance of only very risky forms of development—those in the most accident-prone locations or ones which greatly increase the potential severity—may be affordable. It is for this reason that some ALUCs allow infill development to occur in established urban areas even though the development would typically not conform to compatibility criteria.

Also an element of any cost-benefit evaluation of acceptable land uses near airports is that the outcome is different for existing development than it is for proposed new construction. While the benefits of having compatible land uses are the same whether development already exists or not, the cost of eliminating incompatible uses is usually much greater than the cost of avoiding it in the first place. Safety compatibility policies developed for use in Great Britain acknowledge this distinction (NATS–1997). Specifically, the British policy is:

- To eliminate existing incompatible development, if any, within areas where the individual risk exceeds 1:10,000 (10^{-4}).

- Except for low-intensity nonresidential uses, new development should be avoided in locations where the risk exceeds 1:100,000 (10^{-5}). However, existing development—other than highly risk-sensitive uses such as schools, hospitals, and places of assembly—can remain.

- In locations where the risk level is less than 1:100,000 (10^{-5}), the only necessary restrictions on new development are to avoid schools, hospitals, and places of assembly.

THE GEOGRAPHY OF RISK: IDENTIFYING ACCIDENT LOCATION PATTERNS

A primary element in establishment of safety compatibility policies is knowing where aircraft accidents pose risks to land uses near airports. Of course, the fact that accidents have historically occurred in certain locations is no guarantee that they will happen in precisely those places in the future, especially at any one airport. Nevertheless, it is reasonable to predict that the broad areas within which significant numbers of accidents have taken place in the past will be where most accidents will also occur in the future.

A glance at the aircraft accident distribution patterns presented in Chapter 8 gives a good indication of where accidents are most likely to occur in relationship to a runway. In the form presented, however, the accident patterns are not easily usable for defining appropriate land use safety compatibility criteria. Doing so would be equivalent to attempting to set noise compatibility policies by using noise data for a series of discrete geographic points. An essential first step thus is to aggregate the accident location data into a more functional format. This process is described below.

Accident Distribution Contours

One approach to identifying accident location patterns is to group the accident data points according to their relative degrees of geographic concentration. A particularly illustrative perspective on the distribution of accidents near runways is the three-dimensional view shown in Figure 9B. The vertical dimension to the graph represents the number of accident sites within each of the cells in the grid (the grid spacing used was 300 feet by 300 feet). The approach end of the runway is at the center of the graph and the runway extends up and to the right from there. Clearly evident is the concentration of accident sites—primarily arrivals—near the runway's approach end. The second hump lies along the runway and its extended centerline and is mostly comprised of departure accidents. (Note that this chart is derived from the accident database contained in the 1993 *Handbook*. Although smaller in size than the current database, the locational distribution of accident sites is similar to that of the present, expanded database.)

While informative in a visual sense, the three-dimensional chart is not very useful for analytical purposes. More valuable is to depict the data in the form of a set of accident distribution contours.

Figures 9C through 9J portray contours for various subsets of the general aviation aircraft accident location data from Chapter 8. (No comparable analyses of air carrier and military aircraft accidents have been conducted.) Any number of contours can be defined. In this case, the contours divide the accident data sets into five equal groups of 20% each. The contours encompass the most highly concentrated 20%, 40%, 60%, and 80% of the data points. The remaining 20% occur beyond the outermost contour, including some points beyond the limits of the diagrams. The contours are irregular in shape. No attempt has been made to create geometric shapes.

The accident distribution contours depict where an aircraft accident is most likely to happen when one occurs. Because these contours do not take into account either the accident frequency over time or the consequences of the accidents, they technically are not risk contours.

(Various computer programs potentially can be used to create contours from scattered, individual *x/y* data points such as those represented by the accident location data. The results may vary depending upon the type of program used and the assumptions applied to measuring the degree to which a group of points is concentrated. The contours shown here were developed using geographic information system software to count the number of other points within a certain radius of each specific point, then ranking the results.)

All Runway Lengths

Figure 9B depicts the accident distribution contours for all general aviation arrival accidents in the database; Figure 9C shows the contours for departure accidents. In both instances, all runway lengths are represented. Several geometric patterns are evident from a look at the two graphs:

➤ **Arrival Accident Patterns**

(The zero/zero point on the axes is the landing end of the runway.)

- Arrival accident sites tend to be located close to the extended runway centerline.
- Some 40% fall within a narrow strip, approximately 500 feet wide and extending some 2,000 feet from the runway end.
- Over 80% of the arrival accident sites are concentrated within just 2,000 feet laterally from the extended runway centerline, but extending outward to approximately 11,000 feet (about 2.0 miles) of the runway end.

➤ **Departure Accident Patterns**

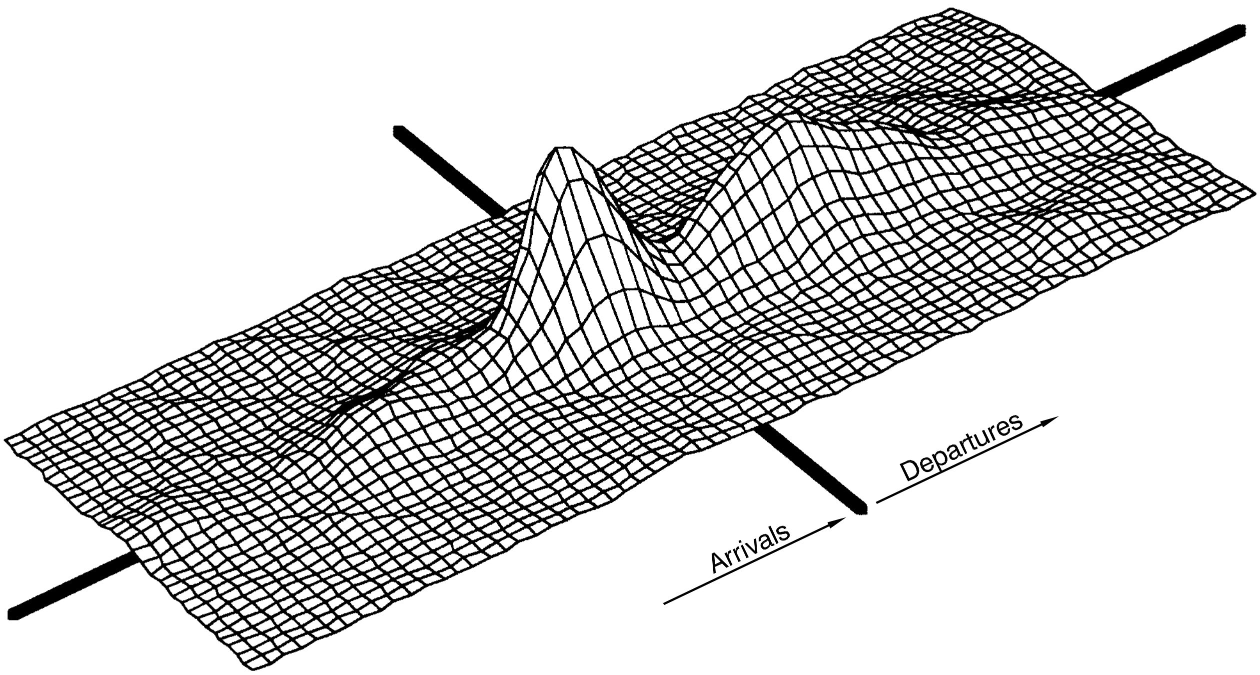
(The zero/zero point on the axes is the takeoff end of the runway.)

- Departure accident sites also tend to be clustered near the runway end, but are not as concentrated close to the runway centerline as are the arrival accident sites.
- The most tightly bunched 40% of the points lie within an area 1,500 feet wide, extending approximately 2,000 feet beyond the runway end, but also adjacent to the edges of the runway.
- The 80% contour extends some 6,000 feet beyond the runway end plus along the sides of the runway and spreads laterally approximately 2,000 feet from the runway centerline.
- Two factors account for the substantial number of departure accident sites lateral to the runway. (1) As defined for the purposes of the database, departing aircraft which crash while attempting to return to the runway are counted as departure accidents unless the aircraft became established in the traffic pattern or on final approach. (2) On long runways, aircraft may begin to turn before reaching the far end of the runway.

Another variable for which an accident location pattern diagram is included in Appendix F is for single-sided traffic patterns. Intuitively, the distribution of accidents at airports with a pattern on only one side can be expected to differ from that at airports with dual traffic patterns. However, as discussed in Chapter 8, the information in the database is insufficient to adequately assess the differences.

Variations by Runway Length

From the data and discussions in Chapter 8, it is evident that the patterns of general aviation aircraft accident locations near runways differ substantially depending upon characteristics of the runway and aircraft involved in

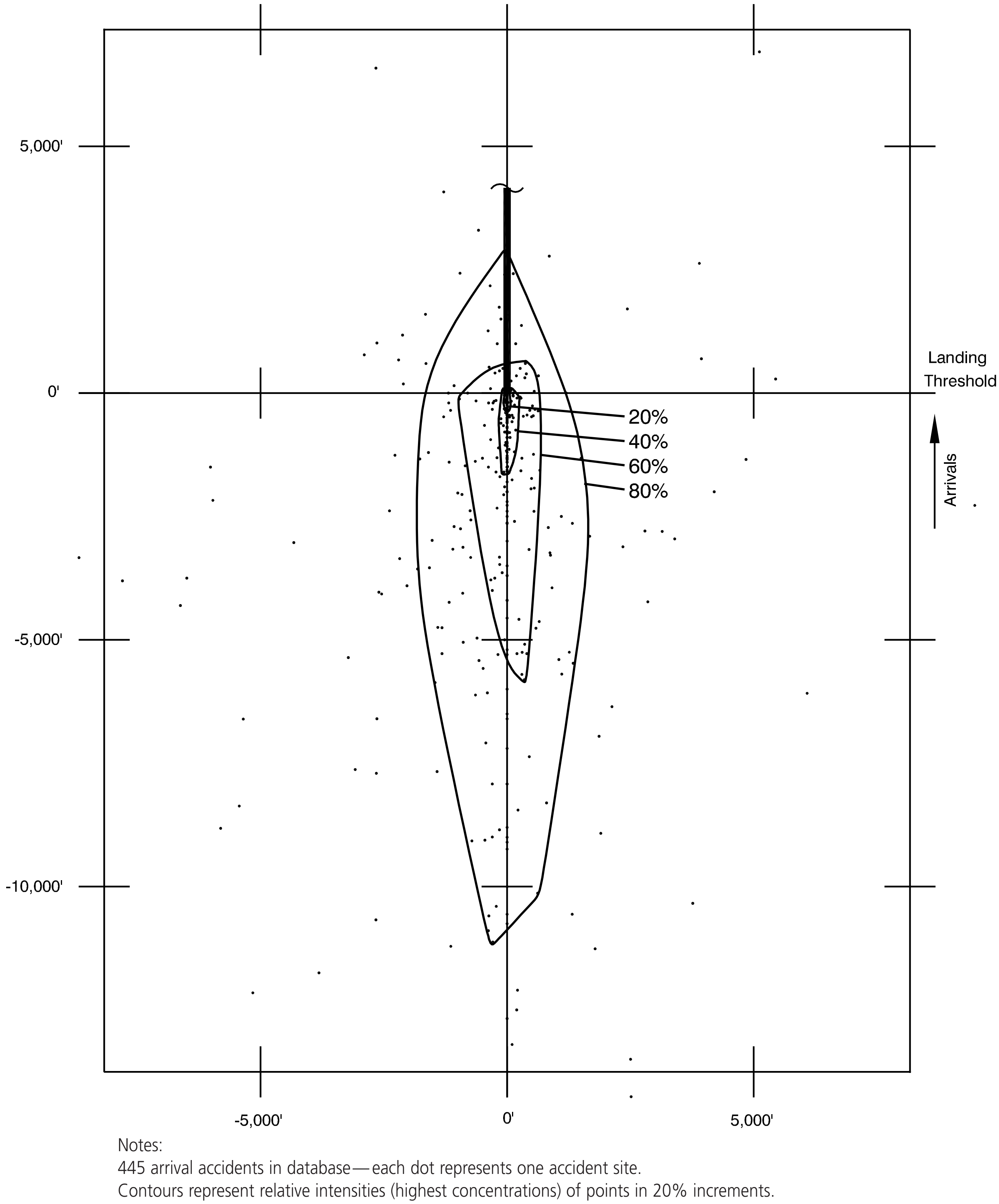


Source: University of California, Berkeley, Institute of Transportation Studies (1993)

FIGURE 9B

Three-Dimensional Plot of Accident Distribution Pattern

General Aviation Aircraft Accident Database

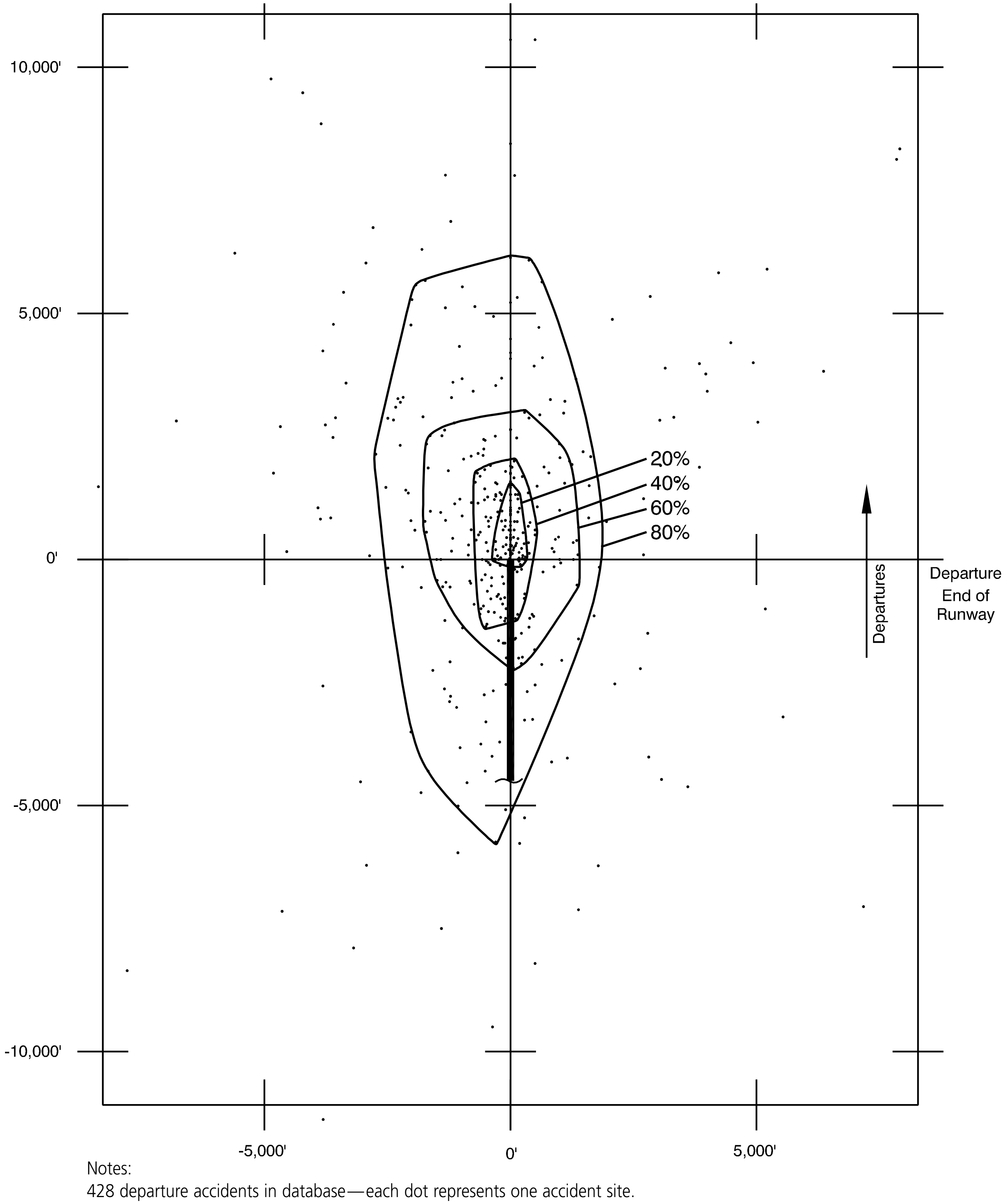


Notes:
445 arrival accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9C

General Aviation Accident Distribution Contours

All Arrivals

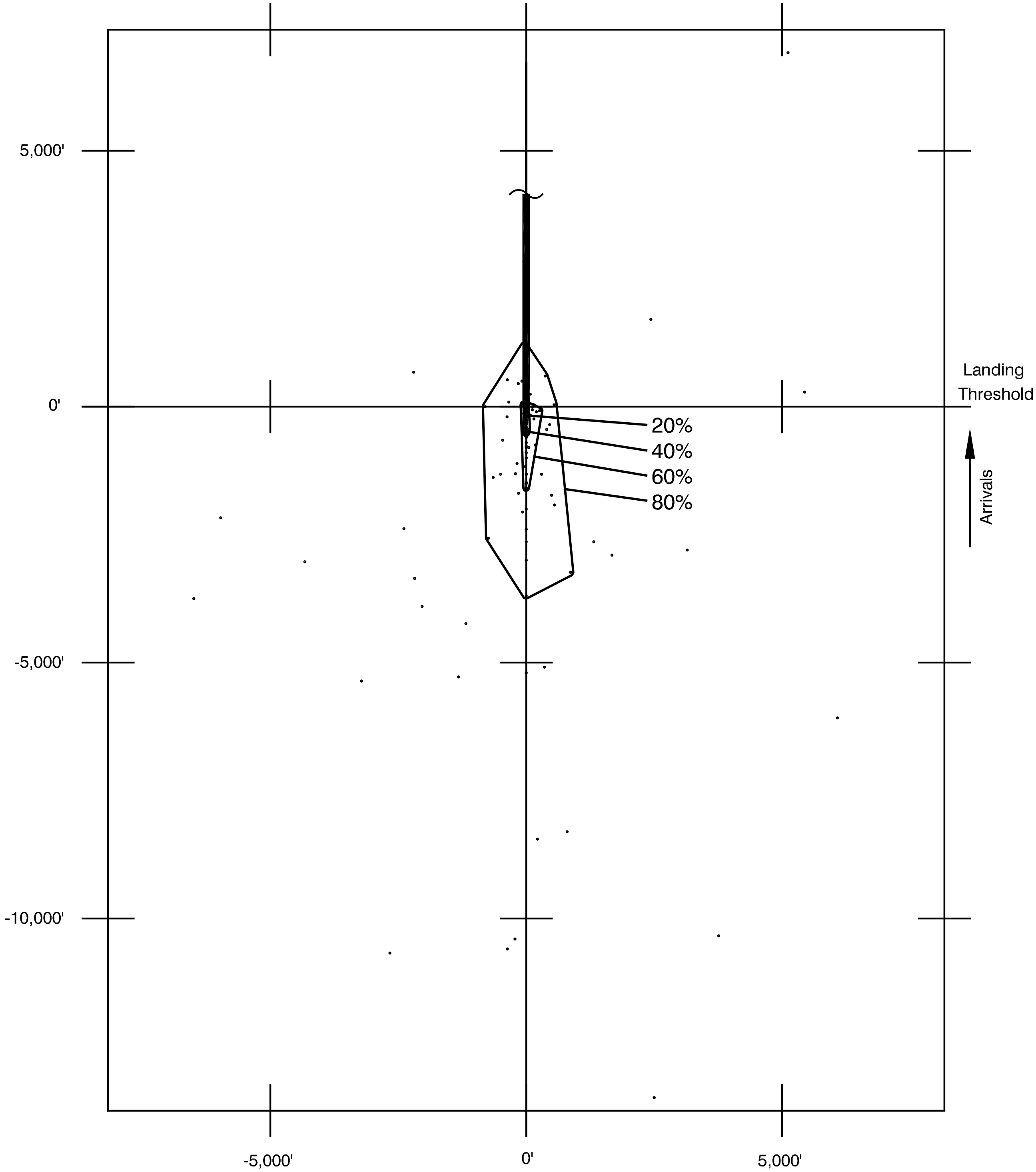


Notes:
428 departure accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9D

General Aviation Accident Distribution Contours

All Departures

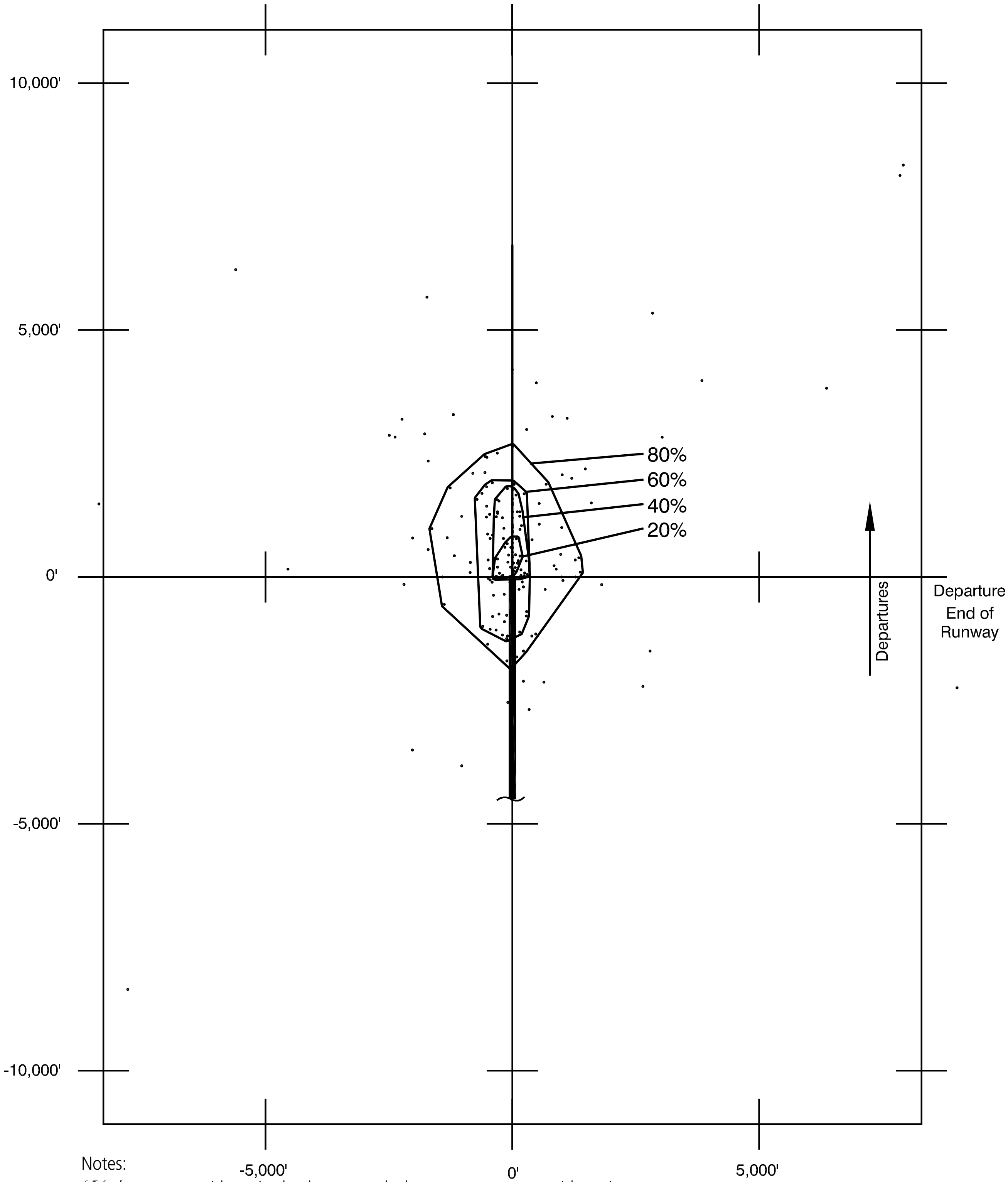


Notes:
153 arrival accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9E

General Aviation Accident Distribution Contours

Arrival Accidents on Runways of Less than 4,000 Feet

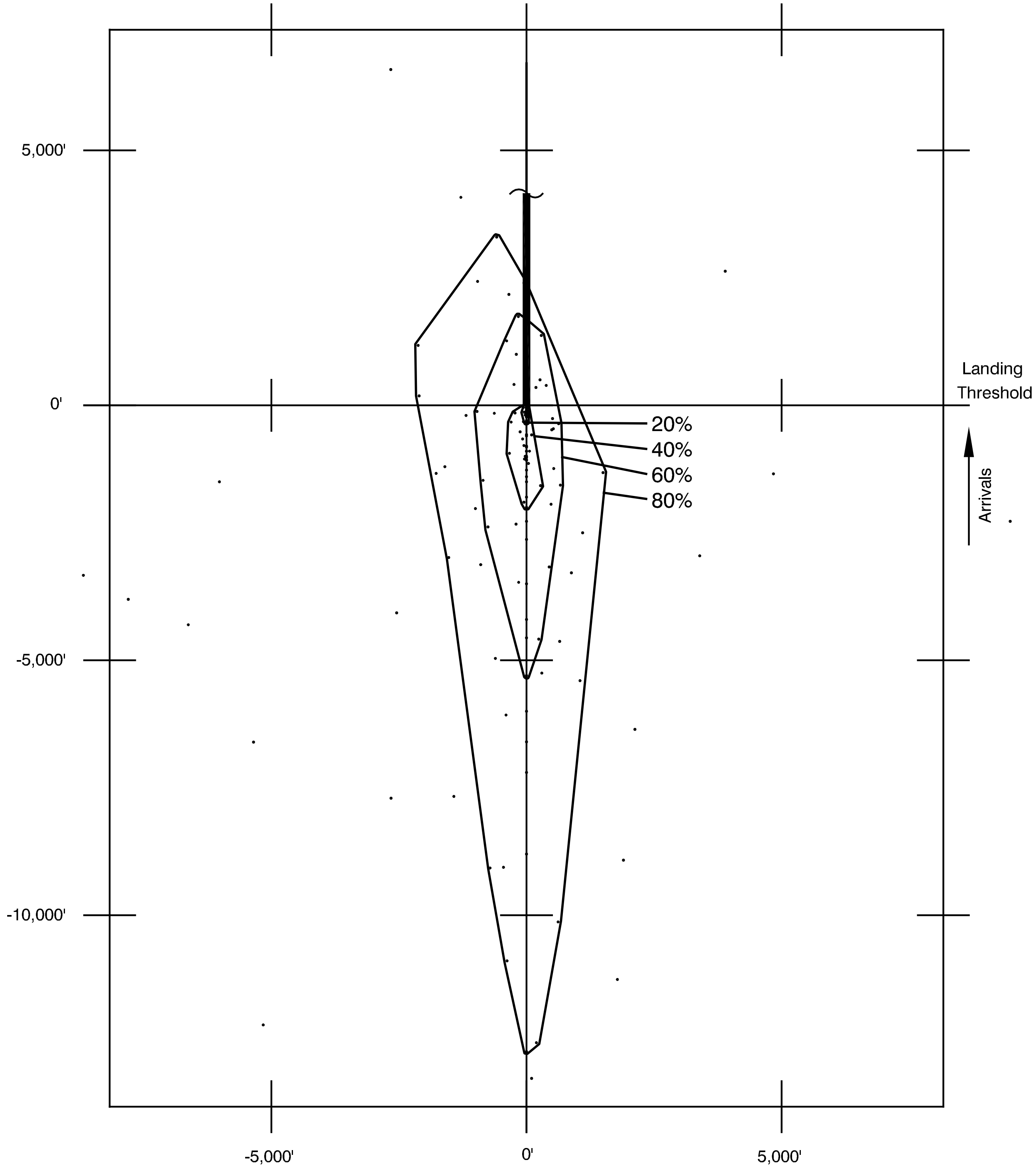


Notes:
191 departure accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9F

General Aviation Accident Distribution Contours

Departure Accidents on Runways of Less than 4,000 Feet

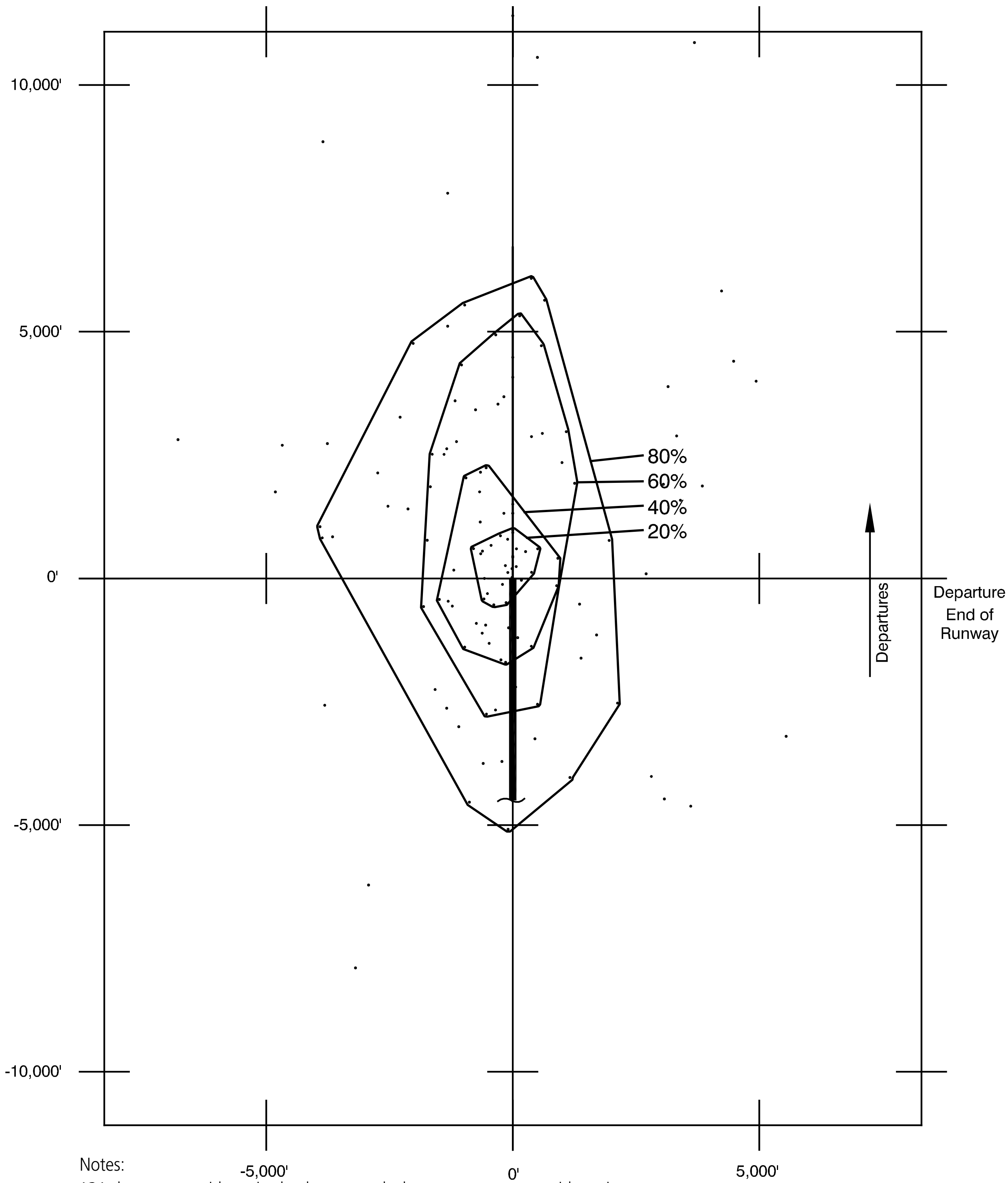


Notes:
150 arrival accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9G

General Aviation Accident Distribution Contours

Arrival Accidents on Runways of 4,000 to 5,999 Feet



Notes:
131 departure accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9H

General Aviation Accident Distribution Contours

Departure Accidents on Runways of 4,000 to 5,999 Feet

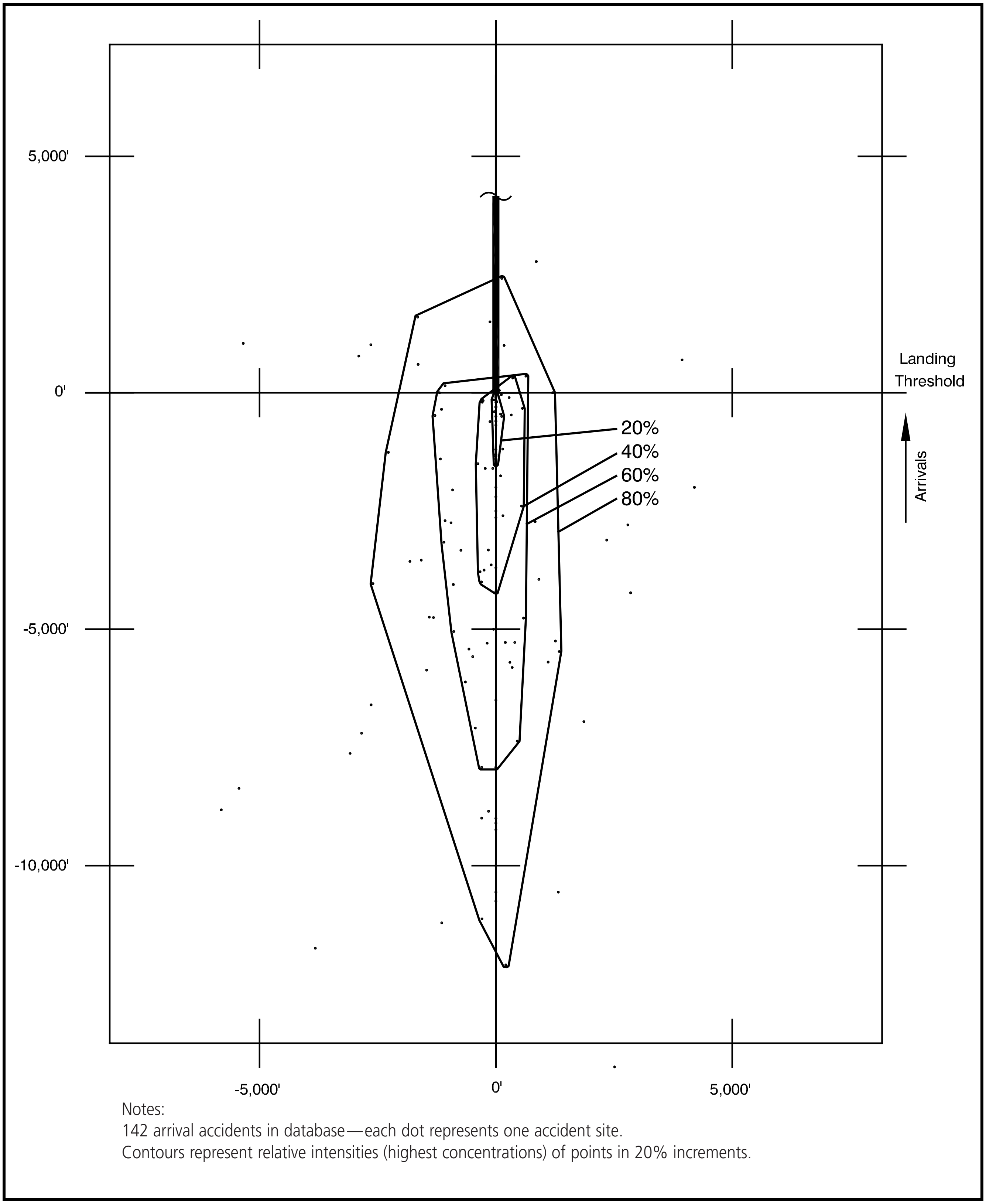
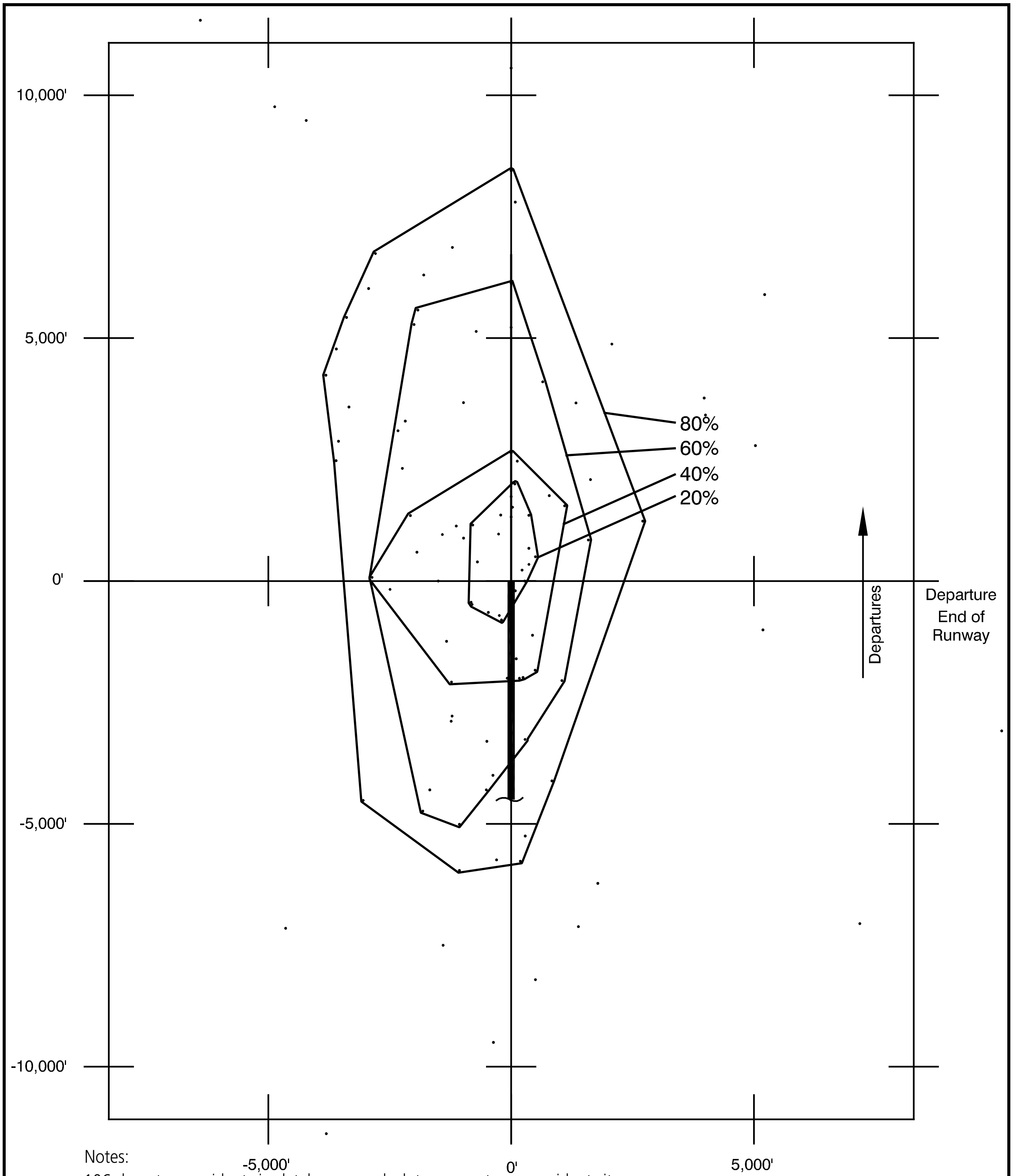


FIGURE 9I

General Aviation Accident Distribution Contours

Arrival Accidents on Runways of 6,000 Feet or More



Notes:
106 departure accidents in database—each dot represents one accident site.
Contours represent relative intensities (highest concentrations) of points in 20% increments.

FIGURE 9J

General Aviation Accident Distribution Contours

Departure Accidents on Runways of 6,000 Feet or More

each instance. Particularly notable in this regard are the differences based on runway length. To portray these differences, the database was divided into three groups according to the length of the runway associated with the accident and accident distribution contours like those described above were developed.

- Runway lengths of less than 4,000 feet: Figures 9E (arrivals) and 9F departures).
- Runway lengths of 4,000 to 5,999 feet: Figures 9G (arrivals) and 9H (departures).
- Runway lengths of 6,000 feet or more: Figures 9I (arrivals) and 9J (departures).

Note that some of the contours, particularly the outer ones, are quite lopsided in shape. This irregularity can at least partially be attributed to the limited numbers of data points in these subsets (only 100 to 150 in most cases). Remaining unknown is whether an extensive expansion of the database would result in more uniformly shaped contours. It could well be that there is truly a geographic bias in the distribution of accident sites reflecting, for example, the left-hand traffic pattern of most runways. Given this uncertainty, no attempt is made here to produce more refined contours.

Because of the data limitations, the accident distribution contours presented here are considered to be more useful in support of regular, geometrically shaped, safety zones than as safety zones themselves. Also, the contours are purely statistical and do not reflect where aircraft fly at a specific airport.

Regular Geometric Zones

While accident distribution contours as described in the preceding section are helpful as means of portraying the geographic pattern of aircraft accident risks near an airport, they are not very satisfactory as the basis for defining safety compatibility policies. Their irregular shape is one drawback—although, in that respect, they are no different from noise contours. More important is the lack of precision which results from the modest size of the database, especially as associated with the contours for the individual runway-length groups.

Historically, regular geometric shapes have been used to define safety zones around airports. The 1952 *Report of the President's Airport Commission* first used accident location data to define the size and shape of clear zones (now called runway protection zones) intended to be created at the end of each runway. Airport land use commissions also have mostly used regular geometric shapes when adopting airport safety compatibility zones. Many times, the geometric airspace surfaces defined by Federal Aviation Regulations, Part 77, have been used at least as a starting point for establishment of safety zones.

Runway protection zones (RPZs) and FAR Part 77 surfaces, however, both have shortcomings for the purposes of land use safety compatibility objectives. Runway protection zones encompass only the most highly concentrated areas of accident locations near runways. As the data in Chapter 8 clearly indicates, a significant percentage of near-airport aircraft accidents occur in locations beyond the runway protection zones. Part 77 surfaces cover a much greater geographic area, but they were established for the purposes of airspace protection, not safety compatibility. Part 77 surfaces, especially the transitional surfaces, have rather minimal correlation to where aircraft accidents occur around airports.

A detailed analysis of aircraft accident location patterns provides the best basis for determining optimum safety zone shapes and sizes. An ideal set of safety zones should have four characteristics:

- The zones should have easily definable geometric shapes;
- The number of zones should be limited to a realistic number (five or six should be adequate in most cases);
- The set of zones should have a distinct progression in the degree of risk represented (that is, the distribution of accidents within each zone should be relatively uniform, but more or less concentrated than adjacent zones); and
- Each zone should be as compact as possible (the percentage of accident points per acre, its capture rate, should be maximized).

An analysis of this type was conducted for general aviation aircraft accidents as part of the 1993 edition of this *Handbook*. A summary is presented in Appendix G of the present edition. The analysis is supportive of the concept, widely used by airport land use commissions, to establish several safety compatibility zones for areas beyond the runway ends with each increasingly larger zone having fewer land use restrictions. The information presented, though, leaves open the question of how best to apply the accident data to delineation of the safety zones at individual airports. Specifically still missing from this process are two things:

- The need to use the data to develop an overall set of safety zones covering the entire geographic area within which safety is a concern. This process involves deciding the optimum shape and size of the most critical safety zone, then determining the shapes and sizes of successive zones in incremental fashion.
- The need to refine these generic results to fit the conditions present at individual airports.

APPLICATION TO INDIVIDUAL AIRPORTS

Ideally, to minimize the risk which aircraft accidents pose to people and property on the ground near airports, no development would be allowed in the airport vicinity. For most airports, however, this is clearly not a practical approach to land use compatibility planning. The question thus becomes one of deciding which land uses are acceptable and which are unacceptable in various portions of airport environs. The resulting policies are normally portrayed in the form of a set of safety zones and compatibility criteria applicable within each zone.

DEPT. OF TRANSPORTATION GUIDANCE
While the material presented here is intended to represent Department of Transportation guidance, it is not the intent or expectation that the methodologies or examples constitute the only acceptable approaches to the issue of airport land use safety compatibility. In

development of policies for a specific airport, careful attention must be made to the characteristics of that airport's design and use. Characteristics of the airport environs are potentially factors as well. The safety zones and/or compatibility criteria appropriate at one airport may be inappropriate at a different airport. This process is no different from that necessary in calculation of noise contours and establishment of noise compatibility policies.

Unlike the case with noise, there is no uniform, widely accepted methodology for measurement of near-airport aircraft accident risks, let alone a process for creation of safety compatibility policies. There is, however, a substantial amount of data—much of it summarized in Chapter 8—upon which to base the process. The following discussion draws heavily upon analyses done for the 1993 edition of this *Handbook*, additional studies conducted in conjunction with preparation of this update, and the experience gained by airport land use commissions in development of safety compatibility policies over the years.

DEPT. OF TRANSPORTATION GUIDANCE
Development of safety compatibility zones must be done in unison with the definition of criteria applicable within those zones. For both of these components, the particular physical and operational characteristics of the individual airport must be considered. The guidance presented in this chapter serves as a starting point for this process.

A point to emphasize is that delineation of safety compatibility zones and definition of criteria applicable within those zones are closely intertwined. The process is usually an iterative one: initial zones and criteria are drafted and then each is fine tuned as necessary in recognition of the peculiarities of the specific airport and its environs. (This process is particularly applicable when compatibility zones and criteria are formulated to take into account a combination of noise and safety compatibility concerns.)

General Approach

The three components of physical risks which were outlined earlier provide the conceptual basis for setting safety compatibility policies. Each of these components needs to be considered either in the delineation of safety compatibility zones or in the definition of the criteria applicable within the zones.

- The spatial distribution component clearly can only be reflected by means of the shape and size of safety compatibility zones.
- Potential consequences are addressed through the compatibility criteria—the limitations on usage intensity and other land use characteristics which affect the potential severity of an accident.
- The frequency component can be accounted for either way—through adjustment of zone sizes or the criteria applicable within each zone.

Frequency is primarily a factor at airports (or on runways) with very low activity. For most airports, the potential consequences component dominates the overall risk equation.

The choice of safety criteria appropriate for a particular zone is largely a function of risk acceptability. Land uses which, for a given proximity to the airport, are judged to represent intolerable risks usually must be prohibited. Where the risks of a particular land use are considered significant but tolerable, establishment of restrictions may reduce the risk to an acceptable level. Uses which are intrinsically acceptable, generally require no limitations.

Finally, to reiterate the point, it is the potentially severe consequences of aircraft accidents which are the driving concern in setting safety compatibility policies. As reflected in the matrix on page 9-14, only where the likelihood of an accident occurrence is so infrequent as to be considered extraordinary does the acceptability of potentially severe consequences reach a level that usually does not warrant some type of compatibility action.

Basic Safety Compatibility Zones

A total of seven examples of different safety zone configurations are delineated in a series of diagrams shown in the figures on the following pages.

Figure 9K includes safety zone examples for five different types of general aviation runways. Figure 9L presents examples for runways at a large air carrier and military airports. The diagrams divide the airport vicinity into as many as six safety zones in addition to the immediate runway environs (defined by the FAR Part 77 primary surface):

- *Zone 1:* Runway protection zone;
- *Zone 2:* Inner approach/departure zone;
- *Zone 3:* Inner turning zone;
- *Zone 4:* Outer approach/departure zone;
- *Zone 5:* Sideline zone; and
- *Zone 6:* Traffic pattern zone.

The intent of the set of zones depicted for each scenario is that risk levels be relatively uniform across each zone, but distinct from the other zones. The shapes and sizes of the zones are largely based upon the accident data and analyses presented in this and the preceding chapter. The flight paths which aircraft typically follow when approaching and departing a runway—particularly at less than traffic pattern altitude—are also considered, however. Other specific assumptions associated with each diagram are noted.

Even this expanded set of safety zone examples addresses only a few of the many variables which affect accident distribution patterns and attendant risks to land uses near airports. Many variables are too dependent upon the configuration and usage of a particular airport to be broadly generalized. Table 9A lists key airport operational variables which warrant consideration during the development of safety compatibility zones for an individual airport. These factors may necessitate adjustments to the shapes and sizes of the zones.

Several other factors deserve consideration when defining safety zones. These factors involve characteristics of the airport environs.

➤ **Airport Area Topography**—Characteristics of the terrain in the vicinity of an airport may sometimes need to be considered when setting safety compatibility zone boundaries. The presence of high terrain, the edge of a precipice, or other such features may influence the location of aircraft traffic patterns. Extension of safety zones may be justified in places where high terrain results in aircraft flying at a relatively low altitude above the ground. Also, some locations might have reduced levels of risk because they are effectively shielded by nearby higher terrain.

➤ **Existing Urban Developmen**t—In most instances, modification of safety compatibility zone boundaries will be based upon aeronautical factors such as those described Table 9A. At airports in urban settings, adjustments reflecting patterns of existing urban development may also be desirable. Most such adjustments are best made with respect to the compatibility criteria rather than the shapes and sizes of the compatibility zones, but both may be appropriate in some situations.

➤ **Locate Boundaries Based on Geographic Features**—Another manner in which safety zone shapes and sizes might be adjusted in response to

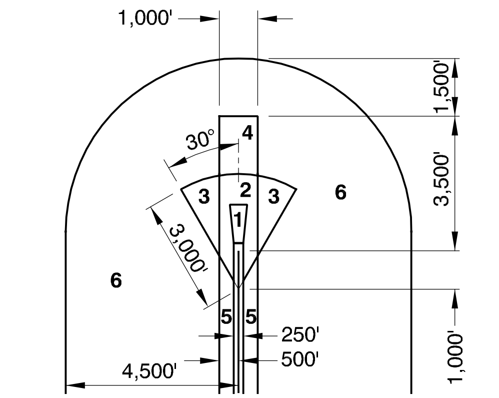
DEPT. OF TRANSPORTATION GUIDANCE

When applying these basic safety zones to a particular airport, it is important to recognize that not every runway will fit neatly into one of the categories shown. In many cases, a combination of the shapes and sizes from different diagrams may be appropriate. Also, it may be appropriate to establish different safety zone geometry at opposite ends of a runway. Other factors, such as those listed in the next section, will often need to be taken into account and the safety zone geometry adjusted accordingly. Finally, the criteria applicable within each zone, as discussed later in this chapter, must be considered when setting the boundaries of safety compatibility zones.

Also, note that, when ALUCs use the composite compatibility criteria and map format described in Chapter 3, the addition of noise as a factor is likely to result in compatibility zones which differ from the safety zone examples described here.

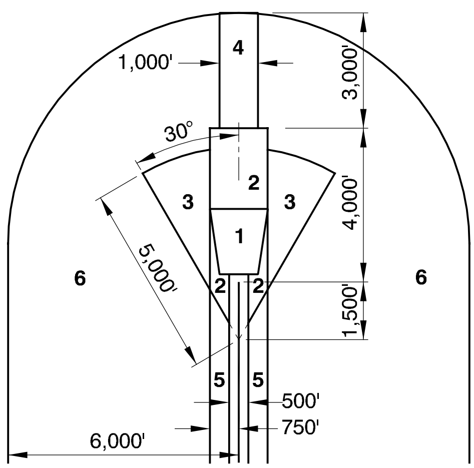
DEPT. OF TRANSPORTATION GUIDANCE

The principal reason for adjusting safety compatibility zone geometry in response to existing land uses is to minimize the extent to which development which is only marginally incompatible is classified as nonconforming. (Especially for residential areas, the consequence can be the unnecessary creation of considerable vocal opposition to the compatibility plan.) Such adjustments may be reasonable in locations where safety concerns are moderate to low. However, care must be taken in making adjustments in critical locations close to the runway ends—it is better for existing development to be deemed nonconforming if it is indeed incompatible with airport activity.



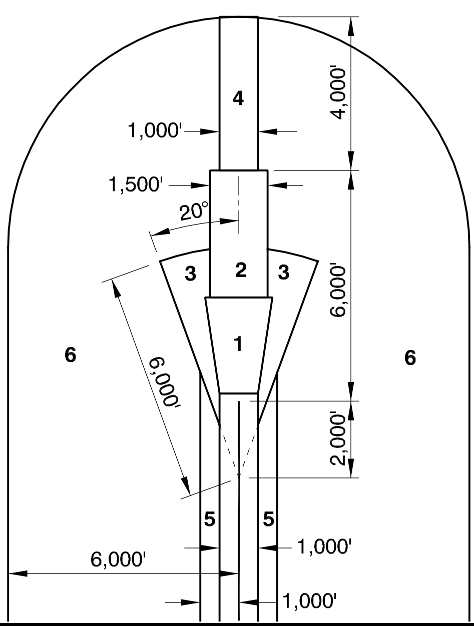
Example 1:
Short General Aviation Runway

Assumptions:
- Length less than 4,000 feet
- Approach visibility minimums ≥ 1 mile or visual approach only
- Zone 1 = 250' x 450' x 1,000'



Example 2:
Medium General Aviation Runway

Assumptions:
- Length 4,000 to 5,999 feet
- Approach visibility minimums ≥ 3/4 mile and < 1 mile
- Zone 1 = 1,000' x 1,510' x 1,700'



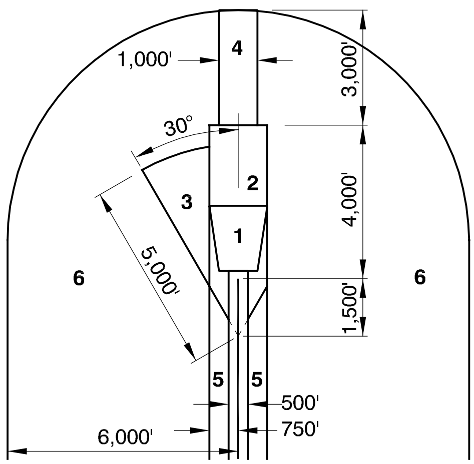
Example 3:
Long General Aviation Runway

Assumptions:
- Length 6,000 feet or more
- Approach visibility minimums < 3/4 mile
- Zone 1 = 1,000' x 1,750' x 2,500'

FIGURE 9K

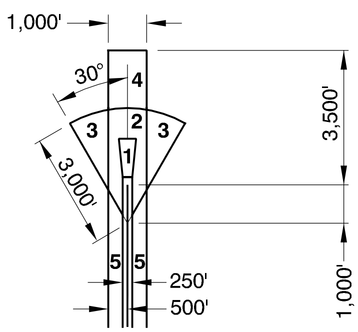
Safety Compatibility Zone Examples

General Aviation Runways



Example 4:
General Aviation Runway with Single-Sided Traffic Pattern

Assumptions:
- No traffic pattern on right
- Length 4,000 to 5,999 feet
- Approach visibility minimums ≥ 3/4 mile and < 1 mile
- Zone 1 = 1,000' x 1,510' x 1,700'



Example 5:
Low-Activity General Aviation Runway

Assumptions:
- Less than 2,000 takeoffs and landings per year at individual runway end.
- Length less than 4,000 feet
- Approach visibility minimums ≥ 1 mile or visual approach only
- Zone 1 = 250' x 450' x 1,000'

Legend

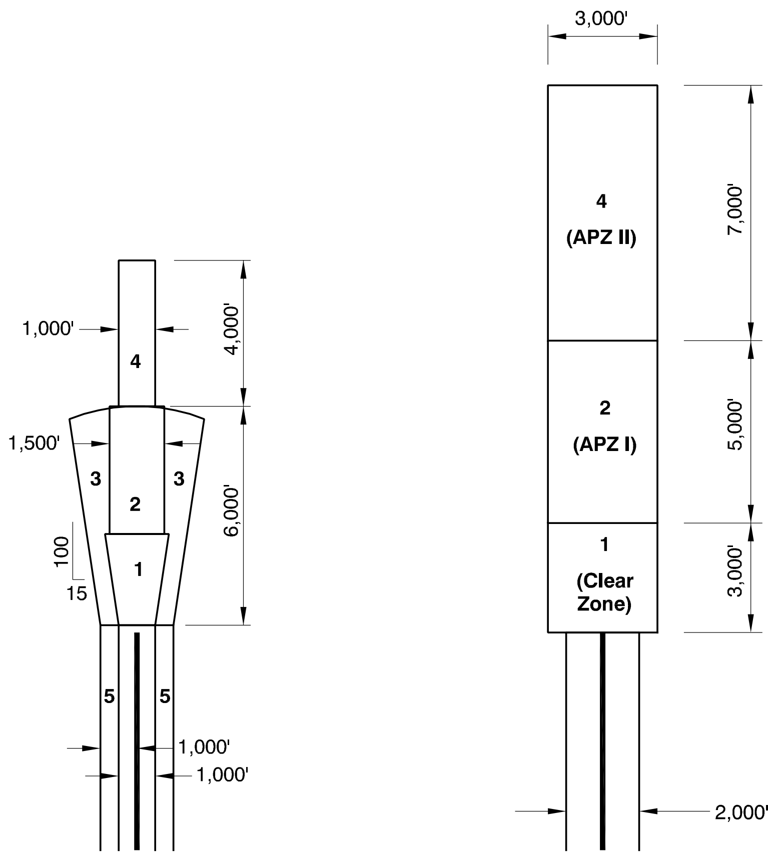
1. Runway Protection Zone
2. Inner Approach/Departure Zone
3. Inner Turning Zone
4. Outer Approach/Departure Zone
5. Sideline Zone
6. Traffic Pattern Zone

Notes:

- RPZ (Zone 1) size in each example is as indicated by FAA criteria for the approach type assumed. Adjustment may be necessary if the approach type differs.
- See Table 9A for factors to consider regarding other possible adjustments to these zones to reflect characteristics of a specific airport runway.
- See Tables 9B and 9C for guidance on compatibility criteria applicable with each zone.

These examples are intended to provide general guidance for establishment of airport safety compatibility zones. They do not represent California Department of Transportation standards or policy.

FIGURE 9K *CONTINUED*



Large Air Carrier Runway

Assumptions:
- Minimal light-aircraft general aviation activity
- Predominately straight-in and straight-out flight routes
- Approach visibility minimums < 3/4 mile
- Zone 1 = 1,000' x 1,750' x 2,500'

Military Runway for Large Aircraft

Assumptions:
- Military airport
- Predominately straight-in and straight-out flight routes (must modify for turning routes and traffic pattern activity)

Legend

1. Runway Protection Zone (Clear Zone)
2. Inner Approach/Departure Zone (Accident Potential Zone I)
3. Inner Turning Zone
4. Outer Approach/Departure Zone (Accident Potential Zone II)
5. Sideline Zone

Notes:

- RPZ (Zone 1) size in the large air carrier runway example is as indicated by FAA criteria for the approach type assumed. Adjustment may be necessary if the approach type differs.
- See Table 9A for factors to consider regarding other possible adjustments to these zones to reflect characteristics of a specific airport runway.
- See Tables 9B and 9C for guidance on compatibility criteria applicable with each zone.

These examples are intended to provide general guidance for establishment of airport safety compatibility zones. They do not represent California Department of Transportation standards or policy.

FIGURE 9L

Safety Compatibility Zone Examples

Large Air Carrier and Military Runways

The generic sets of compatibility zones shown in Figures 9K and 9L may need to be adjusted to take into account various operational characteristics of a particular airport runway. Among these characteristics are the following:

- **Instrument Approach Procedures**—At least within the final two to three miles which are of greatest interest to land use compatibility planning, the flight paths associated with precision instrument approach procedures are highly standardized from airport to airport. Other types of instrument approach procedures are less uniform, however. If such procedures are available at an airport, ALUCs should identify the flight paths associated with them and the extent to which they are used. Procedures which are regularly used should be taken into account in the configuration of safety zones (and in setting height limits for airspace protection). Types of procedures which may warrant special consideration include:
  - *Circling Approaches:* Most instrument approach procedures allow aircraft to circle to land at a different runway rather than continue straight-in to a landing on the runway for which the approach is primarily designed. When airports which have straight-in approaches to multiple runway ends, circling approaches are seldom necessary. However, when only one straight-in approach procedure is available and the wind direction precludes landings on that runway, aircraft may be forced to circle to land on at another runway end. Pilots must maintain sight of the runway while circling, thus turns are typically tight. Also, the minimum circling altitude is often less than the traffic pattern altitude. At airports where circling approaches are common, giving consideration to the associated risks when setting safety zone boundaries is appropriate.
  - *Nonprecision Approaches at Low Altitudes:* Nonprecision instrument approach procedures often involve aircraft descending to a lower altitude farther from the runway than occurs on either precision instrument or visual approaches. An altitude of 300 to 400 feet as much as two to three miles from the runway is not unusual. The safety (and noise) implications of such procedures need to be addressed at airports where they are in common use. (A need for corresponding restrictions on the heights of objects also exists along these routes.)
  - *Nonprecision Approaches not Aligned with the Runway:* Some types of nonprecision approaches bring aircraft toward the runway along a path that is not aligned with the runway. In many cases, these procedures merely enable the aircraft to reach the airport vicinity at which point they then proceed to land under visual conditions. In other instances, however, transition to the runway alignment occurs close to the runway and at a low altitude.
- **Other Special Flight Procedures or Limitations**—Single-sided traffic patterns represent only one type of special flight procedures or limitations which may be established at some airports. Factors such as nearby airports, high terrain, or noise-sensitive land uses may affect the size of the airport traffic pattern or otherwise dictate where and at what altitude aircraft fly when using the airport. These procedures may need to be taken into account in the design of safety compatibility zones.
- **Runway Use by Special-Purpose Aircraft**—In addition to special flight procedures which most or all aircraft may use at some airports, certain special-purpose types of aircraft often have their own particular flight procedures. Most common among these aircraft are fire attack, agricultural, and military airplanes. Helicopters also typically have their own special flight routes. The existence of these procedures needs to be investigated and, where warranted by the levels of usage, may need to be considered in the shaping of safety zones.
- **Small Aircraft Using Long Runways**—When small airplanes take off from long runways (especially runways in excess of 8,000 feet length), it is common practice for them to turn toward their intended direction of flight before passing over the far end of the runway. When mishaps occur, the resulting pattern of accident sites will likely be more dispersed around the runway end than is the case with shorter runways. With short runways, accident sites tend to be more tightly clustered around the runway end and along the extended runway centerline because aircraft are still following the runway heading as they begin their climb.
- **Runways Used Predominantly in One Direction**—Most runways are used sometimes in one direction and, at other times, in the opposite direction depending upon the direction of the wind. Even when used predominantly in one direction, a busy runway may experience a significant number of operations in the opposite direction (for example, a runway with 100,000 total annual operations, 90% of which are in one direction, will still have 10,000 annual operations in the opposite direction). Thus, in most situations, the generic safety zones—which take into account both takeoffs and landings at a runway end—are applicable. However, when the number of either takeoffs or landings at a runway end is less than approximately 2,000 per year, then adjustment of the safety compatibility zones to reflect those circumstances may be warranted.
- **Displaced Landing Thresholds**—A displaced threshold moves the landing location of aircraft down the runway from where they would land in the absence of the displacement. The distribution pattern of landing accident sites as shown in Appendix F would thus shift a corresponding amount. The pattern of accident locations for aircraft taking off toward that end of the runway does not necessarily shift, however. Whether the runway length behind the displaced threshold is usable for takeoffs toward that end of the runway is a key factor in this regard. The appropriateness of making adjustments to safety zone locations in response to the existence of a displaced threshold needs to be examined on a case-by-case basis. The numbers of landings at and takeoffs toward the runway end in question should be considered in making this determination.

TABLE 9A

Safety Zone Adjustment Factors

Airport Operational Variables

existing urban development is to have the zone boundaries follow established geographic features. As discussed in Chapter 3, such features might include, roads, water courses, parcel lines, etc. Such adjustments should be made in a manner which provides a level of safety equivalent to that afforded by the applicable generic safety compatibility zones. Adjustments of this type can greatly simplify implementation of a compatibility plan without compromising the rationale used to establish the zone boundaries.

Basic Safety Compatibility Criteria

By emphasizing adjustments to the shape and size of safety zones as necessary to reflect the geographic pattern of aircraft accident risks, the compatibility criteria applicable to each zone can be held relatively constant among most airports. Table 9B provides a qualitative description of the land use characteristics considered acceptable or unacceptable within each of the six basic safety zones. Also indicated are the general risk factors prevalent in each zone.

The types of variables not fully accounted for in the safety zones, though, are ones involving existing land use characteristics of the airport environs. As previously discussed, more intensive development is often considered acceptable within urban areas because the costs of avoiding that development are greater than in rural areas. Table 9C presents a set of specific safety compatibility criteria guidelines formulated with this factor in mind. A distinction is made between current settings which are heavily urbanized versus ones in suburban or rural areas where much of the land remains undeveloped. Note that this urban versus rural distinction is not limited just to differences between one airport and another, it may also be true between various portions of individual airport's environs. Consequently, it may be reasonable for compatibility criteria to allow comparatively intensive development and/or infill development in one part of an airport vicinity, but not in another.

Guidelines for General Aviation Runways

Figure 9K depicts basic guidelines for general aviation runway safety compatibility zones. Five variations are shown:

- General aviation runway with length of less than 4,000 feet and visibility minimums of 1 mile or visual approaches only;
- General aviation runway with length of 4,000 to 5,999 feet and instrument approach visibility minimums below 1 mile, but not lower than ¾ mile;
- General aviation runway with length of 6,000 feet or more and a instrument approach visibility minimums below ¾ mile;
- General aviation runway with traffic pattern on one side only; and
- General aviation runway with very-low activity levels (less than 2,000 takeoffs and landings projected per year at the runway end under consideration).

Data from the expanded general aviation aircraft accident database has been taken into account in creation of these suggested zones as has the experience of ALUCs in use of the zones shown in the 1993 edition of this *Handbook*.

Runway Length and Approach Visibility Variables

The primary variable among the general aviation runway safety zone examples shown in Figure 9K is the runway length. Additionally, though, different assumptions are made as to the approach visibility minimums for each runway length grouping. For the purposes of illustration, longer runways are assumed to have better instrument approaches. Adjustments to the safety zones may be appropriate for runway ends having approaches which do not match the assumptions noted.

The three examples which focus on runway length as the primary variable are similar, but not identical, to the comparable examples included in the 1993 *Handbook*. A discussion of the differences is included in Appendix G.

Table 9D provides supporting data for three of the general aviation airport safety compatibility zone examples, one in each runway length group. For each of the suggested zones, the table indicates the acreage of the zone and the percentage of arrival, departure, and total accidents which are encompassed within that zone. The capture rates—percentage of accidents divided by acreage—is listed as well.

Single-Sided Traffic Pattern

The single-sided traffic pattern example eliminates the turning zone on the nonpattern side of the runway. This configuration is based upon the assumption that aircraft are less likely to crash in locations over which they normally do not fly. (Insufficient information is available in the general aviation accident database to better assess this operational configuration.) It is recognized, however, that the potential exists for aircraft to deviate to the nonpattern side on either takeoff or landing, especially under emergency conditions. Some amount of buffer is thus important to maintain. Note that the example shown is for a runway in the 4,000-to-5,999-foot length category. Similar safety zone configurations can be devised for other runway lengths.

Low-Activity Runways

The other operational variable which calls for adjustment of the compatibility zones is for runways where activity levels are currently very low and are forecast to remain that way indefinitely. Clearly, the likelihood of an aircraft accident happening is reduced when operational volumes remain low. As suggested previously, this reduced risk could be reflected in compatibility policies either by adjusting the safety zones or by modifying the compatibility criteria. The low-activity runway diagram in Figure 9K works on the basis that adjustment of zone sizes is preferable. Safety compatibility criteria are a reflection of the potential consequences of an accident and that potential does not change even if the activity is low. Furthermore, safety zone shapes and sizes can more readily be adjusted for a single low-activity runway at an otherwise busy airport. Modifying the compatibility criteria would require having different criteria for different runways.

Zone 1: Runway Protection Zone

Risk Factors / Runway Proximity	*Basic Compatibility Qualities*
➤ Very high risk ➤ Runway protection zone as defined by FAA criteria ➤ For military airports, clear zones as defined by AICUZ criteria	➤ Airport ownership of property encouraged ➤ Prohibit all new structures ➤ Prohibit residential land uses ➤ Avoid nonresidential uses except if very low intensity in character and confined to the sides and outer end of the area

Zone 2: Inner Approach/Departure Zone

Risk Factors / Runway Proximity	*Basic Compatibility Qualities*
➤ Substantial risk: RPZs together with inner safety zones encompass 30% to 50% of near-airport aircraft accident sites (air carrier and general aviation) ➤ Zone extends beyond and, if RPZ is narrow, along sides of RPZ ➤ Encompasses areas overflown at low altitudes — typically only 200 to 400 feet above runway elevation	➤ Prohibit residential uses except on large, agricultural parcels ➤ Limit nonresidential uses to activities which attract few people (uses such as shopping centers, most eating establishments, theaters, meeting halls, multi-story office buildings, and labor-intensive manufacturing plants unacceptable) ➤ Prohibit children's schools, day care centers, hospitals, nursing homes ➤ Prohibit hazardous uses (e.g. aboveground bulk fuel storage)

Zone 3: Inner Turning Zone

Risk Factors / Runway Proximity	*Basic Compatibility Qualities*
➤ Zone primarily applicable to general aviation airports ➤ Encompasses locations where aircraft are typically turning from the base to final approach legs of the standard traffic pattern and are descending from traffic pattern altitude ➤ Zone also includes the area where departing aircraft normally complete the transition from takeoff power and flap settings to a climb mode and have begun to turn to their en route heading	➤ Limit residential uses to very low densities (if not deemed unacceptable because of noise) ➤ Avoid nonresidential uses having moderate or higher usage intensities (e.g., major shopping centers, fast food restaurants, theaters, meeting halls, buildings with more than three aboveground habitable floors are generally unacceptable) ➤ Prohibit children's schools, large day care centers, hospitals, nursing homes ➤ Avoid hazardous uses (e.g. aboveground bulk fuel storage)

TABLE 9B

Basic Safety Compatibility Qualities

Zone 4: Outer Approach/Departure Zone

Risk Factors / Runway Proximity

- Situated along extended runway centerline beyond Zone 3
- Approaching aircraft usually at less than traffic pattern altitude
- Particularly applicable for busy general aviation runways (because of elongated traffic pattern), runways with straight-in instrument approach procedures, and other runways where straight-in or straight-out flight paths are common
- Zone can be reduced in size or eliminated for runways with very-low activity levels

Basic Compatibility Qualities

- In undeveloped areas, limit residential uses to very low densities (if not deemed unacceptable because of noise); if alternative uses are impractical, allow higher densities as infill in urban areas
- Limit nonresidential uses as in Zone 3
- Prohibit children's schools, large day care centers, hospitals, nursing homes

Zone 5: Sideline Zone

Risk Factors / Runway Proximity

- Encompasses close-in area lateral to runways
- Area not normally overflown; primary risk is with aircraft (especially twins) losing directional control on takeoff
- Area is on airport property at most airports

Basic Compatibility Qualities

- Avoid residential uses unless airport related (noise usually also a factor)
- Allow all common aviation-related activities provided that height-limit criteria are met
- Limit other nonresidential uses similarly to Zone 3, but with slightly higher usage intensities
- Prohibit children's schools, large day care centers, hospitals, nursing homes

Zone 6: Traffic Pattern Zone

Risk Factors / Runway Proximity

- Generally low likelihood of accident occurrence at most airports; risk concern primarily is with uses for which potential consequences are severe
- Zone includes all other portions of regular traffic patterns and pattern entry routes

Basic Compatibility Qualities

- Allow residential uses
- Allow most nonresidential uses; prohibit outdoor stadiums and similar uses with very high intensities
- Avoid children's schools, large day care centers, hospitals, nursing homes

Definitions

As used in this table, the follow meanings are intended:

- *Allow:* Use is acceptable
- *Limit:* Use is acceptable only if density/intensity restrictions are met
- *Avoid:* Use generally should not be permitted unless no feasible alternative is available
- *Prohibit:* Use should not be permitted under any circumstances
- *Children's Schools:* Through grade 12
- *Large Day Care Centers:* Commercial facilities as defined in accordance with state law; for the purposes here, family day care homes and noncommercial facilities ancillary to a place of business are generally allowed.
- *Aboveground Bulk Storage of Fuel:* Tank size greater than 6,000 gallons (this suggested criterion is based on Uniform Fire Code criteria which are more stringent for larger tank sizes)

TABLE 9B *CONTINUED*

Obvious questions posed by the idea of modifying safety zones for low-activity runways are:

- How low must the activity level continue to be for the runway to be considered low activity?
- How much can the safety zones be adjusted in response to the low activity?

In each case, the answer is a relative one. The assumption employed in the example here is that the runway end under consideration has fewer than 2,000 total takeoffs and landings projected annually (roughly 6 operations per day). Less modification is justified when the activity is higher. Beyond about 10,000 annual operations, the basic safety zone configuration should be applied.

The other factor is that locations close to the runway remain critical even when the activity is low. FAA criteria for runway protection zones, for example, do not depend upon aircraft operations volumes, only the types of approach the runway has and the type of aircraft it accommodates. Thus, depending upon where the common flight tracks are located, it is the outer safety zone and/or the turning zone which can most reasonably be modified. In defining safety zones for low-activity runways, special consideration also needs to be given to the mix of aircraft and the existence of any common but unusual flight tracks. Runways used primarily by agricultural aircraft are a prime example of such situations. Safety zones for low-activity runways which are sometimes used by large aircraft also need to be carefully evaluated.

Guidelines for Large Air Carrier Runways

There are numerous factors that distinguish the risks associated with runways predominantly used by air carrier aircraft from those of runways that have a significant number of general aviation operations.

- Nearly all aircraft are flown by professional pilots;
- Nearly all pilots are instrument rated;
- Pilots are more experienced and fly more frequently;
- Typically, there are at least two pilots in the cockpit;
- Many flights are conducted under the more restrictive requirements of FAR Part 121, 135, etc.;
- The majority of flights are conducted under instrument flight plans, even when weather does not require it;
- The vast majority of aircraft have multiple engines and can remain airborne following the loss of one engine;
- Aircraft maintenance programs are monitored by the FAA;
- Aircraft are much newer on average than small aircraft in the general aviation fleet; and
- Essentially all of these airports have electronic landing aids.

All of these factors support the very low frequency of commercial aviation accidents. At air carrier airports, noise tends to be such a dominant consideration that safety is seldom discussed. However, the consequences of an

Maximum Residential Density

Current Setting	(1) Runway Protection Zone	(2) Inner Approach/ Departure Zone	(3) Inner Turning Zone	(4) Outer Approach/ Departure Zone	(5) Sideline Zone	(6) Traffic Pattern Zone
	Safety Compatibility Zones[a]					
Average number of dwelling units per gross acre						
Rural Farmland / Open Space (Minimal Development)	0	Maintain current zoning if less than density criteria for rural / suburban setting				No limit
Rural / Suburban (Mostly to Partially Undeveloped)	0	1 d.u. per 10 – 20 ac.	1 d.u. per 2 – 5 ac.	1 d.u. per 2 – 5 ac.	1 d.u. per 1 – 2 ac.	No limit
Urban (Heavily Developed)	0	0	Allow infill at up to average of surrounding residential area[b]			No limit

[a] Clustering to preserve open land encouraged in all zones.
[b] See Chapter 3 for discussion of infill development criteria; infill is appropriate only if nonresidential uses are not feasible.

Maximum Nonresidential Intensity

Current Setting	(1) Runway Protection Zone	(2) Inner Approach/ Departure Zone	(3) Inner Turning Zone	(4) Outer Approach/ Departure Zone	(5) Sideline Zone	(6) Traffic Pattern Zone
	Safety Compatibility Zones					
Average number of people per gross acre[a]						
Rural Farmland / Open Space (Minimal Development)	0[b]	10 – 25	60 – 80	60 – 80	80 – 100	150
Rural / Suburban (Mostly to Partially Undeveloped)	0[b]	25 – 40	60 – 80	60 – 80	80 – 100	150
Urban (Heavily Developed)	0[b]	40 – 60	80 – 100	80 – 100	100 – 150	No limit[c]
Multipliers for above numbers[d]						
Maximum Number of People per Single Acre	x 1.0	x 2.0	x 2.0	x 3.0	x 2.0	x 3.0
Bonus for Special Risk-Reduction Bldg. Design	x 1.0	x 1.5	x 2.0	x 2.0	x 2.0	x 2.0

[a] Also see Table 9B for guidelines regarding uses which should be prohibited regardless of usage intensity
[b] Exceptions can be permitted for agricultural activities, roads, and automobile parking provided that FAA criteria are satisfied.
[c] Large stadiums and similar uses should be prohibited.
[d] Multipliers are cumulative (e.g., maximum intensity per single acre in inner safety zone is 2.0 times the average intensity for the site, but with risk-reduction building design is 2.0 x 1.5 = 3.0 times the average intensity).

TABLE 9C

Safety Compatibility Criteria Guidelines

Land Use Densities and Intensities

off-airport air carrier accident are potentially devastating. For land use compatibility planning, defining realistic safety criteria is complicated by the fact that many busy air carrier airports were established decades ago and are now surrounded by urban development.

The accident database relied upon in defining safety zone guidelines for general aviation airports contains data only on general aviation aircraft accidents. Equivalent data for air carrier accidents is comparatively scant. Using data from a 1990 FAA study, Figure 8D in Chapter 8 shows the location pattern for some three dozen near-airport commercial aircraft accidents. A British study also cited in Chapter 8 (Figure 8C) includes additional data, but it is not formatted in a manner showing the overall scatter pattern (data along and lateral to the extended runway centerline are separately summarized).

Both studies portray similar results. The highest concentration of accidents sites are within approximately 1,500 feet of the runway end, but significant numbers occur within an area extending about two miles beyond the runway end. Most of the sites are directly along the runway centerline and the majority of the remainder are within 1,000 feet of the centerline.

This data provides the basis for the safety zones for large air carrier runways depicted in Figure 9L. These zones assume minimal activity by light general aviation aircraft. Also assumed in the example shown is that the runway length is 8,000 feet or more and that essentially all flights are flown straight in and out along the extended runway centerline. To the extent that any of these assumptions do not strictly apply to a specific airport, then modification of the indicated zones should be considered.

As for the criteria applicable within these zones, the presence of large aircraft might argue for greater stringency. That is, the potential consequences of an airline aircraft accident are much greater than they are for small, general aviation aircraft, thus land uses should be more restricted. However, this risk factor is largely offset by the significantly lower frequency of accidents by airline aircraft. Also, the most at-risk locations can be protected by making the most restricted zones relatively large as shown in Figure 9L. Given these factors, the safety compatibility guidelines listed in Tables 9B and 9C can reasonably be applied to large air carrier runways.

Guidelines for Military Runways

Preparation of compatibility plans for military airfields is optional under the State Aeronautics Act (Public Utilities Code, Section 21675(b)).

Guidelines set forth by the U.S. Department of Defense as part of its *Air Installation Compatible Use Zone* (AICUZ) program are the appropriate starting point for ALUC safety compatibility policies for military airport runways. The federal government has prepared individual AICUZ plans for all major military airports.

The AICUZ-recommended accident potential zones (APZs) are illustrated in Figure 9L. The depicted zones assume that flight tracks are straight-in and straight-out. Where different or additional tracks are used on a regular basis, as is often the case, the APZs should be modified or expanded. Considera-

		Example 1: Runway Length Less than 4,000 Feet			Example 2: Runway Length 4,000 to 5,999 Feet			Example 3: Runway Length 6,000 Feet or More		
	Safety Zone	% of Points	Acres	%/Acre	% of Points	Acres	%/Acre	% of Points	Acres	%/Acre
Arrival Accident Sites										
	Primary Surface	29%	–	–	2%	–	–	11%	–	–
Zone 1:	Runway Protection Zone	27%	8	3.35	26%	49	0.53	25%	79	0.32
Zone 2:	Inner Approach/Departure Zone	15%	44	0.34	9%	101	0.09	12%	114	0.11
Zone 3:	Inner Turning Zone	2%	50	0.04	5%	151	0.04	6%	131	0.05
Zone 4:	Outer Approach/Departure Zone	3%	35	0.07	5%	69	0.08	8%	92	0.09
Zone 5:	Sideline Zone	1%	–	–	3%	–	–	1%	–	–
Zone 6:	Traffic Pattern Zone	10%	–	–	11%	–	–	21%	–	–
Total:	*Zones 1-6 + Primary Surface*	*87%*	–	–	*79%*	–	–	*85%*	–	–
Departure Accident Sites										
	Primary Surface	9%	–	–	9%	–	–	16%	–	–
Zone 1:	Runway Protection Zone	17%	8	2.09	14%	49	0.28	13%	79	0.17
Zone 2:	Inner Approach/Departure Zone	28%	44	0.63	11%	101	0.11	3%	114	0.02
Zone 3:	Inner Turning Zone	5%	50	0.10	9%	151	0.06	8%	131	0.06
Zone 4:	Outer Approach/Departure Zone	2%	35	0.06	4%	69	0.06	3%	92	0.03
Zone 5:	Sideline Zone	8%	–	–	8%	–	–	5%	–	–
Zone 6:	Traffic Pattern Zone	24%	–	–	37%	–	–	39%	–	–
Total:	*Zones 1-6 + Primary Surface*	*94%*	–	–	*91%*	–	–	*86%*	–	–
All Accident Sites										
	Primary Surface	18%	–	–	15%	–	–	13%	–	–
Zone 1:	Runway Protection Zone	21%	8	2.65	21%	49	0.40	20%	79	0.26
Zone 2:	Inner Approach/Departure Zone	22%	44	0.50	10%	101	0.10	8%	114	0.07
Zone 3:	Inner Turning Zone	4%	50	0.08	7%	151	0.05	7%	131	0.05
Zone 4:	Outer Approach/Departure Zone	2%	35	0.07	5%	69	0.07	6%	92	0.07
Zone 5:	Sideline Zone	5%	–	–	5%	–	–	3%	–	–
Zone 6:	Traffic Pattern Zone	18%	–	–	23%	–	–	29%	–	–
Total:	*Zones 1-6 + Primary Surface*	*91%*	–	–	*85%*	–	–	*85%*	–	–

Notes:

- Totals may not equal the sum of the numbers above because of mathematical rounding.
- See Figure 9K for the shapes and dimensions of each zone.
- Accident site locations as indicated in expanded general aviation aircraft accident database.

TABLE 9D

Analysis of Safety Zone Examples

General Aviation Runways

tion may also need to be given to providing safety zones lateral to the runway if these areas are not fully contained within the boundaries of the military facility.

The safety compatibility criteria suggested in AICUZ guidelines tend to represent *minimum standards* (more so with respect to noise than safety). Also, the criteria are formatted using a detailed listing of land uses types. ALUCs may choose to use the AICUZ guidelines directly. Alternatively, the safety compatibility guidelines indicated in Tables 9B and 9C may be appropriate, particularly where the ALUC utilizes this format for safety compatibility criteria at other airports within its jurisdiction. In either case, the specific criteria should be reviewed and revised as necessary to fit the operational characteristics of the specific airfield and the land use characteristics of the surrounding area.

Guidelines for Heliports

The guidelines suggested here are applicable to helicopter touchdown and lift-off pads on public-use airports. Additionally, as discussed in Chapter 3, ALUCs have the authority to create compatibility plans for public-use and special-use heliports.

Unlike for airports, very little information is available upon which to base safety compatibility guidelines for heliports. No useful compilation of data on the location of helicopter accidents in the proximity of heliports is known to exist. The only significant policy guidance is contained in the FAA *Heliport Design* Advisory Circular (AC 150/5390-2A), last updated in 1994. The primary concerns of that document are with respect to the design of the touchdown and liftoff pad itself and requirements for obstruction-free approach/departure paths.

As used here, the term *helipad* is considered to relate to *heliport* in the same way that *runway* relates to *airport*. For facilities such as at a hospital, the two terms are basically synonymous.

The one additional FAA safety-related guideline—described as applicable only to public-use facilities—is for creation of helipad protection zones. These zones, equivalent to runway protection zones at airports, extend 280 feet from the edge of the final approach and takeoff area (the latter area, or FATO, is generally larger than the physical pad itself). As with runway protection zones, the helipad protection zone should be clear of incompatible objects and any land uses involving a congregation of people.

Establishment of helipad protection zones is a desirable safety-compatibility objective for all heliports. There are practical limitations to doing so, however. One is that, even when approach/departure routes are formally defined and approved, the highly maneuverable capabilities of helicopters means that their actual routes may differ. The other is that, expect for facilities on an airport, the helipad protection zone is likely to extend onto adjacent property.

Consistent with FAA guidance, the recommendation here is that new heliports be designed so as to place as much of the approach/departure path as possible either on heliport property or along adjacent roads or other publicly controlled lands. As much as practical, buildings (particularly ones higher than the helipad itself) and congregations of people should be avoided within helipad protection zones. Once a heliport is established, the facility owner, local land use jurisdictions, and ALUCs should take whatever actions that are in their respective authorities to preserve compatible uses in the helipad protection zones and, even more critically, to prevent obstructions to the approach/departure surfaces.

Measuring Usage Intensities

The usage intensity or people-per-acre metric used for setting safety compatibility criteria in most compatibility plans (even plans which contain detailed lists of land use types generally have footnotes indicating intensity restrictions for various uses) is not common in other forms of land use planning. The discussion here provides guidance on how usage intensity can be interpreted and measured.

Determining Usage Intensities for Specific Land Uses

The adjacent tabulation lists average usage intensities for several types of nonresidential land uses often found or proposed in the vicinity of airports. Different methods are available by which ALUCs and local land use jurisdictions can estimate the usage intensity of other proposed uses. Each method has its advantages and disadvantages and none is clearly best in all situations. The most common methods are based on:

- Parking requirements as indicated in local parking ordinances;
- Maximum occupancy levels set in accordance with the California Building Code; and
- Surveys of similar uses.

Typical Usage Intensities (People Per Acre)

Light-industrial uses	35–50
Two-story motel	35–50
Shopping center (single story)	75–125
Single-story office structure	50–100
Sit-down restaurant	100
Fast food restaurant	150

Appendix C contains a brief assessment of each of these methods and examples of how usage intensities can be calculated.

Gross versus Net Acreage

Usage intensities can be calculated in terms of the entire site or zone, regardless of streets or parcel lines (its *gross acreage*) or the area of a given parcel (the *net acreage*). Because safety area land use restrictions are applied, at least initially, at a general plan or large development level rather than with respect to small, individual parcels, gross acreage measurements should normally be used for the purposes of safety compatibility criteria. The guidelines indicated in Table 9C are set on the basis of gross acreage averaged over an entire compatibility zone or development site. If net is substituted, the per-acre numeric limitations should be increased (typically 15% to 20%) to account for the acreage devoted streets, etc.

Nonresidential land use intensities (people per acre), as well as residential densities (dwelling units per acre), should both generally be calculated on the basis of gross acreage.

Except in the case of major thoroughfares running through runway protection zones and inner safety zones, the number of people in vehicles can generally be ignored in usage intensity calculations. Roads where traffic is frequently stopped in locations immediately beyond runway ends deserve attention. However, unless the road is newly planned, ALUCs are unlikely to have the opportunity to review these conditions.

Average versus Peak Usage Intensities

Limitations on the numbers of people per acre sometimes are stated as a never-to-exceed maximum and sometimes as an average measured over an

The intensity guidelines indicated in Table 9C are based upon the maximum number of people on the site at any time. If different measures are used, the numbers may need to be adjusted accordingly.

indicated period (typically 2, 8, or even 24 hours). A combination of the two also is possible (e.g., an average of *x* people per acre over an 8-hour period, not to exceed *2x* at any time).

It is recommended that restrictions be stated as a never-to-exceed maximum and the level be set accordingly. This is the same approach as that taken by fire codes for buildings. An averaging approach assumes that an accident will not occur when a higher-than-average number of people is present.

Clustering Versus Spreading of Development

Rarely is the usage intensity of a development spread equally throughout the site. Buildings, for example, normally will have more occupants than the adjacent parking lots. Also, for large developments, most of the buildings and other facilities are sometimes concentrated in one portion of the site, leaving other areas as open space because of terrain, environmental, or other considerations. The latter practice is often referred to as *clustering*. The issues for ALUCs are whether to place limits on clustering or to encourage the practice. Some of the tradeoffs between clustered and spread-out development are as follows.

- **Clustered Development**—The premise behind the concept of clustering is that, in a significant percentage of off-airport mishaps, the aircraft are under some degree of control when forced to land. (The reference here to mishaps is intentional—if a forced landing succeeds with no serious injuries or major damage to the aircraft, it would be categorized as an incident and thus not appear in accident records.) If the area remaining undeveloped is relatively level and free of large obstacles, clustering potentially allows a greater amount of open land toward which a pilot can aim. In addition to reducing the risks for people on the ground, open land provides benefits for aircraft occupants, as addressed later in this chapter. The disadvantage of clustering is that it allows an increased number of people to be in the potential impact area of an uncontrolled crash.
- **Spread-Out Development**—By comparison, a uniform spreading of development may provide fewer emergency landing spots and increase the chance of someone on the ground being injured. On the plus side, a uniform distribution of development limits the maximum number of people who could possibly be in an impact area.

The nonresidential intensity criteria listed in Table 9C indicate maximums both averaged over an entire site and for any single acre.

A compromise between these two strategies represents the optimum approach in most cases. This approach entails limiting the maximum occupancy level of a small area, but otherwise clustering development so as to provide the greatest amount of large open areas. For a small area (one acre is a good guideline), a limitation of two or three times the overall criterion is typical with the lower number applying in safety zones closest to the runway ends.

Uses in Structures versus Ones Not in Structures

Some compatibility plans make a distinction between the acceptable number of people per acre in land uses where people are *outdoors* versus those where the people are *in a building* or other enclosed area.

➤ **Outdoor Uses**—One theory is that people outdoors have more of a chance to see a plane coming as well as more directions in which they can move to vacate the impact area. A greater concentration of people thus is sometimes considered acceptable for such land uses. An important exception, however, is for open stadiums and other similar uses where a large number of people are confined in a small area with limited exits. Such facilities can represent equal or higher risks than similar uses in buildings.

➤ **Uses in Buildings**—Buildings provide substantial protection from the crash of a small airplane, particularly when the aircraft is still under control as it descends. If a fire subsequently ensues—historically, a relatively infrequent occurrence—it is unlikely to engulf the entire building instantly.

Taking both of these factors into account, the suggested strategy is to set the acceptable number of people in a given area equal for uses either outdoors or in structures. Additionally, restrictions on stadiums and other open facilities occupied by large numbers of people are appropriate.

Risk Reduction Though Building Design

Although avoidance of intensive uses is always preferable, a concept which may be acceptable in some situations is risk-reduction special building design. This concept should be limited to airports which are situated in highly urbanized locations and are used predominantly by small aircraft. In these circumstances, consideration might be given to allowing higher numbers of people (no more than 1.5 to 2.0 times the basic intensity) in buildings which incorporate special risk-reduction construction features such as:

- Concrete walls;
- Limited number and size of windows;
- Upgraded roof strength;
- No skylights;
- Enhanced fire sprinkler system;
- Single-story height; and/or
- Increased number of emergency exits.

ADDITIONAL SAFETY COMPATIBILITY CONCERNS

The preceding discussion primarily addresses risks which aircraft accidents pose for people and property on the ground. The responses to these risks are all concerned with limiting the consequences of accidents when they take place near airports. As indicated in the summary at the beginning of this chapter, a separate set of safety compatibility concerns involve land use characteristics which can cause an aircraft accident or contribute to its consequences for people on board the aircraft. The following sections address two such concerns: minimizing injury to aircraft occupants; and hazards to flight.

Minimizing Injury to Aircraft Occupants

As noted at the beginning of this chapter, many aircraft accidents as well as lesser incidents involve aircraft which are under control as they descend and the pilots have some discretion as to where to attempt an emergency landing. Especially for small aircraft, the chances of the aircraft occupants

Although terrain is a critical factor in the survivability of emergency landings, it is not a factor over which ALUCs have any influence. At airports in mountainous or densely forested locations, little open land useful for an emergency landing may exist even if no development is present. For such airports, policies to preserve open land may be pointless. The discussion here is thus directed at airports in flat or moderately hilly terrain.

avoiding serious or fatal injury in such situations is significantly affected by the terrain and land use features at the landing site. Preserving some amount of near-airport open land capable of enabling a survivable emergency landing is therefore a desirable safety compatibility objective.

Characteristics of Open Land

Ideal emergency landing sites are ones which are long, level, and free of obstacles, much like a runway. Certainly, the closer that open land areas around airports can fit these criteria the better. For small aircraft, however, successful (meaning survivable irrespective of the damage to the aircraft) emergency landings can be accomplished in much less space. Data from the general aviation aircraft accident database indicates that the median swath length for accidents in which the aircraft was under at least some control is less than 150 feet (see Table 8D).

As a general guideline, open land sites should be at least 300 feet long by 75 feet wide (about 0.5 acre or the size of a football field) to be considered useful. Such sites should be relatively level and free of objects such as structures, overhead lines, and large trees and poles that can send the plane out of control at the last moment. Parking lots, while not ideal, also can be considered as acceptable open lands in urbanized settings.

Guidelines for Extent of Open Land Near Airports

Determining the desirable number of open land sites or the percentage of open land in an airport vicinity is a complex proposition. To assist in this decision, the following three observations are offered:

- The accident location patterns illustrated in Chapter 8 and the data presented in Table 8C reveal that accidents in which aircraft are under control are bunched relatively close to the runway ends—mostly within about 3,000 feet—both for arrivals and departures.
- The number of takeoff accident sites located a short distance laterally from the departure (climb-out) end of the runway may indicate that pilots have either headed for an open spot in that location or have attempted to turn around and land on the runway from the opposite direction, but not quite succeeded.
- A pilot's discretion in selecting an emergency landing site is reduced when the aircraft is at low altitude. Particularly at low altitude, the chance of a pilot seeing and successfully landing in a small open area is increased if there are more such spots from which to choose. At traffic pattern altitude (800 to 1,000 feet above the runway), a small airplane should, in the event of engine failure, normally be able to reach the runway from anywhere within the pattern. On takeoff, a small plane generally must have reached an altitude of at least 400 to 500 feet above the runway for a return to the runway to be possible following engine failure.

Each of these observations speaks to the need for preserving more and preferably larger open areas in locations near runways than in other portions of airport environs. On this basis, the following guidelines are suggested.

➤ **Runway Protection Zones**—Maintain all undeveloped land clear of objects in accordance with FAA standards.

➤ **Inner Approach/Departure Zones**—Seek to preserve 25% to 30% of the overall zone as usable open land. Particular emphasis should be given to preserving as much open land as possible in locations close to the extended runway centerline.

➤ **Inner Turning Zone**—At least 15% to 20% of the zone should remain as open land.

➤ **Outer Approach/Departure Zones**—Maintain approximately 15% to 20% open land within the overall zone, again with emphasis on areas along the extended runway centerline.

➤ **Sideline Zone**—Adjacent to the runway ends and runway protection zones, 25% to 30% usable open land is a desirable objective.

➤ **Traffic Pattern Zone**—Elsewhere within the airport environment, approximately 10% usable open land or an open area approximately every ¼ to ½ mile should be provided.

Open land areas need to meet minimum size criteria to be of value. Therefore, the above guidelines are only practical when applied with respect to land use patterns proposed in general plans, specific plans, or large developments (generally 20 acres or more), not to individual smaller parcels. Both public and private lands should be counted. If the indicated amount of open land can be provided totally on public property, individual private parcels may not need to have any.

One final factor to consider is the pattern of the existing land uses in the airport vicinity. In rural, agricultural areas, requirements for preserving open land can usually be met with little restriction on the prevailing land use form. However, in urban locations, if open land is defined to mean *no development* of private property, the potential for inverse condemnation must be recognized. To avoid this prospect, the property must be allowed to have an economically viable use. In urban areas, open land is generally only a viable land use designation if the property is in public ownership or its natural environmental constraints make development infeasible or inappropriate. If no development is the desired end, the airport proprietor may need to acquire the property or at least the development rights.

See the discussion of inverse condemnation in Chapter 3.

Hazards to Flight

Unlike the preceding land use characteristics which can only affect the *severity* of an aircraft accident (for better or worse), hazards to flight can be the *cause* of an accident. Hazards to flight fall into three basic categories:

- Obstructions to the airspace required for flight to, from, and around an airport;
- Wildlife hazards, particularly bird strikes; and

See the Safety Policy Foundations section earlier in this chapter for a summary of established federal regulations regarding these types of hazards.

- Other forms of interference with safe flight, navigation, or communication.

Airspace Obstructions

Figure 9M depicts an example of Part 77 surfaces for an airport with a precision instrument approach runway.

Limiting the heights of structures to the heights indicated by the Part 77 surfaces provides an ample margin of safety for normal aircraft operations. The guidance provided by Part 77 is not absolute, however. Deviation from the Part 77 standards does not necessarily mean that a safety hazard exists, only that offending objects must be evaluated by the Federal Aviation Administration and that mitigative actions such as marking or lighting be taken if appropriate.

The airspace surfaces defined by TERPS are typically complex and not easily mapped. Nevertheless, compatibility plans would benefit by including this information if possible. At a minimum, the plans should note the general locations where TERPS surfaces may be critical. ALUCs should request FAA analysis of tall objects proposed for construction in these areas.

In some locations, such as adjacent to a runway, objects exceeding the Part 77 height limits may not be regarded as a hazard. On the other hand, tall objects in the approach corridors—especially along instrument approach routes—may pose risks even though they do not penetrate the defined Part 77 surfaces. Such objects also can adversely affect the minimum instrument approach altitudes allowed in accordance with the U.S. Standard for Terminal Instrument Procedures (TERPS). TERPS is particularly likely to be more restrictive than Part 77 when:

- The approach is not aligned with a runway;
- The procedure includes a circle-to-land option with low minimums;
- The missed approach segment has a low minimum altitude and requires a turning movement; and/or
- High terrain is present beneath portions of the approach procedure which lie beyond the limits of the Part 77 surfaces.

Wildlife Hazards

Both the Federal Aviation Administration (contact the Airport Safety & Certification Branch, AAS-317, at the FAA's Washington Headquarters) and the U.S. Department of Agriculture's Wildlife Service (an office is located in Sacramento) have staff who specialize in managing wildlife hazards at airports. State and local resource agencies may also be able to contribute expertise in managing specific species. The principal concern of ALUCs, though, is with regard to proposed land uses which can increase attraction of birds and other wildlife hazardous to aircraft operations.

Birds are the most common wildlife hazard near airports. Both migratory and nonmigratory species may be of concern. Although the risk of bird strikes is most serious along the corridors required for takeoffs and landings, the concern extends to elsewhere in the airport vicinity. Any land uses which can attract birds should be avoided, but those which are artificial attractors are particularly inappropriate because they generally need not be located near airports. Sanitary landfills are a primary example of the latter type of activity. The FAA recommends that such uses be kept at least 10,000 feet from any runway used by turbine-powered aircraft.

Other land uses that may become artificial attractors include:

- Golf courses with water hazards;
- Drainage detention and retention basins;
- Wetlands created as mitigation measures;
- Landscaping, particularly water features;
- Wildlife refuges; and
- Agriculture, especially cereal grains.

Wildlife other than birds can be also be a concern, depending upon an airport's geographic setting and surrounding land uses. Deer are the most

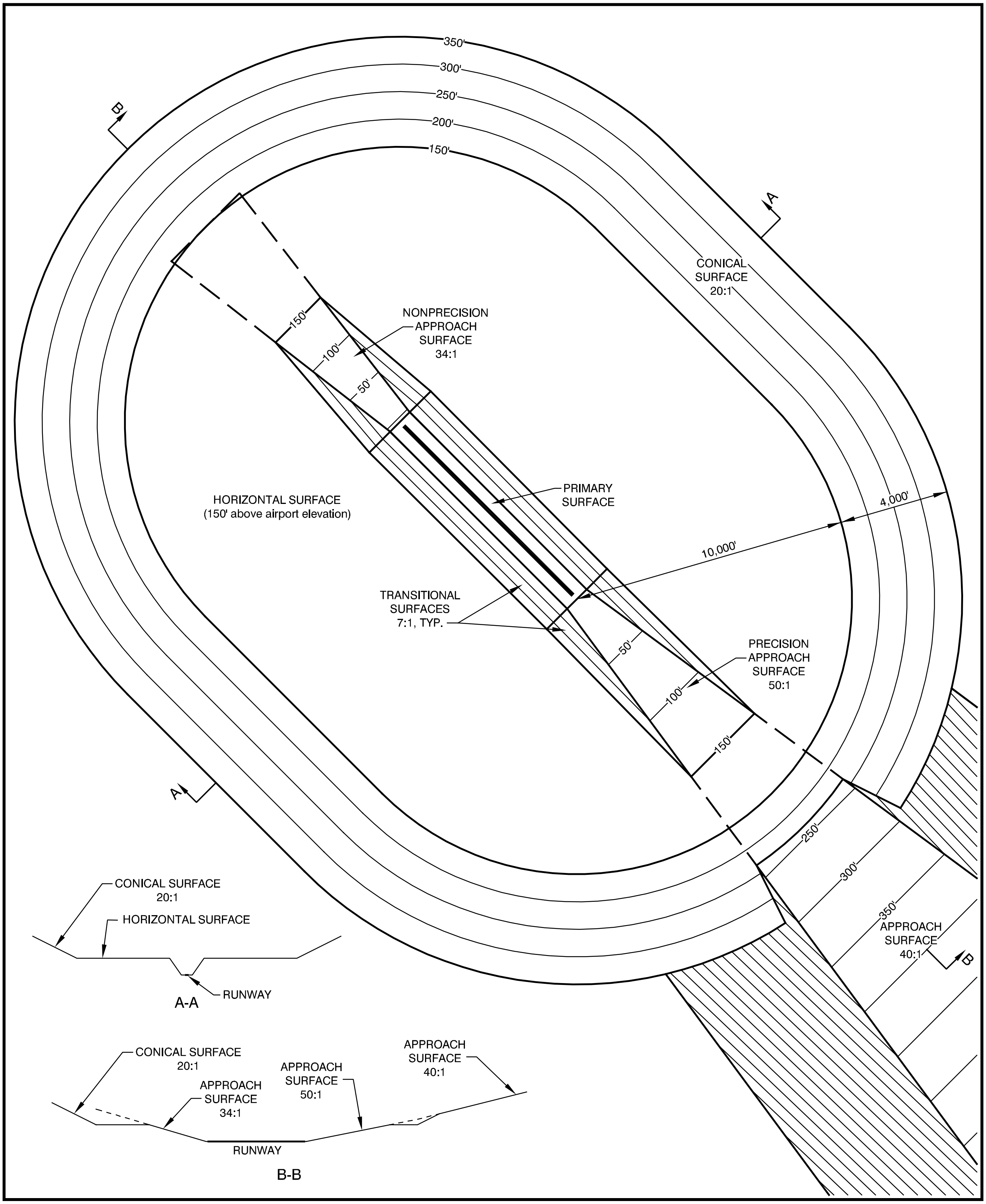


FIGURE 9M

Example of Airspace Protection Surfaces

FAR Part 77

common problem. However, coyotes and other species may also become hazards.

Other Flight Hazards

In addition to the physical hazards to flight posed by tall objects and wildlife, other land use characteristics can present visual or electronic hazards.

- **Visual Hazards**—Visual hazards include distracting lights (particularly lights which can be confused with airfield lights), glare, and sources of smoke.
- **Electronic Hazards**—Electronic hazards include any uses which interfere with aircraft instruments or radio communication.

Questions have arisen from some airports and ALUCs as to whether temporary searchlights such as those used for advertising constitute a hazard to flight. The FAA does not regulate the siting or operation of searchlights and is aware of no significant problems associated with them.

There are no specific FAA standards for visual and electronic hazards. Potential hazards are evaluated on a case-by-case basis. This often occurs only after a problem has arisen. However, ALUCs can request an FAA evaluation of proposed development when certain features appear to be potentially hazardous. Also, ALUC policies should require that outdoor lights are shielded so that they do not aim above the horizon. Additionally, for projects near the airport, outdoor lighting should be flight checked at night to ensure that they do not blind pilots during landings and takeoffs.

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Article 3.5
AIRPORT LAND USE COMMISSION

(As of December 2000)

21670. Creation; Membership; Selection

(a) The Legislature hereby finds and declares that:

(1) It is in the public interest to provide for the orderly development of each public use airport in this state and the area surrounding these airports so as to promote the overall goals and objectives of the California airport noise standards adopted pursuant to Section 21669 and to prevent the creation of new noise and safety problems.

(2) It is the purpose of this article to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses.

(b) In order to achieve the purposes of this article, every county in which there is located an airport which is served by a scheduled airline shall establish an airport land use commission. Every county, in which there is located an airport which is not served by a scheduled airline, but is operated for the benefit of the general public, shall establish an airport land use commission, except that the board of supervisors for the county may, after consultation with the appropriate airport operators and affected local entities and after a public hearing, adopt a resolution finding that there are no noise, public safety, or land use issues affecting any airport in the county which require the creation of a commission and declaring the county exempt from that requirement. The board shall, in this event, transmit a copy of the resolution to the Director of Transportation. For purposes of this section, "commission" means an airport land use commission. Each commission shall consist of seven members to be selected as follows:

(1) Two representing the cities in the county, appointed by a city selection committee comprised of the mayors of all the cities within that county, except that if there are any cities contiguous or adjacent to the qualifying airport, at least one representative shall be appointed therefrom. If there are no cities within a county, the number of representatives provided for by subdivisions (2) and (3) shall each be increased by one.

(2) Two representing the county, appointed by the board of supervisors.

(3) Two having expertise in aviation, appointed by a selection committee comprised of the managers of all the public airports within that county.

(4) One representing the general public, appointed by the other six members of the commission.

(c) Public officers, whether elected or appointed, may be appointed and serve as members of the commission during their terms of public office.

(d) Each member shall promptly appoint a single proxy to represent the member in commission affairs and to vote on all matters when the member is not in attendance. The proxy shall be designated in a signed written instrument which shall be kept on file at the commission offices, and the proxy shall serve at the pleasure of the appointing member. A vacancy in the office of proxy shall be filled promptly by appointment of a new proxy.

(e) A person having an "expertise in aviation" means a person who, by way of education, training, business, experience, vocation, or avocation has acquired and possesses particular knowledge of, and familiarity with, the function, operation, and role of airports, or is an elected official of a local agency which owns or operates an airport.

(f) It is the intent of the Legislature to clarify that, for the purposes of this article, special districts are included among the local agencies that are subject to airport land use laws and other requirements of this article.

21670.1. Action by Designated Body Instead of Commission

(a) Notwithstanding any provisions of this article, if the board of supervisors and the city selection committee of mayors in any county each makes a determination by a majority vote that proper land use planning can be accomplished through the actions of an appropriately designated body, then the body so designated shall assume the planning responsibilities of an airport land use commission as provided for in this article, and a commission need not be formed in that county.

(b) A body designated pursuant to subdivision (a) which does not include among its membership at least two members having an expertise in aviation, as defined in subdivision (e) of Section 21670, shall, when acting in the capacity of an airport land use commission, be augmented so that the body, as augmented, will have at least two members having that expertise. The commission shall be constituted pursuant to this section on and after March 1, 1988.

(c) (1) Notwithstanding subdivisions (a) and (b), and subdivision (b) of Section 21670, if the board of supervisors of a county and each affected city in that county each makes a determination that proper land use planning pursuant to this article can be accomplished pursuant to this subdivision, then a commission need not be formed in that county.

(2) If the board of supervisors of a county and each affected city makes a determination that proper land use planning may be accomplished and a commission is not formed pursuant to paragraph (1) of this subdivision, that county and the appropriate affected cities having jurisdiction over an airport, subject to the review and approval by the Division of Aeronautics of the department, shall do all of the following:

(A) Adopt processes for the preparation, adoption, and amendment of the comprehensive airport land use plan for each airport that is served by a scheduled airline or operated for the benefit of the general public.

(B) Adopt processes for the notification of the general public, landowners, interested groups, and other public agencies regarding the preparation, adoption, and amendment of the comprehensive airport land use plans.

(C) Adopt processes for the mediation of disputes arising from the preparation, adoption, and amendment of the comprehensive airport land use plans.

(D) Adopt processes for the amendment of general and specific plans to be consistent with the comprehensive airport land use plans.

(E) Designate the agency that shall be responsible for the preparation, adoption, and amendment of each comprehensive airport land use plan.

(3) The Division of Aeronautics of the department shall review the processes adopted pursuant to paragraph (2), and shall approve the processes if the division determines that the processes are consistent with the procedure required by this article and will do all of the following:

(A) Result in the preparation, adoption, and implementation of plans within a reasonable amount of time.

(B) Rely on the height, use, noise, safety, and density criteria that are compatible with air port operations, as established by this article, and referred to as the Airport Land Use Planning Handbook, published by the division, and any applicable federal aviation regulations, including, but not limited to, Part 77 (commencing with Section 77.1) of Title 14 of the Code of Federal Regulations.

(C) Provide adequate opportunities for notice to, review of, and comment by the general public, landowners, interested groups, and other public agencies.

(4) If the county does not comply with the requirements of paragraph (2) within 120 days, then the plan and amendments shall not be considered adopted pursuant to this article and a commission shall be established within 90 days of the determination of noncompliance by the division and a plan shall be adopted pursuant to this article within 90 days of the establishment of the commission.

(d) A commission need not be formed in a county that has contracted for the preparation of comprehensive airport land use plans with the Division of Aeronautics under the California Aid to Airport Program (Title 21 (commencing with Section 4050) of the California Code of Regulations), Project Ker-VAR 90-1, and that submits all of the following information to the Division of Aeronautics for review and comment that the county and the cities affected by the airports within the county, as defined by the plans:

(1) Agree to adopt and implement the comprehensive airport plans that have been developed under contract.

(2) Incorporated the height, use, noise, safety, and density criteria that are compatible with airport operations as established by this article, and referred to as the Airport Land Use Planning Handbook, published by the division, and any applicable federal aviation regulations, including, but not limited to, Part 77 (commencing with Section 77.1) of Title 14 of the Code of Federal Regulations as part of the general and specific plans for the county and for each affected city.

(3) If the county does not comply with this subdivision on or before May 1, 1995, then a com mission shall be established in accordance with this article.

(e) (1) A commission need not be formed in a county if all of the following conditions are met:

(A) The county has only one public use airport that is owned by a city.

(B) (i) The county and the affected city adopt the elements in paragraph (2) of subdivision (d), as part of their general and specific plans for the county and the affected city.

(ii) The general and specific plans shall be submitted, upon adoption, to the Division of Aeronautics. If the county and the affected city do not submit elements specified in paragraph (2) of subdivision (d), on or before May 1, 1996, then a commission shall be established in accordance with this article.

21670.2. Applicability to Counties Having over 4 Million Population

(a) Sections 21670 and 21670.1 do not apply to the County of Los Angeles. In that county, the county regional planning commission has the responsibility for coordinating the airport planning of public agencies within the county. In instances where impasses result relative to this planning, an appeal may be made to the county regional planning commission by any public agency involved. The action taken by the county regional planning commission on such an appeal may be overruled by a four-fifths vote of the governing body of a public agency whose planning led to the appeal.

(b) By January 1, 1992, the county regional planning commission shall adopt the comprehensive land use plans required pursuant to Section 21675.

(c) Sections 21675.1, 21675.2, and 21679.5 do not apply to the County of Los Angeles until January 1, 1992. If the comprehensive land use plans required pursuant to Section 21675 are not adopted by the county regional planning commission by January 1, 1992, Sections 21675.1 and 21675.2 shall apply to the County of Los Angeles until the plans are adopted.

21670.4. Intercounty Airports

(a) As used in this section, "intercounty airport" means any airport bisected by a county line through its runways, runway protection zones, inner safety zones, inner turning zones, outer safety zones, or sideline safety zones, as defined by an existing airport land use commission in its comprehensive land use plan in accordance with Section 21675.

(b) It is the purpose of this section to provide the opportunity to establish a separate airport land use commission so that an intercounty airport may be served by a single airport land use planning agency, rather than having to look separately to the airport land use commissions of the affected counties.

(c) In addition to the airport land use commissions created under Section 21670 or the alternatives established under Section 21670.1, for their respective counties, the boards of supervisors and city selection committees for the affected counties, by independent majority vote of each county's two delegations, for any intercounty airport, may either:

(1) Establish a single separate airport land use commission for that airport. That commission shall consist of seven members to be selected as follows:

(A) One representing the cities in each of the counties, appointed by that county's city selection committee.

(B) One representing each of the counties, appointed by the board of supervisors of each county.

(C) One from each county having expertise in aviation, appointed by a selection commit tee comprised of the managers of all the public airports within that county.

(D) One representing the general public, appointed by the other six members of the commission.

(2) In accordance with subdivision (a) or (b) of Section 21670.1, designate an existing appropriate entity as that airport's land use commission.

21671. Airports Owned by a City, District, or County; Appointment of Certain Members by Cities and Counties

In any county where there is an airport operated for the general public which is owned by a city or district in another county or by another county, one of the representatives provided by paragraph (1) of subdivision (b) of Section 21670 shall be appointed by the city selection committee of mayors of the cities of the county in which the owner of that airport is located, and one of the representatives provided by paragraph (2) subdivision (b) of Section 21670 shall be appointed by the board of supervisors of the county in which the owner of that airport is located.

21671.5. Term of Office; Removal of Members; Vacancies; Compensation; Staff Assistance; Meetings

(a) Except for the terms of office of the members of the first commission, the term of office for each member shall be four years and until the appointment and qualification of his or her successor. The members of the first commission shall classify themselves by lot so that the term of office of one member is one year, of two members is two years, of two members is three years, and of two members if four years. The body which originally appointed a member whose term has expired shall appoint his or her successor for a full term of four years. Any member may be removed at any time and without cause by the body appointing him or her. The expiration date of the term of office of each member shall be the first Monday in May in the year in which his or her term is to expire. Any vacancy in the membership of the commission shall be filled for the unexpired term by appointment by the body which originally appointed the member whose office has become vacant. The chairperson of the commission shall be selected by the members thereof.

(b) Compensation, if any, shall be determined by the board of supervisors.

(c) Staff assistance, including the mailing of notices and the keeping of minutes, and necessary quarters, equipment, and supplies shall be provided by the county. The usual and necessary expenses of the commission shall be a county charge.

(d) Notwithstanding any other provisions of this article, the commission shall not employ any personnel either as employees or independent contractors without the prior approval of the board of supervisors.

(e) The commission shall meet at the call of the commission chairperson or at the request of the majority of the commission members. A majority of the commission members shall constitute a quorum for the transaction of business. No action shall be taken by the commission except by the recorded vote of a majority of the full membership.

(f) The commission may establish a schedule of fees necessary to comply with this article. Those fees shall be charged to the proponents of actions, regulations, or permits, shall not exceed the estimated reasonable cost of providing the service, and shall be imposed pursuant to Section 66016 of the Government Code. Except as provided in subdivision (g), after June 30, 1991, a commission which has not adopted the comprehensive land use plan required by Section 21675 shall not charge fees pursuant to this subdivision until the commission adopts the plan.

(g) In any county which has undertaken by contract or otherwise completed land use plans for at least one-half of all public use airports in the county, the commission may continue to charge fees necessary to comply with this article until June 30, 1992, and, if the land use plans are complete by that date, may continue charging fees after June 30, 1992. If the land use plans are not complete by June 30, 1992, the commission shall not charge fees pursuant to subdivision (f) until the commission adopts the land use plans.

21672. Rules and Regulations

Each commission shall adopt rules and regulations with respect to the temporary disqualification of its members from participating in the review or adoption of a proposal because of conflict of interest and with respect to appointment of substitute members in such cases.

21673. Initiation of Proceedings for Creation by Owner of Airport

In any county not having a commission or a body designated to carry out the responsibilities of a commission, any owner of a public airport may initiate proceedings for the creation of a commission by presenting a request to the board of supervisors that a commission be created and showing the need therefor to the satisfaction of the board of supervisors.

21674. Powers and Duties

The commission has the following powers and duties, subject to the limitations upon its jurisdiction set forth in Section 21676:

(a) To assist local agencies in ensuring compatible land uses in the vicinity of all new airports and in the vicinity of existing airports to the extent that the land in the vicinity of those airports is not already devoted to incompatible uses.

(b) To coordinate planning at the state, regional, and local levels so as to provide for the orderly development of air transportation, while at the same time protecting the public health, safety, and welfare.

(c) To prepare and adopt an airport land use plan pursuant to Section 21675.

(d) To review the plans, regulations, and other actions of local agencies and airport operators pursuant to Section 21676.

(e) The powers of the commission shall in no way be construed to give the commission jurisdiction over the operation of any airport.

(f) In order to carry out its responsibilities, the commission may adopt rules and regulations consistent with this article.

21674.5. Training of Airport Land Use Commission's Staff

(a) The Department of Transportation shall develop and implement a program or programs to assist in the training and development of the staff of airport land use commissions, after consulting with airport land use commissions, cities, counties, and other appropriate public entities.

(b) The training and development program or programs are intended to assist the staff of airport land use commissions in addressing high priority needs, and may include, but need not be limited to, the following:

(1) The establishment of a process for the development and adoption of comprehensive land use plans.

(2) The development of criteria for determining airport land use planning boundaries.

(3) The identification of essential elements which should be included in the comprehensive plans.

(4) Appropriate criteria and procedures for reviewing proposed developments and determining whether proposed developments are compatible with the airport use.

(5) Any other organizational, operational, procedural, or technical responsibilities and functions which the department determines to be appropriate to provide the commission staff and for which it determines there is a need for staff training and development.

(c) The department may provide training and development programs for airport land commission staff pursuant to this section by any means it deems appropriate. Those programs may be presented in any of the following ways:

(1) By offering formal courses or training programs.

(2) By sponsoring or assisting in the organization and sponsorship of conferences, seminars, or other similar events.

(3) By producing and making available written information.

(4) Any other feasible method of providing information and assisting in the training and development of airport land use commission staff.

21674.7. Airport Land Use Planning Handbook

An airport land use commission that formulates, adopts or amends a comprehensive airport land use plan shall be guided by information prepared and updated pursuant to Section 21674.5 and referred to as the Airport Land Use Planning Handbook published by the Division of Aeronautics of the Department of Transportation.

21675. Land Use Plan

(a) Each commission shall formulate a comprehensive land use plan that will provide for the orderly growth of each public airport and the area surrounding the airport within the jurisdiction of the commission, and will safeguard the general welfare of the inhabitants within the vicinity of the airport and the public in general. The commission plan shall include and shall be based on a long-range master plan or an airport layout plan, as determined by the Division of Aeronautics of the Department of Transportation, that reflects the anticipated growth of the airport during at least the next 20 years. In formulating a land use plan, the commission may develop height restrictions on buildings, specify use of land, and determine building standards, including soundproofing adjacent to airports, within the planning area. The comprehensive land use plan shall be reviewed as often as necessary in order to accomplish its purposes, but shall not be amended more than once in any calendar year.

(b) The commission may include, within its plan formulated pursuant to subdivision (a), the area within the jurisdiction of the commission surrounding any federal military airport for all the purpose specified in subdivision (a). This subdivision does not give the commission any jurisdiction or authority over the territory or operations of any military airport.

(c) The planning boundaries shall be established by the commission after hearing and consultation with the involved agencies.

(d) The commission shall submit to the Division of Aeronautics of the department one copy of the plan and each amendment to the plan.

(e) If a comprehensive land use plan does not include the matters required to be included pursuant to this article, the Division of Aeronautics of the department shall notify the commission responsible for the plan.

21675.1. Adoption of Land Use Plan

(a) By June 30, 1991, each commission shall adopt the comprehensive land use plan required pursuant to Section 21675, except that any county which has undertaken by contract or otherwise completed land use plans for at least one-half of all public use airports in the county, shall adopt that plan on or before June 30, 1992.

(b) Until a commission adopts a comprehensive land use plan, a city or county shall first submit all actions, regulations, and permits within the vicinity of a public airport to the commission for review and approval. Before the commission approves or disapproves any actions, regulations, or permits, the commission shall give the public notice in the same manner as the city or county is required to give for those actions, regulations, or permits. As used in this section, "vicinity" means land which will be included or reasonably could be included within the plan. If the commission has not designated a study area for the plan, then "vicinity" means land within two miles of the boundary of a public airport.

(c) The commission may approve an action, regulation, or permit if it finds, based on substantial evidence in the record, all of the following:

(1) The commission is making substantial progress toward the completion of the plan.

(2) There is a reasonable probability that the action, regulation, or permit will be consistent with the plan being prepared by the commission.

(3) There is little or no probability of substantial detriment to or interference with the future adopted plan if the action, regulation, or permit is ultimately inconsistent with the plan.

(d) If the commission disapproves an action, regulation, or permit, the commission shall notify the city or county. The city or county may overrule the commission, by a two-thirds vote of its governing body, if it makes specific findings that the proposed action, regulation, or permit is consistent with the purposes of this article, as stated in Section 21670.

(e) If a city or county overrules the commission pursuant to subdivision (d), that action shall not relieve the city or county from further compliance with this article after the commission adopts the plan.

(f) If a city or county overrules the commission pursuant to subdivision (d) with respect to a publicly owned airport that the city or county does not operate, the operator of the airport shall be immune from liability for damages to property or personal injury from the city's or county's decision to proceed with the action, regulation, or permit.

(g) A commission may adopt rules and regulations which exempt any ministerial permit for single- family dwellings from the requirements of subdivision (b) if it makes the findings required pursuant to subdivision (c) for the proposed rules and regulations, except that the rules and regulations may not exempt either of the following:

(1) More than two single-family dwellings by the same applicant within a subdivision prior to June 30, 1991.

(2) Single-family dwellings in a subdivision where 25 percent or more of the parcels are undeveloped.

21675.2. Approval or Disapproval of Actions, Regulations, or Permits

(a) If a commission fails to act to approve or disapprove any actions, regulations, or permits within 60 days of receiving the request pursuant to Section 21675.1, the applicant or his or her representative may file an action pursuant to Section 1094.5 of the Code of Civil Procedure to compel the commission to act, and the court shall give the proceedings preference over all other actions or proceedings, except previously filed pending matters of the same character.

(b) The action, regulation, or permit shall be deemed approved only if the public notice required by this subdivision has occurred. If the applicant has provided seven days advance notice to the commission of the intent to provide public notice pursuant to this subdivision, then, not earlier than the date of the expiration the time limit established by Section 21675.1, an applicant may provide the required public notice. If the applicant chooses to provide public notice, that notice shall include a description of the proposed action, regulation, or permit substantially similar to the descriptions which are commonly used in public notices by the commission, the name and address of the commission, and a statement that the action, regulation, or permit shall be deemed approved if the commission has not acted within 60 days. If the applicant has provided the public notice specified in this subdivision, the time limit for action by the commission shall be extended to 60 days after the public notice is provided. If the applicant provides notice pursuant to this section, the commission shall refund to the applicant any fees which were collected for providing notice and which were not used for that purpose.

(c) Failure of an applicant to submit complete or adequate information pursuant to Sections 65943 to 65946, inclusive, of the Government Code, may constitute grounds for disapproval of actions, regulations, or permits.

(d) Nothing in this section diminishes the commission's legal responsibility to provide, where applicable, public notice and hearing before acting on an action, regulation, or permit.

21676. Review of Local General Plans

(a) Each local agency whose general plan includes areas covered by an airport land use commission plan shall, by July 1, 1983, submit a copy of its plan or specific plans to the airport land use commission. The commission shall determine by August 31, 1983, whether the plan or plans are consistent or inconsistent with the commission's plan. If the plan or plans are inconsistent with the commission's plan, the local agency shall be notified and that local agency shall have another hearing to reconsider its plans. The local agency may overrule the commission after such a hearing by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article stated in Section 21670.

(b) Prior to the amendment of a general plan or specific plan, or the addition or approval of a zoning ordinance or building regulation within the planning boundary established by the airport land use commission pursuant to Section 21675, the local agency shall first refer the proposed action to the commission. If the commission determines that the proposed action is inconsistent with the commission's plan, the referring agency shall be notified. The local agency may, after a public hearing, overrule the commission by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article stated in Section 21670.

(c) Each public agency owning any airport within the boundaries of an airport land use commission plan shall, prior to modification of its airport master plan, refer such proposed change to the airport land use commission. If the commission determines that the proposed action is inconsistent with the commission's plan, the referring agency shall be notified. The public agency may, after a public hearing, overrule the commission by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article stated in Section 21670.

(d) Each commission determination pursuant to subdivision (b) or (c) shall be made within 60 days from the date of referral of the proposed action. If a commission fails to make the determination within that period, the proposed action shall be deemed consistent with the commission's plan.

21676.5. Review of Local Plans

(a) If the commission finds that a local agency has not revised its general plan or specific plan or overruled the commission by a two-thirds vote of its governing body after making specific findings that the proposed action is consistent with the purposes of this article as stated in Section 21670, the commission may require the local agency submit all subsequent actions, regulations, and permits to the commission for review until its general plan or specific plan is revised or the specific findings are made. If, in the determination of the commission, an action, regulation, or permit of the local agency is inconsistent with the commission plan, the local agency shall be notified and that local agency shall hold a hearing to reconsider its plan. The local agency may overrule the commission after hearing by a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of this article as stated in Section 21670.

(b) Whenever the local agency has revised its general plan or specific plan or has overruled the commission pursuant to subdivision (a), the proposed action of the local agency shall not be subject to further commission review, unless the commission and the local agency agree that the individual projects shall be reviewed by the commission.

21677. Marin County Override Provisions

Notwithstanding Section 21676, any public agency in the County of Marin may overrule the Marin County Airport Land Use Commission by a majority vote of its governing body.

21678. Airport Owner's Immunity

With respect to a publicly owned airport that a public agency does not operate, if the public agency pursuant to Section 21676 or 21676.5 overrides a commission's action or recommendation, the operator of the airport shall be immune from liability for damages to property or personal injury caused by or resulting directly or indirectly from the public agency's decision to override the commission's action or recommendation.

21679. Court Review

(a) In any county in which there is no airport land use commission or other body designated to assume the responsibilities of an airport land use commission, or in which the commission or other designated body has not adopted an airport land use plan, an interested party may initiate proceedings in a court of competent jurisdiction to postpone the effective date of a zoning change, a zoning variance, the issuance of a permit, or the adoption of a regulation by a local agency, which directly affects the use of land within one mile of the boundary of a public airport within the county.

(b) The court may issue an injunction which postpones the effective date of the zoning change, zoning variance, permit, or regulation until the governing body of the local agency which took the action does one of the following:

(1) In the case of an action which is a legislative act, adopts a resolution declaring that the proposed action is consistent with the purposes of this article stated in Section 21670.

(2) In the case of an action which is not a legislative act, adopts a resolution making findings based on substantial evidence in the record that the proposed action is consistent with the purposes of this article stated in Section 21670.

(3) Rescinds the action.

(4) Amends its action to make it consistent with the purposes of this article stated in Section 21670, and complies with either paragraph (1) or (2) of this subdivision, whichever is applicable.

(c) The court shall not issue an injunction pursuant to subdivision (b) if the local agency which took the action demonstrates that the general plan and any applicable specific plan of the agency accomplishes the purposes of an airport land use plan as provided in Section 21675.

(d) An action brought pursuant to subdivision (a) shall be commenced within 30 days of the decision or within the appropriate time periods set by Section 21167 of the Public Resources Code, whichever is longer.

(e) If the governing body of the local agency adopts a resolution pursuant to subdivision (b) with respect to a publicly owned airport that the local agency does not operate, the operator of the airport shall be immune from liability for damages to property or personal injury from the local agency's decision to proceed with the zoning change, zoning variance, permit, or regulation.

(f) As used in this section, "interested party" means any owner of land within two miles of the boundary of the airport or any organization with a demonstrated interest in airport safety and efficiency.

21679.5. Deferral of Court Review

(a) Until June 30, 1991, no action pursuant to Section 21679 to postpone the effective date of a zoning change, a zoning variance, the issuance of a permit, or the adoption of a regulation by a local agency, directly affecting the use of land within one mile of the boundary or a public airport, shall be commenced in any county in which the commission or other designated body has not adopted an airport land use plan, but is making substantial progress toward the completion of the plan.

(b) If a commission has been prevented from adopting the comprehensive land use plan by June 30, 1991, or if the adopted plan could not become effective, because of a lawsuit involving the adoption of the plan, the June 30, 1991 date in subdivision (a) shall be extended by the period of time during which the lawsuit was pending in a court of competent jurisdiction.

(c) Any action pursuant to Section 21679 commenced prior to January 1, 1990, in a county in which the commission or other designated body has not adopted an airport land use plan, but is making substantial progress toward the completion of the plan, which has not proceeded to final judgment, shall be held in abeyance until June 30, 1991. If the commission or other designated body does not adopt an airport land use plan on or before June 30, 1991, the plaintiff or plaintiffs may proceed with the action.

(d) An action to postpone the effective date of a zoning change, a zoning variance, the issuance of a permit, or the adoption of a regulation by a local agency, directly affecting the use of land within one mile of the boundary of a public airport for which an airport land use plan has not been adopted by June 30, 1991, shall be commenced within 30 days of June 30, 1991, or within 30 days of the decision by the local agency, or within the appropriate time periods set by Section 21167 of the Public Resources Code, whichever date is later.

AERONAUTICS LAW

PUBLIC UTILITIES CODE
Division 9, Part 1
Chapter 3—Regulation of Aeronautics
(excerpts)

21402. Ownership; Prohibited Use of Airspace

The ownership of the space above the land and waters of this State is vested in the several owners of the surface beneath, subject to the right of flight described in Section 21403. No use shall be made of such airspace which would interfere with such right of flight; provided, that any use of property in conformity with an original zone of approach of an airport shall not be rendered unlawful by reason of a change in such zone of approach.

21403. Lawful Flight; Unauthorized and Forced Landings; Damages; Use of Highways; Burden of Proof; Within Airport Approach Zone

(a) Flight in aircraft over the land and waters of this state is lawful, unless at altitudes below those prescribed by federal authority, or unless conducted so as to be imminently dangerous to persons or property lawfully on the land or water beneath. The landing of an aircraft on the land or waters of another, without his or her consent, is unlawful except in the case of a forced landing or pursuant to Section 21662.1. The owner, lessee, or operator of the aircraft is liable, as provided by law, for damages caused by a forced landing.

(b) The landing, takeoff, or taxiing of an aircraft on a public freeway, highway, road, or street is unlawful except in the following cases:

(1) A forced landing.

(2) A landing during a natural disaster or other public emergency if the landing has received prior approval from the public agency having primary jurisdiction over traffic upon the freeway, highway, road, or street.

(3) When the landing, takeoff, or taxiing has received prior approval from the public agency having primary jurisdiction over traffic upon the freeway, highway, road or street.

The prosecution bears the burden of proving that none of the exceptions apply to the act which is alleged to be unlawful.

(c) The right of flight in aircraft includes the right of safe access to public airports, which includes the right of flight within the zone of approach of any public airport without restriction or hazard. The zone of approach of an airport shall conform to the specifications of Part 77 of the Federal Aviation Regulations of the Federal Aviation Administration, Department of Transportation.

AERONAUTICS LAW

PUBLIC UTILITIES CODE
Division 9, Part 1
Chapter 4—Airports and Air Navigation Facilities

Article 2.7
REGULATION OF OBSTRUCTIONS
(excerpts)

21655. Proposed Site for Construction of State Building Within Two Miles of Airport; Investigation and Report; Expenditure of State Funds

Notwithstanding any other provision of law, if the proposed site of any state building or other enclosure is within two miles, measured by air line, of that point on an airport runway, or runway proposed by an airport master plan, which is nearest the site, the state agency or office which proposes to construct the building or other enclosure shall, before acquiring title to property for the new state building or other enclosure site or for an addition to a present site, notify the Department of Transportation, in writing, of the proposed acquisition. The department shall investigate the proposed site and, within 30 working days after receipt of the notice, shall submit to the state agency or office which proposes to construct the building or other enclosure a written report of the investigation and its recommendations concerning acquisition of the site.

If the report of the department does not favor acquisition of the site, no state funds shall be expended for the acquisition of the new state building or other enclosure site, or the expansion of the present site, or for the construction of the state building or other enclosure, provided that the provisions of this section shall not affect title to real property once it is acquired.

21658. Construction of Utility Pole or Line in Vicinity of Aircraft Landing Area

No public utility shall construct any pole, pole line, distribution or transmission tower, or tower line, or substation structure in the vicinity of the exterior boundary of an aircraft landing area of any airport open to public use, in a location with respect to the airport and at a height so as to constitute an obstruction to air navigation, as an obstruction is defined in accordance with Part 77 of the Federal Aviation Regulations, Federal Aviation Administration, or any corresponding rules or regulations of the Federal Aviation Administration, unless the Federal Aviation Administration has determined that the pole, line, tower, or structure does not constitute a hazard to air navigation. This section shall not apply to existing poles, lines, towers, or structures or to the repair, replacement, or reconstruction thereof if the original height is not materially exceeded and this section shall not apply unless just compensation shall have first been paid to the public utility by the owner of any airport for any property or property rights which would be taken or damaged hereby.

21659. Obstructions Near Airports Prohibited

(a) No person shall construct or alter any structure or permit any natural growth to grow at a height which exceeds the obstruction standards set forth in the regulations of the Federal Aviation Administration relating to objects affecting navigable airspace contained in Title 14 of the Code of Federal Regulations, Part 77, Subpart C, unless a permit allowing the construction, alteration, or growth is issued by the department.

(b) The permit is not required if the Federal Aviation Administration has determined that the construction, alteration, or growth does not constitute a hazard to air navigation or would not create an unsafe condition for air navigation. Subdivision (a) does not apply to a pole, pole line, distribution or transmission tower, or tower line or substation of a public utility.

(c) Section 21658 is applicable to subdivision (b).

AERONAUTICS LAW

PUBLIC UTILITIES CODE
Division 9, Part 1, Chapter 4

Article 3
REGULATION OF AIRPORTS
(excerpts)

21661.5. Approval of Construction Plans; Submission of Plan to Airport Land Use Commission

No political subdivision, any of its officers or employees, or any person may submit any application for the construction of a new airport to any local, regional, state, or federal agency unless the plan for such construction is first approved by the board of supervisors of the county, or the city council of the city, in which the airport is to be located and unless the plan is submitted to the appropriate commission exercising powers pursuant to Article 3.5 (commencing with Section 21670) of Chapter 4 of Division 9, and acted upon by such commission in accordance with the provisions of such article.

21664.5. Approval of Sites; Amended Airport Permits; Airport Expansion Defined

An amended airport permit shall be required for every expansion of an existing airport. An applicant for an amended airport permit shall comply with each requirement of this article pertaining to permits for new airports. The department may by regulation provide for exemptions from the operation of the section pursuant to Section 21661, except that no exemption shall be made limiting the applicability of subdivision (e) of Section 21666, pertaining to environmental considerations, including the requirement for public hearings in connection therewith.

As used in this section, "airport expansion" includes any of the following:

(a) The acquisition of clear zones or of any interest in land for the purpose of any other expansion as set forth in this section.

(b) The construction of a new runway.

(c) The extension or realignment of an existing runway.

(d) Any other expansion of the airport's physical facilities for the purpose of accomplishing or which are related to the purpose of subdivision (a), (b), or (c).

This section shall not apply to any expansion of an existing airport if the expansion commenced on or prior to the effective date of this section and the expansion met the approval on or prior to such effective date of each governmental agency which by law required such approval.

PLANNING AND ZONING LAW

GOVERNMENT CODE
Title 7—Planning and Land Use
Division 1—Planning and Zoning
Chapter 3—Local Planning

Article 5
AUTHORITY FOR AND SCOPE OF GENERAL PLANS
(excerpts)

65302.3. General and Applicable Specific Plans; Consistency with Airport Land Use Plans; Amendment; Nonconcurrence Findings

(a) The general plan, and any applicable specific plan prepared pursuant to Article 8 (commencing with Section 65450), shall be consistent with the plan adopted or amended pursuant to Section 21675 of the Public Utilities Code.

(b) The general plan, and any applicable specific plan, shall be amended, as necessary, within 180 days of any amendment to the plan required under Section 21675 of the Public Utilities Code.

(c) If the legislative body does not concur with any of the provisions of the plan required under Section 21675 of the Public Utilities Code, it may satisfy the provisions of this section by adopting findings pursuant to Section 21676 of the Public Utilities Code.

PLANNING AND ZONING LAW

GOVERNMENT CODE
Title 7, Division 1
Chapter 4.5—Review and Approval of Development Projects

Article 3
APPLICATION FOR DEVELOPMENT PROJECTS
(excerpts)

Note: The following government code sections are referenced in Section 21675.2(c) of the ALUC statutes.

65943. Completeness of Application; Determination; Time; Specification of Parts not Complete and Manner of Completion

(a) Not later than 30 calendar days after any public agency has received an application for a development project, the agency shall determine in writing whether the application is complete and shall immediately transmit the determination to the applicant for the development project. If the written determination is not made within 30 days after receipt of the application, and the application includes a statement that it is an application for a development permit, the application shall be deemed complete for purposes of this chapter. Upon receipt of any resubmittal of the application, a new 30-day period shall begin, during which the public agency shall determine the completeness of the application. If the application is determined not to be complete, the agency's determination shall specify those parts of the application which are incomplete and shall indicate the manner in which they can be made complete, including a list and thorough description of the specific information needed to complete the application. The applicant shall submit materials to the public agency in response to the list and description.

(b) Not later than 30 calendar days after receipt of the submitted materials, the public agency shall determine in writing whether they are complete and shall immediately transmit that determination to the applicant. If the written determination is not made within that 30-day period, the application together with the submitted materials shall be deemed complete for the purposes of this chapter.

(c) If the application together with the submitted materials are determined not to be complete pursuant to subdivision (b), the public agency shall provide a process for the applicant to appeal that decision in writing to the governing body of the agency or, if there is no governing body, to the director of the agency, as provided by that agency. A city or county shall provide that the right of appeal is to the governing body or, at their option, the planning commission, or both.

There shall be a final written determination by the agency of the appeal not later than 60 calendar days after receipt of the applicant's written appeal. The fact that an appeal is permitted to both the planning commission and to the governing body does not extend the 60-day period. Notwithstanding a decision pursuant to subdivision (b) that the application and submitted materials are not complete, if the final written determination on the appeal is not made within that 60-day period, the application with the submitted materials shall be deemed complete for the purposes of this chapter.

(d) Nothing in this section precludes an applicant and a public agency from mutually agreeing to an extension of any time limit provided by this section.

(e) A public agency may charge applicants a fee not to exceed the amount reasonably necessary to provide the service required by this section. If a fee is charged pursuant to this section, the fee shall be collected as part of the application fee charged for the development permit.

65943.5.

(a) Notwithstanding any other provision of this chapter, any appeal pursuant to subdivision (c) of Section 65943 involving a permit application to a board, office, or department within the California Environmental Protection Agency shall be made to the Secretary for Environmental Protection.

(b) Notwithstanding any other provision of this chapter, any appeal pursuant to subdivision (c) of Section 65943 involving an application for the issuance of an environmental permit from an environmental agency shall be made to the Secretary for Environmental Protection under either of the following circumstances:

(1) The environmental agency has not adopted an appeals process pursuant to subdivision (c) of Section 65943.

(2) The environmental agency declines to accept an appeal for a decision pursuant to subdivision (c) of Section 65943.

(c) For purposes of subdivision (b), "environmental permit" has the same meaning as defined in Section 72012 of the Public Resources Code, and "environmental agency" has the same meaning as defined in Section 71011 of the Public Resources Code, except that "environmental agency" does not include the agencies described in subdivisions (c) and (h) of Section 71011 of the Public Resources Code.

65944. Acceptance of Application as Complete; Requests for Additional Information; Restrictions; Clarification, Amplification, Correction, etc; Prior to Notice of Necessary Information

(a) After a public agency accepts an application as complete, the agency shall not subsequently re quest of an applicant any new or additional information which was not specified in the list prepared pursuant to Section 65940. The agency may, in the course of processing the application, request the applicant to clarify, amplify, correct, or otherwise supplement the information required for the application.

(b) The provisions of subdivision (a) shall not be construed as requiring an applicant to submit with his or her initial application the entirety of the information which a public agency may require in order to take final action on the application. Prior to accepting an application, each public agency shall inform the applicant of any information included in the list prepared pursuant to Section 65940 which will subsequently be required from the applicant in order to complete final action on the application.

(c) This section shall not be construed as limiting the ability of a public agency to request and obtain information which may be needed in order to comply with the provisions of Division 13 (commencing with Section 21000) of the Public Resources Code.

65945. Notice of Proposal to Adopt or Amend Certain Plans or Ordinances by City or County, Fee; Subscription to Periodically Updated Notice as Alternative, Fee

(a) At the time of filing an application for a development permit with a city or county, the city or county shall inform the applicant that he or she may make a written request to retrieve notice from the city or county of a proposal to adopt or amend any of the following plans or ordinances:

(1) A general plan.

(2) A specific plan.

(3) A zoning ordinance.

(4) An ordinance affecting building permits or grading permits.

The applicant shall specify, in the written request, the types of proposed action for which notice is requested. Prior to taking any of those actions, the city or county shall give notice to any applicant who has requested notice of the type of action proposed and whose development project is pending before the city or county if the city or county determines that the proposal is reasonably related to the applicant's request for the development permit. Notice shall be given only for those types of actions which the applicant specifies in the request for notification.

The city or county may charge the applicant for a development permit, to whom notice is provided pursuant to this subdivision, a reasonable fee not to exceed the actual cost of providing that notice. If a fee is charged pursuant to this subdivision, the fee shall be collected as part of the application fee charged for the development permit.

(b) As an alternative to the notification procedure prescribed by subdivision (a), a city or county may inform the applicant at the time of filing an application for a development permit that he or she may subscribe to a periodically updated notice or set of notices from the city or county which lists pending proposals to adopt or amend any of the plans or ordinances specified in subdivision (a), together with the status of the proposal and the date of any hearings thereon which have been set.

Only those proposals which are general, as opposed to parcel-specific in nature, and which the city or county determines are reasonably related to requests for development permits, need be listed in the notice. No proposals shall be required to be listed until such time as the first public hearing thereon has been set. The notice shall be updated and mailed at least once every six weeks; except that a notice need not be updated and mailed until a change in its contents is required.

The city or county may charge the applicant for a development permit, to whom notice is provided pursuant to this subdivision, a reasonable fee not to exceed the actual cost of providing that notice, including the costs of updating the notice, for the length of time the applicant requests to be sent the notice or notices.

65945.3. Notice of Proposal to Adopt or Amend Rules or Regulations Affecting Issuance of Permits by Local Agency other than City or County; Fee

At the time of filing an application for a development permit with a local agency, other than a city or county, the local agency shall inform the applicant that he or she may make a written request to receive notice of any proposal to adopt or amend a rule or regulation affecting the issuance of development permits.

Prior to adopting or amending any such rule or regulation, the local agency shall give notice to any applicant who has requested such notice and whose development project is pending before the agency if the local agency determines that the proposal is reasonably related to the applicant's request for the development permit.

The local agency may charge the applicant for a development permit, to whom notice is provided pursuant to this section, a reasonable fee not to exceed the actual cost of providing that notice. If a fee is charged pursuant to this section, the fee shall be collected as part of the application fee charged for the development permit.

65945.5. Notice of Proposal to Adopt or Amend Regulation Affecting Issuance of Permits and Which Implements Statutory Provision by State Agency

At the time of filing an application for a development permit with a state agency, the state agency shall inform the applicant that he or she may make a written request to receive notice of any proposal to adopt or amend a regulation affecting the issuance of development permits and which implements a statutory provision.

Prior to adopting or amending any such regulation, the state agency shall give notice to any applicant who has requested such notice and whose development project is pending before the state agency if the state agency determines that the proposal is reasonably related to the applicant's request for the development permit.

65945.7. Actions, Inactions, or Recommendations Regarding Ordinances, Rules or Regulations; Invalidity or Setting Aside Ground of Error Only if Prejudicial

No action, inaction, or recommendation regarding any ordinance, rule, or regulation subject to this Section 65945, 65945.3, or 65945.5 by any legislative body, administrative body, or the officials of any state or local agency shall be held void or invalid or be set aside by any court on the ground of any error, irregularity, informality, neglect, or omission (hereinafter called "error") as to any matter pertaining to notices, records, determinations, publications, or any matters of procedure whatever, unless after an examination of the entire case, including evidence, the court shall be of the opinion that the error complained of was prejudicial, and that by reason of such error that party complaining or appealing sustained and suffered substantial injury, and that a different result would have been probable if such error had not occurred or existed. There shall be no presumption that error is prejudicial or that injury was done if error is shown.

65946. [Replaced by AB2351 Statutes of 1993]

PLANNING AND ZONING LAW

GOVERNMENT CODE
Title 7, Division 1
Chapter 9.3—Mediation and Resolution of Land Use Disputes
(excerpts)

66030.

(a) The Legislature finds and declares all of the following:

(1) Current law provides that aggrieved agencies, project proponents, and affected residents may bring suit against the land use decisions of state and local governmental agencies. In practical terms, nearly anyone can sue once a project has been approved.

(2) Contention often arises over projects involving local general plans and zoning, redevelopment plans, the California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code), development impact fees, annexations and incorporations, and the Permit Streamlining Act (Chapter 4.5 (commencing with Section 65920)).

(3) When a public agency approves a development project that is not in accordance with the law, or when the prerogative to bring suit is abused, lawsuits can delay development, add uncertainty and cost to the development process, make housing more expensive, and damage California's competitiveness. This litigation begins in the superior court, and often progresses on appeal to the Court of Appeal and the Supreme Court, adding to the workload of the state's already overburdened judicial system.

(b) It is, therefore, the intent of the Legislature to help litigants resolve their differences by establishing formal mediation processes for land use disputes. In establishing these mediation processes, it is not the intent of the Legislature to interfere with the ability of litigants to pursue remedies through the courts.

66031.

(a) Notwithstanding any other provision of law, any action brought in the superior court relating to any of the following subjects may be subject to a mediation proceeding conducted pursuant to this chapter:

(1) The approval or denial by a public agency of any development project.

(2) Any act or decision of a public agency made pursuant to the California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code).

(3) The failure of a public agency to meet the time limits specified in Chapter 4.5 (commencing with Section 65920), commonly known as the Permit Streamlining Act, or in the Subdivision Map Act (Division 2 (commencing with Section 66410)).

(4) Fees determined pursuant to Sections 53080 to 53082, inclusive, or Chapter 4.9 (commencing with Section 65995).

(5) Fees determined pursuant to Chapter 5 (commencing with Section 66000).

(6) The adequacy of a general plan or specific plan adopted pursuant to Chapter 3 (commencing with Section 65100).

(7) The validity of any sphere of influence, urban service area, change of organization or reorganization, or any other decision made pursuant to the Cortese-Knox Local Government Reorganization Act (Division 3 (commencing with Section 56000) of Title 5).

(8) The adoption or amendment of a redevelopment plan pursuant to the Community Redevelopment Law (Part 1 (commencing with Section 33000) of Division 24 of the Health and Safety Code).

(9) The validity of any zoning decision made pursuant to Chapter 4 (commencing with Section 65800).

(10) The validity of any decision made pursuant to Article 3.5 (commencing with Section 21670) of Chapter 4 of Part 1 of Division 9 of the Public Utilities Code.

(b) Within five days after the deadline for the respondent or defendant to file its reply to an action, the court may invite the parties to consider resolving their dispute by selecting a mutually acceptable person to serve as a mediator, or an organization or agency to provide a mediator.

(c) In selecting a person to serve as a mediator, or an organization or agency to provide a mediator, the parties shall consider the following:

(1) The council of governments having jurisdiction in the county where the dispute arose.

(2) Any subregional or countywide council of governments in the county where the dispute arose.

(3) The Office of Permit Assistance within the Trade and Commerce Agency, pursuant to its authority in Article 1 (commencing with Section 15399.50) of Chapter 11 of Part 6.7 of Division 3 of Title 2.

(4) Any other person with experience or training in mediation including those with experience in land use issues, or any other organization or agency which can provide a person with experience or training in mediation, including those with experience in land use issues.

(d) If the court invites the parties to consider mediation, the parties shall notify the court within 30 days if they have selected a mutually acceptable person to serve as a mediator. If the parties have not selected a mediator within 30 days, the action shall proceed. The court shall not draw any implication, favorable or otherwise, from the refusal by a party to accept the invitation by the court to consider mediation. Nothing in this section shall preclude the parties from using mediation at any other time while the action is pending.

PLANNING AND ZONING LAW

GOVERNMENT CODE
Title 7—Planning and Land Use
Division 2—Subdivisions
Chapter 3—Procedure

Article 3
REVIEW OF TENTATIVE MAP BY OTHER AGENCIES
(excerpts)

66455.9.

Whenever there is consideration of an area within a development for a public school site, the advisory agency shall give the affected districts and the State Department of Education written notice of the proposed site. The written notice shall include the identification of any existing or proposed runways within the distance specified in Section 17215 of the Education Code. If the site is within the distance of an existing or proposed airport runway as described in Section 17215 of the Education Code, the department shall notify the State Department of Transportation as required by the section and the site shall be investigated by the State Department of Transportation required by Section 17215.

EDUCATION CODE
Title 1—General Education Code Provisions
Division 1—General Education Code Provisions
Part 10.5—School Facilities
Chapter 1—School Sites

Article 1
GENERAL PROVISIONS
(excerpts)

Note: SB 161, Statutes of 1997, replaced Education Code Section 39005 with Section 17215; SB 967, Statutes of 1995, deleted Sections 39006 and 39007.

17215.

(a) In order to promote the safety of pupils, comprehensive community planning, and greater educational usefulness of school sites before acquiring title to property for a new schoolsite, the governing board of each school district, including any district governed by a city board of education, shall give the State Department of Education written notice of the proposed acquisition and shall submit any information required by the State Department of Education if the proposed site is within two miles, measured by air line, of that point on an airport runway or a potential runway included in an airport master plan that is nearest to the site.

(b) Upon receipt of the notice required pursuant to subdivision (a), the State Department of Education shall notify the Department of Transportation in writing of the proposed acquisition. If the Department of Transportation is no longer in operation, the State Department of Education shall, in lieu of notifying the Department of Transportation, notify the United States Department of Transportation or any other appropriate agency, in writing, of the proposed acquisition for the purpose of obtaining from the department or other agency any information or assistance that it may desire to give.

(c) The Department of Transportation shall investigate the proposed site and, within 30 working days after receipt of the notice, shall submit to the State Department of Education a written report of its findings including recommendations concerning acquisition of the site. As part of the investigation, the Department of Transportation shall give notice thereof to the owner and operator of the airport who shall be granted the opportunity to comment upon the proposed schoolsite. The Department of Transportation shall adopt regulations setting forth the criteria by which a proposed site will be evaluated pursuant to this section.

(d) The State Department of Education shall, within 10 days of receiving the Department of Transportation's report, forward the report to the governing board of the school district. The governing board may not acquire title to the property until the report of the Department of Transportation has been received. If the report does not favor the acquisition of the property for a schoolsite or an addition to a present schoolsite, the governing board may not acquire title to the property. If the report does favor the acquisition of the property for a schoolsite or an addition to a present schoolsite, the governing board shall hold a public hearing on the matter prior to acquiring the site.

(e) If the Department of Transportation's recommendation does not favor acquisition of a proposed site, state funds or local funds may not be apportioned or expended for the acquisition of that site, construction of any school building on that site, or for the expansion of any existing site to include that site.

(f) This section does not apply to sites acquired prior to January 1, 1966, nor to any additions or extensions to those sites.

EDUCATION CODE
Title 3—Postsecondary Education
Division 7—Community Colleges
Part 49—Community Colleges, Education Facilities
Chapter 1—School Sites

Article 2
SCHOOL SITES
(excerpts)

81033. Investigation: Geologic and Soil Engineering Studies; Airport in Proximity

(c) To promote the safety of students, comprehensive community planning, and greater educational usefulness of community college sites, the governing board of each community college district, if the proposed site is within two miles, measured by air line, of that point on an airport runway, or a runway proposed by an airport master plan, which is nearest the site and excluding them if the property is not so located, before acquiring title to property for a new community college site or for an addition to a present site, shall give the board of governors notice in writing of the proposed acquisition and shall submit any information required by the board of governors.

Immediately after receiving notice of the proposed acquisition of property which is within two miles, measured by air line, of that point on an airport runway, or a runway proposed by an airport master plan, which is nearest the site, the board of governors shall notify the Division of Aeronautics of the Department of Transportation, in writing, of the proposed acquisition. The Division of Aeronautics shall make an investigation and report to the board of governors within 30 working days after receipt of the notice. If the Division of Aeronautics is no longer in operation, the board of governors shall, in lieu of notifying the Division of Aeronautics, notify the Federal Aviation Administration or any other appropriate agency, in writing, of the proposed acquisition for the purpose of obtaining from the authority or other agency such information or assistance as it may desire to give.

The board of governors shall investigate the proposed site and within 35 working days after receipt of the notice shall submit to the governing board a written report and its recommendations concerning acquisition of the site. The governing board shall not acquire title to the property until the report of the board of governors has been received. If the report does not favor the acquisition of the property for a community college site or an addition to a present community college site, the governing board shall not acquire title to the property until 30 days after the department's report is received and until the board of governors' report has been read at a public hearing duly called after 10 days' notice published once in a newspaper of general circulation within the community college district, or if there is no such newspaper, then in a newspaper of general circulation within the county in which the property is located.

(d) If, with respect to a proposed site located within two miles of an operative airport runway, the report of the board of governors submitted to a community college district governing board under subdivision (c) does not favor the acquisition of the site on the sole or partial basis of the unfavorable recommendation of the Division of Aeronautics of the Department of Transportation, no state agency or officer shall grant, apportion, or allow to such community college district for expenditure in connection with that site, any state funds otherwise made available under any state law whatever for a community college site acquisition or college building construction, or for expansion of existing sites and buildings, and no funds of the community college district or of the county in which the district lies shall be expended for such purposes; provided that provisions of this section shall not be applicable to sites acquired prior to January 1, 1966, nor any additions or extensions to such sites.

If the recommendations of the Division of Aeronautics is unfavorable, such recommendations shall not be overruled without the express approval of the board of governors and the State Allocation Board.

PUBLIC RESOURCES CODE
California Environmental Quality Act Statutes
Chapter 2.6—General

(excerpts)

21096. Airport Planning

(a) If a lead agency prepares an environmental impact report for a project situated within airport comprehensive land use plan boundaries, or, if a comprehensive land use plan has not been adopted, for a project within two nautical miles of a public airport or public use airport, the Airport Land Use Planning Handbook published by the Division of Aeronautics of the Department of Transportation, in compliance with Section 21674.5 of the Public Utilities Code and other documents, shall be utilized as technical resources to assist in the preparation of the environmental impact report as the report relates to airport-related safety hazards and noise problems.

(b) A lead agency shall not adopt a negative declaration for a project described in subdivision (a) unless the lead agency considers whether the project will result in a safety hazard or noise problem for persons using the airport or for persons residing or working in the project area.

LEGISLATIVE HISTORY SUMMARY

PUBLIC UTILITIES CODE
Section 21670 et seq.
Airport Land Use Commission Statutes

1967 Original ALUC statute enacted.

- Establishment of ALUCs required in each county containing a public airport served by a certificated air carrier.
- The purpose of ALUCs is indicated as being to make recommendations regarding height restrictions on buildings and the use of land surrounding airports.

1970 Assembly Bill 1856 (Badham) Chapter 1182, Statutes of 1970—Adds provisions which:

- Require ALUCs to prepare comprehensive land use plans.
- Require such plans to include a long-range plan and to reflect the airport's forecast growth during the next 20 years.
- Require ALUC review of airport construction plans (Section 21661.5).
- Exempt Los Angeles County from the requirement of establishing an ALUC.

1971 The function of ALUCs is restated as being to require new construction to conform to Department of Aeronautics standards.

1973 ALUCs are permitted to establish compatibility plans for military airports.

1982 Assembly Bill 2920 (Rogers) Chapter 1041, Statutes of 1982—Adds major changes which:

- More clearly articulate the purpose of ALUCs.
- Eliminate reference to "achieve by zoning."
- Require consistency between local general and specific plans and airport land use commission plans; the requirements define the process for attaining consistency, they do not establish standards for consistency.
- Eliminate the requirement for proposed individual development projects to be referred to an ALUC for review once local general/specific plans are consistent with the ALUC's plan.
- Require that local agencies make findings of fact before overriding an ALUC decision.
- Change the vote required for an override from 4/5 to 2/3.

1984 Assembly Bill 3551 (Mountjoy) Chapter 1117, Statutes of 1984—Amends the law to:

- Require ALUCs in all counties having an airport which serves the general public unless a county and its cities determine an ALUC is not needed.
- Limit amendments to compatibility plans to once per year.
- Allow individual projects to continue to be referred to the ALUC by agreement.
- Extend immunity to airports if an ALUC action is overridden by a local agency not owning the airport.
- Provide state funding eligibility for preparation of compatibility plans through the Regional Transportation Improvement Program process.

1987 Senate Bill 633 (Rogers) Chapter 1018, Statutes of 1987—Makes revisions which:

- Require that a designated body serving as an ALUC include two members having "expertise in aviation."
- Allows an interested party to initiate court proceedings to postpone the effective date of a local land use action if a compatibility plan has not been adopted.
- Delete sunset provisions contained in certain clauses of the law.
- Allows reimbursement for ALUC costs in accordance with the Commission on State Mandates.

1989 Senate Bill 255 (Bergeson) Chapter 54, Statutes of 1989—

- Sets a requirement that comprehensive land use plans be completed by June 1991.
- Establishes a method for compelling ALUCs to act on matters submitted for review.
- Allows ALUCs to charge fees for review of projects.
- Suspends any lawsuits that would stop development until the ALUC adopts its plan or until June 1, 1991.

1989 Senate Bill 235 (Alquist) Chapter 788, Statutes of 1989—Appropriates $3,672,000 for the payment of claims to counties seeking reimbursement of costs incurred during fiscal years 1985–86 through 1989-90 pursuant to state-mandated requirement (Chapter 1117, Statutes of 1984) for creation of ALUCs in most counties. This statute was repealed in 1993.

1990 Assembly Bill 4164 (Mountjoy) Chapter 1008, Statutes of 1990—Adds Section 21674.5 requiring the Division of Aeronautics to develop and implement a training program for ALUC staffs.

1990 Assembly Bill 4265 (Clute) Chapter 563, Statutes of 1990—With the concurrence of the Division of Aeronautics, allows ALUCs to use an airport layout plan, rather than a long-range airport master plan, as the basis for preparation of a compatibility plan.

1990 Senate Bill 1288 (Beverly) Chapter 54, Statutes of 1990—Amends Section 21670.2 to give Los Angeles County additional time to prepare compatibility plans and meet other provisions of the ALUC statutes.

1991 Senate Bill 532 (Bergeson) Chapter 140, Statutes of 1991—

- Allows counties having half of their compatibility plans completed or under preparation by June 30, 1991, an additional year to complete the remainder.
- Allows ALUCs to continue to charge fees under these circumstances.
- Fees may be charged only until June 30, 1992, if plans are not completed by then.

1993 Senate Bill 443 (Committee on Budget and Fiscal Review) Chapter 59, Statutes of 1993—Amends Section 21670(b) to make the formation of ALUCs permissive rather than mandatory as of June 30, 1993. (Note: Section 21670.2 which assigns responsibility for coordinating the airport planning of public agencies in Los Angeles County is not affected by this amendment.)

1994 Assembly Bill 2831 (Mountjoy) Chapter 644, Statutes of 1994—Reinstates the language in Section 21670(b) mandating establishment of ALUCs, but also provides for an alternative airport land use planning process. Lists specific actions which a county and affected cities must take in order for such alternative process to receive Division of Aeronautics' approval. Requires that ALUCs be guided by information in the Airport Land Use Planning Handbook when formulating airport land use plans.

1994 Senate Bill 1453 (Rogers) Chapter 438, Statutes of 1994—Amends California Environmental Quality Act (CEQA) statutes as applied to preparation of environmental documents affecting projects in the vicinity of airports. Requires lead agencies to use the Airport Land Use Planning Handbook as a technical resource when assessing the airport-related noise and safety impacts of such projects.

1997 Assembly Bill 1130 (Oller) Chapter 81, Statutes of 1997—Added Section 21670.4 concerning airports whose planning boundary straddles a county line.

2000 Senate Bill 1350 (Rainey) Chapter 506, Statutes of 2000—Added Section 21670(f) clarifying that special districts are among the local agencies to which airport land use planning laws are intended to apply.

Federal Aviation Regulations Part 77

Objects Affecting Navigable Airspace

Subpart A
GENERAL

Amdt. 77-11, Sept. 25, 1989.

77.1 Scope.

This part:

(a) Establishes standards for determining obstructions in navigable airspace;

(b) Sets forth the requirements for notice to the Administrator of certain proposed construction or alteration;

(c) Provides for aeronautical studies of obstructions to air navigation, to determine their effect on the safe and efficient use of airspace;

(d) Provides for public hearings on the hazardous effect of proposed construction or alteration on air navigation; and

(e) Provides for establishing antenna farm areas.

77.2 Definition of Terms.

For the purpose of this part:

"Airport available for public use" means an airport that is open to the general public with or without a prior request to use the airport.

"A seaplane base" is considered to be an airport only if its sea lanes are outlined by visual markers.

"Nonprecision instrument runway" means a runway having an existing instrument approach procedure utilizing air navigation facilities with only horizontal guidance, or area type navigation equipment, for which a straight-in nonprecision instrument approach procedure has been approved, or planned, and for which no precision approach facilities are planned, or indicated on an FAA planning document or military service military airport planning document.

"Precision instrument runway" means a runway having an existing instrument approach procedure utilizing an Instrument Landing System (ILS), or a Precision Approach Radar (PAR). It also means a runway for which a precision approach system is planned and is so indicated by an FAA approved airport layout plan; a military service approved military airport layout plan; any other FAA planning document, or military service military airport planning document.

"Utility runway" means a runway that is constructed for and intended to be used by propeller driven aircraft of 12,500 pounds maximum gross weight and less.

"Visual runway" means a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA approved airport layout plan, a military service approved military airport layout plan, or by any planning document submitted to the FAA by competent authority.

77.3 Standards.

(a) The standards established in this part for determining obstructions to air navigation are used by the Administrator in:

(1) Administering the Federal-aid Airport Program and the Surplus Airport Program;

(2) Transferring property of the United States under section 16 of the Federal Airport Act;

(3) Developing technical standards and guidance in the design and construction of airports; and

(4) Imposing requirements for public notice of the construction or alteration of any structure where notice will promote air safety.

(b) The standards used by the Administrator in the establishment of flight procedures and aircraft operational limitations are not set forth in this part but are contained in other publications of the Administrator.

77.5 Kinds of Objects Affected.

This part applies to:

(a) Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, and apparatus of a permanent or temporary character; and

(b) Alteration of any permanent or temporary existing structure by a change in its height (including appurtenances), or lateral dimensions, including equipment or materials used therein.

Subpart B
NOTICE OF CONSTRUCTION OR ALTERATION

77.11 Scope.

(a) This subpart requires each person proposing any kind of construction or alteration described in §77.13(a) to give adequate notice to the Administrator. It specifies the locations and dimensions of the construction or alteration for which notice is required and prescribes the form and manner of the notice. It also requires supplemental notices 48 hours before the start and upon the completion of certain construction or alteration that was the subject of a notice under §77.13(a).

(b) Notices received under this subpart provide a basis for:

(1) Evaluating the effect of the construction or alteration on operational procedures and pro posed operational procedures;

(2) Determinations of the possible hazardous effect of the proposed construction or alteration on air navigation;

(3) Recommendations for identifying the construction or alteration in accordance with the current Federal Aviation Administration Advisory Circular AC 70/7460-1 entitled “Obstruction Marking and Lighting,” which is available without charge from the Department of Transportation, Distribution Unit, TAD 484.3, Washington, D.C. 20590.

(4) Determining other appropriate measures to be applied for continued safety of air navigation; and

(5) Charting and other notification to airmen of the construction or alteration.

77.13 Construction or Alteration Requiring Notice.

(a) Except as provided in §77.15, each sponsor who proposes any of the following construction or alteration shall notify the Administrator in the form and manner prescribed in §77.17:

(1) Any construction or alteration of more than 200 feet in height above the ground level at its site.

(2) Any construction or alteration of greater height than an imaginary surface extending out ward and upward at one of the following slopes:

(i) 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport specified in paragraph (a)(5) of this section with at least one runway more than 3,200 feet in actual length, excluding heliports.

(ii) 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport specified in paragraph (a)(5) of this section with its longest runway no more than 3,200 feet in actual length, excluding heliports.

(iii) 5 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area of each heliport specified in paragraph (a)(5) of this section.

(3) Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance, 15 feet for any other public roadway, 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road, 23 feet for a railroad, and for a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed a standard of paragraph (a) (1) or (2) of this section.

(4) When requested by the FAA, any construction or alteration that would be in an instrument approach area (defined in the FAA standards governing instrument approach procedures) and available information indicates it might exceed a standard of Subpart C of this part.

(5) Any construction or alteration on any of the following airports (including heliports):

(i) An airport that is available for public use and is listed in the Airport Directory of the current Airman’s Information Manual or in either the Alaska or Pacific Airman’s Guide and Chart Supplement.

(ii) An airport under construction, that is the subject of a notice or proposal on file with the Federal Aviation Administration, and, except for military airports, it is clearly indicated that airport will be available for public use.

(iii) An airport that is operated by an armed force of the United States.

(b) Each sponsor who proposes construction or alteration that is the subject of a notice under paragraph (a) of this section and is advised by an FAA regional office that a supplemental notice is required shall submit that notice on a prescribed form to be received by the FAA regional office at least 48 hours before the start of the construction or alteration.

(c) Each sponsor who undertakes construction or alteration that is the subject of a notice under paragraph (a) of this section shall, within 5 days after that construction or alteration reaches its greatest height, submit a supplemental notice on a prescribed form to the FAA regional office having jurisdiction over the region involved, if—

(1) The construction or alteration is more than 200 feet above the surface level of its site; or

(2) An FAA regional office advises him that submission of the form is required.

77.15 Construction or Alteration Not Requiring Notice.

No person is required to notify the Administrator for any of the following construction or alteration:

(a) Any object that would be shielded by existing structures of a permanent and substantial character or by natural terrain or topographic features of equal or greater height, and would be located in the congested area of a city, town, or settlement where it is evident beyond all reasonable doubt that the structure so shielded will not adversely affect safety in air navigation.

(b) Any antenna structure of 20 feet or less in height except one that would increase the height of another antenna structure.

(c) Any air navigation facility, airport visual approach or landing aid, aircraft arresting device, or meteorological device, of a type approved by the Administrator, or an appropriate military service on military airports, the location and height of which is fixed by its functional purpose.

(d) Any construction or alteration for which notice is required by any other FAA regulation.

77.17 Form and Time of Notice.

(a) Each person who is required to notify the Administrator under §77.13(a) shall send one executed form set (four copies) of FAA Form 7460-1, Notice of Proposed Construction or Alteration, to the Manager, Air Traffic Division, FAA Regional Office having jurisdiction over the area within which the construction or alteration will be located. Copies of FAA Form 7460-1 may be obtained from the headquarters of the Federal Aviation Administration and the regional offices.

(b) The notice required under §77.13(a)(1) through (4) must be submitted at least 30 days before the earlier of the following dates:

(1) The date the proposed construction or alteration is to begin.

(2) The date an application for a construction permit is to be filed.

However, a notice relating to proposed construction or alteration that is subject to the licensing requirements of the Federal Communications Act may be sent to FAA at the same time the application for construction is filed with the Federal Communications Commission, or at any time before that filing.

(c) A proposed structure or an alteration to an existing structure that exceeds 2,000 feet in height above the ground will be presumed to be a hazard to air navigation and to result in an inefficient utilization of airspace and the applicant has the burden of overcoming that presumption. Each notice submitted under the pertinent provisions of this Part 77 proposing a structure in excess of 2,000 feet above ground, or an alteration that will make an existing structure exceed that height, must contain a detailed showing, directed to meeting this burden. Only in exceptional cases, where the FAA concludes that a clear and compelling showing has been made that it would not result in an inefficient utilization of the airspace and would not result in a hazard to air navigation, will a determination of no hazard be issued.

(d) In the case of an emergency involving essential public services, public health, or public safety that requires immediate construction or alteration, the 30 day requirement in paragraph (b) of this section does not apply and the notice may be sent by telephone, telegraph, or other expeditious means, with an executed FAA Form 7460-1 submitted within 5 days thereafter. Outside normal business hours, emergency notices by telephone or telegraph may be submitted to the nearest FAA Flight Service Station.

(e) Each person who is required to notify the Administrator by paragraph (b) or (c) of §77.13, or both, shall send an executed copy of FAA Form 117-1, Notice of Progress of Construction or Alteration, to the Manager, Air Traffic Division, FAA Regional Office having jurisdiction over the area involved.

77.19 Acknowledgment of Notice.

(a) The FAA acknowledges in writing the receipt of each notice submitted under §77.13(a).

(b) If the construction or alteration proposed in a notice is one for which lighting or marking standards are prescribed in the FAA Advisory Circular AC 70/7460-1, entitled “Obstruction Marking and Lighting,” the acknowledgment contains a statement to that effect and information on how the structure should be marked and lighted in accordance with the manual.

(c) The acknowledgment states that an aeronautical study of the proposed construction or alteration has resulted in a determination that the construction or alteration:

(1) Would not exceed any standard of Subpart C and would not be a hazard to air navigation;

(2) Would exceed a standard of Subpart C but would not be a hazard to air navigation; or

(3) Would exceed a standard of Subpart C and further aeronautical study is necessary to deter mine whether it would be a hazard to air navigation, that the sponsor may request within 30 days that further study, and that, pending completion of any further study, it is presumed the construction or alteration would be a hazard to air navigation.

Subpart C
OBSTRUCTION STANDARDS

77.21 Scope.

(a) This subpart establishes standards for determining obstructions to air navigation. It applies to existing and proposed manmade objects, objects of natural growth, and terrain. The standards apply to the use of navigable airspace by aircraft and to existing air navigation facilities, such as an air navigation aid, airport, Federal airway, instrument approach or departure procedure, or approved off airway route.

Additionally, they apply to a planned facility or use, or a change in an existing facility or use, if a proposal therefor is on file with the Federal Aviation Administration or an appropriate military service on the date the notice required by §77.13(a) is filed.

(b) At those airports having defined runways with specially prepared hard surfaces, the primary surface for each such runway extends 200 feet beyond each end of the runway. At those airports having defined strips or pathways that are used regularly for the taking off and landing of aircraft and have been designated by appropriate authority as runways, but do not have specially prepared hard surfaces, each end of the primary surface for each such runway shall coincide with the corresponding end of the runway. At those airports, excluding seaplane bases, having a defined landing and takeoff area with no defined pathways for the landing and taking off of aircraft, a determination shall be made as to which portions of the landing and takeoff area are regularly used as landing and takeoff pathways. Those pathways so determined shall be considered runways and an appropriate primary surface as defined in §77.25(c) will be considered as being longitudinally centered on each runway so determined, and each end of that primary surface shall coincide with the corresponding end of that runway.

(c) The standards in this subpart apply to the effect of construction or alteration proposals upon an airport if, at the time of filing of the notice required by §77.13(a), that airport is—

(1) Available for public use and is listed in the Airport Directory of the current Airman's Information Manual or in either the Alaska or Pacific Airman's Guide and Chart Supplement; or

(2) A planned or proposed airport or an airport under construction, that is the subject of a notice or proposal on file with the Federal Aviation Administration, and, except for military airports, it is clearly indicated that that airport will be available for public use; or,

(3) An airport that is operated by an armed force of the United States.

77.23 Standards for Determining Obstructions.

(a) An existing object, including a mobile object, is, and a future object would be, an obstruction to air navigation if it is of greater height than any of the following heights or surfaces:

(1) A height of 500 feet above ground level at the site of the object.

(2) A height that is 200 feet above ground level or above the established airport elevation, whichever is higher, within 3 nautical miles of the established reference point of an airport, excluding heliports, with its longest runway more than 3,200 feet in actual length, and that height increases in the proportion of 100 feet for each additional nautical mile of distance from the airport up to a maximum of 500 feet.

(3) A height within a terminal obstacle clearance area, including an initial approach segment, a departure area, and a circling approach area, which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area or segment to be less than the required obstacle clearance.

(4) A height within an en route obstacle clearance area, including turn and termination areas, of a Federal airway or approved off airway route, that would increase the minimum obstacle clearance altitude.

(5) The surface of a takeoff and landing area of an airport or any imaginary surface established under §77.25, §77.28, or §77.29. However, no part of the takeoff or landing area itself will be considered an obstruction.

(b) Except for traverse ways on or near an airport with an operative ground traffic control service, furnished by an air traffic control tower or by the airport management and coordinated with the air traffic control service, the standards of paragraph (a) of this section apply to traverse ways used or to be used for the passage of mobile objects only after the heights of these traverse ways are increased by:

(1) Seventeen feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance.

(2) Fifteen feet for any other public roadway.

(3) Ten feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road.

(4) Twenty-three feet for a railroad, and,

(5) For a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it.

77.25 Civil Airport Imaginary Surfaces.

The following civil airport imaginary surfaces are established with relation to the airport and to each runway. The size of each such imaginary surface is based on the category of each runway according to the type of approach available or planned for that runway. The slope and dimensions of the approach surface applied to each end of a runway are determined by the most precise approach existing or planned for that runway end.

(a) Horizontal surface. A horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by swinging arcs of specified radii from the center of each end of the primary surface of each runway of each airport and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc is:

(1) 5,000 feet for all runways designated as utility or visual;

(2) 10,000 feet for all other runways.

The radius of the arc specified for each end of a runway will have the same arithmetical value. That value will be the highest determined for either end of the runway. When a 5,000 foot arc is encompassed by tangents connecting two adjacent 10,000 foot arcs, the 5,000 foot arc shall be disregarded on the construction of the perimeter of the horizontal surface.

(b) Conical surface. A surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

(c) Primary surface. A surface longitudinally centered on a runway. When the runway has a specially prepared hard surface, the primary surface extends 200 feet beyond each end of that runway; but when the runway has no specially prepared hard surface, or planned hard surface, the primary surface ends at each end of that runway. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width of a primary surface is:

(1) 250 feet for utility runways having only visual approaches.

(2) 500 feet for utility runways having nonprecision instrument approaches.

(3) For other than utility runways the width is:

(i) 500 feet for visual runways having only visual approaches.

(ii) 500 feet for nonprecision instrument runways having visibility minimums greater than three-fourths statute mile.

(iii) 1,000 feet for a nonprecision instrument runway having a nonprecision instrument approach with visibility minimums as low as three-fourths of a statute mile, and for precision instrument runways.

The width of the primary surface of a runway will be that width prescribed in this section for the most precise approach existing or planned for either end of that runway.

(d) Approach surface. A surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. An approach surface is applied to each end of each runway based upon the type of approach available or planned for that runway end.

(1) The inner edge of the approach surface is the same width as the primary surface and it expands uniformly to a width of:

(i) 1,250 feet for that end of a utility runway with only visual approaches;

(ii) 1,500 feet for that end of a runway other than a utility runway with only visual approaches;

(iii) 2,000 feet for that end of a utility runway with a nonprecision instrument approach;

(iv) 3,500 feet for that end of a nonprecision instrument runway other than utility, having visibility minimums greater than three-fourths of a statute mile;

(v) 4,000 feet for that end of a nonprecision instrument runway, other than utility, having a nonprecision instrument approach with visibility minimums as low as three-fourths statute mile; and

(vi) 16,000 feet for precision instrument runways.

(2) The approach surface extends for a horizontal distance of:

(i) 5,000 feet at a slope of 20 to 1 for all utility and visual runways;

(ii) 10,000 feet at a slope of 34 to 1 for all nonprecision instrument runways other than utility; and,

(iii) 10,000 feet at a slope of 50 to 1 with an additional 40,000 feet at a slope of 40 to 1 for all precision instrument runways.

(3) The outer width of an approach surface to an end of a runway will be that width prescribed in this subsection for the most precise approach existing or planned for that runway end.

(e) Transitional surface. These surfaces extend outward and upward at right angles to the runway centerline and the runway centerline extended at a slope of 7 to 1 from the sides of the primary surface and from the sides of the approach surfaces. Transitional surfaces for those portions of the precision approach surface which project through and beyond the limits of the conical surface, extend a distance of 5,000 feet measured horizontally from the edge of the approach surface and at right angles to the runway centerline.

77.27 [Reserved]

77.28 Military Airport Imaginary Surfaces.

(a) Related to airport reference points. These surfaces apply to all military airports. For the purposes of this section a military airport is any airport operated by an armed force of the United States.

(1) Inner horizontal surface. A plane is oval in shape at a height of 150 feet above the established airfield elevation. The plane is constructed by scribing an arc with a radius of 7,500 feet about the centerline at the end of each runway and interconnecting these arcs with tangents.

(2) Conical surface. A surface extending from the periphery of the inner horizontal surface outward and upward at a slope of 20 to 1 for a horizontal distance of 7,000 feet to a height of 500 feet above the established airfield elevation.

(3) Outer horizontal surface. A plane, located 500 feet above the established airfield elevation, extending outward from the outer periphery of the conical surface for a horizontal distance of 30,000 feet.

(b) Related to runways. These surfaces apply to all military airports.

(1) Primary surface. A surface located on the ground or water longitudinally centered on each runway with the same length as the runway. The width of the primary surface for runways is 2,000 feet. However, at established bases where substantial construction has taken place in accordance with a previous lateral clearance criteria, the 2,000 foot width may be reduced to the former criteria.

(2) Clear zone surface. A surface located on the ground or water at each end of the primary surface, with a length of 1,000 feet and the same width as the primary surface.

(3) Approach clearance surface. An inclined plane, symmetrical about the runway centerline extended, beginning 200 feet beyond each end of the primary surface at the centerline elevation of the runway end and extending for 50,000 feet. The slope of the approach clearance surface is 50 to 1 along the runway centerline extended until it reaches an elevation of 500 feet above the established airport elevation. It then continues horizontally at this elevation to a point 50,000 feet from the point of beginning. The width of this surface at the runway end is the same as the primary surface, it flares uniformly, and the width at 50,000 is 16,000 feet.

(4) Transitional surfaces. These surfaces connect the primary surfaces, the first 200 feet of the clear zone surfaces, and the approach clearance surfaces to the inner horizontal surface, conical surface, outer horizontal surface or other transitional surfaces. The slope of the transitional surface is 7 to 1 outward and upward at right angles to the runway centerline.

77.29 Airport Imaginary Surfaces for Heliports.

(a) Heliport primary surface. The area of the primary surface coincides in size and shape with the designated takeoff and landing area of a heliport. This surface is a horizontal plane at the elevation of the established heliport elevation.

(b) Heliport approach surface. The approach surface begins at each end of the heliport primary surface with the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet where its width is 500 feet. The slope of the approach surface is 8 to 1 for civil heliports and 10 to 1 for military heliports.

(c) Heliport transitional surfaces These surfaces extend outward and upward from the lateral boundaries of the heliport primary surface and from the approach surfaces at a slope of 2 to 1 for a distance of 250 feet measured horizontally from the centerline of the primary and approach surfaces.

Subpart D
AERONAUTICAL STUDIES OF EFFECT OF PROPOSED CONSTRUCTION ON NAVIGABLE AIRSPACE

77.31 Scope.

(a) This subpart applies to the conduct of aeronautical studies of the effect of proposed construction or alteration on the use of air navigation facilities or navigable airspace by aircraft. In the aeronautical studies, present and future IFR and VFR aeronautical operations and procedures are reviewed and any possible changes in those operations and procedures and in the construction proposal that would eliminate or alleviate the conflicting demands are ascertained.

(b) The conclusion of a study made under this subpart is normally a determination as to whether the specific proposal studied would be a hazard to air navigation.

77.33 Initiation of Studies.

(a) An aeronautical study is conducted by the FAA:

(1) Upon the request of the sponsor of any construction or alteration for which a notice is submitted under Subpart B of this part, unless that construction or alteration would be located within an antenna farm area established under Subpart F of this part; or

(2) Whenever the FAA determines it appropriate.

77.35 Aeronautical Studies.

(a) The Regional Manager, Air Traffic Division of the region in which the proposed construction or alteration would be located, or his designee, conducts the aeronautical study of the effect of the proposal upon the operation of air navigation facilities and the safe and efficient utilization of the navigable airspace. This study may include the physical and electromagnetic radiation effect the proposal may have on the operation of an air navigation facility.

(b) To the extent considered necessary, the Regional Manager, Air Traffic Division or his designee:

(1) Solicits comments from all interested persons;

(2) Explores objections to the proposal and attempts to develop recommendations for adjustment of aviation requirements that would accommodate the proposed construction or alteration;

(3) Examines possible revisions of the proposal that would eliminate the exceeding of the standards in Subpart C of this part; and

(4) Convenes a meeting with all interested persons for the purpose of gathering all facts relevant to the effect of the proposed construction or alteration on the safe and efficient utilization of the navigable airspace.

(c) The Regional Manager, Air Traffic Division or his designee issues a determination as to whether the proposed construction or alteration would be a hazard to air navigation and sends copies to all known interested persons. This determination is final unless a petition for review is granted under §77.37.

(d) If the sponsor revises his proposal to eliminate exceeding of the standards of Subpart C of this part, or withdraws it, the Regional Manager, Air Traffic Division, or his designee, terminates the study and notifies all known interested persons.

77.37 Discretionary Review.

(a) The sponsor of any proposed construction or alteration or any person who stated a substantial aeronautical objection to it in an aeronautical study, or any person who has a substantial aeronautical objection to it but was not given an opportunity to state it, may petition the Administrator, within 30 days after issuance of the determination under §77.19 or §77.35 or revision or extension of the determination under §77.39(c), for a review of the determination, revision, or extension. This paragraph does not apply to any acknowledgment issued under §77.19(c)(1).

(b) The petition must be in triplicate and contain a full statement of the basis upon which it is made.

(c) The Administrator examines each petition and decides whether a review will be made and, if so, whether it will be:

(1) A review on the basis of written materials, including study of a report by the Regional Manager, Air Traffic Division of the aeronautical study, briefs, and related submissions by any interested party, and other relevant facts, with the Administrator affirming, revising, or reversing the determination issued under §77.19, §77.35 or §77.39(c); or

(2) A review on the basis of a public hearing, conducted in accordance with the procedures prescribed in Subpart E of this part.

77.39 Effective Period of Determination of No Hazard.

(a) Unless it is otherwise extended, revised, or terminated, each final determination of no hazard made under this subpart or Subpart B or E of this part expires 18 months after its effective date, regardless of whether the proposed construction or alteration has been started, or on the date the proposed construction or alteration is abandoned, whichever is earlier.

(b) In any case, including a determination to which paragraph (d) of this section applies, where the proposed construction or alteration has not been started during the applicable period by actual structural work, such as the laying of a foundation, but not including excavation, any interested person may, at least 15 days before the date the final determination expires, petition the FAA official who issued the determination to:

(1) Revise the determination based on new facts that change the basis on which it was made; or

(2) Extend its effective period.

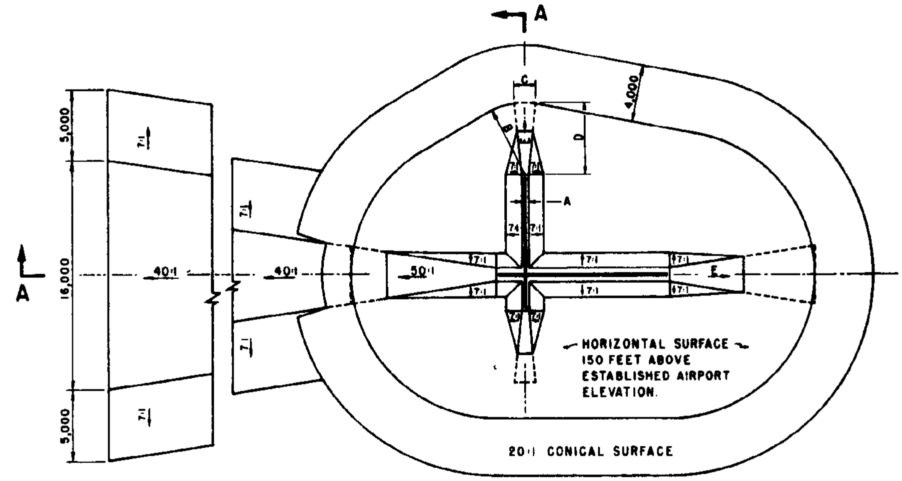
(c) The FAA official who issued the determination reviews each petition presented under paragraph (b) of this section, and revises, extends, or affirms the determination as indicated by his findings.

(d) In any case in which a final determination made under this subpart or Subpart B or E of this part relates to proposed construction or alteration that may not be started unless the Federal Communications Commission issues an appropriate construction permit, the effective period of each final determination includes:

(1) The time required to apply to the Commission for a construction permit, but not more than 6 months after the effective date of the determination; and

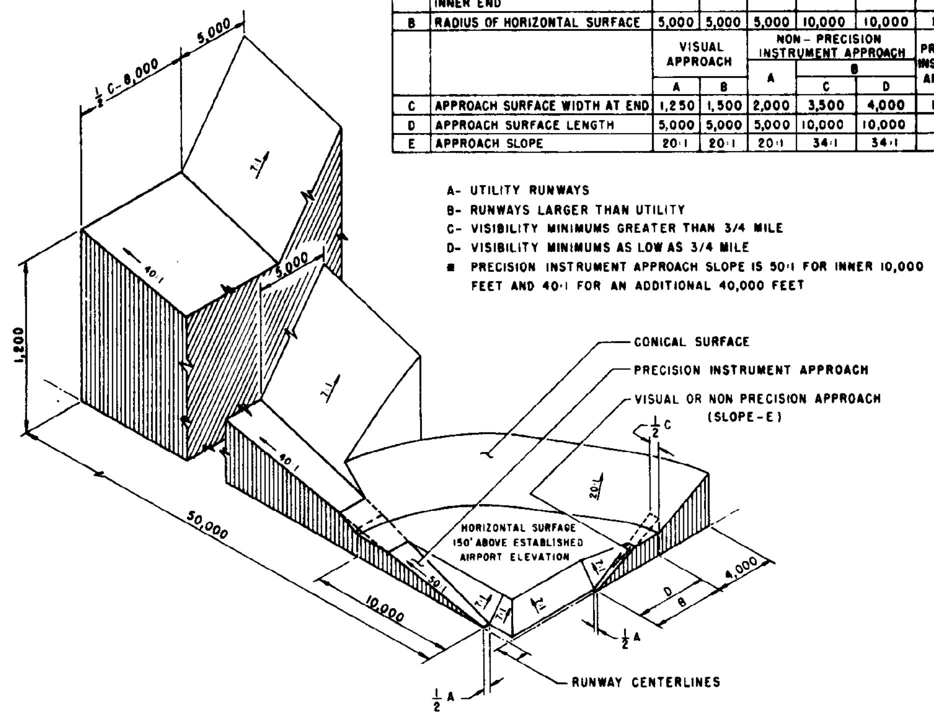
(2) The time necessary for the Commission to process the application except in a case where the Administrator determines a shorter effective period is required by the circumstances.

(e) If the Commission issues a construction permit, the final determination is effective until the date prescribed for completion of the construction. If the Commission refuses to issue a construction permit, the final determination expires on the date of its refusal.



DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		A	B	A	B		
					C	D	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
		A	B	A	B		
					C	D	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A- UTILITY RUNWAYS
B- RUNWAYS LARGER THAN UTILITY
C- VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D- VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



ISOMETRIC VIEW OF SECTION A-A

§ 77.25 CIVIL AIRPORT IMAGINARY SURFACES

Source: Federal Aviation Regulations Part 77

EXHIBIT B-1

FAR Part 77 Imaginary Surfaces

Please Type or Print on This Form — Form Approved OMB No. 2120-0001

U.S. Department of Transportation
Federal Aviation Administration

Failure To Provide All Requested Information May Delay Processing of Your Notice

Notice of Proposed Construction or Alteration

FOR FAA USE ONLY
Aeronautical Study Number
- - -

1. Sponsor *(person, company, etc. proposing this action) :*
Attn. of: ____
Name: ____
Address: ____
City: ____ State: ____ Zip: ____
Telephone: ____ Fax: ____

2. Sponsor's Representative *(if other than #1) :*
Attn. of: ____
Name: ____
Address: ____
City: ____ State: ____ Zip: ____
Telephone: ____ Fax: ____

3. Notice of: ☐ New Construction ☐ Alteration ☐ Existing

4. Duration: ☐ Permanent ☐ Temporary (months, days)

5. Work Schedule: Beginning ____ End ____

6. Type: ☐ Antenna Tower ☐ Crane ☐ Building ☐ Power Line ☐ Landfill ☐ Water Tank ☐ Other ____

7. Marking/Painting and/or Lighting Preferred:
☐ Red Lights and Paint ☐ Dual - Red and Medium Intensity White
☐ White - Medium Intensity ☐ Dual - Red and High Intensity White
☐ White - High Intensity ☐ Other ____

8. FCC Antenna Structure Registration Number *(if applicable):*
____

9. Latitude: ____ ____ ' ____ . ____ "

10. Longitude: ____ ____ ' ____ . ____ "

11. Datum: ☐ NAD 83 ☐ NAD 27 ☐ Other____

12. Nearest: City: ____ State:____

13. Nearest Public-use (not private-use) or Military Airport or Heliport:
____

14. Distance from #13. to Structure: ____

15. Direction from #13. to Structure: ____

16. Site Elevation *(AMSL):* ____**ft.**

17. Total Structure Height *(AGL):* ____**ft.**

18. Overall height (#16. + #17.) *(AMSL):* ____**ft.**

19. Previous FAA Aeronautical Study Number (if applicable):
____ - OE

20. Description of Location: (Attach a USGS 7.5 minute Quadrangle Map with the precise site marked and any certified survey.)

21. Complete Description of Proposal:

Frequency/Power (kW)	

Notice is required by 14 Code of Federal Regulations, part 77 pursuant to 49 U.S.C., Section 44718. Persons who knowingly and willingly violate the notice requirements of part 77 are subject to a civil penalty of $1,000 per day until the notice is received, pursuant to 49 U.S.C., section 46301 (a).

I hereby certify that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to mark and/or light the structure in accordance with established marking and lighting standards as necessary.

Date	Typed or Printed name and Title of Person Filing Notice	Signature

FAA Form 7460-1 (2-99) Supercedes Previous Edition — NSN: 0052-00-012-0008

Source: Federal Aviation Administration (www.faa.gov/arp/ace/forms/7460-1.pdf

EXHIBIT B-2

Notice of Proposed Construction or Alteration

FAA Form 7460

Methods for Determining Concentrations of People

One criterion used in many compatibility plans is the maximum number of people per acre that can be present in a given area at any one time. If a proposed use exceeds the maximum density, it is considered inconsistent with compatibility planning policies. This appendix provides some guidance on how the people-per-acre determination can be made.

The most difficult part about making a people-per-acre determination is estimating the number of people likely to use a particular facility. There are several methods which can be utilized, depending upon the nature of the proposed use:

- **Parking Ordinance**—The number of people present in a given area can be calculated based upon the number of parking spaces provided. Some assumption regarding the number of people per vehicle needs to be developed to calculate the number of people on-site. The number of people per acre can then be calculated by dividing the number of people on-site by the size of the parcel in acres. This approach is appropriate where the use is expected to be dependent up on access by vehicles. Depending upon the specific assumptions utilized, this methodology typically results in a number in the low end of the likely intensity for a given land use.
- **Maximum Occupancy**—The Uniform or California Building Code can be used as a standard for determining the maximum occupancy of certain uses. The chart provided as Exhibit C-1 indicates the required number of square feet per occupant. The number of people on the site can be calculated by dividing the total floor area of a proposed use by the minimum square feet per occupant requirement listed in the table. The maximum occupancy can then be divided by the size of the parcel in acres to determine the people per acre. Surveys of actual occupancy levels conducted by various agencies have indicated that many retail and office uses are generally occupied at no more than 50% of their maximum occupancy levels, even at the busiest times of day. Therefore, the number of people calculated for office and retail uses should usually be adjusted (50%) to reflect the actual occupancy levels before making the final people-per-acre determination. Even with this adjustment, the UBC-based methodology typically produces intensities at the high end of the likely range.
- **Survey of Similar Uses**—Certain uses may require an estimate based upon a survey of similar uses. This approach is more difficult, but is appropriate for uses which, because of the nature of the use, cannot be reasonably estimated based upon parking or square footage.

Exhibit C-2 shows sample calculations.

	Use	Minimum Square Feet per Occupant
1.	Aircraft Hangars (no repair)	500
2.	Auction Rooms	7
3.	Assembly Areas, Concentrated Use (without fixed seats) Auditoriums Churches and Chapels Dance Floors Lobby Accessory to Assembly Occupancy Lodge Rooms Reviewing Stands Stadiums	7
	Waiting Area	3
4.	Assembly Areas, Less Concentrated Use Conference Rooms Dining Rooms Drinking Establishments Exhibit Rooms Gymnasiums Lounges Stages	15
	Gaming	11
5.	Bowling Alley (assume no occupant load for bowling lanes)	4
6.	Children's Homes and Homes for the Aged	80
7.	Classrooms	20
8.	Congregate Residences	200
9.	Courtrooms	40
10.	Dormitories	50
11.	Dwellings	300
12.	Exercising Rooms	50
13.	Garage, Parking	200
14.	Health-Care Facilities	80
	Sleeping Rooms	120
	Treatment Rooms	240
15.	Hotels and Apartments	200
16.	Kitchen — Commercial	200
17.	Library Reading Room	50
	Stack Areas	100
18.	Locker Rooms	50
19.	Malls	Varies
20.	Manufacturing Areas	200
21.	Mechanical Equipment Room	300
22.	Nurseries for Children (Day Care)	35
23.	Offices	100
24.	School Shops and Vocational Rooms	50
25.	Skating Rinks	50 on the skating area; 15 on the deck
26.	Storage and Stock Rooms	300
27.	Stores — Retail Sales Rooms	
	Basements and Ground Floor	30
	Upper Floors	60
28.	Swimming Pools	50 for the pool area; 15 on the deck
29.	Warehouses	500
30.	All Others	100

Source: California Building Code (1998), Table 10-A

EXHIBIT C-1

Occupancy Levels—California Building Code

Example 1

Proposed Development: Two office buildings, each two stories and containing 20,000 square feet of floor area per building. Site size is 3.0 net acres. Counting a portion of the adjacent road, the gross area of the site is 3.5± acres.

A. *Calculation Based on Parking Space Requirements*

For office uses, assume that a county or city parking ordinance requires 1 parking space for every 300 square feet of floor area. Data from traffic studies or other sources can be used to estimate the average vehicle occupancy. For the purposes of this example, the number of people on the property is assumed to equal 1.5 times the number of parking spaces.

The average usage intensity would therefore be calculated as follows:

1) 40,000 sq. ft. floor area x 1.0 parking space per 300 sq. ft. = 134 required parking spaces
2) 134 parking spaces x 1.5 people per space = 200 people maximum on site
3) 200 people ÷ 3.5 acres gross site size = 57 people per acre average for the site

Assuming that occupancy of each building is relatively equal throughout, but that there is some separation between the buildings and outdoor uses are minimal, the usage intensity for a single acre would be estimated to be:

1) 20,000 sq. ft. bldg. ÷ 2 stories = 10,000 sq. ft. bldg. footprint
2) 10,000 sq. ft. bldg. footprint ÷ 43,560 sq. ft. per acre = 0.23 acre bldg. footprint
3) Building footprint < 1.0 acre; therefore maximum people in 1 acre = bldg. occupancy = 100 people per single acre

B. *Calculation Based on Uniform Building Code*

Using the UBC (Appendix C1) as the basis for estimating building occupancy yields the following results for the above example:

1) 40,000 sq. ft. bldg. ÷ 100 sq. ft./occupant = 400 people max. bldg. occupancy (under UBC)
2) 400 max. bldg. occupancy x 50% adjustment = 200 people maximum on site
3) 200 people ÷ 3.5 acres gross site size = 57 people per acre average for the site

Conclusions: In this instance, both methodologies give the same results. For different uses and/or different assumptions, the two methodologies are likely to produce different numbers. In most such cases, the UBC methodology will indicate a higher intensity.

EXHIBIT C-2

Sample People-Per-Acre Calculations

Example 2

Proposed Development: Single-floor furniture store containing 24,000 square feet of floor area on a site of 1.7 net acres. Counting a portion of the adjacent road, the gross area of the site is 2.0 acres).

A. *Calculation Based on Parking Space Requirements*

For furniture stores, the county requires 1 parking space per 400 square feet of use area. Assuming 1.5 people per automobile, the average usage intensity would be:

1) 24,000 sq. ft. bldg. x 1.0 parking space per 400 sq. ft. = 60 required parking spaces
2) 60 parking spaces x 1.5 people per space = 90 people maximum on site
3) 90 people ÷ 1.26 acres gross site size = 72 people per acre average for the site

Again assuming a relatively balanced occupancy throughout the building and that outdoor uses are mini mal, the usage intensity for a single acre would be estimated to be:

1) 24,000 sq. ft. bldg. footprint ÷ 43,560 sq. ft. per acre = 0.55 acre bldg. footprint
3) Building footprint < 1.0 acre; therefore maximum people in 1 acre = bldg. occupancy = 90 people per single acre

B. *Calculation Based on Uniform Building Code*

For the purposes of the UBC-based methodology, the furniture store is assumed to be consist of 50% retail sales floor (at 30 square feet per occupant) and 50% warehouse (at 500 square feet per occupant). Usage intensities would therefore be estimated as follows:

1) 12,000 sq. ft. retail floor area ÷ 30 sq. ft./occupant = 400 people max. occupancy in retail area
2) 12,000 sq. ft. warehouse floor area ÷ 500 sq. ft./occupant = 24 people max. occupancy in warehouse area
3) Maximum occupancy under UBC assumptions = 400 + 24 = 424 people
4) Assuming typical peak occupancy is 50% of UBC numbers = 212 people maximum expected at any one time
5) 212 people ÷ 1.26 acres = 168 people per acre average for the site

With respect to the single-acre intensity criteria, the entire building occupancy would again be within less than 1.0 acre, thus yielding the same intensity of 168 people per single acre.

Conclusions: In this instance, the two methods produce very different results. The occupancy estimate of 30 square feet per person is undoubtedly low for a furniture store even after the 50% adjustment. The 72 people-per-acre estimate using the parking requirement methodology is probably closer to being realistic. As part of the general plan consistency process, ALUCs and local jurisdictions should decide which method or combination of methods is to be used in reviewing development proposals.

EXHIBIT C-2 *CONTINUED*

Sample Implementation Documents

The responsibility for implementation of the policies set forth in the compatibility plans adopted by airport land use commissions rests largely with the affected local jurisdictions. This appendix contains samples of two types of implementation documents.

- **Avigation Easement**—Avigation easements transfer certain property rights from the owner of the underlying property to the owner of an airport. ALUCs may require avigation easement dedication as a condition for approval of development on property subject to high noise levels or a need to restrict heights of structures and trees to less than might ordinarily occur on the property. Also, airports may require avigation easements in conjunction with programs for noise insulation of existing structures in the airport vicinity. A sample of a standard avigation easement is included in Exhibit D-1.
- **Recorded Deed Notice**—Deed notices are a form of buyer awareness measure whose objective is to ensure that prospective buyers of airport area property, particularly residential property, are informed about the airport's impact on the property. Unlike easements, deed notices do not convey property rights from the property owner to the airport and do not restrict the height of objects. They only document the existence of certain conditions which affect the property—such as the proximity of the airport and common occurrence of aircraft overflights at or below the airport traffic pattern altitude. ALUCs may make recording of deed notices a requirement for project approval within portions of the airport influence area where avigation easements are not essential. Exhibit D-2 contains a sample of a deed notice.

An additional type of implementation document available to local jurisdictions is an airport combining zone ordinance. Possible components for such an ordinance are described in Chapter 5, Table 5B.

This indenture made this_____day of ______________, 20___, between_____________________herein after referred to as Grantor, and the [Insert County or City name], a political subdivision in the State of California, hereinafter referred to as Grantee.

The Grantor, for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, does hereby grant to the Grantee, its successors and assigns, a perpetual and assignable easement over the following described parcel of land in which the Grantor holds a fee simple estate. The property which is subject to this easement is depicted as ____________________ on “Exhibit A” attached and is more particularly described as follows:

[Insert legal description of real property]

The easement applies to the Airspace above an imaginary plane over the real property. The plane is described as follows:

> The imaginary plane above the hereinbefore described real property, as such plane is defined by Part 77 of the Federal Aviation Regulations, and consists of a plane [describe approach, transition, or horizontal surface]; the elevation of said plane being based upon the ______________ Airport official runway end elevation of ________ feet Above Mean Sea Level (AMSL), as determined by [Insert name and Date of Survey or Airport Layout Plan that determines the elevation] the approximate dimensions of which said plane are described and shown on Exhibit A attached hereto and incorporated herein by reference.

The aforesaid easement and right-of-way includes, but is not limited to:

(1) For the use and benefit of the public, the easement and continuing right to fly, or cause or permit the flight by any and all persons, or any aircraft, of any and all kinds now or hereafter known, in, through, across, or about any portion of the Airspace hereinabove described; and

(2) The easement and right to cause or create, or permit or allow to be caused or created within all space above the existing surface of the hereinabove described real property and any and all Airspace laterally adjacent to said real property, such noise, vibration, currents and other effects of air, illumination, and fuel consumption as may be inherent in, or may arise or occur from or during the operation of aircraft of any and all kinds, now or hereafter known or used, for navigation of or flight in air; and

(3) A continuing right to clear and keep clear from the Airspace any portions of buildings, structures, or improvements of any kinds, and of trees or other objects, including the right to remove or demolish those portions of such buildings, structures, improvements, trees, or other things which extend into or above said Airspace, and the right to cut to the ground level and remove, any trees which extend into or above the Airspace; and

(4) The right to mark and light, or cause or require to be marked or lighted, as obstructions to air navigation, any and all buildings, structures, or other improvements, and trees or other objects, which extend into or above the Airspace; and

(5) The right of ingress to, passage within, and egress from the hereinabove described real property, for the purposes described in subparagraphs (3) and (4) above at reasonable times and after reasonable notice.

EXHIBIT D-1

Typical Avigation Easement

For and on behalf of itself, its successors and assigns, the Grantor hereby covenants with the [Insert County or City name], for the direct benefit of the real property constituting the __________________ Airport hereinafter described, that neither the Grantor, nor its successors in interest or assigns will construct, install, erect, place or grow in or upon the hereinabove described real property, nor will they permit to allow, any building structure, improvement, tree or other object which extends into or above the Airspace, or which constitutes an obstruction to air navigation, or which obstructs or interferes with the use of the easement and rights-of-way herein granted.

The easements and rights-of-way herein granted shall be deemed both appurtenant to and for the direct benefit of that real property which constitutes the __________________ Airport, in the [Insert County or City name], State of California; and shall further be deemed in gross, being conveyed to the Grantee for the benefit of the Grantee and any and all members of the general public who may use said easement or right-of-way, in landing at, taking off from or operating such aircraft in or about the __________________ Airport, or in otherwise flying through said Airspace.

Grantor, together with its successors in interest and assigns, hereby waives its right to legal action against Grantee, its successors, or assigns for monetary damages or other redress due to impacts, as described in Paragraph (2) of the granted rights of easement, associated with aircraft operations in the air or on the ground at the airport, including future increases in the volume or changes in location of said operations. Furthermore, Grantor, its successors, and assigns shall have no duty to avoid or mitigate such damages through physical modification of airport facilities or establishment or modification of aircraft operational procedures or restrictions. However, this waiver shall not apply if the airport role or character of its usage (as identified in an adopted airport master plan, for example) changes in a fundamental manner which could not reasonably have been anticipated at the time of the granting of this easement and which results in a substantial increase in the impacts associated with aircraft operations. Also, this grant of easement shall not operate to deprive the Grantor, its successors or assigns, of any rights which may from time to time have against any air carrier or private operator for negligent or unlawful operation of aircraft.

These covenants and agreements run with the land and are binding upon the heirs, administrators, executors, successors and assigns of the Grantor, and, for the purpose of this instrument, the real property firstly hereinabove described is the servient tenement and said __________________ Airport is the dominant tenement.

DATED: ________________

STATE OF }
ss
COUNTY OF }

On ____________, before me, the undersigned, a Notary Public in and for said County and State, personally appeared ____________, and ____________ known to me to be the persons whose names are subscribed to the within instrument and acknowledged that they executed the same.

WITNESS my hand and official seal.

____

Notary Public

EXHIBIT D-1 *CONTINUED*

A statement similar to the following should be included on the deed for any real property subject to the deed notice requirements set forth in the [Insert ALUC name] *Airport Land Use Compatibility Plan*. Such notice should be recorded by the county of [Insert County name]. Also, this deed notice should be included on any parcel map, tentative map, or final map for subdivision approval.

> The [Insert ALUC name] *Airport Land Use Compatibility Plan* and [Insert County/City name] Ordinance (Ordinance No. ___________) identify a [Insert Airport name] Airport Influence Area. Properties within this area are routinely subject to overflights by aircraft using this public-use airport and, as a result, residents may experience inconvenience, annoyance, or discomfort arising from the noise of such operations. State law (Public Utilities Code Section 21670 et seq.) establishes the importance of public-use airports to protection of the public interest of the people of the state of California. Residents of property near such airports should therefore be prepared to accept the inconvenience, annoyance, or discomfort from normal aircraft operations. Residents also should be aware that the current volume of aircraft activity may increase in the future in response to [Insert County name] County population and economic growth. Any subsequent deed conveying this parcel or subdivisions thereof shall contain a statement in substantially this form.

EXHIBIT D-2

Sample Deed Notice

Accident Data Research Methodology

DATA SOURCES INITIALLY INVESTIGATED

As discussed in Chapter 8, data regarding virtually all of the characteristics pertinent to analysis of off-airport accidents is contained in the computer-based accident briefs covering all accidents investigated by the National Transportation Safety Board. Information regarding the *precise location* of each accident relative to the runway used is the key exception. To the extent that exact location information is recorded by the NTSB, it is included only in the individual Factual Record assembled for each accident. Depending upon the nature of the accident, the Factual Record may be anywhere from a dozen to hundreds of pages long. This data is maintained on microfiche and is not available in computerized form.

Prior to preparation of the 1993 edition of this *Handbook*, preliminary investigation by the study team into the Factual Records for a test group of accidents revealed that many contain the necessary location data, but most do not. Also, it was recognized that the process of extracting this information from the records would be a time-consuming one.

Other possible sources of information were therefore investigated to determine whether any could be more efficiently researched or would yield more complete or more accurate data than the NTSB records. The sources reviewed included:

- **Managers of Individual Airports**—Direct contact with the management of individual airports was the principal alternative initially considered. A major difficulty with this approach is that the completeness of the accident records maintained by different airports varies greatly. The number of years recorded, the level of detail, and the accuracy of the data from these sources would thus be inconsistent. Time-consuming follow-up letters and phone calls would be necessary in order to clarify the information received or to get any response at all. Also, correlating individual accident information obtained from airport managers with other categories of data readily available only in NTSB records would be difficult.
- **Local Newspapers**—Information from this source is essentially limited to published reports and pictures. As protection against possible erosion of first amendment rights, unpublished notes and photographs are not released to the public, even under court order. The probability of published stories or photographs adding to the information available from other sources is small.
- **Local Police and Fire Department Records**—A check with several California emergency agencies regarding specific accidents within their jurisdiction yielded little in the way of official (written) information other than that which is already included in the Factual Report. The only way this source could be useful would be to contact the individuals who went out on call and ask them to try to pinpoint the accident site.
- **State Aeronautics Offices**—Of the fifty states, only seven (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, Ohio, and Rhode Island) did any of their own investigating in 1992. Even among these seven, the investigations are usually quite limited and often done for a specific purpose (i.e., Massachusetts checks to make sure that the aircraft owner is insured or has sufficient net worth to cover damages).
- **Aircraft Owners and Pilots Association**—This organization relies almost entirely on the FAA and the NTSB for the information they collect and publish regarding accidents. There is no new or enhanced information available from this source.
- **Airline Pilots Association**—The union for airline pilots is involved in investigations of commercial air carrier accidents only and would be of no help in general aviation accident locations. Their reports on commercial accidents would shed no new light on location.

- **Aircraft Insurance Companies**—A check with two of the major general aviation insurance companies (USAIG and Associated Aviation Insurance) yielded little in the way of useful results. Except in cases where location is useful in assessing fault (such as defective navigational aid or cockpit instrument) specific accident location is not of interest, and therefore, not included. Even in cases where accurate site data is given, two problems arise. First, finding the cases that would be of use would require a hand search through individual accident reports. Second, it would probably be difficult to obtain permission to go through the files as the information is considered proprietary and also could expose the company to lawsuits.

The conclusion reached from the review of these alternative data sources was that each could provide some useful information, but—for the purposes of ascertaining accident location data—none would be as complete, accurate, or accessible as the NTSB Factual Reports.

Summary of Research Methodology

The task of gathering the desired data was accomplished by the University of California, Berkeley, Institute of Transportation Studies working under contract to the California Department of Transportation Division of Aeronautics. The data-gathering process evolved to some extent even after the basic approach and scope of the research were decided. Three major steps were involved, each with several components:

- **Review Briefs of All Accidents**—First, a computer listing of all aircraft accident records for the selected time period was obtained from the NTSB in *minibrief* format. Each brief was then reviewed and an assessment made as to whether its location appeared to fall within the airport-vicinity range defined for the research. This process narrowed the number of accidents fitting the defined parameters to approximately 20% of the total.
- **Review of Selected Accident Factual Records**—Next, microfiche copies of the complete Factual Record for each of the selected accidents were ordered. These records were then scanned to determine whether the necessary location information was included. Location data could be found in any of several sections of the record including the investigators notes, the pilot's statement, or statements of witnesses or emergency response personnel. Only about one record in six was determined to contain usable data.
- **Preparation of Database**—Finally, location information on each accident was entered into a computer database along with the data in the other categories which had been selected. Frequently, the Factual Records identify the accident sites with reference to local streets. In order to establish the distance of the accident site from the airport runway involved, local street maps often had to be obtained and measurements taken from them. At that time, the various other categories of data for each accident were also added to the database.

Scope of Research

Beyond the principal requirement for precise accident location data, various decisions were necessary in order to define the scope of the research effort. Some of these parameters were decided by the Division of Aeronautics and the study team at the outset of the research effort; others were modified in response to the outcome of the early phases of the process.

- **Definition of Airport Vicinity**—Although the fundamental interest of the study is on off-airport accidents, an accident occurring say 2,000 feet from the end of a runway may be within the boundaries of a large airport, but well beyond the property line of a smaller facility. Therefore, for the purposes of the analysis, *off-airport* was broadened to include any accidents not confined to the immediate vicinity of the runway (generally defined as Federal Aviation Regulations Part 77 primary surface), even if the accident site is on property actually owned by the airport. At the outer edge, a 5 mile radius—measured from the airport center in accordance with the NTSB data format—was selected as the limits of the airport vicinity. It is recognized that, at this distance from an airport, some of the accidents included may more properly be defined as en route rather than airport-related.

- **Accidents versus Incidents**—The NTSB defines an aircraft *accident* as an occurrence in which people on board or on the ground sustained serious or fatal injuries or in which the aircraft incurred substantial damage to the extent that it could no longer be considered airworthy. Other mishaps are classified as *incidents*. The NTSB and/or the FAA may conduct preliminary investigations into incidents to determine if they qualify as accidents. However, the extensive records maintained and compiled for accidents are not available for incidents. Given that the NTSB was selected as the data source for the research effort, it was necessary to exclude incidents from the database. (See Glossary for a complete definition of *aircraft accident*.)
- **Aircraft Types**—Initially, all categories of civilian-use airplanes—airline and general aviation—were to be included in the database. Very few airline aircraft accident records were actually found, however. These were eliminated from the completed database because of the statistical bias they could give to some of the data (especially with regard to the number of injuries). Helicopters and other types of aircraft are omitted because of their markedly different operational characteristics. Accidents involving military and other government aircraft are not investigated by the NTSB and therefore are excluded from the database as well.
- **Data Categories**—Although the data of central interest to the research effort was the accident location information, other categories of data also were determined to be important to the subsequent analysis of the accidents' geographic distribution pattern. Many of the data categories selected for inclusion in the database were chosen with the thought that they might prove to be significant variables affecting where accidents occur. A complete list of the categories included in the database is included in Exhibit E-1. A description of each category and the manner in which the data was obtained or determined is noted as well.
- **Time Frame Covered**—The time period to be included within the research effort was at first planned to cover a minimum of 10 years, beginning with 1980 and extending to the then most recently available data. However, the format of the NTSB's computer records essential to the initial step of the investigation was changed in 1983 and the earlier format was found to be less readily usable for the purposes of the project. The database was therefore extended to cover the 10-year period from 1983 through 1992.
- **States Included**—To enable statistically significant analysis of various subsets of accident points, a target of 500 accident records was set as the goal for the initial database development in 1993. It was anticipated that a database of this size could be obtained by review of accidents from just the 4 to 8 *sunbelt* states which generate the highest volumes of aircraft operations. However, a trial run of the process found a high rate of records which do not contain sufficiently accurate locational data. This factor necessitated extending the research scope to include all 50 states. Time and budgetary limitations, however, prevented completion of the research. The original 1993 *Handbook* database thus included records for 11 states for the years 1983–1989, while records for the other 39 states were searched only for the years 1983–1985. In the subsequent research completed in 1998, the remaining records were examined for all 50 states over the full 10-year period. The expanded database now contains records from 43 states.
- **Total Records**—The original database included a total of 400 records including records from 190 arrival accidents and 210 departure accidents. As used for the analyses presented in this *Handbook*, the expanded database contains 873 records, 445 for arrival accidents and 428 for departure accidents.

File Data

- ➤ Date
- ➤ NTSB File Number
- ➤ Airport Name
- ➤ Airport Identifier
- ➤ City
  Associated city of airport involved.
- ➤ State

Aircraft

- ➤ Manufacturer
- ➤ Model
- ➤ Weight (Maximum Gross Takeoff Weight)
  Obtained from Janes Aircraft or other sources.
- ➤ Number of Engines
- ➤ Engine Type
- ➤ Registration Number

Flight Information

- ➤ Phase of Flight (Arrival/Departure)
  An arrival becomes a departure when:
  - ■ A missed approach is executed during an instrument approach.
  - ■ The aircraft leaves the ground on a touch-and-go.
  - ■ The pilot aborts a VFR approach while under control.

  A departure becomes an arrival when:
  - ■ The aircraft is established downwind on a touch-and-go.
  - ■ The aircraft is under control and established inbound on a return to the airfield, whether in an emergency or otherwise.
- ➤ Arrival/Departure Notes
- ➤ Takeoff Roll Start
  Point where takeoff roll began if not at end of runway.
- ➤ Approach Type (VFR/IFR)
  Flight rules category being followed at time of accident.
- ➤ Time of Day

Airport Conditions

- ➤ Weather
  Weather conditions at time of accident.
- ➤ VMC/IMC
  Whether visual meteorological conditions or instrument meteorological conditions existed.
- ➤ Light (Day/Dusk/Night)

Runway Information

- ➤ Runway Number
  Duty runway used or intended to be used.
- ➤ Runway Type
  Pavement type: asphalt, concrete, gravel, coral, grass, dirt
- ➤ Runway Heading
  Magnetic bearing of duty runway.
- ➤ Runway Length
- ➤ Runway Width
- ➤ Available Instrument Approach Procedures
  Available instrument approach procedures, regardless of approach type in use during accident.

EXHIBIT E-1

Database Fields

- Pattern Direction (Left/Right)
  As indicated in flight guides, not necessarily what the aircraft involved in the accident was intending to fly.
- FAA Tower
  Whether airport had an air traffic control tower

Accident Location

- Relative Bearing
  Accident site relative bearing from arrival/departure threshold
- X Coordinate Distance
  Distance left (ñ) or right (+) of runway centerline to initial point of ground or object contact.
- Y Coordinate Distance
  For arrivals: distance from landing threshold to initial point of ground or object contact.
  (-) if site is prior to threshold; (+) if beyond landing threshold.
  For departures: distance from start of takeoff roll to initial point of ground contact.
- Distance from Departure End of Runway
  For departures only: distance along runway centerline from departure (climb-out) end of runway to initial point of ground or object contact (Y Coordinate Distance minus Runway Length).

Accident Characteristics

- Pilot Control (Some/None)
  A somewhat subjective assessment of whether the pilot had some or no control over the path of the aircraft at the time of descent.
  Some control is judged to have occurred when the pilot materially and successfully affected the location of ground contact. For example, the pilot may have stated in record that he saw a spot for a forced landing and put down in that spot.
  No control of the aircraft is assumed to have existed if, for example:
  - The aircraft is observed descending in a near vertical spin.
  - The accident investigation determines that the aircraft was out of control when it crashed.
  - The aircraft was on an instrument approach, unless there is evidence that the aircraft broke free of the clouds or fog and the pilot intentionally put down in a particular location.
- Swath Length
  Distance from initial point of contact with the ground or an object on the ground to the point where the aircraft came to a stop.
- Swath Bearing
- In-Flight Collision with Object (Yes/No)
  Indicates whether the aircraft struck an object on the ground while still in flight.
- Collision Factor
  Indicates whether the collision affected where the aircraft ultimately crashed.

On-Board Injuries

- Number of Fatal Injuries
- Number of Serious Injuries
- Number of Minor Injuries

On-Ground Injuries

- Number of Fatal Injuries
- Number of Serious Injuries
- Number of Minor Injuries

Damage

- To Aircraft (Destroyed/Substantial)
- On Ground
  Obstructs struck and extent of damage.

Other

- Notes
  Miscellaneous pertinent information not included in other categories

EXHIBIT E-1 *CONTINUED*

General Aviation Aircraft Accident Location Patterns

The diagrams on the following pages illustrate the location patterns of various subsets of data contained in the Division of Aeronautics general aviation aircraft accident database. The complete database includes a total of 873 accident location points.

- Exhibit F-1 Arrival Accidents
- Exhibit F-2 Departure Accidents
- Exhibit F-3 Departure Accidents, Normalized
- Exhibit F-4 Accidents on Runways of Less than 4,000 Feet
- Exhibit F-5 Accidents on Runways of 4,000 to 5,999 Feet
- Exhibit F-6 Accidents on Runways of 6,000 Feet or More
- Exhibit F-7 Single-Engine Aircraft Accidents
- Exhibit F-8 Multi-Engine Aircraft Accidents
- Exhibit F-9 Accidents with Some Pilot Control
- Exhibit F-10 Accidents with No Pilot Control
- Exhibit F-11 IFR Accidents
- Exhibit F-12 VFR Accidents
- Exhibit F-13 Daytime Accidents
- Exhibit F-14 Nighttime Accidents
- Exhibit F-15 Accidents on Runways with Left-Hand Traffic Pattern

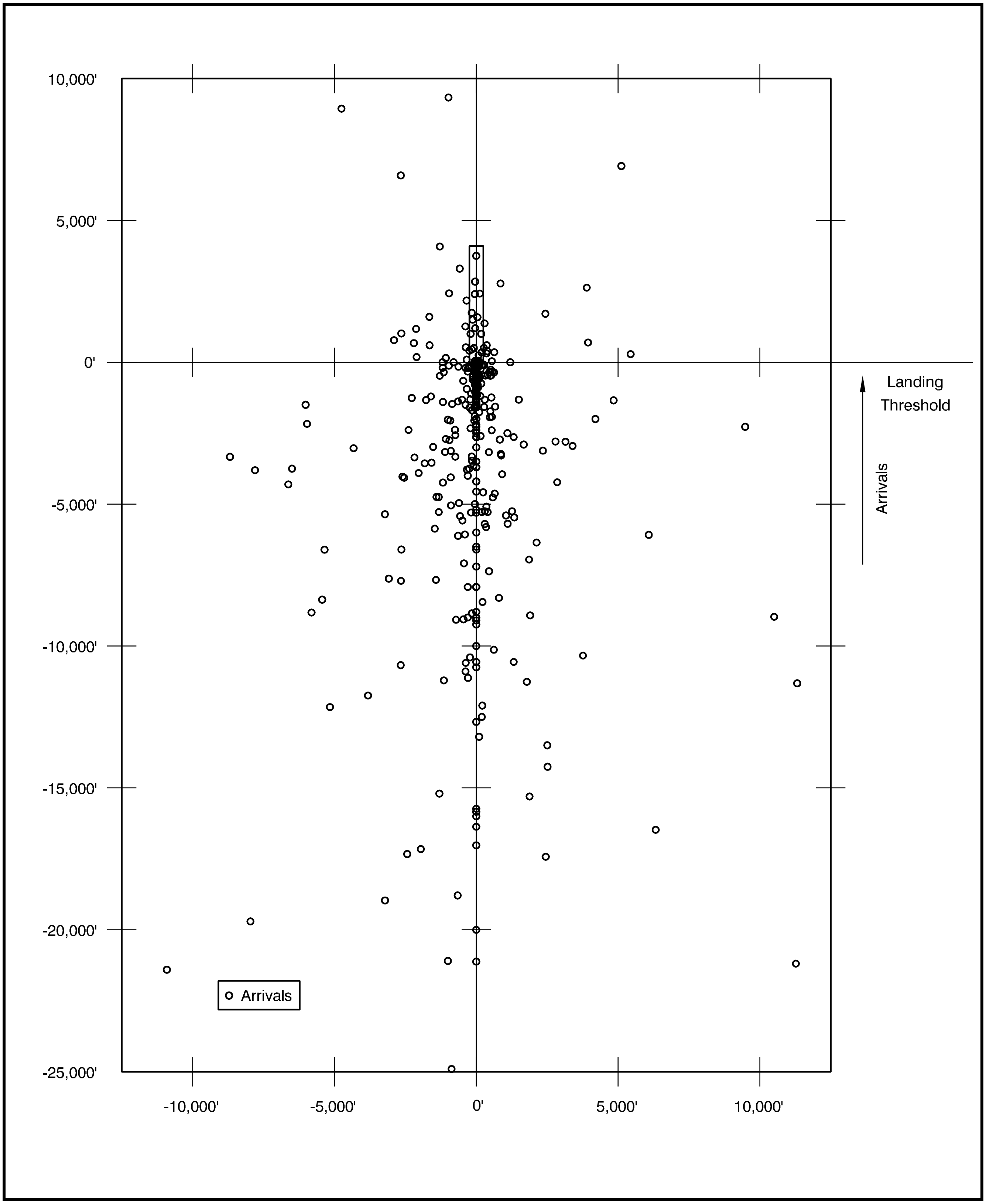


EXHIBIT F-1

Arrival Accidents

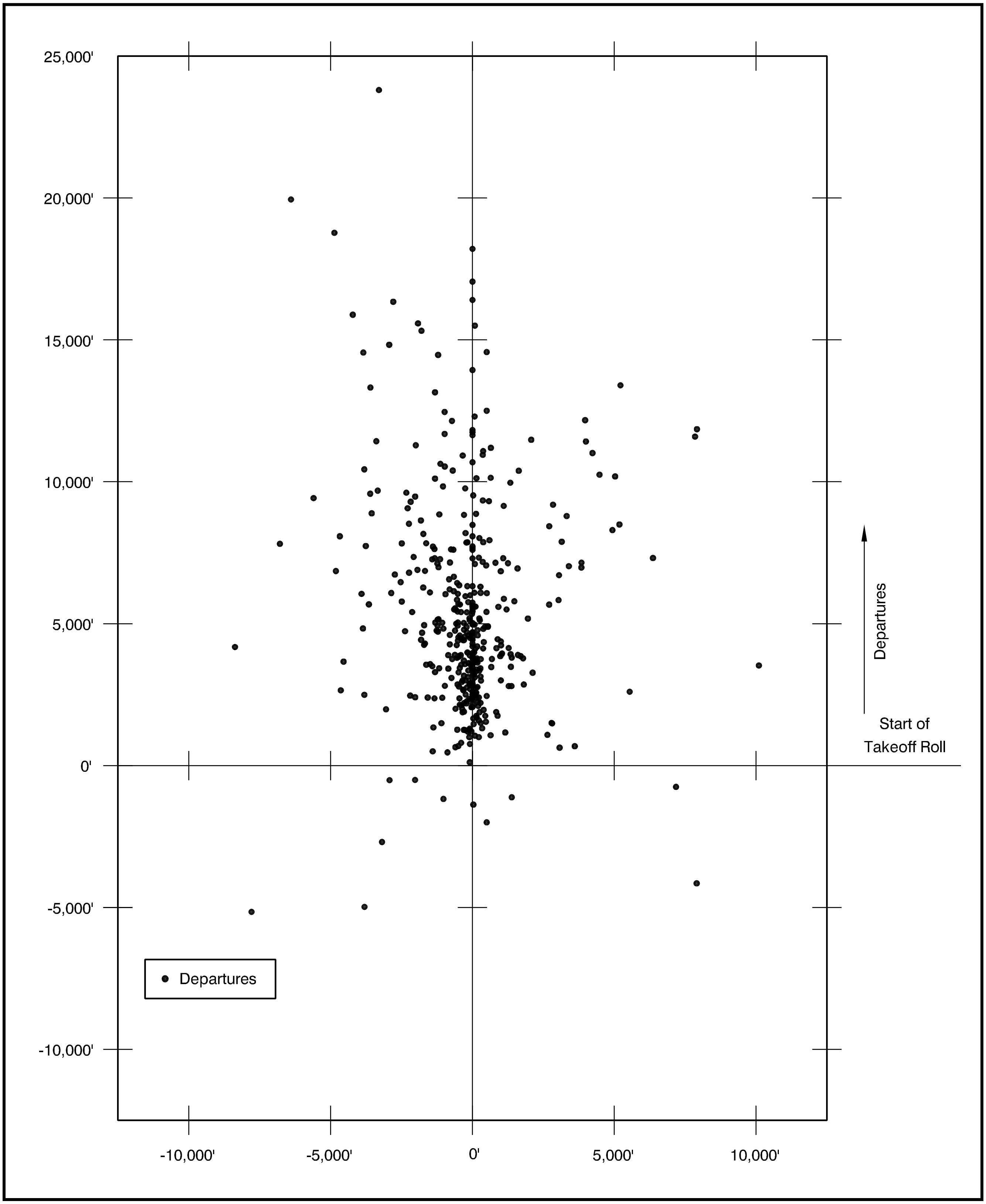


EXHIBIT F-2

Departure Accidents

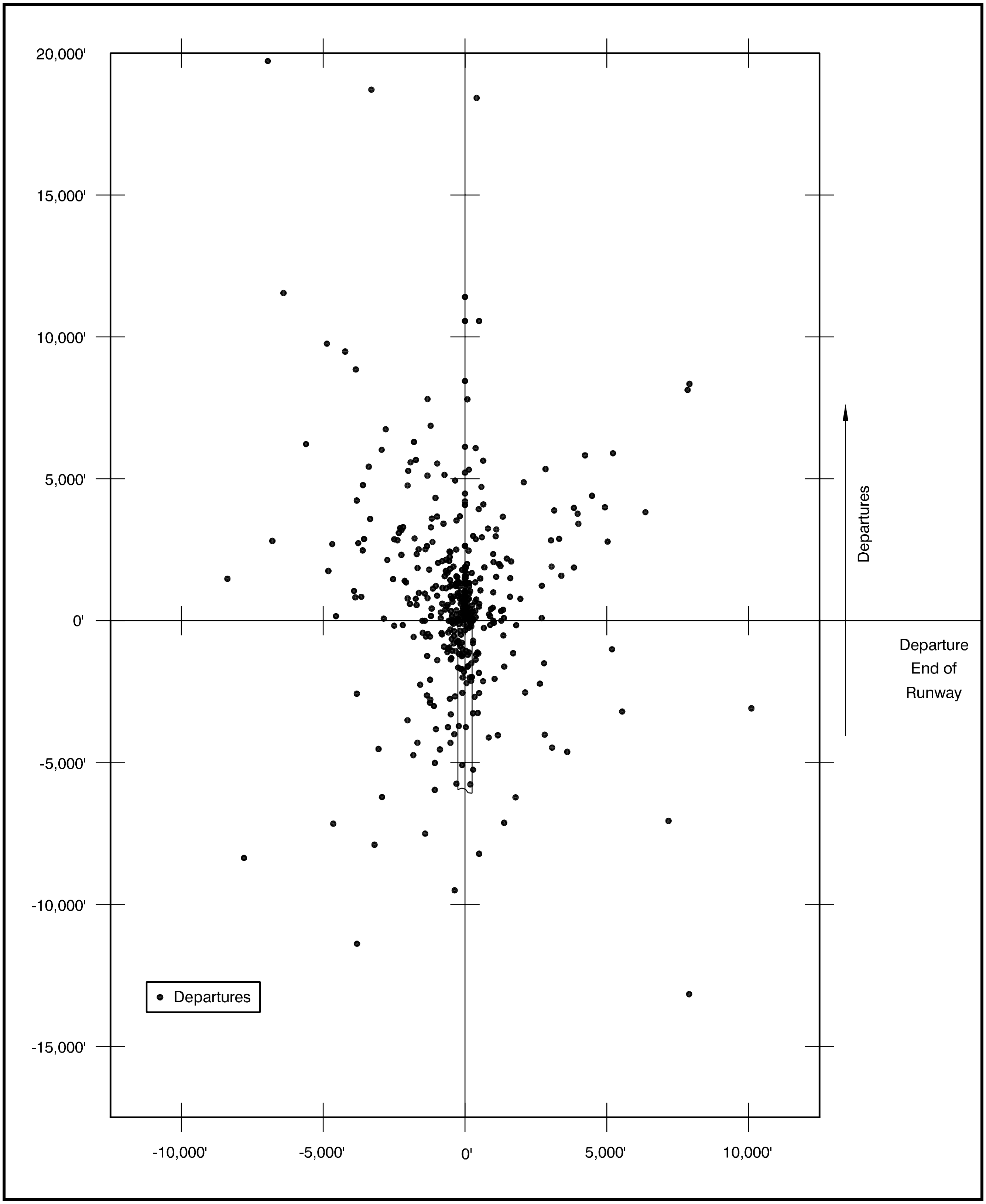


EXHIBIT F-3

Departure Accidents, Normalized

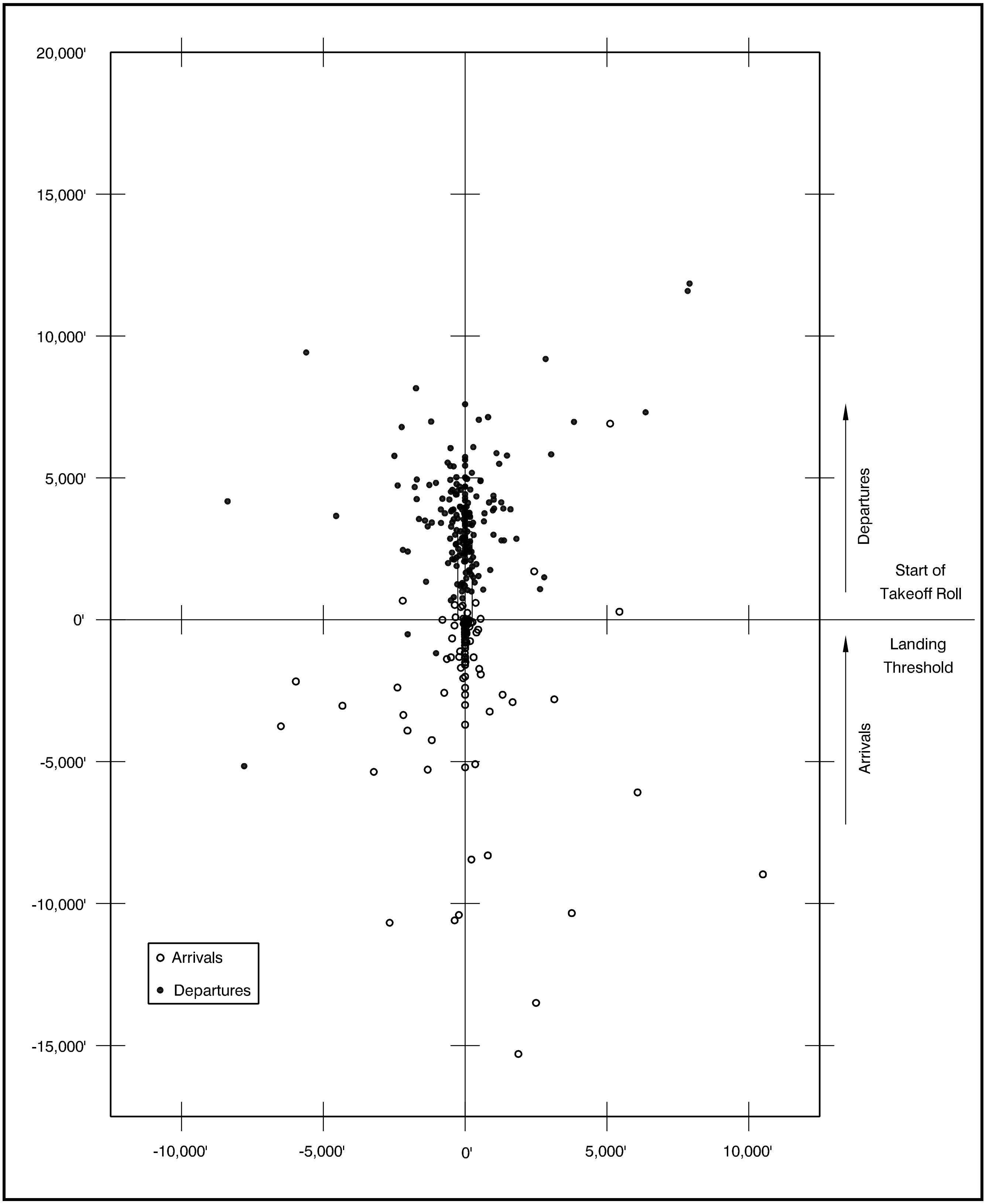


EXHIBIT F-4

Accidents on Runways of Less than 4,000 Feet

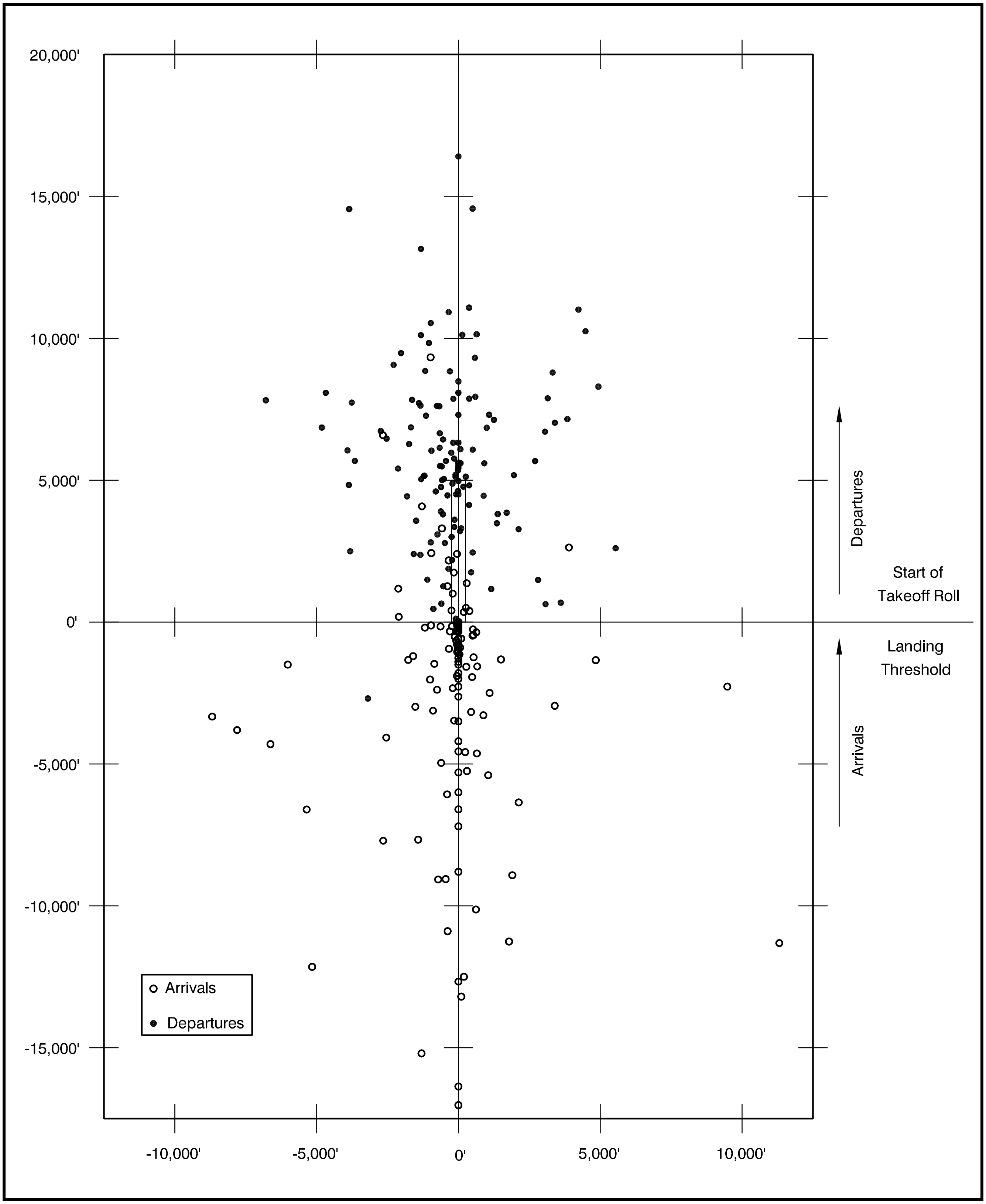


EXHIBIT F-5

Accidents on Runways of 4,000 to 5,999 Feet

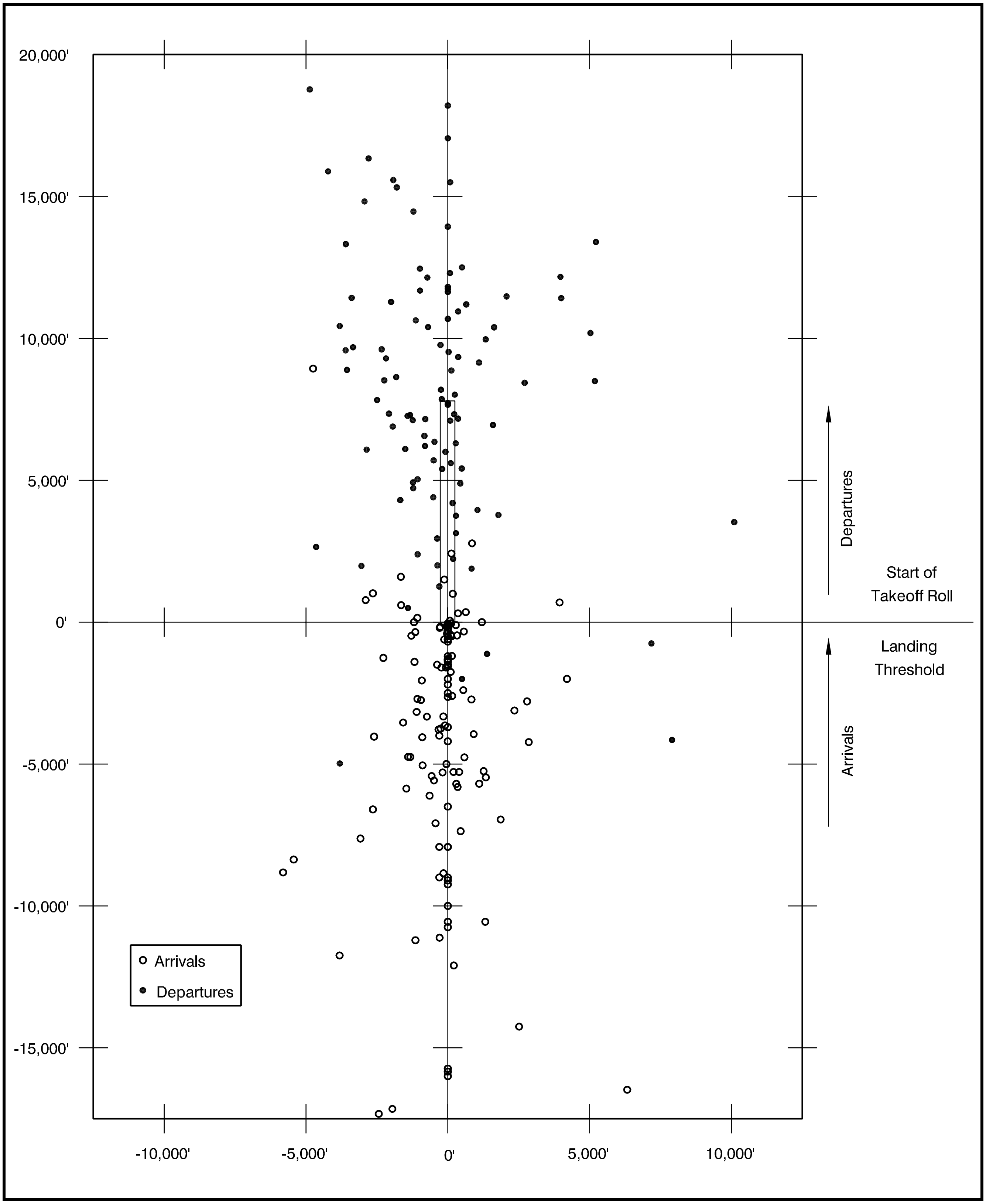


EXHIBIT F-6

Accidents on Runways of 6,000 Feet or More

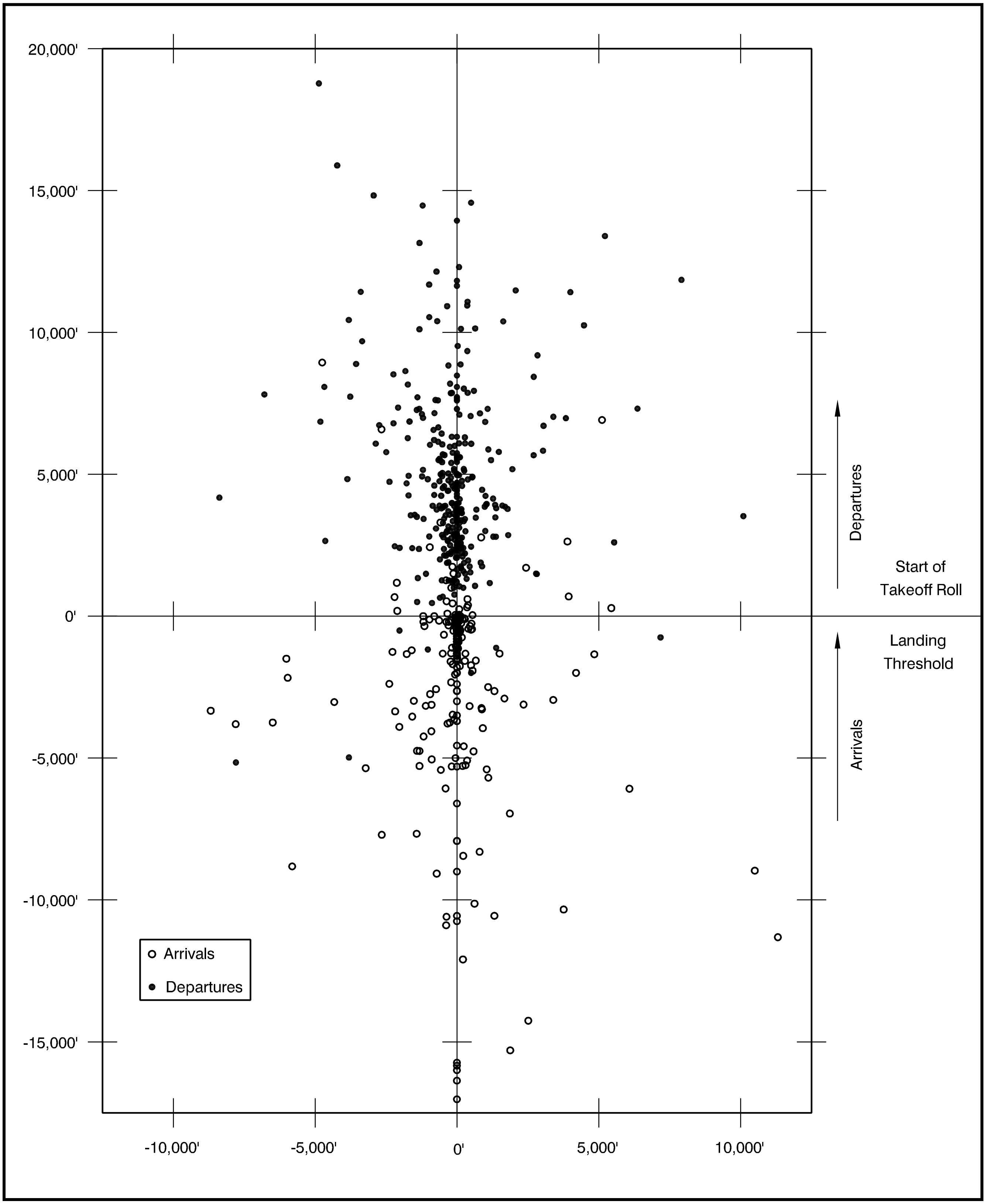


EXHIBIT F-7

Single-Engine Aircraft Accidents

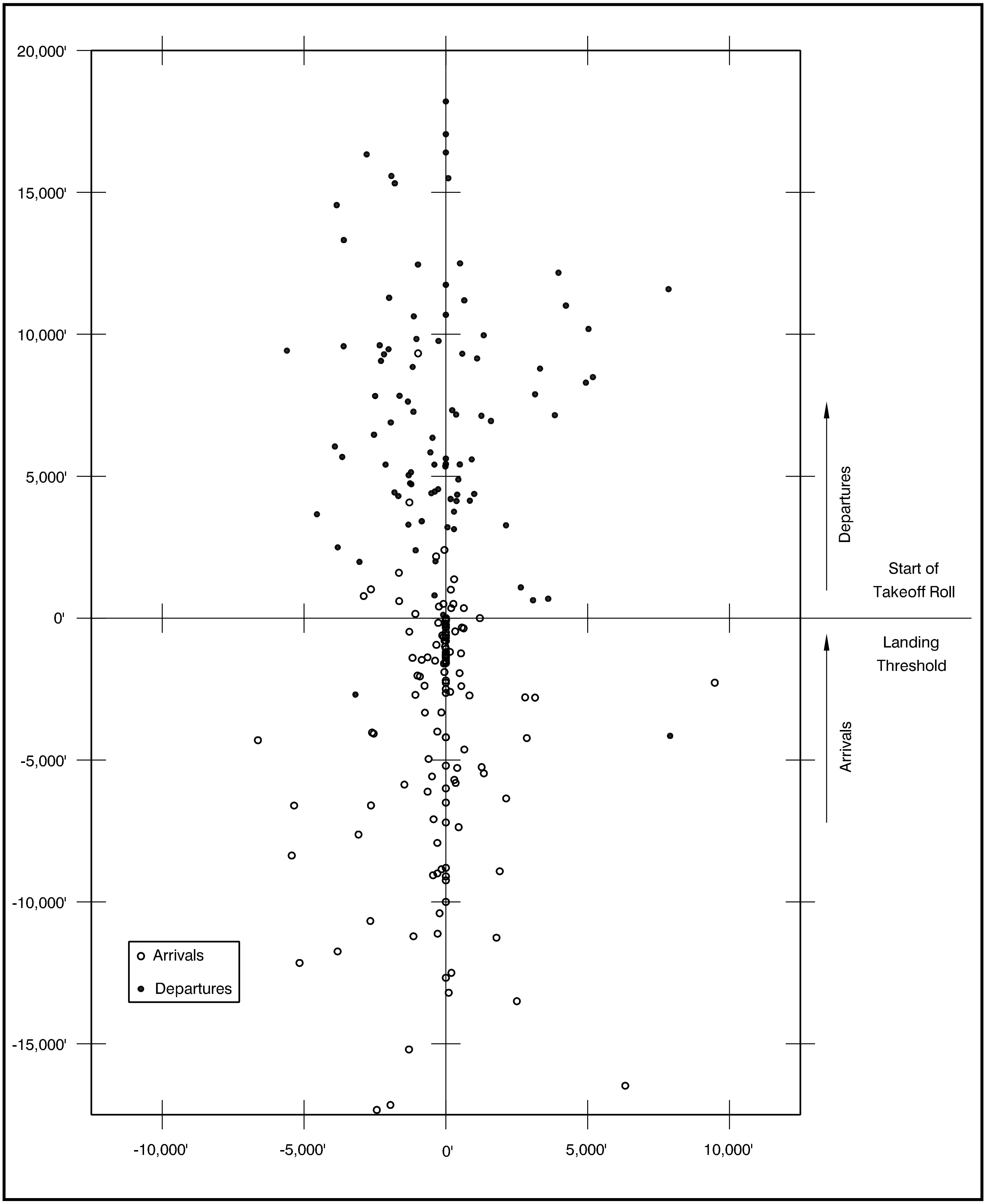


EXHIBIT F-8

Multi-Engine Aircraft Accidents

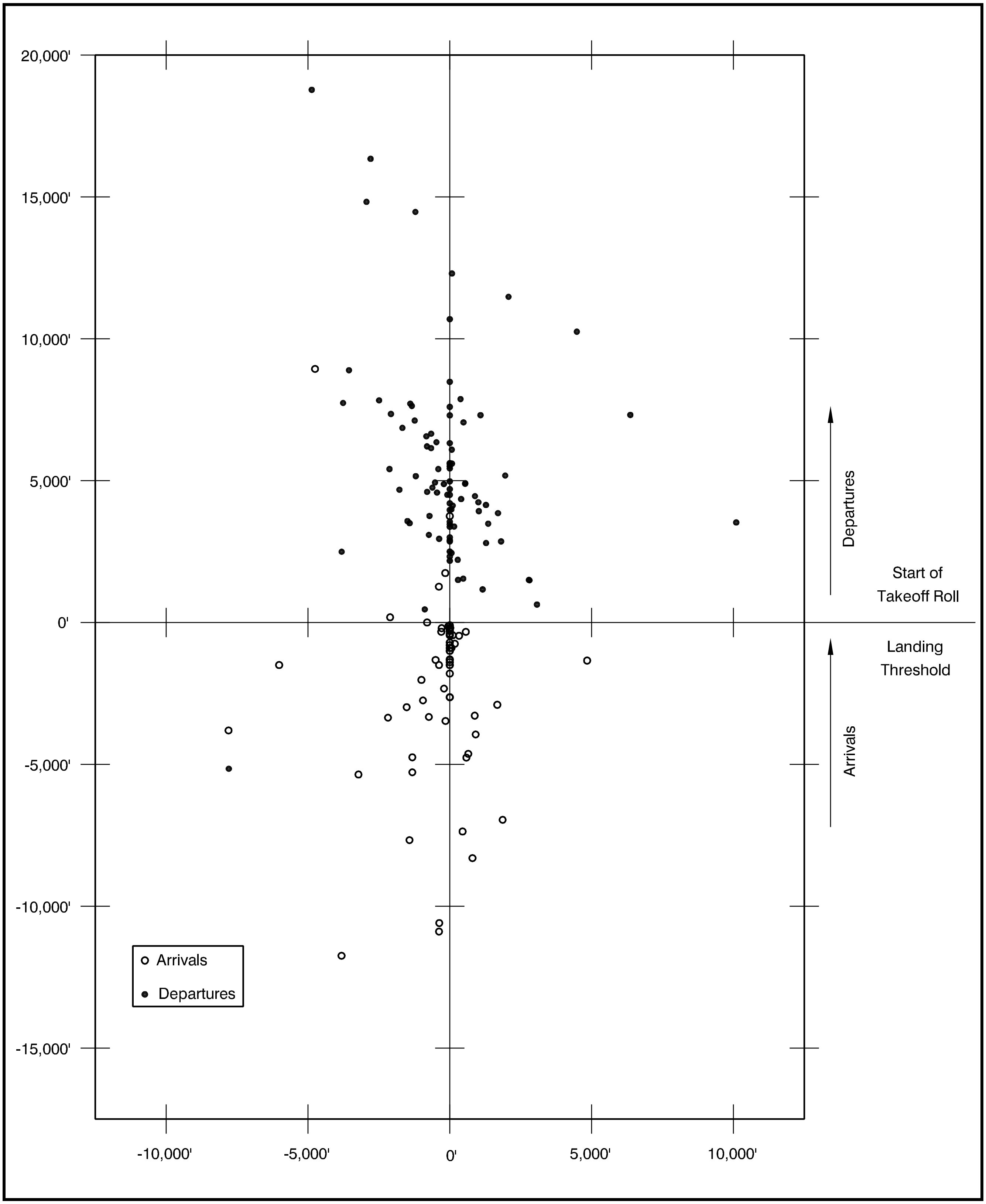


EXHIBIT F-9

Accidents with Some Pilot Control

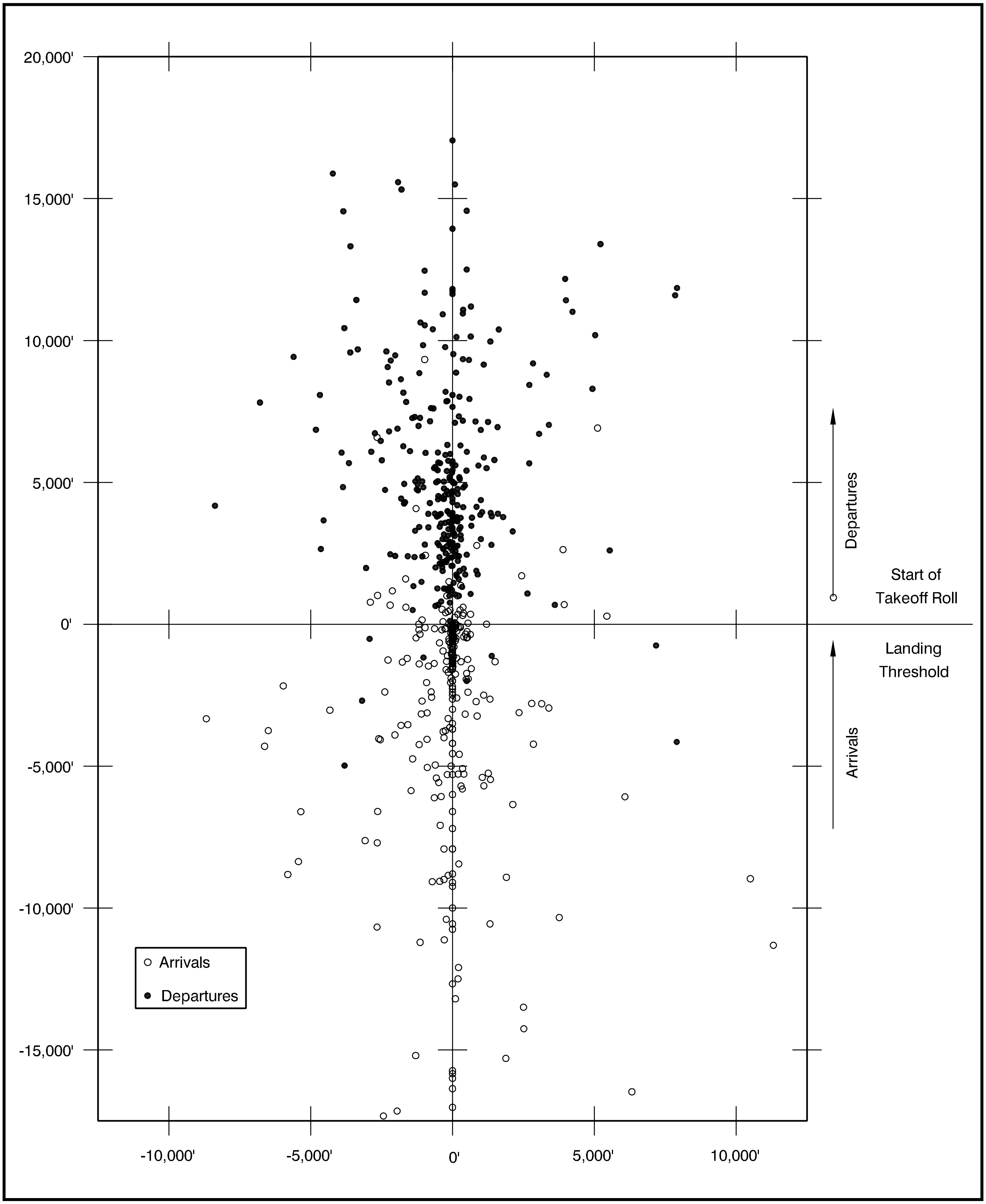


EXHIBIT F-10

Accidents with No Pilot Control

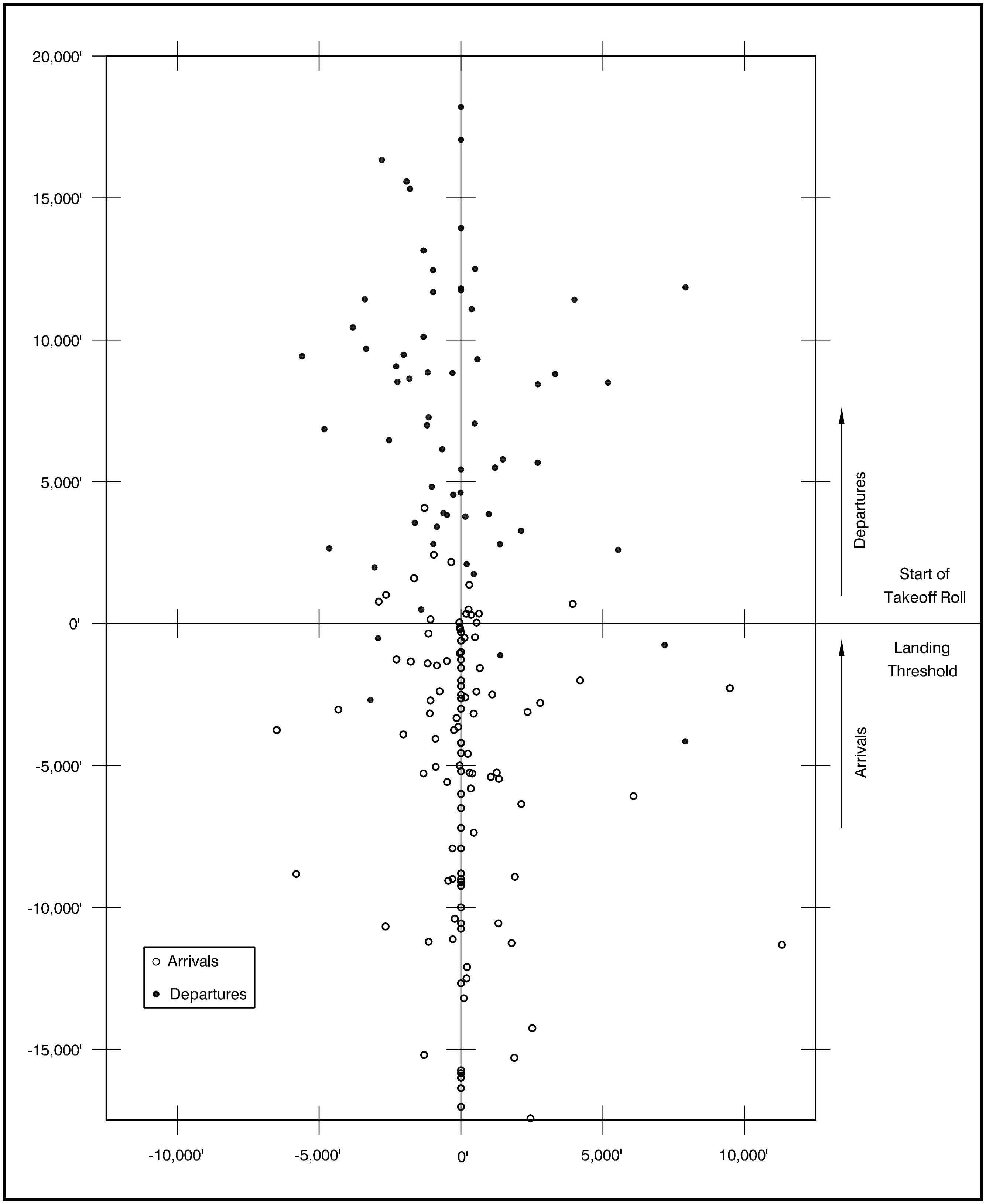


EXHIBIT F-11

IFR Accidents

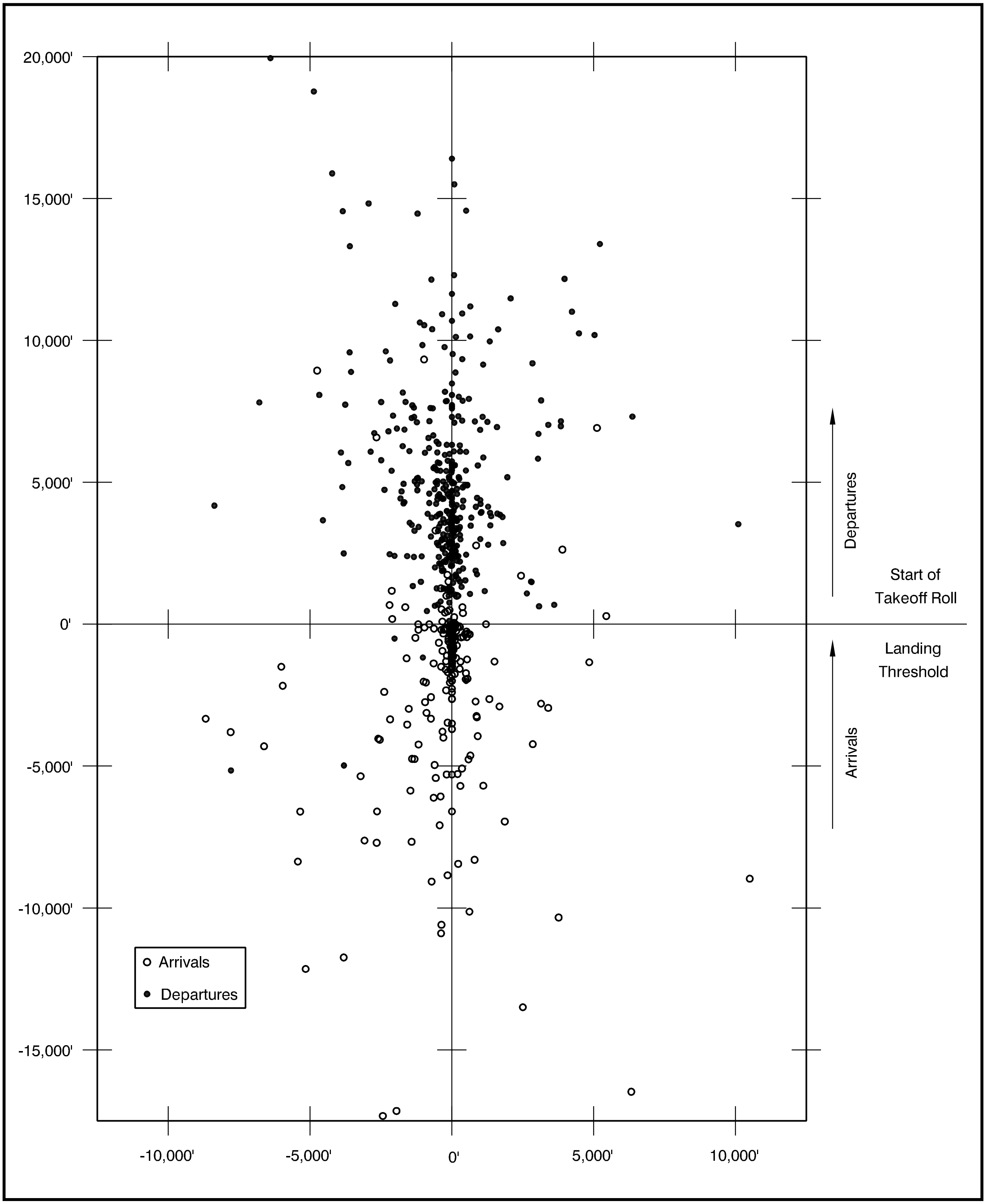


EXHIBIT F-12

VFR Accidents

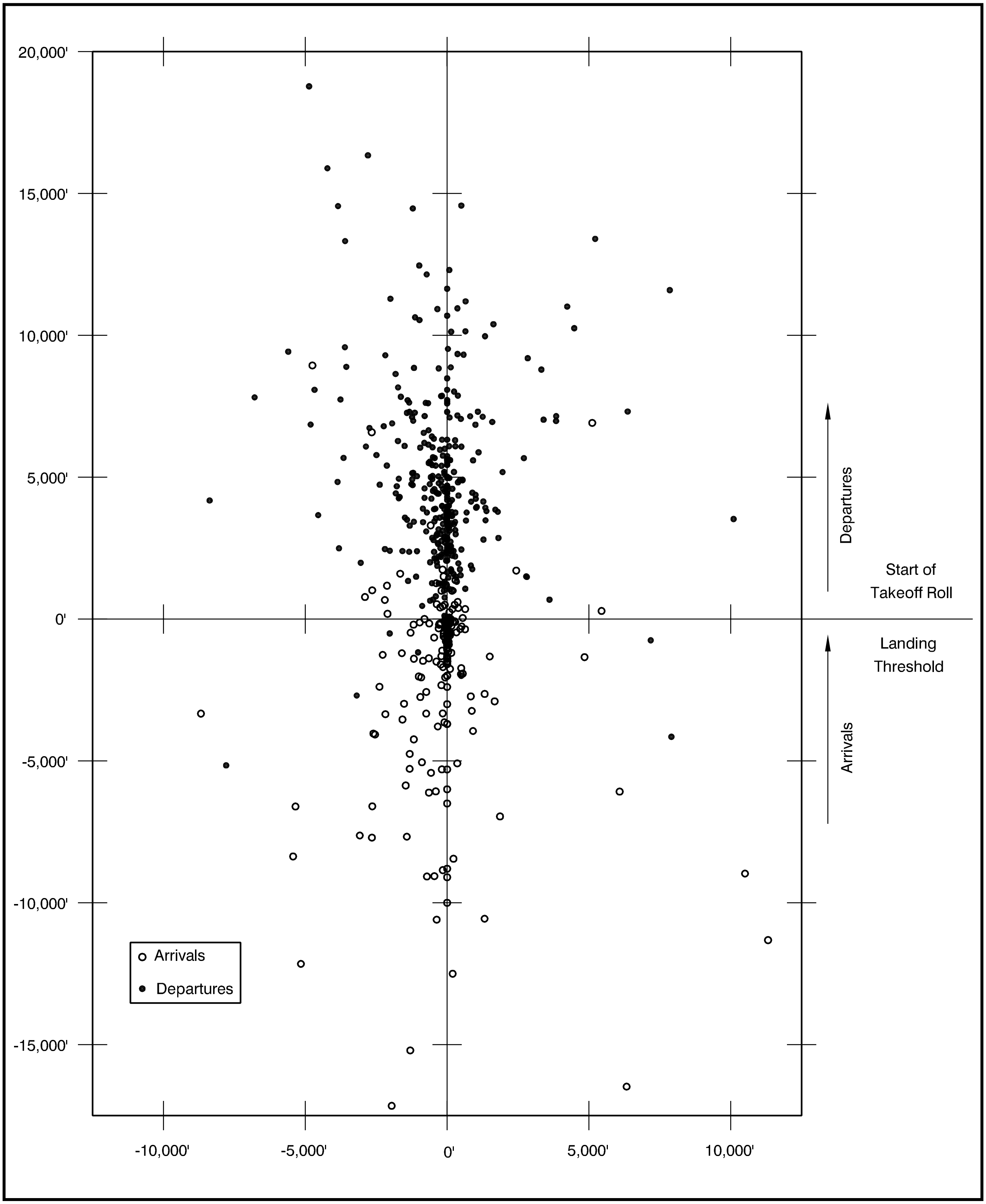


EXHIBIT F-13

Daytime Accidents

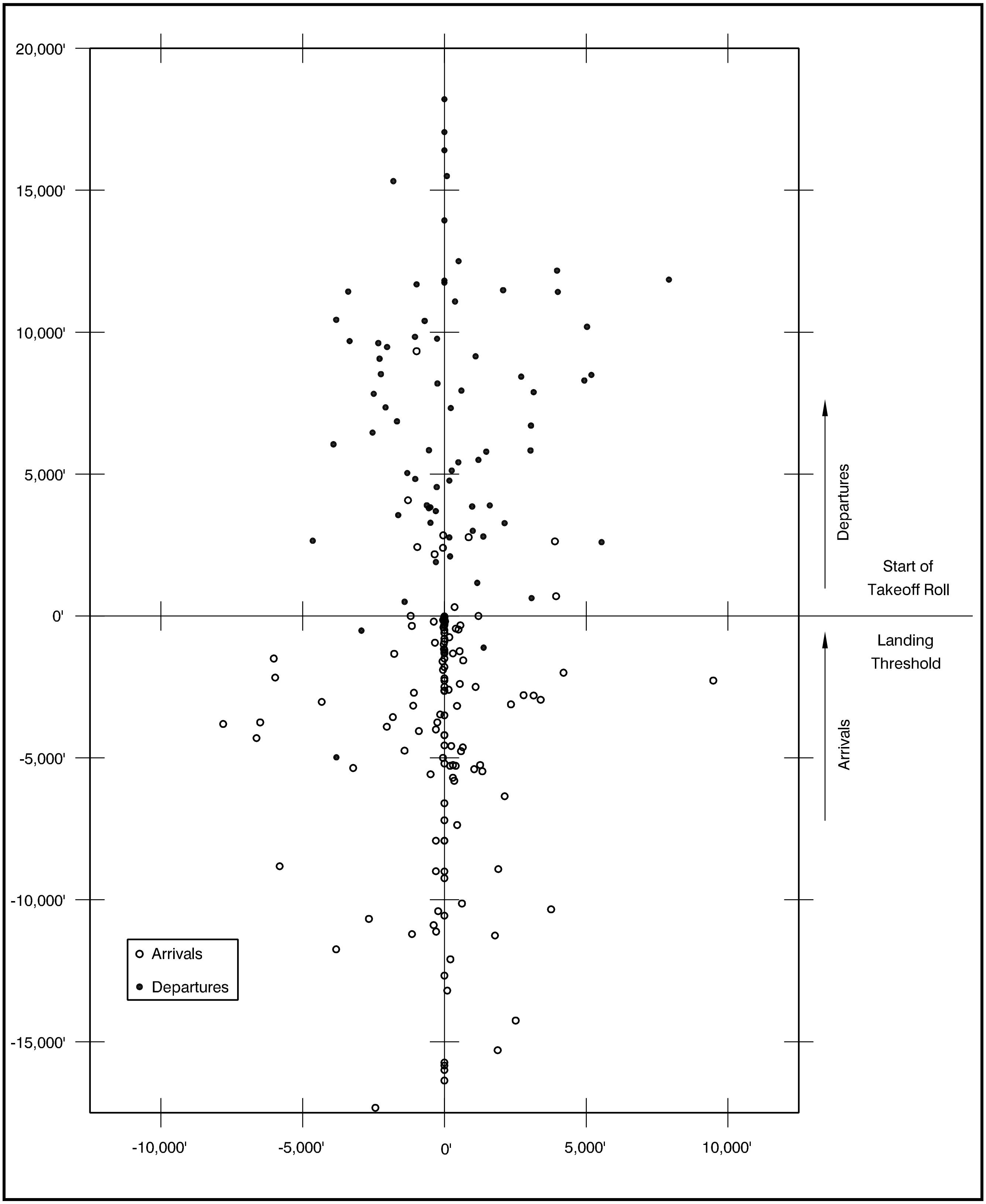


EXHIBIT F-14

Nighttime Accidents

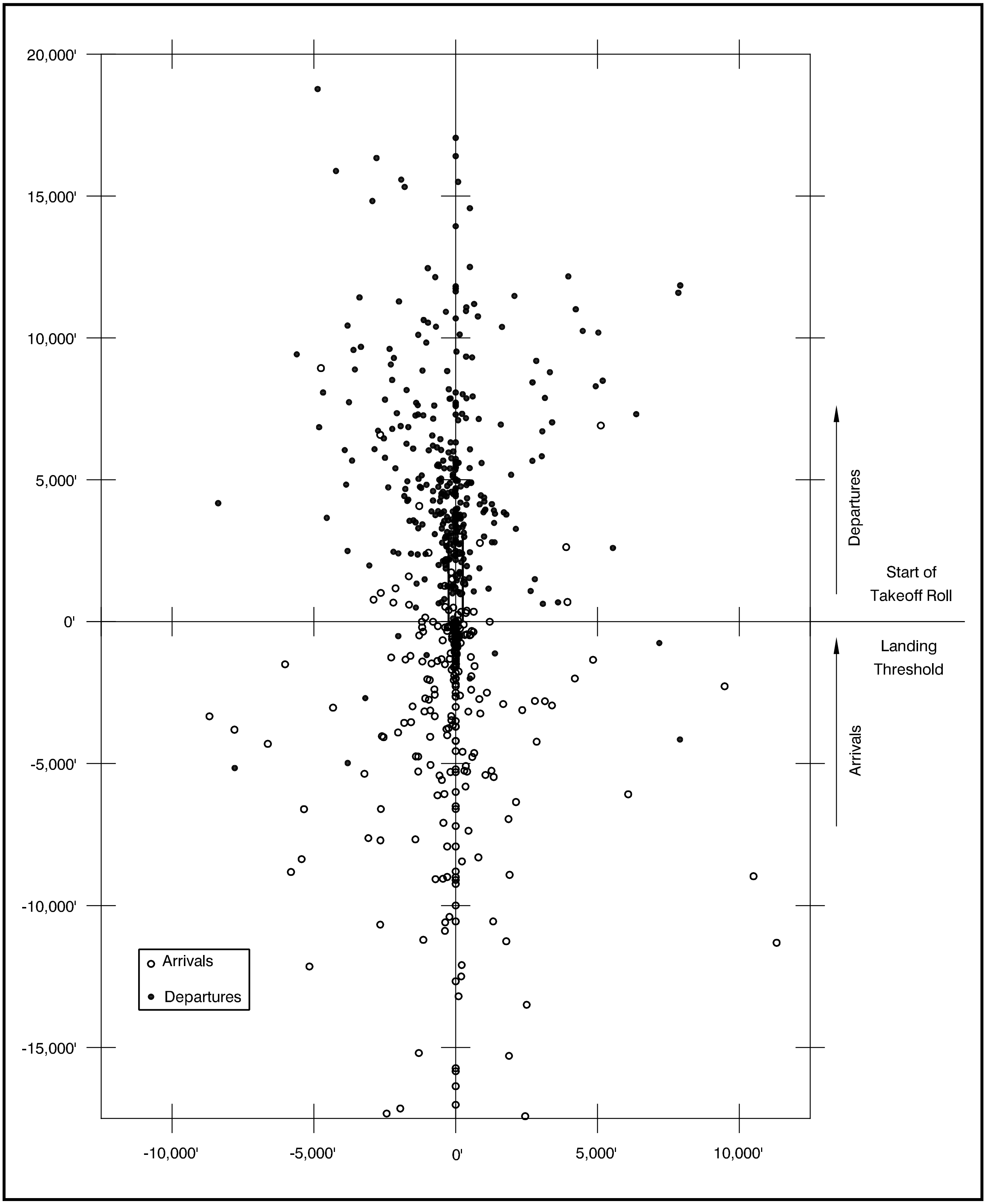


EXHIBIT F-15

Accidents on Runways with Left-Hand Traffic Pattern

APPENDIX **G**

Comparison Between 1993 and 2002 Safety Compatibility Zone Examples

Overview

The 1993 edition of this *Handbook* featured a diagram (Figure 9G) depicting examples of safety zone configurations for general aviation runways. The examples of safety compatibility zones depicted in Figure 9K of the current volume represent a refinement of that earlier work. Because of this relationship, the description of the analyses supporting the original delineation of safety zones is not repeated in the body of the present *Handbook* edition. For continuity, however, the 1993 analyses are summarized in the first part of this appendix.

Runway length was the only identified variable among the three general aviation runway safety zone configuration examples illustrated in the 1993 *Handbook*. Figure 9K of the current edition both notes the additional assumptions associated with the original three examples and adds three new examples in which other variables are taken into account. Figure 9L illustrates basic safety zones for runways at large air carrier airports and military airports. In the three examples brought forward from the 1993 *Handbook*, slight modifications have been made to the original configurations. These differences are summarized in the second section of this appendix.

Previous Safety Compatibility Zones Analysis

The safety compatibility zone examples presented in Figure 9G of the 1993 *Handbook* were created through analysis of the general aviation aircraft accident location data gathered for that purpose. The following steps were involved:

- Several basic geometric shapes potentially applicable to use as safety zones were identified;
- The efficiency of the various shapes in capturing the greatest number of accident location data points in the smallest area was assessed;
- Particular sizes at which one shape zone becomes more efficient than another were identified; and
- Shapes and dimensions for an overall set of safety zones were established.

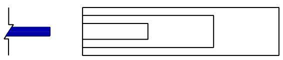
Basic Safety Zone Shapes and Sizes

To develop geometrically shaped safety compatibility zones which better reflect the geographic pattern of aircraft accidents, both the shapes and sizes of the zones must be decided. The approach used in making this decision was to compare, over a range of sizes, the relative efficiency of various safety zone shapes in capturing the most accident sites within the same amount of area. This mea sure is referred to here as the capture rate.

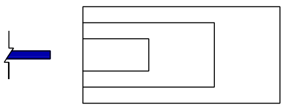
For the purposes of this analysis, six different safety zone shapes were examined as depicted on the next page. Three of the shapes are rectangles with varying aspect (length to width) ratios; one is a trapezoid; and two are fan-shaped sectors of a circle centered on the runway end.

The comparative capture rates of these alternative shapes is graphed in Exhibits G–1 through G–4. This analysis used the accident-site data obtained from the 1993 *Handbook* database. The 1993 database contained information of 400 accidents.

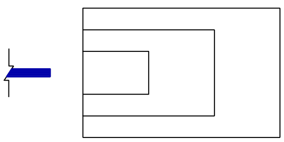
Basic Safety Zone Shapes



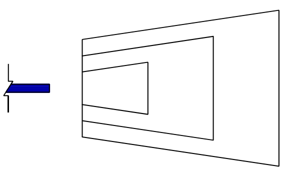
4:1 Rectangles



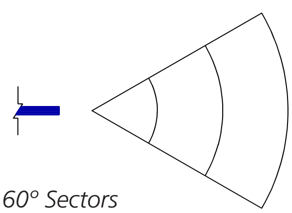
2:1 Rectangles



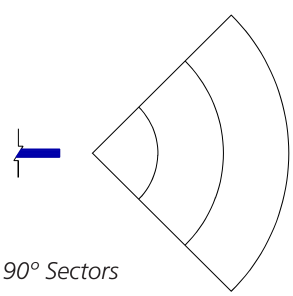
3:2 Rectangles



2:1:1.6 Trapezoids



60° Sectors



90° Sectors

Data on arrival accidents is graphed in the first two figures; departure accident data in the second pair. The departure accident site data is graphed based upon distances normalized for the length of the runway — that is, acreage and distance are plotted with respect to the departure (climb-out) end of the runway. Within each pair of figures, the first examines a large area encompassing 1,200 acres and extending 2 to 3 miles from the runway ends. The second graph in each set focuses on the 100 acres closest to the runway ends.

Several observations can be made from a review of the graphs:

- The optimum safety zone shape for capturing arrival accident sites is not necessarily the best shape for en compassing departure accident sites, and vice versa.
- The most efficient shapes for the area closest to a runway end generally do not have the greatest capture rates over a more extended area.
- For close-in arrival accident sites, the two fan-shaped sectors capture the most points per acre. These shapes also do well for close-in departure accidents sites, although other shapes are generally equivalent.
- Over larger acreages, the sector shapes and the narrow rectangle have slightly better capture rates for arrival accident sites, but the wide rectangles and the trapezoid shape do better for departures.

Overall Set of Safety Zones

A basic objective to be kept in mind when defining safety zones is that the degree of risk represented by each zone should be relatively equal throughout that zone. From the above conclusions, as well as simple examination of the accident location pattern diagrams, it is evident that no single safety zone can meet this objective if a substantial portion of the accident sites are to be encompassed. A set of zones having different shapes and sizes is needed.

Deciding where to draw the zone boundaries would be easy if the accident distribution pattern changed in distinct increments relative to the airport runway. As with noise levels, though, accident site concentrations diminish in a more-or-less-continuous gradient with increased distance from the runway.

Given this reality, the capture rate graphs were reviewed to look for places where relatively sharp changes in the distribution patterns are apparent. Where a curve is steep, relatively small increments of acreage significantly increase the percentage of accident sites encompassed. On the other hand, the flatter sections indicate that large amounts of acreage would have to be added to the size of a safety zone in order to gain a few more percentage points on the vertical scale. The most distinguishable breaks in the slope of the curve occur at three points:

- Within the first 20 to 25 acres, all of the curves are steep. This area (about 650-by-1,300 to 750-by-1,500 feet at an aspect ratio of 2:1) is roughly that of a runway protection zone for a visual or non-precision instrument runway with approach visibility minimums of 1 mile or more.
- At about 100 acres the curves begin to flatten.
- In the 100-to-300-acre range, the slopes of the curves become even more shallow.
- Finally, at about 500 to 600 acres, the curves become quite flat. Even in this large acreage range, it should be noted that only some 60% of the arrival accident sites and 50% of the departure accidents

sites occurring within 5 miles of the runway are encompassed. This is reflected in the accident location pattern diagrams (see Appendix F) which show numerous accident sites throughout the runway environs. Also, accident sites adjacent to the runway and in areas lateral to the runway end are not contained within any of the safety zone shapes evaluated here.

Next, a complete set of safety zones and possible dimensions for each zone were postulated. A decision was made to hold the number of zones to no more than six. The accident location diagrams, the capture rate curves described above, and typical zones adopted by various ALUCs were used as guidance. The percentage of accident sites in each zone was then counted from the database and the capture rate was computed. Finally, the dimensions were adjusted in an effort to obtain a reasonable balance between the percentage of points falling within each zone and the zone's capture rate. One exception was the runway protection zone (RPZ) size which was fixed at standard FAA dimensions. These calculations were done for three different subsets of the database: accidents associated with runways less than 4,000 feet long; those for runways 4,000 to 5,999 feet in length; and ones involving runways of 6,000 feet length or greater. For the purposes of the RPZ sizes, runways in the short-length group were assumed to have a visual approach; those in the mid-length group to have a nonprecision approach; and runways in the longest range to have a precision approach.

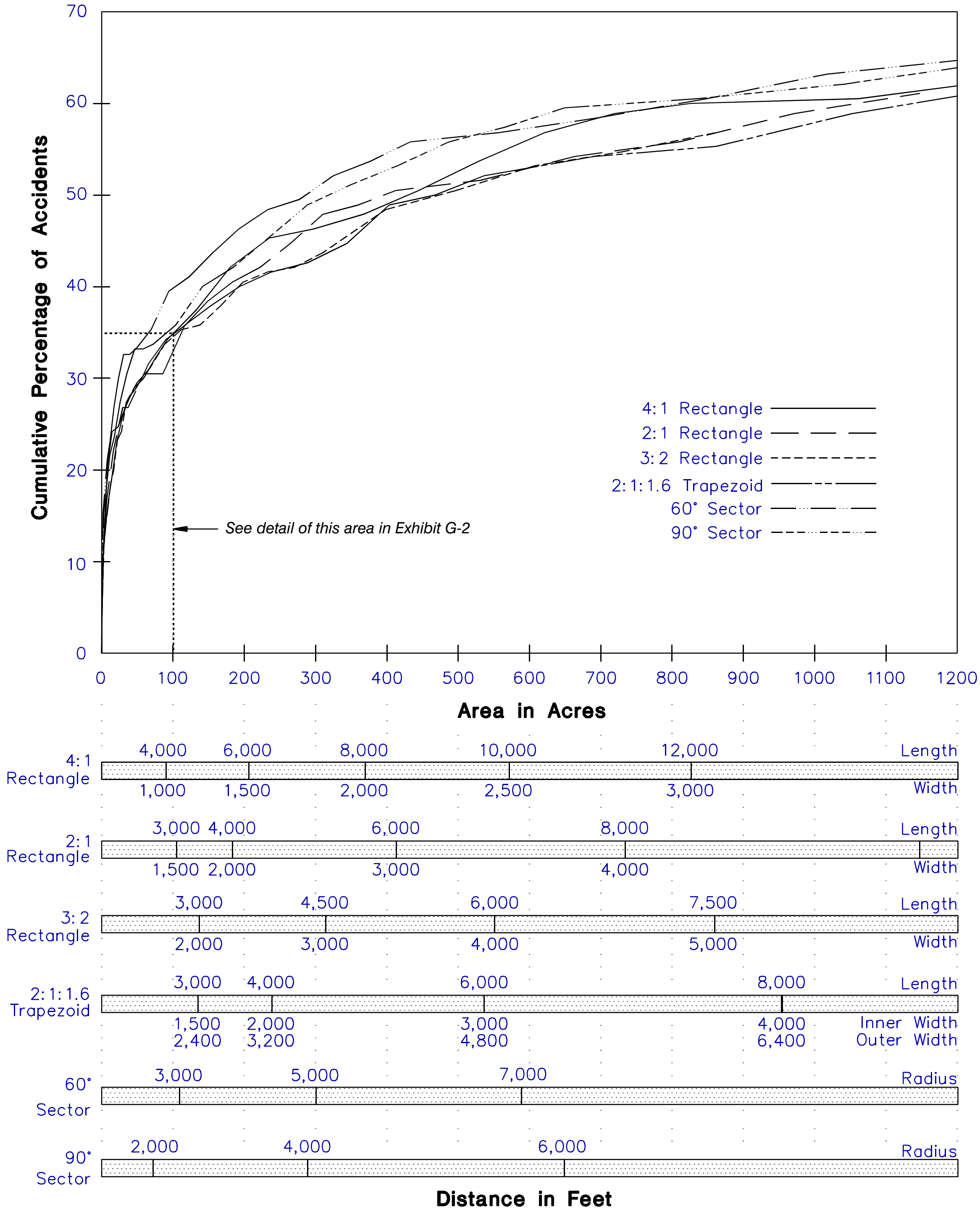
DIFFERENCES BETWEEN OLD AND NEW SAFETY ZONE EXAMPLES

An important caveat included with the previous analysis was that the safety zone shapes and sizes as shown were presented only to illustrate the way in which the accident data could be used to create a set of safety compatibility zones. The results were derived in a purely mathematical manner. The only variables considered were runway length and, with respect to RPZs, the type of approach. The expectation was that the results would serve only as a starting point for ALUCs to use in delineating safety compatibility zones for a particular runway. The examples indicated in Figure 9G of the 1993 *Handbook* explicitly were not intended to represent Division of Aeronautics recommendations. However, passage of the 1994 legislation requiring ALUCs to be "guided by" the *Handbook* when preparing compatibility plans gave new meaning to the previous Figure 9G. The depicted example sometimes became a convenient end product with little consideration given to conditions present at a specific airport or to the relationship between the geometry of safety zones and the land use criteria applicable within them.

Given this status, the safety zone configuration examples from the 1993 *Handbook* were reexamined as part of the analysis for this present edition. The major objectives of this effort were to expand upon the range of examples provided and to more clearly indicate the assumptions associated with each example. Additionally, various factors are identified which can and typically should be used to adjust the basic zones and/or criteria. The purpose of these changes is to emphasize that, rather than simply selecting a predefined set of compatibility zones from the *Handbook*, airport land use commissions are expected to evaluate the specific conditions at the airport involved and make adjustments to the zones as necessary.

With respect to the three examples brought forward from the 1993 edition, a reassessment of the previously identified safety zones relative to the expanded accident database reveals no vastly different results or need for major changes in the shapes or sizes of the zones as postulated. Several small modifications are indicated in Figure 9N, however. Some zones have been made slightly larger or smaller. The most notable change is that the outer ends of the sideline zones (Zone 5) have been shifted into either the inner safety zone (Zone 2) or the inner turning zone (Zone 3). These areas adjacent to the runway ends have concentrations of accidents which are more equivalent to the latter zones than to the areas adjacent to the middle of runways where accidents are relatively few. The inner safety zones have also been shifted closer to the runway.

The color diagrams at the end of this appendix provide a comparison between the previous and new general aviation runway safety compatibility zones examples. To aid visualization of the relationship of the zones to aircraft accident locations, the data points from the expanded (873-point) general aviation aircraft accident database and the associated accident distribution contours for each runway length range are illustrated as well.

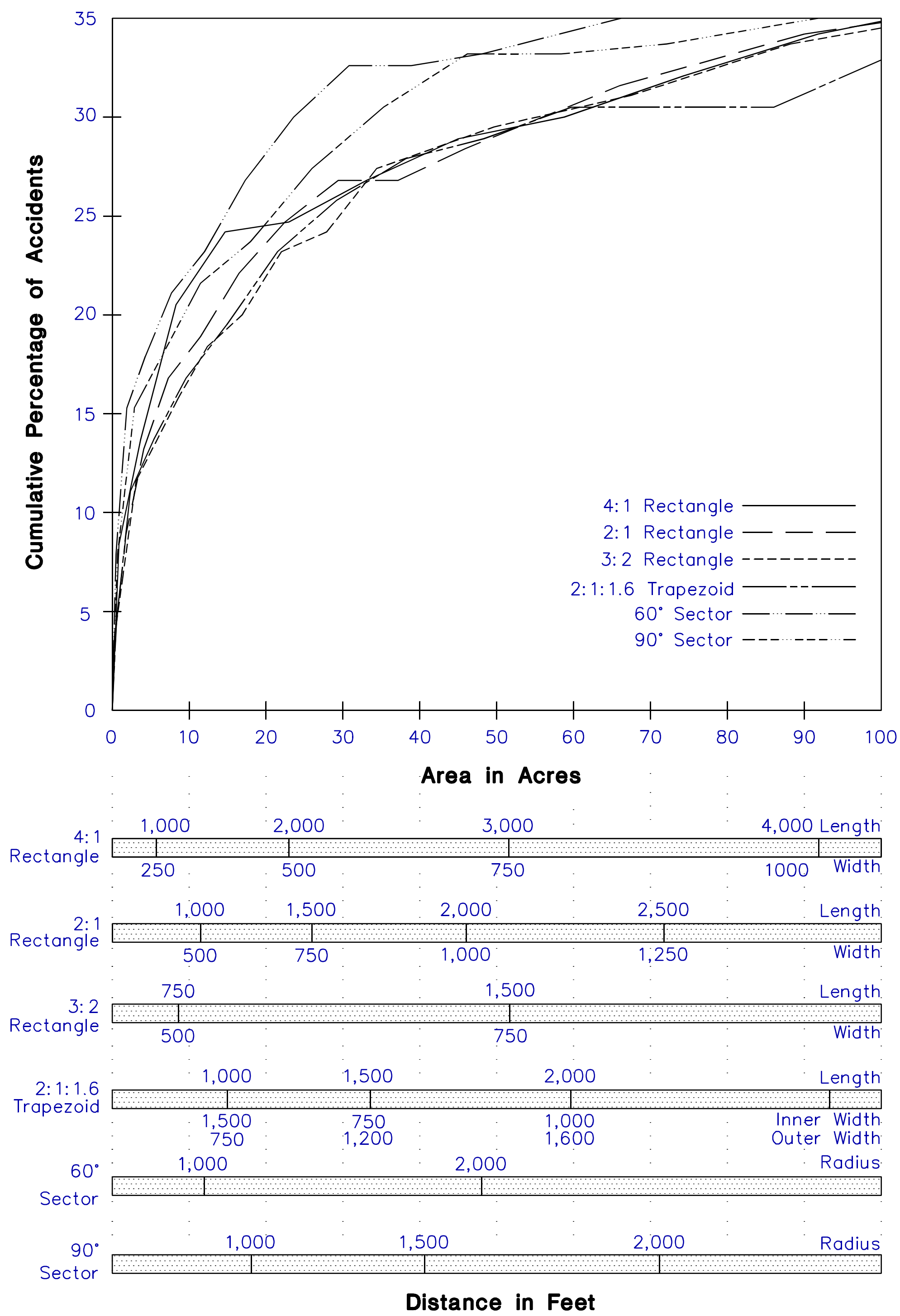


Source: Caltrans Airport Land Use Planning Handbook (1993)

FIGURE G-1

Comparison of Safety Zone Capture Rates

Arrival Accident Sites

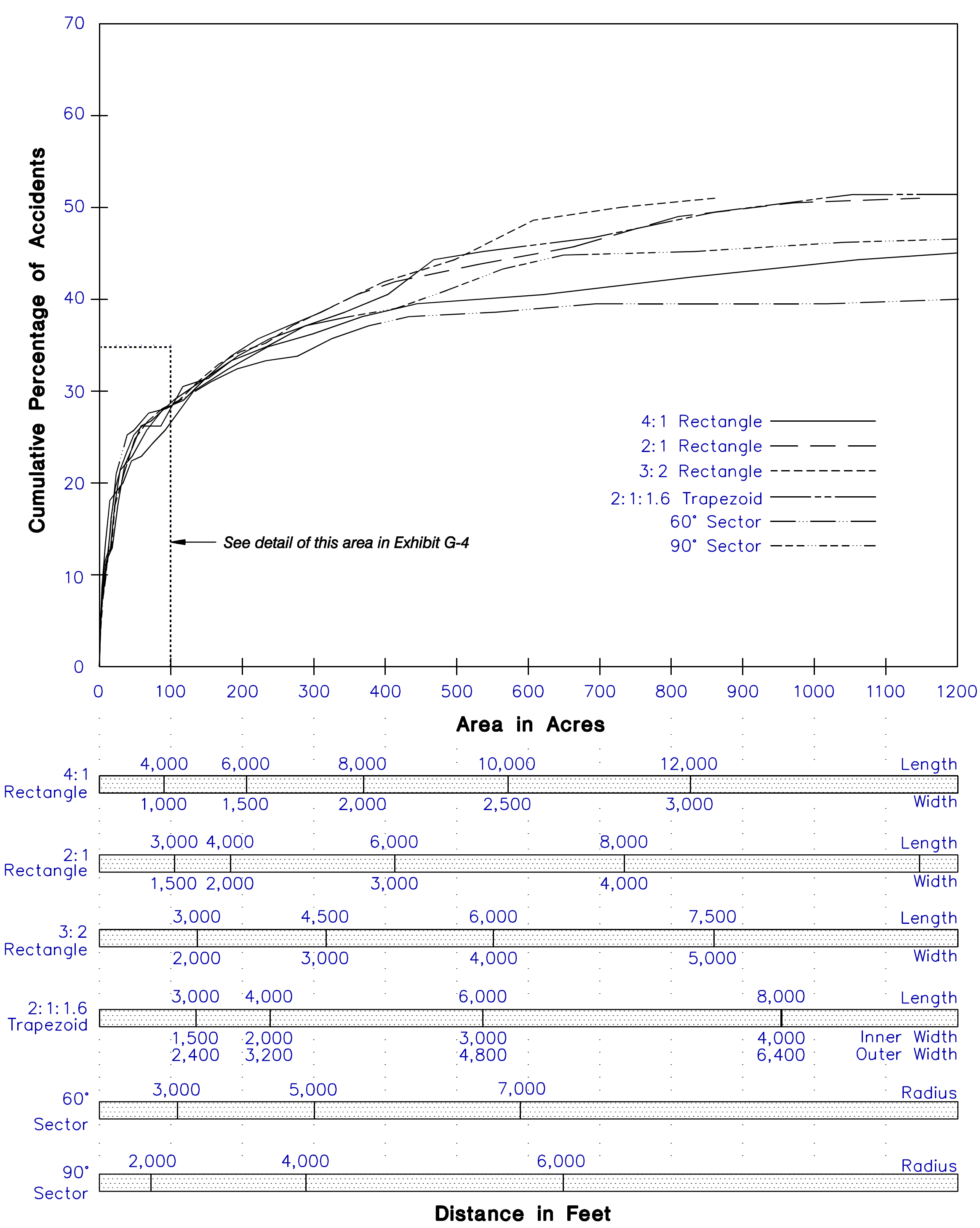


Source: Caltrans Airport Land Use Planning Handbook (1993)

FIGURE G-2

Comparison of Safety Zone Capture Rates

Close-In Arrival Accident Sites

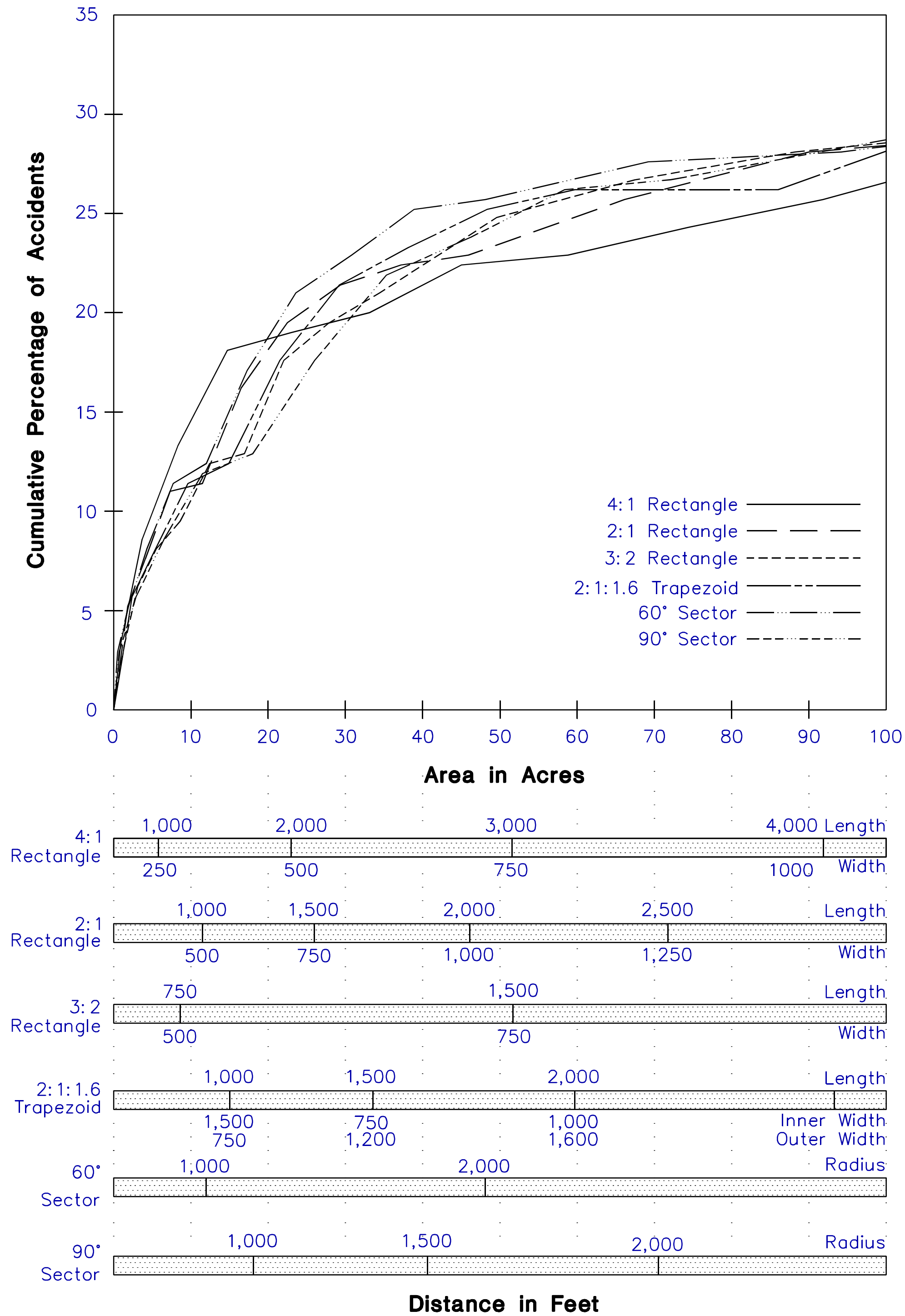


Source: Caltrans Airport Land Use Planning Handbook (1993)

FIGURE G-3

Comparison of Safety Zone Capture Rates

Departure Accident Sites



Source: Caltrans Airport Land Use Planning Handbook (1993)

FIGURE G-4

Comparison of Safety Zone Capture Rates

Close-In Departure Accident Sites

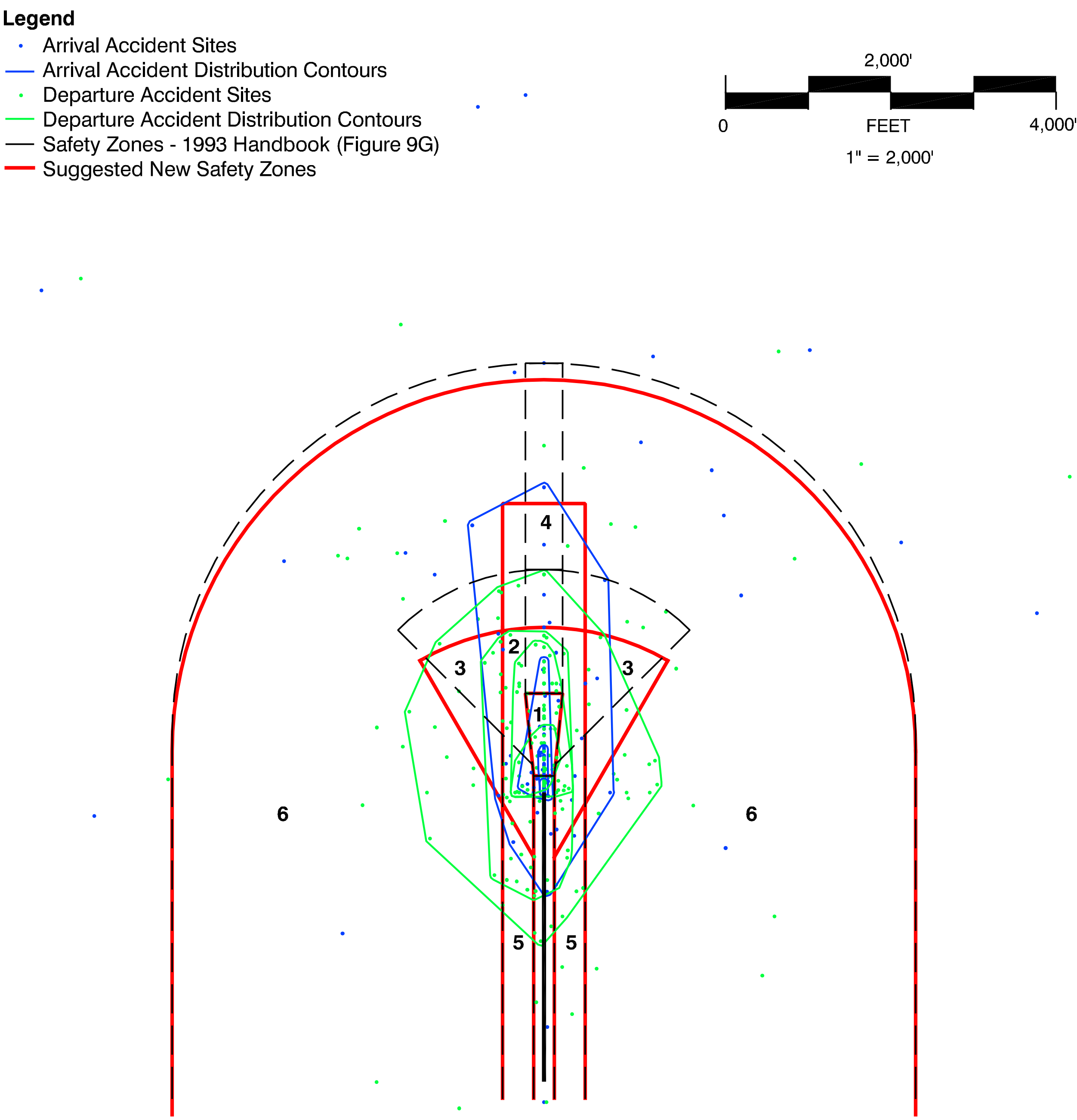


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EXHIBIT G-5

Safety Compatibility Zones Comparison

Accidents on Runways of Less than 4,000 Feet

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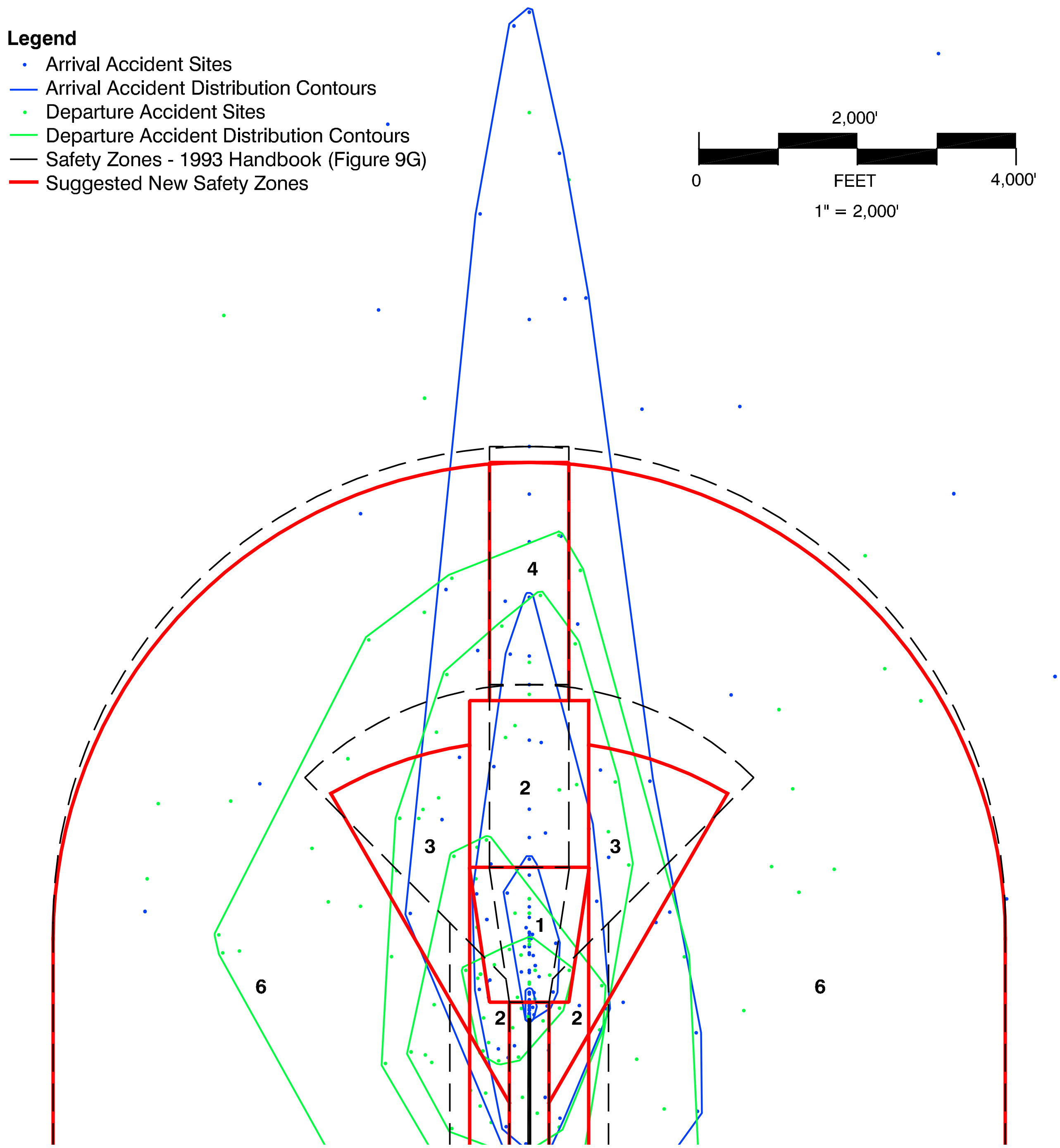

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EXHIBIT G-6

Safety Compatibility Zones Comparison

Accidents on Runways of 4,000 to 5,999 Feet

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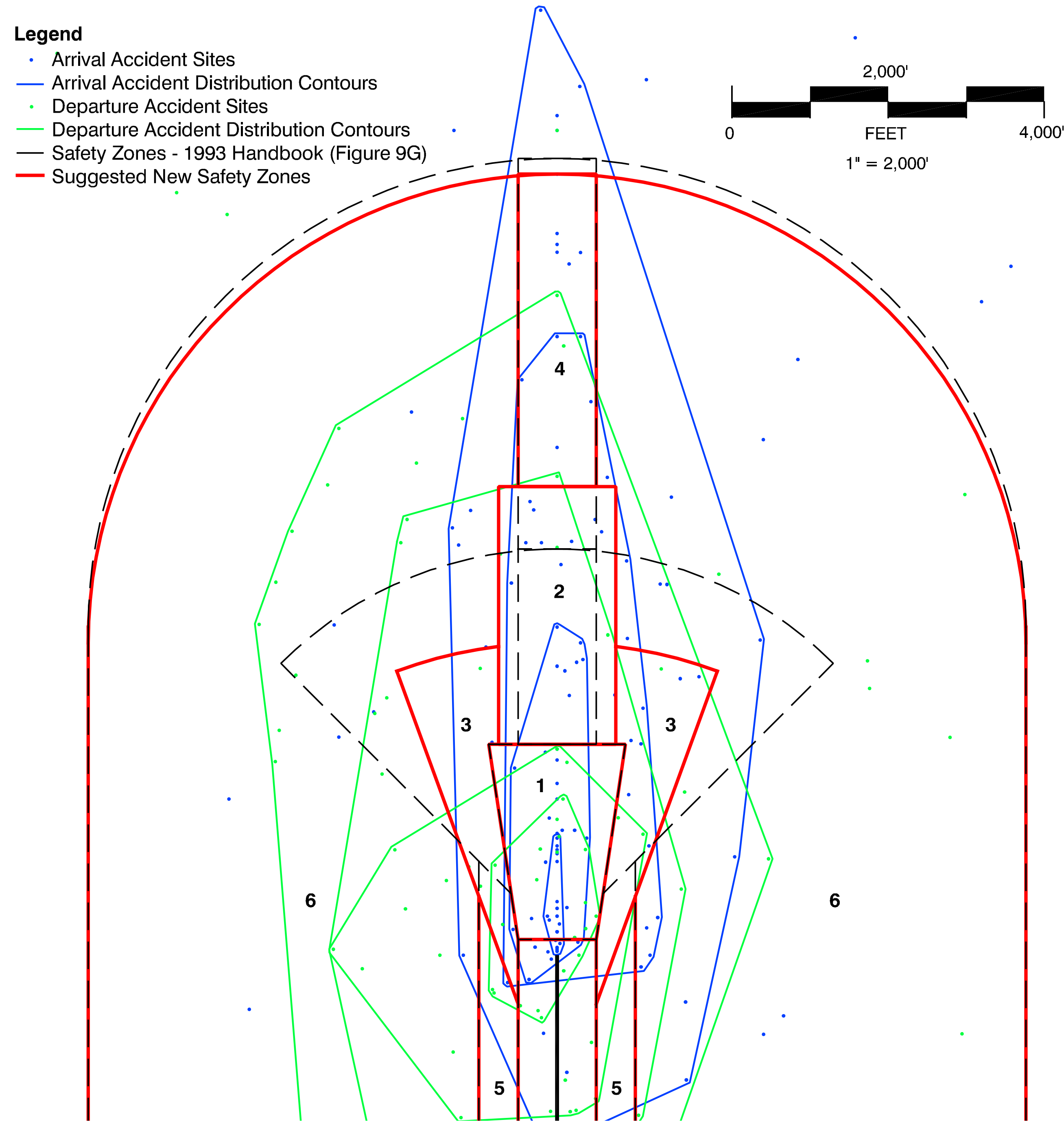

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EXHIBIT G-7

Safety Compatibility Zones Comparison

Accidents on Runways of 6,000 Feet or More

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Note: In the *Handbook* text, document references are cited using the short form indicated in the left column below.

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Glossary of Terms

Air Carriers: The commercial system of air transportation, consisting of the certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Air Installation Compatible Use Zone (AICUZ): A land use compatibility plan prepared by the U.S. Department of Defense for military airfields. AICUZ plans serve as recommendations to local government bodies having jurisdiction over land uses surrounding these facilities.

Aircraft Accident: An occurrence incident to flight in which, as a result of the operation of an air craft, a person (occupant or nonoccupant) receives fatal or serious injury or an aircraft receives substantial damage.

- Except as provided below, *substantial damage* means damage or structural failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component.
- Engine failure, damage limited to an engine, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered substantial damage.

Aircraft Incident: A mishap associated with the operation of an aircraft in which neither fatal or serious injuries nor substantial damage to the aircraft occur.

Aircraft Mishap: The collective term for an aircraft accident or an incident.

Aircraft Operation: The airborne movement of aircraft at an airport or about an en route fix or at other point where counts can be made. There are two types of operations: local and itinerant. An operation is counted for each landing and each departure, such that a touch-and-go flight is counted as two operations. (FAA Stats)

Airport: An area of land or water that is used or intended to be used for the landing and taking off of aircraft, and includes its buildings and facilities, if any. (FAR 1)

Airport Elevation: The highest point of an airport's usable runways, measured in feet above mean sea level. (AIM)

Airport Influence Area: The area in which current or future airport-related noise, overflight, safety, and/or airspace protection factors may significantly affect land uses or necessitate restrictions on those uses. In most circumstances, the airport influence area is designated by the ALUC as its *planning area boundary* for the airport and the two terms can be considered synonymous.

Airport Land Use Commission (ALUC): A commission authorized under the provisions of California Public Utilities Code, Sections 21670 et seq. and established (in any county within which a public-use airport is located) for the purpose of promoting compatibility between airports and the land uses surrounding them.

Airport Layout Plan (ALP): A scale drawing of existing and proposed airport facilities, their location on an airport, and the pertinent clearance and dimensional information required to demonstrate conformance with applicable standards.

Airport Master Plan (AMP): A long-range plan for development of an airport, including descriptions of the data and analyses on which the plan is based.

Airport Reference Code (ARC): A coding system used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport. (Airport Design AC)

Airports, Classes of: For the purposes of issuing a Site Approval Permit, the California Department of Transportation, Division of Aeronautics classifies airports into the following categories. (CCR)

- *Agricultural Airport or Heliport:* An airport restricted to use only by agricultural aerial applicator aircraft (FAR Part 137 operators).
- *Emergency Medical Services (EMS) Landing Site:* A site used for the landing and taking off of EMS helicopters that is located at or as near as practical to a medical emergency or at or near a medical facility and
  (1) has been designated an EMS landing site by an officer authorized by a public safety agency, as defined in PUC Section 21662.1, using criteria that the public safety agency has determined is reasonable and prudent for the safe operation of EMS helicopters and
  (2) is used, over any twelve month period, for no more than an average of six landings per month with a patient or patients on the helicopter, except to allow for adequate medical response to a mass casualty event even if that response causes the site to be used beyond these limits, and
  (3) is not marked as a permitted heliport as described in Section 3554 of these regulations and
  (4) is used only for emergency medical purposes.
- *Heliport on Offshore Oil Platform:* A heliport located on a structure in the ocean, not connected to the shore by pier, bridge, wharf, dock, or breakwater, used in the support of petroleum exploration or production.
- *Personal-Use Airport:* An airport limited to the non-commercial use of an individual owner or family and occasional invited guests.
- *Public-Use Airport:* An airport that is open for aircraft operations to the general public and is listed in the current edition of the *Airport/Facility Directory* that is published by the National Ocean Service of the U.S. Department of Commerce.
- *Seaplane Landing Site:* An area of water used, or intended for use, for landing and takeoff of seaplanes.
- *Special-Use Airport or Heliport:* An airport not open to the general public, access to which is controlled by the owner in support of commercial activities, public service operations, and/or personal use.
- *Temporary Helicopter Landing Site:* A site, other than an emergency medical service landing site at or near a medical facility, which is used for landing and taking off of helicopters and
  (1) is used or intended to be used for less than one year, except for recurrent annual events, and
  (2) is not marked or lighted to be distinguishable as a heliport and
  (3) is not used exclusively for helicopter operations.

Ambient Noise Level: The level of noise that is all-encompassing within a given environment for which a single source cannot be determined. It is usually a composite of sounds from many and varied sources near to and far from the receiver.

Approach Protection Easement: A form of easement which both conveys all of the rights of an avigation easement and sets specified limitations on the type of land uses allowed to be developed on the property.

Approach Speed: The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration. (AIM)

Aviation-Related Use: Any facility or activity directly associated with the air transportation of persons or cargo or the operation, storage, or maintenance of aircraft at an airport or heliport. Such uses specifically include runways, taxiways, and their associated protected areas defined by the Federal Aviation Administra-tion, together with aircraft aprons, hangars, fixed base operations facilities, terminal buildings, etc.

Avigation Easement: A type of easement which typically conveys the following rights:

- A right-of-way for free and unobstructed passage of aircraft through the airspace over the property at any altitude above a surface specified in the easement (usually set in accordance with FAR Part 77 criteria).
- A right to subject the property to noise, vibrations, fumes, dust, and fuel particle emissions associated with normal airport activity.
- A right to prohibit the erection or growth of any structure, tree, or other object that would enter the acquired airspace.
- A right-of-entry onto the property, with proper advance notice, for the purpose of removing, marking, or lighting any structure or other object that enters the acquired airspace.
- A right to prohibit electrical interference, glare, misleading lights, visual impairments, and other hazards to aircraft flight from being created on the property.

Based Aircraft: Aircraft stationed at an airport on a long-term basis.

California Environmental Quality Act (CEQA): Statutes adopted by the state legislature for the purpose of maintaining a quality environment for the people of the state now and in the future. The Act establishes a process for state and local agency review of projects, as defined in the implementing guidelines, which may adversely affect the environment.

Ceiling: Height above the earth's surface to the lowest layer of clouds or obscuring phenomena. (AIM)

Circling Approach/Circle-to-Land Maneuver: A maneuver initiated by the pilot to align the aircraft with a runway for landing when a straight-in landing from an instrument approach is not possible or not desirable. (AIM)

Combining District: A zoning district which establishes development standards in areas of special concern over and above the standards applicable to basic underlying zoning districts.

Commercial Activities: Airport-related activities which may offer a facility, service or commodity for sale, hire or profit. Examples of commodities for sale are: food, lodging, entertainment, real estate, petroleum products, parts and equipment. Examples of services are: flight training, charter flights, maintenance, aircraft storage, and tiedown. (CCR)

Commercial Operator: A person who, for compensation or hire, engages in the carriage by aircraft in air commerce of persons or property, other than as an air carrier. (FAR 1)

Community Noise Equivalent Level (CNEL): The noise metric adopted by the State of California for evaluating airport noise. It represents the average daytime noise level during a 24-hour day, adjusted to an equivalent level to account for the lower tolerance of people to noise during evening and nighttime periods relative to the daytime period. (State Airport Noise Standards)

Compatibility Plan: As used herein, a plan, usually adopted by an Airport Land Use Commission, which sets forth policies for promoting compatibility between airports and the land uses which surround them. Often referred to as a *Comprehensive Land Use Plan (CLUP)*.

Controlled Airspace: Any of several types of airspace within which some or all aircraft may be subject to air traffic control. (FAR 1)

Day-Night Average Sound Level (DNL): The noise metric adopted by the U.S. Environmental Protection Agency for measurement of environmental noise. It represents the average daytime noise level during a 24-hour day, measured in decibels and adjusted to account for the lower tolerance of people to noise during nighttime periods. The mathematical symbol is L_{dn}.

Decibel (dB): A unit measuring the magnitude of a sound, equal to the logarithm of the ratio of the intensity of the sound to the intensity of an arbitrarily chosen standard sound, specifically a sound just barely audible to an unimpaired human ear. For environmental noise from aircraft and other transportation sources, an *A-weighted sound level* (abbreviated dBA) is normally used. The A-weighting scale adjusts the values of different sound frequencies to approximate the auditory sensitivity of the human ear.

Deed Notice: A formal statement added to the legal description of a deed to a property and on any subdivision map. As used in airport land use planning, a deed notice would state that the property is subject to aircraft overflights. Deed notices are used as a form of buyer notification as a means of ensuring that those who are particularly sensitive to aircraft overflights can avoid moving to the affected areas.

Designated Body: A local government entity, such as a regional planning agency or a county planning commission, chosen by the county board of supervisors and the selection committee of city mayors to act in the capacity of an airport land use commission.

Displaced Threshold: A landing threshold that is located at a point on the runway other than the designated beginning of the runway (see *Threshold*). (AIM)

Easement: A less-than-fee-title transfer of real property rights from the property owner to the holder of the easement.

Equivalent Sound Level (L_{eq}): The level of constant sound which, in the given situation and time period, has the same average sound energy as does a time-varying sound.

FAR Part 77: The part of the Federal Aviation Regulations which deals with objects affecting navigable airspace.

FAR Part 77 Surfaces: Imaginary airspace surfaces established with relation to each runway of an airport. There are five types of surfaces: (1) primary; (2) approach; (3) transitional; (4) horizontal; and (5) conical.

Federal Aviation Administration (FAA): The U.S. government agency which is responsible for ensuring the safe and efficient use of the nation's airports and airspace.

Federal Aviation Regulations (FAR): Regulations formally issued by the FAA to regulate air commerce.

Findings: Legally relevant subconclusions which expose a government agency's mode of analysis of facts, regulations, and policies, and which bridge the analytical gap between raw data and ultimate decision.

Fixed Base Operator (FBO): A business which operates at an airport and provides aircraft services to the general public including, but not limited to, sale of fuel and oil; aircraft sales, rental, maintenance, and repair; parking and tiedown or storage of aircraft; flight training; air taxi/charter operations; and specialty services, such as instrument and avionics maintenance, painting, overhaul, aerial application, aerial photography, aerial hoists, or pipeline patrol.

General Aviation: That portion of civil aviation which encompasses all facets of aviation except air carriers. (FAA Stats)

Glide Slope: An electronic signal radiated by a component of an ILS to provide vertical guidance for aircraft during approach and landing.

Global Positioning System (GPS): A navigational system which utilizes a network of satellites to determine a positional fix almost anywhere on or above the earth. Developed and operated by the U.S. Department of Defense, GPS has been made available to the civilian sector for surface, marine, and aerial navigational use. For aviation purposes, the current form of GPS guidance provides en route aerial navigation and selected types of nonprecision instrument approaches. Eventual application of GPS as the principal system of navigational guidance throughout the world is anticipated.

Helipad: A small, designated area, usually with a prepared surface, on a heliport, airport, landing/ takeoff area, apron/ramp, or movement area used for takeoff, landing, or parking of helicopters. (AIM)

Heliport: A facility used for operating, basing, housing, and maintaining helicopters. (HAI)

Infill: Development which takes place on vacant property largely surrounded by existing development, especially development which is similar in character.

Instrument Approach Procedure: A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority (refer to *Nonprecision Approach Procedure* and *Precision Approach Procedure*). (AIM)

Instrument Flight Rules (IFR): Rules governing the procedures for conducting instrument flight. Generally, IFR applies when meteorological conditions with a ceiling below 1,000 feet and visibility less than 3 miles prevail. (AIM)

Instrument Landing System (ILS): A precision instrument approach system which normally consists of the following electronic components and visual aids: (1) Localizer; (2) Glide Slope; (3) Outer Marker; (4) Middle Marker; (5) Approach Lights. (AIM)

Instrument Operation: An aircraft operation in accordance with an IFR flight plan or an operation where IFR separation between aircraft is provided by a terminal control facility. (FAA ATA)

Instrument Runway: A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved. (AIM)

Inverse Condemnation: An action brought by a property owner seeking just compensation for land taken for a public use against a government or private entity having the power of eminent domain. It is a remedy peculiar to the property owner and is exercisable by that party where it appears that the taker of the property does not intend to bring eminent domain proceedings.

Land Use Density: A measure of the concentration of land use development in an area. Mostly the term is used with respect to residential development and refers to the number of dwelling units per acre. Unless otherwise noted, policies in this compatibility plan refer to *gross* rather than *net* acre age.

Land Use Intensity: A measure of the concentration of nonresidential land use development in an area. For the purposes of airport land use planning, the term indicates the number of people per acre attracted by the land use. Unless otherwise noted, policies in this compatibility plan refer to *gross* rather than *net* acreage.

Large Airplane: An airplane of more than 12,500 pounds maximum certificated takeoff weight. (Airport Design AC)

Localizer (LOC): The component of an ILS which provides course guidance to the runway. (AIM)

Minimum Descent Altitude (MDA): The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided. (FAR 1)

Missed Approach: A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing. (AIM)

National Transportation Safety Board (NTSB): The U.S. government agency responsible for investigating transportation accidents and incidents.

Navigational Aid (Navaid): Any visual or electronic device airborne or on the surface which provides point-to-point guidance information or position data to aircraft in flight. (AIM)

Noise Contours: Continuous lines of equal noise level usually drawn around a noise source, such as an airport or highway. The lines are generally drawn in 5-decibel increments so that they resemble elevation contours in topographic maps.

Noise Level Reduction (NLR): A measure used to describe the reduction in sound level from environmental noise sources occurring between the outside and the inside of a structure.

Nonconforming Use: An existing land use which does not conform to subsequently adopted or amended zoning or other land use development standards.

Nonprecision Approach Procedure: A standard instrument approach procedure in which no electronic glide slope is provided. (FAR 1)

Nonprecision Instrument Runway: A runway with an approved or planned straight-in instrument approach procedure which has no existing or planned precision instrument approach procedure. (Airport Design AC)

Obstruction: Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, the height of which exceeds the standards established in Subpart C of Federal Aviation Regulations Part 77, *Objects Affecting Navigable Airspace*.

Overflight: Any distinctly visible and audible passage of an aircraft in flight, not necessarily directly overhead.

Overflight Easement: An easement which describes the right to overfly the property above a specified surface and includes the right to subject the property to noise, vibrations, fumes, and emissions. An overflight easement is used primarily as a form of buyer notification.

Overflight Zone: The area(s) where aircraft maneuver to enter or leave the traffic pattern, typically defined by the FAR Part 77 horizontal surface.

Overlay Zone: See *Combining District*.

Planning Area Boundary: An area surrounding an airport designated by an ALUC for the purpose of airport land use compatibility planning conducted in accordance with provisions of the State Aeronautics Act. Also see *Airport Influence Area*.

Precision Approach Procedure: A standard instrument approach procedure where an electronic glide slope is provided. (FAR 1)

Precision Instrument Runway: A runway with an existing or planned precision instrument approach procedure. (Airport Design AC)

Referral Area: The area around an airport defined by the planning area boundary adopted by an airport land use commission within which certain land use proposals are to be referred to the commission for review.

Runway Protection Zone (RPZ): An area (formerly called a *clear zone*) off the end of a runway used to enhance the protection of people and property on the ground. (Airport Design AC)

Safety Zone: For the purpose of airport land use planning, an area near an airport in which land use restrictions are established to protect the safety of the public from potential aircraft accidents.

Single-Event Noise: As used in herein, the noise from an individual aircraft operation or overflight.

Single Event Noise Exposure Level (SENEL): A measure, in decibels, of the noise exposure level of a single event, such as an aircraft flyby, measured over the time interval between the initial and final times for which the noise level of the event exceeds a threshold noise level and normalized to a reference duration of one second. SENEL is a noise metric established for use in California by the state Airport Noise Standards and is essentially identical to *Sound Exposure Level (SEL)*.

Site Approval Permit: A written approval issued by the California Department of Transportation authorizing construction of an airport in accordance with approved plans, specifications, and conditions. Both public-use and special-use airports require a site approval permit. (CCR)

Small Airplane: An airplane of 12,500 pounds or less maximum certificated takeoff weight. (Airport Design AC)

Sound Exposure Level (SEL): A time-integrated metric (i.e., continuously summed over a time period) which quantifies the total energy in the A-weighted sound level measured during a transient noise event. The time period for this measurement is generally taken to be that between the moments when the A-weighted sound level is 10 dB below the maximum.

Straight-In Instrument Approach: An instrument approach wherein a final approach is begun without first having executed a procedure turn; it is not necessarily completed with a straight-in landing or made to straight-in landing weather minimums. (AIM)

Taking: Government appropriation of private land for which compensation must be paid as required by the Fifth Amendment of the U.S. Constitution. It is not essential that there be physical seizure or appropriation for a *taking* to occur, only that the government action directly interferes with or substantially disturbs the owner's right to use and enjoyment of the property.

Terminal Instrument Procedures (TERPS): Procedures for instrument approach and departure of aircraft to and from civil and military airports. There are four types of terminal instrument procedures: precision approach, nonprecision approach, circling, and departure.

Threshold: The beginning of that portion of the runway usable for landing (also see *Displaced Threshold*). (AIM)

Touch-and-Go: An operation by an aircraft that lands and departs on a runway without stopping or exiting the runway. (AIM)

Traffic Pattern: The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach. (AIM)

Visual Approach: An approach where the pilot must use visual reference to the runway for landing under VFR conditions.

Visual Flight Rules (VFR): Rules that govern the procedures for conducting flight under visual conditions. VFR applies when meteorological conditions are equal to or greater than the specified minimum-generally, a 1,000-foot ceiling and 3-mile visibility.

Visual Runway: A runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA-approved airport layout plan. (Airport Design AC)

Zoning: A police power measure, enacted primarily by units of local government, in which the community is divided into districts or zones within which permitted and special uses are established, as are regulations governing lot size, building bulk, placement, and other development standards. Requirements vary from district to district, but they must be uniform within districts. A zoning ordinance consists of two parts: the text and a map.

Glossary Sources

FAR 1: *Federal Aviation Regulations Part 1, Definitions and Abbreviations*

AIM: *Aeronautical Information Manual*

Airport Design AC: Federal Aviation Administration, *Airport Design* Advisory Circular 150/5300-13

CCR: California Code of Regulations, Title 21, Section 3525 et. seq. *Division of Aeronautics*

FAA ATA: Federal Aviation Administration, *Air Traffic Activity*

FAA Stats: Federal Aviation Administration, *Statistical Handbook of Aviation*

HAI: Helicopter Association International

NTSB: National Transportation and Safety Board

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