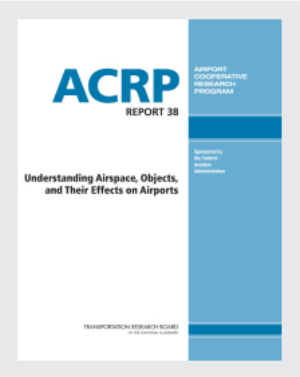

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 38

Understanding Airspace, Objects, and Their Effects on Airports

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

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The research discussed in this report was performed under ACRP Project 03-13, "Understanding Airspace, Objects, and Their Effects on Airports," by a research team of recognized experts in airport planning, airspace obstruction study, and flight procedure design. LeighFisher (formerly Jacobs Consultancy) was the primary research consultant. William J. Dunlay, PhD, Director at LeighFisher was the Principal Investigator, and Byron Thurber, Associate Director at LeighFisher was the Deputy Principal Investigator. The other authors were Tom Cornell, Vice President at Landrum & Brown; Robert Varani, Director at ASRC Research and Technology Solutions; Seth Young, PhD, Associate Professor, The Ohio State University; and Elizabeth Ike, Graduate Researcher, The Ohio State University.

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FOREWORD

By Joseph D. Navarrete
Staff Officer
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ACRP Report 38: Understanding Airspace, Objects, and Their Effects on Airports provides a comprehensive description of the regulations, standards, evaluation criteria, and processes designed to protect the airspace surrounding airports. Aviation practitioners, local planning and zoning agencies, and developers all have a need to understand and apply the appropriate airspace design and evaluation criteria to ensure a safe operating environment for aircraft, to maintain airport operational flexibility and reliability, without unduly restricting desirable building development and attendant economic growth in the surrounding community.

Many airports are facing the challenge of protecting their airspace from encroaching development; developers, desiring to maximize their investment, frequently propose buildings of significant height; and local planning and zoning agencies often face the apparently conflicting goals of ensuring a safe operating environment for aircraft and promoting economic growth. By their very nature, airspace design, evaluation, and protection criteria are complex and technical, because aircraft operate in three dimensions and their performance characteristics vary greatly. In addition, airspace protection requirements depend on runway layouts and the instrument flight procedures designed for the airport, which change over time as the airport expands physically and operationally, and new technologies are implemented. Topography and existing development in the airport vicinity also directly affect airspace needs and geometry. Finally, there are different airspace evaluation criteria and procedures, depending on the purposes of the evaluation.

The research, led by LeighFisher (formerly Jacobs Consultancy), shows that, while a thorough understanding of airspace issues is essential, many stakeholders find the rules, evaluation criteria, and processes are difficult to understand. Additionally, many stakeholders are simply not aware of airspace issues. Through the presentation of case studies, the research team documents several serious airspace/building development conflicts that highlight how airspace issues arose and were resolved.

The Guidebook first lists and describes the key airspace protection criteria and how they are to be applied, including *Federal Aviation Regulations Part 77; United States Standard for Terminal Instrument Procedures (TERPS)*; Advisory Circular 150/5300-13, *Airport Design*; and one-engine-inoperative (OEI) requirements. The Guidebook then clarifies the roles and responsibilities of key stakeholders, including the FAA, the airport, local authorities who issue building permits, and developers. The Guidebook concludes with recommendations for best practices for airports, local planning and zoning agencies, and developers that should significantly mitigate airspace-building development conflicts.

Reading this Guidebook will help key stakeholders better understand the processes for evaluating potential airspace impacts and for protecting airspace, and should lead to a stakeholder partnering that will both preserve airport operational flexibility and promote economic growth.

CONTENTS

CHAPTER 1

Introduction and Background

Introduction

What Is this Guidebook About?

This Guidebook provides a comprehensive and understandable source of information and advice regarding the variety of rules, regulations, design standards, and policies associated with the protection of airspace, evaluation of proposed objects on and near airports, and their effects on navigable airspace. Failure to protect an airport's navigable airspace can lead to critical degradations of the airport's safety, efficiency, utility, and air service capability.

One of the goals of this Guidebook is to provide the reader with a better understanding of the FAA airspace analysis process known as "Obstruction Evaluation/Airport Airspace Analysis" (OE/AAA), and the levels of airspace protection it offers and does not offer for airports. The OE/AAA process is the primary method by which the FAA determines whether or not an object, most often a proposed man-made structure such as a building, utility tower, or a wind turbine, would constitute an "obstruction" and/or a "hazard" to aircraft operating in the local airspace. The OE/AAA process may also be undertaken to determine whether proposed modifications to an airport, such as the extension of a runway or the creation of a new instrument-based approach procedure, would be compatible with the existing terrain and man-made objects.

This Guidebook provides step-by-step descriptions of the OE/AAA process, identifying when and how notification of proposed development should be provided to the FAA, what the variety of outcomes of an FAA evaluation may be, and what steps may be taken to achieve appropriate balance between building development and airspace protection, should an issue of conflict arise. The guidebook also describes how the FAA OE/AAA process and outcomes may be incorporated by reference into state and local regulations.

Research conducted to prepare this Guidebook also included a series of case studies of airports that have encountered challenges protecting their airspace when faced with nearby proposed building development. These case studies highlight how these airports have overcome initial difficulties and developed a variety of innovative strategies to improve communication among stakeholders, including the FAA, surrounding municipalities, the business community, individual building developers, and the airport's users, particularly the air carriers. The case studies also highlight how a balance between building development and airspace protection has been or can be achieved and can be continued. Also highlighted are circumstances where reliance on the FAA OE/AAA process alone has not resulted in the level of airspace protection required or desired by the airport sponsor or aviation community. Excerpts from the case studies are highlighted within this Guidebook to provide examples of lessons learned and best practices that may be applied to other airports.

This Guidebook provides tools for understanding airspace protection issues for key stakeholders at an airport and its surrounding community.

It also provides guidelines to implement airspace protection for local municipalities and serves to inform building developers about the processes they should follow in order to avoid conflicts between proposed structures and airspace requirements.

The case studies document real-world examples of airspace conflicts, resolutions, and lessons learned.

Why Was the Guidebook Written?

The research conducted for this Guidebook was performed through the Airport Cooperative Research Program (ACRP). This program was designed to address issues of direct concern to airport management and other groups with interest in the U.S. National Airspace System (NAS). The issue of protecting navigable airspace from encroaching development in the vicinity of airports is of significant concern, for a number of reasons:

This Guidebook was written to document, clarify, and make recommendations for implementation of airspace protection criteria.

- First, the rules and regulations concerning the OE/AAA process have been perceived to be cumbersome and confusing to some in airport management.
- Second, there is confusion related to the basic airspace surface mapping required to be prepared by airport sponsors for FAA-approved airport layout plan (ALP) drawings, and, in some cases, its apparent inconsistencies with OE/AAA results.
- Third, other groups and stakeholders with interests in this area are virtually unaware that many such rules, regulations, and evaluation procedures exist. As a result, a certain number of real estate development plans and actual construction in the vicinity of airports have resulted in serious conflicts with the use of surrounding airspace. Often, resolutions of these conflicts become very time consuming and costly.

A primary goal of this Guidebook is to educate, inform, and enable stakeholders by (1) providing a clear description of the current rules, regulations, and policies; (2) identifying the roles of various interested parties and their responsibilities in the application of the rules; and (3) encouraging a cooperative working environment to avoid future conflict based on lessons learned and best practices.

Even in situations where the rules, regulations, and policies are understood, conflicts may still arise based on the individual—often inherently conflicting—interests of airport management, private developers, aircraft operators, and local municipalities. This Guidebook provides further examples of best practices, in an attempt to help mitigate or resolve those conflicts.

Who Should Understand and Use the Guidebook?

This Guidebook has been designed to be used as a reference for groups interested in the use and development of land on and in the vicinity of airports including:

- Airport Management
- Municipal and Regional Planning Agencies
- State Departments of Transportation
- Building Developers

Each of these groups has different perspectives on land use around airports and/or the use of airspace. This Guidebook is designed to provide a better understanding from each perspective of the rules, regulations, policies, benefits, and costs associated with achieving an appropriate balance between the development of land on and around airports, and the preservation and protection of airspace vital to aircraft operations in the airport environment.

The airport manager is a key central figure in the airport–land use compatibility issues, including airspace protection.

Airport Management

This Guidebook is primarily focused on the perspective of the airport manager (a term used generically to refer to the staff person or persons authorized to act on the airport's behalf regarding airspace issues), for it is the airport manager who most often is the key figure responsible for managing airport operations and maintaining compatibility with the surrounding community. The airport manager is often expected to be knowledgeable on issues regarding airport land use compatibility, including the protection of airport airspace, and is often the conduit of informa-

tion between local government entities, building developers, and the airport's users, including air carriers and operators of general aviation aircraft.

Conflicts will inevitably arise with respect to the use and protection of local airspace. Such conflicts can be exacerbated when the airport management does not have a complete understanding of airspace protection, does not have appropriate channels of communication with local jurisdictions, and/or is not fully aware of the requirements of the users of the airport. This Guidebook is intended to provide airport management with a clear understanding and "how-to playbook" regarding airspace protection requirements and the assortment of regulations related to the OE/AAA process. With improved understanding, airport management will be better prepared to ensure that the local airspace around their airport is maintained free of objects that may degrade its safety, capacity, efficiency, utility, and air service capability.

Local jurisdictions share in the responsibility to protect airspace, in that they have final authority over construction permits. Therefore, the construction permit process should include considerations of airspace protection, the two fundamental aspects being FAA notification and FAA determination.

Local and Regional Planning Agencies, State Transportation Departments

While the process of determining the impacts on navigable airspace of proposed development is primarily performed at the federal level, it is usually the local planning agencies—sometimes with state department of transportation backing—that have the ultimate jurisdictional authority deciding whether or not to issue a construction permit for a particular proposed structure. As such, it is critical for local agencies to have policies in place to ensure that proposed development would be compatible with local airport and airspace operations. Surprisingly, however, the overall permit evaluation procedures in most municipalities in the United States lack airspace protection considerations. In some states, the state department of transportation, through an aviation division, provides a measure of backup, most commonly by requiring a special permit for proposed structures that would be declared a hazard by the FAA, irrespective of whether the local jurisdiction does.

This Guidebook is intended to provide local and regional planning agencies with a better understanding of what it means to consider airspace protection in their overall construction permit evaluation process, and to provide examples of how local planning agencies can include airspace analysis as part of their land use planning, zoning, and construction permitting processes.

Building Developers

Building developers should investigate airspace protection compatibility issues as early as possible in the project planning process.

Market forces often lead real estate development interests to propose buildings in the vicinity of an airport. Building developers, of course, are interested in maximizing their return on investment, which is most often achieved by developing to the "highest and best use" potential of their land, and as such can desire to build structures of substantial height above the ground. Most building developers are familiar with state and local regulations regarding structure height limits that are based on civic considerations such as urban density, infrastructure, sunlight, view access, water and utility capacity, and the like. However, developers—and even many local jurisdictions—are unaware of height limits based on aeronautical requirements that may extend for many miles around an airport.

This Guidebook is designed to provide the building developer with an understanding of the rules and regulations that define when FAA notification must be provided, based on the proposed height of a planned structure and the structure's proximity to an airport or established airway in the local airspace, and help navigate the OE/AAA process, including interpretations of the FAA's final height determinations and how they may relate to local permits and entitlements. Building developers are also encouraged to consider that the airport is a regional transportation asset, connecting the local area with distant destinations, providing jobs, and having certain federal obligations to protect airspace.

Background

Airports support local and regional economies by providing services and means of connection to distant destinations that are attractive for both local businesses and the markets they serve. There are instances, however, when other types of economic development, infrastructure for energy or communications, civic and other critical uses of the land create demand for vertical development that is at odds with the airspace protection requirements needed for safe and efficient airport operations. Reconciliation of conflicting land uses and airspace needs is an important challenge to airports and their local economic bases alike.

Along with the conflicts that often arise due to opposing interests between building development and airport operations on the "best" use of local lands and their associated airspace, a number of key challenges exist that have recently resulted in increased conflicts and greater difficulty in resolving those conflicts.

Incomplete Information

Airspace protection criteria have different purposes and functions. Some are more well-known, others are less well-known.

Airports, municipal authorities, and building development interests are often working with incomplete, inaccurate, and/or incongruent information with respect to the variety of airspace protection requirements.

Often, the initial evaluation of whether or not proposed development will be in conflict with the local airspace around an airport is performed by either the airport management, the local municipal planning office, and/or the developer, using only one basic set of evaluation criteria, which can lead to inaccurate assumptions early in the process.

The civil airport imaginary surfaces specified in FAR Part 77 are the most familiar type of airspace protection criteria, but they are only one piece of a much larger puzzle.

Most often the sole criteria applied are found under Federal Aviation Regulations (FAR) Part 77.25—"Civil Airport Imaginary Surfaces" (Refer to Chapter 2, *Fundamental Airspace Protection Criteria,* for a more detailed description of FAR Part 77). These criteria define a series of three-dimensional aeronautical surfaces, whose geometry is based on the runway configurations at the airport, the weather conditions under which each runway may be used, and the type of aircraft authorized to use each runway. The civil airport imaginary surfaces, which apply to all public-use airports, are almost always the first, and sometimes only, criteria applied because they are depicted on the "Airport Airspace Drawings" in an airport's FAA-approved ALP drawing set, which is often readily available, public information. However, it should be noted that FAR Part 77 and other airspace protection requirements apply independent of whether or not an ALP drawing set exists.

They should not be considered the sole airspace compatibility criteria.

The most common misconception is that if a proposed object does not exceed the elevation of the FAR Part 77 civil airport imaginary surfaces, then it would be compatible with airport operations; and if the proposed object would exceed the elevation of the surfaces, it would be incompatible. In fact, reliance on FAR Part 77 civil airport imaginary surfaces as the sole airspace protection criteria can lead to incorrect conclusions for several reasons:

- Penetration of civil airport imaginary surfaces indicates the FAA would classify the object as an "obstruction to air navigation." *Civil airport imaginary surfaces are one of the five types of obstruction criteria defined in FAR Part 77.* Other types include being 500 feet in height, being 200 feet in height in proximity to an airport, affecting terminal instrument approach or departure procedures ("TERPS" criteria, a much more complex set of surfaces to be discussed later), and affecting enroute procedures (see §77.23). Objects may be classified as an obstruction under one of the other four types of obstruction standards, even if they would not penetrate a civil airport imaginary surface.

- Many stakeholders do not understand the distinction between an airspace "obstruction" and "hazard." *Being classified as an obstruction does not necessarily mean an object would be incompatible with airport operations;* it means (1) the object should be subject to further aeronautical study in order to assess whether it would constitute a hazard to air navigation; and (2) assuming it would not be a hazard and is allowed to be constructed, obstruction status subjects it to special marking and lighting requirements.
- Approach, departure, and en route operations are developed and maintained through a complex set of criteria known as TERPS, which is shorthand for FAA Order 8260.3B, *The United States Standard for Terminal Instrument Procedures.* TERPS establishes criteria for Standard Instrument Arrivals (STAR), Standard Instrument Approach Procedures (SIAP), Obstacle Departure Procedures (ODP), and Standard Instrument Departures (SID). These procedures are used by pilots to navigate to and from airports using cockpit instruments only—not the pilot's view out the cockpit window—a technique which must be applied under inclement low-visibility weather or "instrument meteorological conditions" (IMC). These procedures are developed, in part, so that aircraft are on flight paths that safely avoid existing terrain and vertical development in the vicinity of the airport, which may not be visible to the pilot during flight. In many cases, the criteria used to determine a safe TERPS departure or approach procedure at an airport can be significantly lower or higher than the civil imaginary surfaces. While incorporated by reference in Part 77.23 as a type of obstruction standard, the obstacle clearance surfaces (OCSs) protecting TERPS procedures are less well known and often overlooked in initial assessments.
- At airports that have commercial service air carriers operating under FAR Part 121—*Operating Requirements: Domestic, Flag, and Supplemental Operations* (i.e., the "airlines"), as well as several charter operators operating under FAR Part 135—*Operating Requirements: Commuter and On-Demand Operations,* each such carrier must develop emergency flight procedures to be followed in the event of complete loss of power to one engine, known as "One Engine Inoperative" (OEI) procedures. The airspace requirements for these procedures are not evaluated in the OE/AAA process; therefore, considerable conflicts may result in the capability or willingness of an air carrier to provide certain service—often lucrative long-haul service—at an airport when new obstacles are constructed that would impede OEI procedures.
- Airport design criteria found in FAA Advisory Circular 150/5300-13, *Airport Design,* contain design specifications including airspace clearance requirements for allowable construction immediately surrounding and aligned with the ends of runways. The geometries of these criteria do not in all cases match the geometries of FAR Part 77 civil airport imaginary surfaces or TERPS surfaces.
- Finally, all airports have established Visual Flight Rules (VFR) procedures allowing improved access and separation from Instrument Flight Rules (IFR) traffic. These procedures are developed using FAR Part 91 and various Air Traffic Control (ATC) criteria.

Working with incomplete, inaccurate, and/or incongruent information with respect to the variety of airspace protection requirements can lead to critical conflicts between building development and air navigation.

Various airspace protection criteria are established for various functions. They do not always relate directly to one another.

In assessing a proposed structure's potential airspace conflicts, it is often the case that several previously mentioned criteria are either not considered or appear in conflict with either each other or with local planning criteria. If left unresolved, such ambiguities or gaps in enforcement of airspace protection criteria can lead to even greater conflicts between actual building development and airspace navigation. This Guidebook is designed to assist local planning agencies to consider all of the above types of airspace protection criteria. Based on a review of the case studies, it can be seen that a clear understanding of these airspace protection criteria, including preparation of mapping or other materials to establish an appropriate expectation of development heights and level of airspace protection, helps set reasonable expectations and minimizes uncertainty and conflicts. For example, the Daytona Beach and Ohio State University Airport case studies show how a lack of awareness of airspace protection requirements allowed the construction of incompatible structures while the other three case studies show how partial understanding of airspace

protection requirements led to building development proposals that would have been incompatible to proceed to significant stages of design and investment, which in turn spurred the airport sponsors to improve public awareness and approval processes in various creative manners.

FAA Analysis Process Misunderstood

The FAA's OE/AAA process is often misunderstood, misinterpreted, or unknown to developers or local planning agencies.

The FAA's OE/AAA process functions well for a variety of purposes, but is often overlooked.

The FAA's OE/AAA process is often misunderstood, misinterpreted, or unknown to those with interests in building development and/or airspace protection. As a result, various issues often arise, including the possibility that notification of potential development is never properly reported to the FAA for evaluation. Failure to file notification not only precludes proper evaluation from being performed, but also, because the formal FAA OE/AAA process is often the only vehicle for communicating such notifications to other interested parties (such as airports and their aviation stakeholders) these entities may never become aware of potential development until actual construction has begun, which is often too late to resolve conflicts that may arise between the building development and local airspace protection requirements.

The FAA does not have direct jurisdictional authority to limit building heights.

A common misunderstanding of the OE/AAA process is that the FAA's determinations are "enforceable" in that they directly function to limit the height of, or prevent construction of, any proposed building development. In fact, this is not the case. Even if there would be conflicts between proposed development and FAR Part 77, TERPS, or other airspace protection criteria, the FAA does not have direct jurisdictional authority to limit or prevent any such development. Typically, it is the municipality that has this jurisdictional authority. Some municipalities and other state and local governmental entities, even some that are airport sponsors, do not formally consider FAA's determinations when it comes to airspace protection under their local codes. As a result, FAA recommendations and determinations have the potential of being "ignored" by pro-development interests.

Furthermore, at present the FAA does not factor protection of individual airlines' OEI procedures into its determinations. The lack of consideration of individual airlines' OEI procedures can allow for proposed structures that may be considered compatible development from a safety hazard standpoint by the FAA, but may actually result in decisions by individual airlines to reduce service (i.e., limit markets served or ranges flown) at the airport because of the new obstacle. The FAA is addressing this discrepancy in an OEI Pilot Study which is ongoing at the time of this report (March 2010), and is expected to conclude with broadly applicable results later in 2010 or early 2011. At some of the pilot study airports, protection of an aggregate of multiple airlines' OEI procedures is being implemented in coordination with local authorities having jurisdiction over building height limits.

Chapter 4 of this Guidebook provides specific recommendations to address some of the potentially problematic issues described above.

How this Guidebook Was Created

The development of this Guidebook was the result of a comprehensive review of the FARs, Orders, Advisory Circulars (AC), and other reference materials on the subject of airspace protection and local height zoning regulations. An annotated bibliography of the sources, including descriptions of criteria and their purpose, function, and applications may be found in Appendix A.

In addition, a series of cases studies was performed at a number of civil use airports. The airports selected for study have experienced many of the challenges associated with understanding

objects, airspace, and their effect on airport operations, and in turn have developed practices to overcome these challenges. Case studies can be found in Appendix D.

Finally, the expertise and experience of the research team dealing with these issues in consulting and academic practices was drawn upon to help create a comprehensive, practice-based reference for use by airport managers, municipal and regional planners, and other stakeholders with interests in the balance between vertical building development around airports and protection of airport airspace.

In addition to this Guidebook, a comprehensive report has been produced, documenting the research as it was conducted step-by-step, per ACRP guidelines. The report is intended for use by researchers, consultants, or anyone with an interest in further technical details.

Following this introduction and background chapter, this Guidebook is organized into the following chapters.

The Guidebook's main chapters describe the criteria and mechanisms for airspace protection, and provide conclusions and recommendations based on best practices.

Chapter 2: Fundamental Airspace Protection Criteria, describes the major types of criteria for determining (1) whether objects in the vicinity of an airport should be evaluated for their potential impact on navigable airspace, (2) the criteria for determining obstruction status, (3) the criteria for determining hazard status, and (4) other criteria related to airport design standards and airline OEI procedures.

Chapter 3: Mechanisms and Processes of Airspace Protection, describes the formal process for evaluating objects, including the process for notifying the FAA, the FAA's process for determining the impact of the object on the local airspace, and procedures for dealing with any conflicts between objects and the airspace.

Chapter 4: Conclusions, Recommendations, and Best Practices, conveys a number of conclusions and recommendations the research team deduced from the research process and case study examples.

The Guidebook appendices elaborate on the subject matter of the research, providing further technical details and illustrations of concepts.

The Appendices provide a more thorough technical description of criteria and processes, and provide full descriptions of the case studies.

Appendix A: The Purpose, Function, and Application of Criteria, provides more technically detailed descriptions of the criteria, including source document information.

Appendix B: The Interrelationships Among Criteria, describes how airspace protection criteria relate to one another and to municipal height zoning in various manners including regulatory, functional, and geometric.

Appendix C: The FAA's Obstruction Evaluation/Airport Airspace Analysis Process, describes the aeronautical study process, including multiple potential choices and outcomes; from the beginning, assessing whether notification needs to be provided to the FAA; through the aeronautical study process resulting in a final determination; to the end, when a building is constructed, and notification of actual construction must be provided to the FAA.

Appendix D: Case Studies, provides individual narratives of the case study airports, based on personal interviews, media accounts, reviews of publicly available FAA OE/AAA paperwork and final determinations.

CHAPTER 2

Fundamental Airspace Protection Criteria

Airspace protection criteria are found in a variety of Federal Aviation Regulations (FARs), Orders, and Advisory Circulars (ACs).

The process for determining whether or not an object in the vicinity of an airport, sea plane base, or heliport is compatible with the use of that facility is based on a defined set of criteria. Most of these criteria are found in FAA FARs, Orders, and ACs. The criteria in these publications provide guidance for analyzing existing and proposed objects, to assess whether or not the object (1) would be classified as an "obstruction to air navigation," requiring it to be marked and lighted, and noted on aeronautical publications; (2) would constitute a "hazard to air navigation," requiring specific action to mitigate the hazard; (3) would be compatible with airport design standards related to runway end siting and other factors; and (4) may be in conflict with a specific airline's flight procedures at the airport, particularly those developed to address an emergency condition involving the loss of power to one engine, known as a OEI event.

Principal Sources of Criteria

The principal sources for these criteria are:

- FAR Part 77—*Objects Affecting Navigable Airspace.* This FAR is the central regulation governing airspace protection, with cross-references to many other criteria documents. It sets forth the requirements for notifying the FAA of proposed construction; defines obstruction criteria; and describes aeronautical studies required to assess hazard status.
- FAA Order 8260.3B—*United States Standard for Terminal Instrument Procedures (TERPS).* This Order, along with several derivative orders in the 8260 series and other related orders, define criteria that FAA flight procedure designers utilize when designing instrument flight procedures. Airspace protection requirements for instrument flight procedures are one of the types of obstruction standards referenced in FAR Part 77; they are also one of the most common criteria analyzed for hazard status in aeronautical studies.
- FAA AC 150/5300-13—*Airport Design.* This AC is the principal document utilized by the FAA, airport sponsors, and planning consultants when planning and designing new airports or modifications to airports. Airspace clearances for key runway end features are defined in the AC's Appendix 2, *Runway End Siting Surfaces.*
- FAR Part 25—*Airworthiness Standards: Transport Category Airplanes.* This FAR provides regulations for aircraft compliance during takeoff, landing, and during OEI procedures. Transport category aircraft must be in compliance with a variety of airworthiness standard criteria to receive certification for airworthiness.

The fundamental criteria within these documents are described in Table 2.1. The following descriptions are meant to be instructive and provide a certain level of usable information, geo-

Table 2.1. Airport management's priority checklist of airspace protection criteria.

Airspace Protection Criteria	Airport Type			
	Air Carrier, Part 139	General Aviation, existing or planned precision instrument	General Aviation, existing or planned non-precision instrument	General Aviation, visual flight rules (VFR) only
FAR Part 77 Notification, height standards and surfaces	X	X	X	X
FAR Part 77 Obstruction, height standards and surfaces	X	X	X	X
TERPS instrument departure	X	X	X	
TERPS non-precision approach	X	X	X	
TERPS precision approach	X	X		
FAA AC 150/5300-13, Apx. 2, threshold siting surfaces	X	X	X	X
FAA AC 150/5300-13, Apx. 2, instr. departure siting surface	X	X	X	
FAA AC 150/5300-13, Apx. 2, OEI obstacle iden. surface	X			
OEI air carrier criteria, ICAO and FAA AC 120-91	X			
FAA Order 7400.2 VFR airspace protection	X	X	X	X

Prepared by: Jacobs Consultancy

metric configurations, dimensions, and the like, and are current as of the time of this writing (early 2010). For more detail, the reader is encouraged to refer to this guidebook's Appendix A, The Purpose, Function, and Application of Criteria, and Appendix B, *The Interrelationships Among Criteria;* for the most current information please refer to the source documents themselves, which are updated periodically by their respective authors.

Table 2.1 provides a high-level checklist indicating which criteria families are most critical for different types of airports. This is not to say that the criteria types not checked would never be relevant or worth studying, but is intended to indicate which types should be of primary focus for routine application.

Terminology—Definitions and Abbreviations

As part of the descriptions of criteria, various technical terms found within the criteria documents are defined. In addition, definitions and common abbreviations of relevant aviation terms are listed below:

AMSL/MSL—Above Mean Sea Level: absolute elevation with respect to mean sea level

AGL—Above Ground Level: relative height above the ground. An object's height AGL, added to the site grade elevation AMSL, yields the top-of-structure or overall object elevation AMSL. The object's overall elevation AMSL is the value most commonly used in aeronautical calculations, because it relates directly to flight altitudes which are almost always expressed elevation AMSL.

VFR—Visual Flight Rules: Air traffic regulations under which aircraft fly when there is sufficient visibility (at least 3 miles at low altitudes around airports), and cloud ceilings are

sufficiently high (at least 1,000 feet AGL). Such conditions are known as VMC—visual meteorological conditions.

IFR—Instrument Flight Rules: Air traffic regulations under which aircraft fly when the visibility and ceiling requirements for VMC are not met. When flying under IFR conditions (or IMC), aircraft may often be given directions to follow published instrument flight procedures when departing from or arriving to an airport. Note: most commercial aircraft, including air carriers, tend to fly under IFR regardless of local meteorological conditions.

Clear definitions and consistent use of terminology improves understanding and discussion of issues.

Prior to describing the criteria, it is essential that the definitions of "object," "obstruction," "obstacle," and "hazard" are understood.

For purposes of evaluation requirements, an **object** is any element of natural growth, terrain, or man-made structure whose height is greater than 3 inches. There are countless objects on and around airports, ranging from lights, to signs, buildings, cranes, hilltops, trees, flagpoles, electric power transmission poles, smokestacks, and towers. Objects also include clearance zones representing temporary or transient vehicles or vessels—for example, a 17-foot high clearance zone must be considered above interstate highways, clearance zones representing the tallest vessels must be considered over shipping channels, and envelopes of operation must be considered for mobile cargo cranes. Depending on the location of these objects relative to a runway, maximum height requirements may apply. For example, any objects within close proximity to the runway (often up to 250 feet from the runway edge) must be 3 inches or less in height; or, if an object higher than 3 inches above ground is "fixed by function" at an otherwise disallowed location, it should be constructed on low-impact-resistant supports (frangible mounted structures) of the lowest practical height with the frangible point no higher than 3 inches above ground.

All existing and proposed objects must be evaluated if they are of a certain height and certain distance from the runway. The criteria for determining whether or not an object requires evaluation will be discussed below. Any **object** can be independently classified as an **obstruction,** and/or an **obstacle,** and/or a **hazard.** Classification as one of these types is not necessarily related to classification as another type.

Any object could be independently classified as any of the following, not necessarily related types:
- *Obstruction*
- *Obstacle*
- *Hazard*

An **obstruction to air navigation** is defined as any object that, upon evaluation, is determined by the FAA to be required to be properly marked, lighted, and identified on aeronautical publications so that it may be easily recognized by aircraft navigating through the airspace. The criteria for classifying objects as obstructions are contained in FAR §77.23, including exceeding basic heights, effects to terminal or enroute procedures, and penetration of airport imaginary surfaces. Obstructions are subject to further aeronautical study in order to assess hazard status. Properly identifying objects as obstructions allows pilots to pay special attention to maintaining a safe distance from them.

An **obstacle** is defined as any object that does or would penetrate an OCS, or other specific clearance requirements, for a specific flight procedure. An obstacle is known as a "controlling obstacle" when a flight procedure is designed around that obstacle as the limiting factor.

A **hazard to air navigation** is defined as an obstruction or other adverse object that FAA aeronautical study concludes would have a "substantial adverse effect" to a "significant volume of aeronautical operations." FAA Order 7400.2, *Procedures for Handling Airspace Matters,* provides specific guidance for aeronautical studies. Objects that are hazards to navigation have been so determined because they are not sufficiently clear from the normal pathways of aircraft, or because they result in certain other types of defined adverse effects, such as electromagnetic interference, control tower visibility hindrances, or pilot distraction.

There are different criteria for evaluating objects to determine whether it should be considered an obstruction, a hazard to navigation, or both. These criteria are the following:

FAR Part 77—Objects Affecting Navigable Airspace

Perhaps the most well known, but often only partially understood, document containing criteria for evaluating the impact of terrain and vertical development on airspace is FAR Part 77—*Objects Affecting Navigable Airspace.*

FAR Part 77 contains six subparts with specific functions:

Subpart A—Establishes scope, definitions, and standards.

Subpart B—Specifies **notification requirements** for sponsors proposing to build tall structure or structures near airports. Specifies standards to identify construction or alterations requiring notice, construction or alternation not requiring notice, forms required for filing notice, and FAA's role in acknowledging notice.

Subpart C—Specifies the standards for classifying objects as **obstructions to air navigation.** These standards apply to the use of navigable airspace by aircraft and to existing navigation facilities. Provides protection of airspace for civil and military airports and heliports, and for flight procedures.

Subpart D—Provides for **aeronautical studies** of obstructions to air navigation, to determine the effect of proposed construction or alteration on air navigation, leading to a written determination regarding hazard status.

Subpart E—Specifies the Rules of Practice for hearings conducted by FAA.

Subpart F—Provides for the establishment of antenna farms.

FAR Part 77 defines several types of notification standards and obstruction standards, in addition to the familiar civil airport imaginary surfaces, known colloquially as the "Part 77 Surfaces"

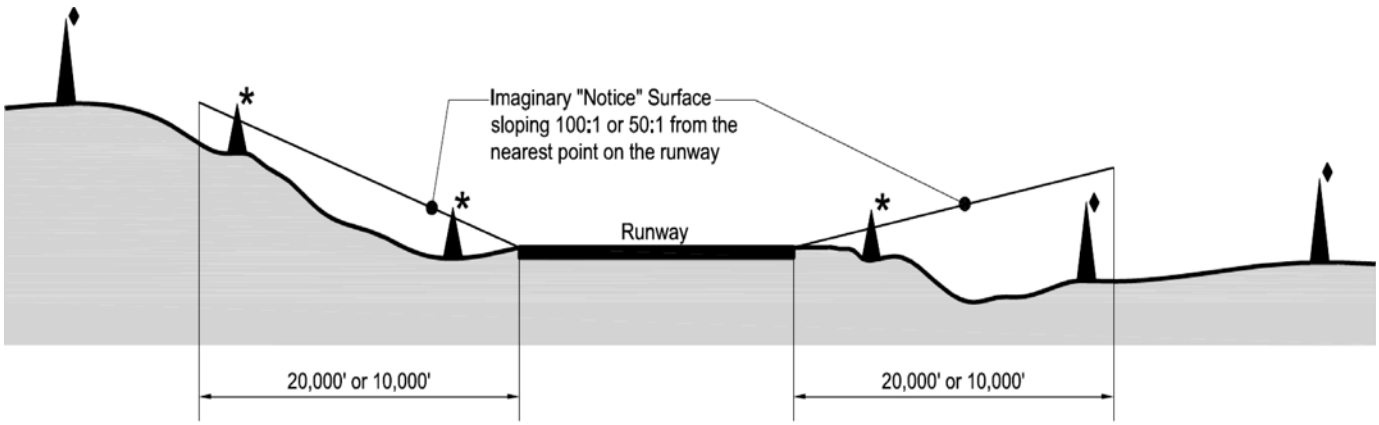
FAR Part 77 considers the entire U.S. airspace, not just in the vicinity of airports. Obstructions can exist anywhere. In fact, any object whose height is more than 500 feet AGL is automatically classified by FAR Part 77 as an obstruction to air navigation. This does not mean that such objects cannot necessarily exist or continue to be constructed. There are hundreds, if not thousands, of buildings, towers, and other objects that have been built that are considered obstructions according to FAR Part 77. Such objects, however, must be made known to the FAA, who then may publish the location and heights of such objects on aeronautical charts and other publications. The following paragraphs describe the notification criteria, obstruction criteria, and provisions for aeronautical studies contained in FAR Part 77.

FAR Part 77 Notification Criteria

Before defining obstruction criteria, FAR Part 77 defines **notification criteria,** which should be used as the first criteria to determine whether or not an object should be evaluated for its potential impact to navigable airspace. According to FAR Part 77, sponsors of proposed construction or alteration in the vicinity of airports are required to provide notification to the FAA as detailed in FAR §77.13 by filing FAA Form 7460-1, *Notice of Proposed Construction or Alteration,* and responding to FAA's inquires that may be posed throughout the aeronautical study process. *Notification is required for any of the following types of structures:*

- §77.13(a)(1) A height more than 200 feet above ground level (AGL) at its site;
- §77.13(a)(2) Within 20,000 feet of a runway more than 3,200 feet in length, and exceeding a 100:1 slope imaginary surface (i.e., a surface rising 1 foot vertically for every 100 feet horizontally) from the nearest point of the nearest runway. See Figure 2.1. (Different standards apply with proximity to airports with runways no greater than 3,200 feet in length and heliports);
- §77.13(a)(3) Roadways, railroads, and waterways are evaluated based on heights above surface providing for vehicles, by specified amounts, or by the height of the highest mobile object normally traversing the transportation corridor;

The notification requirement in §77.13(a)(1) is often overlooked for proposed structures that are distant from airports. However, it applies to any location in the United States, irrespective of proximity to an airport, and irrespective of whether §77.13(a)(2) applies.



♦ §77.13(a)(1) Any proposed construction or alteration more than 200 feet in height above ground level (AGL) at its site requires notice

* §77.13(a)(2) Any proposed construction or alteration penetrating imaginary surfaces in proximity to runways or heliports requires notice

Note: Proposed construction or alteration that is lower than 200 feet AGL and is lower than the 100:1 or 50:1 notification surfaces may require notification under other types of notification requirements. Please see §77.13(a)(3), §77.13(a)(4) and §77.13(a)(5).

Sources: FAR Part 77, FAA Order 7400.2
Prepared by: Jacobs Consultancy

Figure 2.1. Profile view of two types of FAR Part 77.13 notification requirements.

- §77.13(a)(4) When requested by the FAA, any construction or alteration that would be in an instrument approach area and may exceed FAR Part 77 obstruction standards; or,
- §77.13(a)(5) Any construction or alteration on any public-use or military airport.

It is recommended that local municipal planning agencies have these criteria on file, to determine whether or not proposed construction should be considered for its potential impacts to navigable airspace and, irrespective of local requirements, would be required to file notice with the FAA.

Once notification of proposed vertical development is received by the FAA, the FAA begins OE/AAA, a process by which the FAA evaluates whether the proposed object:

(1) Would be classified as an "obstruction to air navigation" and, if so,
(2) Would constitute a "hazard to air navigation."

This process is also commonly known as "The 7460 process," so named after the notification form (FAA Form 7460-1) required to be submitted to FAA. This evaluation process will be discussed in context and a basic level of detail in Chapter 3, and in greater detail in Appendix C, *The FAA's Obstruction Evaluation/Airport Airspace Analysis Process.*

FAR Part 77 Obstruction Criteria

There are five types of obstruction criteria.

According to FAR Part 77, an existing 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:

- §77.23(a)(1)—A height of 500 feet AGL at its site.
- §77.23(a)(2)—A height that is 200 feet AGL or above the established airport elevation, whichever is higher, within 3 nautical miles of the established airport reference point, with its

longest runway more than 3,200 feet in actual length. That height increases in the proportion of 100 feet for each additional nautical mile from the airport up to a maximum of 500 feet. See Figure 2.2.

- §77.23(a)(3)—A height within a terminal obstacle clearance area, including initial approach segment, a departure area, and a circling approach, which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area to be less than the required obstacle clearance. *This incorporates TERPS and other instrument procedure criteria by reference. Any penetration of an instrument procedure obstacle clearance surface is therefore an obstruction, in addition to likely being a hazard.*
- §77.23(a)(4)—A height within an en route obstacle clearance area, including turn and terminal areas, of a Federal airway or approved off-airway route, that would increase the minimum obstacle clearance altitude.
- §77.23(a)(5)—The surface of a takeoff and landing area of an airport or any imaginary surface established in §77.25, §77.28, and §77.29.

The airport imaginary surfaces referenced in §77.23(a)(5) are defined geometrically in subsequent §77.25 (civil), §77.28 (military), and §77.29 (heliports). The most familiar type to

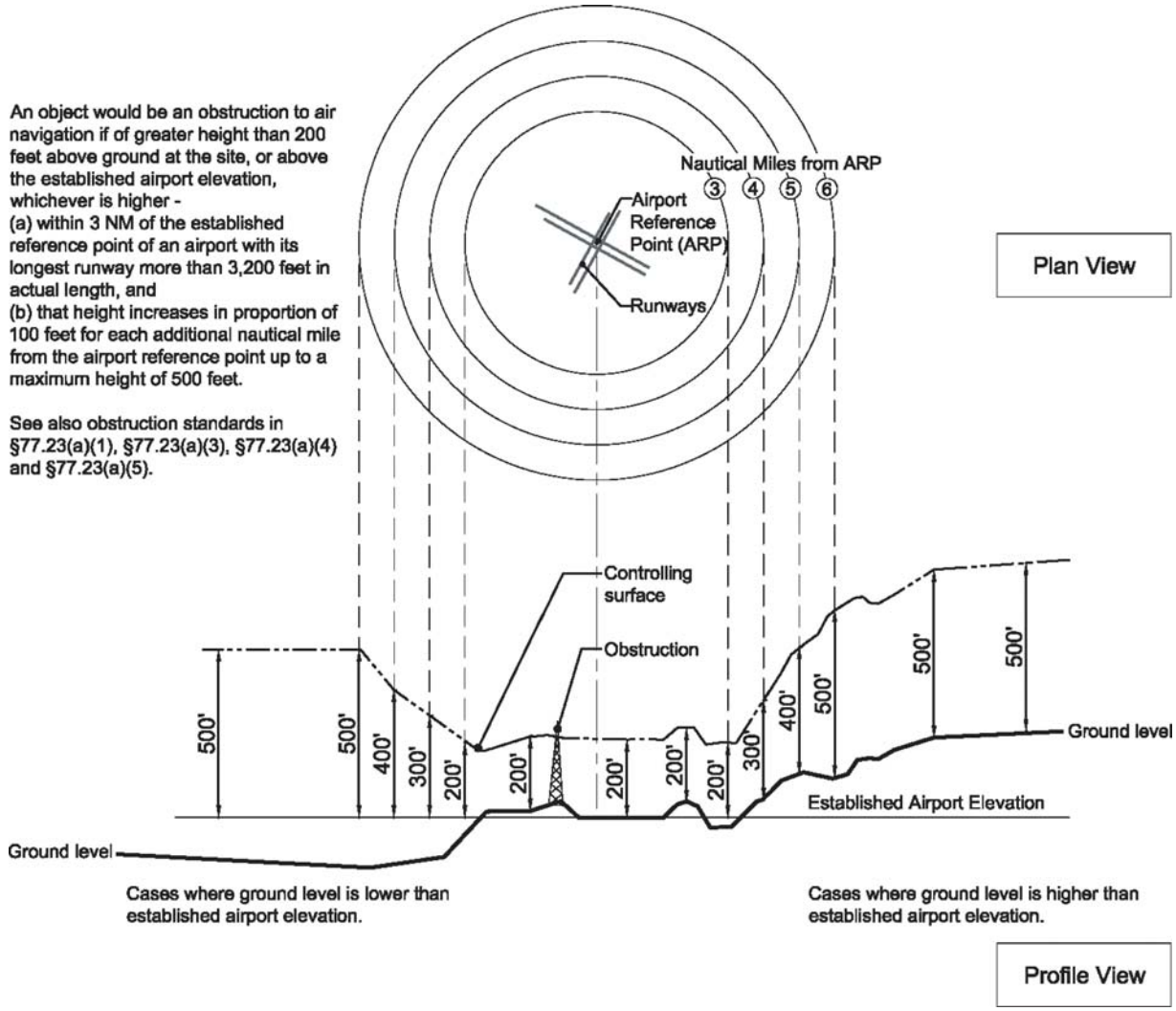


Figure 2.2. Obstruction standards per §77.23(a)(2).

Geometry of civil airport imaginary surfaces is dependent on runway and approach type.

U.S. civil airport operators are the "civil airport imaginary surfaces." They are comprised of five components: primary, horizontal, conical, approach, and transitional. The dimensions of many of the surface components are variable, based on the runway types and approach types. Refer to Appendix A for more detail on how the geometry is developed; as with other criteria definitions in this Guidebook, please refer to the most current source documentations as the ultimate authority.

A scaled depiction of an airport's FAR Part 77 civil airport imaginary surfaces, and a close-up view of the approach surface associated with each runway, are required components of an airport's (ALP) set of drawings. An airport's ALP is often on file at the airport, the local FAA Airports District Office (ADO), and sometimes at local planning agencies. As such, the ALP is the most widely available document to those interested in vertical development in the airport's vicinity.

The ALP airspace drawings are comprised of the following types:

- *Airport Airspace Drawings,* which depict plan and profile views of the entire airport property and surrounding region that is covered by the FAR Part 77 civil airport imaginary surfaces at a large scale.
- *Inner Portion of the Approach Surface Drawings,* which depict plan and profile views of the areas around each runway end, showing the FAR Part 77 civil airport imaginary surfaces, and occasionally other aeronautical surfaces if requested by the FAA.
- *Runway Departure Surface Drawings,* a newer requirement, depicting the TERPS and OEI departure surfaces as specified in AC 150/5300-13, Appendix 2.

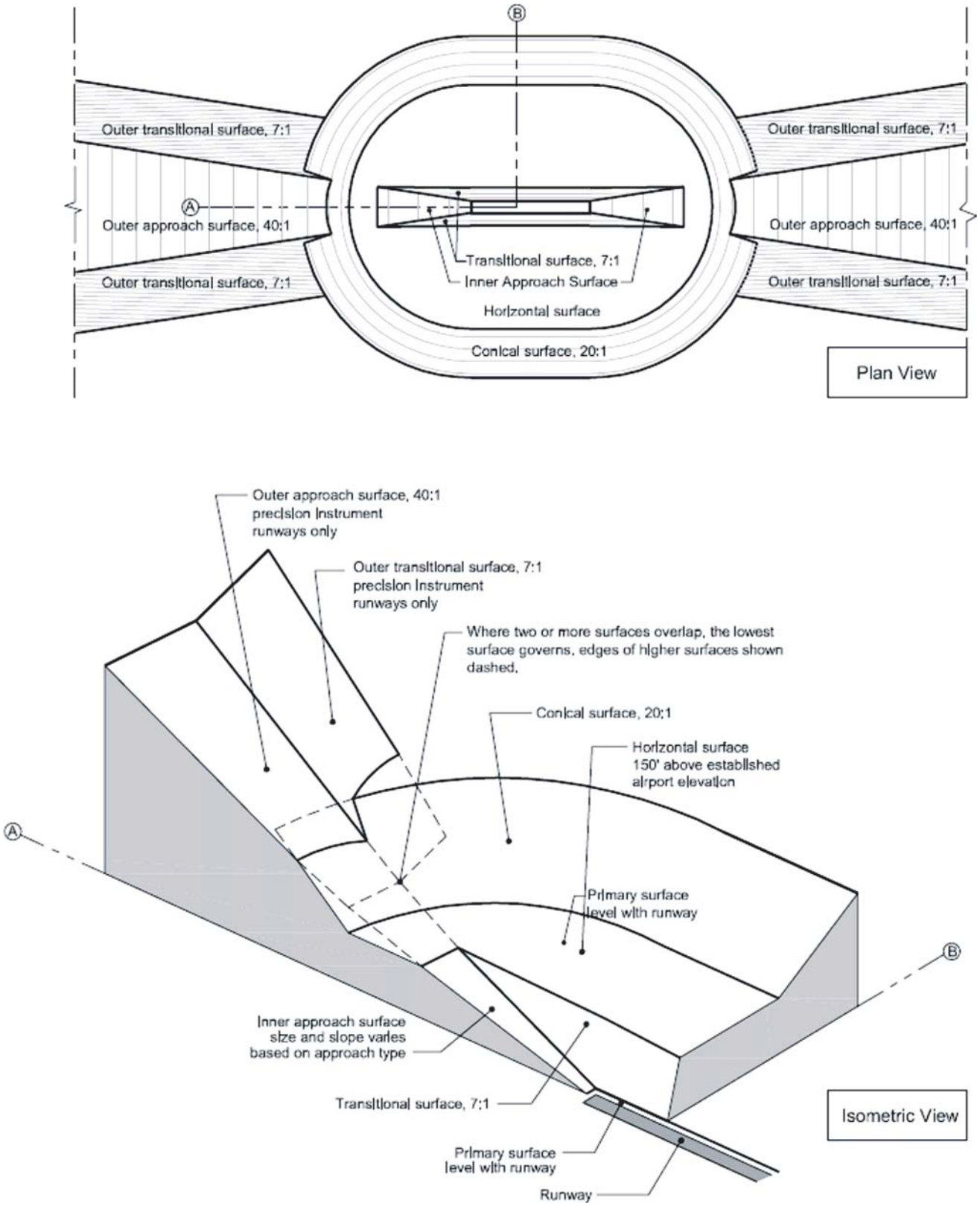
While historically ALP airspace drawings requirements have traditionally focused on FAR Part 77 imaginary surfaces, newer guidance also refers to other criteria that may be relevant. AC 150/5070, *Airport Master Plans,* which has been the governing guidance document for ALP preparation since 2007, asserts (page 78) that:

> The drawing will depict the obstacle identification approach surfaces contained in 14 CFR Part 77, Objects Affecting Navigable Airspace. The drawing may also depict other approach surfaces, including the threshold-siting surface, those surfaces associated with United States Standards for Instrument Procedures (TERPS), or those required by the local FAA office or state agency.

In the research team's experience, this newer guidance has yet to be widely implemented in practice; most airports still default to the old requirements of FAR Part 77 civil airport imaginary surfaces and occasionally threshold siting surfaces, but rarely TERPS or other types of surfaces. It is the research team's recommendation that more types of aeronautical surfaces be depicted, so that multiple types of flight procedures will be protected. This should be coordinated with the FAA as part of the ALP scope development.

Figure 2.3 illustrates the FAR Part 77 civil airport imaginary surfaces, in plan view and isometric view.

Unfortunately, the ALP's airspace drawings are also frequently considered by various stakeholders to be the only source of criteria for which to determine airspace protection compatibility. As frequently emphasized in this Guidebook, this is an inaccurate assumption because other types of airspace criteria for notification, obstruction, and hazard status can and do exist at higher and lower elevations than the civil airport imaginary surfaces. Table 2.2 summarizes the three main functions of FAR Part 77 and outlines some of the limitations and misconceptions that can potentially result.



Sources: FAR Part 77
Prepared by: Jacobs Consultancy

Figure 2.3. FAR Part 77, §77.25 civil airport imaginary surfaces.

Table 2.2. Main functions of FAR Part 77.

What	When	Why	Gaps/Limitations
Notification Criteria	When any of the criteria in §77.13 apply.	To promote evaluation of proposals using obstruction standards.	Lack of awareness; project sponsors may fail to file notification, if not directed by municipal staff
Obstruction Criteria	When any of the criteria in §77.23 are exceeded.	To estimate the critical airspace requirements on and around airports.	Sometimes presumed to be "hard and fast", or even the only criteria applicable to building height limits when other criteria may be more applicable
Aeronautical Study (Hazard Assessment)	When a proposed structure exceeds obstruction standards **and** the project sponsor seeks further aeronautical study in lieu of a reduced structure height.	To trigger detailed aeronautical study using procedure design (TERPS) and other criteria.	In many cases, TERPS or other criteria are significantly higher or lower than the obstruction standards, and therefore contradict early expectations about building height limitations. Does not evaluate airline emergency departure procedures.

Prepared by: Jacobs Consultancy Team

Why FAR Part 77 Alone Is Inadequate

FAR Part 77 does not contain hazard criteria.

FAR Part 77 itself does not contain the criteria for determining whether or not an obstruction will be considered a hazard to air navigation. The FAA's OE/AAA process, as described in FAA Order 7400.2, is the mechanism by which aeronautical study of proposed obstructions is undertaken in order to assess whether or not they would constitute a hazard to air navigation. This process is discussed in greater detail in Chapter 3 and Appendix C.

As related to the relatively simple notification and obstruction criteria found in FAR Part 77, the more complex criteria applied in the OE/AAA process can be difficult to understand for several reasons:

TERPS surfaces can be lower than, and extend beyond, FAR Part 77 civil airport imaginary surfaces.

1. One limitation is that the review undertaken in an FAA aeronautical study involves a more detailed, airport-specific evaluation of multiple types of criteria. For evaluating the impact of a proposed structure, TERPS and other flight procedure design criteria are applied. Occasionally, construction proponents assume, incorrectly, that there are no aeronautical height limitations beyond the edges of the FAR Part 77 civil airport imaginary surfaces. However, TERPS surfaces and other aeronautical factors can be lower than, and/or extend beyond, the FAR Part 77 civil airport imaginary surfaces.

Individual airlines' OEI procedures are not factored into OE/AAA evaluations.

2. Another limitation is that airline emergency departure procedures, specifically OEI procedures, are not routinely considered in an aeronautical study. For commercial service airports, this may be a critical gap, as airlines must comply with the surface criteria related to these procedures. Degradation of the clear airspace available for these procedures, due to the construction of incompatible structures, can make it economically infeasible for airlines to carry out certain operations. The general effect is to shorten the usable runway length for departure operations and limit the air service capability (non-stop markets that can be reached by a majority of aircraft operating at the airport) of the airport.

Common Misconceptions

Issues related to these limitations that were generally found at the case study airports, and relayed to the research team from many other airports, included:

1. Project sponsors may fail entirely to submit notification to the FAA even when they exceed the FAR Part 77 notification criteria. Encouraging project sponsors to initiate the FAA OE/AAA process should occur at the local municipal or county government level as a routine part of the entitlements process, and should also be encouraged by the airport sponsor through community outreach.
2. Misconception that the FAR Part 77.25 imaginary surfaces are the only criteria to consider. As discussed above, there are many other criteria required to be considered by the FAA, airlines, and even the airport sponsor. As a corollary, there is a lack of awareness of the differences between notification, obstruction, and hazard limits—often there is assumed to be a single type of airspace limit.
3. Misconception that if an object is underneath the FAR Part 77.25 imaginary surfaces the object will not be a hazard to air navigation. There are many cases where TERPS or other airspace protection criteria are more restrictive, that is, have "lower surfaces" than those in FAR Part 77.25.
4. Misconception that a no-hazard determination by the FAA fully protects the air service capability of the airport. Historically the FAA has explicitly not considered OEI procedure impacts to be the basis for a determination of hazard. There have been cases where a building has received a no-hazard determination but resulted in airline weight penalties and potential loss of service to long-haul and/or international markets.

Lack of awareness or misconceptions regarding airspace protection requirements can allow a construction project to proceed through stages of planning and design, based on a height limit that is incompatible with aeronautical operations.

These common misconceptions can (and have) lead to serious conflicts between airport sponsors, land use developers, redevelopment agencies, municipal planners, and the aviation community, state transportation departments, and the FAA. These issues cannot be resolved by changing the existing Federal criteria, and therefore can only be addressed with enhanced airport management understanding of the various airspace protection criteria; communication and outreach with the FAA, local development community and local aviation community; and local policies and/or regulations.

Refer to Chapter 4 for conclusions and recommendations related to application of various airspace protection criteria by various parties. Airspace protection criteria related to specific flight procedures is discussed in the following sections.

TERPS criteria are primarily used by FAA instrument procedure designers to design instrument flight procedures.

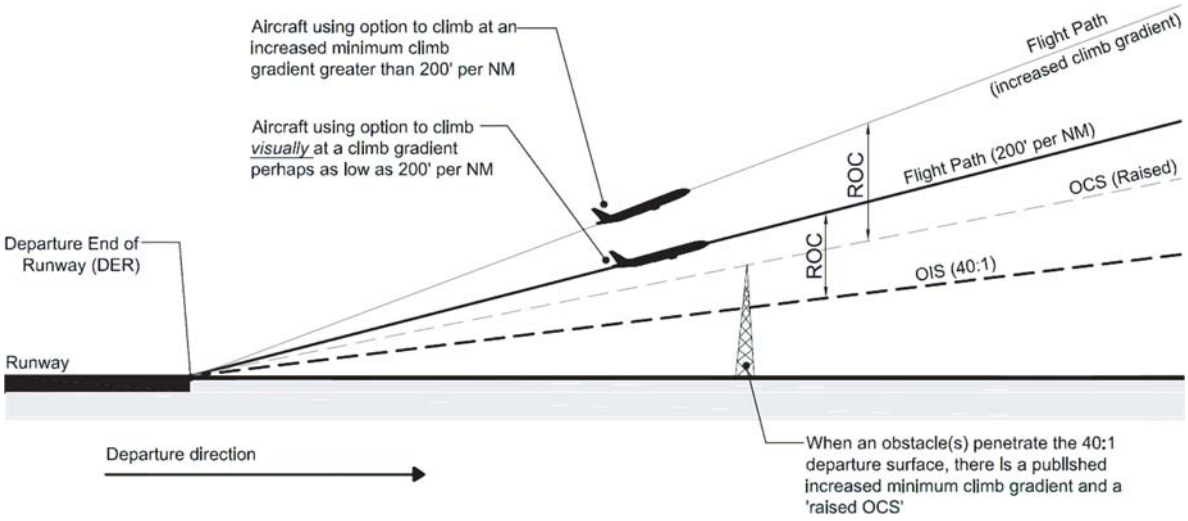
They are also applied "in reverse" to map obstacle clearance surfaces that are one of the most common factors dictating hazard status, because affecting an instrument procedure is generally considered a significant adverse effect.

FAA Order 8260.3B, *The United States Standard for Terminal Instrument Procedures (TERPS)*

The instrument flight procedure developer uses the criteria contained within Order 8260.3B to develop a particular instrument flight procedure, for example, a precision approach to a certain runway at a certain airport.

TERPS criteria are designed to provide a margin of safety, known as required obstacle clearance (ROC), between aircraft in flight and permanent objects, including terrain, vegetation, and man-made objects. After mapping the runways, terrain, and critical obstacles, the procedure designer applies the criteria to develop the specific flight path. Criteria for different systems of instrumentation are different based on the horizontal and vertical margins of error (i.e., deviation of actual versus reported flight path) known for each system of instrumentation (Figure 2.4).

For each segment of each procedure, an obstacle accountability area (OAA) is first developed. The OAA is a two-dimensional area showing the limits of where obstacles need to be considered for the particular flight procedure. Based on the flight path and ROC, the obstacle identification surface (OIS) is constructed next at default or ideal alignments. If the OIS is found to be clear of obstacles, it functions as an obstacle clearance surface (OCS), and the procedure can have optimal flight path parameters. If the OIS is found to have penetrating obstacles, an alternative OCS



Sources: FAA Order 8260.3B
Prepared by: Jacobs Consultancy

Figure 2.4. Illustration of Flight Paths, Obstacle Identification Surface (OIS), Obstacle Clearance Surface (OCS) and Required Obstacle Clearance (ROC) Concepts, as applied to TERPS Obstacle Departure Procedures.

is created that clears the obstacles, and/or the visibility minimums of the procedure are raised from the ideal elevations upwards to an elevation where the penetrating obstacle would not cause a reduction in minimum ROC. As a general practice, OCSs are **not** raised to accommodate new obstacles.

Although TERPS (and its derivative) and related instrument flight procedure design criteria documents are primarily written for the use of FAA instrument procedure designers, with respect to aeronautical studies, the criteria are also applied "in reverse" to map existing procedures' OCSs. The OCSs of existing procedures are one of the most common factors dictating hazard status, because affecting an instrument procedure is generally considered a "significant adverse effect."

TERPS surface mapping is complex and time-consuming, and needs periodic updating because procedures and criteria change.

Although TERPS OCSs can be mapped, the majority of airports rely on the OE/AAA process to effectively "protect" TERPS OCSs, for a variety of reasons:

- An airport can't effectively protect what it doesn't know. TERPS OCSs are difficult to map correctly because the criteria are technically complex. TERPS is often regarded as a "black box" even by those in the aviation industry. Successful mapping requires accurate plotting of the designed flight paths, followed by accurate depictions of the OCSs, including both horizontal and vertical information. This effort is time-consuming, and can be costly if conducted by outside consultants.
- Even when a high level of expertise and care is exercised in a TERPS surface mapping effort, any errors made can lead to misinformed judgments in response to height feasibility questions, which can subsequently conflict with the results of the OE/AAA process and with actual flight procedures. This can be a significant liability for the airport.
- Even the most accurate and complete TERPS surface mapping effort represents a "snapshot in time" of the airport's protection requirements for its current catalog of published instrument flight procedures. The mapping needs to be updated periodically, because the TERPS surfaces can and do change over time, for several reasons:
  - Parameters specified in certain published instrument flight procedures (e.g., waypoints, visibility minimums, glideslope angles, etc.) may be changed.

Airports that have invested in the effort have found it beneficial, both internally and externally.

It does not replace the FAA OE/AAA process.

- The criteria specifying how various OCSs are configured may be changed, as the criteria Orders are updated, cancelled, or new Orders are published.
- Existing procedures may be cancelled and new procedures may be implemented as old types of instrumentation technology are replaced by new types.

That said, several of the case study airports (Boston-Logan, Oakland International, and San Jose International) and other airports nationwide have undertaken composite aeronautical surface mapping efforts, including all known TERPS surfaces, and sometimes additional criteria such as OEI, VFR, and certain obstruction standards. These airports have found the mapping efforts to be beneficial because a comprehensive map of aeronautical protection requirements gives airport management the capability to respond quickly to height feasibility inquiries for both on- and off-airport proposed development. When responding to height feasibility inquiries, especially from non-airport parties, liability is mitigated by providing caveats and qualifiers that the airport's information may not be entirely accurate and does not supersede or replace the FAA OE/AAA process.

FAA AC 150/5300-13, *Airport Design,* Appendix 2: Runway End Siting Requirements

Familiarity with the basic airport design standards in AC 5300-13 is critical to understanding many airport planning issues.

FAA AC 150/5300-13, *Airport Design,* contains most of the fundamental criteria for designing civil use airports. It contains references to, and is referenced by, many related criteria documents. The criteria it specifies include runway widths and safety area requirements (runway length criteria are published under a separate AC), taxiway dimensional requirements, and other requirements for protecting the immediate airspace around runways.

The AC's Appendix 2, *Runway End Siting Requirements,* includes a set of criteria that determines whether or not an object and a runway threshold or departure end would be compatible, based on the object's height and proximity to the end of the runway, and the type of runway and flight procedures authorized for the runway. These criteria function to ensure the areas immediately around the ends of runways are clear of obstacles for approaching and departing aircraft.

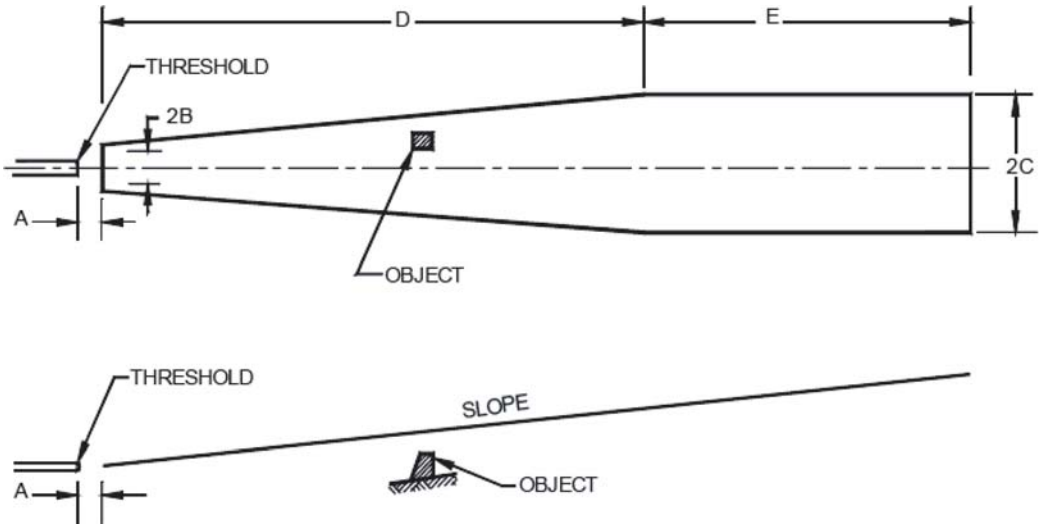
Runway end siting surfaces can be applied to locate a runway end with respect to existing obstacles or in the reverse, check a proposed obstacle for compatibility with existing runway ends.

The primary purpose of runway end siting surfaces is to set criteria for determining the location and siting of a proposed runway or runway extension. That is, given an existing set of obstacles (terrain, vegetation, and man-made objects), the criteria may be used to determine the allowable location of a runway end. However, these criteria should also be applied when considering the opposite situation: whether or not any object (whether existing or proposed, whether natural vegetation or man-made) would be incompatible with the safe approaches and departures of aircraft to an existing runway end.

The criteria for determining whether or not an object near the end of the runway would be incompatible with runway operations are based on sloped trapezoidal surfaces known as the "runway end siting surfaces." The siting surfaces have varying dimensions based on the runway type, approach type, the runway's "design aircraft," and other parameters. Refer to Appendix A, and the source documentation, for more detail.

There are two types of runway end siting surfaces:

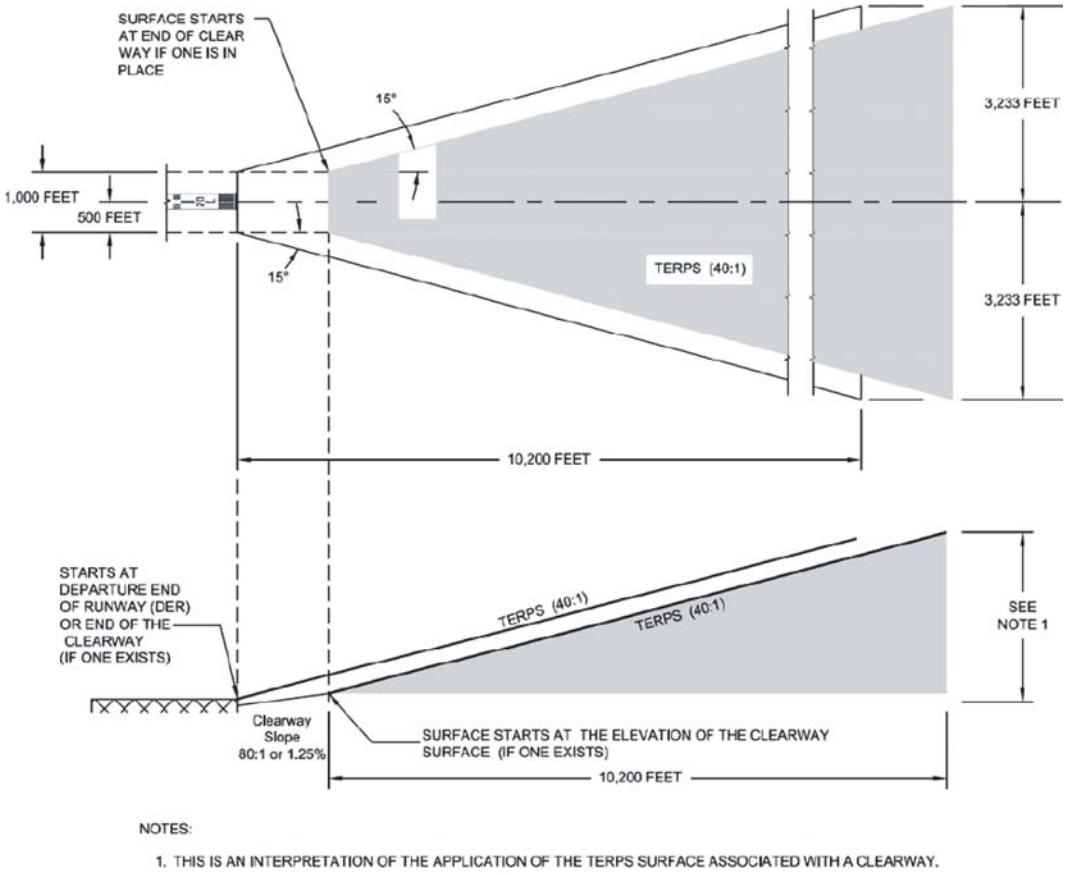
1. **Threshold siting surfaces** (Figure 2.5), which ensure compatibility between nearby objects and the runway's threshold, which is defined as the first part of pavement available and suitable for landing; and
2. **Departure end siting surfaces,** which ensure compatibility between nearby objects and the Departure End of Runway (DER), which is essentially the point on the runway where, during a takeoff operation, the aircraft must be airborne and ascending (Figure 2.6).



Source: AC 150/5300-13, Appendix 2

Figure 2.5. Threshold siting surface.

Most U.S. airports do not apply a clearway, therefore the instrument departure surface normally begins at the pavement endpoint, or a displaced position if the takeoff run available (TORA) is shortened.



Source: AC 150/5300-13, Appendix 2

Figure 2.6. Departure end siting surface.

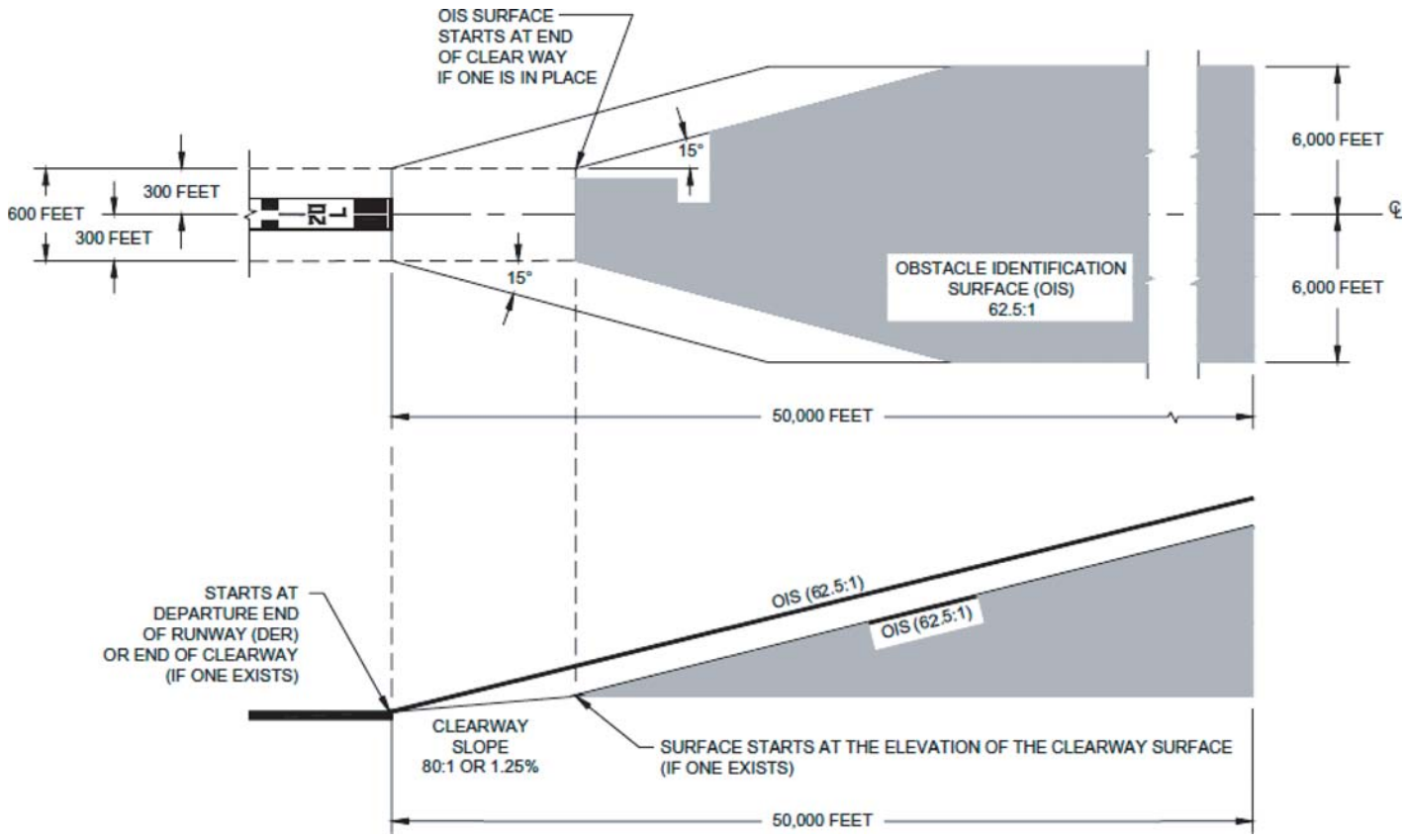
As a basic airport design requirement, threshold siting surfaces must be kept clear of obstacles either by removing or lowering the obstacles or displacing the threshold (discussion follows). Several of the case study airports experienced FAA Part 139 inspectors compelling the clearance of threshold siting surfaces.

The 40:1 departure siting surface mirrors TERPS requirements. Therefore, certain exceptions are acceptable for existing obstacles mitigated by published climb gradients.

The requirements related to departure end siting surfaces are less inflexible. The 40:1 departure surface is a duplicate of the TERPS requirement for instrument departures at the standard minimum climb gradient of 200 feet per nautical mile (fpnm). For most runways at most commercial service airports, the default value for the climb gradient specified the Obstacle Departure Procedure (ODP), is 200 fpnm; but for some runways at some airports, obstacles preclude this value, and steeper minimum climb gradients are specified. Where this is the case, the 40:1 OIS is replaced by a steeper OCS (refer to this chapter's prior discussion of TERPS including departure surface diagram). In these cases, the 40:1 departure siting surface would be impossible to "enforce" as the obstacles would be considered "grandfathered". Therefore, the 40:1 departure end siting surface is applied as an ideal standard for new runways, and the operative standard for runways that do not have a published increased minimum climb gradient, but should not be considered "retroactive" nor force the displacement of an existing DER.

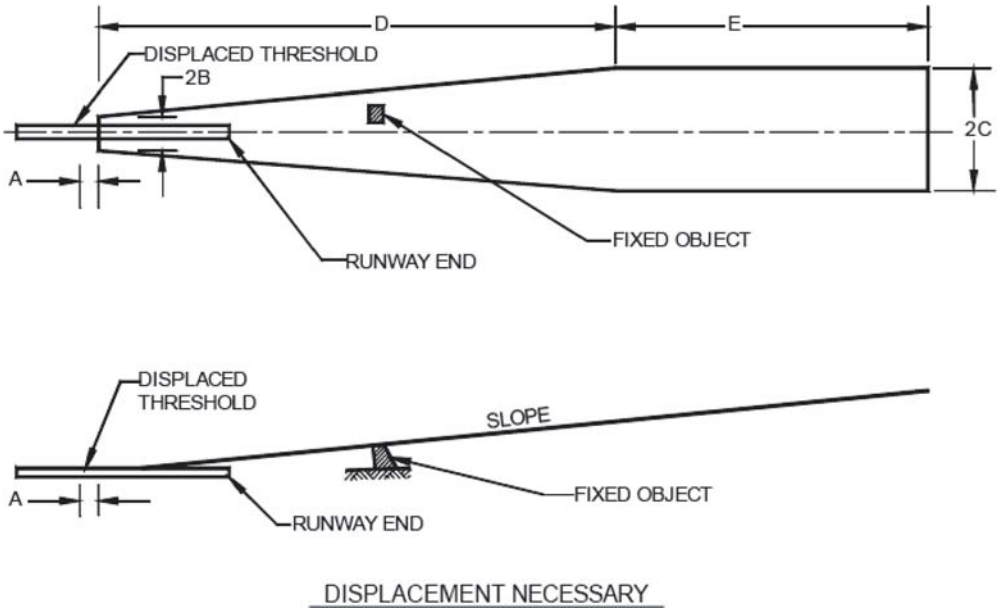
The OEI OIS is for obstacle identification purposes. It is not a clearance requirement.

The newest type of departure end siting surface in AC 150/5300-13, Appendix 2, is the OEI OIS. As Figure 2.7 illustrates, this is a very large surface extending from the DER 50,000 feet at a slope of 62.5:1. The purpose of this surface is to identify objects in the departure corridor that may be of concern to airlines in developing OEI procedures, and for incorporating into obstacle databases maintained by the FAA. As discussed in various parts of this Guidebook, airline



Source: AC 150/5300-13, Appendix 2

Figure 2.7. OEI OIS.



Source: AC 150/5300-13, Appendix 2

Figure 2.8. Threshold siting surface, displacement necessary.

OEI procedures are not considered in the current OE/AAA analysis process. However, such procedures are vitally important to the airport.

In addition to describing the runway end siting surface criteria, Appendix 2 presents the runway design alternatives to adjusting for obstacles near the end of the runway. These alternatives focus on the idea of creating what is known as "declared distances," which effectively shortens the useable lengths of the runway, through displacing the threshold and/or DER.

The FAA considers threshold displacement a "last resort," if no other feasible alternate exists, because it results in the loss of operating runway length.

On any given runway, the threshold is the demarcation line that defines the beginning of useable pavement for an aircraft to land. Typically, the threshold is located at the end of the physical pavement of the runway, thereby allowing an approaching aircraft to land with the maximum amount of pavement provided. A displaced threshold is defined by the placement of the threshold line away some distance from the end of the pavement. This displaced threshold defines a new location along the runway where an approaching aircraft may touchdown on the runway. Often, the purpose of the displaced threshold is to allow an approaching aircraft ample clearance over obstacles in the approach area (i.e., those obstacles that would exceed the threshold siting surfaces defined in AC 150/5300-13, Appendix 2). Displacement of the threshold shortens the useable runway length for landing, while not affecting the length of the runway available for departing aircraft (Figure 2.8).

Thresholds can also be displaced for a variety of purposes including obstacle clearance, noise abatement, runway protection zones, runway safety areas, navigational aid (NAVAID) clearances, approach light system (ALS) alignments, or air traffic management (i.e., removing or mitigating "adverse stagger" with respect to a parallel runway). It is generally **not** an acceptable practice to displace a threshold on an existing runway for no other reason than to accommodate proposed obstacles that would penetrate the threshold siting surface or other aeronautical surface.

OEI Criteria

Over the last 10 to 20 years, there has been an ongoing dialogue concerning the protection of airspace associated with airline OEI emergency flight procedures. A fundamental issue is whether OEI procedures should be included in as an obstruction or hazard criterion in the OE/AAA process.

OEI is not typically a criterion considered by the FAA in OE/AAA evaluations, because OEI procedures are designed by individual airlines, can vary considerably, and can be adjusted to accommodate new obstacles—although sometimes to a degree that is unacceptable to airlines. Airlines have become increasingly vocal in their call to include OEI considerations in FAA OE/AAA evaluations. Airport sponsors and airport users are concerned about the potential impacts to their airport's air service capability—the range of markets that can be feasibly reached in a nonstop flight. Degradation of OEI procedures can lead to a shrinking range of air service capability. Some municipalities and the real estate development community are concerned about overly restricting developable heights on private land. As a result of these constituencies and concerns, there is less certainty in obstruction evaluations for OEI procedures than in other obstruction criteria as discussed above.

Airspace protection for OEI procedures is complex and not standardized. Degradation of OEI procedures leads to weight penalties, which can significantly reduce air service capability.

It is important to note that the 62.5:1 slope used in many OEI evaluations is an obstacle identification surface and not considered by the FAA to be an OE/AAA obstruction or hazard criteria surface, nor a runway end siting surface that must be clear of obstacles. Issues that must be resolved in order for OEI to become a standardized protection criterion include:

- OEI procedures are specific to airline and runway end.
- Different members of the aviation community consider OEI as either a safety or economic issue.
- TERPS criteria is based on normal (all engines operating) conditions.
- The basic measure of the affect of and obstacle on OEI procedures is airline weight penalties (loss of capability to carry passengers, cargo, or fuel/range).
- Obstacles can affect OEI procedures to the point where airlines discontinue service to markets whose flights would incur unreasonably high weight penalties.
- Existing obstacles define the airline OEI performance capability—existing obstacles may result in climb rates greater than 62.5:1.
- Airlines will request different departure runways to maximize OEI performance/safety margins—potentially resulting in aircraft delays or other operational impacts when nonstandard runways are requested.

At the time of this writing (early 2010), the FAA is conducting an OEI Pilot Program at five U.S. airports, attempting to resolve the above issues. At some of these airports, as well as some of the case study airports (Boston-Logan, San Jose International), an airport-initiated effort has led to the development of a customized aeronautical surface protecting an aggregate of the airlines' OEI procedures. Because this surface was not developed by the FAA and is not routinely considered in the OE/AAA process, it must either (1) have recommendation-only status, or (2) be adapted by the local municipalities into height zoning ordinances.

The criteria discussed are the fundamental standards by which objects in the vicinity of airports must be considered for their potential impact to air navigation.

Summary

FAR Part 77 provides criteria for whether or not a proposed object should be submitted to the FAA for evaluation; whether or not that object would be classified as an obstruction to air navigation; and, if so, whether it should be studied further in order to assess hazard status.

TERPS and related instrument procedure design criteria provide the basis of how the aircraft relying on cockpit instrumentation take off and land at the airport in a safe and efficient manner while avoiding the existing obstacles. TERPS criteria can also be applied to evaluate whether proposed objects would conflict with existing or planned instrument procedures.

AC 150/5300-13's Runway End Siting Requirements provide basic design standards for locating runway ends that do not conflict with existing objects and may be used to determine conflicts between existing runway ends and proposed objects. Runway end siting criteria also

provide criteria for initially evaluating whether or not an object may be in conflict with all-engine instrument departure procedures and whether or not notification of a potential obstacle should be given to air carriers using the airport for evaluation of its potential effect on their OEI procedures.

OEI requirements are currently not standardized to the degree they can be consistently applied as an obstruction or hazard criteria in the OE/AAA process. However, they are vitally important to an airport's air service capabilities, and efforts are underway at individual airports and nationally to standardize OEI procedure protection.

The process of notifying the FAA of any proposed objects, and the subsequent steps that are taken to determine whether or not the object would be an obstruction to air navigation, a hazard to air navigation, and/or have any implications on air carrier operations, is a complex and often lengthy and confusing process. Chapter 3 provides an explanation of the process, the challenges that can occur during the process, and strategies to overcome these challenges.

CHAPTER 3

Mechanisms and Processes of Airspace Protection

This chapter describes the who, what, where, when, and how of airspace protection. Specifically, it outlines the mechanisms and processes, and the roles and responsibilities of the various parties to the process. Please refer to Chapter 4 for recommendations and best practices related to these processes.

Roles and Responsibilities of the Authority Having Jurisdiction to Issue Construction Permits

A good starting point for assessing whether a proposed structure ought to be checked for airspace compatibility issues is when it exceeds any of the heights specified in the "Notification Requirements" in FAR Part 77.13.

The evaluation of any proposed object that may affect navigable airspace, particularly within close proximity to an airport, should begin with the staff on the local planning agencies and permitting authorities recognizing that such an evaluation may be necessary. At a minimum, any proposed object that would exceed the heights in the notification criteria found in FAR Part 77 must be formally evaluated by the FAA. Additionally, proposed objects in the approach-departure corridors or meeting other alignment and/or height criteria as requested by the FAA or the local airport should be evaluated.

The local authority having jurisdiction has the responsibility of working in partnership with the FAA and the local airport management to protect airspace vital for the airport's operations. This protection is achieved by incorporating airspace protection considerations in height zoning regulations and the construction permit process, whether through direct height limits or through indirect means such as requiring a favorable determination from the FAA.

Roles and Responsibilities of the Construction Proponent

File notice with the FAA as early as possible in the project planning process, because the FAA aeronautical study process can be lengthy.

The construction proponent (a generic term for owner, real estate developer, or other individual or partnership) is required to file notice with the FAA when the height of the proposed construction would exceed the heights specified in the "notification requirements" in FAR Part 77.13. Because the FAA aeronautical review process can be lengthy and cannot be expedited through paying premium fees (it is free of charge), notice should be filed as early as possible in the planning stages of the project, when the location of the structure and its desired maximum height are established.

The construction proponent is responsible for providing (1) complete and accurate data on the notification form; (2) timely responses to any questions from the FAA that may arise during

Consider informally notifying the local airport, who can be a good source of information, and a potential ally in the FAA review process.

the aeronautical review process; and (3) when the structure is complete, notification of actual construction.

Although perhaps not required by laws or regulations, it may be advantageous for the construction proponent to notify the local airport(s) that may be affected by the proposed construction, including smaller general aviation airports that may be affected as well. An informal meeting to discuss early ideas and alternatives can often build trust between the parties and help avoid or mitigate potential conflicts before spending significant time and effort in the planning and design of construction that may be incompatible with airspace protection standards.

The FAA's OE/AAA Process

As set forth in Title 49 of the U.S. Code of Federal Regulations, §40103, "The United States Government has exclusive sovereignty of airspace of the United States." In protecting and administering the use of U.S. airspace,

> The Administrator [of the FAA] shall prescribe air traffic regulations on the flight of aircraft (including regulations on safe altitudes) for—
>
> (A) navigating, protecting, and identifying aircraft;
> (B) protecting individuals and property on the ground;
> (C) using the navigable airspace efficiently; and
> (D) preventing collision between aircraft, between aircraft and land or water vehicles, and between aircraft and airborne objects.

The FAA carries out these responsibilities through a variety of means. The primary means by which the FAA analyzes proposed construction or alteration ("protecting individuals and property on the ground") that may affect navigable airspace is through the OE/AAA process.

The following paragraphs highlight the major steps of the OE/AAA process. A more detailed description of the multiple steps, choices, and potential outcomes can be found in Appendix C, *The FAA's Obstruction Evaluation/Airport Airspace Analysis Process.*

The OE/AAA website allows anyone to create a user account, to file notices and receive automatic updates.

The formal airspace evaluation process begins with the submission of FAA Form 7460-1, *Notice of Proposed Construction or Alteration.* This form may be submitted on paper via U.S. mail, or online at http://oeaaa.faa.gov. Filing online expedites processing. Any individual may create a user account on this website, which can be used to file notices and track the progress of pending cases and also to submit comments on pending cases.

The OE/AAA website is a user interactive system that not only allows for the electronic submittal of Form 7460-1 information, it also provides background and context information that various types of users may find useful regarding the processes and regulations applicable to aeronautical studies.

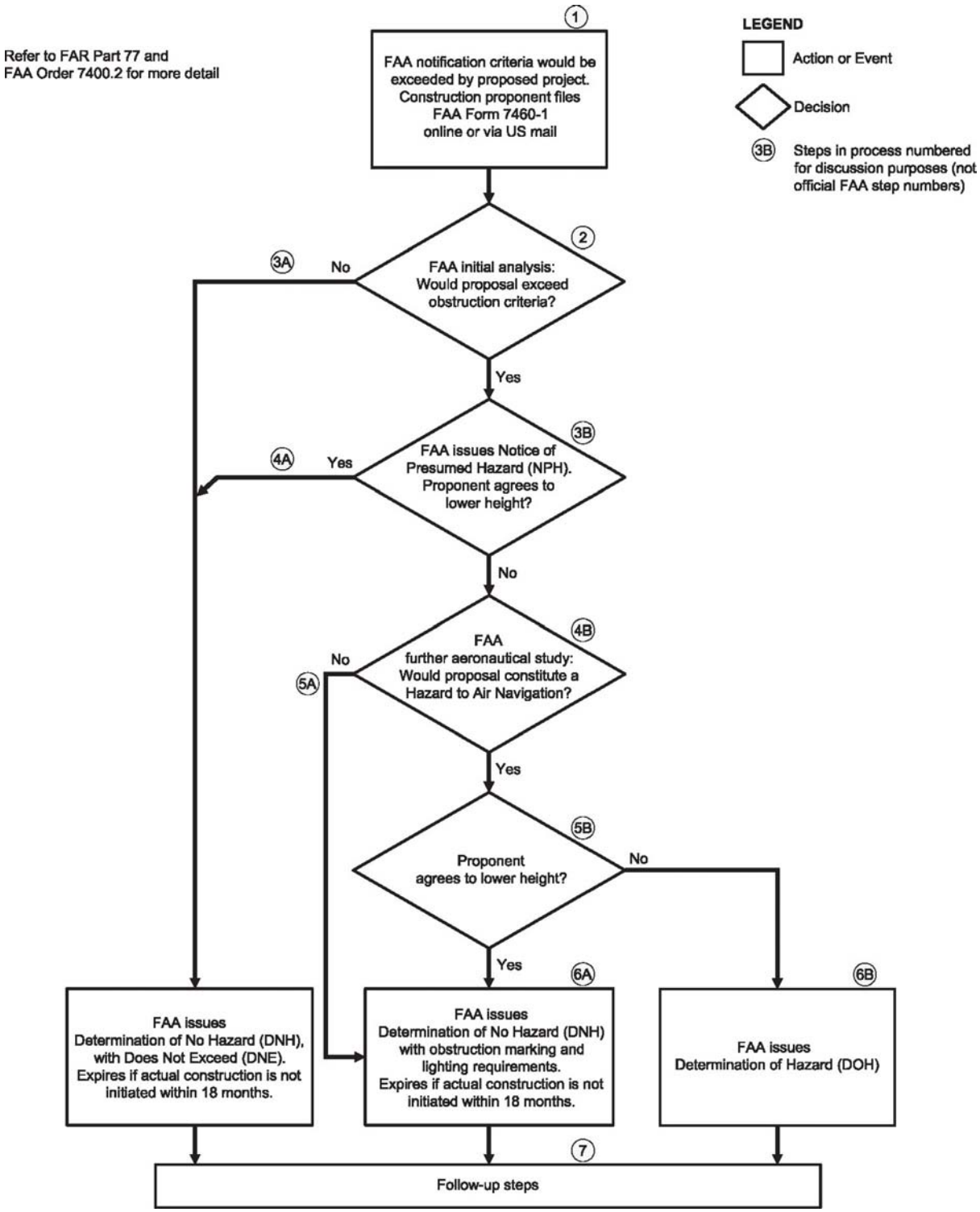
For good background information, review the documents in the "Information Resources" links.

The website also allows subscribers to specify certain geographic boundaries within which they would be automatically notified when OE/AAA cases are circularized under Public Notice and issued final determinations. This feature is of particular utility to airport management, so that they may become aware of proposals in the vicinity of their airport that may be of concern.

Figure 3.1 illustrates the major steps that occur following the submission of a Form 7460-1, resulting eventually in a final determination.

The following is a brief summary of the major steps in the FAA's OE/AAA process. Numbered steps refer to Figure 3.1.

(1) Any proponent planning on any new construction or alteration that might affect navigable airspace, as defined in FAR Part 77.13, must file an **FAA Form 7460-1, *Notice of Proposed Construction or Alteration***.



Sources: FAR Part 77, FAA Order 7400-2
Prepared by: Jacobs Consultancy

Figure 3.1. Major steps in the FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) Process.

(2) When the Form 7460-1 has been filed, the FAA acknowledges receipt, assigns an aeronautical study number (ASN), and conducts an initial analysis to determine whether the proposal would exceed any of the five types of **obstruction criteria,** as defined in FAR Part 77.23.

Because of limited FAA staff resources and the complexities involved with aeronautical study, specific timelines cannot be guaranteed in the OE/AAA process.

(3A) If the proposal would not exceed any of the five types of obstruction criteria, including basic heights, effects to instrument or en route procedures, or imaginary surfaces, the FAA issues a **Determination of No Hazard (DNH)** with Does Not Exceed (DNE). This type of DNH takes the shortest amount of time to obtain.

(3B) If the proposal would exceed obstruction criteria, a **Notice of Presumed Hazard (NPH)** is issued, and the proponent is requested to lower the height of the proposed construction or alteration to the height not exceeding obstruction criteria.

(4A) If the proponent agrees to lower the height of the proposed construction or alteration to the height not exceeding obstruction criteria, the FAA routinely issues DNH with DNE. This type of DNH takes somewhat longer to obtain.

The construction proponent can help expedite the process by filing online, providing complete and accurate data, responding to FAA in a timely manner, and agreeing to lower the height of the proposal if it is likely to be determined to be a hazard to air navigation.

(4B) If the proponent does not agree to lower the height of the proposed construction or alteration to the height not exceeding obstruction criteria, the proponent requests the FAA to perform **further aeronautical study** in order to assess whether the proposal would constitute a **hazard to air navigation.** FAA Order 7400.2, *Procedures for Handling Airspace Matters,* articulates the primary methods for conducting aeronautical studies to ensure the safety of air navigation and the efficient use of the navigable airspace by aircraft. Multiple lines of business within the FAA (and the U.S. military, if applicable) evaluate the proposal against multiple types of criteria protecting specific operations at and near the airport(s) that may be affected. These criteria routinely include instrument flight procedures (TERPS and related criteria), visual flight procedures, navigational aids and radar, control tower line-of-sight, and air traffic control procedures.

If the FAA deems the proposal may be controversial, complex, or otherwise require additional outside input, the proposal may be circularized under **Public Notice,** whereby stakeholders may comment on the potential aeronautical effects. This is the main opportunity for airport management and other aviation stakeholders to provide input. Comments submitted under Public Notice must be of a significant aeronautical nature in order to be considered by the FAA.

A "hazard to air navigation" is indicated if the FAA concludes that the proposal would cause a "substantial adverse effect" to a "significant volume of aeronautical operations." FAA Order 7400.2 defines the criteria for determining "substantial adverse affect" and "significant volume of aeronautical operations."

Typical triggers of hazard status include the following:

- Height: the primary focus of this research—the object would be an obstacle that would affect published instrument procedures (TERPS and related criteria), and/or visual flight procedures, and/or runway end siting surfaces.
- Electromagnetic interference: the object, due to its size, position, material composition, or electromagnetic emissions, would block or distort electromagnetic signals to or from critical navigation aids, satellites, radar, or aircraft.
- Visual impediments: the object would block or otherwise interfere with FAA control tower line of sight, or would cause pilot or controller distraction due to glare, smoke, dazzling lights, sun reflection, or other factors.
- Wildlife attractants: the object—or, more commonly, use—would attract birds or other wildlife that could jeopardize aircraft operations. The most common example is a garbage dump that would likely attract a large number of birds.

(**5A**) At the conclusion of further aeronautical study, if the FAA determines that the original proposal would not constitute a hazard to air navigation, the FAA issues a DNH with obstruction marking and lighting requirements. This type of DNH takes longer to obtain, due to coordination with multiple reviewers.

(**5B**) If the FAA determines that the original proposal would constitute a hazard to air navigation, the proponent is requested to lower the height of the proposed construction or alteration to some negotiated height not exceeding hazard criteria.

(**6A**) If the proponent agrees to lower the height of the proposed construction or alteration to a negotiated height not exceeding hazard criteria, the FAA issues a DNH with obstruction marking and lighting requirements. This type of DNH takes the longest to obtain, because it requires the most coordination with multiple FAA lines of business, other stakeholders, and the construction proponent's team.

(**6B**) If the proponent does not agree to lower the height of the proposed construction or alteration to some negotiated height not exceeding hazard criteria, the FAA issues a **Determination of Hazard (DOH).**

(**7**) The FAA final determinations are referenced by various authorities and stakeholders for a variety of purposes. **DNHs have an 18-month expiration period,** although an 18-month extension can sometimes be granted if requested in writing. The DNH becomes permanent once actual construction has begun. Actual construction is defined as foundations or structure; site clearing and earthwork are not considered actual construction.

The elevations and heights stated in the DNH, which began with the data on the Form 7460-1 notice and may have been adjusted through negotiation, represent the **tallest physical object on the building,** including any parapets, obstruction lighting, appurtenances, antennas, elevator housings, flagpoles, mechanical equipment, window washing equipment, etc., whether temporary or permanent, frangible or not.

Separate Form 7460-1 notices should be filed for temporary cranes and other equipment required for the construction of the building. These are often granted conditional DNHs for heights slightly taller than the permanent building, subject to lowering at night or in inclement weather, and special marking and lighting.

The construction proponent is required to file FAA Form 7460-2, *Notice of Actual Construction,* as directed on the DNH letter.

Roles and Responsibilities of the Airport Management

Depending on a variety of local conditions, airport management can take a more active or passive role in the airspace protection process.

The airport management—a term used generically in this Guidebook to refer to the person or persons on the airport sponsor's staff authorized to act on the airport's behalf in airspace protection matters—can assume a role that is active or passive, proactive or reactive. The decision of what role to take depends on a variety of technical, regulatory, political, and legal factors, and may be different at different times and for different construction proposals.

If local height zoning restrictions adequately addressed airspace protection, and the FAA OE/AAA process always resulted in favorable determinations for heights no greater than would be acceptable to the airport and all its users, the airport management would have theoretically little-to-no role in the airspace analysis and construction permit process.

In practice, this is rarely the case, for several reasons.

- Local height zoning restrictions often contain inadequate airspace protection considerations, or none at all, and the state's DOT often does not provide adequate backup regulations where

When presented with a proposal that would negatively affect airport operations, the airport manager should be ready to provide technically-based input regarding any objections.

Caution: because there is the chance that height limit recommendations could be perceived as undue burden, it may be prudent to consult with legal counsel.

local regulations may be lacking. In these cases, the airport manager must coordinate with local authorities to encourage construction proponents to file FAA Form 7460-1 where required, and work with construction proponents and other stakeholders to mitigate or remove object-airspace conflicts.

- Even when appropriate height zoning restrictions are in place, civic, political, or other types of outside pressures can encourage local authorities to grant exceptions, which would allow tall structures that could conflict with airport operations. In these cases, the airport management must provide full information to the local authorities regarding the potential negative effects the proposed construction would have on aviation, so that fully informed compromises can be achieved. Proactive education of municipal authorities can be beneficial in minimizing the number of exceptions granted and/or involve airport management in the discussion of potential exceptions early in the process.
- There may be airspace protection needs that are not considered in the FAA OE/AAA process. In many cases, these are airline's OEI emergency procedures. The airport manager can discuss these needs with tenant airlines and can coordinate with local authorities to establish (1) air service capability objectives for the airport and (2) airspace protection measures required to meet these objectives, that are in some areas more restrictive in certain locations than the heights that would receive a favorable determination from the FAA. Otherwise, there is a chance that obstacles will be constructed in OEI flight path areas that discourage or preclude particular routes, as detailed elsewhere in this Guidebook.
- The airport sponsor is a department of a municipal organization (city, county, port, or other), another department of which is the construction permit authority. In these cases, the airport management may be routinely consulted regarding airspace protection issues in the development of General Plans, redevelopment efforts, and specific project proposals.

When a construction proposal is presented to the airport management for review, it should be reviewed against all known airspace protection criteria, both in parallel with the FAA OE/AAA process, and applying any known necessary additional criteria such as OEI. If the proposal would exceed certain airspace protection criteria that airport management is concerned the routine OE/AAA process may not take into account, airport management may provide a height limit recommendation or other expression of concern through formal channels, such as submitting a comment to the case when it is circularized under Public Notice in the OE/AAA process or in writing to the construction permit authority. In rare cases, when a DNH is issued for a proposed structure that the airport management considers significantly objectionable for aeronautical reasons, the airport management can petition for discretionary review of the determination.

Any such messages conveying the airport management's desired height limits should clearly state the technical aeronautical reason(s) that the proposal may be of concern. Airport management should consult legal counsel if there is a chance that the recommendation could be perceived as placing an undue burden on the construction proponent.

Summary

The mechanisms and processes of airspace protection are complex, and can occasionally lead to conflicts between the requirements of aviation and the economic or civic pressures of vertical construction.

1. Local authorities having jurisdiction to issue construction permits may or may not recognize airspace protection. Ideally, they should reference universal FAA notification requirements, and require a favorable determination from the FAA as a condition for permit approval.
2. Construction sponsors must file notice (Form 7460-1) with the FAA when required, providing accurate data and timely responses.

3. When a specific structure proposal is submitted to the FAA, the FAA provides its assessment of the proposal through the OE/AAA process, concluding with a final determination. This process can include stakeholder input through the Public Notice function.
4. Local airport management should support municipalities and the FAA in the above processes where appropriate and can provide proactive or reactive input where the processes in place may not afford full protection. The nature of the airport management's role depends on a variety of local factors. Because height limit recommendations may be construed as burdensome, input regarding these should be undertaken with advice from legal counsel.
5. It is ultimately up to the local authorities (occasionally backed by a state DOT), with input from all stakeholders, to determine the most appropriate compromise that best serves the community in the near- and long-term.

Chapter 4, *Conclusions, Recommendations, and Best Practices,* will discuss some of the issues, conflicts, and resolutions that arose in the authors' collective experience and in the Case Study examples documented in Appendix D.

CHAPTER 4

Conclusions, Recommendations, and Best Practices

Through carrying out the research for ACRP Project 03-13, together with our collective experiences, the authors have reached the following conclusions:

A partnership comprised of fully informed local stakeholders, airport management, and the FAA should cooperate to inform balanced community decisions.

Protection of an airport's navigable airspace requires a **partnership** comprised of the airport sponsor, the FAA, local municipal authorities, the aviation community, and the local community, including real estate development interests. This partnership has been more frequently observed to have formed *reactively,* in response to a combination of controversial construction projects and several parties' incomplete understanding of airspace protection needs. But it can be formed *proactively,* by putting into place the proper mechanisms and public outreach in anticipation of potentially controversial construction proposals.

Protection of an airport's navigable airspace sometimes involves **compromise and balance** between interests of aviation, the establishment of municipal infrastructure (bridges, roads, transmission lines etc.), and civic and private real estate development. For the partnership between airport and community to work effectively, all stakeholders must (1) be fully informed on technical and jurisdictional issues; (2) understand and respect opposing viewpoints; and (3) be willing to consider reasonable alternatives. All sides must understand the potential costs, benefits, and sacrifices that each alternative or compromise may entail, and the authorities having jurisdiction must render fair decisions that consider both the short-term and long-term community implications for both civic development and aviation. Identifying where high-rise development potential exists in a community is as important as determining where appropriate airspace protection is required.

An aeronautical study is technically complex and can be time-consuming.

Protection of an airport's navigable airspace is **technically complex,** involving a number of agencies, regulations, criteria, and standards. Compounding the complexity, the research team frequently observed difficulties arising from misunderstandings of technical issues, and incomplete or erroneous data sources (for example, missing objects on obstruction databases, and incorrect latitude-longitude coordinates given on 7460-1 submittals).

The FAA's OE/AAA process provides the public with the formal framework for official airspace analyses and determinations. The FAA carries out this responsibility free of charge; however, the length of time the process sometimes takes, especially where difficult or controversial analyses are undertaken, may be considered burdensome to some construction proponents. Early coordination with the local airport management and FAA can mitigate some of these delays

Where airport sponsors, municipalities, and other stakeholders desire greater understanding, policy guidance, or public awareness than is provided by individual FAA airspace determinations, a careful reading, documentation, and dissemination of the FAA's airspace protection criteria can inform general policies and specific individual construction decisions.

Recommendations and Best Practices

Recommendations for Airport Management

1. Become familiar with your airport's airspace protection needs.

Review *Appendix A, The Purpose, Function, and Application of Criteria* in this document. Obtain copies of the source documents for more detailed review where appropriate. Most source documents are available free of charge online. Check for updates, because most documents are "live," with periodic updates published and posted online.

The airport that knows its airspace protection needs will be able to provide timely and informed responses to construction proposals.

At a minimum, familiarize yourself with the geometric configurations and regulatory functions of the following:

- FAR Part 77 notification requirements
- FAR Part 77 obstruction criteria—imaginary surfaces, and other types
- FAR Part 77 hazard criteria—including a basic understanding of TERPS criteria, the existing and planned instrument flight procedures at the airport, implications of penetrations of TERPS surfaces, and also the various other types of adverse effects
- OEI obstacle clearance requirements for current and prospective airlines
- Runway end siting surfaces—threshold siting, departure end siting, and OEI obstacle identifying
- Other types of airport design-related criteria, such as Obstacle Free Zone (OFZ) clearance standards, NAVAID critical areas, and approach-light-plane clearances

In your ALP set of drawings, the Airport Airspace Drawings, Inner Portion of Approach Drawings and Departure Surface Drawings are a good starting point for understanding airspace protection. However, these drawings alone do not depict comprehensive airspace protection because they do not show the complete range of obstruction criteria or the hazard criteria that the FAA will use in evaluations and determinations, nor individual airline OEI obstacle clearance requirements, and may or may not contain runway end siting surfaces.

Designate a staff member to manage airspace protection issues.

Most airports that have established successful airspace protection programs have designated a specific staff person or persons as the primary point of contact for airspace protection matters. Depending on the size of the airport, and the market pressures for vertical development in the surrounding communities, this staff position can be as much as a half-time commitment (i.e., management would assume roughly half of a full-time person's work responsibilities are dedicated to airspace protection). As the community adapts to the airspace protection requirements over several years, this commitment of time may diminish. The Oakland International Airport case study and other case studies provide examples of staff trained and designated to coordinate airspace protection issues.

When your airport proposes runway extensions, alterations, or new runways, ensure that the ultimate proposed runway configuration is made known to the FAA, via the local Airports District Office (ADO), as expeditiously as possible. Contact the ADO to coordinate the appropriate notification method. Generally:

- For larger airports, those receiving Federal assistance, and those obligated to have an ALP on file, proposed runway changes are normally communicated to the FAA through a Master Plan update or ALP update.
- For smaller airports not subject to ALP requirements, heliports, helipads, seaplane bases, and the like, the process falls under FAR Part 157, *Notice of Construction, Alteration, Activation, and Deactivation of Airports.* Under this regulation, the proponent notifies the FAA of proposed runway changes via FAA Form 7480-1, *Notice of Landing Area Proposal.*

When future runway configurations are received and approved, the coordinates for future runway endpoints and thresholds become part of the FAA's database and can therefore be

evaluated in subsequent OE/AAA evaluations, which take into account both the existing and approved future runway configurations.

2. *Become familiar and involved with the FAA's OE/AAA process.*

Through automatic notifications, an airport can actively monitor OE issues, and avoid surprises.

Review the descriptions of the OE/AAA process described elsewhere in this Guidebook (Chapter 3, Appendix C). Take note of the steps in the process where airport management and other aviation stakeholders may have the opportunity to (1) become aware of a proposal; (2) review the FAA's preliminary assessment; (3) provide input to FAA's decision making; and (4) when necessary, appeal the FAA's determination. For more detail, see Appendix C, *The Obstruction Evaluation/Airport Airspace Analysis Process,* of this Guidebook, and source documents including FAR Part 77 and FAA Order 7400.2.

Review information available on the OE/AAA website http://oeaaa.faa.gov. It contains helpful information and advice for construction proponents, airports, and other stakeholders. Establish a user account; anyone can do so and there are no special qualifications or credentials necessary. Set preferences in your user account to request automatic email notifications when a 7460-1 notice is filed for proposed construction near your airport, when NPH letters are issued, when proposals are circularized under Public Notice, and when final determinations are issued. Early receipt of NPHs and Public Notice proposals will allow airport management, tenant airlines, and other stakeholders to evaluate the proposal, and, if necessary, formulate strategic responses within the 30-day timeframe.

In addition, having a user account will allow airport management to file 7460-1 forms online for on-airport projects. Establish regular lines of communication with the FAA OES staff responsible for the state or region where your airport is located, for improved coordination of off-airport OE cases. Do likewise with your local ADO staff, for improved coordination of on-airport AAA cases.

3. *Become familiar with height zoning and airspace protection regulations in the communities surrounding your airport and encourage improvements where practicable.*

Awareness of local regulations can put airspace protection issues in context.

Research and review any State airspace protection regulations that may be in place. These vary greatly from state to state, but are most often the jurisdiction of the State's Department of Transportation (DOT), aviation division. They can be the operative regulation if local regulations do not include airspace protection, or as a backup to local regulations. The Daytona Beach International Airport and Ohio State University Airport case studies provide examples of how state law played a key backup role in airspace protection when local regulations were incomplete.

The local municipality is most often the ultimate authority having jurisdiction to issue construction permits, including the specific height of the structure. Research and analyze existing height zoning regulations operative in the municipalities surrounding your airport:

- Do the regulations contain any references or considerations of airspace protection such as the following?:
  - FAA OE/AAA process? Usually this takes the form of describing FAA Form 7460-1 notification requirements, and requiring "a favorable determination from the FAA" as a contingency for permit approval.
  - Depictions of civil airport imaginary surfaces? If so, do the regulations reference other types of FAR Part 77 obstruction standards as well? As discussed in other parts of this Guidebook, reliance on the civil airport imaginary surfaces as the sole criteria for aeronautical compatibility can be misleading.

  - All five types of FAR Part 77 obstruction standards (see FAR Part 77.23)?
  - Any other airspace protection considerations (state/local/customized)?
  - What are the mechanisms, if any, for a property owner to obtain "relief" (called "variance" in some jurisdictions) from nominal height restrictions (i.e., permission to construct taller than the nominal height limit) subject to discretion of the authority having jurisdiction?
- Are there areas of potential concern: districts zoned for high-rise development (i.e., downtown, commercial, heavy industrial) located near runway ends or along runway centerline extensions where airspace protection needs are most critical? Rising terrain exacerbates this issue.
- Have there been frequent Form 7460-1 submittals and determinations focused in a certain area?
- Is there a requirement to obtain the Airport Manager's approval to exceed identified height limits in certain situations?
- If there are local airport-land-use compatibility regulations in place, do they recognize airspace protection, in addition to other factors such as airport noise compatibility? Avoid land-use compatibility maps based only on noise contours, which can sometimes mistakenly be assumed to function as the extent of the airport influence area and are sometimes misconstrued as the airport's "flight paths" that are also indicative of airspace protection needs.

Keeping your airport informed and local municipalities aware of airspace protection issues will facilitate a successful partnership to protect aviation interests and identify high-rise development areas.

Be proactive establishing a positive working relationship with the local municipalities. Establish lines of communication at appropriate levels. The Norman Y. Mineta—San Jose International Airport case study provides examples of improved coordination among Airport, Redevelopment, and Planning agencies within the City of San Jose.

If it appears that airspace protection is missing or inadequate in the local municipalities' height zoning regulations (this is not uncommon), develop short-term and long-term strategies to encourage the municipalities to incorporate airspace protection:

- At a minimum, requiring a favorable determination from the FAA should be a contingency for construction permits, for proposed structures within certain proximity to the airport (i.e., those requiring a Form 7460-1 notification).
- More comprehensive strategies can involve development of composite mapping of various surfaces and criteria, including TERPS, runway end siting, other airport design standards, and/or OEI clearance requirements, to provide the local municipalities with height limit guidelines over a designated area near the airport.

When encouraging improved airspace protection, airport management may encounter resistance to the establishment of height limits that may seem burdensome and new, even though in most cases they are not new but just more detailed documentation of existing limitations of which some stakeholders were not aware. Emphasize to the local community members—elected officials, appointed staff, and the public—that:

- **The airport is a regional asset,** connecting residents, visitors and businesses to national and global markets and destinations. It is an economic engine supporting multiple regional jobs, direct and indirect economic benefits, and tax revenues. Degradation of the airport's operational capabilities could have significant negative economic repercussions.
- **The airport is a national asset.** As a component of the NAS, most airports receive public investment, in the form of Federal grant assistance, to construct major improvements. In accepting these grants, the airport sponsor must provide guarantees (called Federal grant assurances) that it will maintain the airport's functionality in specific ways. Among the grant assurances is protection of airspace required for takeoff, landing, and maneuvering of aircraft around the airport. Until recently, the National Oceanic and Atmospheric Administration

An airport is a significant element of transportation infrastructure at the local, regional, and national levels. Most airports have been developed through substantial public investment, which requires the sponsor to commit to maintaining certain standards.

(NOAA), a division of the U.S. Department of Commerce, was responsible for much of the obstruction charting at airports nationwide, because impedance of air service capabilities is an interstate commerce issue. NOAA's role in charting is being migrated to individual airports via AC 150/5300-16, -17, and -18.

- **Although not physically visible, an airport's navigable airspace is a critical component of infrastructure,** because it is needed for the safe and efficient operation of aircraft. Clear airspace facilitates transitioning between the airport's runways to en route airspace, similar in function to on-ramps and off-ramps connecting local road systems to Interstate highways. The concept of "airspace as infrastructure" is sometimes difficult to convey, because clear airspace is not a tangible physical entity. The clearance requirement is analogous to a seaport needing clear waterways and channels to allow ships to arrive from the ocean to port—if obstacles block the channels, ships are impeded from reaching port.
- **Moving the airport or changing its runways or flight procedures to accommodate an obstruction is normally not an option** due to the multiple complex and time-consuming regulatory and environmental requirements for establishing new airports, adjustments to runway configurations or new flight procedures. Therefore, the airport is less flexible than the typical construction project is to relocate or adjust physically in order to eliminate or mitigate potential conflicts between structures and airspace protection requirements.

Moving the airport or changing its runways or flight procedures to accommodate an obstruction is normally not an option.

Recommendations for Local and Regional Planning Agencies, and Municipal Authorities

1. *Recognize that the airport is a regional and national asset.*

Be aware that even a single obstacle in a flight path area can critically degrade the safety, utility, efficiency, and air service capability of an airport. Degradation of the airport's capabilities is detrimental to the region it serves and the NAS. Mitigation measures of such obstruction impacts could involve runway extensions costing in the tens or hundreds of millions of dollars, or construction of new runways at even higher costs.

Recognize that protection of the airport's airspace is a benefit for the entire community.

2. *Consider the airport's virtually unchangeable physical configuration.*
3. *Recognize that the process of identification of areas of height* restrictions *can also identify areas of height* potential*, where taller buildings would not conflict with aeronautical requirements.*
4. Account for airspace protection in height zoning regulations. *Work with legal counsel when implementing such regulatory changes.*

Use this Guidebook as a resource. Also meet with local airport management, the FAA, and industry groups/peers to discuss best practices, such as the following:

Implement consistent measures to protect airspace, and inform construction proponents of airspace issues.

- Remind property owners of the universal Federal requirement to file an FAA Form 7460-1 where notification requirements of FAR Part 77 dictate.
- Understand that appropriate protection of airspace is just as important at a general aviation airport as it is for a major air carrier hub airport.
- Require a favorable determination from the FAA as a contingency for issuing construction permits for proposed structures above certain heights and within certain proximity to the airport. The parameters for this contingency at a minimum should match the Form 7460-1 filing requirements and can be further augmented—discuss with local airport management.
- Work with local airport management to coordinate airspace protection needs with the actual building height limits that exist in various zoning districts. When changes to zoning district height limits are proposed, either through a routine periodic update to the municipality's General Plan or at other times, carefully coordinate the changes with airspace protection requirements.

- Where exceptions are occasionally granted to allow taller structures than the nominal height limit, ensure that adequate airspace protection is maintained. Be sure to notify the local airport when exceptions are under consideration, and ensure the building developer files notice with the FAA where required.

Recommendations for Building Developers

1. *At the earliest conceptual stages of project planning, meet with staff from the local municipality and airport to learn about airspace-related height restrictions.*

Check for compatibility with airspace protection considerations as early as possible in the project planning process.

Early identification and mitigation of potential conflicts saves significant time and design/redesign costs. In the case studies researched for this project, the most challenging conflicts arose when the construction sponsor had proceeded well into planning and design—and sometimes even partial construction—investing significant time, money, and other resources, unaware of airspace protection considerations.

2. *At the earliest conceptual stages of project planning, file Form 7460-1,* Notice of Proposed Construction or Alteration, *with the FAA.*

File notice with the FAA as soon as the structure's location and tallest potential height is established.

File the notice as early in the project planning process as feasible. The FAA's OE/AAA process leading to a final determination can take several weeks or months, depending on the complexity of analyses and whether there is an attempt to "push the envelope" for a maximum feasible height not exceeding hazard standards. The process also requires careful coordination among multiple divisions within the FAA, and may require a Public Notice period, which takes approximately 40 days, to solicit comments from stakeholders.

Filing the notice online at http://oeaaa.faa.gov will result in more expeditious processing than filing via paper forms through the U.S. mail. The website also contains ample background information and instructions.

Provide accurate data, especially the geographic coordinates (latitude and longitude), site elevation, and proposed building height. Provide data in current reference systems, i.e., North American Datum of 1983 (NAD83) and North American Vertical Datum of 1988 (NAVD88).

A professional survey of geographic information (lat-long and elevation) is strongly preferred, and may be required by the FAA, especially for proposed structures that exceed or closely approach obstruction criteria.

It pays to rely on trusted professional sources for this critical information.

- **A professional certified survey of geographic data is strongly recommended,** and is sometimes requested by the FAA during the OE/AAA process, especially when the proposal would exceed obstruction standards. An American Land Title Association (ALTA) survey, which documents the ownership, title, property lines, easements, and other cadastral data, locates features relative to local benchmarks or street centerlines, but usually **does not** provide geographic coordinates (i.e., the property is located relative to a local fixed feature, not absolute location on the earth), and does not always provide terrain contours. Geographic surveys may be commissioned as an add-on to an ALTA survey, or independently. The professional survey of geographic coordinates and elevations should contain an affidavit of accuracy (Figure 4.1) to National Geodetic Standards (NGS) standard accuracy tolerances of "1A" or "2C", and the surveyor's professional seal and signature. Note "1A" or "2C" for the accuracy level on the Form 7460-1 submittal.
- If a professional survey including geographic coordinates and site elevations is not feasible, use multiple sources to ascertain the information, note the sources used, and note "NONE" for the accuracy level on the Form 7460-1 submittal. Geographic information sources include:
  - Online global viewers such as Google Earth or Microsoft Virtual Earth. Be aware of the limitations of these convenient, free tools, as outlined in their usage agreements.
  - Mobile global positioning system (GPS) devices. When obtaining coordinates in the field, allow the device ample time (usually 15-30 minutes) in a fixed position to acquire and refine the satellite signals. Be aware of the device's accuracy limitations inherent to the device (is it an "amateur" device meant for driving directions, hiking, and camping; or a "professional"

Re: (Proposed Project Name), Located (in / near) City Name, State

I certify that the above point is at latitude ___-___-_____(N) and longitude ___-___-____(W) and that the site elevation is ____ feet AMSL. These coordinates are accurate to within ± ____ feet horizontally; and the elevation is accurate within ± ____ feet vertically. The horizontal datum (coordinates) are in terms of the North American Datum of 1983 (NAD 83) and are expressed as degrees, minutes and seconds, to the nearest hundredth of a second. The vertical datum (heights) are in terms of the North American Vertical Datum of 1988 (NAVD88) and are determined to the nearest foot.

_____ (Signature and date)

(The Surveyor's Seal must be affixed and readable, for this to be a valid Survey)

Professional Surveyor No. _____

Source: National Geodetic Survey
Prepared by: Jacobs Consultancy

Figure 4.1. Example of surveyor's affidavit of accuracy.

device for surveying and engineering?), and environmental factors especially in urban areas where signal shadowing, distortions, or reflections can be an issue.

- Local detailed maps from trustworthy sources. USGS quadrangle maps are generally an accurate source to confirm data, but are generally too large-scale to ascertain data to the level of precision and accuracy required for Form 7460-1 filing.
- Geographic information system (GIS) desktop software.
- **Do not** rely on the map background images found on the OE/AAA website that display after coordinates are entered for an online 7460-1. These map images function to provide a general confirmation of location, not a detailed site position.

Caution: reliance on sources other than professional surveyors or civil engineers to derive geographic coordinates and elevations can allow erroneous data to be filed on 7460-1 forms and analyzed by the FAA. The building developer is responsible for the accuracy of this information. The project design and development process may be significantly hindered if and when the information is found erroneous—FAA aeronautical review must be re-initiated with corrected data, and related entitlements suspended until the new FAA studies are completed.

A site map provides FAA reviewers with information about the size and bulk of the proposed building. It should provide complete and accurate information about the building's physical characteristics as they may affect navigable airspace.

Provide a project site map depicting nearby streets, the property outline, and the outline of the proposed structure on the property. Clearly denote the point on the structure that was used for the geographic coordinates and elevations entered on the 7460-1 data. For most buildings, the preferred method is for the geographic coordinates to be the building corner closest to the airport, and the height of the highest object on the building, whether or not it occurs at the building corner. This maximum height must include parapets, mechanical screens, signage, antennas, flagpoles, FAA-required obstruction lighting, or any other physical object. See Figure 4.2 for a typical site plan.

Provide the geographic coordinates and top-of-structure heights of additional points on the building if the building has an irregular shape, has significantly different high points on different parts, and/or is very large. If in doubt, it is better to provide more information.

File individual Form 7460-1 notices for each corner and/or high point on a building, and note that they are part of a single building. During the analysis process the FAA may elect to consolidate several cases representing a single building or cluster of buildings into one. When this occurs, the FAA cancels the other cases, and states on the determination letter(s) issued for the remaining case(s) that the consolidation has occurred.

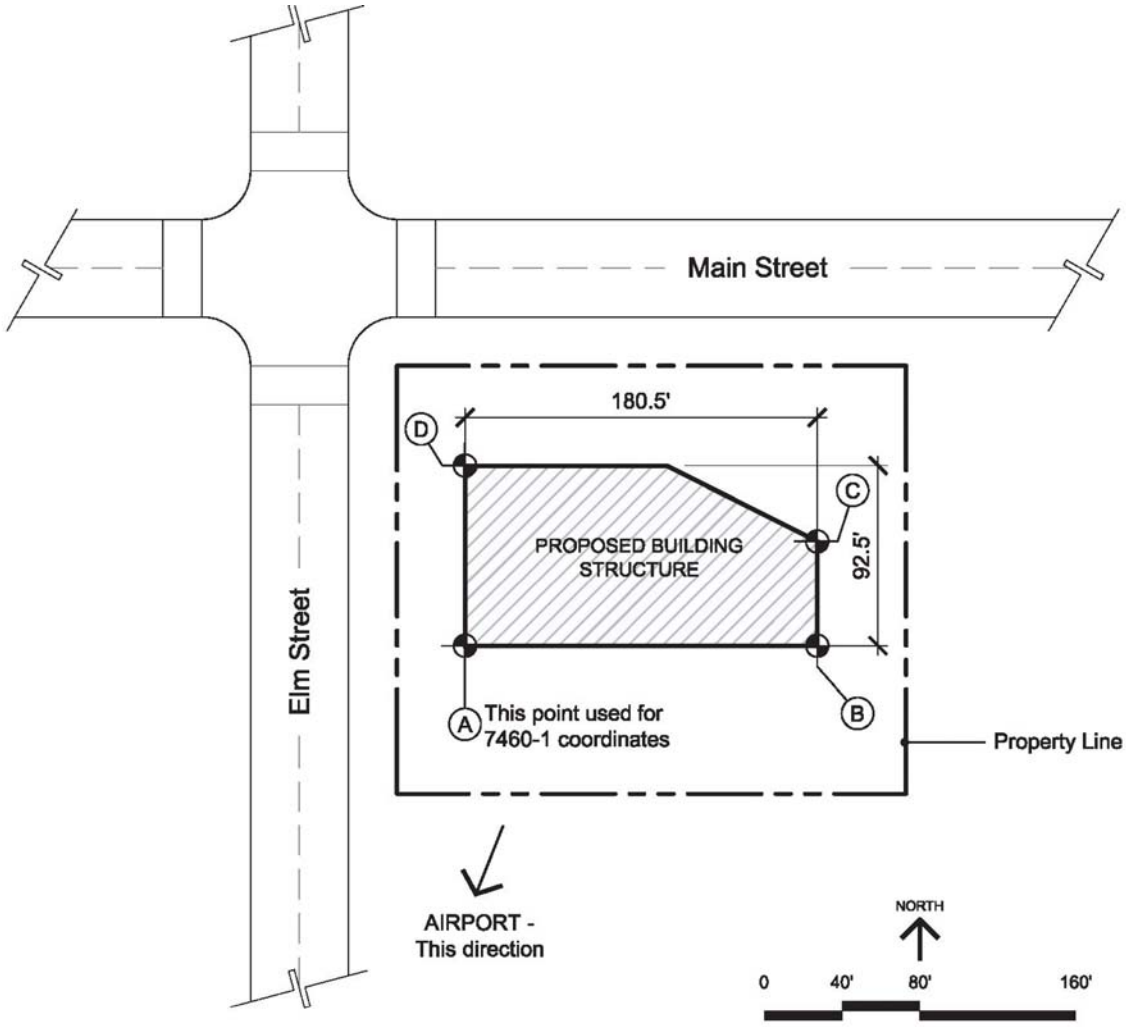


Table of Geographic Coordinates and Elevations
Horizontal Datum: NAD83. Vertical Datum: NAVD88

Point	Latitude (north)	Longitude (west)	Site Elevation (feet AMSL)	Structure Height (feet AGL)
A	37° 35' 19.51"	122° 20' 22.44"	250	140
B	37° 35' 19.49"	122° 20' 20.16"	251	120
C	37° 35' 20.07"	122° 20' 20.14"	252	120
D	37° 35' 20.35"	122° 20' 22.42"	250	140

Surveyor's Affidavit of Accuracy

PROFESSIONAL SEAL

Signature

Sources: FAR Part 77, FAA Order 7400.2, FAA OE/AAA website, FAA OES
Prepared by: Jacobs Consultancy

Figure 4.2. Sample project site map. Submitted with Form 7460-1 filing.

Do not include information on the 7460-1 submittal that is extraneous to aeronautical analysis, including number of stories (the FAA analyzes overall structure height, **not** the number of stories), architectural or aesthetic character, color, commercial marketing language, and the like. Do include landscaping information if the trees are, or may become, the tallest objects on the property. Include use and occupancy information if the proposal may be located within one of the airport's runway protection zones or other designated land-use restriction zones.

Provide accurate and timely responses when the FAA requests additional information, or attempts to negotiate an alternative structure height.

Help expedite the issuance of a determination by providing complete, accurate information, and timely responses when requested.

3. *Be aware that a final DNH is not "permanent" or "final".*

Because airports and flight procedures may change over time, a DNH has an 18-month expiration date. You can request a one-time, 18-month extension for a total of 3 years. New analysis may need to be performed when an extension is requested. The DNH becomes permanent when actual construction begins. Actual construction is defined as the start of the structure itself, i.e., foundations or framing, not site preparation and earthwork.

Of note: the initial issuance of a DNH is not absolutely final and permanent. Within the first 40 days of issuance, a party who opposes the structure height for aeronautical reasons can file an appeal, known as a request for discretionary review, to FAA Headquarters. In this case, the DNH is suspended until the matter is resolved. Also, the FAA reserves the right to rescind the DNH at any time if new aeronautical information comes to light that was not known to the FAA at the time they performed the analysis that led to the DNH; however, such rescissions of determinations are rare.

After a DNH is issued, follow through on the required steps.

4. *File FAA Form 7460-2,* Notice of Actual Construction, *Parts 1 and 2, at the required times as specified on the determination letter.*
5. *If obstruction marking and/or lighting are required for the structure, provide and maintain them.*

APPENDIX A

The Purpose, Function, and Application of Criteria

Introduction

Appendix A highlights the primary purpose and function of each referenced document and explains the specific application and relevance to Airspace, Objects, and Their Effects on Airports. Although these criteria documents contain substantial overlap and cross-referencing, they can generally be grouped into three major categories, based on their primary function: (1) airspace protection; (2) airport design; and (3) flight procedure design. These categories consider airspace interference caused by physical objects. A fourth category of criteria documents address electro-magnetic interference, or NAVAID and surveillance protection. The criteria documents annotated herein include:

Airspace Protection

- Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace*
- FAA Order JO 7400.2, *Procedures for Handling Airspace Matters*
- FAA Advisory Circular (AC) 70/7460-1, *Obstruction Marking and Lighting*
- FAA AC 70/7460-2, *Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace*
- FAA Form 7460-1, *Notice of Proposed Construction or Alteration*
- FAA Form 7460-2, *Notice of Actual Construction*
- The OE/AAA External User Website
- FAA, Airport Obstructions Standards Committee (AOSC), Decision Documents
- FAA, AC 150/5190 4A, *A Model Zoning Ordinance to Limit Height of Objects Around Airports*
- FAA AC 150/5070-6B, *Airport Master Plans*

Airport Design

- FAA AC 150/5300-13, *Airport Design*
- FAA AC 150/5300-18, *General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards*
- FAA AC 150/5390-2A, *Heliport Design*
- FAA AC 150/5395-1, *Seaplane Bases*
- FAA Order 6750, *Siting Criteria for Instrument Landing Systems*
- FAR Part 139, *Certification of Airports*
- FAR Part 157, *Notice of Construction, Alteration, Activation, and Deactivation of Airports*

Flight Procedure Design

- FAA Order 8260.3B, *The United States Standard for Terminal Instrument Procedures* (TERPS)
- TERPS Derivative Orders (8260 Series)

- TERPS Instruction Letters (TILs)
- FAA AC 90-80B, *Approval of Offshore Standard Approach Procedures, Airborne Radar Approaches, and Helicopter En Route Decent Areas*
- FAR Part 25, *Airworthiness Standards: Transport Category Airplanes*
- FAA AC 120-91, *Airport Obstacle Analysis*
- FAA AC 120-29A, *Criteria for the Approval of Category I and II Weather Minima for Approach*
- FAA AC 120-28D, *Criteria for the Approval of Category III Weather Minima for Takeoff, Landing, and Rollout*
- FAR Part 121, *Operating Requirements: Domestic, Flag, and Supplemental Operations*
- FAA Handbook, FAA-H-8261-1A, *Instrument Procedures Handbook*
- FAA Air Traffic Publication, *Aeronautical Information Manual*
- FAA, National Aeronautical Charting Office (NACO) Website

Electromagnetic Interference

- FAA Order 6310.6, *Primary/Secondary Terminal Radar Siting Handbook*
- FAA Order 6340.15, *Primary/Secondary En Route Radar Siting Handbook*
- FAA Order 6820.10, *VOR, VOR/DME and VORTAC Siting Criteria*
- NITA Technical Report TR-08-454, *Assessment of the Effects of Wind Turbines on Air Traffic Control Radars*

Airspace Protection Criteria

As outlined here, airspace protection criteria are set forth in the following documents:

- U.S. Code of Federal Regulations (CFR), Title 14—Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace*
- FAA Order JO 7400.2, *Procedures for Handling Airspace Matters*
- FAA Advisory Circular 70/7460-1, *Obstruction Marking and Lighting*
- FAA Advisory Circular 70/7460-2, *Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace*
- FAA Form 7460-1, *Notice of Proposed Construction or Alteration*
- FAA Form 7460-2, *Notice of Actual Construction*
- FAA OE/AAA Website, http://oeaaa.faa.gov
- FAA, Airport Obstruction Standards Committee (AOSC), Decision Documents
- FAA Advisory Circular 150/5190-4A, *A Model Zoning Ordinance to Limit Height of Objects Around Airports*
- FAA Advisory Circular 150/5070-6B, Airport Master Plans

Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace*

Latest amendment 2004. Notice of Proposed Rulemaking (NPRM) changes June 2006, pending.

http://www.access.gpo.gov/nara/cfr/waisidx_04/14cfr77_04.html

Purpose

- Establishes the Federal law for the protection of airspace
- Sets forth the requirements for Notification to the Administrator of certain proposed construction or alteration
- Establishes the standards for classifying an object as an "obstruction to air navigation"
- Provides for aeronautical studies of obstructions to air navigation, to determine the effect of proposed construction or alteration on air navigation
- Provides for the establishment of antenna farms

Function

- Subpart A—Provides general terms that apply to objects affecting navigable airspace.
- Subpart B—Specifies notification requirements for sponsors proposing to build tall structure or structures near airports. Specifies standards to identify construction or alterations requiring notice, construction or alternation not requiring notice, forms required for filing notice, and FAA's role in acknowledging notice.
- Subpart C—Specifies the standards for determining obstructions to air navigation. These standards apply to the use of navigable airspace by aircraft and to existing navigation facilities. Provides protection of airspace for civil and military airports and heliports, and for flight procedures.
- Subpart D—Specifies the aeronautical study process by the FAA.
- Subpart E—Specifies the Rules of Practice for hearings conducted by FAA.
- Subpart F—Specifies the establishment of antenna farm areas.

Application of Criteria

FAR Part 77 serves as Federal law as it pertains to objects that affect navigable airspace. The criteria apply both to sponsors proposing construction and to the FAA.

Sponsors

Sponsors of proposed construction or alteration in the vicinity of airports are required to provide notification to the FAA as detailed in FAR §77.13 by filing FAA Form 7460-1, *Notice of Proposed Construction,* and responding to FAA's inquires that may be posed throughout the aeronautical study process. Notification is required for the following types of structures:

§77.13(a)(1) A height more than 200 feet above ground level (AGL) at its site (Figure A.1);

§77.13(a)(2) Within 20,000 feet of a runway more than 3,200 feet in length, and exceeding a 100:1 slope imaginary surface (i.e., a surface rising 1 foot vertically for every 100 feet horizontally) from the nearest point of the nearest runway. (Different standards apply with proximity to airports with runways no greater than 3,200 feet in length, and heliports) (Figure A.1);

§77.13(a)(3) Roadways, railroads, and waterways are evaluated based on heights above surface providing for vehicles; by specified amounts or by the height of the highest mobile object normally traversing the transportation corridor;

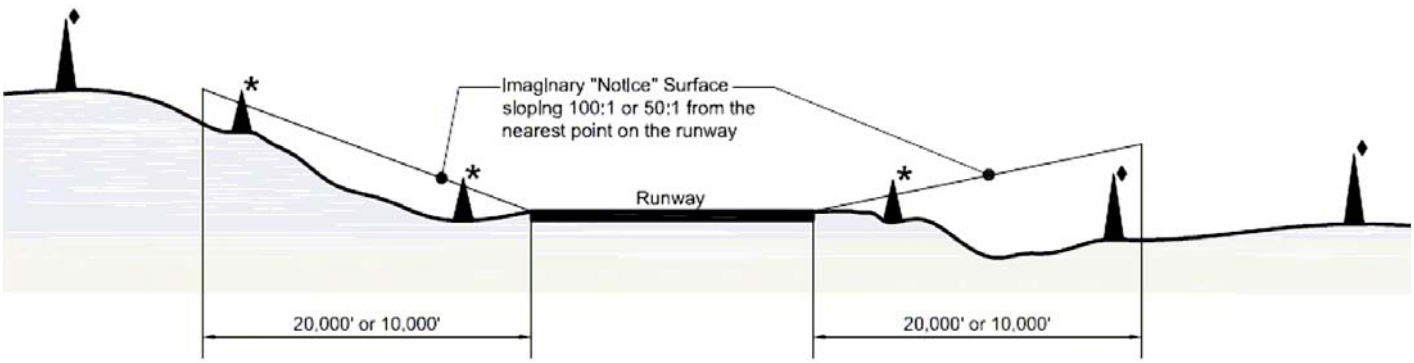


Figure A.1. Profile view of two types of FAR Part 77.13 notification requirements.

§77.13(a)(4) When requested by the FAA, any construction or alteration that would be in an instrument approach area and may exceed FAR Part 77 obstruction standards; or,

§77.13(a)(5) Any construction or alteration on any public-use or military airport.

FAA

The FAA is responsible for acknowledging the receipt of the notice of proposed construction, and conducting an aeronautical study based on the obstruction standards presented in FAR §77.23.

An existing 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:

§77.23(a)(1)—A height of 500 feet AGL.

§77.23(a)(2)—A height that is 200 feet AGL or above the established airport elevation, whichever is higher, within 3 nautical miles of the established airport reference point, with its longest runway more than 3,200 feet in actual length. That height increases in the proportion of 100 feet for each additional nautical mile from the airport up to a maximum of 500 feet. See Figure A.2.

§77.23(a)(3)—A height within a terminal obstacle clearance area, including initial approach segment, a departure area, and a circling approach, which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area to be less than the required obstacle clearance.

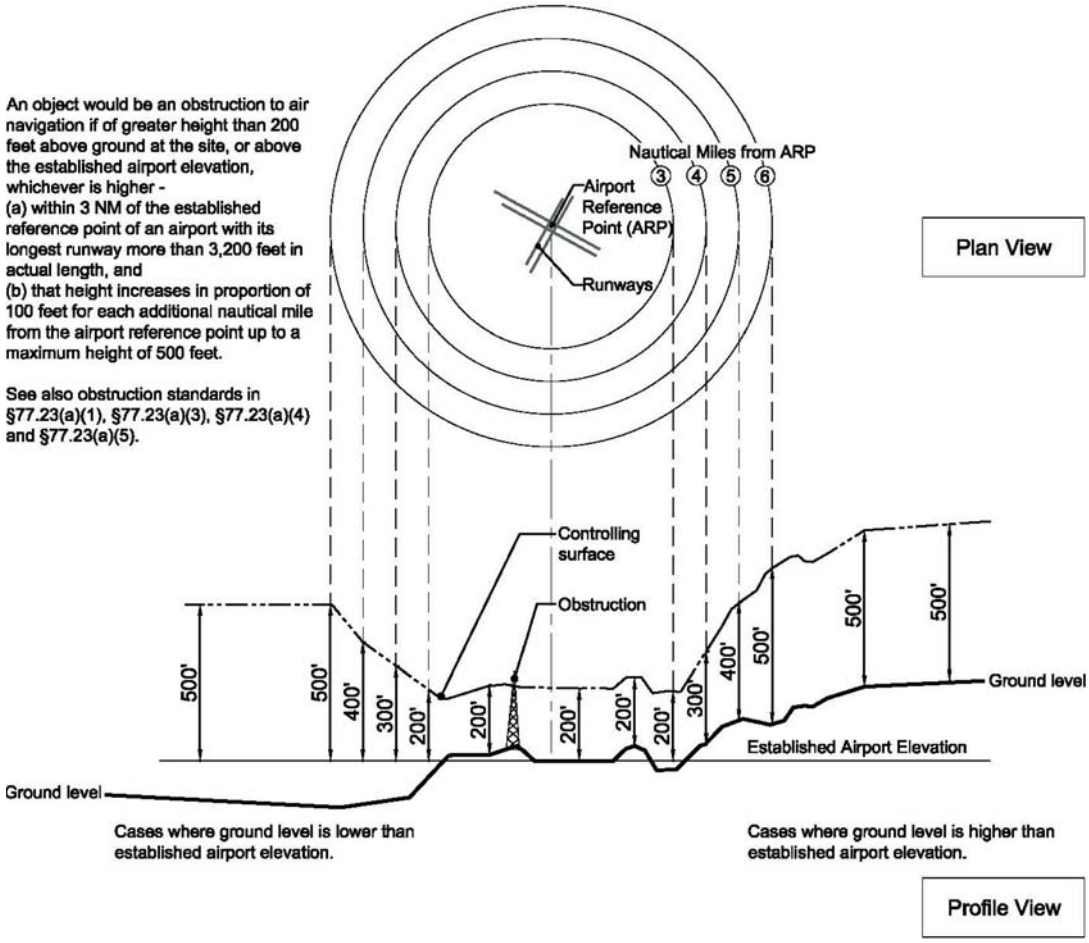


Figure A.2. Obstruction standards per §77.23(a)(2).

> §77.23(a)(4)—A height within an en route obstacle clearance area, including turn and terminal areas, of a Federal airway or approved off-airway route, that would increase the minimum obstacle clearance altitude.
>
> §77.23(a)(5)—The surface of a takeoff and landing area of an airport or any imaginary surface established in §77.25, §77.28, and §77.29.

The imaginary surfaces referenced in §77.23(a)(5) are defined geometrically in §77.25 (civil), §77.28 (military), and §77.29 (heliports). The most familiar type to U.S. civil airport operators are the "civil airport imaginary surfaces", illustrated in Figure A.3.

The dimensions of many of the surface components are dependent on runway and approach types. **Therefore, the runway and approach types must be established first, as follows:**

A **utility runway** is a runway that is constructed and intended to be used by propeller driven aircraft of no more than 12,500 pounds maximum gross weight. While the FAA does not set a specific length to determine a utility runway, in general they are no more than 3,500 feet in length, and may not necessarily be paved or lighted.

A **visual runway** is a runway that is intended solely for the operation of aircraft using visual approach procedures. Visual runways are only used when "VFR" conditions exist, that is, when cloud ceilings are at least 1,000 feet AGL and visibility is at least 3 statute miles (under certain circumstances visibility may be as low as 1 statute mile). These runways are identified by their basic runway markings (runway designator and centerlines).

A **non-precision instrument runway** is one that may be accessed for approach using an FAA published "nonprecision instrument approach procedure." Nonprecision instrument approach procedures are those procedures where the use of a nonprecision instrument NAVAID is used as the basis for the approach. Nonprecision instrument procedures include those that reference VORs, NDBs, and GPS waypoints. Nonprecision instrument procedures offer only lateral guidance to the runway. These runways may be accessed under less than VFR conditions, typically conditions where the cloud ceilings are as low as 700 feet AGL and visibility is greater than ½ mile. These runways are identified by "nonprecision" runway markings (runway designator, centerline, and threshold markings).

A **precision instrument runway** is a runway that has an existing instrument approach procedure that utilizes an Instrument Landing System (ILS) or a Precision Approach Radar (PAR). These procedures provide both lateral and vertical guidance to a particular runway, and thus allow aircraft to approach the runway during conditions of minimal visibility. These runways are identified by "precision" runway markings (runway designator, centerline, threshold markings, and touchdown zone markings).

The civil airport imaginary surfaces are then constructed as follows:

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

250 feet for utility runways having only visual approaches.

500 feet for utility runways having nonprecision instrument approaches.

For other than utility runways the width is:

(i) 500 feet for visual runways having only visual approaches.

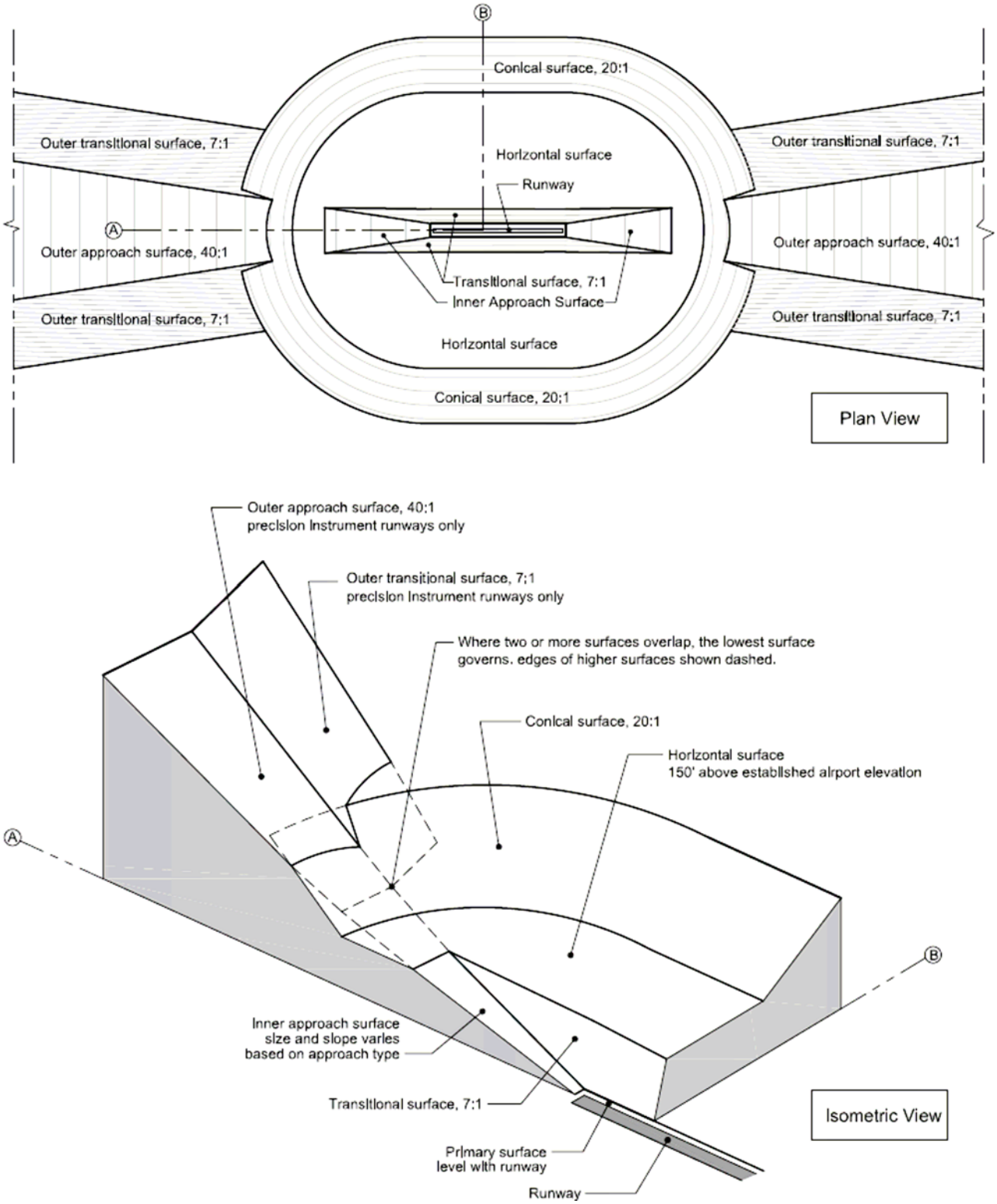


Figure A.3. FAR Part 77, §77.25 civil airport imaginary surfaces.

(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.

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.

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.

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.

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.

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.

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.

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 up to the elevation of the hori-

zontal or conical surface. 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.

As previously mentioned, in addition to notification criteria and obstruction criteria, FAR Part 77 provides for aeronautical studies. The aeronautical studies are conducted by the FAA Regional Air Traffic Division Manager or his designee within the Obstruction Evaluation Service (OES). The aeronautical study includes analysis of the effects of the proposed construction on air navigation facilities and the safe efficient use of navigable airspace. Refer to Appendix C for a detailed description of the FAA OE/AAA process.

FAA Order JO 7400.2G—*Procedures for Handling Airspace Matters*

Latest amendment April 2008

http://www.faa.gov/airports_airtraffic/air_traffic/publications/atpubs/AIR/

Purpose

Joint Order (JO) 7400.2G specifies policy, criteria, guidelines, and procedures for use by all personnel in the joint administration applicable to the System Operation Services, System Operation Airspace, and Airman's Informational Manual (AIM), Technical Operations, ATC Spectrum Engineering Services, the Office of Airport Planning and Programming, the Office of Airport Safety and Standards, Technical Operations Aviation System Standards, and the Flight Standards Service. This Order also applies to all regional service area, and field organization offices involved in the rulemaking and non-rulemaking actions associated with airspace allocation, obstruction evaluation, obstruction marking and lighting, airport airspace analysis, and the management of air navigation aids.

The document incorporates several orders, notices, and directives to provide Federal government (all agencies listed previously) personnel procedures for the management of all airspace programs. It serves as a single reference document for all airspace matters in the NAS, however it is important to note that additional criteria and procedures may exist that supplement these procedures.

Function

The primary function of this order is to provide procedures for agency handling of Airspace Management, Objects Affecting Navigable Airspace, Airport Airspace Analysis, Special Use Airspace and other miscellaneous airspace procedures.

Application of Criteria

The criteria contained in Order 7400.2 are directly applicable to the current airspace structure as it exists today and as it will exist in the future. Part 2, Objects Affecting Navigable Airspace, is directly applicable to objects affecting navigable airspace (as it is titled). The guidance provides the basis for the FAA OE/AAA program, and defines the role of FAA, procedures to be followed, obstacle evaluation automation, training requirements, aeronautical study structure, process and considerations, verification of proposed case, the identification of aeronautical effect of proposed construction, determinations, post determination actions, and the discretionary review process.

Order 7400.2, Chapter 6—Aeronautical Studies, specifies the steps in the OE/AAA process, which is described in more detail in Chapter 5 of this report. The FAA's Determination of Hazard is based on the judgment that a proposed structure would cause a "substantial adverse

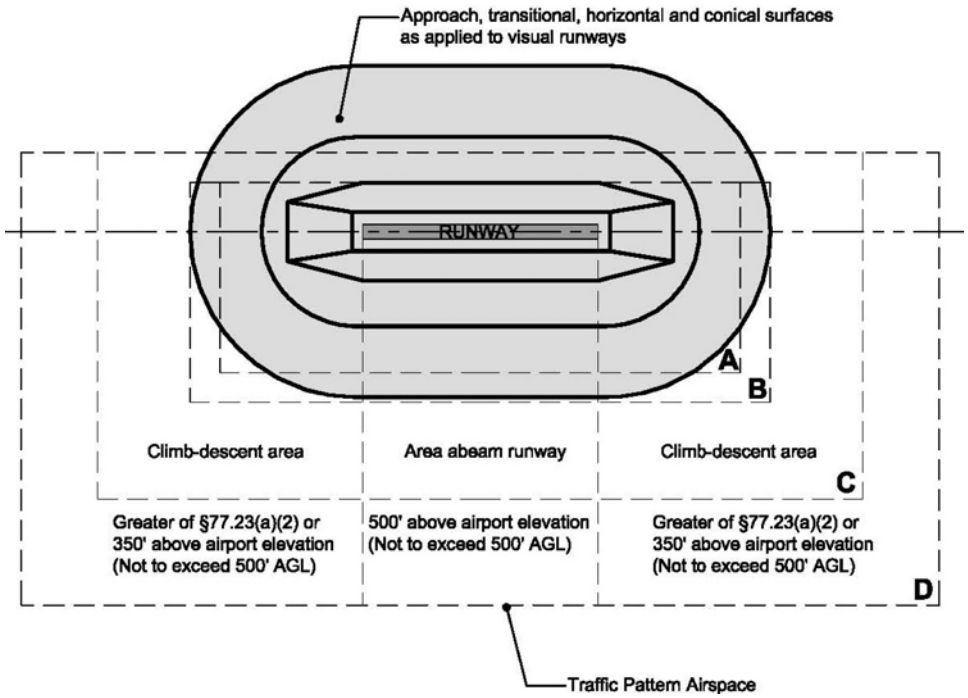


Figure A.4. Visual flight rules adverse effect per FAA Order 7400.2, 6-3-8(d).

effect" to a "significant volume of traffic". Section 3 of Chapter 6 describes the criteria for determining adverse effect, significant adverse effect, and significant volume of activity.

Besides functioning as an interpretive manual for application of criteria specified in other documents (FAR Part 77, TERPS) to airspace matters, Order 7400.2 specifies criteria not found elsewhere for protection of VFR airspace (Figure A.4). Subsection 6-3-8 specifies criteria for protection of VFR routes, VFR traffic pattern airspace, and helicopter operations. Subsections 6-3-13 and 6-3-14 discuss shielding criteria, the criteria that apply to structures whose aeronautical effects can be shown to be no worse than those caused by existing precedent structures.

FAA personnel associated with OE/AAA or conducting airspace assessments follow these criteria. These criteria are transparent and provide the sponsor of proposed construction insight to the process to be followed for the evaluation of any Notice of Proposed Construction case.

FAA Advisory Circular 70/7460-1, Obstruction Marking and Lighting

Latest amendment February 2007

https://oeaaa.faa.gov/oeaaa/external/content/AC70_7460_1K.pdf

Purpose

The primary purpose of FAA AC 70/7460-1 is to provide guidance on marking and lighting for structures that exceed obstruction standards. The intent of marking and lighting is to make structures visible to pilots during the day or night for collision avoidance.

Function

The function of the criteria is to provide marking and lighting guidance to sponsors whose structures exceed 200 feet AGL or any obstruction standards as defined in §77.23. The guidance specifically details marking patterns, colors, and schemes for various types of structures and addresses obstruction light requirements (color and intensity) and vari-

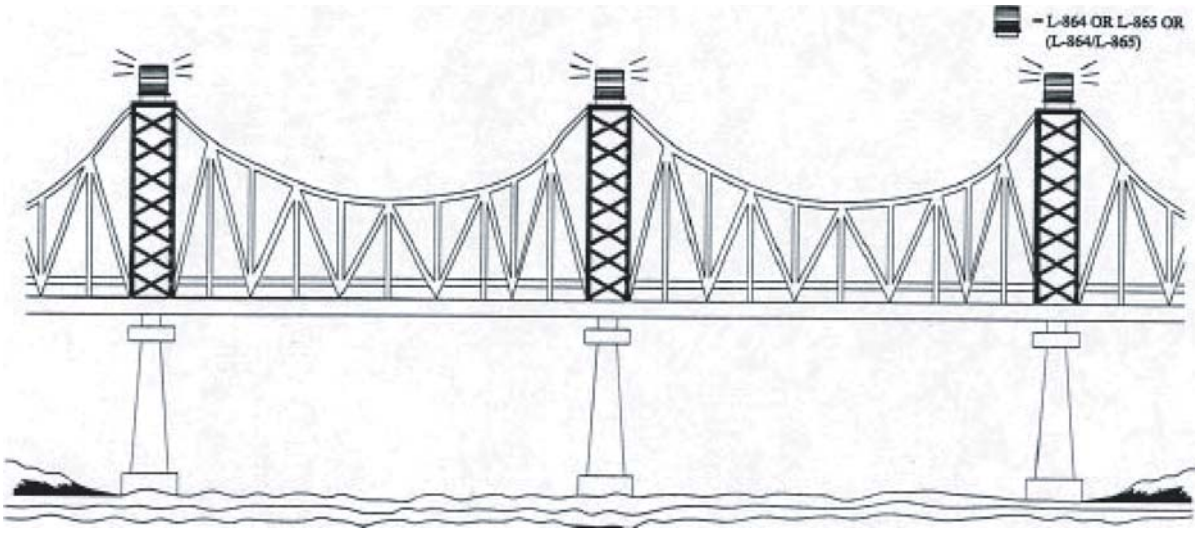


Illustration of lighting criteria from AC70/7460-1

Figure A.5. Illustration of lighting criteria.

ous lighting configurations for structures of varying heights. The criteria also include guidance for sponsors who wish to voluntarily mark or light the structure, even if not required (Figure A.5).

Application of Criteria

In many OE/AAA cases where a proposed structure exceeds obstruction standards, issuance of a DNH is contingent on the proposed construction being properly marked and lighted. These criteria are provided to sponsors so that they may comply with marking and lighting requirements determined by FAA. Additionally, obstruction marking and lighting are often an insurance coverage requirement.

Any structure exceeding 200 feet above ground level or any other FAR 77 obstruction standard must be marked and/or lighted.

Marking and lighting of a structure allows pilots to see and avoid the obstacle to ensure the safety to air navigation. The guidance varies depending on structure height, shielding, terrain features, weather patterns, geographic location, and in the case of wind or antenna farms, the number of structures and overall layout (see Figure A.5).

FAA Advisory Circular 70/7460-2, Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace

Latest amendment March 2000, currently cancelled.

http://rgl.faa.gov/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146db0931f186256c2a00721867/$FILE/ac70-7460-2K.pdf

Purpose

The purpose of these criteria is to provide simplified, concise guidance about the OE/AAA process to sponsors proposing to erect or alter an object that may affect navigable airspace, filing 7460-1 notices, and describes the FAA's OE/AAA process, including determinations and discretionary reviews.

Function

The information provides a general audience with details and notice requirements as identified in FAR Part 77, and provides reference to documents for marking and lighting, airport design, lighting equipment, and notice forms 7460-1 and 7460-2. Also included is FAA contact information for assistance, identification of the FAA role, and petition guidance.

Application of Criteria

These criteria are specific to sponsors who are proposing construction of structures that may affect navigable airspace, largely reflecting the criteria in FAR Part 77. Sponsors may use this document as guidance to ensure the proposed construction meets FAA requirements.

FAA Form 7460-1, Notice of Proposed Construction

http://oeaaa.faa.gov/oeaaa/external/content/7460-1.pdf

Purpose

Form 7460-1 provides the formal means for a sponsor to provide notice of a proposed construction or alternation project to FAA as detailed in FAR Part 77. The form is designed to collect the information necessary for the FAA to evaluate the effect of proposed construction or alteration on navigable airspace.

Function

Form 7460-1 serves as the means for a sponsor to provide the data necessary for FAA to initiate an aeronautical study.

Application of Criteria

Form 7460-1 is to be completed and submitted by sponsors (or their representative) of any proposed construction or alteration project that trigger the FAA reporting requirements as detailed in FAR Part 77, AC 70/7460-2, and JO Order 7400.2G. The notification form serves to start the FAA OE/AAA process. Sponsors can file a paper form by mail or file online at the FAA OE/AAA website. In addition to restating the notification height criteria described in FAR Part 77.13, the form and accompanying instructions (paper or website) contain criteria for timing of submission, accuracy standards of geographic coordinates, and other filing details.

FAA Form 7460-2, Notice of Actual Construction

http://oeaaa.faa.gov/oeaaa/external/content/7460-2.pdf

Purpose

Form 7460-2 provides the formal means for a sponsor to provide notice of actual construction to the FAA, as detailed in FAR Part 77. The form is designed to collect the information necessary to monitor and catalogue proposed construction projects for which the FAA has issued a DNH.

Function

Form 7460-2 serves as means for a sponsor to provide all the required data necessary for FAA to monitor the proposed construction project. Form 7460-2, Part I notifies FAA when construction has begun. Part II notifies FAA when the structure has reached its maximum height.

Application of Criteria

Form 7460-2 is to be completed and submitted by sponsors as detailed in FAR Part 77, AC 70/7460-2, and JO Order 7400.2G. This notification form serves as the final phase of the FAA OE/AAA process. The form and accompanying instructions (paper or website) contain criteria for timing of submissions, accuracy standards of actual surveyed geographic coordinates, verification of marking and lighting installation, and other filing details.

FAA OE/AAA Website

Established 2004, regularly updated with improved functions

http://oeaaa.faa.gov

Purpose

The OE/AAA website is a user interactive system allowing for the electronic submittal of Notice of Proposed Construction forms for on- and off-airport construction. It also provides background and context information that users may find useful, and allows subscribers to specify certain geographic boundaries within which they would be automatically notified when OE/AAA cases are circularized under Public Notice and/or determined. This automated system was developed in the 2004 timeframe in order to automate and streamline what had previously been an all-paper process; to reduce time and workload for users and the FAA; and to make the process more transparent.

Function

The public OE/AAA webpage is designed to provide a convenient means for sponsors to submit and monitor all OE cases, public circularization of OE cases, and a historical archive of determined cases. The public OE/AAA system also sends and receives information from the FAA's internal-only OE/AAA system.

Application

The OE/AAA website is located on the internet at http://oeaaa.faa.gov. It provides users with a means to file 7460-1 and 7460-2 forms and receive determinations electronically through an automated process. It contains abundant FAA reference information including policy, procedures, criteria, forms, contact information, and tools for determining reporting requirements, and potential radar impacts. It also contains a searchable, historical database of determined cases, and various tools for sponsors of construction. Anyone may create a user account on this system. Sponsors may create a user account allowing them the ability to create, verify, submit, and manage multiple 7460-1 cases at any given time. **Airport owners and municipalities may create a user account and set preferences to receive automatic notification of proposed, circularized, and determined cases in the vicinity of their airport. The authors of this ACRP research strongly encourage airport managers to do so.**

FAA, Airport Obstruction Standards Committee, Decision Documents

Established 2003

http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/aosc/

The Airport Obstruction Standards Committee (AOSC) was established as a harmonization group for FAA obstruction criteria. The AOSC is charged with development of a transition strategy to guide the application of obstruction standards for airport and operations where no standards currently existed or were applied or where there was confusion or ambiguity regarding application of standards.

The AOSC also serves as an entity promoting the transformation of outdated, inconsistent obstacle standards and to establish new evolving standards that balance operational safety, efficiency, and economic benefit. As of March 2009, the AOSC has published seven decision documents.

Purpose

The purpose of the decision documents is to provide additional or updated guidance for obstacle protection as it pertains to specific subjects: the Precision Obstruction Free Area (POFA), which was re-designated the Precision Obstacle Free Zone (POFZ) in a subsequent issue of AC 150/5300-13; the effects of Obstacle Free Zone (OFZ) clearance areas on taxiway separation; application of the TERPS 40:1 departure surface; siting criteria for perimeter end around taxiways; the effect of airport traffic control towers greater than 300 feet AGL; clarification of obstacle survey requirements; the transition process for TERPS Paragraph 251 (visual segment of an instrument approach) covering nighttime operations; analysis of obstacle/airspace/safety relationship pertaining to the Collision Risk Model; measures for compliance with obstruction standards at non air carrier airports; and improved FAA headquarters guidance to assure integrated participation of all lines of FAA business during the construction process.

Function

These decision documents serve as updated guidance for airports, airport developers, engineers, OE/AAA evaluators and the general public. They provide clear decisions on matters of contention or ambiguity.

Application of Criteria

These decision documents are directly applicable to areas they cover. To date six documents have been published pertaining to POFA: 40:1 departure surface obstructions and evaluations; Atlanta Runway 8R-26L end-around taxiway; runway/parallel taxiway separation standards; airport Air Traffic Control Tower interim siting guidance; Dallas/Fort Worth end around taxi system; and national departure case standard for end around taxiway.

These criteria are applicable to specific cases. Some of the criteria have been incorporated into FAA Orders and ACs referenced in OE/AAA determinations, and it is likely that ultimately all of these criteria will be incorporated in the future. For example, Decision Document #02b regarding application of the TERPS 40:1 departure surface is occasionally referenced in OE/AAA determinations (see Figure A.6).

FAA Advisory Circular 150/5190-4A, A Model Zoning Ordinance to Limit Height of Objects Around Airports

Latest amendment December 1987

http://www.faa.gov/airports_airtraffic/airports/resources/advisory_circulars/media/150-5190-4A/150_5190_4A.PDF

Purpose

The primary purpose of this advisory circular is to provide a model zoning ordinance to be used as a guide for state and/or local planning agencies to protect airspace and control the height of objects around airports.

Function

The model zoning guidance provided is predicated on FAR Part 77 and other established airport zoning standard recommendations. It provides various zones required to prevent the creation or establishment of objects that would interfere with the operation of various types of airports.

AOSC Decision (Refer to Figure 1)

In issuing determinations for proposed obstacles under 14 CFR Part 77, the following cases will apply:

- Case I. Any proposed obstacle that is below a 40:1 surface originating at the DER, at DER elevation, will be evaluated according to existing OE/AAA guidance.
- Case II. Any proposed obstacle that penetrates the 40:1 surface originating at the DER, at DER elevation, by up to 35 feet will be evaluated for aeronautical effect and circularized.
- Case III. Any obstacle that penetrates a 40:1 surface originating at the DER, at DER elevation, by more than 35 feet will have a presumed adverse aeronautical effect and will be evaluated according to OE/AAA guidance for "Determination of Presumed Hazards (DPH)".

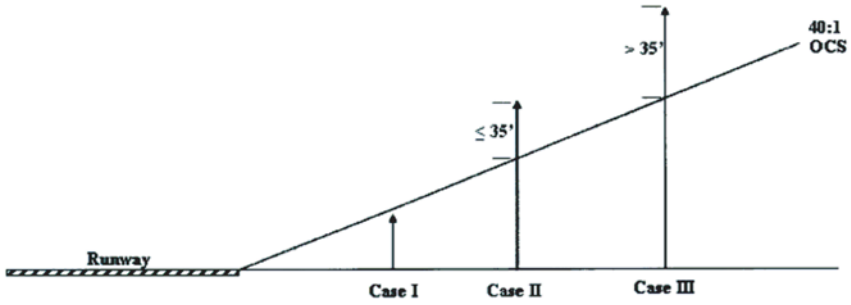


Figure 1

Figure A.6. AOSC Decision Document example: clarification of the TERPS 40:1 departure surface.

Application of Criteria

This advisory circular is directly applicable to airport owners and all types of municipal sovereign bodies. The model zoning includes textual examples of zoning that can be used as the basis of establishing an ordinance. The guide serves to establish an initial set of height limitations around the airport for existing and planned development. Although it does not necessarily protect for the most conservative reporting surfaces (62.5:1) or a comprehensive set of obstruction standards, establishment of zoning ordinances based on these and other criteria is critical as FAA can not prevent the construction of any structure, and relies on the local zoning ordinances and authorities having jurisdiction for the enforcement of airspace surrounding airports.

Implementation of these criteria involves the establishment of an airport land use map, depicting the FAR Part 77 civil airport imaginary surfaces, and the establishment of a review board to hear appeals and special cases for the establishment of proposed construction.

This advisory circular provides a good foundation and model for airspace protection regulations, but for readers unfamiliar with the range of airspace protection criteria, it may oversimplify the geometric configuration of maximum obstruction and/or no-hazard height, because the civil airport imaginary surfaces (1) are not always the lowest type of obstruction standard, and (2) TERPS surfaces, that in many cases dictate maximum no-hazard height, are in some areas lower than civil airport imaginary surfaces. The authors of this ACRP research project hope that the Report and Guidebook will serve as useful supplements to the technical and policy guidance contained in the advisory circular.

FAA Advisory Circular 150/5070-6B, *Airport Master Plans*

Latest amendment May 2007

http://www.faa.gov/airports_airtraffic/airports/resources/advisory_circulars/media/150-5070-6B/150_5070_6b_chg1.pdf

Purpose

The criteria contained in this advisory circular provide guidance for the preparation of master plans for airports of all sizes and types. They include basic airspace protection criteria related to runway planning.

Function

These criteria serve to identify the function of an airport Master Plan, its content, and the planning activities that are required to develop the document. They further identify the elements of a Master Plan including public involvement, environmental considerations, and inventory of existing conditions, aviation forecasts, facilities requirements, alternatives for development, evaluation of alternatives, airport master plans, document facilities implementation plans, and financial analyses.

Application of Criteria

These criteria are applied when an airport sponsor prepares a Master Plan or a Master Plan Update. The elements in a Master Plan focusing on future development plans and the development of an ALP set of drawings directly address navigable airspace. Obstruction clearance issues must be considered if any of the following are proposed: 1) a new runway; 2) change to runway configuration, including new applications of, or adjustments of, declared distances; 3) changes to existing obstructions; and 4) change to flight procedures.

The development of an ALP includes an airspace analysis that shows the civil airport imaginary surfaces drawings based on FAR 77.25 for the ultimate planned development alternative, and a set of departure drawings including the 40:1 TERPS departure surface and the 62.5:1 one engine inoperative obstacle identification surface. When an ALP is submitted for review by the airport to FAA, it follows an approval process defined in JO 7400.2. As part of this process, FAA is required to conduct an aeronautical study of the future development alternative. Once an ALP set is approved by FAA, all future OE/AAA cases must consider the proposed runway configuration in addition to existing runway configuration.

Airport Design Criteria

Various FAA ACs have been issued in order to establish guidance and recommendations pertaining to airport development and design. Airport design criteria are contained within the following:

- FAA AC 150/5300-13, *Airport Design*
- FAA AC 150/5300-18, *General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards*
- FAA AC 150/5390-2A, *Heliport Design*
- FAA AC 150/5395-1, *Seaplane Bases*
- FAA Order 6750, *Siting for Instrument Landing Systems*
- FAR Part 139, *Certification of Airports*
- FAR Part 157, *Notice of Construction, Alteration, Activation, and Deactivation of Airports*

The following sections discuss the purpose, function, and application of criteria contained in each of the documents listed above.

FAA AC 150/5300-13, *Airport Design*

Latest amendment November 2008

http://www.faa.gov/airports_airtraffic/airports/resources/advisory_circulars/

Purpose

FAA AC 150/5300-13 was first published in 1989 with the purpose of establishing the FAA's general standards and recommendations for airport design. For example, some of the specific direction provided in this AC includes basic airport geometry standards such as:

- Runway, taxiway, and taxilane design standards
- Surface gradient and line-of-sight standards
- Siting requirements for NAVAID and ATC facilities
- Guidance for the establishment of the airport reference point (ARP)
- Wind analysis standards

AC 150/5300-13 serves as the principal reference document pertaining to FAA standards for airport design.

Function

The intended function of AC 150/5300-13 is to provide the guidance needed in order to develop and maintain a national system of safe, delay-free, and cost-effective airports. The standards and recommendations contained in this publication do not serve to limit or regulate the operation of aircraft.

AC 150/5300-13 details many facets of airport design. Obstacle analysis is one of many topics covered in this publication. Certain aspects of AC 150/5300-13 should be considered when performing on-airport obstruction analysis. For example, the design standards outlined in AC 150/5300-13 dictate that certain areas, such as runway safety areas, runway protection zones, runway object free areas, and taxiway safety areas, etc., be kept essentially free of any obstructions. In addition, siting requirements for NAVAID and ATC facilities outlined in this AC dictate that certain areas are kept free of obstructions that may interfere with signals and lines-of-sight associates with these facilities.

Application of Criteria

The criteria contained in this AC apply to airports and are also used by specialists in the FAA Airports Division to evaluate proposed construction on airport. The standards and recommendations contained within AC 150/5300-13 are *recommended* by the FAA for application in the design of all civil airports. For airport projects receiving Federal grant-in-aid assistance, the use of these standards is *mandatory.* At certified airports, the standards and recommendations provided by AC 150/5300-13 may be used to satisfy the requirements of FAR Part 139, *Certification and Operations: Land Airports Serving Certain Air Carriers,* Subpart D.

The following paragraphs and figures provide examples of Appendix 2 *runway end siting criteria,* the primary geometric criteria used to determine how close to existing obstacles certain defined points of a runway may be sited, namely (1) the **threshold** (the first part of the runway available and suitable for landing) (Figure A.7), and (2) the **departure end of runway** (or DER, the point at which a departing aircraft must become airborne) (Figure A.8). Both of these defined points are routinely co-located with the runway pavement endpoint, but may be inset or "displaced" from the endpoint, if obstacle clearance requirements for departing or

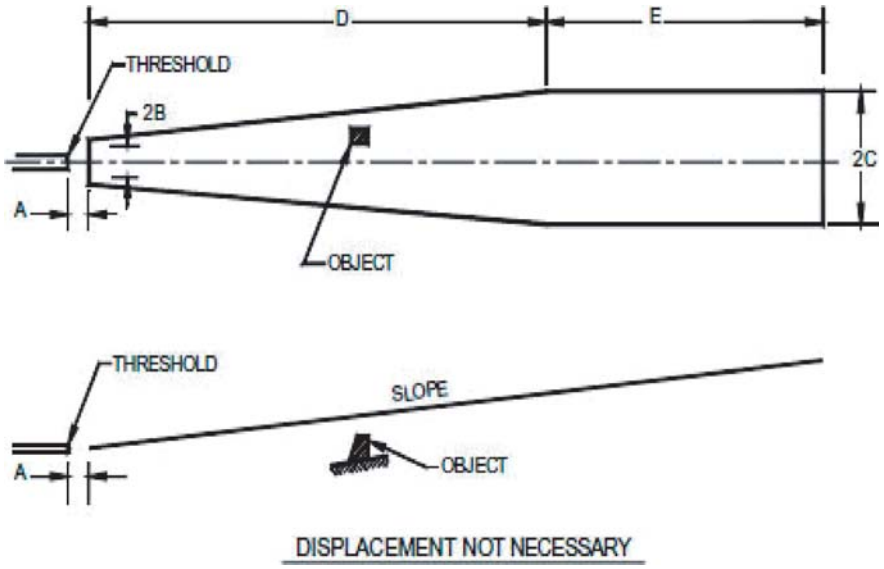


Figure A.7. From AC 150/5300-13, Appendix 2, Runway End Siting Criteria: Threshold Siting Surface.

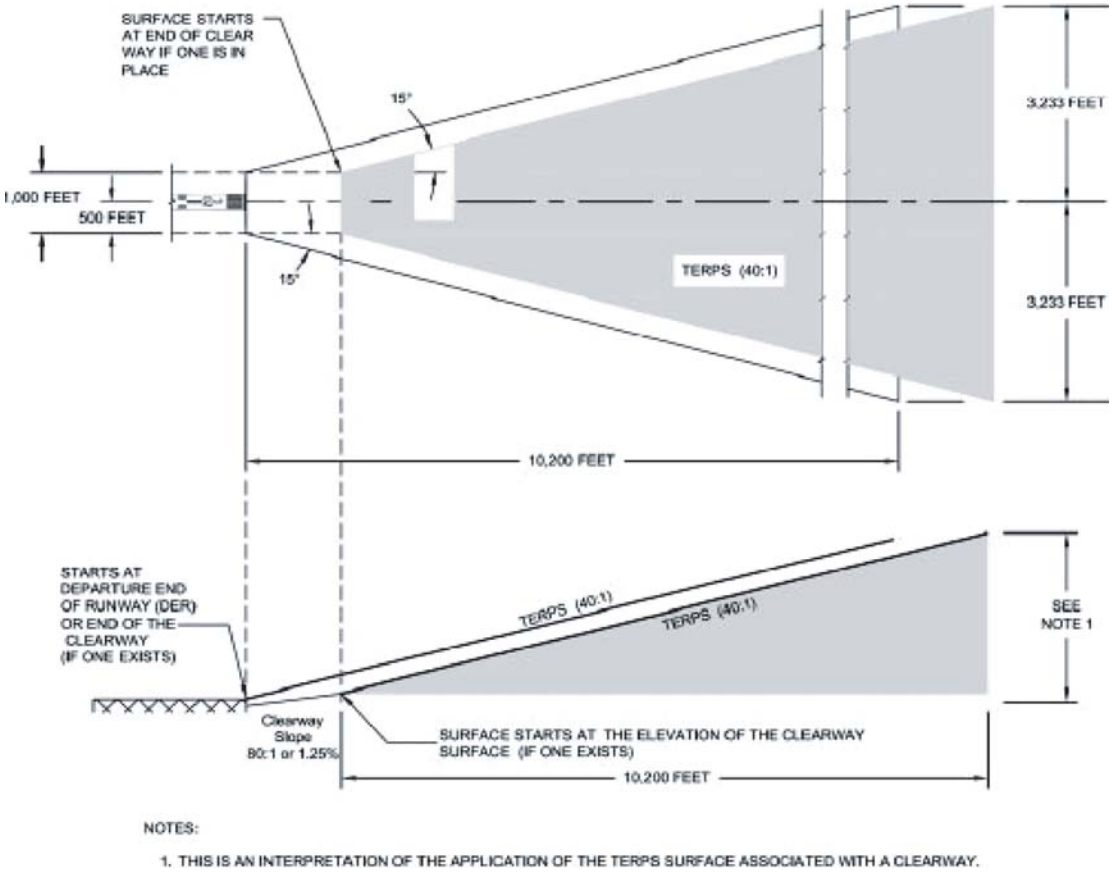


Figure A.8. From AC 150/5300-13, Appendix 2, Runway End Siting Criteria: Departure Siting Surface.

Table A.1. From AC 150/5300-13, Appendix 2.

	Runway Type	DIMENSIONAL STANDARDS* Feet					Slope/ OCS
		A	B	C	D	E	
1	Approach end of runways expected to serve small airplanes with approach speeds less than 50 knots. (Visual runways only, day/night)	0	60	150	500	2,500	15:1
2	Approach end of runways expected to serve small airplanes with approach speeds of 50 knots or more. (Visual runways only, day/night)	0	125	350	2,250	2,750	20:1
3	Approach end of runways expected to serve large airplanes (Visual day/night); or instrument minimums ≥ 1 statute mile (day only).	0	200	500	1,500	8,500	20:1
4	Approach end of runways expected to support instrument night circling. [1]	200	200	1,700	10,000	0	20:1
5	Approach end of runways expected to support instrument straight in night operations, serving approach category A and B aircraft only. [1]	200	200	1,900	10,000 [2]	0	20:1
6	Approach end of runways expected to support instrument straight in night operations serving greater than approach category B aircraft. [1]	200	400	1,900	10,000 [2]	0	20:1
7 [3, 6, 7, 8]	Approach end of runways expected to accommodate approaches with positive vertical guidance (GQS).	0	½ width runway + 100	760	10,000 [2]	0	30:1
8	Approach end of runways expected to accommodate instrument approaches having visibility minimums ≥ 3/4 but < 1 statute mile, day or night.	200	400	1,900	10,000 [2]	0	20:1
9	Approach end of runways expected to accommodate instrument approaches having visibility minimums < 3/4 statute mile or precision approach (ILS, GLS, or MLS), day or night.	200	400	1,900	10,000 [2]	0	34:1
10	Approach runway ends having Category II approach minimums or greater.	The criteria are set forth in TERPS, Order 8260.3.					
11	Departure runway ends for all instrument operations.	0 [4]	See Figure A2-3				40:1
12	Departure runway ends supporting Air Carrier operations. [5]	0 [4]	See Figure A2-4				62.5:1

* The letters are keyed to those shown in Figure A2-1.

Notes:

1. Lighting of obstacle penetrations to this surface or the use of a VGSI, as defined by the TERPS order, may avoid displacing the threshold.
2. 10,000 feet is a nominal value for planning purposes. The actual length of these areas is dependent upon the visual descent point position for 20:1 and 34:1 and Decision Altitude point for the 30:1.
3. Any penetration to this surface will limit the runway end to nonprecision approaches. No vertical approaches will be authorized until the penetration(s) is/are removed except obstacles fixed by function and/or allowable grading.
4. Dimension A is measured relative to Departure End of Runway (DER) or TODA (to include clearway).
5. Data Collected regarding penetrations to this surface are provided for information and use by the air carriers operating from the airport. These requirements do not take effect until January 1, 2009.
6. Surface dimensions/Obstacle Clearance Surface (OCS) slope represent a nominal approach with 3 degree GPA, 50'

arriving aircraft require. The emphasis of this appendix is that a new object that penetrates a critical runway end siting surface may result in serious impacts on the use of the runway by requiring the critical points to be moved, resulting in a reduction of usable runway length, which, in most cases, will incrementally reduce the capacity of that runway. As a companion to Appendix 2, Appendix 14 ('Declared Distances') prescribes the usable length reductions that must be made in order for the runway to be in compliance with runway end siting and other airport design standards.

Table A.1 is Table A2-1 from AC 150/5300-13, Appendix 2. It specifies the dimensions of threshold siting surfaces and departure end siting surfaces, which depend on the runway type, approach type, and other factors, including the following:

- Whether or not the runway is authorized for a visual, nonprecision, precision approaches, nighttime operations, and the approach visibility minimums.
- Whether or not there are published instrument departure procedures on the runway.
- Whether or not the runway is used by scheduled air carriers (those operating under FAR Part 121).

  and
- The approach category of the runway's design aircraft.

In many cases the requirements for maintaining airspace clear of objects depend, in part, on the type of aircraft that typically use a runway. Airport runway design standards are based, in fact, on what is known as the runway's "design aircraft."

Design Aircraft: A design aircraft is one that is deemed to be most critical to the design of a runway, and that is planned to use the runway for at least 500 itinerant operations annually. A runway may be designed with a number of different design aircraft. For example, a very large aircraft may be the design aircraft when it comes to runway length specifications, while a very small aircraft may be the design aircraft when designing for runway orientation, while yet another may be used to design the pavement specifications of the runway. For the purposes of airspace protection, the aircraft with the greatest "approach speed" is used.

Design Aircraft Approach Category: The approach speed is the airspeed that the aircraft is designed to be traveling while on approach to the runway. Based on the approach speed of the design aircraft, the runway is given an Aircraft Approach Category. This category is a letter from A to E, based on the following:

Aircraft Approach Category

Category	Approach Speed
A	< 91 knots
B	91–120 knots
C	121–140 knots
D	141–166 knots
E	> 166 knots

Once these parameters are established, refer to Table A.1 (Table A2-1 from Appendix 2) for specific dimensions. **Please note that additional coordination with TERPS criteria and airline-specific OEI criteria is necessary for some types of runway end siting surfaces.**

FAA AC 150/5300-18, General Guidance and Specifications for *Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards*

Latest amendment 150/5300-18B, May 2009

http://www.faa.gov/airports_airtraffic/airports/resources/advisory_circulars/index.cfm?template=Document_Listing&Keyword=150/5300-18

Purpose

FAA AC 150/5300-18 provides the specifications for the collection of airport data via field and office methodologies in support of the FAA. It also stipulates how the data is to be submitted to FAA and who will then forward the safety critical data to the National Geodetic Survey (NGS) for their independent verification and validation. The primary purpose of the guidelines contained in this advisory circular is to establish the requirements for data collection and processing conducted at airports in support of the FAA Airport Surveying-GIS Program.

Function

The standards presented in this publication provide information that is "critical to the operation and safety of the National Airspace System (NAS)". The International Civil Aviation Organization (ICAO) classifies data as critical when "*there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe*".

Figure A.9 depicts the "Airport Airspace Survey Surfaces," a set of surfaces that are similar to, but generally wider and lower than, the FAR Part 77 Civil Airport Imaginary Surfaces. The function of the Airport Airspace Survey Surfaces is as a screening tool—any object that penetrates any of these surfaces must be catalogued in the airport airspace survey. The surfaces

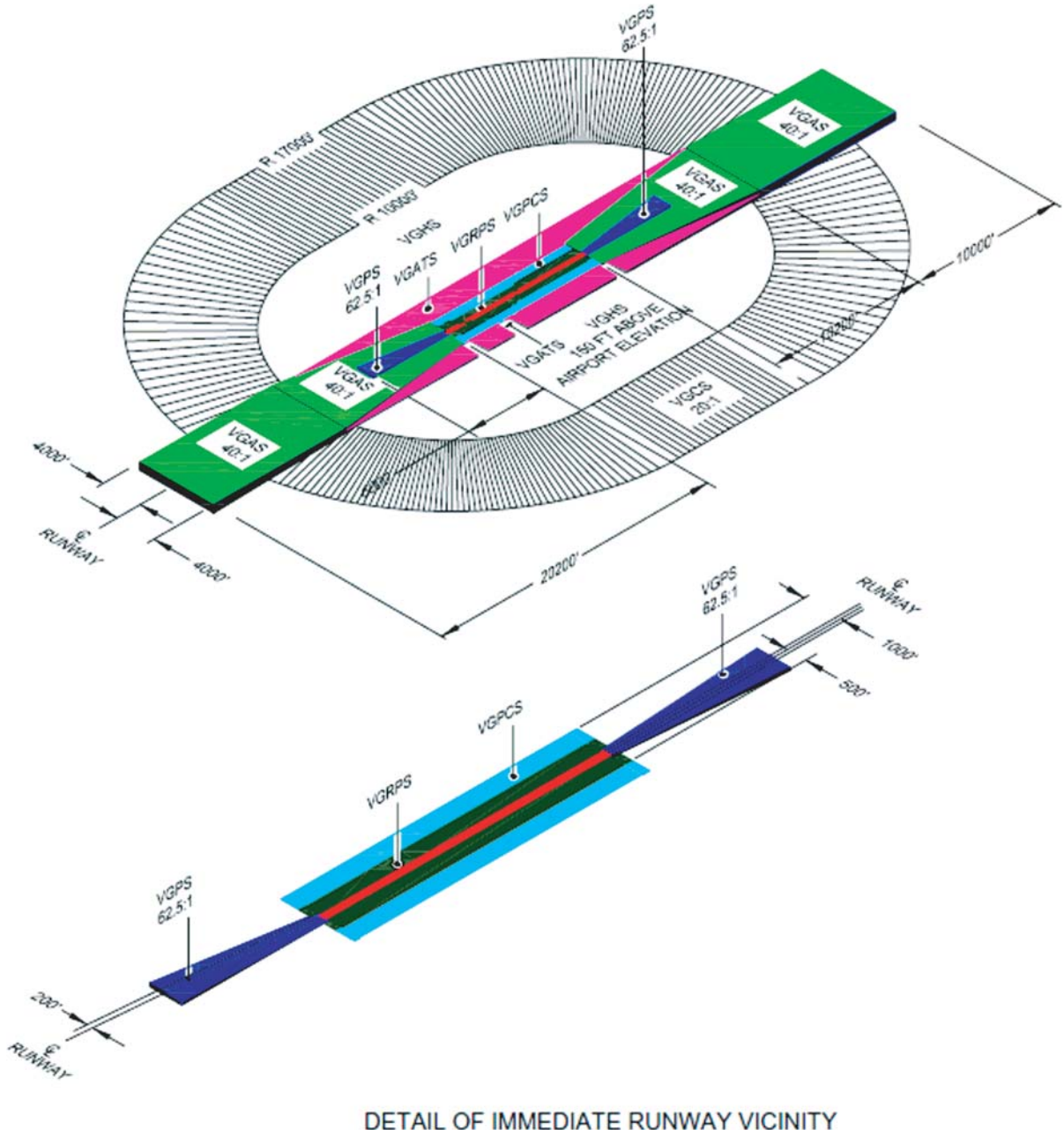


Figure A.9. Airport airspace survey surfaces.

shown in the example are for airports whose runways have vertical guidance (vertically-guided approaches). Other surfaces apply for runways without vertical guidance. See Section 2.7 of the AC for more detail. The surfaces shown on the figure are as follows:

- Vertically Guided Runway Primary Surface (VGRPS)
- Vertically Guided Primary Connection Surface (VGPCS)
- Vertically Guided Approach Surface (VGAS)
- Vertically Guided Protection Surface (VGPS)
- Vertically Guided Approach Transitional Surface (VGATS)
- Vertically Guided Horizontal Surface (VGHS)
- Vertically Guided Conical Surface (VGCS)

The guidance provided in AC 150/5300-18 encompasses the entire range of the FAA's airport data requirements. This includes but is not limited to: runway and stopway data; navigational aid data; obstruction data; and data on various airport features including taxiways, aprons, landmark features, and airspace obstructions. Most of this data is source data, acquired by field survey or remote sensing methods. The methodology described in this publication should be used when gathering data to be used for obstacle analysis efforts related to airport improvement projects. Criteria define obstacle survey surfaces, screening for obstacles that must be included in the 3D database.

Application of Criteria

The FAA *recommends* the guidelines provided in this AC for the collection of geospatial airport and aeronautical data. Compliance with these guidelines is mandatory for the collection of geospatial airport and aeronautical data for airfield improvement projects funded by Federal grant assistance programs. This AC also provides one, but not the only, means of meeting the requirements for the collection of geospatial airport and aeronautical data stipulated by CFR Part 139, *Certification of Airports.* The obstacles identified as part of these surveys are entered into a database and are considered when preparing instrument flight procedures at each airport.

FAA AC 150/5390-2A, *Heliport Design*

Latest amendment January 2004

http://rgl.faa.gov/Regulatory_and_Guidance_Library%5CrgAdvisoryCircular.nsf/0/A1CC4566A988F08986256C6A00721BC6?OpenDocument

Purpose

FAA AC 150/5390-2 provides recommendations for heliport design and describes acceptable requirements for the development of a heliport. This AC applies to any individual or entity that is proposing to construct, modify, activate, or deactivate a heliport within the NAS.

Function

The intended function of AC 150/5390-2 is to provide the guidance necessary to develop and maintain safe, efficient, and cost-effective heliports. The standards and recommendations contained in this publication do not serve to limit helicopter or heliport operations.

AC 150/5390-2 is essentially the heliport counterpart to AC 150/5300-13. It is a wide-ranging document covering nearly every facet of heliport design including basic obstruction analysis. Certain aspects of this AC should be considered when performing obstacle analysis on heliport property. For example, the design standards outlined within this publication dictate that certain areas, such as final approach reference areas, safety areas, certain protection zones, etc., be kept free of any obstructions (see Figure A.10).

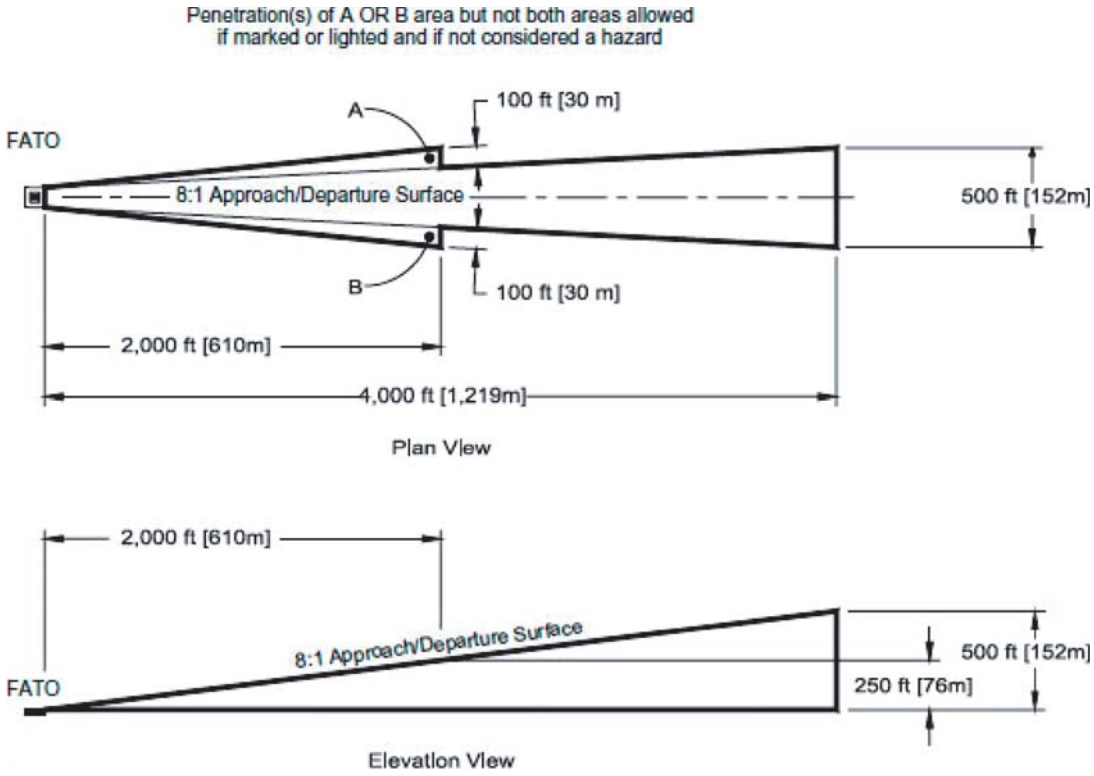


Figure A.10. Heliport approach/departure surfaces.

Application of Criteria

The standards and recommendations contained within AC 150/5390-2 are generally *recommended* by the FAA for application in the design of heliports. For heliport projects receiving Federal grant assistance, the use of these standards is *mandatory*. These recommendations and standards are predicated on average conditions. Adaptation to meet the specific conditions of a particular site may be necessary. To the greatest extent possible, the standards contained in AC 150/5390-2 should be used when planning and designing improvements to existing heliports.

FAA Advisory Circular 150/5395-1, *Seaplane Bases*

Latest amendment June 1994

http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/79ADABA388B6BE6186256C6A00721C2A?OpenDocument&Highlight=seaplane%20bases

Purpose

FAA AC 150/5395-1 provides guidance to assist operators in planning, designing, and constructing seaplane base facilities.

Function

The intended function of AC 150/5395-1 is to provide the guidance needed in order to develop and maintain safe, efficient, and cost-effective seaplane bases. The standards and recommendations contained in this publication do not serve to limit or regulate the operation of aircraft.

AC 150/5395-1 is a comprehensive document detailing seaplane base planning, design, and construction. Basic obstacle analysis is described in this publication. Criteria pertain-

ing to seaplane bases differ from those for airports. For example, FAR Part 77 applies to seaplane bases only if the sea lanes are outlined by visual markers. This AC covers the FAA process for the study of existing objects. As with airports, it is necessary to submit 7460-1 forms for proposed construction or alteration of structures on, or in the vicinity of a seaplane base.

Application of Criteria

Establishment of a new seaplane base or modification of a seaplane base requires advance notification to the FAA. In support of such establishment or notification, FAA recommends the design embody the guidance provided by AC 150/5395-1.

FAA Order 6750, Siting Criteria for Instrument Landing Systems

Latest amendment February 2004

http://www.airweb.faa.gov/

Purpose

The purpose of FAA Order 6750 is to provide engineering guidance pertaining to the siting of FAA ILS. Because ILS siting conditions vary site to site, it is not possible for the FAA to provide guidance on overcoming or offsetting the potential effects of every potential adverse condition. This order provides guidelines that are to be used in conjunction with a thorough understanding of ILS facility operations in order to determine the optimum site and operating conditions.

Function

The intended function of FAA Order 6750 is to provide sufficient information, along with supporting drawings, to enable the selection of the optimum ILS site, within defined limits, for each of the subsystems that comprise Category I, II, or III ILS systems. Subsystems that may comprise an ILS installation include localizer antennas, glide slope antennas, marker beacons, and approach lighting systems.

The criteria in this Order should be taken into consideration when conducting an obstruction analysis for proposed structures near an airport utilizing one or more ILS systems or an airport that has a planned ILS system. The Order specifies critical areas that must be free of certain types of obstructions in order to ensure the continuous integrity of the signal received by the aircraft, and visibility of approach lighting.

Application of Criteria

The criteria applied in FAA Order 6750 apply only to newly established or relocated ILS facilities to include Localizer, Marker Beacon, Localizer-Type Directional Aids, and Offset Localizers. Additional criteria are accessible for Non-Directional Beacon and Distance Measuring Equipment (DME) specific to collocation with ILS facilities. It is not required that existing facilities be changed for the sole purpose of compliance with the latest criteria established in this Order.

FAR Part 139, Certification of Airports

Latest amendment June 2004

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgFAR.nsf/Frameset?OpenPage

Purpose

FAR Part 139 establishes certification requirements for airports. FAR Part 139 requires the FAA to issue airport operating certificates to airports that:

- Serve scheduled and unscheduled air carrier aircraft with more than 30 seats;
- Serve scheduled air carrier operations in aircraft with more than 9 seats but less than 31 seats; and
- The FAA Administrator determines are required to have a certificate.

This regulation does not apply to airports at which air carrier passenger operations are conducted only because the airport has been designated as an alternate airport. The regulation allows the FAA to issue certain exemptions to airports that serve low numbers of passengers on a yearly basis, and for which some of the requirements might create undue financial hardship.

Function

Airport Operating Certificates serve to promote a consistent level of safety in air transportation. To obtain a certificate, an airport must agree to certain operational and safety standards and provide for such facilities as firefighting and rescue equipment. These requirements vary depending on the size of the airport and the type and number of flights available. The FAA inspects the airport periodically in order to ensure compliance.

Certain aspects of this regulation must be considered when conducting obstruction analyses pertaining to airports. Paragraph 139.331 addresses obstructions specifically and states:

> In a manner authorized by the Administrator, each certificate holder must ensure that each object in each area within its authority that has been determined by the FAA to be an obstruction is removed, marked, or lighted, unless determined to be unnecessary by an FAA aeronautical study. FAA Advisory Circulars contain methods and procedures for the lighting of obstructions that are acceptable to the Administrator.

Safety areas and protection of NAVAIDS are also covered in this regulation. These aspects of the airport certification regulations must also be considered when conducting obstruction analyses.

Application of Criteria

Generally, airports in any state of the United States, the District of Columbia, or any territory or possession of the United States, serving passenger-carrying operations of an air carrier certificated under FAR Part 121 and FAR Part 380 must hold Airport Operating Certificates if:

- Scheduled passenger-carrying operations are conducted in aircraft designed for more than 9 passenger seats; and
- Unscheduled passenger-carrying operations are conducted in aircraft designed for at least 31 passenger seats

The authorizing statute exempts Alaskan airports that serve air carrier aircraft with less than 30 seats from Federal airport certification requirements. Also, any such airport that either leases from or shares its facility with the U.S. Government, such as the Department of Defense, must obtain a Part 139 Airport Operating Certificate for those portions of a joint-use or shared-use airport that are within the authority of a person serving passenger-carrying operations defined above.

FAR Part 157, Notice of Construction, Alteration, Activation, and Deactivation of Airports

Latest Amendment July 1991

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c5ecfr&rgn5div5&view5text&node514:3.0.1.3.24&idno514

Purpose

FAR Part 157 establishes notification requirements for construction, alteration, activation, and deactivation of airports and/or take-off or landing area components of airports, for those airports that are not required to have an approved ALP on file with the FAA. The FAA must be made aware of all airports and landing areas in the U.S. airspace, irrespective of size, in order to investigate airspace interactions, airspace obstructions, land use compatibility, and other considerations.

Function

FAR Part 157 functions as a means for the FAA to be notified and to make airspace determinations and other types of determinations for the large number of non-public and small public airports that either do not receive Federal assistance, or for other reasons are not routinely represented with ALPs. These can include small general aviation airports, heliports, seaplane bases, rooftop helipads, gliderports, and the like.

Application of Criteria

Sponsors of airport and/or landing area proposals that fall under FAR Part 157 are required to file FAA Form 7480-1, *Notice of Landing Area Proposal,* with the FAA ADO having jurisdiction. The FAA Airports Division will assign a non-rulemaking airport (NRA) case number, and will process the form in accordance with FAA Order 7400.2, Part 3 (Chapters 10, 11, and 12), with appropriate coordination among other FAA divisions and other stakeholders, and will subsequently issue determinations.

Flight Procedure Design Criteria

Various FARs, FAA Orders and AC have been issued in order to establish guidance and recommendations pertaining to instrument flight procedure design. The criteria contained in these documents also inform the OE/AAA process when the FAA evaluates the effects a proposed structure would have on a specific procedure. Flight procedure design criteria are defined in the following documents:

- FAA Order 8260.3B, *The United States Standard for Terminal Instrument Procedures (TERPS)*
- TERPS Derivative Orders (8260 series)
- TERPS Instruction Letters (TILs)
- FAA AC 90-80B, *Approval of Offshore Standard Approach Procedures, Airborne Radar Approaches, and Helicopter En Route Decent Areas*
- FAR Part 25, *Airworthiness Standards: Transport Category Airplanes*
- FAA AC 120-91, *Airport Obstacle Analysis*
- FAA AC 120-29A, *Criteria for the Approval of Category I and II Weather Minima for Approach*
- FAA AC 120-28D, *Criteria for the Approval of Category III Weather Minima for Takeoff, Landing, and Rollout*
- FAR Part 121, *Operating Requirements: Domestic, Flag, and Supplemental Operations*
- FAA Handbook, *FAA-H-8261-1A, Instrument Procedures Handbook*
- FAA Air Traffic Publication, *Aeronautical Information Manual*
- FAA, National Aeronautical Charting Office (NACO) Website

FAA Order 8260.3B, *The United States Standard for Terminal Instrument Procedures* (TERPS)

Latest amendment Change 20, December 2007

http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgOrders.nsf/0/12B3D4C9B4F46DCE862572D700538895?OpenDocument&Highlight58260.3b

66 Understanding Airspace, Objects, and Their Effects on Airports

Purpose

This order prescribes standardized methods for use in designing instrument flight procedures. The criteria contained in this Order must be used to formulate, review, approve, and publish procedures for instrument flight operations to and from civil and military airports. The Flight Procedure Standards Branch, AFS-420, of the Flight Technologies and Procedures Division, AFS-400, is responsible for the rulemaking process of the Flight Procedures program which includes development, application, and oversight of the National Flight Procedures Program and development of criteria pertinent to designing instrument flight procedures. This includes all of the 8260 Series Orders, approximately 20 in number.

Function

FAA Order 8260.3B is designed to provide the instrument flight procedure developer with the criteria to safely and efficiently construct instrument flight procedures in accordance with standardized regulatory framework. This framework includes the evaluation of existing and proposed obstructions, in the NAS.

Application of Criteria

The instrument flight procedure developer uses the criteria contained within Order 8260.3B to develop a particular instrument flight procedure, such as a precision approach to a certain runway at a certain airport. Much of the process guidance contained within this Order has also been programmed into the FAA Instrument Approach Procedure Automation (IAPA) System. This offers the instrument flight procedure developer the ability to use the automated system to develop the majority of instrument procedures.

TERPS criteria are designed to provide a margin of safety, known as ROC, between aircraft in flight and permanent objects, including terrain, vegetation, and manmade objects. After mapping the runways, terrain, and critical obstacles, the procedure designer (human or computer) applies the criteria to develop the specific flight path. Criteria for different systems of instrumentation are different based on the horizontal and vertical margins of error (i.e., deviation of actual versus reported flight path) known for each system of instrumentation.

For each segment of each procedure, an obstacle accountability area (OAA) is first developed. The OAA is a two-dimensional area showing the limits of where obstacles need to be considered for the particular flight procedure. Based on the flight path and ROC, the OIS is constructed next at default or ideal alignments. If the OIS is found to be clear of obstacles, it functions as an obstacle clearance surface (OCS), and the procedure can have optimal flight path parameters. For certain types of procedures, if the OIS is found to have penetrating obstacles, an alternative OCS is created that clears the obstacles, and/or the visibility minimums of the procedure are raised from the ideal elevations upwards to an elevation where the penetrating obstacle would not cause a reduction in minimum ROC (see Figure A.11). For other types of procedures, any penetration of crucial surfaces such as the glidepath qualification surface (GQS) or visual segment are not allowed; if penetrations are found, they must be removed, otherwise the procedure is not authorized.

In the OE/AAA process, either the manual construction or the automated system, or a combination therein, will be used to evaluate the effects of proposed or existing construction on existing or proposed instrument flight procedures. These criteria apply at any location where an appropriate U.S. agency exercises jurisdiction. Instrument flight procedures can be "reverse engineered" to depict large-scale representations of the OCSs to develop airspace surface mapping (see Figure A.12).

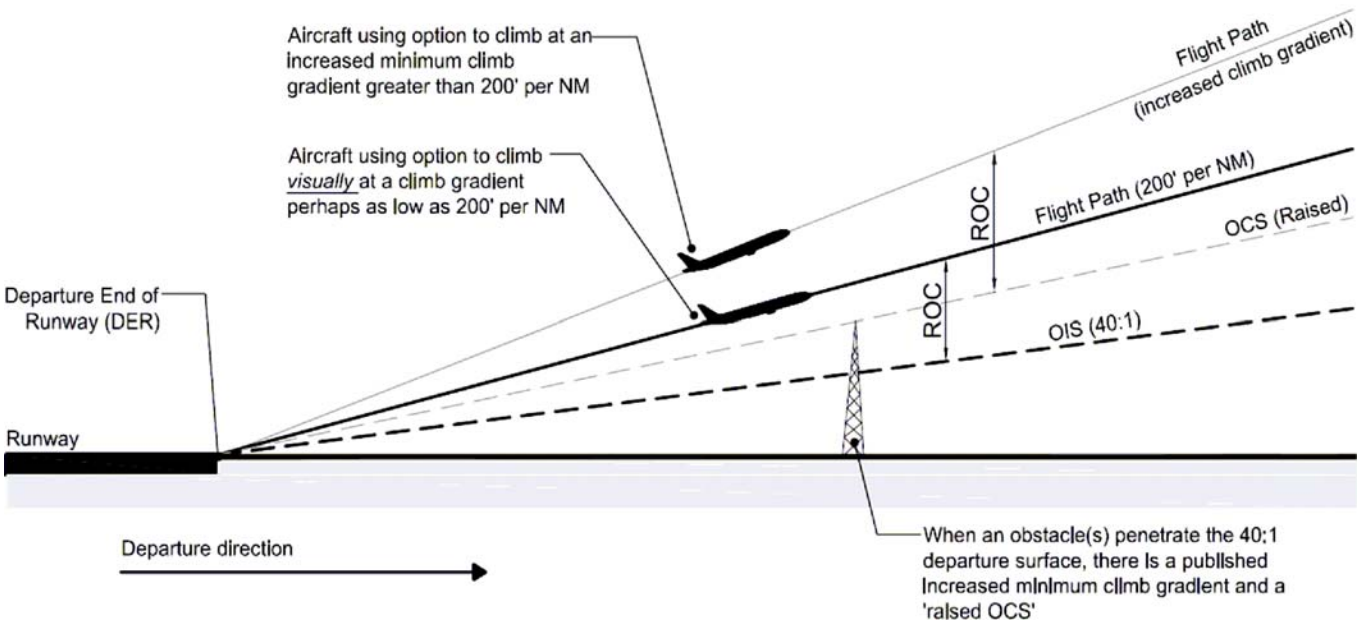


Figure A.11. Illustration of flight paths, obstacle identification surface (OIS), obstacle clearance surface (OCS) and required obstacle clearance (ROC) concepts, as applied to TERPS obstacle departure procedures.

TERPS Derivative 8260 Series Orders

http://www.faa.gov/regulations_policies/orders_notices/index.cfm?fuseAction=c.dspTopicBrowse&parentTopicID=16

- 8260.4 *ILS Obstacle Risk Analysis*
- 8260.15E *United States Army Terminal Instrument Procedures Service*
- 8260.16 *Airport Obstruction Surveys*
- 8260.19D *Flight Procedures and Airspace*
- 8260.23 *Calculation of Radio Altimeter Height*
- 8260.31B *Foreign Terminal Instrument Procedures*
- 8260.32D *U.S. Air Force Terminal Instrument Procedures Service*
- 8260.37 *Helicopter Civil Utilization of Collocated Microwave Landing Systems (MLS)*
- 8260.40B *Flight Management System (FMS) Instrument Procedures Development*
- 8260.42A *Helicopter Global Positioning System (GPS) NonPrecision Approach Criteria*
- 8260.43A *Flight Procedures Management Program*
- 8260.44A CHG 2 *Civil Utilization of Area Navigation (RNAV) Departure Procedures*
- 8260.45A *Terminal Arrival Area (TAA) Design Criteria*
- 8260.46C CHG 1 *Departure Procedure (DP) Program*
- 8260.49A *Simultaneous Offset Instrument Approach (SOIA)*
- 8260.52 *United States Standard for Required Navigation Performance (RNP) Approach Procedures with Special Aircraft and Aircrew Authorization Required (SAAAR)*
- 8260.53 *Standard Instrument Departures That Use RADAR Vectors To Join RNAV Routes*
- 8260.54A *The United States Standard for Area Navigation (RNAV)*
- N8260.64 *Radar Approaches and Minimum Vectoring Altitudes—Current Guidance and Criteria*
- N8260.65 *Guidelines for Application of Glidepath Qualification Surface (GQS)*
- 7130.3A *Holding Pattern Criteria*

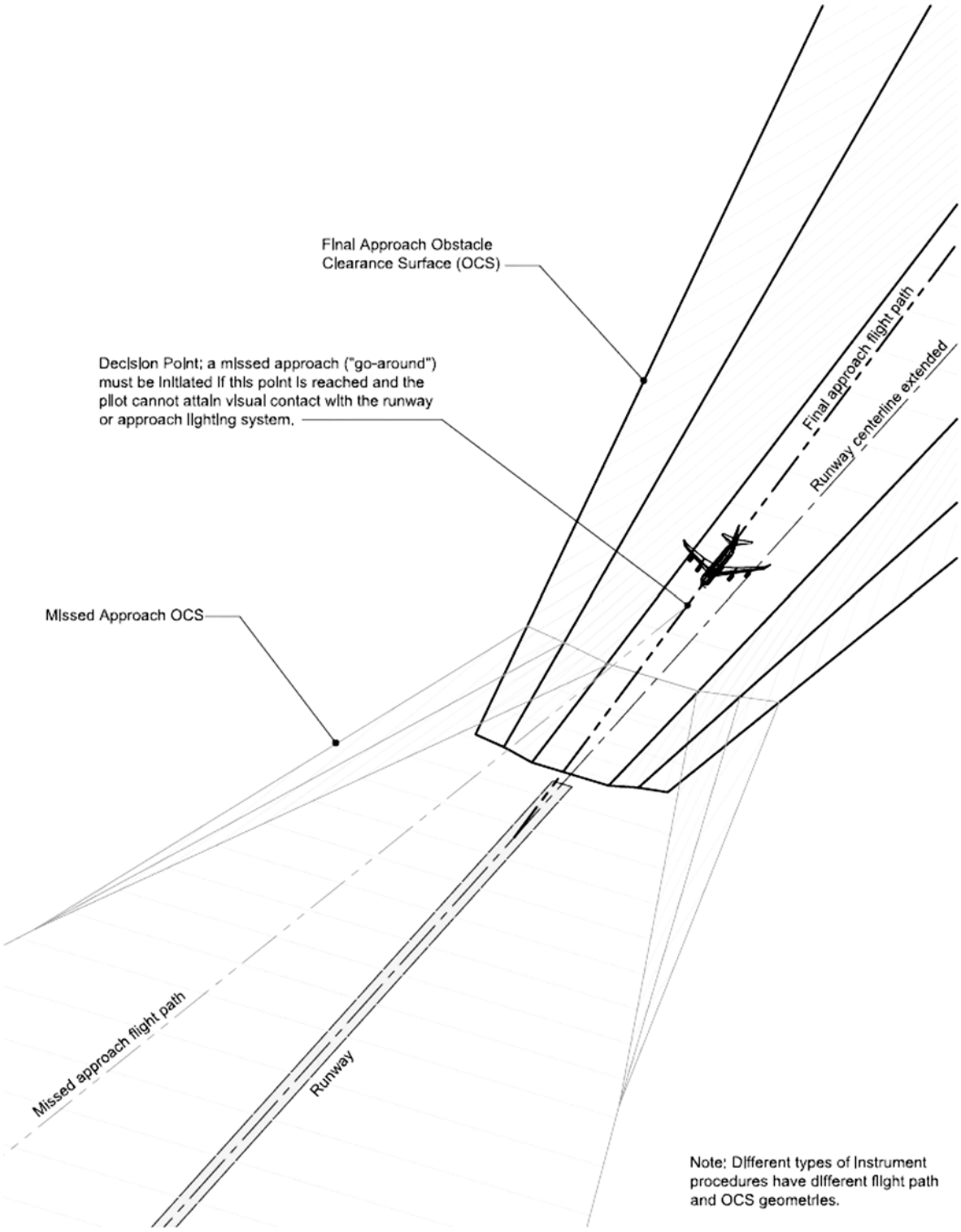


Figure A.12. TERPS final approach and missed approach as illustrated for generic vertically-guided approach.

Purpose

As new types of instrumentation technology are developed, the FAA publishes new Orders describing how procedures should be developed that utilize new types of instrumentation.

Function

The various 8260 Series Orders are designed to provide the instrument flight procedure developer with guidance in the development, evaluation, and analysis of various facets, different types of instrument procedures that supplement, and/or address additional airspace design that is not an integral part of the basic TERPS Order 8260.3B. These include, but are not limited to, Instrument approach procedure development, departure development, risk assessment and terminal area design. The majority of the Orders address various types of air navigation including the use of conventional NAVAIDS, Radar and Area Navigation (RNAV) along with GPS. They also address special procedures such as helicopter operations.

Application of Criteria

Each of the various 8260 Series Orders provide additional guidance for specific new procedure technology to the Airspace Specialist that is not fully contained within Order 8260.3B. This provides the Airspace Specialist with the ability to analyze and develop instrument procedures that require additional information, criteria and guidelines.

Of the 8260 Series Orders, FAA Order 8260.19 provides additional guidance to Airspace Specialists during the Obstruction Evaluation process. Order 8260.19 provides guidance to all FAA personnel for the administration and accomplishment of the FAA Flight Procedures and Airspace Program. It specifically requires that the National Flight Procedures Office (FPO) ensure that a complete evaluation of the effect that any proposed construction or alterations will have on IFR aircraft operations, including the visual portion of an IFR procedure, is conducted.

TERPS Instruction Letters (TILs)

http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs400/afs420/policies_guidance/tils/

- 99-003 Taxiing Aircraft as Departure Obstructions; AVN-160 E-Mail
- 99-014 Adding Descent Angles to Nonprecision Approach Charts
- 00-009 Successive Fly-over Waypoints
- 00-012 Paragraph 252, Descent Angle/Gradient
- 00-015 Airport Reference Code (ARC) Application
- 00-016 Interim United States Army Helicopter Departure Criteria
- 01-020 FAA Order 8260.44 Interim Change 1
- 01-024 Construction Criteria for Leg Segments VA to CF
- 01-025 Turning Area Curve Radii at 10,000 Feet MSL
- 02-039 Guidance on the Use of RNAV-Pro Software to Pre-Screen Instrument Procedures
- 02-042 Area Navigation (RNAV) "Q" Route Processing
- 02-043 United States Standard for TERPS Change 19, Correction #1
- 03-048 Interim Correction to Order 8260.3B, United States Standard for Terminal Instrument Procedures (TERPS)

Purpose

TERPS Instruction Letters (TILs) are intended to provide interim guidance and/or clarification to a particular Order until a revision to the Order is accomplished.

Function

The TIL provides the Airspace Specialist clarification or additional guidance when conducting an airspace evaluation, when some portion of TERPS criteria may be incomplete, ambiguous, in conflict with other criteria, or outdated.

Application of Criteria

TILs are applied in a similar manner to full TERPS orders in the OE/AAA process and flight procedure development process.

FAA AC 90-80B, Approval of Offshore Standard Approach Procedures, Airborne Radar Approaches, and Helicopter En Route Descent Areas

Latest amendment April 1992

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/key/AC%2090-80B

Purpose

This AC 90-80B provides criteria and describes acceptable methods for obtaining approval to use the Offshore Standard Approach Procedure (OSAP), the Airborne Radar Approach (ARA) and the Helicopter En Route Descent Area (HEDA) and useful information for obstruction evaluation as the process relates to flight procedures.

Function

The criteria for developing offshore approaches are unlike those used for SIAP. This AC provides additional criteria for offshore approach course alignments that may vary from one approach to the next.

Application of Criteria

The Airspace Specialist uses these criteria when determining whether or not proposed structures may impact the offshore approaches, airborne radar approaches or helicopter operations.

FAR Part 25, Airworthiness Standards: Transport Category Airplanes

Latest amendment September 2008

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?&c=ecfr&tpl=/ecfrbrowse/Title14/14tab_02.tpl

Purpose

FAR Part 25 provides strict technical regulations for aircraft compliance during takeoff, landing, and during one engine inoperative procedures. Transport category aircraft must be in compliance with a variety of airworthiness standard criteria to receive certification for airworthiness.

Function

The guidelines described a variety of criteria for aircraft evaluation including performance, controllability and maneuverability, trim, stability, stalls, ground and water handling characteristics, and other miscellaneous flight requirements. Individual air carriers can use the guidance in FAR Part 25 to determine compliance for takeoff, landing, and OEI procedures.

Application of Criteria

This AC provides information on the performance requirements of aircraft, which in turn determines the appropriate flight profiles of arriving and departing aircraft from runways. These profiles in turn contribute to determining flight procedures, under both normal and one-engine-inoperative conditions, for airport runways, given existing surrounding terrain or other objects in the vicinity.

FAA AC 120-91, Airport Obstacle Analysis

Latest Amendment May 2006

http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/55a6248632ed6e8d86257184005a2188/$FILE/AC120-91.pdf

Purpose

This advisory circular describes acceptable methods and guidelines for developing takeoff and initial climb-out airport obstacle analyses and in-flight procedures to comply with the intent of the regulatory requirements of FARs, and other associated OEI requirements relating to turbine engine powered airplanes operated under FAR Parts 121 and 135.

Function

The methods and guidelines described in this AC have been derived from extensive FAA and industry experience and are considered acceptable to the FAA when appropriately used. Individual air carriers can use the guidance in AC 120-91 as a framework to develop emergency OEI flight procedures.

Application of Criteria

This AC provides information for determining safe clearance from obstacles for the actual flight path, and for considering factors that may cause a divergence of the actual flight path from the intended flight path. Each airline is required to develop OEI procedures for each runway at each airport. Each has their own procedures, but all must be approved by the FAA.

OEI procedures are constructed similar to TERPS procedures. The airline flight operations engineer begins with a basemap of the runways, terrain, and obstacles. An ideal OEI flight path is developed, accounting for reduced climb performance resulting from loss of power to one engine. An OAA or "splay" (see Figure A.13) is applied to obstacles in the flight path, and the procedure designer reviews the obstacle clearance between the flight path and obstacles within the OAA. If the obstacle clearance is less than required, the flight path must be adjusted, either upwards (by reducing take-off weight), or incorporating a turn to avoid the obstacle. Both of these adjustment options are undesirable. Reducing takeoff weight (some combination of passengers, fuel, and cargo), known as a "weight penalty," can have a substantial negative financial impact on the flight, or it may make the flight technically infeasible. Incorporating turns into an emergency procedure is undesirable, since it adds a layer of complexity to an extremely stressful situation for the pilot.

Proposed construction may adversely impact one or more airlines' OEI procedures, even if it would not affect any TERPS procedures. Air carriers, their representatives, or other stakeholders may file OEI-related comments under Public Notice when the FAA is conducting an aeronautical study.

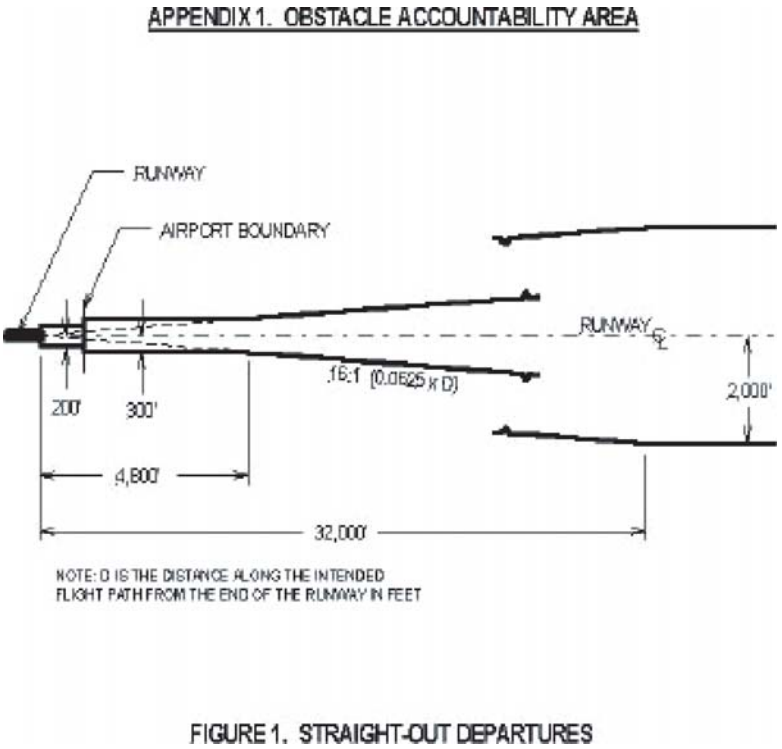


Figure A.13. Illustration of the standard OEI OAA from AC 120-91.

FAA AC 120-29A, Criteria for Approval of Category I and Category II Weather Minima for Approach

Latest Amendment August 2002

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/key/AC%20120-29A

Purpose

This AC provides an acceptable means, but not the only means, for obtaining and maintaining approval of operations in Category I and II Landing Weather Minima including the installation and approval of associated aircraft systems.

Function

Approach weather minima are approved through applicable operating rules use of approved instrument procedures and issuance of Operations Specifications (Op-Specs). Op-Specs are unique FARs applicable to a particular operator. Op-Specs are based on the regulations; however, they are specifically applicable to and tailored to a particular operator's aircraft, routes, and operating circumstances.

Application of Criteria

Instrument Approach procedures in the United States and its territories must be validated by an authorized FAA process. This includes the obstruction evaluation process for objects in approach and missed approach areas.

FAA AC 120-28D, Criteria for Approval of Category III Weather Minima for Takeoff, Landing, and Rollout

Latest Amendment July 1999

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/8ce3f88c034ae31a85256981007848e7/bbada17da0d0bbd1862569ba006f64d0/$FILE/AC120-28D.pdf

Purpose

This AC provides an acceptable means, but not the only means, for obtaining and maintaining approval of operations in Category III Landing Weather Minima and low visibility takeoff including the installation and approval of associated aircraft systems.

Function

The main body of this AC contains criteria related to operational approval. The provisions of the main body of this AC outline concepts, objectives, and provisions necessary for operators.

Application of Criteria

Instrument Approach procedures in the United States and its territories must be validated by an authorized FAA process. This includes the obstruction evaluation process for objects in approach and missed approach areas.

FAR Part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations

Latest amendment December 2007

http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&tpl=/ecfrbrowse/Title14/14cfr121_main_02.tpl

Purpose

This regulation mandates certain criteria for air carrier operators. Among the requirements are minima for approaches, departures, and weather. The regulation also mandates air carriers to develop an OEI procedure for every runway that they serve based on criteria such as the most restrictive aircraft by performance, average warm temperature, and obstacles.

Function

FAR Part 121 is the primary operating regulation under which commercial air carriers operate. Adherence to these regulations is required to maintain an air carriers operating certificate.

Application of Criteria

Within FAR Part 121 is the requirement that air carriers develop procedures for the event where an engine failure is experienced upon takeoff. These procedures, known as OEI procedures, typically involve an emergency climb out at the maximum feasible climb rate to a given altitude, followed by a procedure for maneuvering back to the airport for landing. In determining these procedures, consideration is given to the type and operating weight of each aircraft operation, as well as the local environmental conditions (field elevation and outside air temperature), and the existing surrounding terrain and other objects in the vicinity of the airport.

FAA-H-8261-1A, Instrument Procedures Handbook

Latest Amendment 2007

http://www.faa.gov/library/manuals/aviation/instrument_procedures_handbook/media/FAA-H-8261-1A.pdf

Purpose

This Handbook is designed as a technical reference for professional pilots who operate under IFR in the NAS.

Function

The Instrument Procedures Handbook provides detailed coverage of instrument charts and procedures including IFR takeoff, departure, en route, arrival, approach, missed approach, and landing.

Application of Criteria

The Handbook addresses obstacle identification surfaces for approach and departure procedures. It generally informs the reader of the criteria applied; and the expectations of the pilot during departure and arrival. How the FAA protects the obstacle clearance surfaces is relevant to the instrument pilot so that the pilot is aware of the manner in which aircraft is protected.

FAA Air Traffic Publication—Aeronautical Information Manual

Latest amendment July 2008

http://www.faa.gov/airports_airtraffic/air_traffic/publications/atpubs/aim/

Purpose

The Aeronautical Information Manual is designed to provide the aviation community with basic flight information and ATC procedures for use in the NAS of the United States.

Function

This manual contains fundamental information required in order to fly in the United States NAS.

Application of Criteria

The Handbook addresses obstacle identification surfaces for approach and departure procedures. It generally informs the reader of the criteria applied; and the expectations of the pilot during departure and arrival. It also expands on the ATC issuance of approach and departure instructions.

FAA, National Aeronautical Charting Office Website

Updated January 2009

http://www.naco.faa.gov/

Purpose

The FAA, National Aeronautical Charting Office (NACO), publishes and distributes United States government civil aeronautical charts and flight information publications. Its URL is

http://www.naco.faa.gov/

Function

The NACO webpage is a user interactive system allowing for search and the retrieval of instrument approach and departure procedure charts. It also allows for the retrieval of Airport Diagrams, airport obstruction charts, and other types of obstruction databases.

Application

NACO continuously collects topographic and aeronautical data from a large number of sources and uses this source data to compile and maintain the charts and products provided to the aviation community. This includes the depictions of obstructions that are deemed necessary to a safe operation, primarily in the Digital Obstacle File (DOF), a compilation of assumed and actual structure locations based on 7460-1, 7460-2, and final determinations. Flight procedure designers from the FAA and airlines utilize the DOF and NOAA AOC as the primary source data for obstructions.

Communication, Navigation, and Surveillance Criteria

Various FAA Orders and publications have been issued in order to establish guidance and recommendations pertaining to communication, navigation, and surveillance facilities in the NAS. These criteria are primarily comprised of the following:

- FAA Order 6310.6, *Primary/Secondary Terminal Radar Siting Handbook*
- FAA Order 6340.15, *Primary/Secondary En Route Radar Siting Handbook*
- FAA Order 6820.10, *VOR, VOR/DME and VORTAC Siting Criteria*
- NITA Technical Report TR-08-454, *Assessment of the Effects of Wind Turbines on Air Traffic Control Radars*

FAA Order 6310.6—Primary/Secondary Terminal Radar Siting Handbook

Latest amendment May 1982

Available for purchase at:

http://aero-defense.ihs.com/document/abstract/BCZCDBAAAAAAAAAA

Purpose

FAA Order 6310.6 provides guidance for selection of Airport Surveillance Radar/ATCBI radar sites to meet FAA operational requirements.

Function

Order 6310.6 performs the following functions:

- Description of the radar and beacon systems with emphasis on siting aspects
- Description of several special problem areas of concern with detailed technical data
- Details the site selection process:
  - Preliminary Studies and Selection
  - Site Surveys including obstacle analysis
  - Data Analysis
  - Report Preparation

Application of Criteria

These criteria are designed for use by FAA engineers for establishing new and/or relocated radar facilities and for the correction of siting problems. All of these scenarios require an adequate

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line of sight from the facility to the intended flight path of the aircraft. Consideration of obstacles is an essential component to ensure system performance. An analysis of radar coverage is performed as a standard part of an FAA aeronautical study based on these criteria.

FAA Order 6340.15—Primary/Secondary En Route Radar Siting Handbook

Latest amendment May 1983

Available for purchase at:

http://aero-defense.ihs.com/document/abstract/OHVYDAAAAAAAAAAA

Purpose

FAA Order 6310.15 establishes specific procedures to be used in the selection of sites for Air Route Surveillance Radar/Air Traffic Control Radar Beacon Interrogator (ARSR/ATCBI) en route facilities. The use of these procedures ensures uniform and objective analysis of candidate radar sites and allows for the selection of the optimum site.

Function

This document performs the following functions:

- Summarizes operational performances achievable with various en route radars and discusses equipment characteristics as they apply to site selection.
- Presents a detailed description of ARSR and ATCBI siting criteria including:
  - Coverage and Facility Requirements
  - Coverage Capabilities
  - Operational Limitations
  - Site Requirements and Limitations
- Step-by-step radar siting procedure including:
  - Preliminary data acquisition
  - Preliminary Site Selection
  - Site Survey
  - Detailed Site Analysis

Application of Criteria

These criteria are designed primarily by FAA engineers for siting new FAA en route radar facilities, but may also be applied to facilities relocation and to the correction of siting problems. Consideration of obstacles is an essential component to ensure system performance. An analysis, based on these criteria, of enroute radar coverage is performed as a standard part of an FAA Aeronautical study.

FAA Order 6820.10—VOR, VOR/DME and VORTAC Siting Criteria

Latest amendment April 1986

Available for purchase at:

http://aero-defense.ihs.com/document/abstract/UPVYDAAAAAAAAAAA

Purpose

This order deals with the procedures and techniques that apply to the initial evaluation, selection, and acquisition of sites suitable for VHF omni-directional range (VOR), VOR/DME, and Tactical Radar (VORTAC) facilities. It also offers guidance on site improvement and the

minimization of performance degradation due to multipath. It also provides instruction on the consolidation of buildings and antenna structures associated with those facilities.

Function

This document describes the following functions:

- Overview of Location and Coverage Considerations
- Site Evaluation
- Site Selection and Acquisition
- Site Improvement
- Considerations of Longitudinal and Lateral Multipath
- Scattering Simulations

Application of Criteria

The criteria in this document are used by FAA engineers and apply only to new installations and relocations. Existing equipment need not be moved or altered for the sole purpose of complying with this document. The VOR signal integrity and potential degradation due to new obstacles is a consideration of the FAA OE/AAA process.

NITA Technical Report TR-08-454—Assessment of the Effects of Wind Turbines on Air Traffic Control Radars

July 2008

http://www.its.bldrdoc.gov/pub/ntia-rpt/08-454/

Purpose

This order describes the effects that electricity producing wind turbines have on FAA ATC radars. It outlines a process by which it is possible to determine whether a proposed wind farm facility will have adverse effects on current or proposed radar facilities.

Function

- Review of Literature on Wind Turbine Effects on ATC Radars
- Process for Analyzing Wind Turbine and Radar Electromagnetic Compatibility
  - Line of Sight Distance between Wind Turbines and Radar
  - Terrain Shadowing Methodology for Assessing the Effects of Wind Turbine Clutter Returns on Radar Performance
  - Effects of Shadowing on Detection of Desired Targets
  - Consideration of Wind Turbine Aggregate Effects
- Potential for Desired Targets to be Lost in Azimuths Other than those of Wind Turbine Farms
- Consideration of the Effects of Wind Turbines on Secondary Radar (ATCBI) Performance

Application of Criteria

This report is to be used in identifying potential operational conflicts between wind turbines and Air Traffic Control radars and does not pertain to object height and imaginary protection surface penetrations.

APPENDIX B

Interrelationships Among Criteria

Introduction

Appendix A introduced various airspace protection criteria documents, and specified the purpose, function, and application of the broad range of criteria included within those documents. This Appendix describes the interrelationships among criteria. The specialized and varied purposes of each of the main groups of criteria can create confusion for airport sponsors, municipal planners, and real estate developers in their application. Discerning how and why the criteria relate to one another, first by **general categories** and then by **specific criteria** will facilitate a better understanding of airspace protection. This text briefly diagrams and describes the interrelationships between the four general categories of criteria, and then specific criteria; followed by more detailed discussions of specific issues encountered in the case studies and in research team members' experience.

Interrelationships Among the General Categories of Criteria

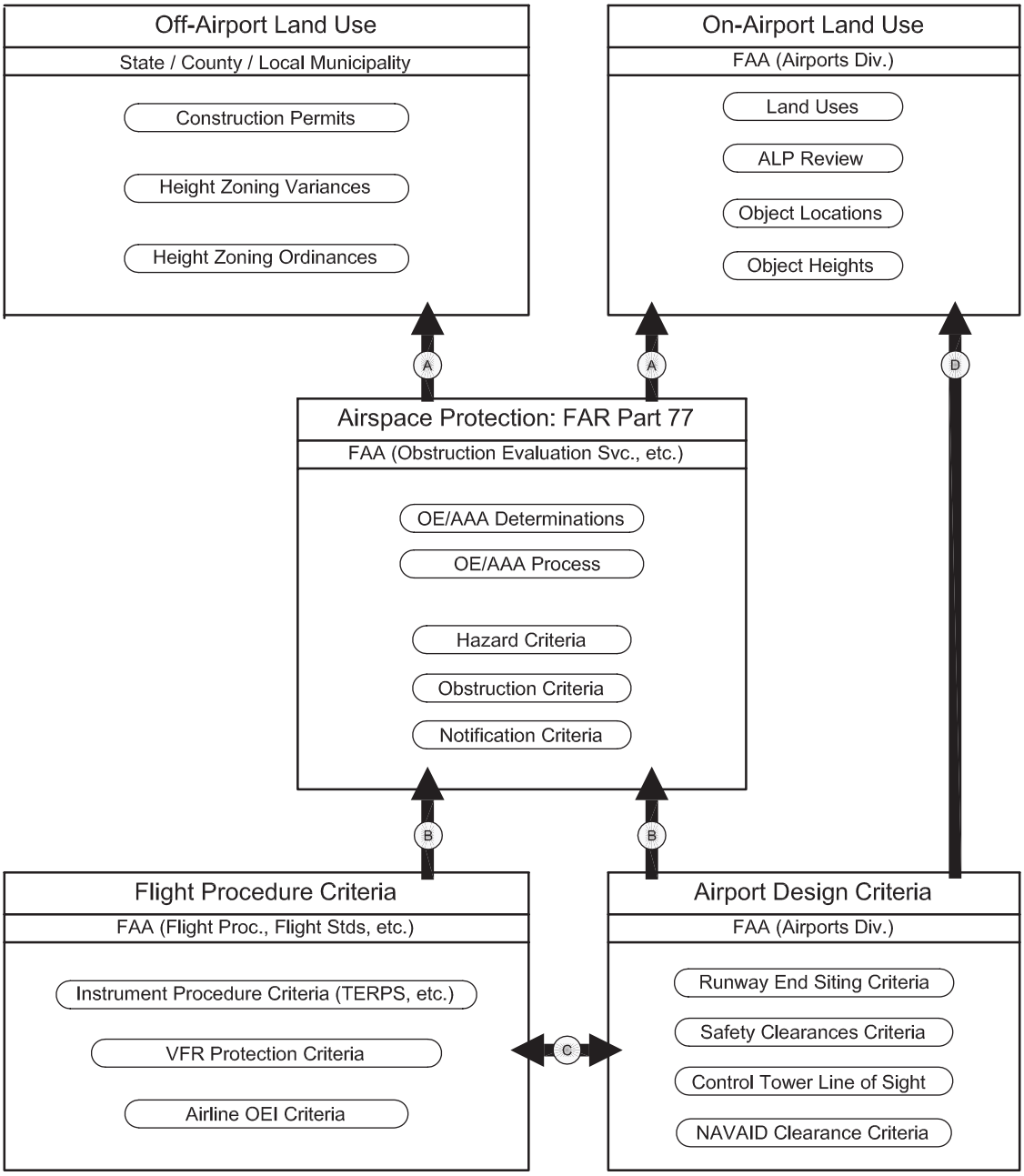
The criteria are organized in four general categories:

1. Land Use Criteria, for both
   a. off-airport construction (jurisdiction of the state and/or local municipality), and
   b. on-airport construction (jurisdiction of the FAA)
2. Airspace Protection Criteria as defined by FAR Part 77
3. Airport Design Criteria
4. Flight Procedure Criteria

The relationships between the four general categories are diagrammed in Figure B.1. This diagram specifically shows the hierarchical nature of the criteria. At the top are land use criteria—the criteria that lead to the "final say" as to whether or not a structure is permitted to be constructed in a certain manner, location, and height. The other categories and specific types of criteria all support the final land use decision.

The letter-keyed arrows on Figure B.1 denote the relationships between the four general categories, described as follows:

A. Land use decisions, for both off-airport and on-airport construction, are influenced by airspace protection regulatory criteria, which are defined in FAR Part 77.
B. The airspace protection regulatory decisions that result from analyses defined in FAR Part 77 are influenced by a multitude of technical criteria, including those from both flight procedure design and airport design.



This diagram illustrates the interrelationships among various criteria and processes that function to protect airspace by limiting object heights. Arrows indicate a criteria or process influences another criteria or process; reading in the reverse direction of an arrow indicates "is based on"

Figure B.1. Interrelationships among criteria.

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C. Certain individual flight procedure design and airport design criteria influence one another.
D. Airport design criteria influence land use decisions on-airport, for airspace and other-than-airspace reasons.

Interrelationships Among Specific Criteria

Within each of the general categories reside specific criteria governing specific actions and events. These were described in detail in Appendix A. The following paragraphs describe the relationships between the individual criteria:

Within Off-Airport Land Use

1. Height zoning ordinances inform construction permits, the final say, by the authority having jurisdiction, as to whether a proposed structure is legally allowed to be constructed. With respect to height limits, construction permits will generally be approved when the proposed height of the structure is equal to, or lower than, the nominal height zoning limit for the parcel or property in question.
2. Proposed construction that exceeds the nominal height limit listed in the height zoning ordinance may be granted a construction permit if the authority having jurisdiction approves a variance. Local authorities apply judgment to grant variances based on a variety of factors, including technical, compliance with General Plan, social, civic, political, and others.
3. Height zoning ordinances inform variances in that they provide the basis or starting point for negotiations, and may additionally state limits or other parameters for granting variance approvals. For example, a height limit may be stated as "height limit is 80 feet, with up to 120 feet allowable by variance."

Airspace Protection influences Off-Airport Land Use

4. Height zoning variances should, and often do, require a favorable determination from the FAA as one of many contingencies for approval. For example, "height limit is 80 feet, or as high as 120 feet by variance, which is contingent on a favorable determination from the FAA." Refer to Task 5 for more detailed information on the FAA OE/AAA process which results in the issuance of FAA airspace determinations.
5. Height zoning ordinances should, and often do, require a favorable determination from the FAA as an additional factor besides a numerical height. For example, "height limit is 80 feet; all construction above 35 feet requires a favorable determination from the FAA."
6. Height zoning ordinances can reference FAA hazard criteria, in locations near airports where the airport sponsor or other authority has undergone an airspace surfaces mapping effort, and the predicted FAA no-hazard height limits are then relatively well-documented. This is not common, because FAA no-hazard height limits are complex to map and change over time as flight procedures and technologies change. For this reason, many municipalities that recognize the FAA OE/AAA process simply rely on the FAA to make determinations on a case-by-case basis at the time each project is proposed (see #4 and #5 above). Mapping the FAA no-hazard height limits can remove some of the uncertainty from the process, and can allow users to assess likely maximum feasible heights more quickly.
7. Height zoning ordinances can reference FAA obstruction criteria, which are simpler geometrically. However, these often include only a few of the five types of obstruction criteria defined in FAR Part 77.23, such as imaginary surfaces only, or imaginary surfaces and 500 feet above ground level. In these cases, the height zoning ordinances do not provide comprehensive airspace protection, because heights exceeding hazard standards are in many cases lower than one or more obstruction standard heights, and development can be approved that would not exceed the one or two obstruction standards referenced in the height zoning regulations, but would exceed unmapped hazard standards.

8. Height zoning ordinances should, and often do, reference FAA notification criteria, so that developers will be aware of the Federal requirement to submit an FAA Form 7460-1, *Notice of Proposed Construction or Alteration,* when their proposed structure exceeds any of the FAA notification criteria.

Within Airspace Protection

9. The FAA OE/AAA process is a multi-step process involving a structure proponent who proposes to construct or alter a structure submitting a Form 7460-1 notice to the FAA, and several steps of analysis within the FAA and related agencies, and input from local stakeholders where the FAA deems appropriate. It results in the issuance of an airspace determination, which is used in various capacities by various other agencies.
10. FAA hazard criteria inform the FAA OE/AAA process, where the FAA judges whether a proposed project would cause a substantial adverse effect to a significant amount of air traffic. If so, the proposal would constitute a hazard to air navigation, and the FAA issues a DOH. If not, the proposal would not constitute a hazard to air navigation, and the FAA issues a DNH.
11. FAA obstruction criteria inform the initial part of the FAA OE/AAA process, where the FAA first analyzes whether a proposed project would exceed obstruction standards. If not, a DNH can be issued. If so, a Notice of Presumed Hazard (NPH) is issued, asking the project sponsor whether or not they would be willing to lower the proposal to a height not exceeding obstruction standards. If so, a DNH can be issued. If not, the sponsor may ask the FAA to perform further aeronautical study to assess hazard status.
12. FAA notification criteria guide structure proponents on whether or not they need to file a Form 7460-1 notice with the FAA, to initiate the OE/AAA process.

Flight Procedure Design influences Airspace Protection

13. Instrument procedure airspace protection criteria are a component of obstruction criteria, as noted in FAR §77.23(a)(3), defining an obstruction as an object with "A height within a terminal obstacle clearance area, including initial approach segment, a departure area, and a circling approach, which would result in the vertical distance between any point on the object and an established minimum instrument flight altitude within that area to be less than the required obstacle clearance".
14. VFR airspace protection criteria are a component of obstruction criteria, as noted in FAR §77.23(a)(3) (see note in #13).
15. Instrument procedure airspace protection criteria are the most frequently cited component of hazard assessments. This is because published instrument procedures are often limited to less than ideal parameters based on existing critical obstacles; new obstacles would further degrade the procedures, which would be categorized as a substantial adverse effect.
16. VFR airspace protection criteria can be a component of hazard criteria, especially at airports with few or no instrument procedures, because they protect the main type of flight procedures at the airport. Confusion sometimes arises because one component of the VFR airspace protection defined in FAA JO 7400.2, §6-3-8, is geometrically identical to the obstruction standard, civil airport imaginary surfaces for visual-only runways.
17. Airline OEI emergency procedures are not currently a factor in FAA hazard determinations. However, the FAA is currently undertaking a Pilot Program at several airports where OEI protection would factor into hazard determinations. The results of the OEI Pilot Program are expected to be completed and distributed in mid to late 2010.

Flight Procedure Design influences Airport Design

18. Runway end siting criteria as defined in FAA AC 150/5300-13, Appendix 2, provide obstacle clearance requirements for two critical points on runways: (1) the threshold, which is the first part of the runway available and suitable for landings, and (2) the departure end of runway

or "DER", the final point on the runway surface for take-off procedures. The clearance geometrics for arriving or departing aircraft overflying obstacles are informed by performance tolerances and parameters developed in instrument flight procedure criteria.

19. Similar to #18 above, the clearance geometrics for visual types of runway end siting surfaces are informed by VFR flight protection criteria.
20. Airline OEI protection requires comprehensive obstacle data for the departure corridor. The OEI OIS defined with the runway end siting surfaces requires obstacles that penetrate the surface to be identified and made known to carriers serving the airport. Unlike the other types of runway end siting surfaces, the OEI OIS does not require clearance of the obstacles, and does not dictate the DER position.

Airport Design influences Airspace Protection

21. Runway end siting surfaces, inasmuch as several types relate directly to instrument flight procedures' glideslope and departure climb angles, and threshold and DER locations, could contribute to an obstruction determination under FAR §77.23(a)(3).
22. Runway end siting surfaces, inasmuch as several types relate directly to instrument flight procedures' glideslope and departure climb angles, and threshold and DER locations, could contribute to a hazard criteria if an object that would affect the surface would, in doing so, cause a substantial adverse effect to a significant amount of air traffic.

Airspace Protection influences On-Airport Land Use

23. Filing a 7460-1 is required for all on-airport construction. In its routine analysis, the FAA checks for compliance with airspace protection criteria.

Airport Design influences On-Airport Land Use

24. Filing a 7460-1 is required for all on-airport construction. In its routine analysis, the FAA checks for compliance with various types of airport design standard criteria, in addition to airspace protection criteria.

The foregoing pages described the interrelationships among airspace protection and related criteria, including positive relationships between local permitting processes and airspace protection. However, local construction permit regulations sometimes completely lack, or have inadequate references to, airspace protection criteria and processes; and the airspace protection criteria themselves can be difficult to understand, even for airport staff and other aviation stakeholders. There can be a breakdown in communication and acceptance of responsibility when problems arise.

Conflicts may emerge between a proposal to develop a structure on property and a desire to protect airspace near an airport, or conversely between a proposal to modify or build new airport runways and the clearance of existing land uses or structures to accommodate those changes. In either case, greater clarity at the onset could enhance the resolution process as well as the outcome. This goal necessitates a clear understanding of who is responsible for administering and protecting the various airspace criteria, and who benefits from protecting (or not protecting) those criteria—whether the benefits are safety, capacity, economic, or otherwise. There are logical relationships between the objective sought and the appropriate criteria to apply or protect, but to make smart and reasonable tradeoffs in the negotiation process, these relationships will require greater clarity.

A Common Misconception

There is a problematic misconception that FAR Part 77, Subpart C, *Obstruction Standards* is the only regulation governing airspace protection. The *civil airport imaginary surfaces,* presented in §77.25 seem to dominate airport operators' perception of the airspace around their airport.

These surfaces are found in ALP sets, and are therefore an available source of airspace information for airport operators to provide to municipal land use planners and developers. AC 150/5070-6b, Change 1, *Airport Master Plans* (AC 150/5070) provides airports with guidance and requirements for preparing an ALP. AC 150/5070 states, "the approved ALP will . . . allow the FAA to protect the airspace required for facility or approach procedure improvements" (Page 76). The AC describes how this stated function of the ALP can be fulfilled, with a requirement to include an *Airport Airspace Drawing* within the ALP drawing set, which is "a drawing depicting obstacle identification surfaces for the full extent of all airport development" (Page 78).

The ALP Airport Airspace Drawing requirement focuses on FAR Part 77 imaginary surfaces, but also refers to other criteria that may be relevant. AC 150/5070 asserts (Page 78) that:

> The drawing will depict the obstacle identification approach surfaces contained in 14 CFR Part 77, *Objects Affecting Navigable Airspace.* **The drawing may also depict other approach surfaces, including the threshold-siting surface, those surfaces associated with United States Standards for Instrument Procedures (TERPS), or those required by the local FAA office or state agency.**

While these other criteria (in **bold**) are mentioned in AC 150/5070, they are rarely if ever included in the ALP drawing set. As FAR Part 77.25 imaginary surfaces become the focus, so too are the other criteria within FAR Part 77 and other criteria diminished in their perceived importance in the airspace protection decisions that are made. However, exceeding the height of any of the five types of obstruction standards will classify an object as an "obstruction to air navigation".

Figure B.2 illustrates the five types of obstruction standards defined in FAR §77.23

Airspace Criteria: FAR Part 77 and Beyond

Because the ALP requires a drawing depicting FAR Part 77.25 imaginary surfaces, airport managers and land use planners alike tend to rely on these criteria in their planning processes. The other criteria that are critical, but commonly overlooked are:

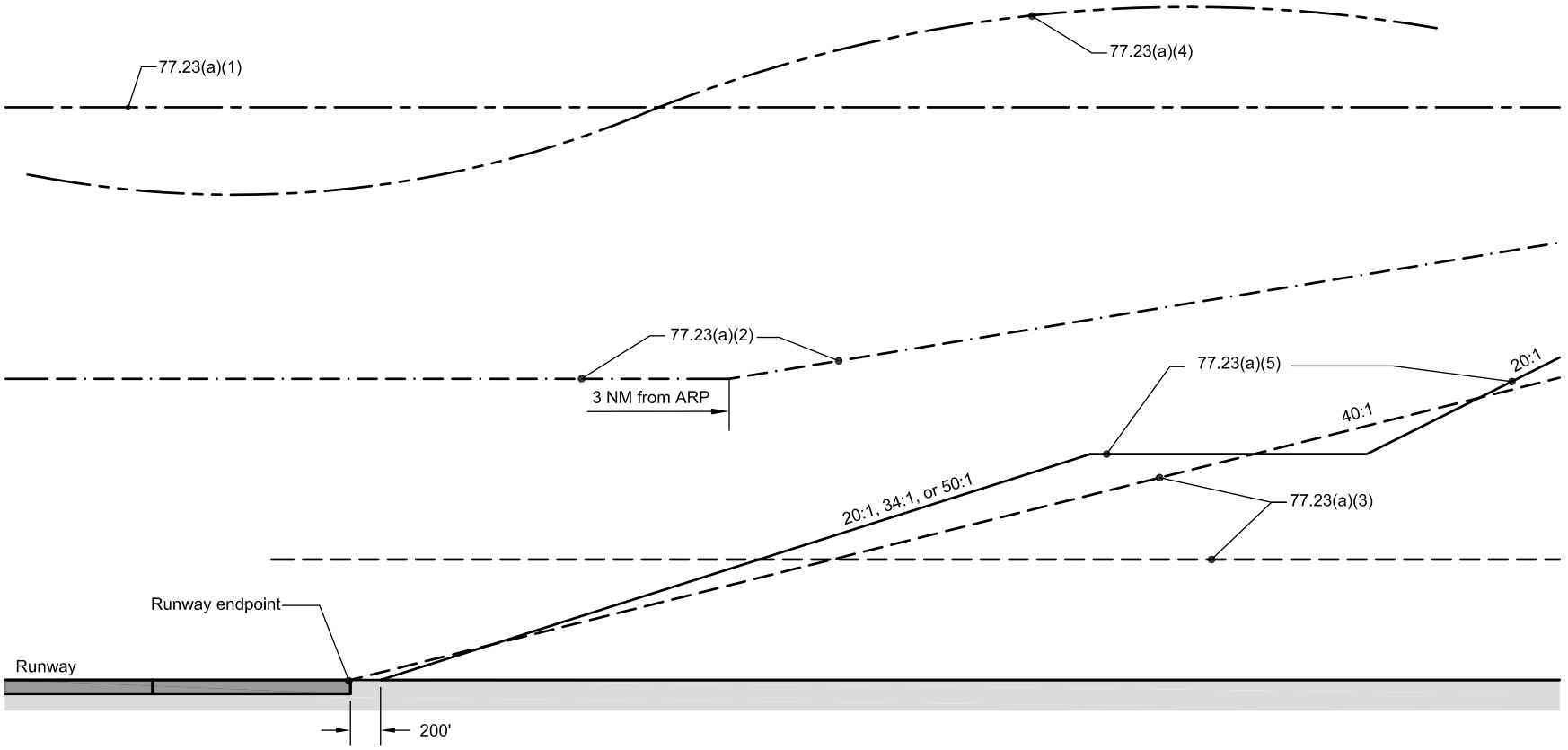
1. Threshold Siting Requirements in AC 150/5300-13 Appendix 2
2. TERPS Instrument Approach and Departure Procedures
3. One Engine Inoperative Procedures
4. VFR Procedures
5. Other FAR Part 77 Notification and Obstruction Criteria (e.g., Part 77.13 and 77.25)

Land Use Planning Criteria: FAR Part 77

The main purpose of FAR Part 77, *Objects Affecting Navigable Airspace* is to define and provide for notifications and aeronautical studies of proposed objects. Designed as a standard obstruction identification tool, the regulation provides general obstruction identification standards, which focus on providing initial criteria for evaluating whether or not an object or terrain would be an obstruction to aircraft either en-route or on approach to an airport's runway. As such, the criteria were intended to be mostly consistent with other standard procedure criteria.

It is critical to recognize that the FAR Part 77 criteria are meant to be general enough to apply to all airports, therefore standardizing the FAA's initial evaluation of proposed or existing structures. As such, it serves as a helpful estimate of when an existing or proposed structure will require a more detailed review. Without some method for estimating the critical airspace above the Earth's surface, there would be a need to evaluate every proposed or existing structure, regardless of height or proximity to an airport. Clearly, this is not a feasible or desirable approach.

The Five Types of Obstruction Standards Defined in FAR Part 77.23



LEGEND

- 77.23(a)(1) : 500 feet Above Ground Level
- 77.23(a)(2) : Up to 3 NM from Airport Reference Point (ARP), 200 feet Above Ground Level or Above Airport Elevation, whichever is greater. From 3 NM, rises 100 feet per NM to 6 NM from ARP.
- 77.23(a)(3) : Terminal Procedures (multiple unique shapes)
- 77.23(a)(4) : Enroute Procedures
- 77.23(a)(5) : Airport Imaginary Surfaces, geometry varies with different aircraft types and approach types. See 77.25 (civil), 77.28 (military) and 77.29 (heliports)

Note: A common misconception is that the imaginary surfaces referenced in 77.23(a)(5) are the only type of obstruction standard, or are the lowest and most critical type of obstruction standard for all areas in the vicinity of an airport. For locations near the runway end, several types of obstruction standards could be exceeded by a proposed object. If any type of obstruction standard would be exceeded by a proposed object, the object is classifed as an "obstruction to air navigation", and is therefore subject to further aeronautical study in order to assess hazard status, and is subject to obstruction marking and lighting requirements.

Figure B.2. Profile view—obstruction standards.

Table B.1. How FAR Part 77 can inform on- and off-airport project sponsors and municipalities about airspace protection.

What	When	Why	Gaps/Limitations
Notification Requirements	When any of the 5 Criteria in §77.13 apply.	To promote evaluation of proposals using obstruction standards.	• Project sponsors may fail to file notification, if not directed by municipal staff.
Obstruction Standards for New or Modified Structures	When any of the 5 criteria in §77.23 are triggered by the project sponsor's notification.	To estimate the critical airspace requirements on and around airports.	• Sometimes presumed to be "hard and fast", or even the only criteria.
Hazard Evaluation (Aeronautical Study)	When a proposed structure exceeds obstruction standards **and** the project sponsor seeks further aeronautical study in lieu of a reduced structure height.	To trigger detailed aeronautical study using procedure design (TERPS) and other criteria.	• In many cases, other criteria are either higher or lower than the obstruction standards, and therefore contradict expectations about building height limitations. • Does not evaluate airline emergency departure procedures.

Table B.1 describes the three main functions of FAR Part 77 and describes some of the limitations of this regulation. The first limitation identified through the case studies is that project sponsors may fail entirely to submit notification to the FAA even when they meet one of the five notification criteria. In this case, there are no other criteria available at the Federal level to correct for this limitation. Encouraging project sponsors to initiate the FAA OE/AAA process can only occur at the local municipal or county government level.

The second limitation found in the case studies is the aforementioned misassumption that the *Obstruction Standards* found in Subpart C of FAR Part 77 imaginary surfaces are "hard and fast", or even the only criteria to consider. While this is not always true, it is correct to assume that the FAR Part 77 obstruction standards are designed to be mostly consistent with standard procedure criteria. Table B.2 demonstrates how the FAR Part 77 imaginary surfaces relate to those standards.

Hypothetically, should an object fall underneath all the surface criteria in FAR Part 77.25, the object would not be a hazard to air navigation. However, as have been found through a number of the case studies presented, there are many cases where other airspace protection criteria are more restrictive, that is, have "lower surfaces" than those in FAR Part 77.25. Under these circumstances, an object may indeed be a hazard to air navigation even though it had not been found to be an obstruction and possible hazard according to FAR Part 77.25. Therefore, the misunderstanding that FAR Part 77.25 is the absolute and only obstruction evaluation criteria can, and has, led to serious conflicts between land use development and local airspace protection around airports.

Table B.2. FAR Part 77.25 surfaces are consistent with many standard procedure criteria.

FAR Part 77.25 Imaginary Surface Criteria	Standard Procedure Criteria
20:1 Approach Surface	Standard Descent Rate for Aircraft Visual Approach
34:1 Approach Surface	Standard Descent Rate for Aircraft Non-Precision Approach
50:1 Approach Surface	Standard Descent Rate for Aircraft Precision Approach
150' AGL Horizontal Surface	Circling Approaches; Missed Approached; and Go-Arounds
Primary Surface	"Off-Centerline" Approaches
No Departure Surfaces	*Ascent Rates are Typically Greater than Descent Rates*

For example, the FAR Part 77 civil airport imaginary surfaces do not have any "Departure Surfaces" because it is assumed that aircraft will depart at a greater climb rate than approach descent rate. However, there are cases when a published instrument departure procedure will have a lower climb rate than a given runways descent rate, the following hypothetical scenario demonstrates how such an inconsistency might work:

> There is be a published instrument departure procedure off Runway 9 that only requires the aircraft to maintain a 200 ft. per nautical mile climb rate, and as such requires airspace protection at a 40:1 sloped OCS from the end of the departure runway. At the same time, the approach to Runway 27 (the same end of the runway) may only be a visual approach, only requiring a 20:1 sloped approach surface, or a non-precision instrument approach with a 34:1 sloped approach surface. In this situation, FAR Part 77 civil airport imaginary surfaces do not "protect" the TERPS departure slope requirement.

This challenge leads into the third limitation, that the review provided in an aeronautical study involves review of more detailed, airport-specific review of other criteria. For evaluating the impact of a proposed structure, the U.S. TERPS or other flight procedure design criteria would be used. These criteria can be lower than the imaginary surfaces presented in FAR Part 77.25 and can extend beyond the area covered by the FAR Part 77.25 surfaces.

A final limitation is that airline emergency departure procedures, specifically OEI procedures, are not considered in an aeronautical study. For commercial service airports, this may be a critical gap, as airlines must comply with the surface criteria related to these procedures. Degradation of these surfaces due to the construction of incompatible structures can make it economically infeasible for airlines to carry out certain operations. The general effect is to shorten the usable runway length for departure operations and limit the air service capability (non-stop markets that can be reached by a majority of aircraft operating at the airport) of the airport. A more detailed discussion of OEI follows.

In summary, FAR Part 77 airspace protection are useful for early evaluation of proposed or existing structures. The surface criteria in this regulation provide standards that can be applied consistently to every airport. The obstruction standards are useful, as proposed or existing structures that interact with these surfaces will trigger a more in-depth review. However, this leads to the need for additional criteria that directly relate to the operational procedures at a given airport. There are other limitations that can only be addressed at the airport and/or local jurisdiction level. These constraints cannot be resolved by Federal criteria, and therefore can only be rectified with enhanced communication and outreach, local policies, or local regulation.[1]

Airport Design Criteria: AC 150/5300-13, Appendix 2

The primary purpose of FAA Advisory Circular 150/5300-13, Appendix 2, Runway End Siting Criteria, is the evaluation of the airspace impacts when designing a new or expanded airport or runway. The criteria in AC 150/5300-13 may also be applied when evaluating the impacts of new NAVAIDs on existing structures. The criteria in AC 150/5300-13 provide a much greater level of detail. Unlike FAR Part 77, these criteria include specifications for various airport-specific approach and departure surfaces. Also, references to TERPS criteria, and OEI procedures and other airline or user defined criteria are provided.

With this AC, there are particular slopes, which can be directly associated with factors including aircraft approach categories, airplane design groups, and NAVAIDs. However, much as FAR Part 77 criteria are limited to land use planning (obstruction evaluation and airport airspace analysis), AC 150/5300-13 criteria are considered only when siting a new or expanded runway end, or when evaluating the impacts of new NAVAIDs on existing structures.

[1]For more discussion of airport and local jurisdiction involvement in airspace protection, refer to Tasks 4, 5 and 6.

Because AC 150/5300-13 defines surfaces for a separate purpose, and in some cases with inconsistent geometries, airport operators that expect decisions related to new or modified airport designs to be based in FAR Part 77 may find major discrepancies with their expectations. A specific example comes from the case study of Daytona Beach International Airport:

> During a FAR Part 139 standard certification maintenance inspection, the FAA inspector noted that due a change from visual to GPS non-precision approaches on Runways 7R and 25L, the 20:1 approach slopes as defined in FAR Part 77.25 had become 34:1 due to the newly established non-precision approach procedures. The Airport was already involved in an obstruction removal project but because of this expanded clearance area, a more significant amount of obstruction removal was required. Most of the removal included trees on the airport property, but the tree removal also affected several private properties. The widened primary surface (from 250 feet to 500 feet wide) caused by the new non-precision status altered the starting position of the associated 7:1 transitional surface, which in turn created a potential conflict with proposed hangar development.
>
> The Airport submitted an airspace study checklist to the Airport District Office (ADO) for the proposed development and were surprised to learn that 20:1 is the appropriate approach slope for Runway 7R/25L, even though the GPS approaches were published and active. When questioned, the ADO explained that approach slopes are determined by more factors than simply approach types. According to the FAA's Advisory Circular (AC) 150/5300-13, Airport Design (Change 12, Appendix 2 Runway End Siting Requirements), the use of Runway 7R-25L for only "small aircraft" (maximum certificated takeoff weight <12,500 pounds) classifies it as a "utility" runway. As a utility runway, the 20:1 approach slope is appropriate, whether it has a visual or non-precision approach.
>
> Interestingly during this process of soliciting guidance from the Part 139 Inspector, Runway 34 (also changed from visual to GPS non-precision), which is not a utility runway, was also confirmed to have a 20:1 approach slope. The airport expected that Runway 34 would have a greater clearance area and a 34:1 approach slope. Airport staff questioned whether the approach is a "non-solid state" approach (not utilizing any ground based localizer or VOR instruments), allowing for the less expansive 20:1 slope. Once the Airport provided the Part 139 inspector with more detailed information regarding this runway, the determination was made that Runway 34 should have a 34:1 approach slope, as required by AC 150/5300-13 for all non-precision runways that serve large aircraft (maximum certificated takeoff weight > 12,500 pounds).

This example demonstrates how the surfaces in FAR Part 77 and in AC 150/5300-13 are related to a certain degree, yet the two cannot be assumed as interchangeable. This example did not present a need to explore airspace design criteria, however it is also important to consider that they will play a role in circumstances where approach runway ends have Category II approach minimums or greater (requires TERPS consideration), and when the runway is used for commercial air carrier service departures (requires One Engine Inoperative consideration).

Figures B.3 through B.7, following pages, illustrate the geometric differences between some of the criteria discussed above, in both plan and profile views.

Discussion of OEI Procedures

Over the last 10 to 20 years, there has been an ongoing dialogue concerning the protection of airspace associated with airline OEI emergency flight procedures. A fundamental issue is whether OEI procedures should be included in as a criterion in obstruction evaluation process.

OEI is not typically a criterion considered by the FAA in OE/AAA evaluations, because OEI procedures are designed by individual airlines, can vary considerably, and can be adjusted to accommodate new obstacles—although sometimes to a degree that is unacceptable to airlines. Airlines have become increasingly vocal in their call to include OEI considerations in FAA OE/AAA evaluations. Airport sponsors and airport users are concerned about the potential impacts to their airport's **air service capability**—the range of markets that can be feasibly reached in a nonstop flight. Degradation of OEI procedures can lead to a shrinking range of air service capability. Some municipalities and the real estate development community are concerned about overly restricting

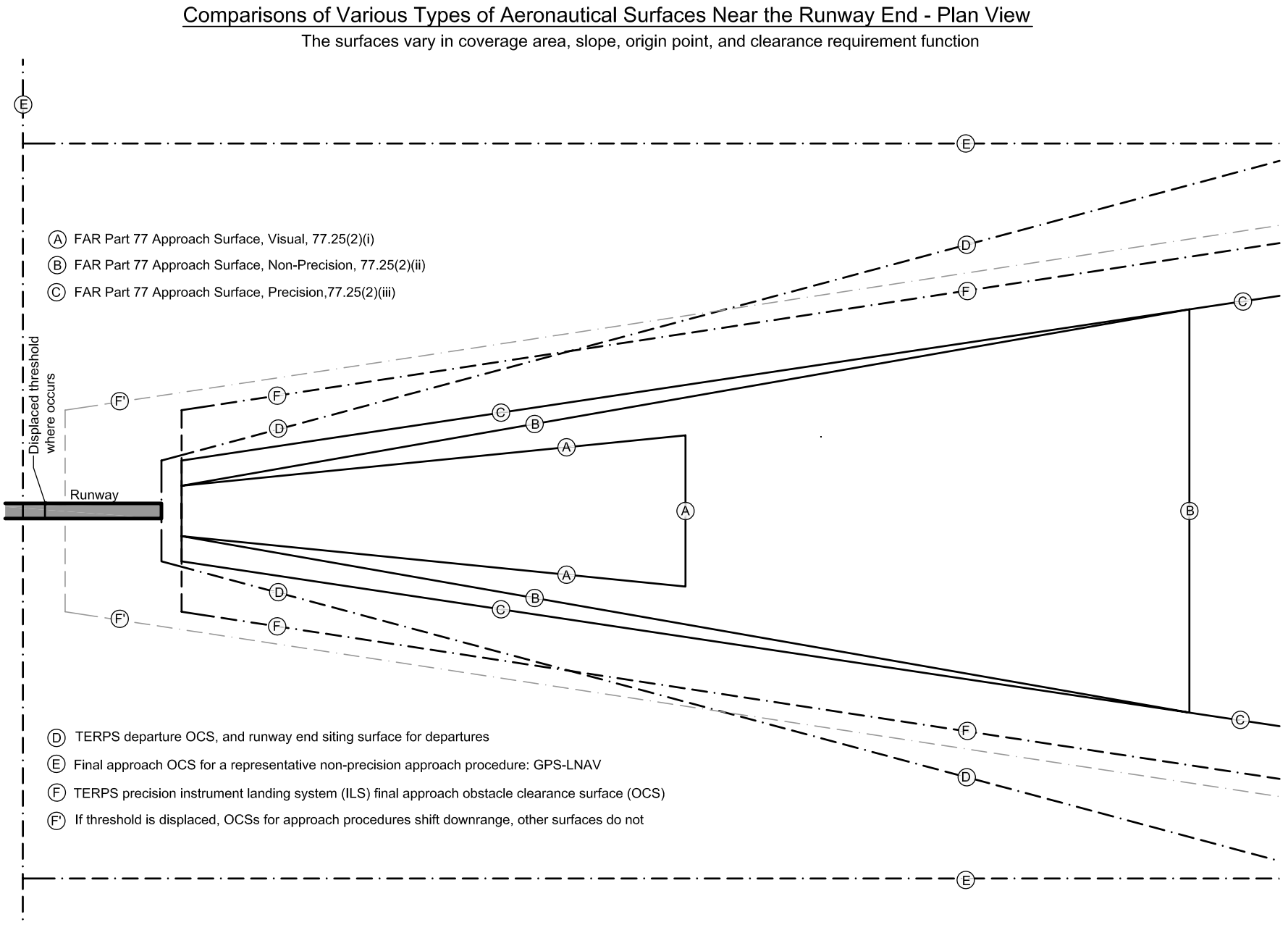


Figure B.3. Plan view—runway approach area.

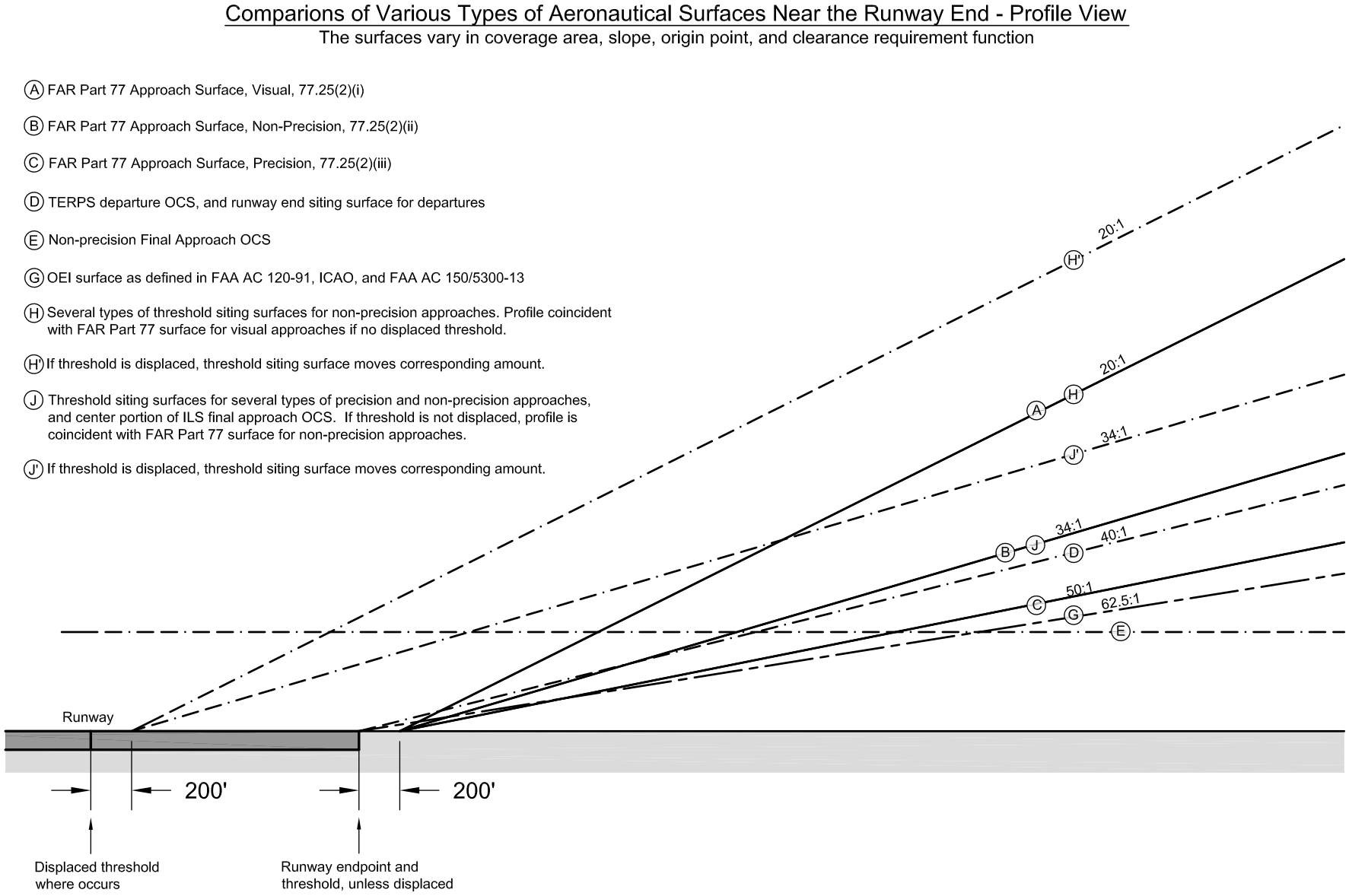


Figure B.4. Profile view—runway approach area.

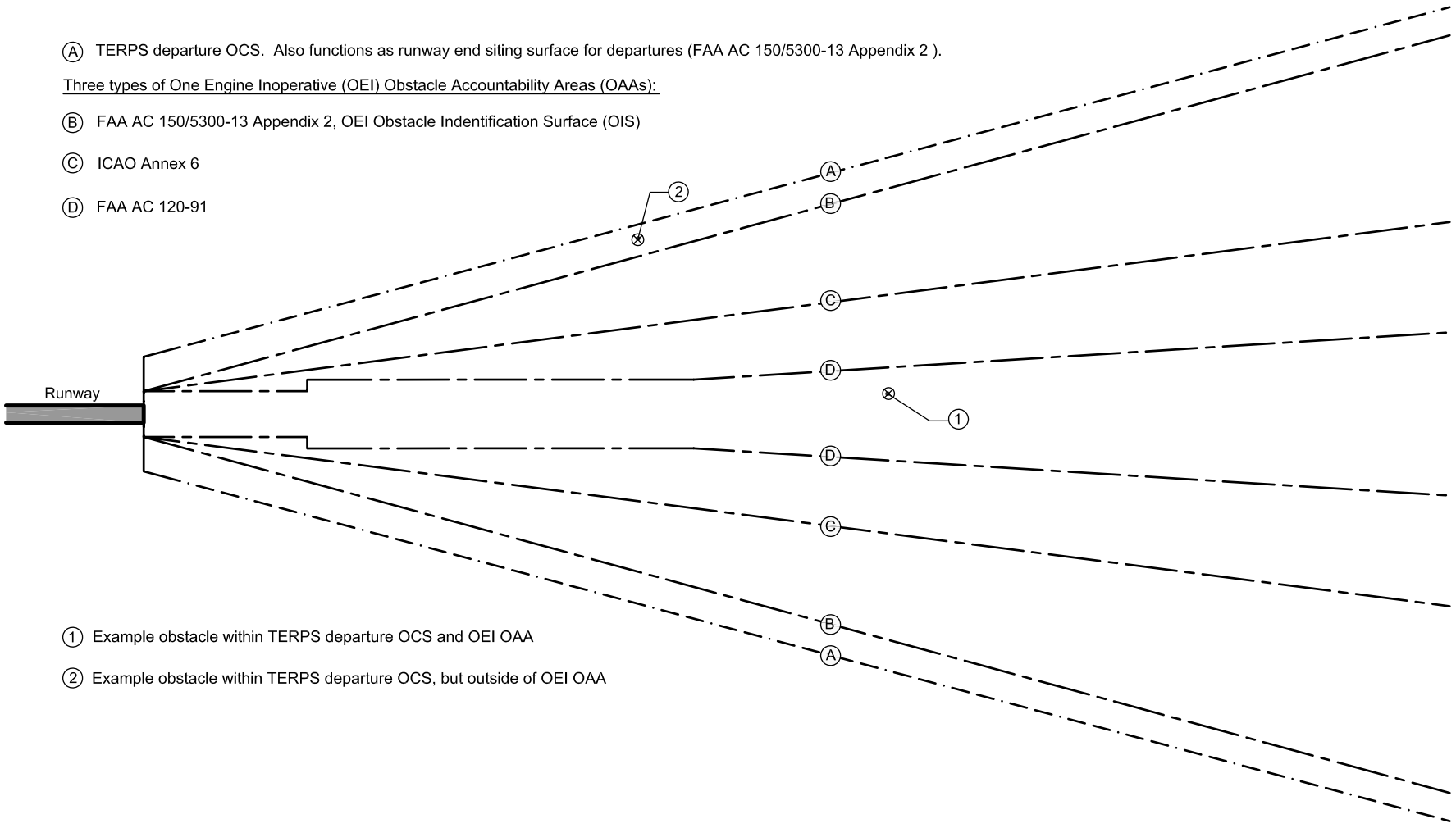


Figure B.5. Plan view—departure considerations.

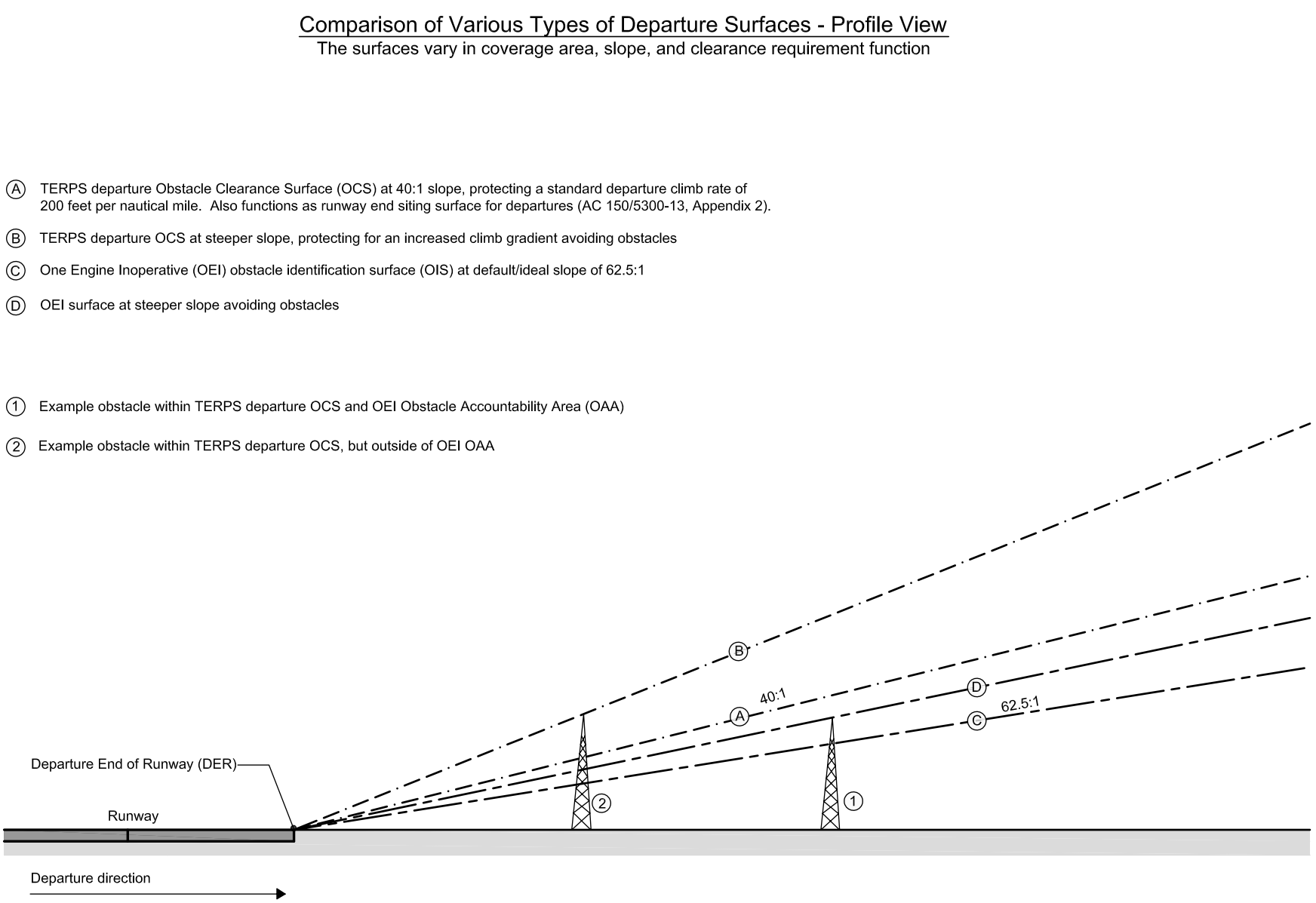


Figure B.6. Plan view—departure considerations.

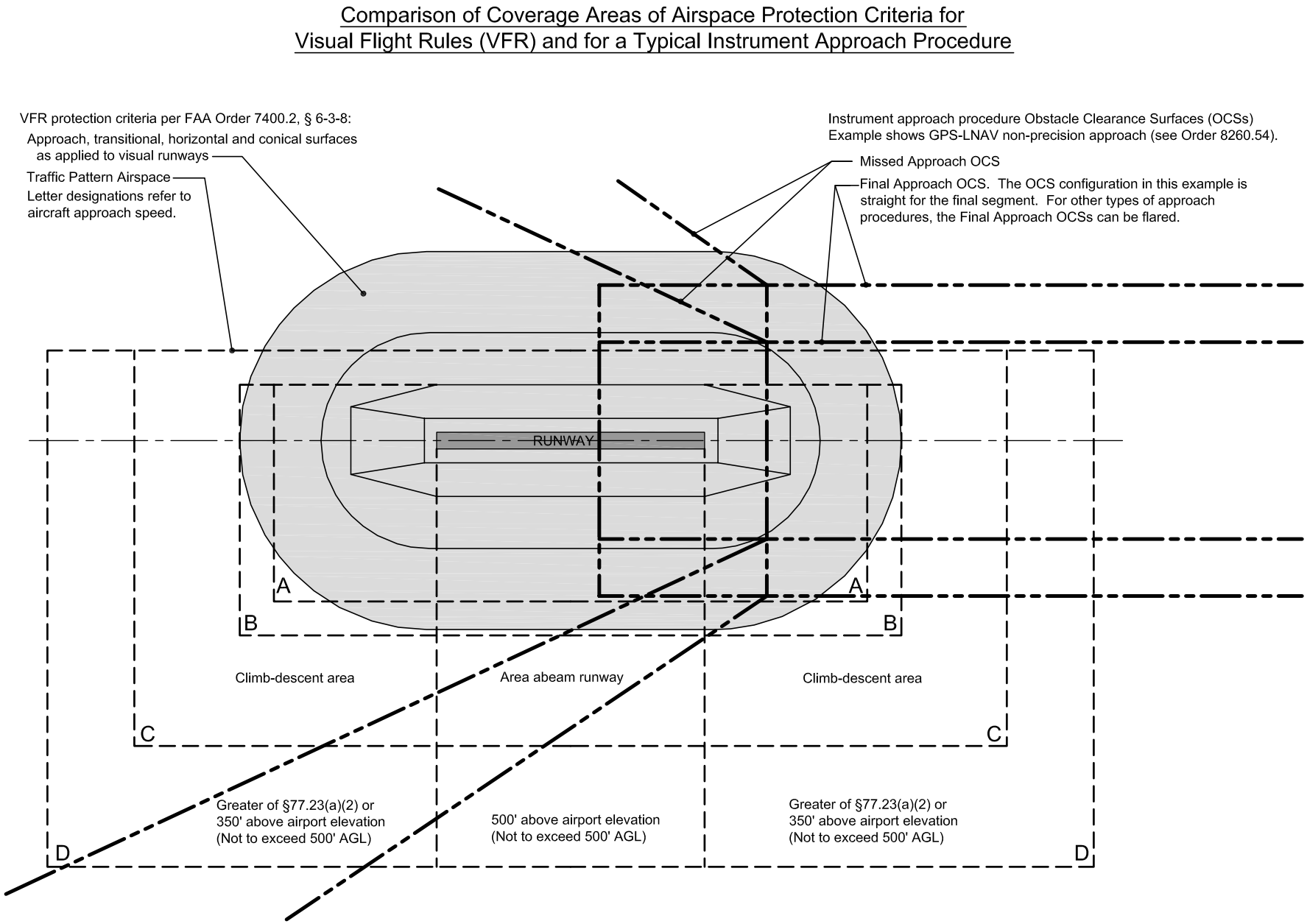


Figure B.7. Plan view of VFR protection and instrument procedure protection.

developable heights on private land. As a result of these constituencies and concerns, there is less certainty in obstruction evaluations for OEI procedures than in other obstruction criteria (TERPS, FAR Part 77, AC 150/5300-13, etc.). Questions that are being debated include:

- Is OEI a safety issue, capacity/delay issue, or an airline economic issue?
- Is there an adverse affect to aviation?
  - Reduced effective length of useable runway
  - Increased airline costs / reduced range capability from resulting weight penalties
  - Reduced passenger level of service
  - Runway use impacts and associated ATC complexity and delay
- Is a substantial amount of air traffic affected?
  - Frequency of a weight penalty event
  - Amount of the weight penalty
- How does it define the air service capability of an airport?
- Is it an airport/runway design issue or an airspace/air traffic issue?
- How to protect for OEI when some airlines may have a slightly different OEI procedure for a specific runway/aircraft? For example, straight vs. turning.

Appendix A identifies a number of regulations and criteria concerning departure and OEI procedures (see 2.1.8, 2.2.1, 2.2.2, 2.3.1, and 2.3.5). This section discusses a number of the issues regarding OEI procedures and their comparison with other airport design criteria routinely considered in the OE/AAA process, and airport planning and design activities.

OEI Obstacle Identification Surfaces

The obstacles considered by the airlines in their OEI calculations are taken from a variety of industry sources.

- Airport Obstruction Charts (AOC) produced by the National Oceanic and Atmospheric Administration (NOAA) have traditionally been the primary source obstacle data and major airport features such as runways, taxiways, buildings, etc. NOAA field-surveys most airports on a cycle of approximately 5 to 10 years, and makes the AOCs and their accompanying aeronautical data sheets (ADS) available through the National Aeronautical Charting Office (NACO) both in paper and online electronic formats. AOCs are generally a very accurate representation of the airport and surrounding obstacles at the date of the survey. As years pass between surveys, there may be changes to runways and obstacles that would not be reflected on an older AOC. In the coming years, NOAA's role in conducting and charting airport obstruction surveys will be replaced by surveys by others (including airport sponsors, and private surveying firms) conducted under ACs 150/5300-16, -17, and -18.
- NACO also maintains a nationwide database of obstacles known as the Digital Obstacle File (DOF). The DOF is built up from various sources, including field surveys, and new buildings receiving a DNH and/or reported by building sponsors filing Form 7460-2, Notice of Actual Construction. It is updated on a 56-day cycle, therefore it may contain newer obstructions that have been introduced since the last AOC was surveyed. However, it has been our experience that some of the data are inaccurate (off location laterally or in height), and some obstacles have either been removed or were never built.
- Obstruction surveys conducted by the airport sponsor are another source for such information.
  - FAA AC 150/5300-13, Appendix 2, provides guidance for developing survey data within a wide 62.5:1 OEI OIS for reporting obstacles to air carriers for consideration in their OEI procedure development. This surface is required to be depicted on ALPs.
  - AC 150/5300-18 provides guidance for conducting an overall airport-wide photogrammetry survey, including documentation of obstacles not only in the OEI departure area but

also all around the airfield, largely duplicating the process of developing an AOC. The lateral "splays" and lengths of these surfaces cover a much wider area than is typically used in an individual airline OEI procedure development. However, because of the various lateral splays used by different airlines and the potential inclusion of slight turns in an OEI procedure, a larger OIS for use in surveys is appropriate (see Figure B.5).

It is important to note that the 62.5:1 slope to the OIS is an obstacle *identification* surface and not considered by the FAA to be an OE/AAA obstruction or hazard criteria surface, nor a runway end siting surface that must be clear of obstacles.

OEI Procedures Are Airline-Specific

FAR Part 25 establishes the performance requirements for the certification of turbojet aircraft. Through this certification, procedures and performance data are established by the aircraft manufacturer. Using this data, airline operations engineering departments develop specific emergency flight procedures designed to provide adequate obstacle clearance in the event of the loss of power to one engine. A unique OEI procedure must be designed for each runway heading at each airport the airline serves. Pilots review the OEI procedure for a particular runway as they are preparing for departure, because they must react within seconds in the event of loss of power.

While the FAA must approve OEI procedures, because they are developed by each individual airline, they can vary from airline to airline, even for the same aircraft departing the same runway. FAA provides some guidance for the development of these procedures in FAA AC 120-91 (discussed in Task 2).

A first step in providing adequate obstacle clearance for OEI procedures is to identify the obstacles that need to be considered. Obstacles within an obstacle accountability area (OAA) or "splay" from the runway end through the intended OEI flight path are considered by the procedure designer. The obstacle identification surface (OIS) within this splay is 62:5:1 for two engine turbojet aircraft. (Increased slopes are considered for 3- and 4-engine aircraft.)

Many U.S. carriers utilize FAA AC 120-91 splay to determine the lateral splay. Most foreign flag carriers, many cargo carriers, and some U.S. carriers utilize the ICAO OEI splay. (ICAO Annex 6 to the Convention on International Civil Aviation, *Operation of Aircraft,* Eighth Edition, July 2001.) Some airlines have developed their own custom OEI splay. A comparison of some of these OEI procedure and OIS splays is presented on Figure B.5. The procedure designer has some latitude to have a slight turn in the flight path or course adjustment to avoid specific obstacles, but airline policies differ on how close to the runway end / how soon after liftoff / at what minimum altitude such a course adjustment can feasibly commence. Generally, turns are undesirable because (1) aeronautical lift decreases with an increased bank angle of the aircraft, and (2) a turn represents a potential complexity or distraction in an emergency situation that is likely to be stressful.

TERPS vs. OEI Requirements

FAA AC 120-91, Airport Obstacle Analysis, Paragraph 7(a) provides the following description of TERPS vs. OEI requirements:

> Standard Instrument Departures (SID) or Departure Procedures (DP) based on TERPS or ICAO Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS) are based on normal (all engines operating) operations. Thus, one-engine-inoperative obstacle clearance requirements and the all-engines-operating TERPS requirements are independent, and one-engine-inoperative procedures do not need to meet TERPS requirements. Further, compliance with TERPS all-engines-operating climb gradient requirements does not necessarily assure that one-engine-inoperative obstacle clearance requirements are met.

FAA OE/AAA Process and OEI

Typically, OEI is not considered in the OE/AAA analysis process because FAA has historically taken a position that they have no legal basis to declare a hazard based on what is ostensibly a solely economic impact to airlines. Airlines submit negative comments when an OE case is circularized, and FAA paraphrases them in the DNH but notes that unless TERPS or other criteria are exceeded, economic impact to an airline, in and of itself, is not grounds for a hazard determination.

In recent years, there has been FAA acknowledgement that OEI is an issue that needs to be addressed. The FAA has established a pilot program at five airports reviewing methods that could be used to incorporate OEI protection.

Effect of Obstacles on Airlines

The OEI procedure designer at the airline must review the obstacles identified and ensure that the calculated balance between thrust, lift, and weight of the aircraft permits adequate obstacle clearance during an OEI event. In addition to weight and obstacles, many other variables are considered in these calculations such as aircraft performance, runway length, temperature, winds, runway gradient, runway condition (rain/snow), range, reserve fuel requirements, etc.

If the aircraft is deemed too heavy to clear an obstacle, some combination of passengers, fuel, and cargo are removed to reduce the overall weight of the aircraft. This is known as a "weight penalty". Weight penalties can have a substantial negative financial impact on the flight, rendering it economically infeasible, or may make the flight technically infeasible.

In many cases, an obstacle (above the 62.5:1 OIS) will have no negative OEI-related effect on the departure performance calculation for a specific airline/aircraft/city combination. In some cases this is true of obstacles that are as high as the TERPS departure surface (typically 40:1). On the other hand, even a small penetration of a 62.5:1 surface by an obstacle could result in weight penalties. The amount of a weight penalty and frequency of occurrence can be considerations when an airline is evaluating the response to weight penalties, such as: removal of passengers and/or cargo from an aircraft, refuel at interim stopover airport, change to a different type of aircraft, cease service to particular markets.

Because of the many variables and considerations there is not yet agreement on standardized surface gradient above the 62.5:1 that can completely protect for all OEI related weight penalties. The fact that each airline could have a slightly different splay and gradient requirement has complicated the process of developing common OEI airspace protection criteria.

Effect on Airport Users

If significant weight penalties result from obstacles within the OEI OAA, an airline will need to determine whether it is (1) technically feasible to operate the aircraft to a specific market given potential limitations on fuel loads and (2) financially feasible to provide air service to a specific city given the loss of passenger or cargo revenue. In cases where such weight penalties may be infrequent additional costs of rerouting displaced passengers and cargo are considered by the airlines in determining the financial feasibility of the market.

The result of such weight penalties can affect the air service capability of an airport by limiting the types of aircraft or the markets served from an airport. In the Case Studies, the air service impacts from OEI obstacles tended to be limitations on long-range domestic air service and trans-oceanic air service.

Effect on Airports

The effect of OEI obstacles that result in weight penalties is the equivalent to reducing the **runway length** available. While the overall length of a runway can comply with FAA airport design criteria and aircraft manufacturers recommendations to accommodate a critical aircraft and provide the range capability to serve distant markets, obstacles off the end of the runway can effectively reduce that length.

The 40:1 gradient of the departure runway end siting surface criteria in FAA AC 150/5300-13 (see 2.2.1) is intended to provide clearance from the runway ends to surrounding obstacles, for standard all-engine departures climbing at a rate of 200 fpnm. The threshold siting surface closely relates to the TERPS departure surface discussed above. As previously mentioned, the TERPS departure surface is based on all engines operating. Therefore, the threshold siting surface may not provide full consideration for specific aircraft OEI performance and resultant air service capability of a runway.

For airports with multiple runways, an airline or pilot may request a specific departure runway to minimize weight penalties that could affect **runway use,** or the pilot's voluntary selection of a departure runway that is nonstandard. Depending on the obstructions in the OEI OAA for each runway, the runway with the minimum weight penalty may or may not be the longest runway at the airport. In some cases the runway that minimizes weight penalties may conflict with the standard runway use configuration at the airport such as:

- ✈ Use of a primary arrival runway for departures
- ✈ Use of an intersecting runway
- ✈ Use of a runway that operationally conflicts with the current arrival and departure flows
- ✈ Creation of increased workload and complexity for ATC staff by changing taxi routes for a specific aircraft or group of aircraft

Such operational complexities can result in increased ATC complexity, decreased airfield capacity, and increased aircraft delays.

Protecting for OEI

As previously mentioned, the FAA is conducting a pilot program aimed at evaluating methods for protecting for OEI procedures at five airports. In BOS, a composite map was developed incorporating a number of the specific airline OEI procedure splays. In such cases, it may not be feasible to protect for the 62.5:1 surface gradient because of existing obstructions. In these cases, the existing obstruction becomes the "controlling obstacle" that results in a higher surface gradient (steeper slope), as was the case at SJC. See Figure B.6 for a profile view of ideal vs. actual OEI surfaces based on existing obstacles.

An appendix in the Final Report describes in more detail how some airports are incorporating OEI surface protection into their overall airspace protection programs in the "OEI Pilot Program."

APPENDIX C

The FAA's Obstruction Evaluation/ Airport Airspace Analysis Process

Introduction

The jurisdictional authority to limit structure heights through the construction permit process rests with local authorities (some combination of State, County, and/or Local Municipal), and not with the FAA. For optimal land use compatibility and airspace protection, local regulations should reference FAA and/or other types of airspace protections; however, this is not always the case.

With respect to local structure height regulations, for any given project site, there are two general classifications of potential structure height: (1) the nominal or standard height limit as set forth in code or ordinance, and (2) the height limit available when an individual proposal is granted a variance, e.g., permitted to be taller than standard, after due consideration by authorities.

With respect to the FAA OE/AAA process, for any given project site, there are three general classifications of potential structure height: (1) the height requiring FAA **notification,** (2) the maximum height not exceeding FAA **obstruction** standards, and (3) the maximum height not exceeding FAA **hazard** standards.

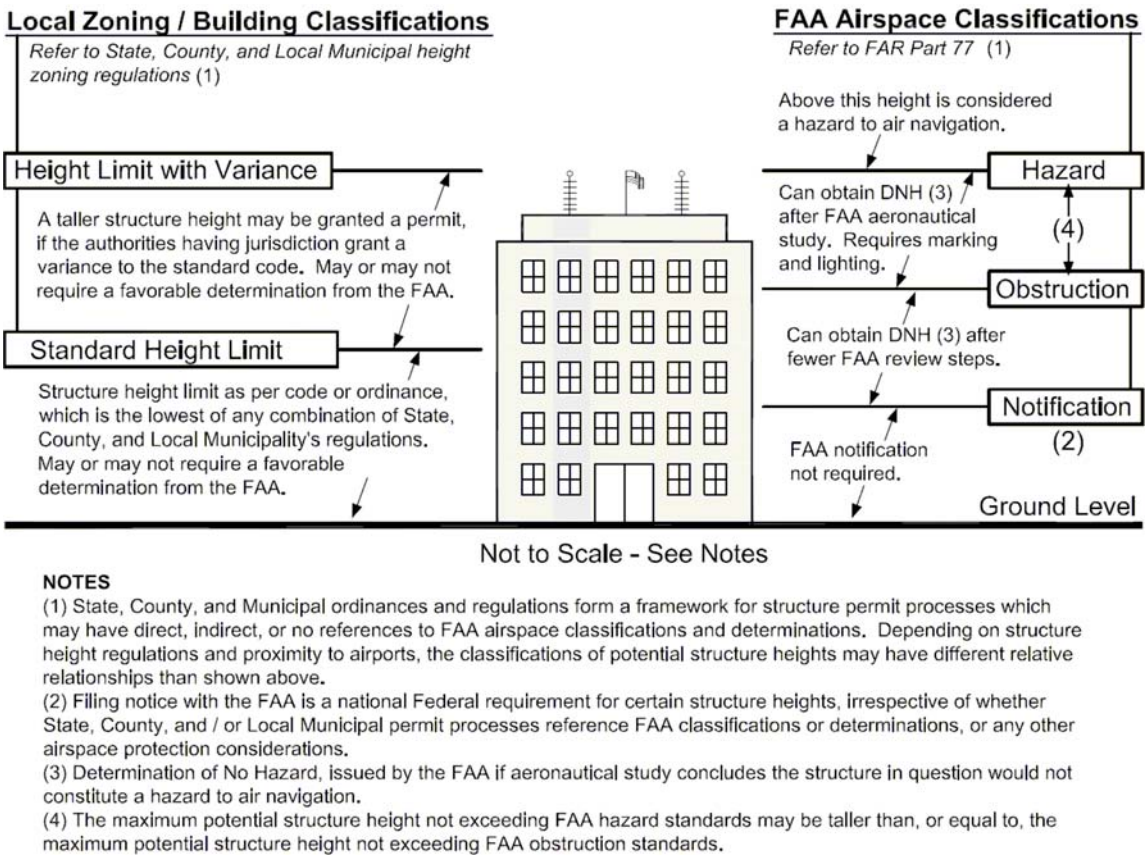
Figure C.1 shows the typical relationships between the various height classifications.

As set forth in Title 49 of the U.S. Code of Federal Regulations, §40103, "The United States Government has exclusive sovereignty of airspace of the United States." In protecting and administering the use of U.S. airspace,

> The Administrator [of the FAA] shall prescribe air traffic regulations on the flight of aircraft (including regulations on safe altitudes) for—
>
> (A) navigating, protecting, and identifying aircraft;
>
> (B) protecting individuals and property on the ground;
>
> (C) using the navigable airspace efficiently; and
>
> (D) preventing collision between aircraft, between aircraft and land or water vehicles, and between aircraft and airborne objects.

The FAA carries out these responsibilities through a variety of means. The primary means by which the FAA analyzes proposed construction or alteration ("protecting individuals and property on the ground") that may affect navigable airspace is through the OE/AAA process.

The following paragraphs describe the OE/AAA process that is undertaken by the FAA and other parties following receipt of notification from a structure proponent. This process is depicted in logic diagram format at the end of this section.



NOTES

(1) State, County, and Municipal ordinances and regulations form a framework for structure permit processes which may have direct, indirect, or no references to FAA airspace classifications and determinations. Depending on structure height regulations and proximity to airports, the classifications of potential structure heights may have different relative relationships than shown above.

(2) Filing notice with the FAA is a national Federal requirement for certain structure heights, irrespective of whether State, County, and / or Local Municipal permit processes reference FAA classifications or determinations, or any other airspace protection considerations.

(3) Determination of No Hazard, issued by the FAA if aeronautical study concludes the structure in question would not constitute a hazard to air navigation.

(4) The maximum potential structure height not exceeding FAA hazard standards may be taller than, or equal to, the maximum potential structure height not exceeding FAA obstruction standards.

Figure C.1. Classifications of potential structure heights.

Filing of Form 7460-1

A structure proponent must file FAA Form 7460-1, *Notice of Proposed Construction or Alteration,* for any proposed construction or alteration that meets any of the following *Notification Criteria* described in FAR Part 77.13:

§77.13(a)(1) - A height more than 200 feet AGL at its site;

§77.13(a)(2) - Within 20,000 feet of a runway more than 3,200 feet in length, and exceeding a 100:1 slope imaginary surface (i.e., a surface rising 1 foot vertically for every 100 feet horizontally) from the nearest point of the nearest runway. (Different standards apply with proximity to airports with no runways greater than 3,200 feet in length, and heliports);

§77.13(a)(3) - Roadways, railroads, and waterways are evaluated based on heights above surface providing for vehicles; by specified amounts or by the height of the highest mobile object normally traversing the transportation corridor;

§77.13(a)(4) - When requested by the FAA, any construction or alteration that would be in an instrument approach area and may exceed FAR Part 77 obstruction standards; or,

§77.13(a)(5) - Any construction or alteration on any public-use or military airport.

Structure proponents or their representatives may file via traditional paper forms via U.S. mail, or online at the FAA's OE/AAA website, http://oeaaa.faa.gov.

Terminology Note: the FAA paperwork and website refer to the party proposing to construct or alter a structure as "sponsor" or "project sponsor", and (if applicable) the party filing the notification and interfacing with the FAA and stakeholders during the OE/AAA process as the

"sponsor's representative". To distinguish clearly from the term "airport sponsor" used to refer to the owner and/or manager of an airport, this text uses the term "proponent" or "structure proponent" to refer collectively to the party proposing to construct or alter a structure, and their representative, if any.

Initial Processing of Form 7460-1

FAA follows the following steps to process the Form 7460-1:

1. An aeronautical study number (ASN) is assigned, and data for the case is entered into the OE automation program, the FAA's internal processing website.
2. An acknowledgement letter is sent to proponent or, in the case of online filing, the data and ASN are immediately available.
3. The FAA Obstruction Evaluation Service (OES) distributes the case to other FAA divisions and related entities (such as military) for review and comment.

Initial Aeronautical Study: Obstruction Standards

The FAA conducts an initial aeronautical study to determine whether the proposal would exceed obstruction standards under the provisions of FAR Part 77.23. An object constitutes an obstruction to air navigation if any of the following obstruction standards are exceeded:

§77.23(a)(1) - A height more than 500 feet AGL at the object site.

§77.23(a)(2) - A height AGL or above the airport elevation, whichever is greater, exceeding 200 feet within 3 nautical miles (NM) of the ARP, and that height increases at a rate of 100 fpnm up to 500 feet within 6 miles.

§77.23(a)(3) - A height that increases a minimum instrument flight altitude within a terminal area. This standard references instrument procedure criteria such as TERPS.

§77.23(a)(4) - A height that increases a minimum obstruction clearance (MOCA) under en-route criteria.

§77.23(a)(5) - The surface of a take-off and landing area of an airport or any imaginary surface defined in later sections: §77.25 for civil airports, §77.28 for military airports, and §77.29 for heliports.

Of note: FAR Part 77 as a whole, or FAR Part 77 obstruction standards, are sometimes narrowly understood only to be constituted of the imaginary surfaces referenced in §77.23(a)(5) and defined in §77.25. However, FAR Part 77 is an entire set of regulations; and there are five distinct types of obstruction standards, as listed above.

Initial Aeronautical Study Results

The FAA issues one of the following responses after conducting the initial aeronautical review:

- If the project does not meet notice criteria, or does not exceed obstruction standards, a DNH with DNE status is issued with no expiration date and no marking/lighting requirements.
- If the project exceeds notice criteria, but does not exceed obstruction standards and is 200 feet AGL or less, a DNH with DNE status is issued with no expiration date and no marking/lighting is necessary.
- If the project exceeds notice criteria, but does not exceed obstruction standards and is more than 200 feet AGL, a DNH is issued with appropriate marking/lighting recommendations.
- If the project exceeds obstruction standards, a NPH, (formerly known as a Determination of Presumed Hazard or DPH) is issued. The NPH recommends lowering the proposal to the height not exceeding obstruction standards (DNE height) and sometimes lists another height—the maximum "height for not exceeding" (HFNE), or occasionally called "no effects height"

(NEH), with respect to hazard criteria. The HFNE height may be noted if the proposal is in proximity to other proposals or existing structures the FAA has already studied, and the hazard limitations have already been calculated and/or if the FAA anticipates the structure proponent would not accept the DNE height and will want the proposal to obtain a DNH at maximum feasible height.

The NPH is temporary, with a 60-day expiration date. If no resolution is attempted within 60 days, the FAA terminates the case. If the structure proponent requires a favorable determination from the FAA as part of the construction permit process, or for any other reason, the structure proponent must respond within 60 days.

The NPH contains language specifically stating that the situation requires resolution, and that the NPH document does not imply FAA's favorable acceptance of the proposal at any height. This is so that the NPH document will not be misconstrued as a favorable determination from the FAA, even if the structure proponent agrees to lower the proposed height to the DNE or HFNE elevations.

When an NPH is issued, the project proponent has several resolution options:

1. The proponent may accede in writing to lower the proposed height of the structure so that it would not exceed obstruction standards (the DNE elevation). This routinely results in the FAA issuing a DNH.
2. The proponent may accede in writing to lower the height of the structure to the HFNE height, if one was indicated on the NPH. This routinely results in the FAA issuing of a DNH, with marking and lighting requirements.
3. The proponent may request in writing the FAA to perform further aeronautical study at the originally requested height.
4. The proponent may request in writing the FAA to perform further aeronautical study at a reduced height that is lower than the originally requested height but not as low as the height not exceeding obstruction standards, depending on a variety of factors.

Further Aeronautical Study

If the structure proponent requests further aeronautical study as described in #3 or #4, the FAA initiates the further aeronautical study process, a complex process which involves analyzing flight procedures, NAVAIDS, radar, and other factors in the airspace in the vicinity of the proposed structure. The objective of further aeronautical study is to determine whether the proposed structure would have a **substantial adverse affect to a significant amount of air traffic,** and thereby constitute a hazard to air navigation. The further aeronautical study process will involve distribution to other FAA lines of business and other interested agencies, and may take several months.

Typical triggers of hazard status include the following:

- Height: the primary focus of this research; the object would be an obstacle that would affect published instrument procedures (TERPS and related criteria) and/or visual flight procedures.
- Electromagnetic interference: the object, due to its size, position, material composition, or electromagnetic transmissions, would block or distort electromagnetic signals to or from critical navigation aids, satellites, radar, or aircraft.
- Visual impediments: the object would block or otherwise interfere with FAA control tower line of sight, or would cause pilot or controller distraction due to glare, smoke, dazzling lights, sun reflection, or other factors.
- Wildlife attractants: the object, or more commonly, use, would attract birds or other wildlife that could jeopardize aircraft operations. The most common example is a garbage dump that would likely attract a large number of birds.

During the further aeronautical study phase, the FAA at its discretion may "circularize" the proposal under the Public Notice process. A Public Notice contains the basic data of the proposal and the amount by which it exceeds obstruction standards, and may contain affects to published instrument procedures if the FAA has calculated those in the early review. The Public Notice is posted on the publicly available portion of the FAA's OE/AAA website, and can also be emailed or mailed to local airport sponsors, airlines, pilots' associations, and other interested parties in the aviation community, at the FAA's discretion. FAA OE/AAA website subscribers who have requested to be notified of proposals, determinations, and public notices in proximity to specified airports will be automatically notified. Any interested stakeholder may submit comments by the due date as specified by the FAA, which generally falls 35 to 40 days after the issuance of Public Notice. Public Notice is the formal, and sometimes the only, opportunity for third-party stakeholders (i.e., not FAA or the structure proponent) to provide input in the OE/AAA process. The FAA must consider all comments of a significant aeronautical nature.

At the conclusion of the further aeronautical study phase, the FAA will determine whether or not the proposed structure would constitute a hazard to air navigation.

Issuance of Determination

If no substantial adverse effects are identified in the further aeronautical study process, a DNH would be issued, with an 18-month expiration date. On the DNH letter, the FAA directs the proponent to file supplemental FAA Form 7460-2, *Notice of Actual Construction,* in two parts: Part 1, at least 10 days prior to beginning construction; and Part 2, within 5 days after structure reaches its greatest height. In addition, the FAA may require a certified professional survey be performed on the finished structure as a contingency on a DNH. If the proposal exceeds obstruction standards, marking and lighting requirements are noted as a contingency of the DNH, with reference to the latest FAA AC containing marking and lighting guidance (Currently, AC 70/7460-1).

If the proposed structure is found to have substantial adverse effect, the FAA contacts the structure proponent to notify them of the results of the further aeronautical study; and generally, proposes a maximum height not exceeding hazard standards (refined calculated HFNE). If the structure proponent accepts this height, a DNH can be issued for the negotiated height.

If the structure proponent does not accept the negotiated height, a DOH to air navigation is issued.

Alternatively, the structure proponent may request the FAA to bring about airspace changes in order to accommodate the proposal at the originally requested height or some other height that exceeds the FAA's calculated HFNE. If the FAA considers the airspace changes may be feasible, the further aeronautical study process is restarted, with Public Notice issued indicating the proposed changes to airspace, flight procedures, and air traffic procedures that would be required if the structure were built as proposed. Stakeholders may comment on the new information and proposed airspace changes, and the further aeronautical study process is carried out again as described above. Acceptable changes to airspace are rare in practice, because (1) airspace procedures as designed are usually sub-optimal in some manner, developed around existing obstacles, and the introduction of new critical obstacles would further degrade them; and (2) changing airspace procedures in order to accommodate proposed structures sets the precedent that further changes could be implemented, which would lead to a gradual degradation of the safety, utility, and efficiency of the airspace surrounding airports.

Although clearly undesirable from the standpoint of aviation stakeholders, proposed structures that received a DOH are occasionally legally constructed. This can occur if, among other factors, the following conditions are met: (1) the local municipal authority having jurisdiction

issues a construction permit even if aware of the DOH; (2) the State, county, or other secondary authority having jurisdiction over airspace matters, if applicable, issues a construction permit or otherwise allows the structure even if aware of the DOH; (3) the sponsor(s) of affected nearby airport(s) are unable to convince local, State, and other authorities to limit the structure height, even if its presence in the airspace would degrade the safety and/or utility of the airport(s) to the point that Federal obligations and grant assurances would be violated; and (4) the structure proponent is able to obtain any required hazard and/or liability insurance coverage, even if the insurance underwriter is aware of the DOH.

Ultimately, it is up to the local community (municipal and State agencies, developers, airport owners, stakeholders, and the public) to decide the most appropriate compromises between the interests of airspace protection and land development.

Petitions for Discretionary Review

Within 30 days of the issuance of a final determination (a DNH or DOH), a petition for discretionary review (an "appeal") may be filed with the FAA Washington, DC Headquarters. A petition could be filed by the structure proponent in protest of a DOH, or by an aviation stakeholder in protest of a DNH. The Airspace and Rules Division (ATA-400) is responsible for processing petitions for discretionary review. A requested review may be granted or denied.

If discretionary review is denied, the original determination will be made final. If discretionary review is granted, ATA-400 will carefully review the original case, and may request additional information from various stakeholders. The potential outcomes of discretionary review are that the original determination may be affirmed, revised, or reversed by FAA Headquarters. The FAA's discretionary review decision is final.

Actual Construction; Cataloguing and Distribution of Obstacle Data

A DNH has an 18-month expiration date. Actual construction of the structure (foundations, framing, and not site work only) must be initiated prior to the expiration date in order for the DNH to become permanent. If actual construction cannot begin by this time, the structure proponent can file for a one-time 18-month extension. If actual construction does not begin within the expiration date of the DNH or the extension, the DNH lapses, the FAA terminates the case, and the structure proponent must file a new Form 7460-1 in order to re-initiate analyses that would lead to a new DNH.

When actual construction begins, the structure proponent is required to file Form 7460-2, Parts 1 and 2, as required on the DNH letter. Depending on criticality to airspace procedures, the FAA may request a certified survey of the completed structure be performed by a licensed civil engineer or surveyor. The structure owner is required to provide and perpetually maintain any mandatory obstruction marking and lighting.

The FAA OES maintains and updates a list of all the proposed projects and projects for which the supplemental Form 7460-2 has been submitted. This information regarding man-made objects is periodically incorporated into the DOF maintained and updated by the FAA's NACO. The DOF can be used internally by the FAA, and can be purchased by airlines, airports, and other vendors or consultants for use in obstacle evaluation, flight procedure design, and the like.

Figure C.2 is a logic diagram depicting the OE/AAA process.

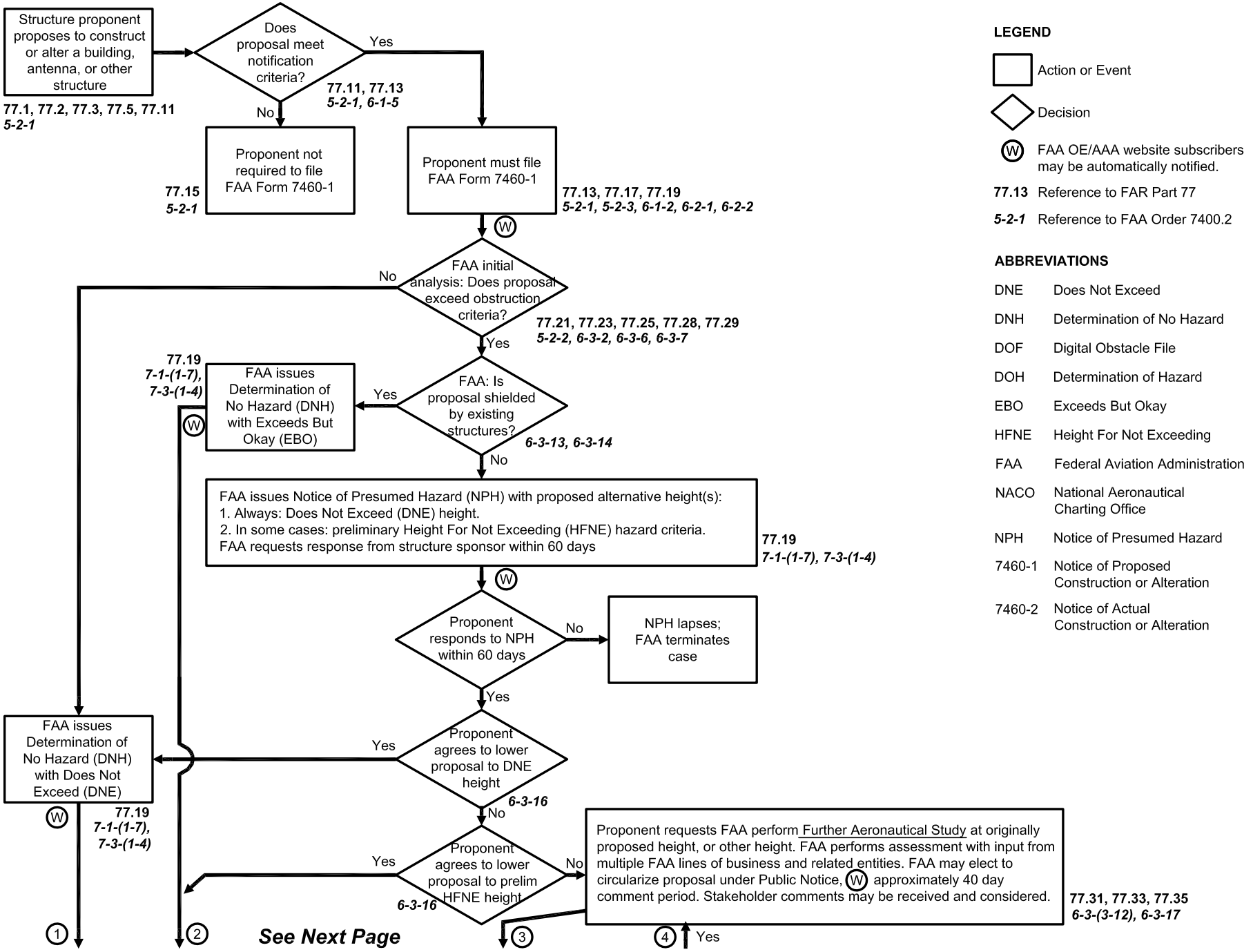


Figure C.2. The FAA's obstruction evaluation/airport airspace analysis process.

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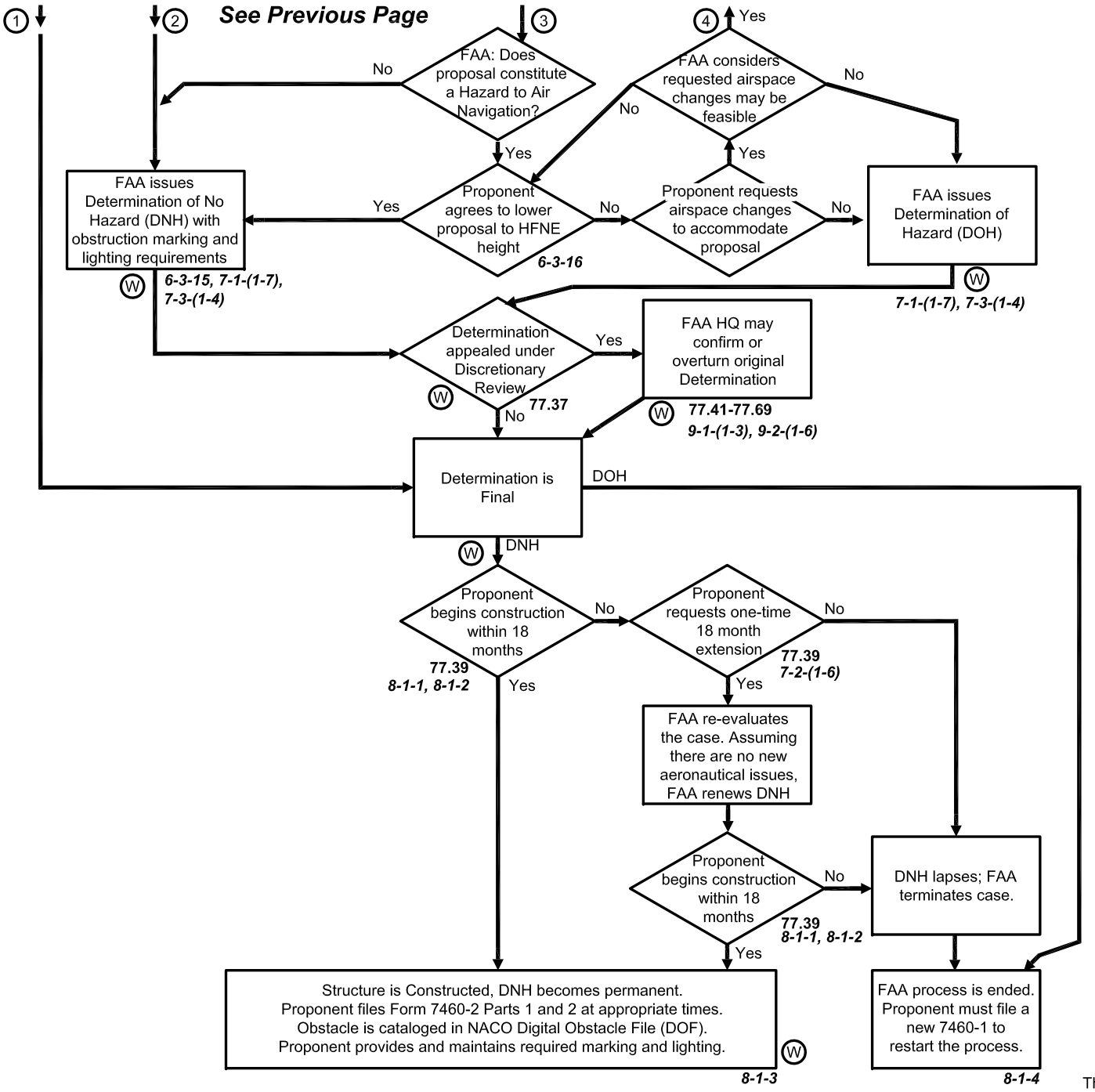


Airport Cooperative Research Program
Project 03-13
"Understanding Airspace, Objects, and Their Effects on Airports"

JACOBS CONSULTANCY
In Association With
ASRC Research & Technology Solutions
Landrum & Brown
The Ohio State University Dept. of Aviation

Figure C.2. Continued.

APPENDIX D

Case Studies

Boston Logan International Airport

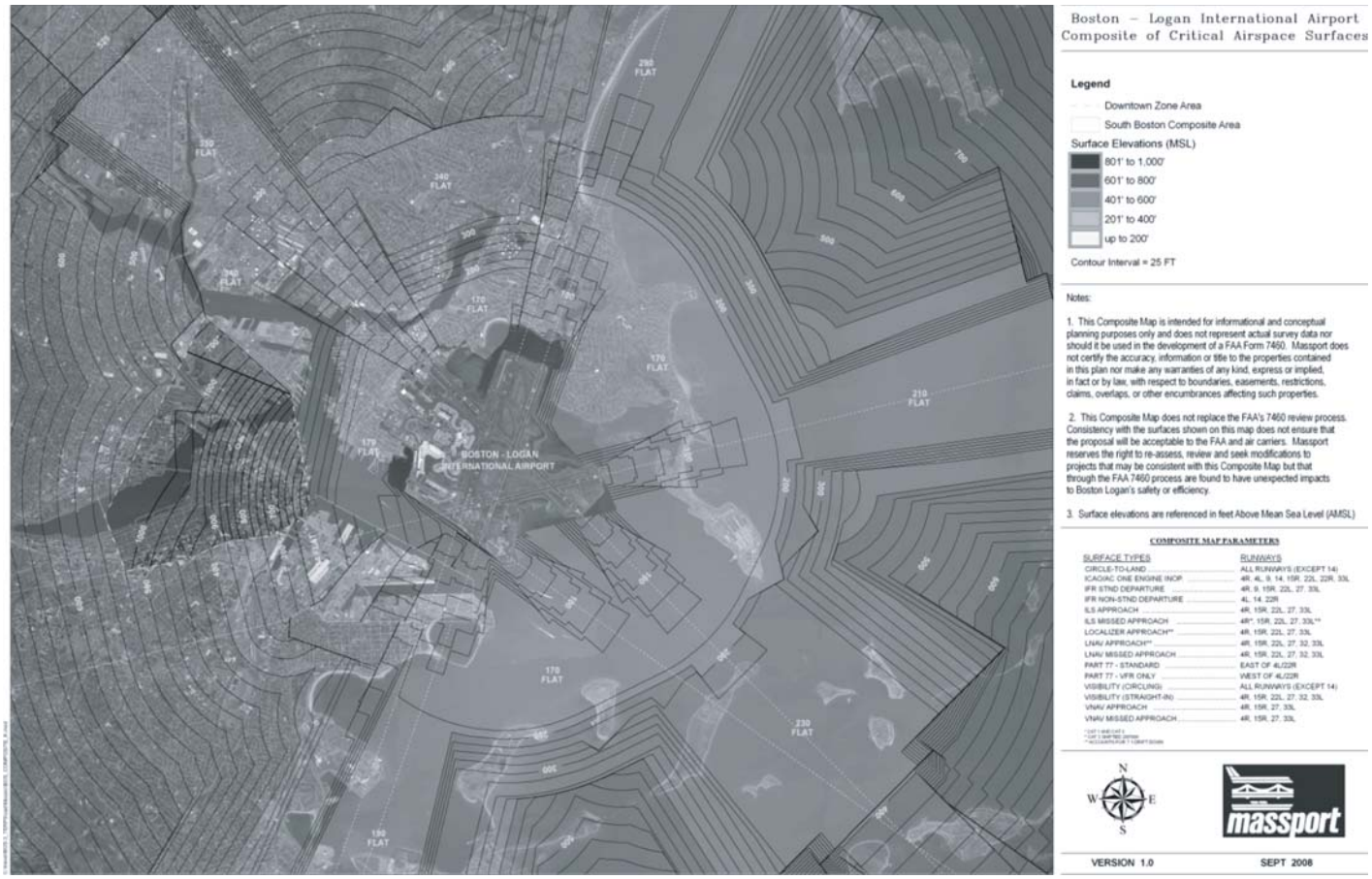
Executive Summary

Many large hub airports are situated in dense urban environments where high land values and intense use of the land encourages vertical development. The Boston Logan International Airport ('BOS' or 'the Airport') falls into this category, as it is located just over two miles east of downtown Boston. In the late 1990s, BOS officials realized a need to explore alternatives to the FAA's OE/AAA process. The standard process evaluated structures one at a time, and placed the Airport, developers and local municipalities alike in a reactive position when conflicts between airspace and land use planning were identified.

The initial trigger that motivated BOS officials to rethink their approach to evaluating potential airport hazards was a redevelopment plan for the South Boston Waterfront. The plan called for numerous tall structures that would be located in the Runway 27 departure corridor. If evaluated piecemeal, the structures may have led to incremental airspace loss and eventually severe limitations on airport operations. Another concern with this strategy is that an increasingly high and narrow flight corridor does not adequately protect OEI conditions, where more lateral and vertical airspace is required to safely maneuver the aircraft that experience loss of power to one engine.

Initially, the Airport worked with developers, the Mayor's office, and the FAA to seek an alternative approach for protecting the Runway 27 Corridor, given the imminence of plans to redevelop the South Boston Waterfront. With support from a consultant, BOS developed a *composite map of critical surfaces* for the Runway 27 Corridor.

The purpose of the map was to guide (not regulate) developers seeking to build in the Runway 27 departure corridor. This proactive and comprehensive approach allowed developers to understand the expectations of the Airport before investing large sums of financial and political capital into a project. In fact, the map for the Runway 27 departure corridor was successful, as it resulted in reductions of proposed building heights for several projects on the South Boston Waterfront.



SOURCE: Massport

Figure D.1. The* Boston-Logan International Airport Composite of Critical Surfaces *was released as an airport land use compatibility tool for the Boston area in 2008.

The map for the Runway 27 departure corridor contrasts with the FAA OE/AAA process. The composite map is revealed to developers early in the development process; it is visually clear and easy to interpret, it only includes those surfaces that are important to the Airport and the airlines in terms of safe and efficient operation; and it is a guidance document that can change over time. The OE/AAA process, on the other hand, often comes late in the development process, which may result in adjustment of procedures instead of lowering structure heights. Second, there are no strong visual tools for communicating an airspace conflict when one exists. Also, the FAA system for obstruction evaluation accounts for all surfaces, which may lead to determinations that lead to conflicts over surfaces that are irrelevant to the Airport from an operations perspective. Finally, the OE/AAA process is rooted in regulation and so is less adaptable to changes to the safety and efficiency needs of an airport.

In response to its success, the composite map approach has since evolved and expanded. In 2008, Massport formally released the *Boston-Logan International Airport Composite of Critical Surfaces* (Figure D.1). Airport officials are hopeful that the map, paired with vigorous communication and outreach to local developers, municipalities, and other stakeholders, will improve their ability to preserve the viability of a major airport in an urban environment.

Airport Description

Boston Logan International Airport opened in 1923. While it started as a military airport, BOS began providing commercial air service as early as 1925. Ownership of the Airport was

passed from the U.S. Army to the Commonwealth of Massachusetts in 1928, and was then leased from the state by the City of Boston until 1941 when the Airport returned to state jurisdiction. The Massachusetts Port Authority ("Massport") was established by the Massachusetts state legislature in 1959 "to be entirely self-sustaining, without cost to the Massachusetts taxpayer and without pledging state credit; supporting itself from three primary sources: the sale of revenue bonds, charges to users of its facilities and income from investments" (www.massport.com/logan).

In fiscal year 2007, BOS saw 13,822,101 air carrier and commuter passenger enplanements and a total of 410,295 aircraft operations (landings and takeoffs) (FAA Terminal Area Forecast, December 2008). BOS operates four passenger terminals, including one international terminal. While BOS serves as a major commercial air service provider, the Airport also provides logistics and general aviation services, and hosts some military activity.

There are six runways at the Airport. Runways 15R-33L and 4R-22L are both just over 10,000 feet long. Runway 4L-22R is 7,861 feet, Runway 9-27 measures at 7,000 feet, Runway 14-32 is 5,000 feet, and Runway 15L-33R is 2,557 feet long (Figure D.2).

Surrounding Communities and Land Use

BOS is located primarily within the City of Boston with a portion of the Airport located within the Town of Winthrop. The Airport is also near the City of Chelsea to the northwest. Beyond these municipalities, several other communities lie within the FAR Part 77 20,000-foot 100:1 notification area (Figure D.3) and include Revere and Everett to the north, and Somerville and Cambridge to the west. Southwest of BOS, there a several islands within Boston's jurisdiction and to the east, beyond Winthrop, is the Atlantic Ocean.

There is significant dense, urban-style development that surrounds the Airport's runways. Just over two miles to the west of the Airport (and in close proximity to the Runway 27 departure path) is Boston's downtown core. The high-density, high-activity urban environment that occupies much of the land area surrounding the Airport includes office, retail, civic, residential, and industrial uses. In addition, the Airport abuts Boston Harbor, which sponsors a variety of commercial and recreation vessel activities as well as the Boston Harbor Islands National Recreation Area.

Massport interacts with many of the surrounding municipalities as well as local and state agencies in planning for the land owned by the authority as well as other land in the Airport vicinity. Massport operates a Planning and Development Unit which works to coordinate "with agencies such as the Massachusetts Highway Department on the Central Artery/Tunnel Project, the Massachusetts Bay Transit Authority on the South Boston Piers Transitway, the Boston Redevelopment Authority, and numerous other City, State, and Federal agencies; community and other advocacy groups; and private property owners" (www.massport.com).

State, County and Local Statutes and Ordinances

The Commonwealth of Massachusetts. The Massachusetts General Law (MGL), Part I, Title XIV, Chapter 90, Sections 35 A-D describes the commonwealth's statutory requirements for airspace protection. The purpose of such regulation is described in section 35 A:

> The safety, welfare and protection of persons and property in the air and on the ground requires that the navigable air space overlying the commonwealth in the approaches to, and the air traffic pattern area of, airports approved by the commission be maintained in a reasonably unobstructed condition for the safe flight of aircraft, and therefore, in the exercise of the police power, the location and height of structures and the use of land thereto related is regulated as provided in sections thirty-five B to thirty-five D, inclusive.

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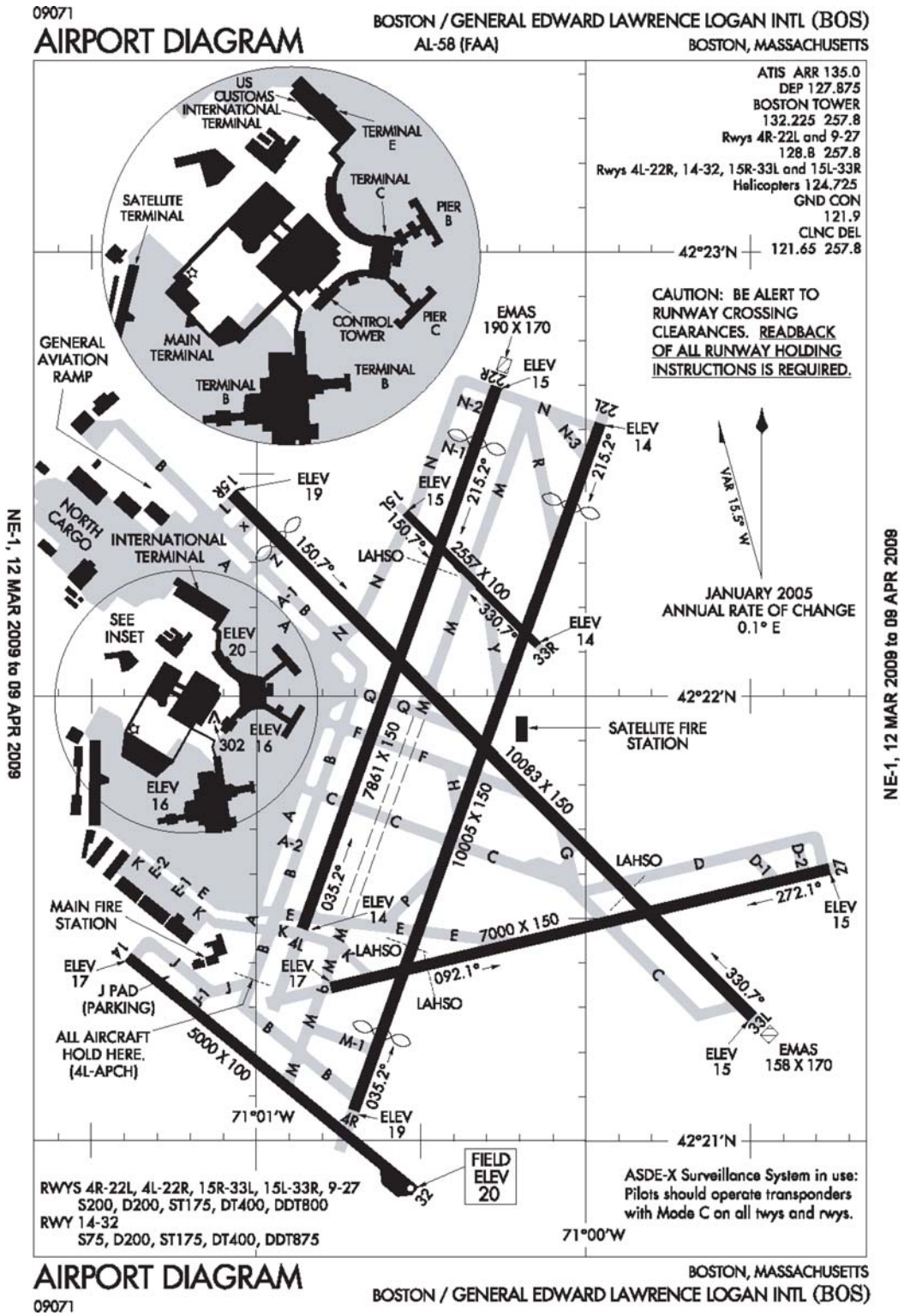
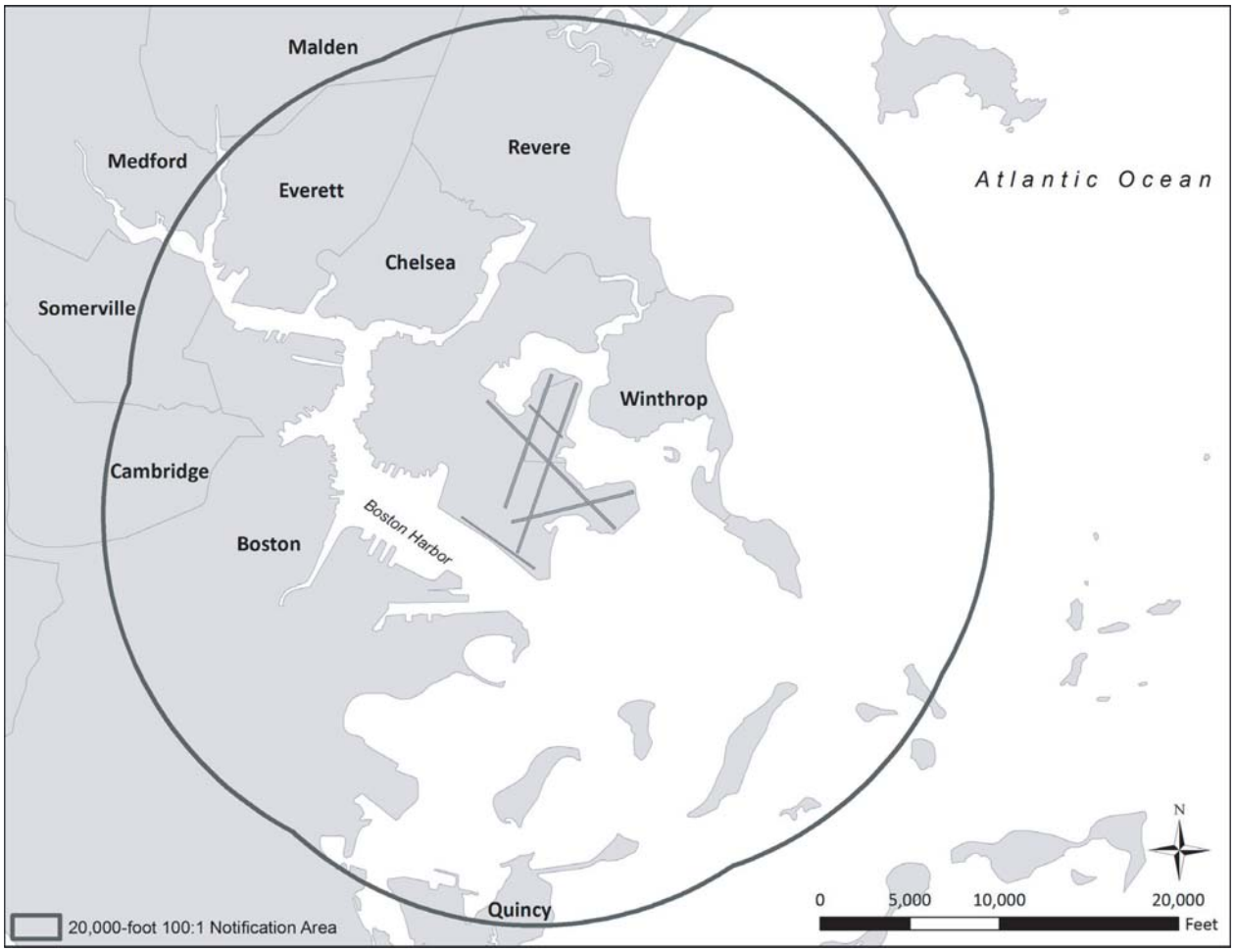


SOURCE: www.naco.faa.gov

Figure D.2. National Aeronautical Charting Office (NACO) diagram of Boston Logan International Airport.



SOURCE: GIS Data compiled from MassGIS and Bureau of Transportation Statistics (Runways)

Figure D.3. The 20,000′ 100:1 notification surface for Boston Logan International Airport affects the City of Boston, Winthrop, Revere, Chelsea, Everett, Somerville, Cambridge, Quincy, Medford and Malden.

Section 35 B of the MGL requires a permit for new construction or additions, pursuant to the following standards (summarized from the statute text):

1. Any structure within a 1,500-foot rectangle of any runway centerline.
2. Any structure taller than 150 feet above ground level within two miles, but beyond 3,000 feet of any runway end.
3. Any structure taller than a 20:1 slope within 3,000 feet of any runway end.

Section 35 C allows for conditional permits, based on appropriate marking and lighting and section 35 D affirms that structures existing prior to the statute (1960) are allowed to remain as built.

Sections 40 A through I grant local governments, excluding the City of Boston, the power to regulate airspace approaches. The statutory language provides specific guidance to how these regulations must be developed, communicated to the public, evaluated, and enforced.

Suffolk County. Suffolk County is entirely incorporated, and therefore operates no county level government.

City of Boston. The City of Boston has no regulations—statutory or otherwise—over the interactions between airspace and land use. The city does have an agency, the Boston Redevelopment Authority, which focuses exclusively on planning and development considerations, which include compatible land use decisions, like airspace compatibility.

Other Neighboring Jurisdictions. The City of Chelsea adopted an Airport Related Overlay District (AROD). The purpose of the zoning overlay "is to provide areas for airport related uses in locations with suitable access to the airport and where such activities can occur without adverse impact upon residential areas" (Chelsea Zoning Ordinance, Section 8.2). While the ordinance speaks to land use and airport compatibility from a noise and possibly visual pollution standpoint, the rule does not refer specifically to building height or airspace issues. No other neighboring jurisdictions carry laws or ordinances related to airports, airspace or aviation.

Summary of Interview Regarding Airspace and Land Use Issues

Many large hub commercial airports in the country have a unique challenge with airspace issues due to their proximity to dense urban areas. BOS is situated just over two miles from Boston's downtown. While the Airport, airlines and the FAA have found ways to compromise with the vertical urban development needs in the vicinity, there is a real concern that continued development of tall structures could degrade the airspace to cause significant impairment of the Airport's operational needs. Another concern is that an increasingly narrow flight corridor does not adequately protect OEI conditions. This is a condition of flight when one engine loses power, which requires more lateral and vertical airspace to safely maneuver the aircraft.

Until the late 1990s, BOS dealt with the OE/AAA process just like most other airports in the nation. Proposals for structures were examined using the OE/AAA process, which evaluated proposals one at a time and did not always involve the airport operator in making the final determination. Occasionally, the OE/AAA process would result in modification of operating procedures following a hazard determination, to allow for a positive determination on building proposals. Adjusting a procedure, however, limits aircraft operating capacity for that runway. Adjusting procedures further compounds the airspace challenge as runway use patterns shift and ultimately airport efficiency is compromised.

Airport officials recognized the need for a new approach to airspace protection when the Boston Redevelopment Authority released plans to develop the South Boston Waterfront. The plans included numerous tall structures in an area used as a major arrival and departure path, which would have significantly affected the Airport's operations.

BOS provides an example of a decade-long effort to manage the Airport airspace by reaching out to developers, local municipalities, the FAA, and the airlines. From the outreach effort, they developed a proactive tool to protect against future airspace degradation and to aid stakeholders in the development review process by providing them with the Airport's expectations early in the process.

Perhaps the biggest challenge in protecting airspace is a lack of clearly defined expectations. This challenge frustrates developers and airports alike. In many cases, by the time developers have submitted a 7460 form to the FAA, they have already invested large amounts of financial and political capital on the project. If a developer receives a determination of hazard from the FAA, the developer inevitably takes a defensive posture. Many times, the negotiation that follows results in an adjustment of aircraft procedures to accommodate the proposed height of the structure. While the airspace impacts of such practices may be mild on an individual project basis, the cumulative impact may be a significant loss of necessary airspace. According to an interview with an Airport representative, this is historically the experience at the Boston Logan International Airport.

In the late 1990s, BOS realized that the South Boston Waterfront was the next frontier for development in the Boston area. Being a large city and a dense urban environment, these plans called for several tall buildings that would impose upon an active arrival and departure path at the Airport. From the South Boston Waterfront development plans, a concrete proposal emerged for six structures comprising a development called *Fan Pier.* The Fan Pier proposal was already deep in the development process. The structures, however, were tall enough that there would have been an airspace conflict if built as proposed. BOS officials began meeting with the developer, the Mayor's office, and the FAA Administrator. The discussions evolved into the establishment of a technical team that worked with an independent consultant to evaluate the proposal's airspace effects. Clearly, the Airport's position was to ensure very little or no impact on airspace, while the developer was prepared to negotiate in favor of minimal changes to their original design.

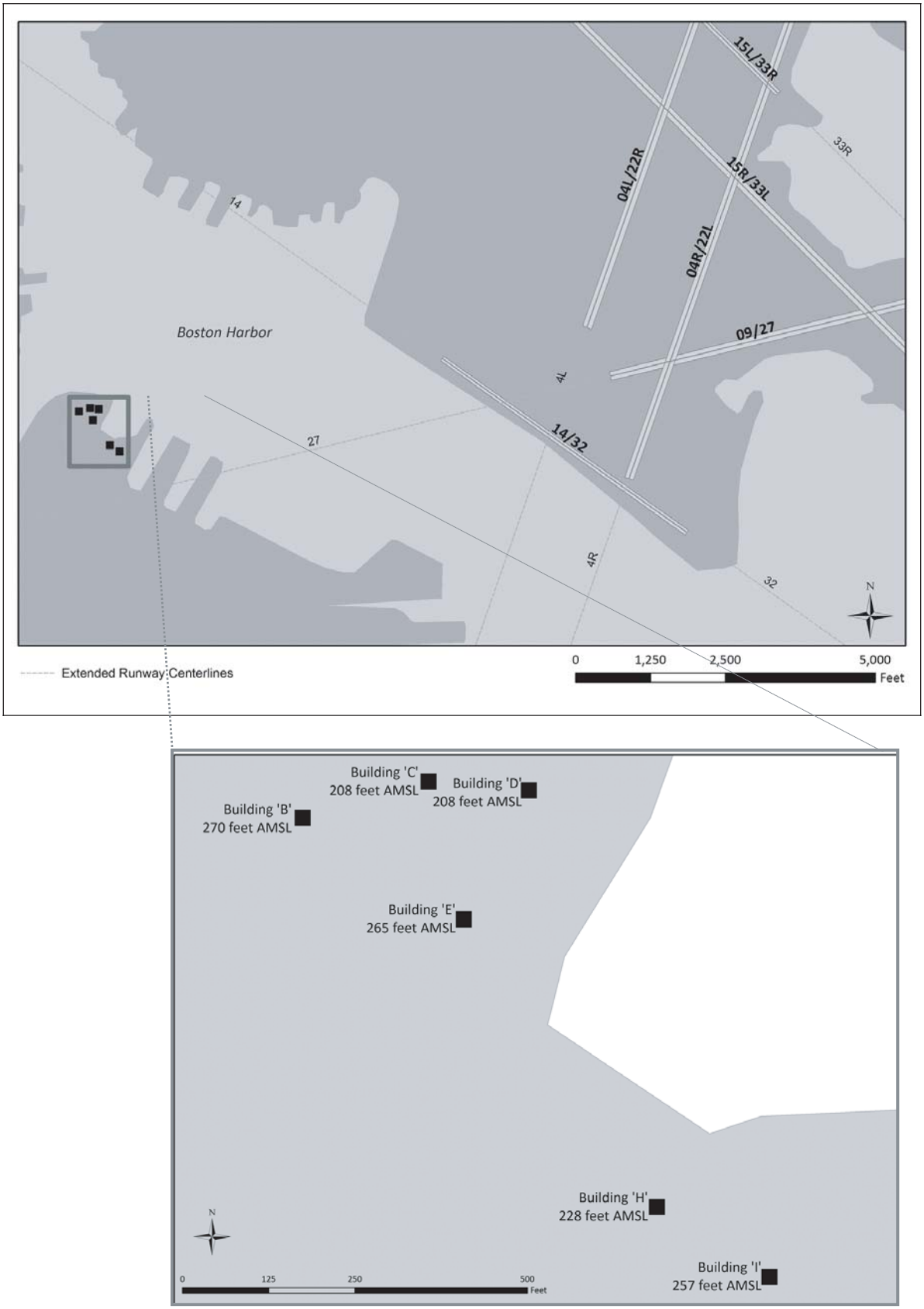
Over time, the Fan Pier developer and the Airport were able to reach an agreement. The effort involved in this approach—working with developers, one proposal at a time—would have posed a significant burden on the Airport, considering the number of substantial structures planned for the South Boston Waterfront. In addition, this approach meant that developers would continue to learn too late in the development process that proposed building heights might not be acceptable from the airspace protection perspective. The project includes six structures (Figure D.4), and each has been studied individually by the FAA, initially in 2002, then again in 2005 and 2008. Attachment A is the "Additional Information" section in the FAA's "Determination of No Hazard to Air Navigation" (ASN 2008-ANE-764-OE) for one of the structures. The discussion in this Attachment reveals many of the considerations and logic used by the FAA to reach a final determination for this building.

BOS officials realized through the Fan Pier negotiation, that the problem would persist if they continued to use a piecemeal and reactive approach. Airport officials, working closely with an independent consultant, developed an overlay map that was the initial concept for the *Boston-Logan International Airport Composite of Critical Surfaces* (Figure D.1).

While the composite map for the entire BOS area was just formally released in 2008, the Airport began by developing and implementing composite surfaces for the Runway 27 departure corridor, which coincides on the ground with the South Boston Waterfront area. The Runway 27 departure corridor surfaces were given to the City of Boston to use as voluntary height guidelines. With these guidelines, the people who have primary contact with developers inquiring about proposals now use them as part of the standard permitting process. In addition, the map provides planners with a tangible tool for integrating airspace considerations into area wide redevelopment plans.

Setting clear expectations and moving the airspace consideration from the end of the development planning process to the beginning produced positive results in the case of the Runway 27 departure corridor. The success of the map took more effort than just the technical process of surface evaluation. The Airport worked to engage major local developers and local municipalities in the process of developing the map. The map itself, along with active outreach, has served to get the Airport more involved in planning decisions. From this success along with a need to ensure airspace protection around the entire Airport, BOS developed the *Boston-Logan International Airport Composite of Critical Surfaces* (Figure D.1) as a planning tool for the whole Airport area.

The composite map is a living document that can adapt to changes in airspace regulations and operating procedures over time. While jurisdictions around the Airport might choose to adopt the map as a zoning ordinance, as a voluntary guideline, the map stays adaptive to change. The goal is to get developers to think about airspace issues as soon as they express interest in developing a parcel. This expectation is not unreasonable, as most people seem to agree that air navigation safety is a priority and that a functioning airport is an asset to economic growth in a city. Whether a developer agrees or disagrees with the constraint created by the surfaces, they are at



SOURCE: GIS data compiled from MassGIS, oeaaa.faa.gov (structure coordinates), and Bureau of Transportation Statistics (Runways)

Figure D.4. Six buildings ranging in height from 208′ to 270′ AMSL comprise the Fan Pier Development project, which prompted BOS to develop a composite map as an airspace protection tool.

least prompted to discuss the issue with the Airport at the beginning of the process when there is less investment in the proposal.

Another advantage is that the map itself is unique from the standard OE/AAA process. BOS realized a need to account for, or at least evaluate all of the surfaces around the Airport, but that it would seem arbitrary to include surfaces that were irrelevant based on actual operations. Because one of the goals of the map is clearly to build understanding and trust with the developers, the Airport only included those surfaces that were critical for the maintenance of the Airport's actual operations (Figure D.5). The map excludes unused surfaces and areas where the airspace is already heavily degraded, such as downtown Boston. This process involved working closely with the airlines, especially, to identify which procedures were currently in use at the Airport and which obstruction surface requirements should be preserved to ensure longevity of the Airport's functional airspace.

In addition to developing a map that would select only those surfaces that were relevant to the Airport's actual operating procedures, BOS officials also realized a need to coordinate the effort with the FAA. BOS was concerned that the FAA standard procedures for obstruction evaluation would be insufficient for protecting the Airport's airspace under the imminent risk associated with redeveloping the South Boston Waterfront. The agency was aware of these concerns, and was flexible in supporting the composite map effort. BOS officials knew from the start that the composite map would in no way undermine or substitute for the OE/AAA process. Instead, the composite maps would complement the FAA procedures. By promoting use of this tool, developers could be informed of the Airport's airspace needs at the onset of the development proposal process. The FAA would also keep the maps on file, and refer any 7460 applicants to the Airport to ensure that the conversation with developers would start as early in the process as possible.

Airport officials have spent the last decade facing the challenge of preserving the viability of a major airport in an urban environment. While they were somewhat motivated by efforts in other

COMPOSITE MAP PARAMETERS

SURFACE TYPES	RUNWAYS
CIRCLE-TO-LAND	ALL RUNWAYS (EXCEPT 14)
ICAO/AC ONE ENGINE INOP.	4R, 4L, 9, 14, 15R, 22L, 22R, 33L
IFR STND DEPARTURE	4R, 9, 15R, 22L, 27, 33L
IFR NON-STND DEPARTURE	4L, 14, 22R
ILS APPROACH	4R, 15R, 22L, 27, 33L
ILS MISSED APPROACH	4R*, 15R, 22L, 27, 33L*^
LOCALIZER APPROACH**	4R, 15R, 22L, 27, 33L
LNAV APPROACH**	4R, 15R, 22L, 27, 32, 33L
LNAV MISSED APPROACH	4R, 15R, 22L, 27, 32, 33L
PART 77 - STANDARD	EAST OF 4L/22R
PART 77 - VFR ONLY	WEST OF 4L/22R
VISIBILITY (CIRCLING)	ALL RUNWAYS (EXCEPT 14)
VISIBILITY (STRAIGHT-IN)	4R, 15R, 22L, 27, 32, 33L
VNAV APPROACH	4R, 15R, 27, 33L
VNAV MISSED APPROACH	4R, 15R, 27, 33L

* CAT 1 AND CAT 3
^ CAT 3 SHIFTED 200'NW
** ACCOUNTS FOR 7:1 DRIFT DOWN

SOURCE: Massport

Figure D.5. Surfaces included in the* Boston-Logan Composite of Critical Surfaces. *Airport officials worked to identify critical operational surfaces around the airport, and exclude those surfaces that would have little or no impact on airport activities.

cities like Miami and Phoenix, the solution for Boston had to be unique. The technical work-product alone was not enough for BOS. It was critical that the Airport reach out to all stakeholders in the process. The outreach work got people—developers, planners, citizens and otherwise—invested in the process from the beginning. They learned how important it is to developers to know about all of their project challenges upfront. They appreciate predictability, and the Airport provided them with a map that would ensure a predictable response from the Airport every time.

Soon, BOS will be distributing the maps electronically to each of the jurisdictions in the area. They believe the jurisdictions will use them as guidelines, and this lets the maps evolve when changes occur. Massport plans to create similar guidance documents for Hanscom Field and Worcester Regional Airport.

So far, early communication has helped allay challenges. The Airport staff has worked closely to ensure that the surfaces drawn and released to city development staff are reasonable and have clear logic behind them. One of the biggest concerns looking forward is the anticipation that a developer will request, for example, a 20-foot adjustment to the surfaces. While BOS will have only an advisory role in the ultimate decision, the Airport believes it will have to stick with its position that it will disagree with all proposals that penetrate these surfaces. The concern rests in fears that the surfaces will lose validity over time and will cause contention between the Airport and developers if the surfaces are changed for some and not others. Clearly, this would defeat the purpose of the maps and the communication efforts made thus far.

It was a long and cumbersome process, but Boston Logan Airport has developed a workable solution to a concern held by many urban airport operators. Over a decade of meetings and technical work provides developers and municipal staff clear expectations for building heights in the Airport area. While the Airport is certain the challenges are not over yet, they do believe their work so far shows great progress. A shift from piecemeal and reactive to comprehensive and proactive, the Airport has altered the dynamic of the airspace issue in the Boston area and is now better positioned to handle future challenges with clarity and fairness.

Attachment A

'Additional Information' for ASN 2008-ANE-764-OE, 'Determination of No Hazard to Air Navigation'

"The proposed construction consists of 6 buildings associated with the Fan Pier development that would be located 1.82 nautical miles (NM) west of the Airport Reference Point of the General Edward L. Logan International Airport (BOS), Boston, MA. Each building has been studied separately under Aeronautical Study Numbers 2008-ANE-764 through 769-OE. In order to facilitate the public comment process these six proposed buildings were circularized under Aeronautical Study Number 2008-ANE-764-OE. All comments received from this circularization have been considered in completing the separate determinations for each of the six proposed buildings under their respective Aeronautical Study Numbers (ASN).

The proposed structure studied under this ASN is identified as an obstruction under the standards of 14 CFR, part 77, as applied to the General Edward L. Logan International Airport as follows:

Section 77.23(a)(2): A height AGL or airport elevation, whichever is higher, exceeding 200 ft. within 3 miles; would exceed by 50 ft.

Section 77.23(a)(3): A height that increases a minimum instrument flight altitude within a terminal area (TERPS criteria); would become the controlling obstacle for Runway 27 departure procedures. This effect could be entirely mitigated with the submission of a certified survey. The

proponent has agreed to provide a 1A survey of this structure. Therefore, there would be no effect to any instrument flight procedure from this proposed structure.

Section 77.23(a)(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; would exceed the horizontal surface by 100 ft.

The proposal was circularized on September 26, 2008, to all known aviation interests and to non-aeronautical interests that may be affected by the proposal. No letters of objection were received as a result of the circularization.

Aeronautical study disclosed that, with the submission of a 1A survey, the proposed structure would have no effect on any existing or proposed arrival, departure, or en route instrument flight rule (IFR) operations or procedures.

Study for possible visual flight rules (VFR) effect disclosed that the proposed structure would have no effect on any existing or proposed arrival or departure VFR operations or procedures.

Although it would lie within the Traffic Pattern Airspace (TPA) for all categories of aircraft that would use BOS, there are some mitigating circumstances.

The proposed structure would lie closest to the approach end of Runway 14. Aircraft do not land on Runway 14 nor do they depart from Runway 32. It is essentially a one-way runway. It would underlie the general, extended final approach area for Runway 9. Runway 9 is a visual runway and this structure would lie well below the height of the 20:1 approach surface.

Therefore, it would not conflict with airspace required to conduct normal VFR traffic pattern operations at BOS or any other known public use or military airports. At 257 ft. AGL, the proposed structure would not have a substantial adverse effect on VFR en route flight operations.

The proposed structure would be appropriately obstruction lighted to make it more conspicuous to airmen should circumnavigation be necessary.

The cumulative impact of the proposed structure, when combined with other proposed and existing structures, is not considered to be significant. Study did not disclose any adverse effect on existing or proposed public-use or military airports or navigational facilities, nor would the proposal affect the capacity of any known existing or planned public-use or military airport.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided all conditions specified within this determination are met.

CAUTIONARY ADVISORY for the actual construction of this building. Any temporary construction equipment (e.g. cranes) to be used during construction should be planned to minimize the impacts on BOS. This airport has over 400,000 aircraft operations per year. We will be unable to tolerate the use of temporary construction equipment that impacts the ability of the airport to operate efficiently especially with regards to Runway 27 departure operations.

Additional Conditions

Our study has disclosed that the above referenced construction/alteration lies in close proximity to an instrument flight rule (IFR) surface. As a condition of this determination, please submit a certified survey to 1A accuracy tolerances (+/- 3 ft. vertically, +/-20 ft. horizontally) within 5 days after the structure reaches its greatest height. This survey performed by a certified land surveyor or P.E. should be on their official letterhead, signed, and with the surveyor's seal or license number affixed."

Daytona Beach International Airport

Executive Summary

Daytona Beach International Airport ('DAB' or 'the Airport') is a county-owned facility with passenger, general aviation and cargo operations. The airport is about three miles southwest of the central business district of the City of Daytona Beach. In general, the area immediately surrounding the airport is low-density residential, retail, the Daytona Beach Racetrack, and office with various public service and safety facilities also nearby.

Florida is a state with significant regulatory language related to airspace protection. The State mimics FAR Part 77 regulations in both its administrative code and statutory regulations. The State requires all political subdivisions within an airport hazard area to include airspace regulations in their local ordinances.

The existence of government regulations, however, does not guarantee the avoidance of airspace and land use conflicts. DAB has had several recent experiences that have led staff to take a more proactive approach, because the regulations themselves are subject to misinterpretation, and developers and airport operators alike receive misinformation. The respondent, an airport representative, recounted three separate recent examples.

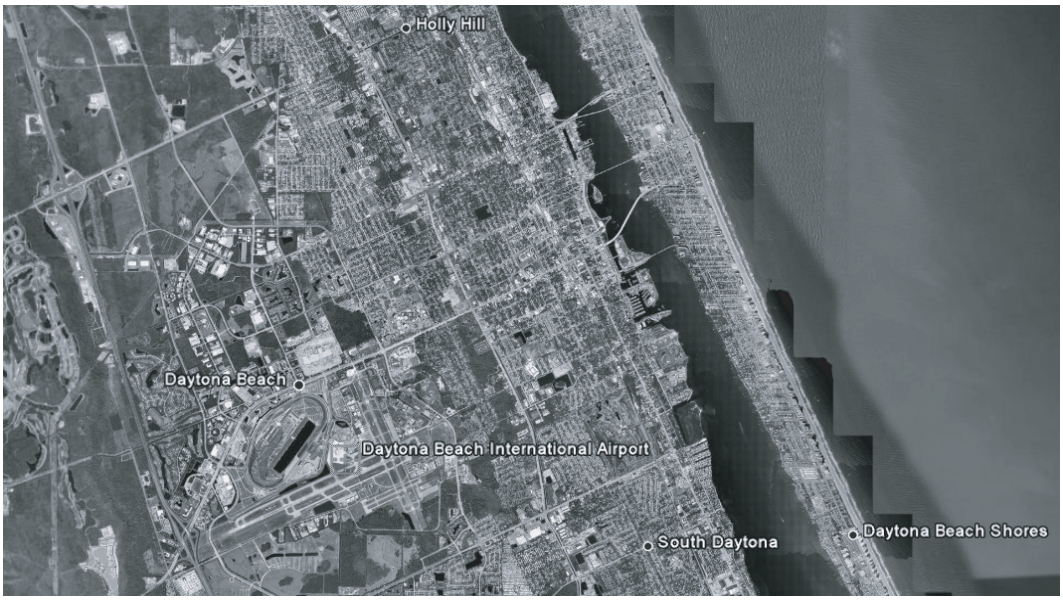
1. Airport representatives expected obstruction surface requirements to change due to the implementation of GPS approaches. Two departments within the FAA provided the airport with information that seemed conflicting. On-airport development projects were contingent on the decision made by the FAA.
2. The Airport was involved in a FAR Part 139 obstruction removal project and discovered a pole sign located approximately one half-mile from the end of Runway 7L. The Airport had not been contacted by the developer or the FAA, but suspected that the sign was a potential obstruction. The study revealed that the sign, along with numerous trees were potential hazards to air navigation.
3. Construction began on a multi-story addition to a hospital located less than one mile north of Runway 16 without notification to the FAA. Upon filing a 7460 form, the developer received a "Notice of Presumed Hazard". The developer made some modifications to design involving air conditioning units and the FAA raised minimums by 12 feet on an approach to Runway 16.

The airport was surprised in all of these cases. Airport officials are now taking several steps to eliminate unexpected airport airspace and land use conflicts. The airport now monitors the FAA's OE/AAA website to learn about 7460-1 notices in the area. The airport also uses Google Earth to check coordinates on 7460-1 notices, to verify accuracy. Finally, the airport is preparing a "self assessment" guidebook to provide to land developers in the airport area. The guidebook will be presented to developers early in the development review process to help guide them through the airspace protection aspects of the review process (Figure D.6).

Airport Description

DAB began operating at its present location in 1930. The Airport was established by the City of Daytona Beach, first as an entertainment source for the city's tourists, and evolving into an airport that provides many services to the local community and region. The Airport was transferred from the City to Volusia County in 1969 and has remained a county-owned and operated airport since that time.

DAB currently operates two terminals for domestic and international air carrier service. The international terminal is touted for its capacity as an international trade port location with



SOURCE: Google Earth

Figure D.6. Daytona Beach International Airport and surrounding jurisdictions.

a Federal Inspection Services Complex, Foreign Trade Zone location, and nearby warehouses. The airport's general aviation activity includes corporate and business aviation along with significant flight education activity—notably, the Embry-Riddle Aeronautical University located on the northeast side of the airfield.

In Fiscal Year 2007, DAB facilitated 333,538 air carrier and commuter passenger enplanements, and 303,591 aircraft operations (FAA Terminal Area Forecast, December 2008). DAB serves as a significant general aviation venue, with 213,686 itinerant and 77,758 local general aviation operations in Fiscal Year 2007. DAB operates three runways. The longest runway, 7L-25R, is 10,500 feet long; runway 16-34 measures 6,001 feet; and runway 7R-25L is 3,195 feet (Figure D.7).

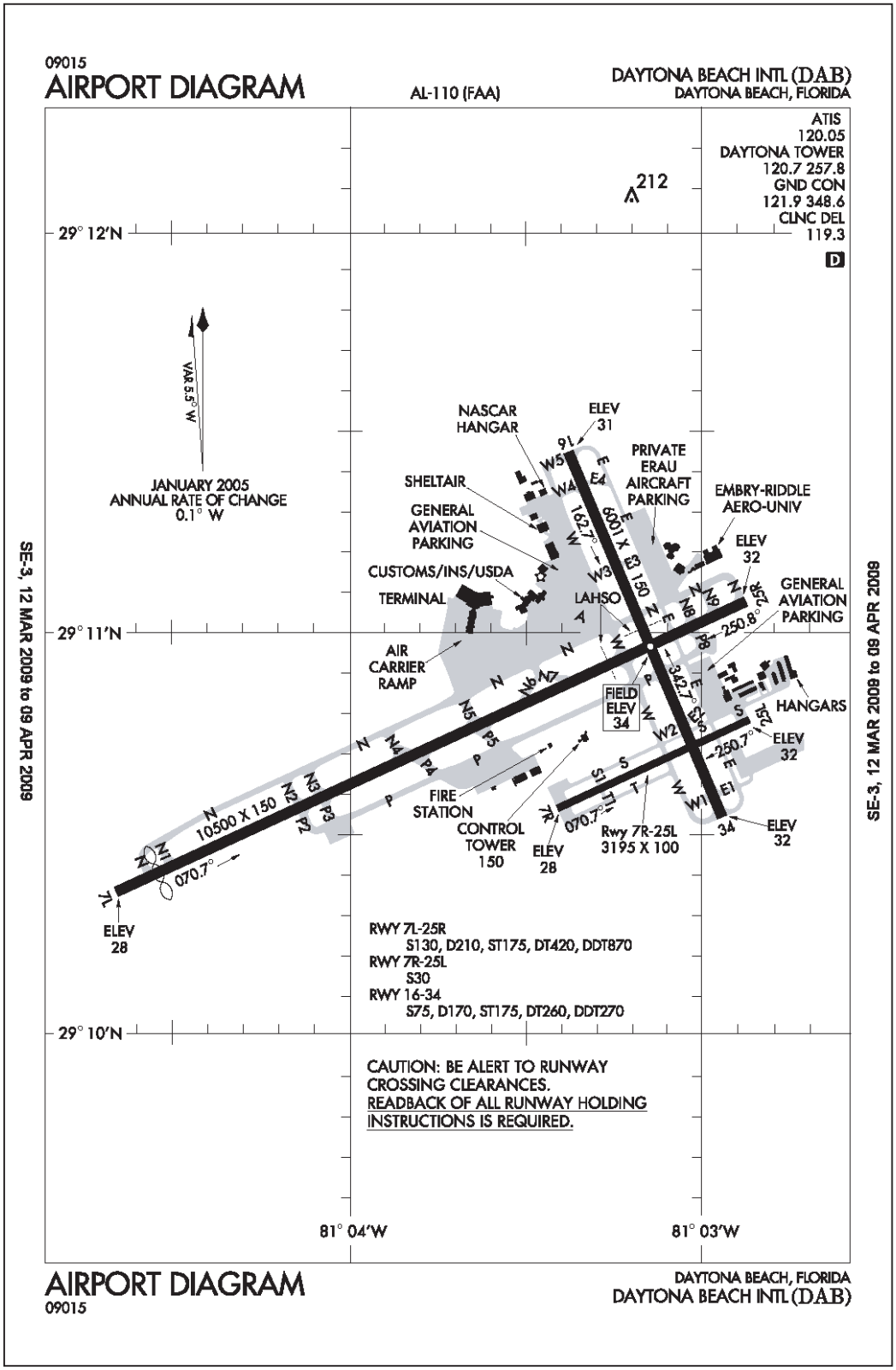
Surrounding Communities and Land Use

DAB is positioned three miles southwest of the City of Daytona Beach central business district. The airport property lies entirely within the City of Daytona Beach, with South Daytona to the southeast and Daytona Beach Shores to the east. Additional jurisdictions that are contained by the 20,000 feet, 100:1 notification requirement area under FAR Part 77 are Holly Hill to the northeast and Port Orange to the southeast (Figure D.8).

DAB is adjacent to significant single family and multi-family residential development, especially to the east and south of the airfield, but also with some scattered development to the north and west. Also present near the airfield is the Daytona International Speedway to the northwest, Embry-Riddle Aeronautical University to the northeast, and retail shopping centers, including the Volusia Mall, to the north of the property. Also in the airport's vicinity are hospitals, several colleges and schools, parks, public service and safety facilities, and cultural and arts facilities. A large area west of the airport is the undeveloped Tiger Bay State Forest.

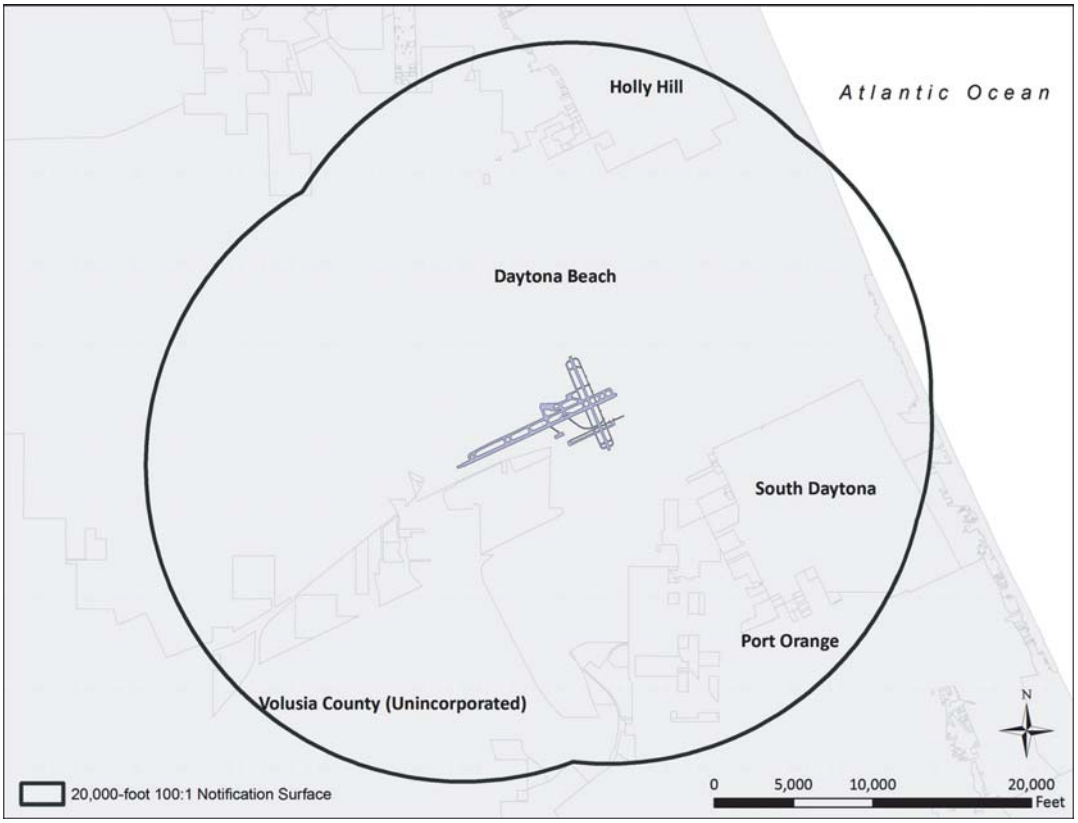
State, County and Local Statutes and Ordinances

The State of Florida. Effective in 2004, the Florida Administrative Code was revised to include rule 14-60.009, *Airspace Protection.* The rule requires any development that would exceed FAR Part 77 height limitations (described as 77.21, 77.23, 77.25, 77.28, and 77.29) and that is within ten



SOURCE: www.naco.faa.gov

Figure D.7. National Aeronautical Charting Office (NACO) diagram of Daytona Beach International Airport.



SOURCE: GIS Data compiled from Volusia County Geographic Information Services

Figure D.8. The 20,000′ 100:1 notification surface for Daytona Beach International Airport covers parts of the City of Daytona, Volusia County, South Daytona, Port Orange and Holly Hill. ***Notification area estimated from airport center point.**

nautical miles of a public airport, to obtain a permit from the state's Department of Transportation (DOT). Permit applications are reviewed by the department's Airspace and Land Use Manager who uses the Florida DOT form 725-040-11 (rule 14-60.011 in the FAC) to review ten considerations:

1. The nature of the terrain and height of existing structures.
2. Public and private interests and investments.
3. The character of flying operations and planned developments of airports.
4. Federal airways as designated by the FAA.
5. Whether the construction of the proposed structure would cause an increase in the minimum descent altitude or the decision height for an instrument flight procedure at the affected airport.
6. Technological advances.
7. The safety of persons on the ground and in the air.
8. Land use density.
9. The safe and efficient use of navigable airspace.
10. The cumulative effects on navigable airspace of all existing structures identified in the applicable jurisdictions' comprehensive plans, and all other known proposed structures in the area. (FAC, Rule 14-60.009, (1)(c)).

The rule gives authority to the state administrator to apply more stringent review than that mandated by federal regulation. In 14-60.009 (1)(d), the department is given the power of authority to deny an application, regardless of an FAA decision that the structure does not "exceed federal

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obstruction or any other federal aviation regulation." The state department of transportation is also given review authority over local applications for variances from airport zoning ordinances [14-60.009, (2) and (3)].

Furthermore, Florida Statute Title XXV, Chapter 333, *Airport Zoning* provides greater state level restrictions on navigable airspace protection and airport hazards. 333.02 (1) provides that,

> [i]t is hereby found that an airport hazard endangers the lives and property of users of the airport and of occupants of land in its vicinity and also, if of the obstruction type, in effect reduces the size of the area available for the taking off, maneuvering, or landing of aircraft, thus tending to destroy or impair the utility of the airport and the public investment therein.

333.01(3) defines an "Airport Hazard" as,

> any structure or tree or use of land which would exceed the federal obstruction standards as contained in 14 C.F.R. ss. 77.21, 77.23, 77.25, 77.28, and 77.29 and which obstructs the airspace required for the flight of aircraft in taking off, maneuvering, or landing or is otherwise hazardous to such taking off, maneuvering, or landing of aircraft and for which no person has previously obtained a permit or variance.

333.02 also declares airport hazards as a public nuisance that should be prevented, "to the extent legally possible, by the exercise of the police power, without compensation" (333.02 (1)(c)).

Chapter 333.025 makes the permit requirement, described above as part of the Florida Administrative Code, a statutory requirement. Chapter 333.03 requires "every political subdivision having an airport hazard area within its territorial limits shall . . . adopt, administer, and enforce, under the police power . . . airport zoning regulations for such airport hazard area" (333.03 (1)(a)).

Volusia County. Volusia County owns and manages the Daytona Beach International Airport and provides the operating requirements of the airport in Chapter 18, Article II of the Volusia County Land Development Code. In Chapter 18, Article I, Volusia County requires an airport zoning commission to ensure compliance with Florida Statute, Chapter 333, described in part above.

City of Daytona Beach. The Daytona Beach Land Development Code provides height restricted classifications pursuant to Florida Statute 333 (Daytona Beach Land Development Code, Chapter 18, Section 6.4). The code requires the city to maintain an airport hazard map, which, in conjunction with FAR Part 77 requirements, guides evaluation of proposals to ensure compliance with the state's statutory requirements.

Other Neighboring Jurisdictions. Any political subdivision with an airport hazard area within its jurisdictional boundaries is required to establish airport-zoning regulations in the State of Florida.

Summary of Interview Regarding Airspace and Land Use Issues

The Daytona Beach International Airport is located in a state with uniquely stringent airspace statutes. It is especially important that political subdivisions of the state—counties and municipalities—are required to provide ordinances that will protect against unsafe airspace hazards and protecting the use of navigable airspace. Despite this statutory requirement that local jurisdictions build their development review processes based on the consideration of airspace and land use interactions, many jurisdictions have not incorporated any such protections into their ordinances, which presents challenges to airport managers. DAB management understands the need to be proactive in dealing with local airspace issues.

Based on discussions with DAB representatives, there are gaps in lines of communication that have led to several issues in recent years. This case study shows evidence that communication of accurate information is of great importance to the effectiveness of airspace protection

regulations. DAB experienced a number of actions with direct implications for the airport and its safe and efficient operation, of which they were not notified. DAB also received what seemed to be conflicting information from the FAA. Recently, DAB has developed a proactive position in dealing with airspace and land use issues. The airport has adopted several readily available modern technologies as tools for strengthening this position, and attempting to avoid future conflicts.

GPS Approaches in Runways 7R-25L and 16-34

Runway 7R-25L is 3,195 feet long and is used primarily for local flight training activity. Runway 16-34 is a 6,001-foot crosswind runway, used to relieve the primary runway (7L-25R), for capacity and wind coverage purposes, and can support aircraft sizes up to certain narrow body commercial aircraft.

In [*month,*year], the FAA established GPS approaches to Runways 7R, 25L and 34. This technology change altered the runways' classifications from visual to non-precision GPS instrument runways. The Airport understood that non-precision approaches have different airspace protection surface standards (encompassing a larger, lower area) than visual approaches under FAR Part 77 regulatory standards.

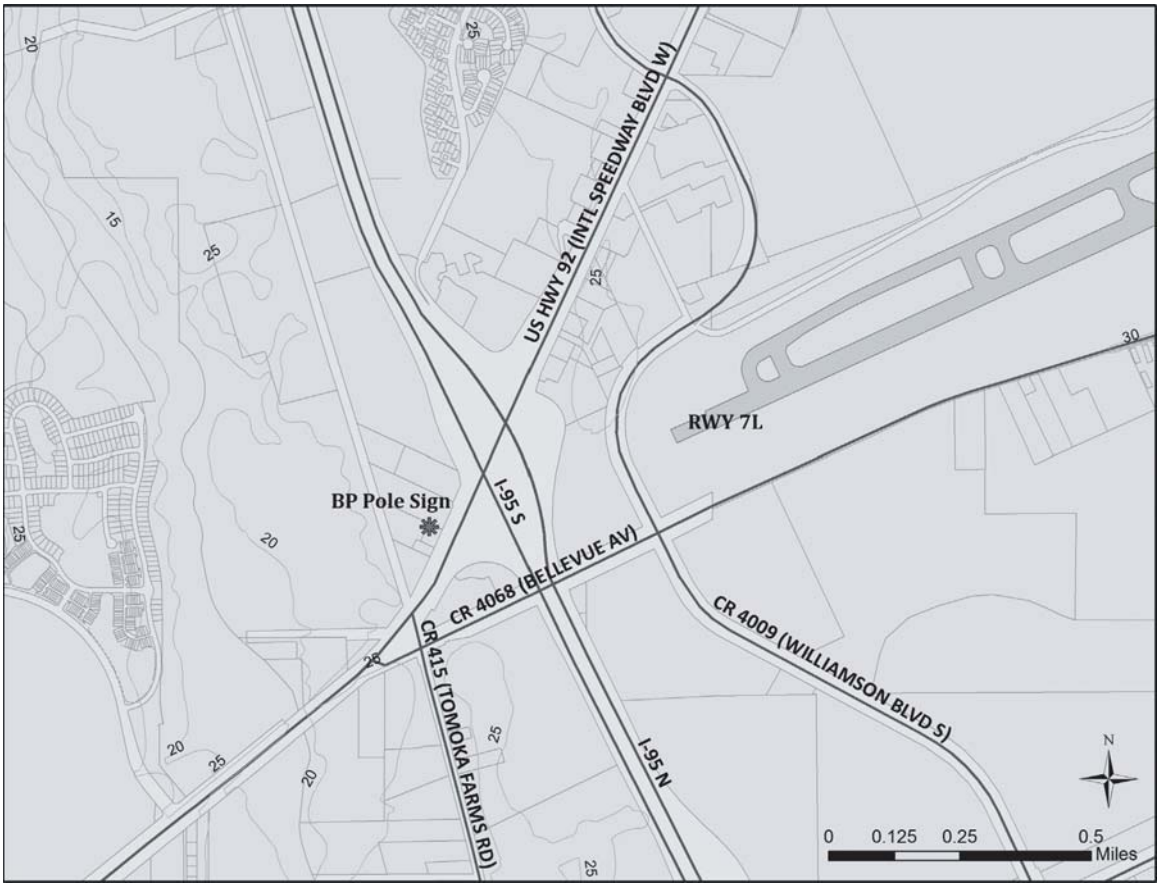
During a FAR Part 139 standard certification maintenance inspection, the FAA inspector noted that due to this change, the 20:1 approach slopes as defined in FAR Part 77.25 had become 34:1 due to the newly established non-precision approach procedures. The Airport was already involved in an obstruction removal project but because of this expanded clearance area, a more significant amount of obstruction removal was required. Most of the removal included trees on the airport property, but the tree removal also affected several private properties. The widened primary surface (from 250 feet to 500 feet wide) caused by the new non-precision status altered the starting position of the associated 7:1 transitional surface, which in turn created a potential conflict with proposed hangar development.

The Airport submitted an airspace study checklist to the Airport District Office (ADO) for the proposed development and were surprised to learn that 20:1 is the appropriate approach slope for Runway 7R/25L, even though the GPS approaches were published and active. When questioned, the ADO explained that approach slopes are determined by more factors than simply approach types. According to the FAA's AC 150/5300-13, *Airport Design* (Change 12, Appendix 2 *Runway End Siting Requirements*), the use of Runway 7R-25L for only "small aircraft" (maximum certificated takeoff weight <12,500 pounds) classifies it as a "utility" runway. As a utility runway, the 20:1 approach slope is appropriate, whether it has a visual or non-precision approach.

Interestingly during this process of soliciting guidance from the Part 39 Inspector, Runway 34, which is not a utility runway, was also confirmed to have a 20:1 approach slope. The airport expected that Runway 34 would have a greater clearance area and a 34:1 approach slope. Airport staff questioned whether the approach is a "non-solid state" approach (not utilizing any ground based localizer or VOR instruments), allowing for the less expansive 20:1 slope. Once the Airport provided the Part 139 inspector with more detailed information regarding this runway, the determination was made that Runway 34 should have a 34:1 approach slope, as required by Part 77 for all non-precision runways that serve large aircraft (maximum certificated takeoff weight > 12,500 pounds).

Pole Sign Off of Runway 7L

Surveys conducted as part of the Airport's Part 139 obstruction removal project indicated that a gas station pole sign next to Interstate 95, about one half-mile off the end of Runway 7L was a FAR Part 77 penetrating obstruction (Figure D.9). Runway 7L is the airport's primary runway, measuring approximately 10,500 feet long, and operating as a precision instrument runway (Category I Instrument Landing System).



SOURCE: GIS data compiled from Volusia County Geographic Information Services. Coordinates for pole sign obtained from oeaaa.faa.gov

Figure D.9. The BP pole sign is located in the approach to Runway 7L. The sign is approximately a half-mile from the runway end, just west of Interstate 95. The sign is 109 feet Above Mean Sea Level.

The Airport could find no record of an airspace study being done for this sign and thus submitted a 7460-1 (Aeronautical Study No. 2007-ASO-6451-OE) to the FAA for review. The FAA issued a "Determination of No Hazard to Air Navigation" as a result of their study. The ADO explained that Part 77 was not used in their determination. The Airport's consultants advised they had always used Part 77 in identifying and removing obstructions. The Airport then contacted the ADO for further clarification. The ADO explained that Part 77 is intended to identify obstructions that penetrate the surfaces described in that regulation. The criteria are for reporting purposes only, which triggers further study. The criteria applied in the study are the FAA's threshold siting requirements, from FAA AC 150/5300-13 *Airport Design* (Change 12, Appendix 2, *Runway End Siting Requirements*) and TERPS. Although it seemed contradictory, it was absolutely appropriate that the sign was classified as an obstruction according to Part 77 guidelines but it was deemed not to be a hazard when design criteria were applied in further aeronautical study.

During this process, the Airport discovered the FAA's OE/AAA website (oeaaa.faa.gov). Now the airport uses this website regularly, for information when a 7460-1 form is filed in the airport area. In addition to the OE/AAA website, the airport began using Google Earth as a tool to verify coordinates reported on relevant 7460-1 forms.

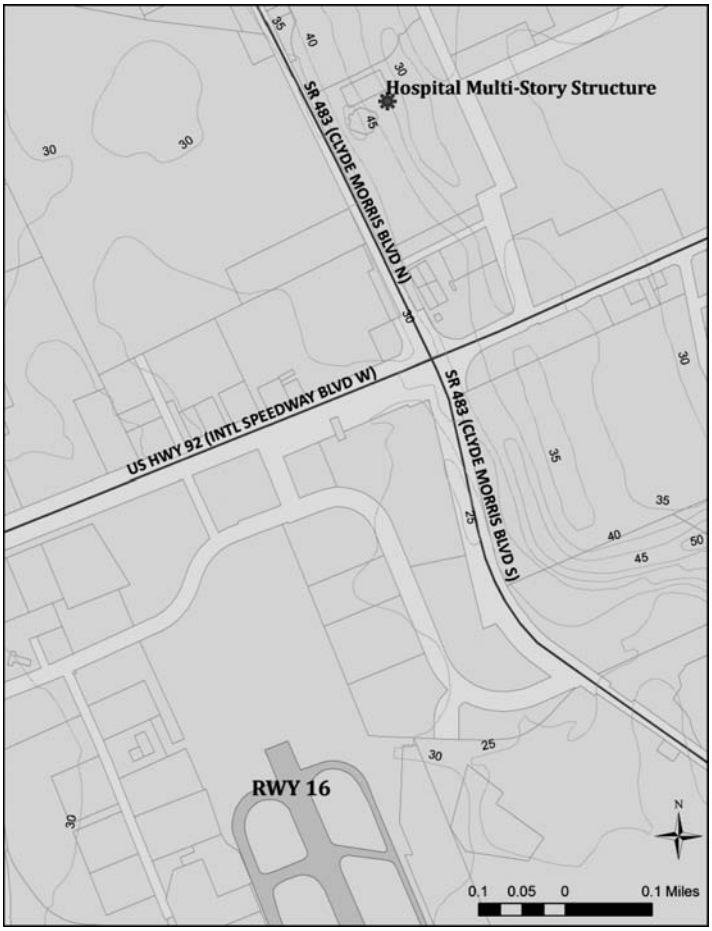
This project also prompted the Airport to become much more knowledgeable in the area of obstruction identification and evaluation. FAR Part 77 is used to identify obstructions, which

are then studied using different criteria, such as TERPS and AC 150/5300-13, to evaluate whether they are hazards to air navigation. If one were to remove all FAR Part 77 identified obstructions, many more obstructions would be removed than necessary, because many may not be hazards.

Hospital Construction

Construction of a multi-story hospital facility less than one mile north of Runway 16 began without a 7460-1 notice being filed, and, consequently, without an airspace study (Figure D.10). The multi-story hospital facility, part of a major expansion to the current facility, is located within the jurisdiction of the City of Daytona Beach, while the airport is under the jurisdiction of Volusia County. The city building permit process did not include airspace study requirements at that time. The airport became aware of the proposed height of the structure when the developer asked the airport to issue a Notice to Airmen (NOTAM) for several construction cranes.

The Airport conducted an informal review of the development and was concerned that DAB airspace may be adversely impacted. The City confirmed that a Development Order and permits had been issued. An internet search indicated that an airspace study had not been performed. The Airport began contacting various agencies and officials for guidance. The FAA suggested



SOURCE: GIS data compiled from Volusia County Geographic Information Services.

Figure D.10. The hospital multi-story structure is approximately 0.8 miles from the end of Runway 16 and approximately 1 mile from the airport reference point. The structure is 230 feet Above Mean Sea Level.

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that a 7460-1 be submitted, but indicated that they had no enforcement authority over off-airport development, which is considered a local issue. The Florida Department of Transportation (FDOT) Aviation Office's legal department indicated that no permit had been requested from FDOT. Since the City did not have airspace protection ordinances, FDOT had the authority to issue an injunction, which would halt development. However, the hospital expansion had significant local and statewide economic and political significance, and such an action would not be beneficial to the community in the end.

The developer filed a 7460-1 notice at this time, although construction had already begun. The FAA's determination was a "Notice of Presumed Hazard", which led to a public circularization process. During the 60-day public comment period, only the airport and FDOT filed comments. The airport notified all air-side tenants and the FAA Air Traffic Control Tower (ATCT) regarding the development and public comment period but none elected to respond. The airport's comment stated, "Creation of this obstruction will require operational changes to the management of airspace around Daytona Beach International Airport that will negatively impact operational efficiency, air navigation and safety without collateral benefit to the public."

Because of this air safety concern, the developer modified design to lower an external air conditioning unit from the roof of the building. The FAA issued a "Determination of No Hazard to Air Navigation" (Aeronautical Study No. 2008-ASO-884-OE). One TERPS procedure on Runway 16 (LNAV/VNAV Final Descent Altitude) was raised from original 472′ AMSL by 12′ to 484′AMSL.

In an effort clear up some of the confusing issues surrounding the OE/AAA process, Airport officials chose to do detailed research, rather than rely solely on consultants, in an effort to thoroughly understand the airspace process and ensure that all appropriate proactive steps were taken. Through this research, the Airport gathered what at first appeared to be conflicting information, but later came to an understanding that different criteria are applied at different stages of the review process. An example of this would be if an object penetrates the airport's 20,000-foot radius 100:1 slope from the 7460-1 form. If this occurs, then the object's location is determined in relation to the FAR Part 77 obstruction identification criteria. If the object penetrates the obstruction identification criteria a different set of criteria applies, such as the threshold siting requirements or TERPS requirements. This evaluation criteria is necessary to ensure that an object is thoroughly reviewed in order to assess potential hazard implications.

One of the airport's principal observations and concerns is the need for improved communication between parties involved with airspace/development issues, especially regarding the OE/AAA process. The Airport was not involved with proposed structures in the vicinity. The airport recognized how important communication with the surrounding jurisdictions is and took steps to improve the process. This will be enhanced by distributing an airspace protection guidebook to neighboring municipalities.

In response to DAB's interest for more inclusion in the OE/AAA process, the FAA indicated there was no mechanism in place to directly notify the airport regarding local airspace issues beyond the existing general email notification system. The Airport has learned that it needs to be very proactive in monitoring the OE/AAA website to watch for ongoing 7460-1 submissions. Even with monitoring, there are few details regarding the proposed development until after an official determination has been posted.

The Airport has learned that the FAA offers guidance and opinions, and it is up to the local jurisdictions, supported by the FDOT, to enforce the regulations. DAB has developed appropriate relationships and procedures, and has become very proactive in researching any proposed development, noting the need to either submit a 7460-1 or conduct an airspace checklist (if development is on airport property), verifying all data, and opening communications with other local jurisdictions. The City of Daytona Beach agreed and implemented a system whereby no Development Orders or permits would be issued that did not include a "Determination of No

Hazard", through an airspace study or documentation from the OE/AAA website that the study is not required. The Airport is included in the review process for all development plans that require study. Of course, these activities all rely on other parties and their adherence to the principles, laws and regulations that govern airspace protection.

Interestingly, the State of Florida has rather stringent and detailed airspace statutes—including a requirement that all political subdivisions include air hazard prevention within their local codes. Despite the state level statutory mandates, DAB experienced conflicts between airspace and development, just as many other airports across the country. The airport hopes that, by using existing tools and developing new ones, it can improve the process. It seems clear that a certain degree of cooperation and communication between the airport, political subdivisions, state and federal officials, developers and other stakeholders—with or without regulations—may be critical in improving the system in future years.

Oakland International Airport

Executive Summary

Oakland International Airport ("OAK" or "the Airport") is located in an area of Oakland, California where prevailing zoning does not typically allow for tall structures. The Airport is adjacent to the San Francisco Bay. The Airport and the busy seaport occupying much of the surrounding land and water are owned and operated by the Port of Oakland ("the Port"). Among the Port of Oakland's activities is the operation of a container shipping facility at the seaport, which requires the use of tall maritime cranes. (Figure D.11). The Port has additional land holdings and real estate development operations throughout the city. Partially due to its assortment of holdings and operations, the Port has had a particular challenge with coordinating internal land use decisions that may impact airspace. This challenge has been largely addressed through strengthening the Port's internal communications, and by developing airspace protection-related internal policies.

An airspace protection function was established within the Port's Aviation Planning department. The airspace protection function at OAK includes three key components for enhancing communication:

1. Established responsibility for airspace issues, centralized in a single department with a single point of contact
2. Training and education of all internal airport staff
3. Education of external stakeholders, such as municipal planners and local developers

An issue that allowed a conflict to arise at OAK was reliance on FAR Part 77 imaginary surfaces, as depicted in their Airport Layout Plan (ALP) set, as the only critical aeronautical factor in land use planning decisions. In the process of planning for new maritime cranes, the Port discovered that airspace criteria were not limited to FAR Part 77 imaginary surfaces alone, and that the FAA would make obstruction and hazard determinations based on other criteria as well. Initially, it was assumed that a newly purchased maritime crane would receive a 'Determination of No Hazard', because it would not penetrate the FAR Part 77 imaginary surfaces. An FAA Form 7460-1 was filed. As the crane was being shipped across the Pacific Ocean, it received a 'Determination of Presumed Hazard'. The determination was based on instrument procedure (TERPS) surfaces, which were in this case lower than the FAR Part 77 imaginary surfaces. This surprise prompted OAK to investigate the matter further, and develop an aeronautical surface mapping tool which included both FAR Part 77 and TERPS surfaces. The tool was developed to improve accuracy in estimating the same aeronautical criteria as used in the FAA's determinations for future development projects.

The OAK case study provides insight on an agency that has enhanced its internal strategy for communicating airspace protection issues, and has expanded its knowledge of its airspace through including both TERPS and FAR Part 77 criteria in its pre-planning considerations.

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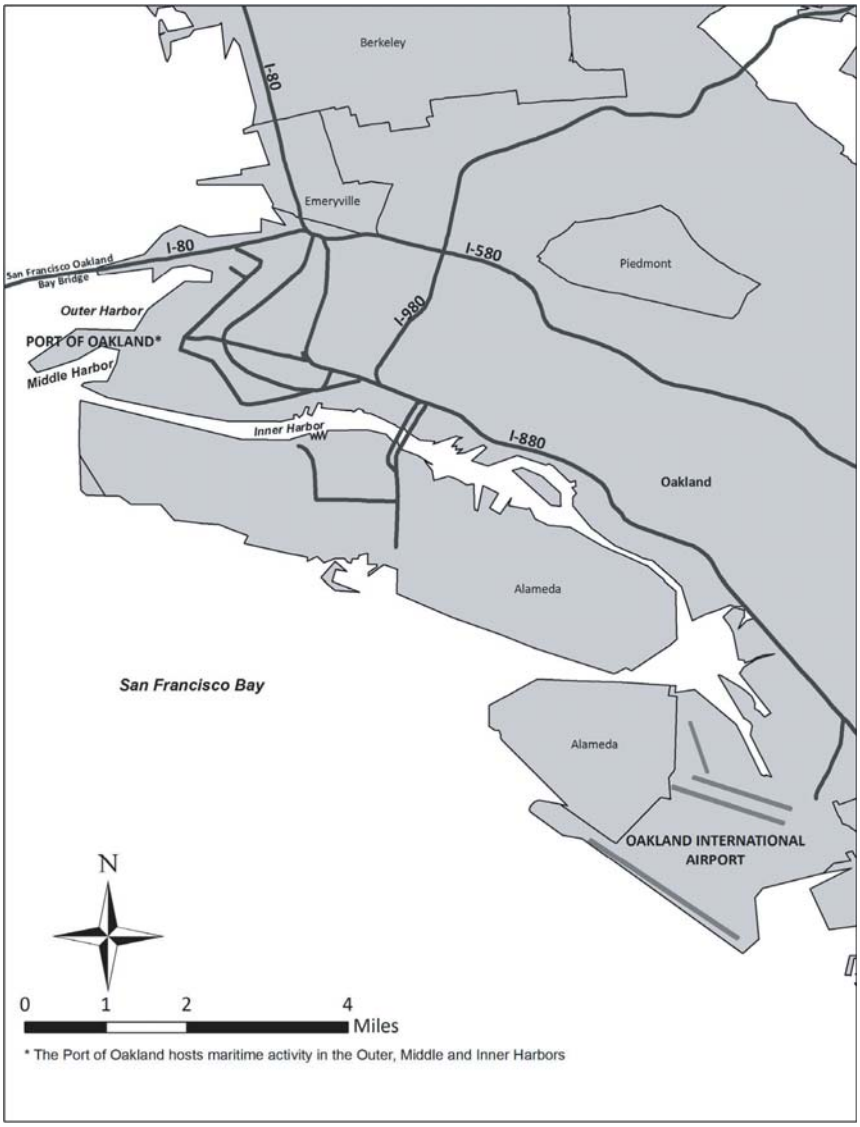

Figure D.11. Oakland International Airport, Port of Oakland and surrounding communities. Cranes are located in the areas noted Outer Harbor, Middle Harbor, and Inner Harbor.

Airport Description

Oakland International Airport began as a commercial service airport in 1927. The Airport has continued as a major air carrier service provider in the Bay Area, except for an interruption during World War II when the facility was converted entirely for military operations. In addition to international and domestic commercial air service, OAK hosts general aviation and cargo activity. The Airport is owned and operated by the Port of Oakland.

According to the FAA Terminal Area Forecast (TAF), December 2008, in fiscal year 2007 OAK saw 7,218,413 air carrier and commuter passenger enplanements and a total of 349,069 aircraft operations (takeoffs and landings). OAK operates two passenger terminals and four runways (Figure D.12). The longest, Runway 11-29, is 10,000′ × 150′, and is the primary runway for air carrier operations. The remaining three runways are used mostly for general aviation activity. Runway 9R-27L is 6,212′ × 150′; Runway 9L-27R is 5,454′ × 150′; and Runway 15-33 is 3,372′ × 75′.

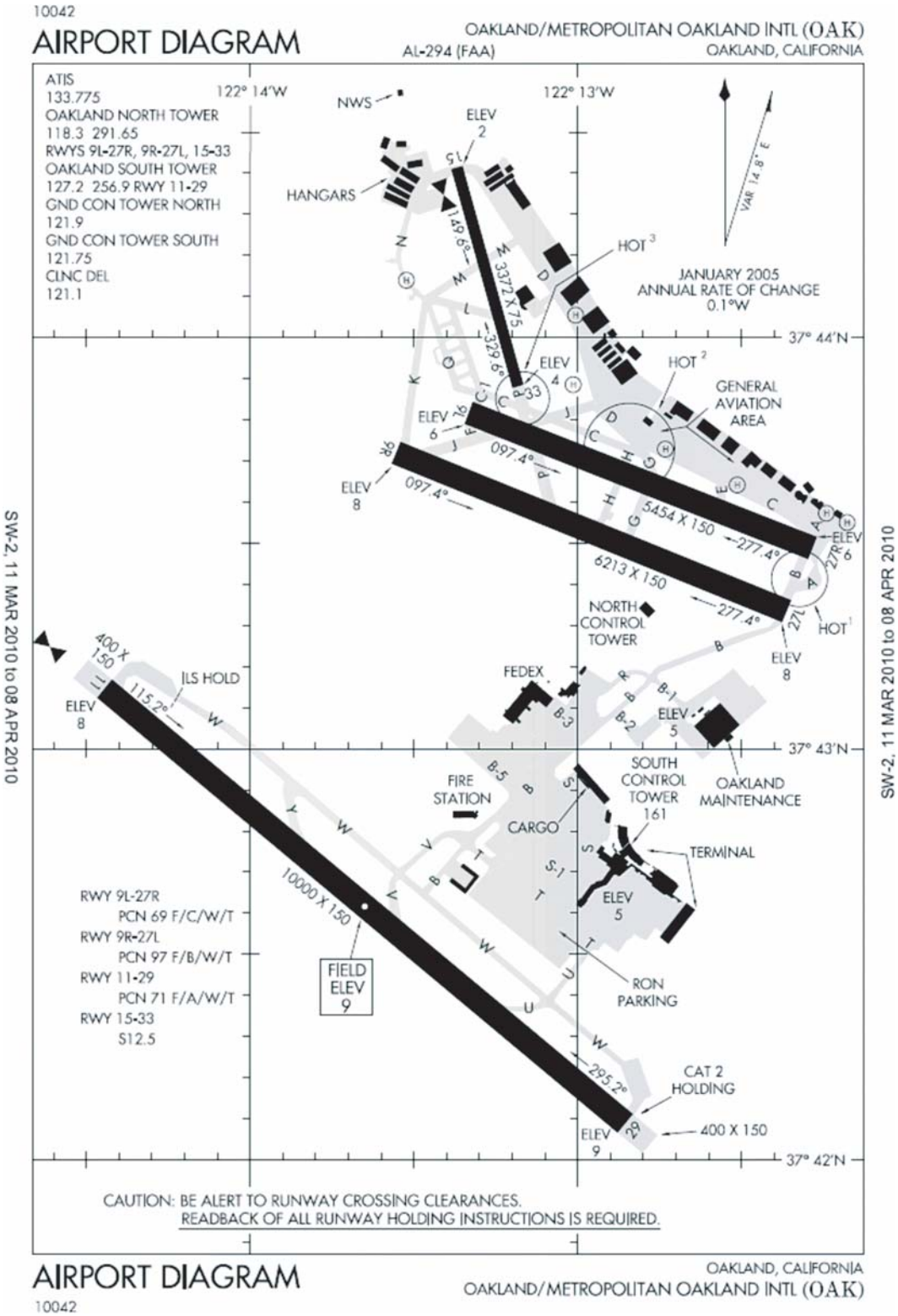

Figure D.12. Airport Diagram, Oakland International Airport (National Aeronautical Charting Office).

Surrounding Communities and Land Use

OAK is located entirely within the City of Oakland, in Alameda County, California. Downtown Oakland is to the north of the airport, Alameda is to the northwest, and San Leandro is to the east. West of OAK is the San Francisco Bay with the City of San Francisco on the opposite shore. The immediate Airport vicinity is zoned in various designations including general industrial and transportation, open space, regional commercial, and residential. These land use designations generally do not indicate significant challenges between vertical land development and airspace. However, the Port of Oakland is a major seaport, which is host to numerous maritime cranes that are significant, tall, movable structures, aligned with the approaches to Runways 9L, 9R, and 11.

State, County, and Local Statutes and Ordinances

The State of California. In the State of California, property owners are granted rights to the land including "free or occupied space for an indefinite distance upwards as well as downwards, subject to limitations upon the use of airspace imposed, and rights in the use of airspace granted, by law" (California Civil Code, Section 659). The limitations to the use of airspace above a property are further defined in other portions of the State code.

California Public Utilities Code (sections 21655-21660) includes building height requirements that reflect the obstruction standards in FAR Part 77, and also refer to relevant FAA hazard determination standards. These code sections require:

- That all State property acquisitions within two miles of any airport submit notice to the Department of Transportation for review.
- That any structure taller than 500 feet cannot be built without a State permit, and that the State may refuse a permit if the proposed structure "would obstruct the airspace overlying the State so as to create an unsafe condition for the flight of aircraft".
- That no new or modified structures, or natural growth is allowed, without permit from the State if they are an obstruction to air navigation, according to FAR Part 77; unless the FAA finds that the structure is not a hazard to air navigation or that it would not create an unsafe condition for air navigation.

California established an Aeronautics Fund in its Public Utilities Code, which creates an airspace contingency for airports seeking financial support from the State:

> No payments shall be made from the Aeronautics Account for expenditure on any airport or for the acquisition or development of any airport, if the Department determines that the height restrictions around the airport are inadequate to provide reasonable assurance that the landing and taking off of aircraft at the airport will be conducted without obstruction or will be otherwise free from hazards.
>
> Height restrictions shall be considered adequate if as a minimum they meet the obstruction standards of subchapter C of Part 77 of the Federal Aviation Regulations of the Federal Aviation Administration, as these standards apply to civil airport imaginary surfaces related to runways.
>
> The airport-owning entity shall have sufficient control over obstructions in the airspace in the vicinity of the airport to assure that height restrictions can be maintained. This control may be in the form of ownership of any land from which obstructions may rise, air navigation easements to guarantee maintenance of restrictions, or height limitation or land use zoning which will prohibit obstructions which would violate the obstruction standards" [California Public Utilities Code, 21688 (a)].

There is also a deed notification requirement for transferred properties within an "Airport Influence Area", which mandates notice to the property purchaser that airspace protection, among other things, "may significantly affect land uses or necessitate restrictions on those uses as determined by an airport land use commission" [California Civil Code, 1353 (a) (2)].

Furthermore, Article 50485 of the California Government Code declares *airport hazards*—defined as "any structure or tree or use of land which obstructs the airspace required for the flight of aircraft in landing or taking off at an airport or is otherwise hazardous to such landing

or taking off of aircraft"—as *public nuisances,* which grants local jurisdictions throughout the State the authority to prevent the creation of airport hazards through prescribed airport zoning regulations. City or county level airport zoning is voluntary, and this section of the State law provides a framework for these jurisdictions to adopt, enact, and implement such statutes and gives them the power to do so. The California Public Utilities Code sections 21670-21679.5 mandate a minimum level of airport planning foresight by requiring all counties containing at least one airport with at least one scheduled air service provider to implement an Airport Land Use Commission. Each commission is required to prepare and oversee an Airport Land Use Compatibility Plan. The Plan and the Commission itself is required to consider airspace protection, among other airport-related land use compatibility concerns (Figure D.13).

Alameda County. Alameda County has an Airport Land Use Commission, as mandated by California Public Utilities Code sections 21670-21679.5. The County has adopted an Airport Land Use Policy Plan.

City of Oakland. The City of Oakland planning code classifies airports as "General Industrial" land uses. The purpose of this zone is "to create, preserve and enhance areas of the City that are appropriate for a wide variety of businesses and related commercial and industrial establishments that may have the potential to generate off-site impacts such as noise, light/glare, odor, and traffic. This zone allows heavy industrial and manufacturing uses, transportation facilities, warehousing and distribution, and similar and related supporting uses. Uses that may inhibit such uses or the expansion thereof are prohibited. This district is applied to areas with freeway,

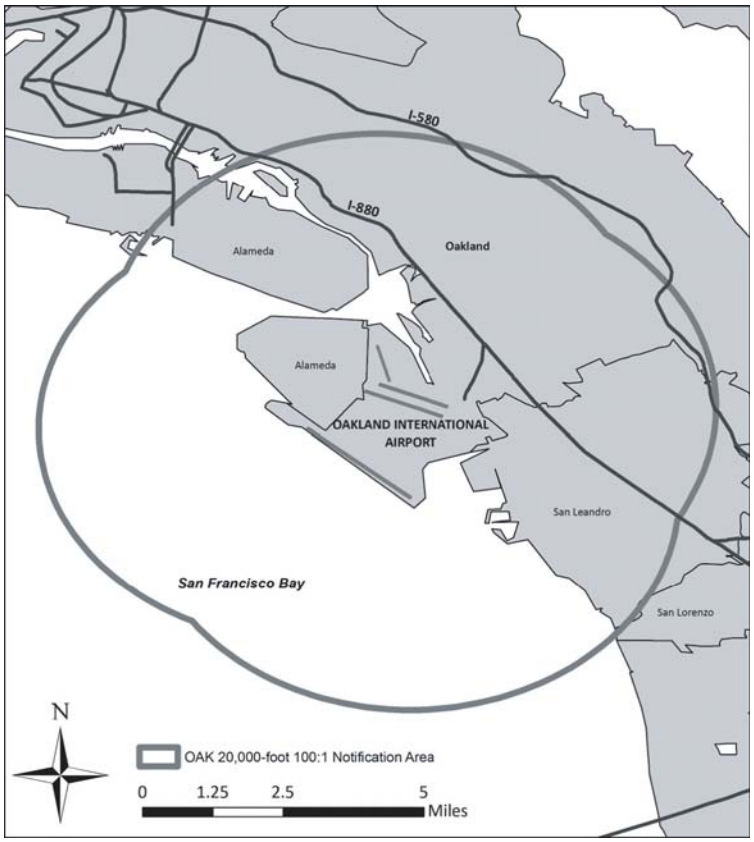

Figure D.13. Jurisdictions having territory within the OAK 20,000-foot 100:1 notification area are Oakland, Alameda, San Leandro, and a small portion of San Lorenzo.

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rail, seaport, and/or airport access" [17.73.010 (7) (C)]. Otherwise, the city has no explicit airport zoning ordinances.

Other Neighboring Jurisdictions. Article 16, Section 4-1676 of the San Leandro zoning code establishes an "Airport Safety Zone", which includes four safety elements including building height limitations. There are two airport safety 'rings'. First, within 1,400 feet of any runway end, "permanent structures or objects projecting above the level (elevation) of the primary surface of the runway" are not permitted. A second ring defined as an area between 1,400 and 5,300 feet of any runway end refers to FAR Part 77 as the building height limit. The code specifies compliance with "height restrictions on structures and facilities contained within FAR Part 77, including Subpart D". Presumably, this means that any of the criteria in FAR Part 77 may apply, including Subpart D, "Aeronautical Studies of Effect of Proposed Construction on Navigable Airspace". Finally, the code specifically suggests avoidance of "concentration of development along the extended runway centerline" and does not permit the construction of hazards to air navigation, as determined by the FAA.

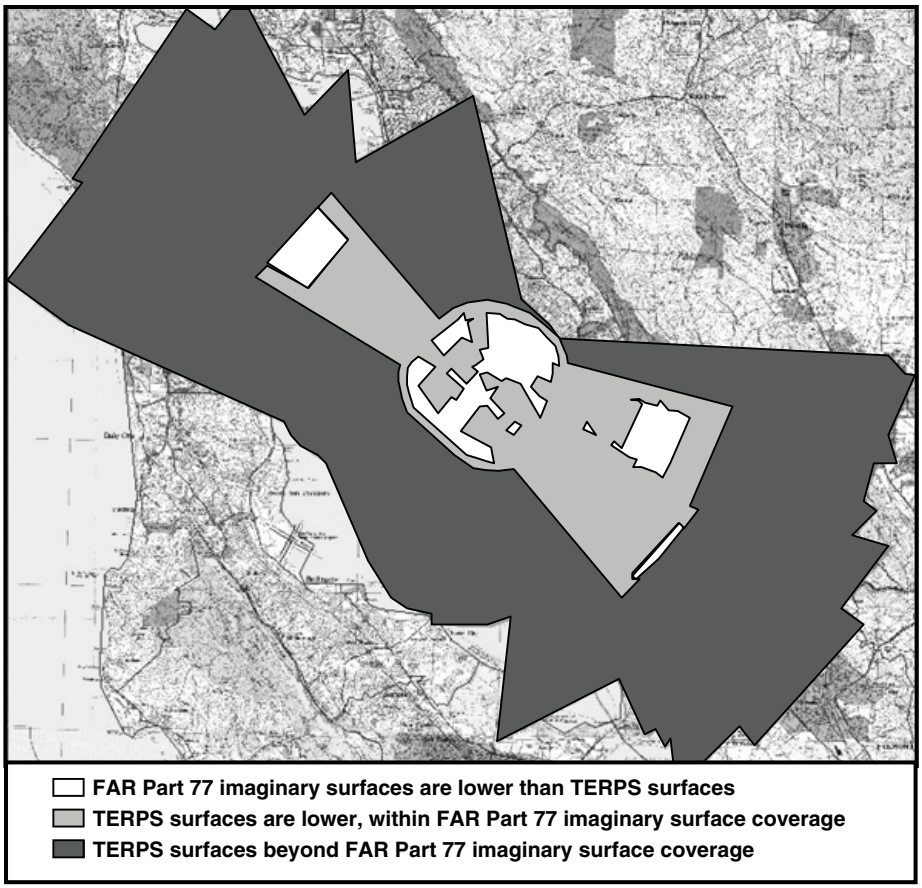
Airspace and Land Use Issues

The Oakland International Airport is in an area that is zoned light industrial, commercial, open space and residential. The San Francisco Bay is west of the Airport. Northwest of the Airport is the Port of Oakland, a major international intermodal trade hub. The Port of Oakland is also the Airport owner and operator. The land use activities near OAK are generally compatible with airspace; however, the airport is not immune from challenging airspace-land use conflict situations. The Port of Oakland owns much of the land in the airport vicinity, which allows for deliberate land use compatibility planning. Port of Oakland aviation planning staff members recognize the need to closely monitor activities, both on land and in water, which may affect airport airspace. For OAK, the biggest threat is missing the opportunity to review and influence the development of potentially incompatible structures. As a result, the Airport's position is proactive, to avoid a potentially serious conflict that may not be obvious early on.

Port staff developed an internal strategy to develop tools to encourage understanding of airspace protection near the airport. Previously, the Airport did not have an established process for the obstruction evaluation and airport airspace analysis (OE/AAA) process for on- or off-airport projects. However, as the Airport began to experience airspace protection incompatibility issues, staff was prompted to implement policies to clarify the process and procedures to promote a consistent approach for handling airspace protection within each department at the airport.

Many of the issues with airspace at OAK are internal to the Port of Oakland due to its adjacent maritime and real estate activities. For this reason, the initial effort for addressing airspace protection was internally focused. The Port identified the Aviation Planning department as the appropriate 'point department' for airspace issues. The overarching goal was to concentrate the expertise on airspace protection in one area of the organization. This expertise was to be disseminated broadly through training and education, to ensure that each staff member in the organization would be able to identify a potential airspace issue and would know whom to inform.

Having the airspace protection within the Aviation Planning department was also viewed as advantageous because airspace issues are often tied to future planning. For on-airport projects, planning staff are well equipped to identify projects in the ALP that may have an effect on airspace. The interview respondent cautioned, however, that the ALP, which includes the civil airport imaginary surfaces from FAR Part 77.25, does not include every surface used to identify obstructions and hazards. Beyond the civil airport imaginary surfaces, FAR Part 77 defines several other obstruction standards, and depending on location, terminal instrument procedures (TERPS) surfaces are often lower and/or have wider coverage areas than FAR Part 77 imaginary surfaces. As seen in Figure D.14, this is the case at OAK.



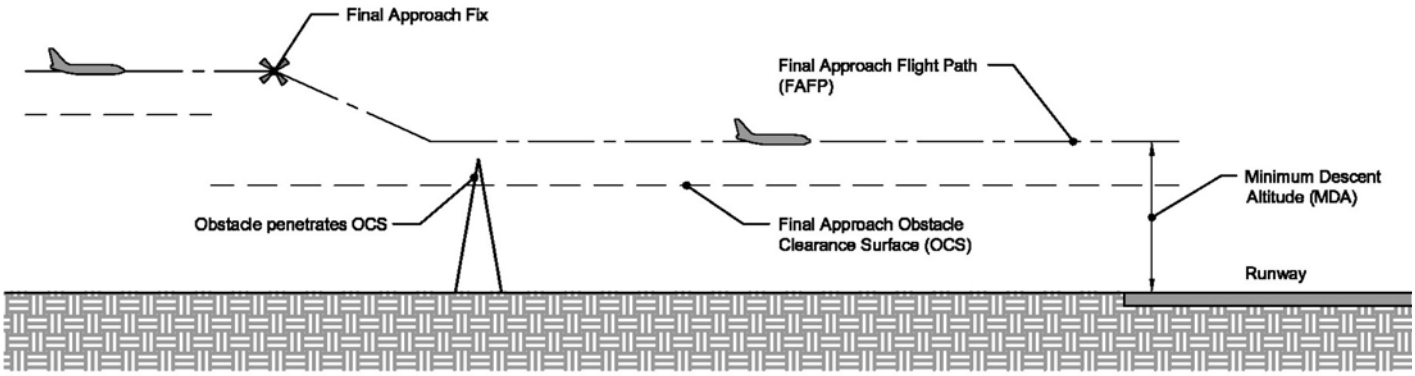
SOURCE: Adapted from Ricondo & Associates, Port of Oakland

Figure D.14. While FAR Part 77 imaginary surfaces are sometimes the lowest surface around an airport, thus guiding the FAA's determination on a proposed structure, there are some instances when TERPS surfaces are lower.

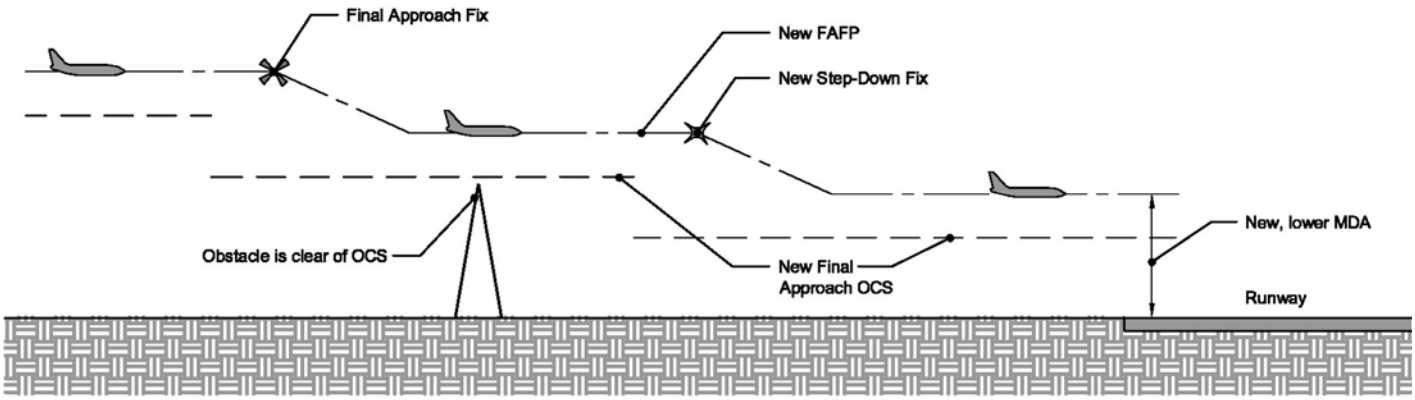
One incident in particular revealed this situation at OAK. A tenant at the Port of Oakland purchased a maritime crane proposed to be located alongside several existing maritime cranes, approximately 6 miles northwest of the Airport. Review of the FAR Part 77 imaginary surfaces as mapped in the ALP set indicated that the crane would be below the FAR Part 77 imaginary surfaces. An FAA Form 7460-1 notice for the new crane was filed with the FAA. To the surprise of Port staff, a 'Determination of Presumed Hazard' was received based on TERPS surface penetrations, for non-precision approaches to Runways 9L and 9R. The Aviation Planning department was asked to assist with the FAA notification requirements. Subsequently, the Port and their consultant team mapped the FAR Part 77 imaginary surfaces and TERPS surfaces, showing that FAR Part 77 surfaces were not always the critical (lowest) surface. Based on a more thorough evaluation of the Port tenant's proposed crane, it was learned that other Port-owned cranes may also constitute an obstruction. While the Port had previously filed Form 7460-1 notices for these cranes, and received a 'Determination of No Hazard', they had filed using only a single set of geographic coordinates (latitude and longitude) and height, i.e. the large, mobile crane structure was analyzed as a single point in space. The Port notified the FAA about the possible obstructions. The FAA conducted an airspace study and issued a Notice To Airmen (NOTAM), temporarily raising the visibility minimums for the Runway 9R VOR instrument approach. Along with the realization that FAR Part 77 imaginary surfaces would not always be the lowest, most critical, or only surface by which the FAA would assess obstruction and hazard status, the Port also learned that reporting inaccurate or over-generalized coordinates on the Form 7460-1 notice could result in an unexpected determination.

A maritime crane is a unique structure. The crane in this example operated on a 1,000-foot rail with a boom that could be positioned in many angles, thus altering the position and height of the structure. While the Port of Oakland reported a single coordinate pair and a single structure height to the FAA, it was found that another possible location along the crane rail would be more critical than that which was reported. As a result, the Port of Oakland established a policy requiring the submission of multiple Form 7460-1 notices for a single complex structure, to include multiple positions possible in the structure's range of operation. The Port also requires that coordinates be reported with survey engineer's certification, in order to promote accuracy. The FAA now includes an option on the online Form 7460-1 notice submission to include multiple coordinates for a single structure.

The instrument procedure whose obstacle clearance surface would have been penetrated by the proposed crane is a non-precision approach with a long, flat final approach that begins several miles before the runway threshold. The potential conflict was resolved by the introduction of a "step-down fix", a point in space that divided the final approach obstacle clearance surface (OCS) into a higher initial area over the cranes, and a lower area closer to the Airport (Figure D.15). This was additionally facilitated by the new documentation of multiple objects that were not included in the obstacle database, which would also penetrate the OCS if left unchanged. The FAA calcu-



Before Introduction of Step-Down Fix - Obstacle Penetration



After Introduction of Step-Down Fix - Obstacle Penetration Removed

Figure D.15. Introduction of a step-down fix to a non-precision final approach.

lated that the minimum descent altitude (MDA) over the crane obstruction area would have to be raised to accommodate the existing (although heretofore undocumented) structures, and also calculated that these structures were positioned far enough from the Airport such that a step-down fix would be feasible to provide for the final segment close to the airport, thereby lowering the final segment MDA from 500 to 460 feet AMSL.

The Port of Oakland found it was a successful strategy to present the FAA with alternative adjustments to procedures, such as the step-down fix, that could mitigate the impact of the proposed object. However, it is not always feasible that an adjustment to the procedure exists that resolves the conflict. In most cases, the FAA does not redesign flight procedures to accommodate proposed development. In this case, the presence of existing structures (the maritime cranes) that penetrated the TERPS surfaces and the ability to reduce the visibility minimums on the last segment of the approach with the addition of the step-down fix resulted in a "win-win" scenario—accommodating the proposed crane and reducing the visibility minimums on the approach to the Airport.

From this series of events, three factors emerged. First, the Port realized the importance of internal understanding of airspace protection and coordination between departments. Second, the Airport learned the importance of understanding TERPS surfaces in addition to FAR Part 77 imaginary surfaces. Third, they realized the importance of accurate and comprehensive reporting of the coordinates, elevations, and heights of proposed structures, especially large and/or mobile structures.

Since many Port of Oakland development projects include departments other than aviation, it has been imperative that the agency enhance communication internally to improve coordination. The airspace protection function at OAK now includes three key components for enhancing communication:

1. Established responsibility for airspace issues, centralized in a single department with a single point of contact
2. Training and education of all internal airport staff
3. Education of external stakeholders, such as municipal planners and local developers

OAK staff believed that the communication effort could only be effective with a solid process in place. To develop a consistent process for airspace protection, OAK has developed a mapping tool, which aggregates the FAR Part 77 imaginary surfaces and TERPS surfaces in the airport area. The surface mapping tool does not include other criteria, such as airline defined one engine inoperative (OEI) procedure criteria. Additionally, the Port of Oakland has developed a guidance document, which describes the FAA OE/AAA process from start to finish, including specific directions for structure proponents. The guidance document, appended to the end of this Case Study, describes the process in a format that is helpful for communication and education of internal employees and external stakeholders.

The surface mapping software tool has also proven successful at OAK. With relevant FAR Part 77 and TERPS surfaces programmed into the software, it is relatively easy for airport staff to either find an optimal location for a particular development project, given the airspace constraints around the Airport; or to identify the probable maximum no-hazard building height at a particular location. While the surface mapping tool is not used in a binding regulatory capacity, it has been helpful in setting the Airport's expectations for building heights, both internally and externally. With the caveat that the surface mapping tool is not guaranteed to predict an FAA determination with complete certainty, it still has done an adequate job of bringing the airspace concern to the forefront of the development process.

Two important questions emerged related to the application of the surface mapping tool. First, it was decided that the software should remain 'local' at OAK, rather than providing the software as a live web application. Interpretation of the various airspace surfaces and their importance/affect is not always straightforward, so keeping the software within the department

most familiar with airspace prevents misinterpretation of the surfaces and criteria embedded within the program. Also, it requires internal and external proponents of new structures to contact the Airport for pre-planning input to the development process, which encourages early communication and awareness. Second, it was decided that the surface mapping tool would remain part of the Port of Oakland's internal policy and would not be implemented as a statutory requirement in any of the surrounding jurisdiction zoning ordinances. This leaves the tool open to changes in the Airport's operations and changes in federal regulations that could alter the surfaces over time. Also, it avoids any legal, social, or political complications in the event of inconsistencies between the local surface mapping tool and an FAA determination. Because TERPS instrument flight procedures and the criteria that define their protection areas change over time, the Airport must be committed to keeping the software up-to-date.

The Aviation Planning department and other departments within the Port of Oakland have worked to develop both policy and technical strategies to protect airspace and prevent land use conflicts. While the relatively low-profile disposition of the vertical development around OAK is not generally a threat to airspace, the Airport has found that there is a real concern that an airspace issue will be overlooked if staff members are not proactive. Internal airspace protection policies, including policies for reporting the location, elevation, and height of a proposed structure; a centralized 'point-of-contact' for airspace issues; and implementation of technical tools have all been successful strategies at OAK.

The following pages contain the guidance document the Port of Oakland has developed to provide structure proponents with background information and instructions for filing FAA Form 7460-1 notifications.

PORT OF OAKLAND
AVIATION PLANNING AND DEVELOPMENT
Oakland International Airport
530 Water Street
Oakland, CA 94607

When Do I Need to File an FAA Form 7460-1?
Objects Affecting Navigable Airspace (14CFR77)

November 2007

Background

The Federal Aviation Administration (FAA) has jurisdiction over airspace in the U.S. It is the FAA's responsibility to define and provide airspace to allow aircraft to safely maneuver on take-off, departure, approach, landing, and enroute. As such, the FAA requires sponsors of new projects to notify them of proposed construction/alteration plans so that they can determine whether the proposed construction/ alteration will be (1) an obstruction to air navigation, in which case the FAA may require appropriate obstruction marking and/or lighting, or (2) a hazard to air navigation (i.e., the project interferes with the safe and efficient use of airspace). FAA requirements and procedures are set forth in the Federal Aviation Regulations Part 77 (Objects Affecting Navigable Airspace), Subchapter C (Aircraft) of Title 14 (Aeronautics and Space) of the Code of Federal Regulations, or 14CFR77.

It is important to note that the FAA does not regulate land use or projects. As such, the FAA cannot legally prohibit or stop construction, even if it determines that a project is a hazard to air navigation. The FAA's recourse is to (1) negotiate with the project sponsor (in fact, most project sponsors are willing to negotiate, as it is difficult to obtain insurance on a project that has been determined to be a hazard to air navigation), or (2) if the sponsor proceeds with the project, adjust flight procedures to mitigate the hazard. In the case of airspace around an airport, the FAA may need to restrict approaches to certain runways during certain weather conditions (e.g., the FAA may need to raise the minimum descent altitude on instrument approach procedures to certain runways).

The FAA also enlists the help of airport owners/operators (e.g., the Port of Oakland) in protecting airspace for the safe and efficient use by aircraft. Because the Port receives federal grant funding for capital projects at Oakland International Airport, the Port is bound by FAA grant assurances. One of the grant assurances requires the Port to "take appropriate action to assure that such commercial airspace as is required to protect instrument and visual operations to the airport (including established minimum flight altitudes) will be adequately cleared and protected by removing, lowering, relocating, marking, or lighting or otherwise mitigating existing airport hazards and by preventing the establishment or creation of future airport hazards."

What kinds of proposed projects require notice to the FAA?

Essentially, all proposed construction or alteration projects over a certain height (see below) require notice to the FAA, including, but not limited to, terrain modifications, buildings, construction equipment (e.g., construction cranes, graders, compacters, etc.) used to build a project, mobile objects (e.g., maritime cranes), tanks, light standards/luminaires, bridge structures, roadways (including the height of vehicles), railways (including the height of trains), antennas, etc.

How tall does my proposed project have to be before I notify the FAA?

The FAA requires that the project sponsor notify them of proposed construction or alterations using FAA Form 7460 (Notice of Proposed Construction or Alteration). In addition to general contact and project information, the most important data that must be provided on FAA Form 7460 are (1) the coordinates of the construction/alteration (in longitude and latitude, preferably down to hundredths of seconds) and (2) the proposed height of the construction/alternation above mean sea level (not above Port datum, the ground, or any other datum).

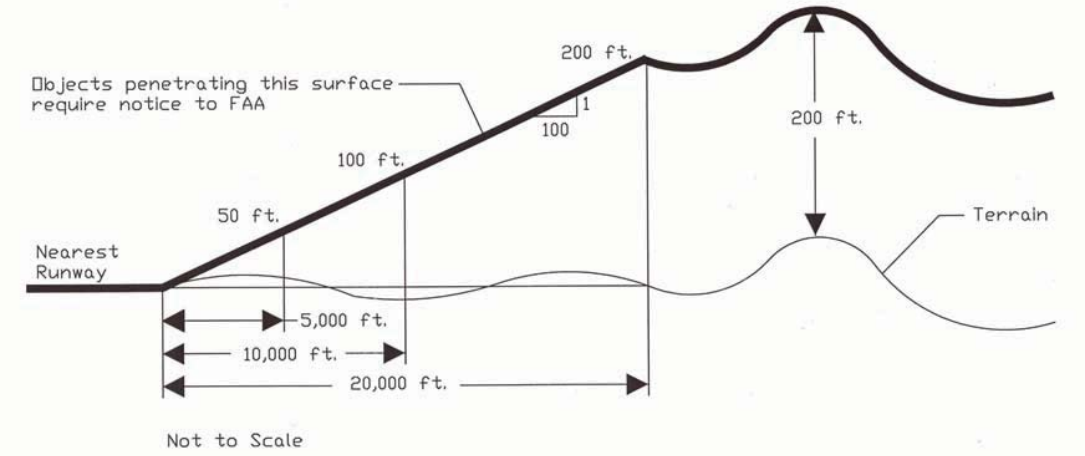
FAA Form 7460 must be filed for any construction/alteration at any of the following locations:

(1) On-Airport: Any and all construction or alterations (essentially, all airside and landside projects not in an existing building, anywhere within the airport boundary).

(2) Off-Airport: Any construction/alteration more than 200 ft. in height above ground level at the site, anywhere. (For example, a new 201 ft. tall structure (above the ground) at a site located 100 miles away from Oakland International Airport would likely not have any direct impact on the airspace around the Airport; however, it may have an impact on airspace around another airport/airports or en route airspace; therefore, the FAA requires that FAA Form 7460 be filed for any construction/alteration more than 200 ft. in height above ground level at the site, anywhere.)

(3) Off-Airport: Any construction/alteration penetrating an imaginary surface emanating from the edge of the nearest runway at a 100 to 1 slope out to 20,000 ft. from that runway.

In graphical form, any construction/alteration that penetrates the following requires notice to the FAA:



For on-Airport projects (i.e., at Oakland International Airport), FAA Form 7460 should be filed with the FAA's San Francisco Airports District Office:

Federal Aviation Administration
San Francisco Airports District Office
Attn.: Mr. Peter Hong
831 Mitten Road
Burlingame, CA 94010

(650) 876-2778 x624
For off-Airport projects, FAA Form 7460 should be filed on-line at https://oeaaa.faa.gov. Before e-filing, the project sponsor must become a registered user by completing a web-based form with contact information and selecting a user name and password. Project sponsors without internet access may file their FAA Form 7460 by mailing it to the following address:

Express Processing Center
Federal Aviation Administration
Southwest Regional Office
Air Traffic Airspace Branch, ASW-520
2601 Meacham Boulevard
Fort Worth, TX 76137-0520

Are there any exceptions where I do not have to file FAA Form 7460?

Yes, there is an exception where the FAA does not require FAA Form 7460 for a construction or alteration project, even when the above criteria are satisfied, but extreme caution is required. According to 14CFR77.15, FAA Form 7460 is not required for "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." By electing to use this exception and not file FAA Form 7460, the project sponsor (and/or possibly the permitting agency) is accepting responsibility for determining beyond all reasonable doubt that the proposed construction or alteration project is not an obstruction or hazard to air navigation. Because of this rather onerous requirement, it is usually better to plan ahead and submit FAA Form 7460, allowing the FAA to determine whether a proposed project might be an obstruction or hazard to air navigation. Stated another way, it is not recommended to use this exception under almost any circumstance.

How long does it take for the FAA to review FAA Form 7460?

Project sponsors, including the Port of Oakland, should allow up to two months for the FAA to review FAA Form 7460, prepare an aeronautical study, and issue an FAA Notice of Determination with the results. FAA Form 7460 is relatively easy to complete as long as you know some basic details about the proposed construction/alteration (i.e., the location and height above mean sea level), which are usually available relatively early in the project development process. By submitting the form well in advance of the start of construction/alteration, the FAA can complete an aeronautical study, and the project sponsor can make adjustments (and re-file) if necessary. Please remember that although your project may be very important, the FAA receives hundreds of these forms each month from all over the western U.S. From their perspective, your project is no more or less important than those submitted on the other forms. Allow enough time (up to two months) for the FAA to review FAA Form 7460, prepare an aeronautical study, and issue an FAA Notice of Determination with the results.

What does the FAA check for?

When FAA Form 7460 is submitted to the FAA, they undertake a comprehensive aeronautical study to check both visual and instrument flight paths for take-off, departure, approach, landing, and enroute. The FAA checks the requirements in 14CFR77 to determine if the proposed construction is a potential obstruction, in which case, they may require that the project be appropriately marked and lit. The FAA will also determine if the proposed construction/alteration is a potential hazard to air navigation using the

requirements in FAA Order 8260.3B, U.S. Standard for Terminal Instrument Procedure (TERPS), and related orders. The FAA, in association with the Federal Communications Commission (FCC), also checks for potential electronic interference with navigation aids, such as instrument landing systems, very high frequency omnidirectional ranges (VORs), radar antennas, etc. The results of the FAA's aeronautical study are returned to the project sponsor in an FAA Notice of Determination.

Tips for Completing FAA Form 7460

Accuracy of latitude/longitude coordinates: We suggest that all coordinates submitted on FAA Form 7460 be presented and accurate to hundredths of seconds of latitude and longitude (e.g., N37°42'48.21" W122°12'54.13"). Because Part 77 and TERPS imaginary surfaces are quite complex, small changes in location can yield significant changes in the allowable height (i.e., where an object would not be considered an obstruction or hazard).

Elevations must be submitted with a reference datum of mean sea level: On FAA Form 7460, the elevation of the site must be submitted "above mean sea level" (or in FAA surveying terminology "above North American Vertical Datum of 1988" or "above NAVD 88"). Elevations should NOT be submitted in reference to the Port of Oakland datum or any other datum.

Complex structures: FAA Form 7460 requires project sponsors provide one elevation (above mean sea level) and one latitude/longitude coordinate to describe the proposed project. However, it is often difficult to describe more complicated projects, such as buildings, moveable gantry cranes, etc., with one elevation and coordinate. For these situations, it is recommended that the project sponsor file multiple forms to more fully define the project for the FAA to evaluate. For example, the project sponsor of a new building should file four separate forms with the four coordinates and four elevations for the four corners of the proposed building. For a movable crane, several forms should be filed with multiple coordinates and elevations defining the operating envelope of the crane. Each coordinate and associated elevation should be placed on a separate FAA Form 7460.

Getting help prior to submitting FAA Form 7460: The Aviation Planning and Development Department of the Port of Oakland is available to assist Port staff and project sponsors with understanding potential airspace issues and completing FAA Form 7460. We are pleased to review FAA Form 7460 prior to being submitted to FAA. Although we may be able to assist project sponsors in determining if a project might be an obstruction, the FAA is ultimately responsible for making this determination. For assistance, please contact:

Mr. Douglas Mansel
Airside Operations Superintendent
Port of Oakland
1 Airport Drive
Oakland, CA 94621
(510) 563-6435
dmansel@portoakland.com

Mr. Joshua Polston, AICP
Aviation Project Manager
Port of Oakland
530 Water Street
Oakland, CA 94607
(510) 627-1260
jpolston@portoakland.com

File FAA Form 7460 early: Please remember that it might take the FAA up to about 2 months to complete an aeronautical study for your project to determine if it is an obstruction or hazard. Remember, your emergency is not the FAA's emergency.

Guarantee the maximum height of your construction/alteration within stated tolerances: The FAA will assume that maximum elevation that you provide on FAA Form 7460 is subject to error (e.g., survey or

construction error), and will add some amount to the elevation provided to account for any potential error. It is therefore recommended that the project sponsor guarantee the height of the proposed construction/alteration (on FAA Form 7460) within certain tolerances (e.g., plus/minus 3 feet, plus/minus 10 feet, plus/minus 20 feet). In certain instances (e.g., depending on how close the construction/alteration is to being considered an obstruction or hazard), the FAA may require a post-construction/alteration survey to verify that the maximum height stated on FAA Form 7460 is indeed what was constructed. For further information on tolerances, please refer to FAA Order 8260.19, Flight Procedures and Airspace, Appendix 2 (Obstacle Accuracy, Standards, Codes, and Sources).

Port permit requirements relative to FAA Form 7460: Prior to issuance of a Port of Oakland building permit, the Port requires that the project sponsor provide (1) a copy of the FAA Form 7460 filed with the FAA, and (2) the results of the FAA aeronautical study (i.e., the FAA Notice of Determination). Please note that any FAA Form 7460 prepared and submitted by a Port tenant must be signed and stamped by a registered professional engineer or land surveyor (in the State of California).

For further information on Port permit requirements, please contact the Port's Permit Coordinator:

Mr. Joe Marsh
Port of Oakland
530 Water Street
Oakland, CA 94607
(510) 627-1480
jmarsh@portoakland.com

Before issuing local Notices to Airmen (NOTAMs) for temporary crane operations, please obtain a copy of the contractor's original FAA Form 7460 and FAA Notice of Determination.

Please remind your tenants of this important Port permit requirement.

How to obtain FAA Form 7460: The most recent version of FAA Form 7460 can be obtained on the FAA's web site at www.faa.gov (search for Form 7460).

Disclaimer

The above information is believed to be accurate as of the date of this technical memorandum and is provided for educational purposes only. Please consult the latest version of 14CFR77 and instructions on FAA Form 7460. Also, please note that there may be other height restrictions for any particular site beyond those imposed by FAA (e.g., city general plans, local zoning ordinances, State requirements, county airport land use commission restrictions, etc.).

The Ohio State University Airport

Executive Summary

The Ohio State University Airport is a self-supported entity of The Ohio State University. The airport serves primarily as a general aviation facility, serving businesses, public agencies, emergency services operations, and a flight education program. The airport is surrounded by low to moderate density, suburban style development. Much of the area is residential, with supporting retail, office and institutional uses.

The State of Ohio reinforces FAR Part 77 regulations in the Ohio Revised Code. Development proposals within the 20,000-foot, 100:1 notification area are required to secure a permit from the state, verifying compliance with the FAR Part 77 standards. The City of Columbus and Franklin County both have an Airport Environs Overlay within their ordinances. The overlay addresses airports and land use primarily from a noise perspective, and limits the overlay to the boundary of each airports' 65-decibel average day-night sound level (65 DNL). For OSU, this boundary falls mainly within the airport property, giving the airport little opportunity for development review in the surrounding community.

Although the land uses that surround the airport do not generally put airspace and land use in conflict, there is concern that ignoring potential conflicts might pose a risk to public safety. Airport staff recognized the need to begin communication with city staff to prevent a serious conflict. An incident that sparked this heightened consideration occurred when a tower crane was positioned directly in a runway approach. No one was notified about the crane, being used for the construction of a nearby shopping center. The construction had been approved without notice to the Ohio Department of Transportation Office of Aviation, the FAA, or the airport, despite the legal requirement for notification.

The airport is currently working to identify a strategy for preventing future miscommunication by adding a step early in the development review process to guide applicants to the FAR Part 77 requirements. While no process or policies have yet been established, the airport envisions that the system could make use of experts in the state's aviation office to provide technical evaluation. The goal is to incorporate the airspace issue into the preliminary checklist of factors that every developer must consider when proposing a structure to the city.

Airport Description

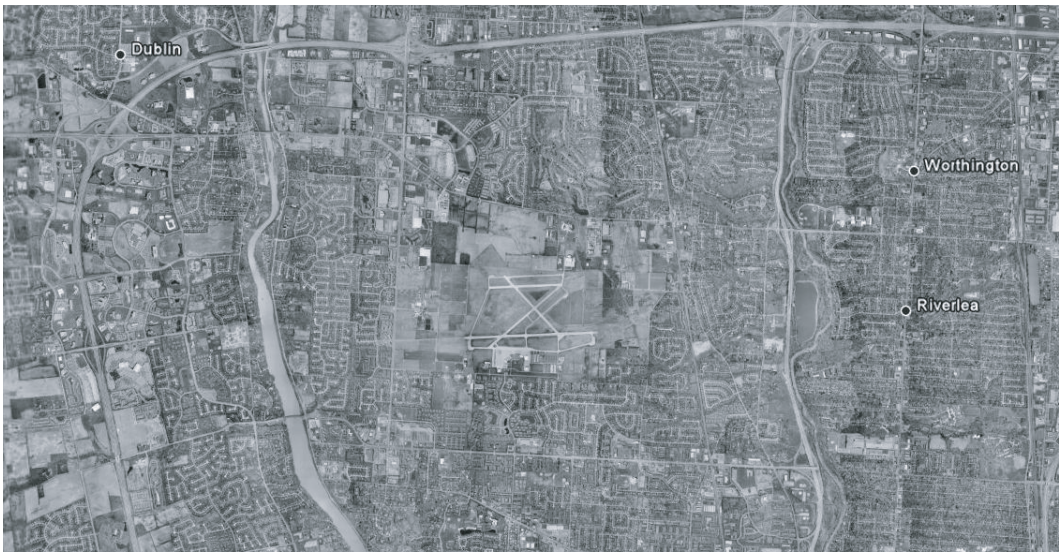
The Ohio State University School of Aviation established Don Scott Airfield in 1942 as a research, education and training facility. The airport, now the Ohio State University Airport ("OSUA"), has since expanded from a once education-focused facility into the primary corporate and business aviation airport for the Central Ohio region (Figure D.16).

OSUA now serves the region as the state's fourth busiest airport. OSU Airport is a key general aviation airport in the State of Ohio, supporting state agencies, emergency medical services, business and corporate aviation and flight education. OSU Airport also serves as a general aviation reliever to nearby Port Columbus. The OSU Airport is "a self-supporting entity of The Ohio State University through the Department of Aviation" (www.osuairport.org).

The airport currently operates four runways. The longest runway, 9L/27R is 5,004 feet; the parallel runway is 9R/27L measuring 2,994 feet; and the two crosswind runways, 5/23 and 14/32, each measure approximately 3,500 feet (Figure D.17).

Surrounding Land Uses and Jurisdictions

OSU Airport is located in the northwest area of Columbus in Central Ohio. The airport property lies primarily within the City of Columbus. Surrounding the airport are Columbus to the immediate north and south; Worthington, Columbus, and the Village of Riverlea to the east; and



SOURCE: Google Earth

Figure D.16. The Ohio State University Airport and surrounding jurisdictions.

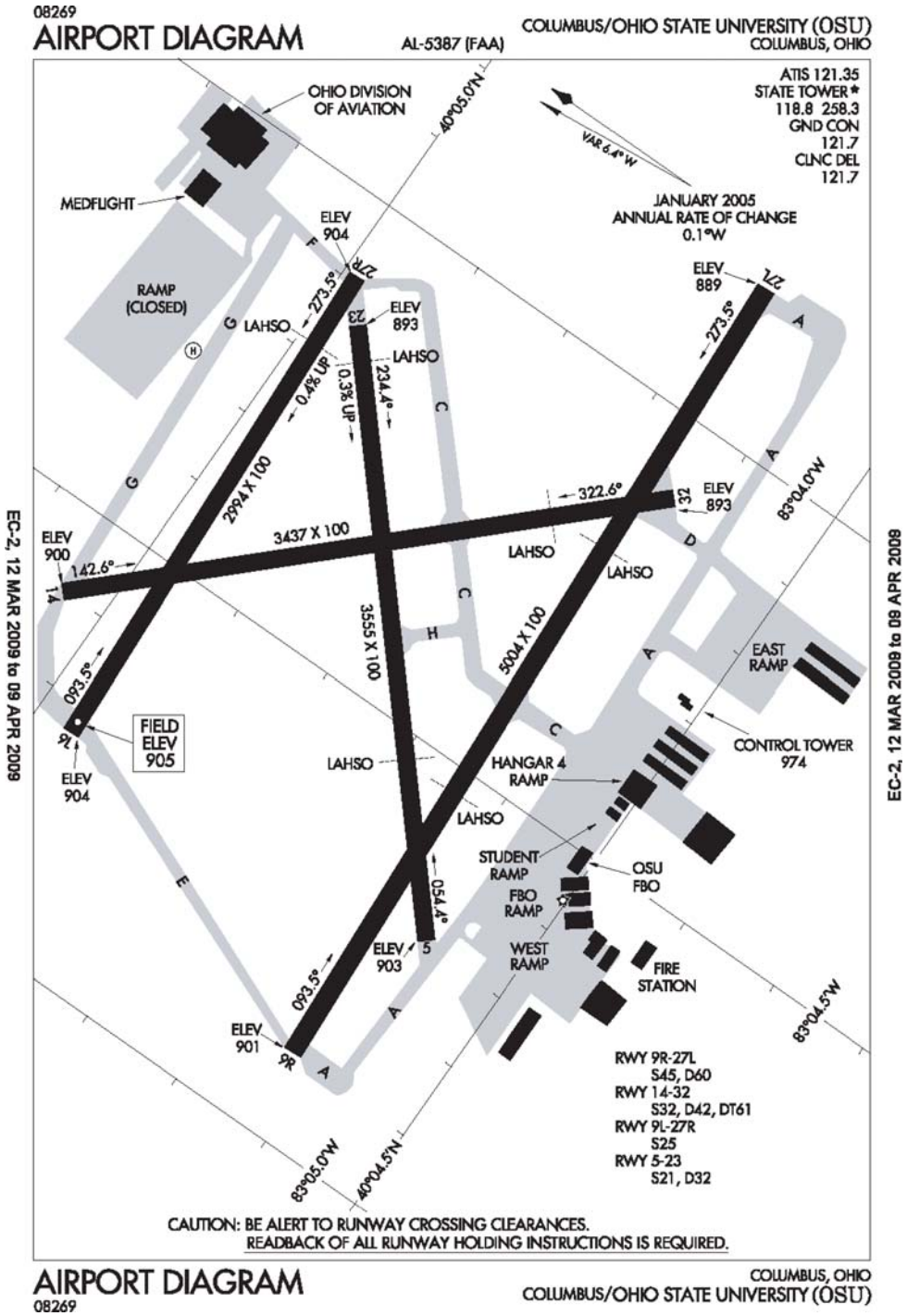
Dublin and Columbus to the west. Columbus has an annexation policy, whereby county land is incorporated on a parcel-by-parcel basis. As a result, there are 'patches' of unincorporated townships of Franklin County throughout the area.

The use of the land that surrounds the airport is primarily single family with some multi-family housing. Major suburban-style commercial and office areas in the airport's proximate vicinity are located along Bethel Road (Columbus) to the south and in the area around Dublin Granville and Sawmill Roads (Dublin) to the northwest. The town center of Worthington is located to the northeast. Additional jurisdictions that are contained by the 20,000 feet, 100:1 notification requirement area under FAR Part 77 are Upper Arlington to the south and Hilliard to the southwest (Figure D.18).

State, County and Local Statutes and Ordinances

The State of Ohio. The Ohio Revised Code (ORC) states in §4563.02 that, "the creation or establishment of an airport hazard shall be a public nuisance." An airport hazard, furthermore, is defined under §4563.01 (B) as, "any structure or object of natural growth or use of land within an airport hazard area that obstructs the air space required for the flight of aircraft in landing or taking off at any airport or is otherwise hazardous to such landing or taking off of aircraft". "Airport hazard area" is defined as "any area of land adjacent to an airport that has been declared to be an 'airport hazard area' *by the office of aviation in connection with any airport approach plan recommended by the office*" (italics added). The Ohio Department of Transportation Office of Aviation is granted, by this language, a considerable degree of discretion in determining whether a structure is a hazard subject to state nuisance law.

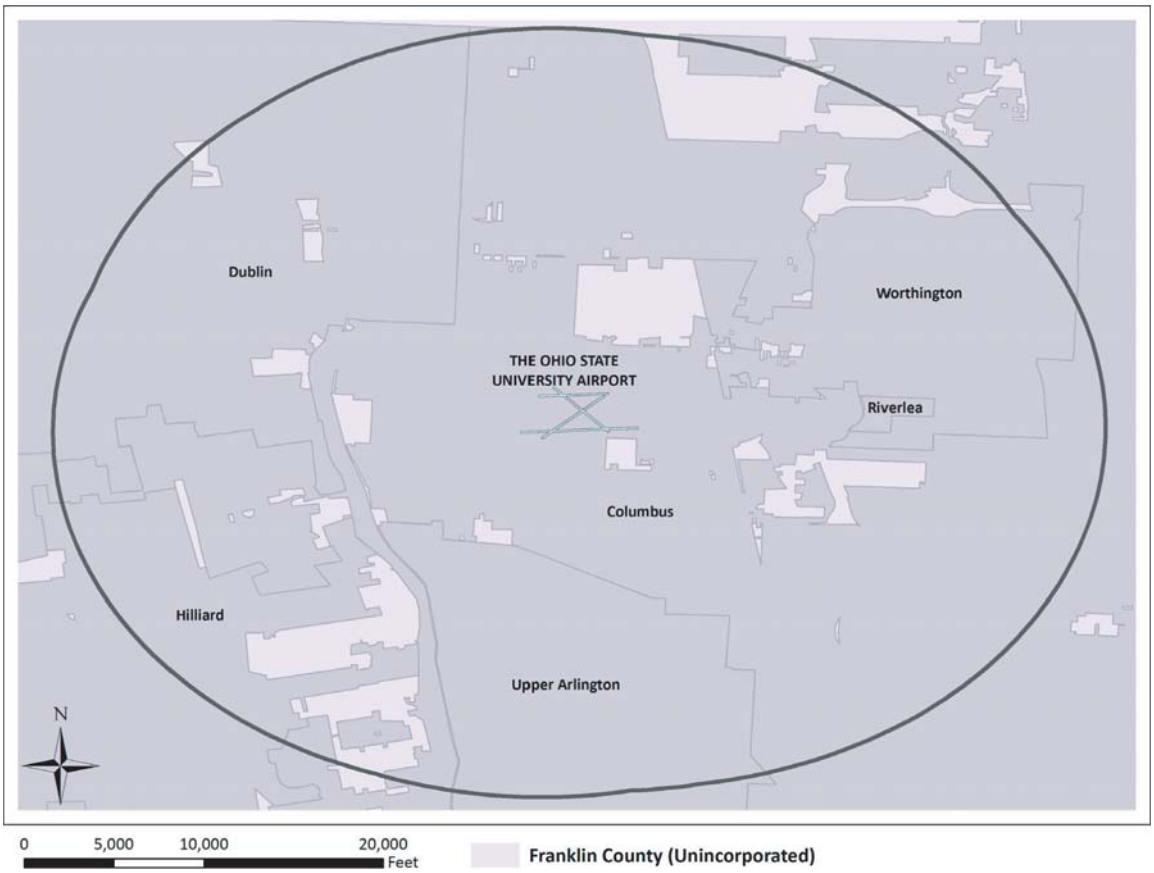
In 1991, the State's legislature adopted the Ohio Airport Protection Act, sometimes referred to as the Ohio Tall Structures Law (adopted as Ohio Revised Code §4561). With this law, the Ohio Department of Transportation must assign an administrator to issue permits for new development which meets the notification requirements of the federal and state law (namely, Title 14 CFR Part 77, §77.13 *Notification Requirements*). The administrator is charged with conducting those activities that ensure that, "no person shall commence to install any structure or object of natural growth in this state, any part of which will penetrate or is reasonably expected to penetrate into navigable airspace, without first obtaining a permit from the department of transportation" (Ohio Revised Code, §4561).



SOURCE: www.naco.faa.gov

Figure D.17. National Aeronautical Charting Office (NACO) diagram of the Ohio State University Airport.

Franklin County. Franklin County adopted an overlay-zoning district called the Airport Environs Overlay (AEO). The AEO was established to encompass the 65 Day/Night average annual noise contour ("65 DNL"), as established by each airport's most recent FAR Part 150 study. The selection of the 65 DNL reveals that the emphasis of this land use measure is on compatibility in terms of noise and not necessarily in terms of airspace protection / building height.



SOURCE: GIS data compiled from Franklin County Auditor GIS, MORPC

Figure D.18. The 20,000′ 100:1 notification area for The Ohio State University Airport affects Columbus, Franklin County, Worthington, the Village of Riverlea, Dublin, Hilliard, and Upper Arlington. ***Notification area estimated based on airport center point.**

The Franklin County zoning ordinance states that, "[a]irport hazards within the AEO-Airport Environs Overlay District are hereby declared a public nuisance" (Franklin County Zoning Resolution, §660.01). "Airport hazard" is defined in the ordinance as, "any building, structure or object of natural growth or use of land within an airport hazard area which obstructs the air space required for the flight of aircraft in landing or taking off at an airport or which is otherwise hazardous to such landing or taking off of aircraft" (Franklin County Zoning Resolution, §660.023). "Airport hazard area" is defined as, "any area of land adjacent to an airport which has been declared to be an "airport hazard area" by its operating authority in connection with any airport approach plan recommended by such authority" (Franklin County Zoning Resolution, §660.024). The AEO is the declared airport hazard area.

City of Columbus. The City of Columbus, along with Franklin County, adopted the Airport Environs Overlay ("AEO") (Columbus City Code, Chapter 3384). Like Franklin County's zoning resolution, Columbus defines the AEO by the 65 DNL noise contour. Airport hazards, like in the Franklin County zoning resolution, are declared a public nuisance within the AEO (Columbus City Code, 3384.01). Under Chapter 3384, airport operators are granted development review only for those properties contained within the 65 DNL noise contours.

Other Neighboring Jurisdictions. Numerous jurisdictions in the Columbus metropolitan area potentially impact, and/or are affected by, one or more of the area's airports. Only Franklin County and the City of Columbus, however, adopted the Airport Environs Overlay into ordinance.

Summary Of Interview Regarding Airspace And Land Use Issues

Once positioned away from the city, OSUA is now surrounded by moderate density suburban style development. The Airport is also unique in that the Airport Sponsor (The Ohio State University), unlike a traditional airport/port authority, does not have a direct connection to the local governmental entities. As a result, these local governments do not have an investment in the Airport or direct vested interest in protecting the Airport through zoning and other land use controls.

Because most structures around the airport are low and do not conflict with safe air navigation, it surprised airport management to learn that a crane was in use in a crosswind runway's direct approach. Although the Ohio Department of Transportation (ODOT) has authority under the Ohio Administrative Code to review proposed development and enforce restrictions on development using the federal obstruction evaluation and airport airspace analysis (OE/AAA) system, many developers and local jurisdictions are unaware of this requirement.

The OSU Airport example illustrates a case where the state has adopted the requirements of Federal Aviation Regulation Part 77 as intrastate law, yet the challenge remains to communicate the requirements to local jurisdictions and then onto developers. The interview respondent in this case study sees the lack of awareness and enforcement of the regulations as a threat to public safety, and as a realistic concern in protecting the future of airport airspace. In working with ODOT and city staff, the respondent looks to a future with opportunities to protect air navigation and airport airspace, while maximizing existing resources and avoiding the creation of new and unnecessary administrative burdens.

A shopping center was undergoing renovations and a crane was erected in the direct approach to Runway 5 (Figure D.19). The study respondent was notified by the air traffic control tower that the crane was present. Airport staff was sent to talk with the crane operator. The crane operator informed the airport representative that all permits from the city were properly in place and that they were not aware of the potential hazard to air navigation.

The airport was not aware of the temporary structure used in the Runway 5 approach until the obstruction was noticed by air traffic control. In fact, the Ohio Department of Transportation Office of Aviation had not been notified either, despite the statutory requirement that the use of such structures, temporary and permanent, be submitted to the agency for review prior to their use. The airport was not involved in the timing and placement of the tower crane, which, according to the study respondent, would have been easily mitigated by issuing a Notice to Airmen (NOTAM). Without such notice to pilots, safety was a serious concern.

According to the respondent, this is the situation that "brought all of this to light". Following this incident, the airport began meeting with the City of Columbus realizing that the lack of communication with airports might result in a serious threat to public safety. "It may not come up again," says the study respondent, "but you never know. Our opinion is, let's fix the issue before it arises a second time".

The ordinance that guides the City of Columbus defines airport hazard areas as those areas contained by the 65 DNL noise contour. Like many airports, the main land use concern in recent years has focused on aircraft noise. This constituent concern at OSU Airport, along with the three airports managed by the Columbus Regional Airport Authority (including Port Columbus International), was apparently the driving force for the adoption of the Airport Environs Overlay.

A second concern regarding the City of Columbus' definition of an airport hazard area deals with the review of objects (existing or proposed) around the airport (Figure D.20). Currently, only those objects proposed for construction within the 65 DNL are reviewed with respect to height and impact on air navigation. In the case of the OSU Airport, the 65 DNL does not leave the airport property; thus, obstructions to air navigation can easily be planned unbeknownst to the Authority. The Port

SOURCE: GIS data compiled from Franklin County Auditor GIS, MORPC, USGS, oeaaa.faa.gov

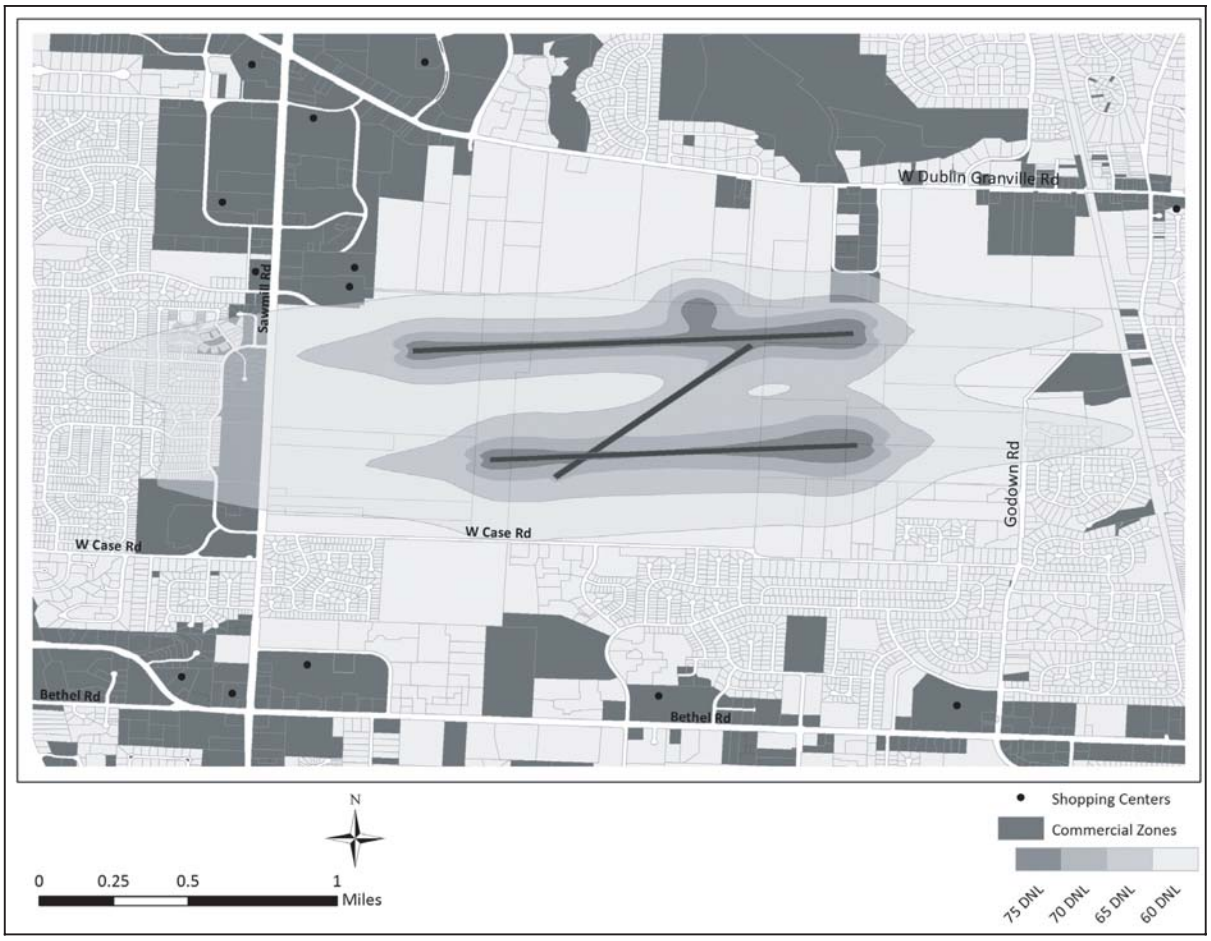
Figure D.19. A construction crane appeared one mile from the end of Runway 5. No 7460-1 Form was filed with the FAA.

Columbus International Airport has a similar concern, but their 65 DNL extends further beyond their property limits, so more protection of airspace occurs via the larger AEO.

The study respondent recognizes that adding to or updating the zoning ordinance will not necessarily fix the problem. With the state aviation office already armed with substantive expertise, it would be ideal to utilize that program. Adding a new ordinance with technical conditions would place too much of the burden of evaluation on city staff with no background in aviation and airspace, and it could place the city in a vulnerable position, both legally and politically.

The State, with resources specifically devoted to aviation planning, is better equipped to understand the complex and abstract regulations that dictate airspace issues. In addition to the state-level expertise, the State of Ohio adopted the Ohio Airport Protection Act in 1991. This act includes a requisite that developers submit an FAA Form 7460-1, *Notice of Proposed Construction or Alteration,* not only to the FAA but also to the Office of Aviation if the structure is within 20,000 feet from an airport with a building height that exceeds a 100:1 slope, or, if beyond 20,000 feet, if the structure is greater than 200 feet above ground level. The state regulation mimics the federal notification requirement.

The respondent views the state law as a strength. It uses the federal regulations as a standard, theoretically protecting against airspace hazards. The weakness is that "no one knows about it". The crane operator confronted by airport staff in this example was granted clearance from the city to be there. It is likely that the developer worked closely with the Development, Planning



SOURCE: GIS data compiled from Franklin County Auditor GIS, MORPC, ESA Airports (draft contours)

Figure D.20. Draft 2013 noise contours for The Ohio State University (reflects draft master plan runway modifications). Under current zoning law for the City of Columbus and Franklin County, the airport has development review authority only within the 65 DNL contour. This contour lies mostly within the airport property and excludes major commercial activity areas in the vicinity.

and Building services arms of the City, but was not directed to the state requirement in the Ohio Airport Protection Act. In addition, because the airport was only granted development plan review within the 65 DNL noise contour, the plan was never sent to the airport and so the airport lacked the opportunity to discuss the need to consider airspace safety during construction.

Looking forward, the study respondent posits that, regardless of the solution, "first the [city] staff has to understand the importance of it". The respondent views communication with and education of city staff and elected officials as an imperative first step. Once there is reasonable consensus among decision makers and implementers that air navigation safety is a critical concern, then there is room for opportunities to strengthen the effectiveness of the federal and state law on a local level. Based on the study respondent's history with the city on this subject, there are two possible opportunities.

First, responding to the current weakness of using the 65 DNL noise contour as the criteria for airport development review, the respondent suggests that the city might expand development review to a greater area. In fact, the respondent recently requested to review development in a five-mile radius around the airport. The city responded that, while new construction permit

review alone may be manageable within this large area, utility upgrades and renovation permits would create a huge volume of work that may not efficiently protect airspace. The respondent suggested that this might still be an opportunity if the city could use a five-mile radius for new construction, and reduce the utility upgrade and renovation development review criteria to a clearly defined runway approach area.

As a second potential opportunity, the study respondent addresses the current weakness that developers are not aware of the state notification requirements. The city, in working firsthand with builders, is well positioned to instruct permit applicants. The respondent believes that the city could easily distribute a summary of the state notification standards along with copies of the FAA Form 7460-1 paperwork and/or OE/AAA website link to permit applicants. The city might require an applicant to submit an ODOT determination letter along with the development plans required in any permit application. The respondent suggests that such a procedural change at the local level could greatly enhance the substantive legal state requirements. Such a change, the study respondent proposes, would not burden city staff with more work nor would it stretch the city budget by requiring the city to have aviation experts on staff.

Using this strategy, the city would simply adopt "responsibility to make people aware of the laws that may affect what they want to do". "Then if an application is denied," says the respondent, "the city isn't the one holding the burden of denying something from one of their own citizens, which could come back politically. You hate to "pass the buck", but ODOT doesn't mind playing that role. They don't have a direct constituency with the individual property owners like the city".

While one of these strategies or a combination of both may be at least the start of a solution, there remains a challenge of promoting regional consistency in the method for protecting air navigation safety and airport airspace in Central Ohio. Paramount to any effective method for ensuring air navigation safety from obstructions, and the long-term protection of airport airspace, will be the cooperation of all jurisdictions in the vicinity.

Central Ohio does not currently face significant pressure of permanent tall structures in the immediate vicinity of its airports. Yet airport management was triggered by the recent experience of an unexpected and potentially dangerous obstruction in a runway approach. From this experience, the study respondent has determined that a proactive posture will be the best strategy for protecting safe air navigation and airport airspace in the future. Whether it is a tower crane, or "a six-story building right in a precision approach", the respondent is keenly aware that there is currently no reliable system in place to prevent an unexpected obstruction. Although the OSU Airport area is currently moderate density, suburban style development, there is no certainty that such a development style will persist in future years, or even decades. Although it is difficult to mitigate uncertain future risks, the respondent sees opportunities that would require additional work proportional to the likelihood of occurrence of those risks.

The existing strength of state regulations and administrative experts is weakened only by a lack of awareness within local jurisdictions and the developer community. Looking forward, there seems a viable opportunity to use local development, planning, and building services staff; and their firsthand interaction with permit applicants to inform developers of their responsibility to seek a permit from the Ohio Department of Transportation. The study respondent suggests developing strategies to achieve this goal, while remaining sensitive to the realities of limited city budgets and the lack of aviation expertise within the city government. The respondent believes that airports should be engaged in the development review process beyond the current 65 DNL noise contour boundary. The respondent also believes that the addition of a minor procedural change to the city's existing permitting process that would direct applicants to the experts at the State agency level would prevent future problems while avoiding new administrative burdens where they would not be feasible or appropriate.

Norman Y. Mineta–San José International Airport

Executive Summary

Norman Y. Mineta–San José International Airport ("SJC" or "the Airport") is located near downtown San José, California, the most populous city in the San Francisco Bay Area. The Airport is also owned and operated by the City of San José through its Airport Department. One objective of any city is to promote economic development; one way for this to occur is through encouraging the construction of tall structures in or near the downtown area in proximity to other businesses, transit hubs, and the like. The City of San José is currently dealing with the balance between (1) tall structure development near the downtown core, and (2) preserving the Airport's air service capabilities by protecting airspace to a greater degree than is effectively protected through the FAA's routine obstruction evaluation / airport airspace analysis (OE/AAA) process. The combined effect of its geographic location and the challenge of balancing competing interests within the city government have made airspace protection a priority concern at SJC.

The primary airspace issue for SJC relates to OEI emergency flight procedures. Under FAR Part 25, airlines are required to design OEI procedures to allow an aircraft that loses power to one engine to climb over terrain and obstacles in the departure area, regain full control, and return to a safe landing. If new obstacles are introduced in the departure path, airlines must redesign the procedures to allow aircraft to climb on a steeper gradient to avoid the new obstacles. Economics dictate that aircraft often carry the maximum amounts of fuel and/or payload (passengers, baggage, and cargo) to achieve the safe OEI climb; therefore, steeper climb gradients can usually only be achieved by reducing the weight of the aircraft by removing a certain amount of fuel and/or payload, known as a "weight penalty". Therefore, the impact of the loss of clear airspace for OEI procedures is commonly viewed as an economic burden on the airlines, and not a safety issue. Through the OE/AAA process, the FAA has in the recent past found that, "economic impact upon airline operations is not, in itself, a basis for a hazard determination." (OE/AAA Case # ASN 2005-AWP-2553-OE).

In the early 2000s, the OEI issue emerged at SJC. Airlines protested three buildings constructed during that time that impacted their OEI procedures. There was a concern that the airlines would have to take weight penalties severe enough that transcontinental and transoceanic service would no longer be economically feasible. Upon realizing that the FAA did not have the power to make hazard determinations on the basis of OEI impacts alone, City and Airport staff considered the potential for local policies to protect SJC's air service capabilities. While a final decision has not yet been reached as of this writing (July 2009), the City is exploring a policy that would designate an "OEI Corridor," in which building height limitations compatible with airline OEI procedures would be enforced.

The SJC case study primarily reveals the challenges and opportunities of OEI protection. Also, this case study describes how the Airport has adjusted its organization to address airspace protection proactively.

Airport Description

San José International Airport was established in 1945. The Airport is owned and operated by the City of San José—the most populous city in the San Francisco Bay Area. SJC is the only major airport in Santa Clara County, and is situated in the heart of Silicon Valley. The Airport primarily serves scheduled commercial flights, while it also hosts corporate, logistics, and general aviation activity.

According to the FAA Terminal Area Forecast (TAF), December 2008, in fiscal year 2007 SJC saw 5,296,175 air carrier and commuter passenger enplanements, and a total of 207,452 aircraft

operations (landings and takeoffs). SJC currently operates two passenger terminals and an international arrivals facility. SJC has two parallel runways (12-30), measuring 11,000 x 150 feet each, along with Runway 11-29 at 4,599 x 100 feet (Figure D.21).

Surrounding Communities and Land Use

The Airport is located almost entirely with the City of San José, with a small portion of the airfield within the City of Santa Clara. Beyond these municipalities, several other communities

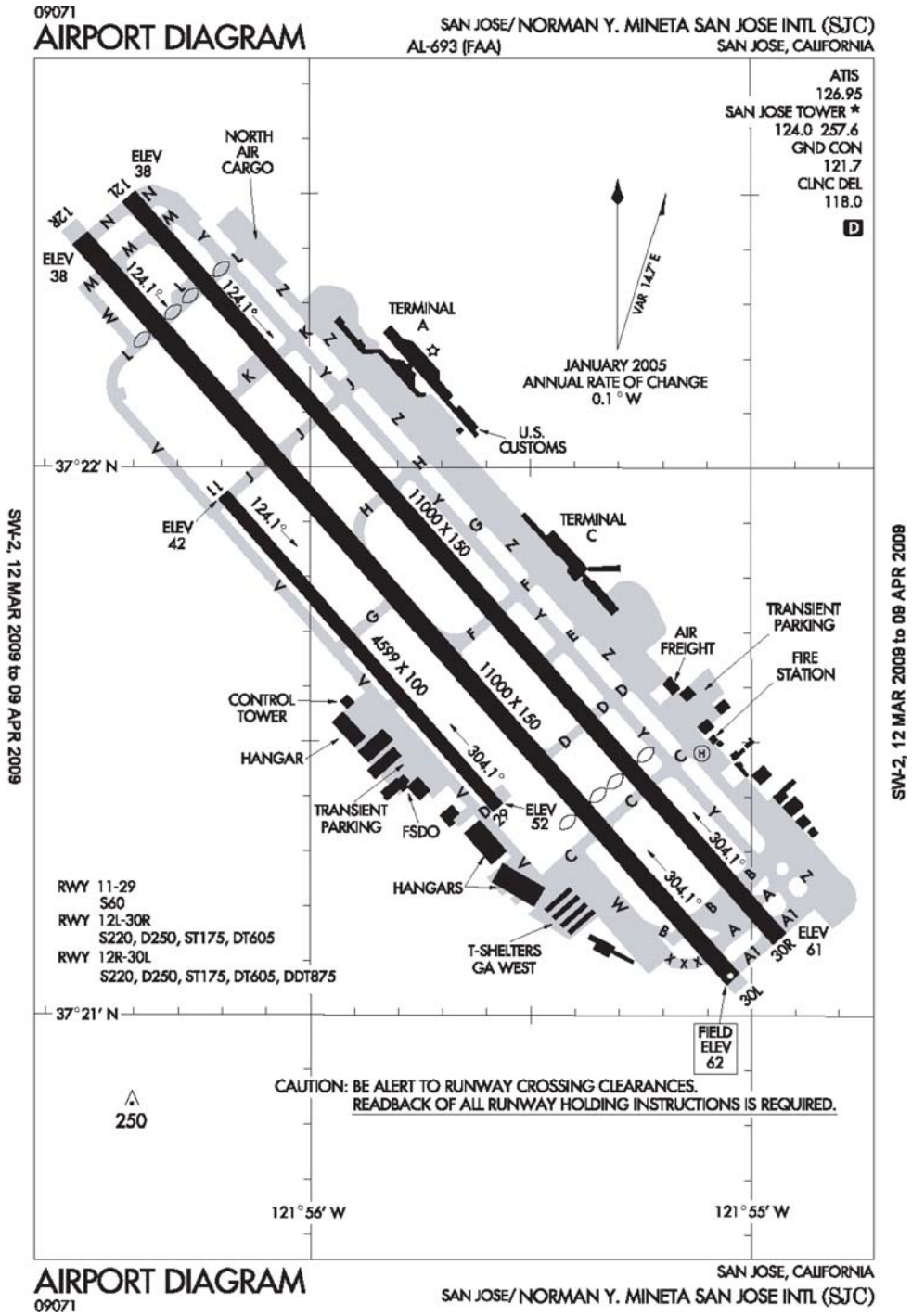


Figure D.21. Airport Diagram of SJC (National Aeronautical Charting Office).

150 Understanding Airspace, Objects, and Their Effects on Airports

lie within the FAR Part 77 20,000-foot 100:1 notification area (see Figure D.22) and include Milpitas to the northeast and Sunnyvale to the west of Santa Clara. Portions of the land within this area are unincorporated, governed by Santa Clara County. SJC is situated in a highly populated urban area, with downtown San José only about two miles southeast of the Airport (Figure D.22).

State, County and Local Statutes and Ordinances

The State of California. In the State of California, property owners are granted rights to the land including "free or occupied space for an indefinite distance upwards as well as downwards, subject to limitations upon the use of airspace imposed, and rights in the use of airspace granted,

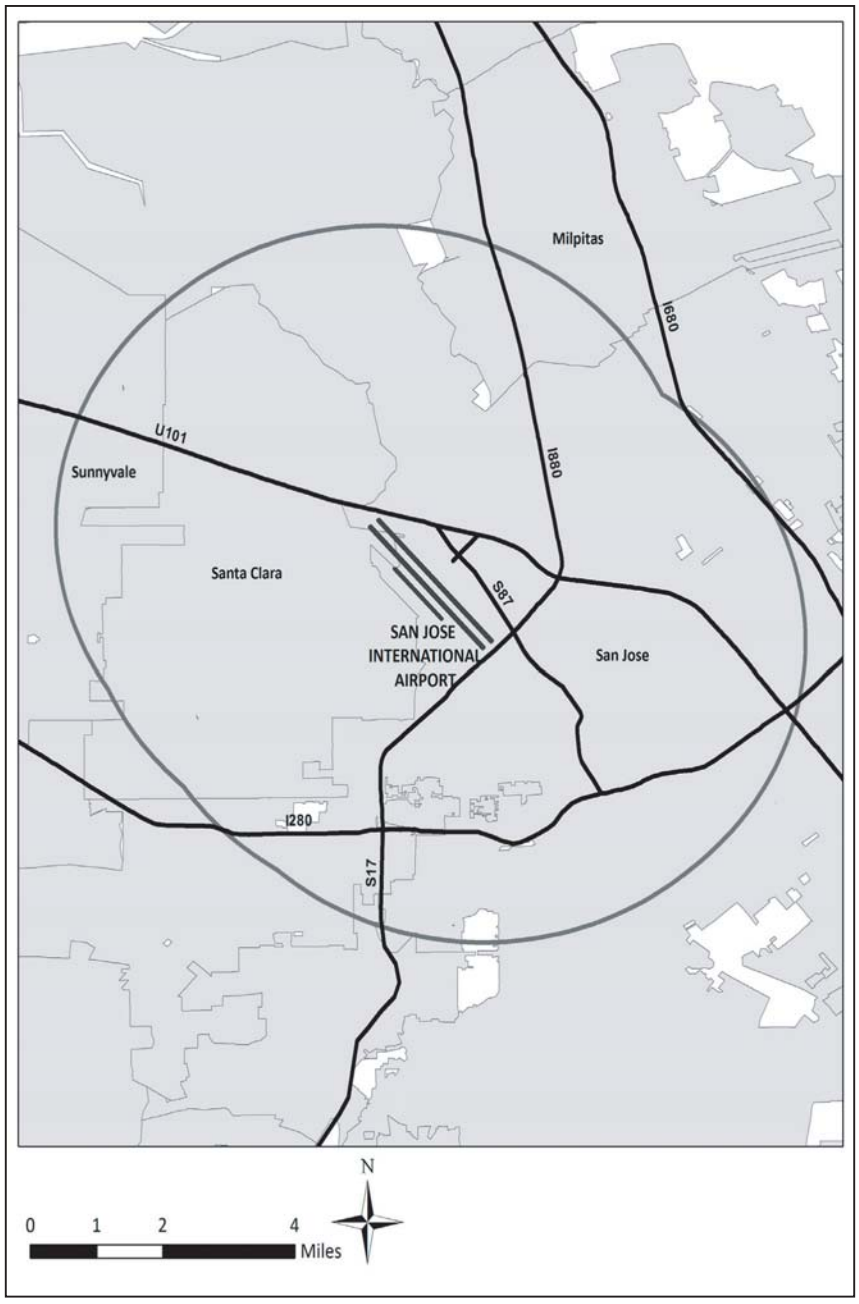


Figure D.22. Airport and surrounding municipalities.

by law" (California Civil Code, Section 659). The limitations to the use of airspace above a property are further defined in other portions of the State code.

California Public Utilities Code (sections 21655-21660) includes building height requirements that reflect the obstruction standards in FAR Part 77, and also refer to relevant FAA hazard determination standards. These code sections require:

- That all State property acquisitions within two miles of any airport submit notice to the Department of Transportation for review.
- That any structure taller than 500 feet cannot be built without a State permit, and that the State may refuse a permit if the proposed structure "would obstruct the airspace overlying the State so as to create an unsafe condition for the flight of aircraft".
- That no new or modified structures, or natural growth is allowed without permit from the State if they are an obstruction to air navigation, according to Part 77, unless the FAA finds that the structure is not a hazard to air navigation or that it would not create an unsafe condition for air navigation.

California established an Aeronautics Fund in its Public Utilities Code, which creates an airspace contingency for airports seeking financial support from the State:

> No payments shall be made from the Aeronautics Account for expenditure on any airport or for the acquisition or development of any airport, if the department determines that the height restrictions around the airport are inadequate to provide reasonable assurance that the landing and taking off of aircraft at the airport will be conducted without obstruction or will be otherwise free from hazards.
>
> Height restrictions shall be considered adequate if as a minimum they meet the obstruction standards of subchapter C of Part 77 of the Federal Aviation Regulations of the Federal Aviation Administration, as these standards apply to civil airport imaginary surfaces related to runways.
>
> The airport-owning entity shall have sufficient control over obstructions in the airspace in the vicinity of the airport to assure that height restrictions can be maintained. This control may be in the form of ownership of any land from which obstructions may rise, air navigation easements to guarantee maintenance of restrictions, or height limitation or land use zoning which will prohibit obstructions which would violate the obstruction standards" [California Public Utilities Code, 21688 (a)].
>
> There is also a deed notification requirement for transferred properties within an "Airport Influence Area", which mandates notice to the property purchaser that airspace protection, among other things, "may significantly affect land uses or necessitate restrictions on those uses as determined by an airport land use commission" [California Civil Code, 1353 (a) (2)].

Furthermore, Article 50485 of the California Government Code declares *airport hazards*—defined as "any structure or tree or use of land which obstructs the airspace required for the flight of aircraft in landing or taking off at an airport or is otherwise hazardous to such landing or taking off of aircraft"—as *public nuisances,* which grants local jurisdictions throughout the State the authority to prevent the creation of airport hazards through prescribed airport zoning regulations. City or county level airport zoning is voluntary, however this section of the State law provides a framework for these jurisdictions to adopt, enact, and implement such statutes and gives them the power to do so. The California Public Utilities Code mandates a minimum level of airport planning foresight by requiring all counties containing at least one airport with at least one scheduled air service provider to implement an Airport Land Use Commission. Each commission is required to prepare and oversee an Airport Land Use Compatibility Plan. The Plan and the Commission itself is required to consider airspace protection, among other airport-related land use compatibility concerns.

Santa Clara County

Santa Clara County has an Airport Land Use Commission, as mandated by California Public Utilities Code sections 21670-21679.5. The County has adopted an Airport Land Use Policy Plan.

City of San José

The City of San José code of ordinances states that buildings within the downtown zoning district are "subject to the height limitations necessary for the safe operation of San José International Airport" [20.70.200 (A)]. Receipt of a building permit requires a favorable determination from the FAA, and therefore the standard FAA OE/AAA process effectively limits building heights. However, as was found to be the case here, proposed structures which do not constitute a hazard under the standard OE/AAA process can have substantial adverse effects to airline OEI procedures.

Other Neighboring Jurisdictions

The major neighboring jurisdictions other than the City of San José do not provide airspace-related ordinances.

Summary Of Airspace And Land Use Issues

It can be challenging to operate an airport from within the City government. In the case of SJC, this is especially difficult because the City of San José is the most populous jurisdiction in the Bay Area, and frequently faces competing development interests. Also challenging is that City staff are generally unaware of airspace protection needs, yet they are the point-of-contact for new development within the City's boundaries. While the Airport Department staff attempt to keep land use decision makers informed of the Airport's airspace needs, the complex nature of airspace criteria and regulations can make it difficult to disseminate accurate and current information. This case study demonstrates an example of the internal push and pull that may occur when a city wishes to simultaneously promote economic development and preserve the Airport's functionality. This case study also reveals some of the challenges and limitations with the FAA's OE/AAA process.

In the late 1990s, SJC staff learned about two buildings in downtown San José that were each issued a 'Determination of No Hazard' (DNH) by the FAA. One building was constructed in 1996 at 259 feet AGL, and the other in 2000 at 260 feet AGL (see Figure D.23). Both structures were along the runway centerline extended, and therefore generally along flight paths in both directions. Both buildings were also constructed without the required completion of an FAA Form 7460-2, *Notice of Actual Construction.* If a structure proponent does not submit this follow-up form to the FAA, the building might not be catalogued in the obstruction database.

In the 2000s, a third building was proposed in the vicinity of the first two. This third building—proposed as 228′ AGL—also received a DNH from the FAA. This time, however, the airlines protested, arguing that the structure would have a detrimental impact on their OEI procedures. OEI procedures, the Airport and airlines learned, are not considered a factor in hazard determination in the OE/AAA review process. Airlines must design OEI procedures to allow disabled aircraft to avoid obstacles laterally and/or vertically. If the introduction of new obstacles would force an adjustment to the OEI procedure, this is considered an economic burden for the airline to bear. As such, the FAA will not issue an obstruction or hazard determination solely to preserve airline OEI procedures.

For the airlines who protested the FAA's DNH determination at SJC, the concern was that the loss of airspace used for OEI procedures would make long-haul transcontinental or transoceanic departures economically infeasible. This is because the departure limitations would necessitate a significant reduction in the weight of the aircraft, which would mean either less fuel (reduction in range) or less payload (some combination of passengers, baggage, and cargo). Despite the concerns raised by the airlines, the FAA responded that OEI, in itself, would not be a consideration in the review; and furthermore, that the proposed structure

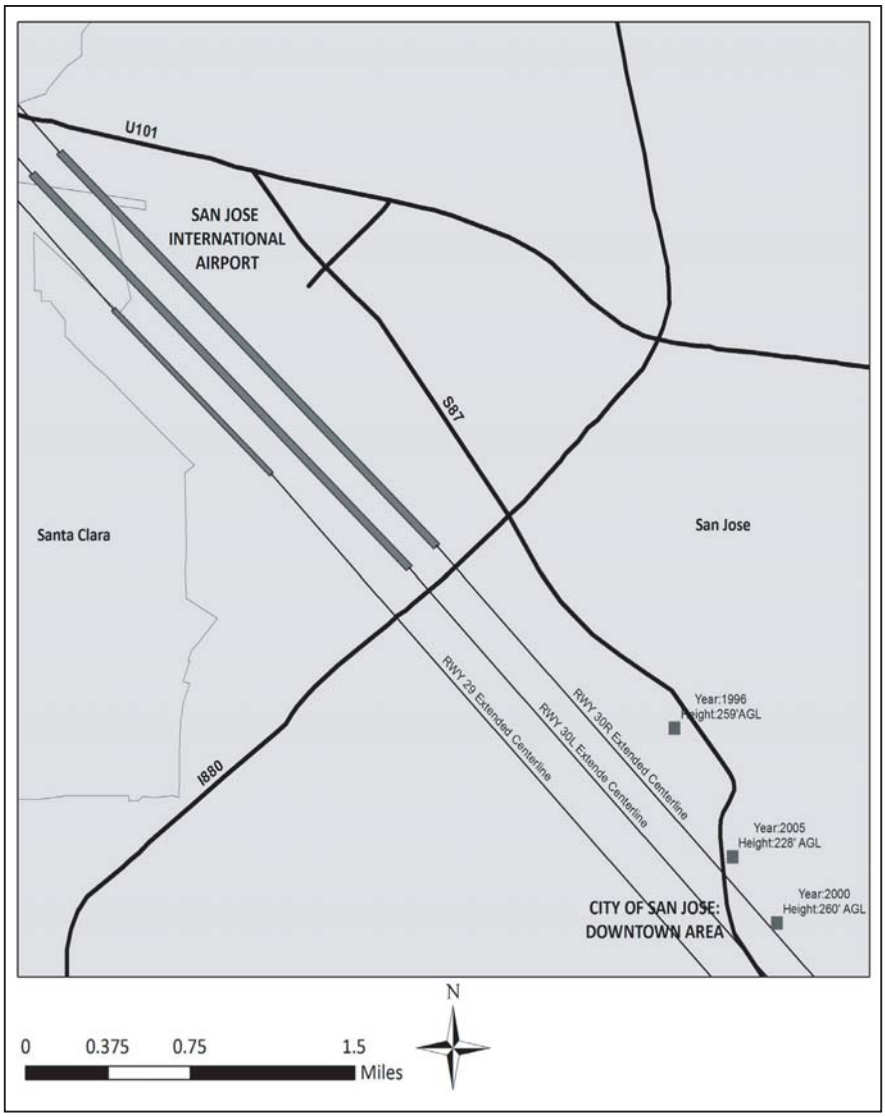


Figure D.23. Three buildings near SJC triggered some important concerns among airlines, airport, and city staff. Terrain in the downtown area is approximately 30 feet higher in elevation than the runways, exacerbating airspace protection issues.

would cause no worse effect than other existing buildings (aforementioned). However, the airlines were not, until that point, aware of the existing buildings, because they had never been reported to the National Aeronautical Charting Office, and were therefore not represented in the obstacle databases.

The FAA maintained the DNH determination. The structure was found to be an obstruction, penetrating FAR Part 77 imaginary surfaces and other obstruction criteria. However, the published climb gradients for Runways 12L and 12R, which were already higher than standard due to other existing buildings in the downtown area, were not found to be impacted by the proposed structure; nor any other TERPS procedures would indicate hazard status. The FAA reports negotiations with the project sponsor, in which the sponsor was unwilling to lower the height of the structure. As a result, DNH was issued at the originally requested height, subject to obstruction marking and lighting requirements.

The following passage, taken directly from the FAA 2005 DNH letter, ASN 2005-AWP-2553-OE, clearly states many of the issues.

THIS PROPOSAL IS FOR A 22-STORY HIGHRISE RESIDENTIAL CONDOMINIUM, THE ALMADEN TOWER, ON A SITE BOUNDED BY SANTA CLARA, NOTRE DAME, CARLYLE, AND ALMADEN, IN SAN JOSÉ, CALIFORNIA. THE CLOSEST PUBLIC-USE LANDING AREA TO THIS PROPOSED STRUCTURE IS SAN JOSÉ INTERNATIONAL AIRPORT (SJC).

THIS POINT OF THE 228-FT ABOVE GROUND LEVEL (AGL) STRUCTURE IS LOCATED 2.33 NAUTICAL MILES (NM) FROM THE (SJC) AIRPORT REFERENCE POINT; 8,671 FEET FROM THE RUNWAY 30R PHYSICAL APPROACH END, THE CLOSEST RUNWAY.

THIS POINT OF THE STRUCTURE IS IDENTIFIED AS AN OBSTRUCTION BY EXCEEDING THE STANDARDS OF FEDERAL AVIATION REGULATION (FAR) PART 77, SUBPART C, AS FOLLOWS:

77.23(a)(2), BY 28 FEET, A HEIGHT MORE THAN 200 FEET AGL, AT THE SITE, WITHIN 3 NM OF THE (SJC) REFERENCE POINT.

77.25(a), BY 97 FEET, A HEIGHT EXCEEDING THE (SJC) HORIZONTAL SURFACE.

77.25(d), BY 78 FEET, A HEIGHT EXCEEDING THE (SJC) RUNWAY 30L APPROACH SURFACE.

77.23(a)(3), BY 31 FEET, A HEIGHT PENETRATING THE (SJC) RUNWAY 12R 40:1 DEPARTURE SURFACE.

77.23(a)(3), BY 32 FEET, A HEIGHT PENETRATING THE (SJC) RUNWAY 12L 40:1 DEPARTURE SURFACE.

NEGOTIATION WAS ATTEMPTED BETWEEN THE FAA AND THE CONSTRUCTION SPONSOR TO REDUCE THE STRUCTURE HEIGHT IN ORDER TO MITIGATE THE PENETRATION OF ONE OR MORE OF THE OBSTRUCTION STANDARDS. THE SPONSOR WAS UNWILLING TO REDUCE THE STRUCTURE HEIGHT.

THE PROPOSAL WAS CIRCULARIZED FOR PUBLIC COMMENT AT THE FILED HEIGHT.

COMMENTS WERE RECEIVED FROM;

ALASKA AIRLINES
SOUTHWEST AIRLINES
AMERICAN AIRLINES
THE CITY OF SAN JOSÉ AIRPORT DEPARTMENT
SANTA CLARA COUNTY AIRPORT LAND USE COMMISSION (ALUC)
LEIGH FISHER ASSOCIATES
ANKROM MOISAN

THE COMMENTS WITH OBJECTIONS CITED THE POTENTIAL FOR THE STRUCTURE HEIGHT AT THIS SITE TO IMPACT ENGINE-OUT OPERATING PROCEDURES, WITH RESULTANT WEIGHT PENALTIES IN THE FORM OF OFF-LOADING EITHER PASSENGERS OR FUEL.

THE COMMENTS WITH OBJECTIONS ALSO CITED INCOMPATIBILITY WITH THE ALUC PLAN FOR (SJC) BECAUSE OF FAR PART 77 OBSTRUCTION STANDARD PENETRATION.

FAA EVALUATION FINDS THAT THE CURRENT PUBLISHED CLIMB GRADIENT FOR (SJC) RUNWAY 12R IS 255 FEET PER NM, AND FOR RUNWAY 12L IS 278 FEET PER NM. ALTHOUGH THE STRUCTURE HEIGHT PENETRATES THE 40:1 DEPARTURE SURFACES FOR THESE RUNWAYS, THE EXISTING PUBLISHED CLIMB GRADIENTS ARE HIGHER THAN REQUIRED FOR THIS OBSTACLE.

FAA EVALUATION FINDS THAT ECONOMIC IMPACT UPON AIRLINE OPERATIONS IS NOT, IN ITSELF, A BASIS FOR A HAZARD DETERMINATION.

FAA EVALUATION FINDS THAT PENETRATION OF FAR PART 77 OBSTRUCTION STANDARDS IS NOT, IN ITSELF, A BASIS FOR A HAZARD DETERMINATION.

FAA EVALUATION FINDS THERE WOULD BE NO SIGNIFICANT ADVERSE EFFECT UPON VISUAL FLIGHT RULES (VFR) OPERATIONS, OR UPON INSTRUMENT FLIGHT RULES (IFR) OPERATIONS, OR UPON THE OPERATION OF AN AIR NAVIGATION AID (NAVAID), IF THE STRUCTURE AT THIS POINT WERE BUILT ONLY TO THE MAXIMUM PROPOSED HEIGHT.

THIS MAXIMUM HEIGHT SHALL INCLUDE ALL ROOF-MOUNTED APPURTENANCES, INCLUDING THE RECOMMENDED RED OBSTRUCTION LIGHTING SYSTEM.

UPON THE STRUCTURE REACHING ITS MAXIMUM HEIGHT, THE SPONSOR SHALL SUBMIT FAA FORM 7460-2, SUPPLEMENTAL NOTICE INFORMATION, WHICH WILL BE USED FOR AERONAUTICAL CHARTING PURPOSES. THE SPONSOR SHALL INCLUDE A 1A-ACCURACY ASBUILT SURVEY ATTACHED TO THE FORM 7460-2.

FAA EVALUATION FINDS THAT THE CUMULATIVE EFFECT OF THE PROPOSED STRUCTURE AT THIS POINT, WHEN COMBINED WITH OTHER PROPOSED AND PREVIOUSLY STUDIED EXISTING STRUCTURES OF SIMILAR HEIGHT IN THE VICINITY, IS NOT CONSIDERED SUBSTANTIAL.

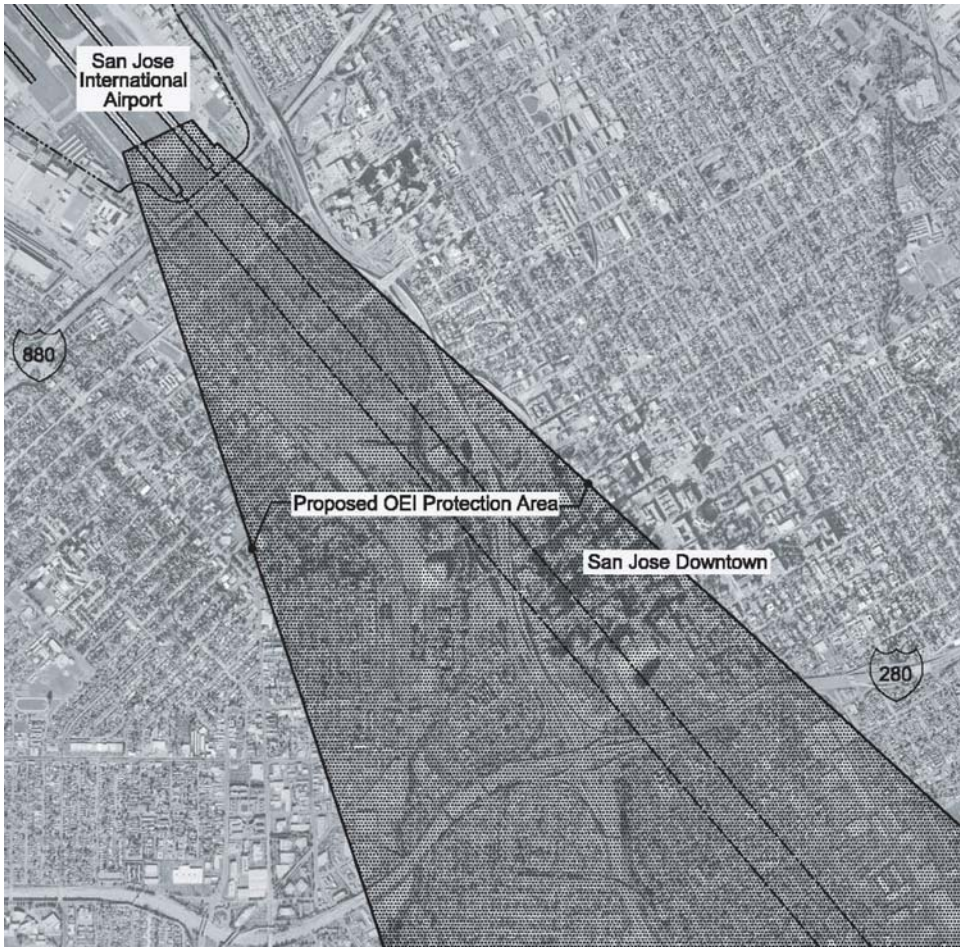
THE PROPOSED STRUCTURE HEIGHT WOULD HAVE NO GREATER EFFECT UPON THE SAFE AND EFFICIENT UTILIZATION OF THE NAVIGABLE AIRSPACE.

This situation brought two major concerns to the surface: first, it became clear that the airlines' OEI concern would need to be addressed outside of the standard FAA OE/AAA process; and second, communication with the FAA, and in particular, developing a reliable obstruction database would be an important short term need. The second concern was resolved by conducting field surveys and observations to compare the obstruction database with actual obstructions or potential obstructions. The first concern, however, is more multidimensional, and remains a point of debate to the present date.

Answering the question 'should OEI procedures be protected and by whom?' is complicated and is often a matter of degree. The FAA has made a policy decision generally not to protect OEI procedures reasoning that changes in OEI procedures will result purely in economic impacts. Yet, commercial service airports need airlines to thrive, and airlines need the airspace to design economically viable procedures if they are to continue service. SJC staff realized that this dynamic was critical to understand, so they have spent the past several years developing a local policy solution to the OEI problem.

One possible solution is for the City of San José to adopt a policy to protect a single OEI corridor, which would have to be shared by all airlines, allowing airlines to continue the provision of long-haul service. Figure D.24 illustrates a proposed 'OEI Corridor' (shaded area) that the City, if adopted, would protect by enforcing building height limitations that are sometimes lower than the maximum no-hazard height obtained through the OE/AAA process within this area.

This proposal has raised some important debates regarding the balance between the benefits of construction of tall structures in and around the City's downtown and the desire to maintain, support, and promote the Airport. Recently, the City has completed the extension of both main runways to 11,000 feet and constructed a new Federal Inspection Services (FIS) immigration and customs facility to accommodate and promote trans-oceanic air service at SJC. The City's expenditures on these Airport improvements demonstrates this commitment.



SOURCE: Jacobs Consultancy, City of San Jose Airport Department

Figure D.24. A possible policy solution for the OEI challenge at SJC: Local protection of a pre-defined OEI Corridor.

These interests support one another, yet land development may have a more immediate and obvious value to the City than the less tangible asset of navigable airspace. Through intelligent dialogue among the various City agencies and stakeholders on all sides, it is the hope of all involved that an ordinance will be adopted in the near future that will allow the maximum feasible development heights in the downtown area while maintaining the safety, utility, and air service capabilities of the Airport.

Airport Department staff members learned a great deal in the past several years. Their experiences have guided them toward building a stronger airspace protection policy. While the OEI corridor is the main issue that remains to be resolved, the Airport is developing other proactive strategies with their newfound airspace knowledge. Working with consultants, they have developed an airspace surface mapping tool that uses FAR Part 77, TERPS and OEI surfaces to estimate the maximum feasible building height at a given location. Also, they actively monitor proposed construction activity around the airport, an effort which is supported by subscribing to automatic notifications from the FAA's OE/AAA website. However, this alone does not guarantee positive collaboration between the Airport and project sponsors. For Airport Department staff, it is still demanding to manage the myriad criteria internally, let alone communicating the criteria and their corresponding regulations to external inquirers, including city staff from other departments.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation