Appendix D — Learning More About: Protecting and Evaluating Airspace for Airports

Introduction

Tall structures, smoke, and rising terrain are just a few conditions that can create hazardous conditions for aircraft. Therefore, protecting against them is essential to promoting effective land use compatibility adjacent to airports. Land uses that are hazards to flight may also impact an airport's continued viability and its ability to promote economic development through navigation and other improvements that are necessary in facilitating transportation access to communities. This appendix presents guidance to assist airports operators, planners, local jurisdictions, and land use developers on how to identify and protect critical airspace for aircraft landing and departing from airports.

Tall Structures

A graphic depiction of airspace obstructions (worst case scenario).

According to Chapter 14.12 RCW, an airspace 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 landing, taking-off and maneuvering of aircraft thus tending to destroy or impair the utility of the airport and the public investment. Accordingly, it is hereby declared:

(1) That the creation or establishment of an airport hazard is a public nuisance and an injury to the community served by the airport in question;

(2) That it is therefore necessary in the interest of the public health, public safety, and general welfare that the creation or establishment of airport hazards be prevented; and

(3) That this should be accomplished, to the extent legally possible, by exercise of the police power, without compensation.

It is further declared that both the prevention of the creation or establishment of airport hazards and the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards are public purposes for which political subdivisions may raise and expend public funds and acquire land or property interests therein."

There are three basic types of airspace hazards that must be considered when establishing land use compatibility policies to protect critical airspace:

- **Height Hazards** – The best recognized among airspace hazards is the potential for structures or tree or the use of land which would obstruct the flight paths of aircraft operating at the airport or would otherwise be hazardous to such landing and taking-off of aircraft at an airport.
- **Wildlife Hazards** – Bird strikes are the most common type of wildlife hazards to aircraft operations on and near airports, but animals such as deer and coyotes are also a significant factor at airports.
- **Other Physical, Visual, or Electronic Hazards** – Thermal plumes from power plants, smoke, glare, and light can also impact aircraft operations.

Local Role in Addressing Airspace Hazards

The standards for identifying obstructions to airspace are set forth in Federal Aviation Regulations (FAR) Part 77 *Imaginary Surfaces*. However, local jurisdictions play a critical role in protecting the airspace around airports from airspace hazards. This is particularly important because the FAA does not have enforcement authority to regulate local land uses. Cities and counties are also on the front lines of the land use permitting process and can provide early notification and assistance to affected development proposals early in the life of a project before large sums of resources are consumed.

Since the mid 1940s, the state has enacted several pieces of legislation to address airspace hazards and other land use activities that may be incompatible with airport operations. State legislation has authorized city and county jurisdictions to adopt comprehensive plans and establish development regulations under their police powers to prevent the creation or establishment of hazards and to discourage incompatible land uses. Under this authority, jurisdictions can adopt, administer, and enforce regulations in a manner that specifies the land uses permitted or restricted. To that end, many implementation tools are available to jurisdictions to control land uses that may impact public use airports. One of the most successful tools that a jurisdiction can adopt for regulating airspace is the development of an airspace hazard overlay. The airspace hazard overlay is a diagram with text that defines critical airspace surfaces around an airport, and provides regulatory criteria that can be used to avoid, minimize or mitigate obstruction. More information on overlay regulations is provided in Chapter 4.

Where an airport is owned or controlled by another jurisdiction, the jurisdiction owning or controlling the airport and the jurisdiction in which the airport is located may by ordinance or resolution create or authorize a joint agreement to adopt, administer, and enforce regulations to regulate land uses to address hazards. Procedures for adopting comprehensive plans and regulations should follow established state and local procedures.

Using the Airport Master Plan

If available, the Airspace Drawing which is prepared as part of the Airport Master Plan and Airport Layout Plan, is a useful tool in identifying critical airspace surfaces and obstruction issues. The airspace plan uses contour elevations to depict a three dimensional diagram of the Part 77 surfaces as they relate to a specific airport.

The Part 77 airspace diagram is overlayed onto a USGS map or other scaled topographic map to graphically portray the relationship between existing landforms and airspace surfaces. Some obstruction detail may already be identified on the airspace drawings. Before relying on the information in the Airspace Drawing, it is important to make certain that the background information which was used to size of Part 77 airspace surfaces addresses future airport improvements such as proposed extensions in the airport runway.

Limits on Federal Authority Under Part 77

The FAA's authority to promote the safe and efficient use of the navigable airspace, whether concerning existing or proposed structures, is predominantly derived from Title 49 USC Section 44718 (Section 44718). However, Section 44718 does not provide specific authority for the FAA to regulate or control land uses activity. The FAA strongly recommends that local governments having jurisdiction over land use activities establish airspace regulations to control obstructions to the FAR Part 77 Surfaces.

Federal action in response to new airspace obstructions is primarily limited to three possibilities:

- For airports with instrument approaches, an obstruction could necessitate modification to one or more of the approach procedures (particularly greater visibility and/or cloud ceiling minimums) or even require elimination of an approach procedure.
- Airfield changes such as displacement of a landing threshold could be required, which would shorten the available runway length for departing and arriving aircraft.
- The airport sponsor could be found in noncompliance with the conditions agreed to upon receipt of grant funds and could become ineligible for future grants (or, in extreme cases, be required to repay part of a previous grant).

Thinking in Multi-Dimensional Levels

The space around airports is conceptualized as conical surfaces and depicted as an inverted cone superimposed over the dimensions of the airport. For the purposes of this discussion, it is helpful to think of the space above and around an airport, in multi-dimensional terms:

- The vertical element encompasses the space above the airport containing the approach to the airport and other flight critical elements.
- The horizontal element encompasses the ground space Immediately underneath aircraft approach and transitional areas.

Height Hazards: Attributes and Issues

The loss of navigable airspace to non-aviation uses particularly within the flight critical airspace of an airport can creates a hazard to flight activity, aircraft passengers, and to people and property on the ground; additionally, these obstructions inhibit the safe and efficient operation of the airport, in general. Two things are necessary to fully understand the seriousness of airspace obstructions: one, the concept of imaginary surfaces and their relationship to the airport, and two, the nature of flight in the vicinity of an airport.

Runway Approaches

As previously mentioned, the size of a runway's imaginary surface is determined by the type of approach established for each runway end:

- **Visual** – Visual approach is the most basic approach; no special navigational aids are required, reasonable weather conditions are necessary, and the approach slope is 20:1.
- **Non-Precision** – A non-precision approach is an instrument approach and landing which utilizes lateral guidance but does not utilize vertical guidance. Non-precision approaches are often conducted with less use of automated systems than precision approaches. The approach slope is 34:1.
- **Precision** – Special navigational support; approach is always aligned with a specific runway and is related to a specific glide path; approach slope 50:1 for inner 10,000 feet, then 40:1 for outer 40,000 feet; weather conditions not as important as reliance for safe landing is upon instruments; often served by an Instrument Landing System, sometimes a Microwave Landing System, and soon a Global Positioning Satellite approach. Precision approaches are typically found at busier facilities.

Defining FAR Part 77 Obstruction Surfaces

Obstruction surfaces (often also referred to as imaginary surfaces) define the critical flight areas in airspace around an airport. FAR Part 77 *Objects Affecting Navigable Airspace* delineates these surfaces based upon the category of the airport runway and the category of runway approach.

The three-dimensional airspace above civil airport runways that requires protection from obstructions is bordered by five surfaces. These surfaces are defined in Part 77 Section 77.25 and are illustrated. The five surfaces are: Primary Surface, Transitional Surface, Horizontal Surface, Conical Surface, and Approach Surface.

- **Primary Surface** – The primary surface must be clear of all obstructions except those fixed by their function, such as runway edge lights, navigational aids, or airport signage. The majority of the primary surface is already controlled by runway safety area criteria contained in FAA AC 150/5300-13, *Airport Design Standards*, and therefore does not warrant inclusion as a land use zone.

  Even though the primary surface is not included as a land use zone, it functions as an important safety area since it is longitudinally centered on a runway and is intended to provide an obstruction-free area around the runway surface. When the runway has a prepared hard surface, the primary surface extends 200 feet beyond each end of that runway.

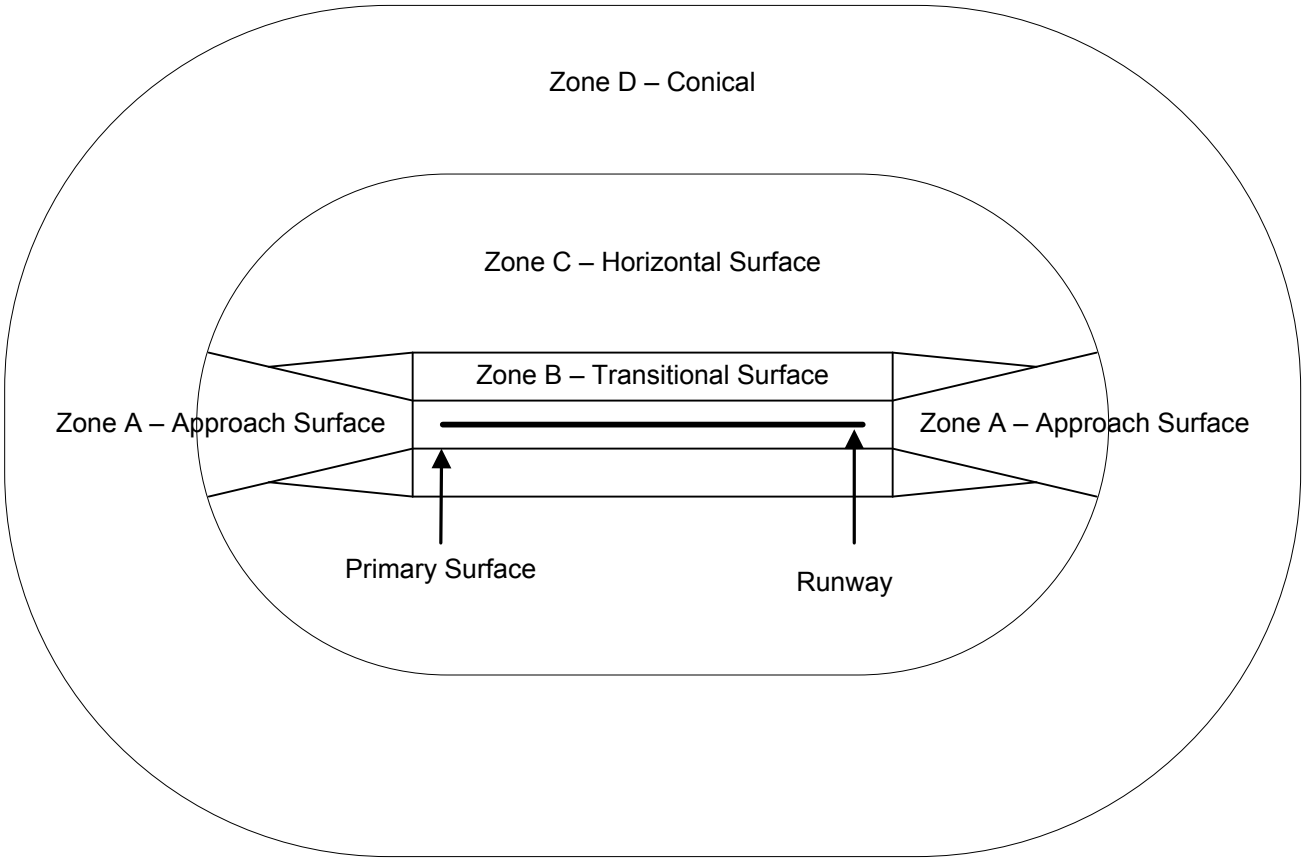
When the runway does not have a prepared hard surface, or planned hard surface, the primary surface terminates at each end of the runway. The width of a primary surface ranges from 250 to 1,000 feet depending on the existing or planned approach and runway type (visual, non-precision, or precision).

- **Transitional Surface** – The transitional surface extends outward and upward at right angles to the runway centerline and extends at a slope of 7 feet horizontally for each 1-foot vertically (7:1) from the sides of the primary and approach surfaces. The transitional surfaces extend to the point at which they intercept the horizontal surface at a height of 150 feet above the established airport elevation. For precision approach surfaces that project through and beyond the limits of the conical surface, the transitional surface also extends 5,000 feet horizontally from the edge of the approach surface and at right angles to the runway centerline.
- **Horizontal Surface** – The horizontal surface is a horizontal plane located 150 feet above the established airport elevation and encompasses an area from the transitional surface to the conical surface. The perimeter is constructed by generating arcs from the center of each end of the primary surface and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc for all runway ends (designated as utility or visual) is 5,000 feet and 10,000 feet for precision and non-precision runway ends.
- **Conical Surface** – The conical surface extends upward and outward from the periphery of the horizontal surface at a slope of 20 feet horizontally for every 1-foot vertically (20:1) for a horizontal distance of 4,000 feet. Height limitations for the surface range from 150 feet above the airport reference elevation at the inner edge to 350 feet above ground level (AGL) at the outer edge.
- **Approach Surface** – The approach surface is longitudinally centered on the extended runway centerline and extends outward and upward from the end of the primary surface. The approach slope of a runway is a ratio of 20:1, 34:1, or 50:1, depending on the approach type. The length of the approach surface varies from 5,000 to 50,000 feet and also depends upon the approach type. The inner edge of the approach surface is the same width as the primary surface and expands uniformly to a width ranging from 1,250 to 16,000 feet, depending on the type of runway and approach.

Figure D-1 and Table D-1 depict various dimensional requirements for the primary surface and other FAR Part 77 surfaces. A visual approach runway has relatively small surfaces with approach and horizontal surfaces extending 5,000 feet from the primary surface at an approach slope of 20 feet horizontally for each 1-foot vertically (20:1). For a non-precision approach runway, both the approach and horizontal surfaces extend either 5,000 or 10,000 feet from the primary surface, depending on the design category of the runway. The approach surfaces for precision approach runways are similar to those for non-precision approach runways except that the approach surface extends 50,000 feet from the primary surface, and the horizontal surface extends 10,000 feet from the primary surface.

New approach procedures that use Global Positioning Systems (GPS) such as Area Navigation (RNAV), and Lateral Precision with Vertical Guidance (LPV) approaches, which create a greater degree of flexibility in the definition of non-precision and precision instrument approaches. The FAA has not altered the text related to FAR Part 77 to reflect these changes to date.

Figure D-1
Part 77 Obstruction Surfaces
(One Utility Runway - Visual Approach)



Source: Federal Aviation Administration

Table D-1
FAR Part 77 Surface Dimensional Requirements

Dim.	Item	Dimensional Standard (feet)					
		Visual Runway		Non-Precision Instrument Runway			Precision Instrument Runway
		Utility	Larger Than Utility	Utility	Larger Than Utility X	Larger Than Utility Y	
A	Width of primary surface and approach surface width at inner end	250	500	500	500	1,000	1,000
B	Radius of horizontal surface	5,000	5,000	5,000	10,000	10,000	10,000
Dim.	Item	Visual Approach		Non-Precision Instrument Approach			Precision Instrument Runway
		Utility	Larger Than Utility	Utility	Larger Than Utility X	Larger Than Utility Y	
C	Approach surface width at end	1,250	1,500	2,000	3,500	4,000	16,000
D	Approach surface length	5,000	5,000	5,000	10,000	10,000	*
E	Approach slope	20:1	20:1	20:1	34:1	34:1	*

X Visibility minimums greater than ¾ mile.
Y Visibility minimums as low as ¾ mile.
* Precision instrument approach slope is 50:1 for inner 10,000 feet and 40:1 for an additional 40,000 feet.

How to Perform a FAR Part 77 Airspace Assessment

Getting Started – Data Collection Checklist

Before making an airspace assessment, be sure to gather basic information about the airport, structure, and geography. Do you have the following information?[1]

- Structure height _____
- Mean Sea Level (MSL) elevation of the terrain under the structure _____
- The distance, in a straight line, from the nearest point on runway to the structure _____
- Runway elevation (MSL) _____
- Approach type _____
- Runway length[2] _____
- Runway weight-bearing capacity _____
- Do you have a FAR Part 77 Airspace Diagram[3] _____

The Assessment – Step by Step

Step 1: Identify Type of Runway and Approach

Use the information from the data collection checklist to identify the runway approach type, runway length, and weight-bearing capacity. Then apply it to the table below to obtain the airspace dimensional standards for the runway.

There are two types of Visual Runway:

1. **Utility** – Accommodates aircraft less than 12,500 pounds.
2. **Larger Than Utility** – Accommodates aircraft more than 12,500 pounds.

There are three types of Non-Precision Instrument Runway:

1. **Utility** – Accommodates aircraft less than 12,500 pounds.
2. **Larger Than Utility** – Accommodates aircraft more than 12,500 pounds.
   - **Larger Than Utility X** – Accommodates aircraft more than 12,500 pounds with visible minimums greater than ¾ a mile.
   - **Larger Than Utility Y** – Accommodates aircraft over 12,500 pounds with visible minimums as low as ¾ a mile.

[1] Open-source software such as Google Earth™ and ArcGIS® Explorer can assist you in locating and obtaining basic distance and elevation data.

[2] Runway data for Washington State airports is available from the following sources: www.wsdot.wa.gov/aviation/allstateairports/default.htm and www.gcr1.com/5010web

[3] The FAA's FAR Part 77 Airspace Diagram is available at: www.wsdot.wa.gov/aviation/planning/civapimagsurf
Additional information about the FAA's FAR Part 77 and airspace obstructions is available at: www.wsdot.wa.gov/aviation/planning/default and www.faa.gov/airports_airtraffic/airports/regional_guidance/central/construction/part77

There is one type of precision instrument runway approach: precision instrument approach.

Slope Ratio (Run and Rise) – Now use and mapping resources to identify which airspace surface your structure falls under. This will give you the exact surface and slope ratio necessary for your airspace assessment.

Use Table D-1 to identify the applicable FAR Part 77 surfaces and dimensional standards in feet for your airport.

Step 2: Determining the Structure Height

Use the following simple equation to determine the height of the proposed structure.

A = Elevation of terrain under structure _____

B = Height of Structure _____

A	+	B	=	Obstruction Height
_____	+	_____	=	_____

Step 3: Subtract the Airport Elevation to Find Total Obstruction Height

Airport Runway Elevation	-	Obstruction Height from Step 2	=	Total Height of possible obstruction or (X)
_____	-	_____	=	_____

Step 4: Determine the Distance From the Airport

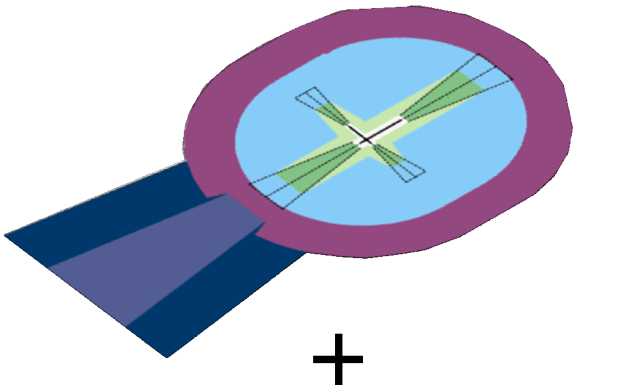
C = Distance from airport to proposed site _____

D = Slope Ratio _____ (See FAR Part 77 "Imaginary Surfaces" Diagram to determine necessary Ratio. Ratios include 7:1, 20:1, 34:1, 40:1 and 50:1)

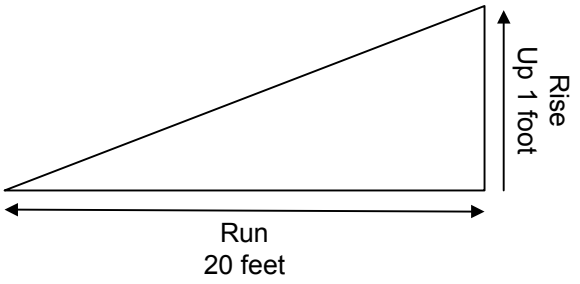
F = Allowable Height at proposed location

C	÷	D	=	F
_____	÷	_____	=	_____

FAR Part 77 Airspace Diagram



Map Resource

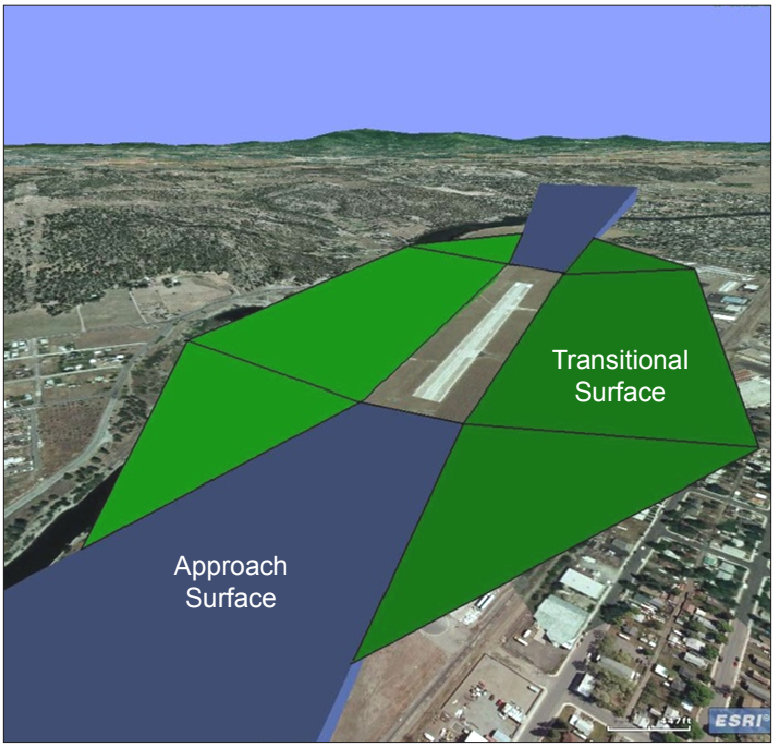


How the ratios work:
At a 20:1 ratio, for every 20 feet you go out, your elevation rises 1 foot.
At a 40:1 ratio, for every 40 feet you go out, your elevation rises 1 foot.

Step 5: Compare Obstruction Height to Allowable Height

Does the height of the Possible Obstruction (X) in Step 3 exceed the Allowable Height (F) in Step 4? If it does, then your structure penetrates the airspace surface. Air space assessments are just assessment: they provide a generalized idea of the structures relationship to the imaginary surface. Trained FAA professionals are the only individuals who should perform these highly specialized Aeronautical studies.

FAR Part 77 Transitional and Approach Imaginary Surfaces



The transitional surface can be one of the most difficult surfaces to understand, visualize, and measure. Note, the flared triangular portions are attached to the approach surface. This concept is critical to understanding the allowable height within these areas.

To calculate the allowable height within the flared triangular portions of the transitional surface, first determine the height of the closest point on the approach surface. Then measure from the approach surface point using a 7:1 run rise. This should give you a general idea of the allowable height in this area.

Remember, airspace assessments are used for general planning purposes only. Aeronautical studies are highly specialized and should only be performed by trained FAA professionals.

Role of the FAA in Regulating Airspace Hazards

As previously discussed above and in Chapter 4, the FAA has limited authority and scope to ensure that the imaginary surfaces described in FAR Part 77 are free of obstructions. To help ensure protection of the airspace essential to the safe operation of aircraft at and around airports, the FAA has established a process that requires project proponents to inform the agency about

No Objection – The subject construction did not exceed obstruction standards and marking/lighting is not required.

Conditional Determination – The proposed construction/alteration would be acceptable contingent upon implementing mitigating measures (marking and lighting, etc.)

Objectionable – The proposed construction/alteration is determined to be a hazard and is thus objectionable. The reasons for this determination are outlined to the proponent.

A Determination of No Hazard indicating that it has no objection to a proposed construction does not mean that the proposal is compatible with the airport.

The standards by which this airspace is defined are set forth by the federal government in Federal Aviation Regulations Part 77 (FAR Part 77) *Objects Affecting Navigable Airspace* (officially Title 14, Part 77 of the Code of Federal Regulations or 14 CFR Part77). Additionally, FAR Part 77 establishes requirements for notifying the FAA with regard to any proposed construction that could be deemed a hazard and it provides for aeronautical studies of these proposals to be conducted by the FAA.

Notification Requirements

Note that these notification sur-faces have a much shallower slope and extend farther from the runway than the obstruction surfaces typically shown in an airspace plan as described below.

Subpart B of the Part 77 regulations requires that the FAA be notified of any proposed construction or alteration within 20,000 feet of a runway and having a height that would exceed a 100:1 imaginary surface (1 foot upward per 100 feet horizontally) beginning at the nearest point of the runway. This requirement applies to runways more than 3,200 feet in length. For shorter runways, the notification surface has a 50:1 slope and extends 10,000 from the runway. Notification is required with regard to any public-use or military airport. Also requiring notification is any proposed object more than 200 feet in height regardless of proximity to an airport.

Exceptions to the notification requirement are allowed 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 would not adversely affect safety in air navigation."

When determining the height of structures, it is important to consider all of its components including elevator shafts, flag poles, and antennas that would extend above the roof level. Furthermore, proposed objects do not need to be permanent to require submittal of a notification. Notice also must be provided for temporary objects such as construction cranes. Such objects are critically important to airspace protection in that they often are taller than the ultimate height of the structure. Mobile objects on roads must be taken into account as well. To allow for vehicles, 17 feet must be added to the road elevation of Interstate highways, 15 feet added for other public roadways, and 10 feet to private roads. A 23-foot clearance over railroad lines is required.

The notification is to be provided using FAA Form 7460-1, Notice of Proposed Construction or Alteration. These days, the notice can be submitted on-line (https://oeaaa.faa.gov/oeaaa/external/portal.jsp) Receipt of the notice enables the FAA to evaluate the effect of the proposed object on air navigation and chart the object or take other appropriate action to ensure continued safety.

There is no cost for filing the Form 7460 notice. However, persons failing to comply with the provisions of FAR Part 77 are subject to Civil Penalty under Section 902 of the Federal Aviation Act of 1958, as amended and pursuant to 49 USC Section 46301(a).

By definition, any object that penetrates one of the imaginary surfaces is deemed an obstruction to air navigation. Not all obstructions are necessarily hazards, however. The determination of whether an object would be a hazard to air navigation is made as part of an aeronautical study conducted by the FAA as described below. However, the determination may not address cumulative impacts, or be consistent with the local jurisdictions own land use regulations, and may allow penetration of FAR Part 77 *Surfaces*.

In general, local governments should restrict the heights of objects near airports to below the FAR Part 77 Subpart C *Obstruction Surfaces*. Exceptions can be made for areas of high terrain, objects that are shielded by taller nearby objects, and objects that the FAA has determined to not be hazards. To assist in this regard, the state has several model zoning ordinances on file that are available to local governments. The model ordinance is built around the airspace plan drawing.

📖 www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.information/documentNumber/150_5190-4A

Aeronautical Studies

When the FAA receives a notice submitted by the project proponent in accordance with Subpart B requirements, Subpart D dictates that the FAA conduct an aeronautical study of the proposal.

The responsibility for preventing hazardous obstructions to airport airspace rests with state and local governments and the airport operator. The FAA merely provides technical expertise.

"In the aeronautical studies, present and future IFR and VFR aeronautical operations and procedures are reviewed and any possible changes in those operations and procedures and in the construction proposal that would eliminate or alleviate the conflicting demands are ascertained."

Several divisions of the FAA are involved in conducting aeronautical studies. Each division contributes to the review based on its particular area of expertise. The regulations do not specify a time limit for the FAA to complete an aeronautical study, but a typical turn-around time is 30 to 45 days.

After the FAA completes its aeronautical study of the proposed construction, it usually issues a form letter indicating its determination as to whether the specific proposal studied would be a hazard to air navigation. If the object is shielded by other taller objects or is located away from the normal traffic patterns and instrument approach routes, the outcome in most cases will be a "Determination of No Hazard" even if the object is technically an obstruction. As a condition for non-objection, the FAA may recommend that the object be marked and lighted in accordance with FAA standards.

If the aeronautical study finds that the object could adversely affect air navigation, the FAA will work with the proponent to seek modification to eliminate the problem. Adjustments to aviation requirements that would accommodate the proposed object are investigated as well. Ultimately, a "Determination of Hazard" could be issued.

Critical Concept!
Simply because the FAA has issued a Determination of No Hazard indicating that it has no objection to a proposed construction does not mean that the proposal is compatible with the airport.

Even under these circumstances, however, the determination is advisory and the FAA has no authority to prevent construction of the object. Federal action in response to new airspace obstructions is primarily limited to three possibilities:

- For airports with instrument approaches, an obstruction could necessitate modification to one or more of the approach procedures (particularly greater visibility and/or cloud ceiling minimums) or even require elimination of an approach procedure.
- Airfield changes such as displacement of a landing threshold could be required (especially at airports certificated for commercial air carrier service).
- The owner of an airport could be found in noncompliance with the conditions agreed to upon receipt of airport development or property acquisition grant funds and could become ineligible for future grants (or, in extreme cases, be required to repay part of a previous grant).

In the broader context of airport land use compatibility planning, the significance and limitations of FAA aeronautical study determinations are essential to recognize. These studies only address airspace issues. Simply because the FAA has issued a Determination of No Hazard indicating that it has no objection to a proposed construction does not mean that the proposal is compatible with the airport. Project proponents are known to wave the FAA determination in front of local decision makers and say that, because the federal government has no concerns, the local agency should approve the proposal. Compatibility with regard to noise, the density or intensity or the land use, and other factors also must be considered in the local decision. Height of the structure and its affect on airspace is only one part of the puzzle.