



CHAPTER 3: COMPATIBLE AIRPORT LAND USES



*Introduction*²¹

This chapter first discusses the two primary categories of compatibility risks to airports: (1) Uses that put too many people on the ground in harm's way (e.g., a dense residential subdivision or gathering place like a sports stadium); and (2) Airspace obstructions (such as tall buildings and towers) and uses that interfere with actual aircraft flight or may distract pilots (such as those that emit smoke). It then presents a detailed compatible land use table that local governments may utilize in their local zoning ordinances and in development reviews to help protect airport operations and the public safety.

What are the Primary Compatibility Concerns?

With careful planning, development can be accommodated and even encouraged within the airport vicinity. Too often, however, local governments review and approve uses and structures with little thought of how they might affect airport operations. Local officials may make decisions detrimental to an airport for a variety of reasons, including the promise of substantial fiscal benefits from certain types of commercial uses, or simply unawareness about how a perfectly acceptable development in other circumstances can have potentially devastating impacts on airport operations and public safety.

This section explores the two primary categories of compatibility risks to airports: (1) Uses that put too many people on the ground in harm's way; and (2) Airspace obstructions and uses that may interfere with actual aircraft flight or may distract pilots.

CHAPTER 3 OVERVIEW

- Introduction
- What Are the Primary Compatibility Concerns?
- An Alternative Approach to Regulating Compatible Land Uses

²¹ If this chapter is read in full, we recognize its contents may overlap with other discussions presented in other chapters. We believe most users will read specific chapters of this manual as needed and, therefore, we feel it is better to include some discussions that may be repetitive. Where possible, however, we have eliminated duplicate text and included cross references.



CONDITIONS THAT CREATE RISK OF INJURY TO PEOPLE ON THE GROUND AND DAMAGE TO PROPERTY

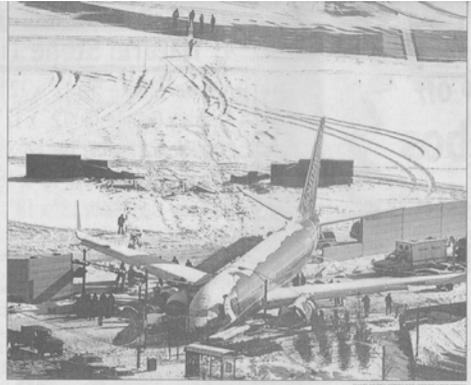
Limits on Intensity of Use and Building Density (Including Concentration of Residents/Users/Visitors to Specific Land Uses)

As discussed earlier in this manual, the greatest risk of an aviation-related accident is during takeoff and landing within a few miles of an airport, particularly in areas closest to the ends of the runway and the runway centerline extended. If there are few structures in this area, such as houses that pilots can avoid, the risk to both people on the ground and in the airplane is reduced significantly. The primary way to limit the risk of damage and personal injury from aviation accidents that occur near the airport is therefore quite simple—limit population and building density in the areas where aviation accidents are more likely to occur, particularly off the ends of runways.

More specifically, areas where aircraft regularly fly less than 500 feet above the ground, such as in Runway Protection Zones (RPZs), are regarded as the most critical. Low flight altitudes present the greatest risks because they offer pilots less opportunity to recover from unexpected occurrences. Because aircraft turn to follow the prescribed traffic pattern, this area encompasses more than just the area beneath the Federal Aviation Regulation (FAR) Part 77 approach surface. Turns predominantly take place between 2,000 and 5,000 feet from the runway end, depending upon the aircraft type, the number of aircraft in the traffic pattern, and the pilot's flying technique.

This raises a question regarding the degree of risk to which adjacent areas will be subjected. The most commonly used measure of acceptable development density in this context is the number of persons per acre. As discussed in detail in the following section of this chapter, a good regulatory approach is to ban certain high-density residential uses and places of public assembly in airport approach corridors (i.e., Safety Zones A and B) that, by their very character, attract or house large crowds of persons at one time (e.g., a sports stadium or church) or that exceed a specified population per acre density. Thus, for example, a residential development with a density of one dwelling unit per acre would not be allowed in Zone B, while a development that was developed at a lower density of one unit per three acres may be acceptable. Commercial and other nonresidential uses might be allowed only if they do not exceed specified densities for a particular type of use (e.g., industrial uses that house less than 15 persons/acre).

Choosing an appropriate development density to use as the threshold for permitted or prohibited uses near public airports is not an exact science. Jurisdictions around the country use varying density thresholds in their airport zoning rules and regulations. For example, since 1959, Minnesota has had in place rules prohibiting public assembly uses and limiting population and building density in Safety Zones A and B. Minnesota Rule



A Southwest Airlines jet rests at the intersection of West 55th and Central avenues in Chicago on Friday after crashing through a barrier and fence on Thursday. The jet struck several cars, killing a boy.

Midway crash boosts calls for buffer zones

By Mike Colias
 ASSOCIATED PRESS

CHICAGO — A deadly accident in which a Boeing 737 slid off the end of a snowy runway brought renewed demands Friday for buffer zones or other safety measures at hundreds of airports around the nation to give pilots a wider margin for error. In Thursday night's tragedy at Midway International Airport, a Southwest Airlines jet making a landing glowed through a fence and into a street, killing a 6-year-old boy who was a passenger in a car. Ten other people, most of them on the ground, were injured. The National Transportation Safety Board said the cause of the accident was still under investigation, and the plane's voice and data recorders were sent to Washington for analysis. But

Overrun safety
 An Engineered Material Arresting System (EMAS) provides enhanced overrun safety for commercial airports.



■ The system is composed of cellular-cement material and crushes under the weight of an aircraft to provide controlled deceleration in case of an overrun.
Source: Engineered Material Arresting System

much of the attention focused on the 6,500-foot runway. Like nearly 300 other U.S. commercial airports, Midway lacks 1,000-foot buffer zones at the ends of its runways. Midway, just 1 mile square, was built in 1923 during the propeller era and has shorter runways than most major airports, with no room to extend them because it is hemmed in by houses and businesses. Safety experts say such airports can guard against accidents by using beds of crushable concrete that slow an aircraft if it slides off the end of a runway. The concrete beds—called En-

Real life evidence supports the need for safety zone requirements, such as this accident that occurred at the Chicago Midway airport in December 2005.



8800.2400, containing these prohibitions and limits, is reprinted below (population and building density limits are highlighted in bolded text):

“Zone A shall contain no buildings, temporary structures, exposed transmission lines, or other similar land use structural hazards, and **shall be restricted to those uses which will not create, attract, or bring together an assembly of persons thereon.** Permitted uses may include, but are not limited to, such uses as agriculture (seasonal crops), horticulture, raising of livestock, animal husbandry, wildlife habitat, light outdoor recreation (non-spectator), cemeteries, and auto parking.”

“Zone B shall be restricted in use as follows. **Each use shall be on a site whose area shall not be less than three acres. Each use shall not create, attract, or bring together a site population that would exceed 15 times that of the site acreage.**”

“**Each site shall have no more than one building plot** upon which any number of structures may be erected. A building plot shall be single, uniform, and non-contrived area, whose shape is uncomplicated and **whose area shall not exceed the following minimum ratios with respect to the total site area.**” See Table 3-1 below.

“The following uses are **specifically prohibited** in zone B: **churches, hospitals, schools, theaters, stadiums, hotels and motels, trailer courts, camp grounds, and other places of public or semipublic assembly.**”

TABLE 3-1: ZONE B MINIMUM RATIOS

(Source: Minnesota Rule 8800.2400 (2005))

Site Area at Least (Acres)	But Less Than (Acres)	Ratio of Site Area to Building Plot Area	Building Plot Area (Square Feet)	Maximum Site Population (15 Persons/Acre)
3		12:1	10,900	45
	4	12:1		
4		10:1	17,400	60
	6	10:1		
6		8:1	32,600	90
	10	8:1		
10		6:1	72,500	150
	20	6:1		
20	and up	4:1	218,000	300

Comparison with Other States

Jurisdictions outside Minnesota have adopted similar density limits and prohibitions on public assembly uses for their airport safety zones, although the exact thresholds vary from place to place. Tables 3-2 through 3-4 below present population and building density guidelines adopted by California, Washington and Florida in their respective model airport zoning guides and regulations. Local government users of this manual should



reference the minimum Minnesota density standards stated in table 3-1 above, and the alternatives shown in Tables 3-2 through 3-4 below to guide local decisions about appropriate population and building density thresholds for particular land uses.

CALIFORNIA—GUIDELINES FOR DENSITY LIMITS ON USES IN AIRPORT SAFETY ZONES

In Table 3-2, the State of California provides guidance to local government and airport planners about the range of acceptable densities and intensities of compatible land uses located in the six California airport safety zones. A map of the six California airport safety zones is pictured following Table 3-2 for the reader's reference. It is important to note, however, that California's safety zones are allowed to vary in their size and shape depending on several factors, including the type of airport, the length of the runway, and type/intensity of aircraft traffic.

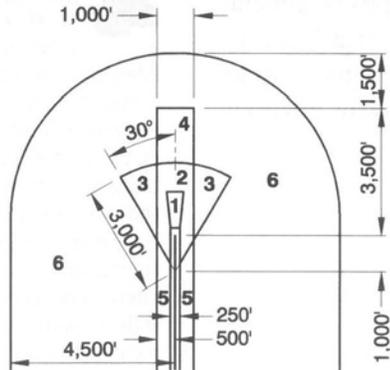
Translating California's six safety zones into Minnesota's three safety zones is difficult at best; however, for purpose of rough comparison only, Minnesota's Safety Zone A is approximately equivalent to California's Zone 1 (the RPZ) plus Zone 2 (Inner Approach/Departure Zone); Minnesota's Safety Zone B is roughly equivalent to California's Zone 4 (Other Approach/Departure Zone); and Minnesota's Safety Zone C is roughly equivalent to California's Zone 3 (Inner Turning Zone), Zone 5 (Sideline Zone), and Zone 6 (Traffic Pattern Zone).



TABLE 3-2: CALIFORNIA SAFETY COMPATIBILITY CRITERIA GUIDELINES						
Safety Compatibility Zones (Note 1)						
	(1) Runway Protection Zone	(2) Inner Approach/ Departure Zone	(3) Inner Turning Zone	(4) Outer Approach/ Departure Zone	(5) Sideline Zone	(6) Traffic Pattern Zone
Current Setting □	Maximum Residential Density					
	AVERAGE NUMBER OF DWELLING UNITS PER GROSS ACRE					
Rural Farmland / Open Space (Minimal Development)	0	Maintains current zoning if less than density criteria for rural / suburban setting				No limit
Rural / Suburban (Mostly to Partially Undeveloped)	0	1 d.u. per 10-20 ac.	1 d.u. per 10-20 ac.	1 d.u. per 10-20 ac.	1 d.u. per 10-20 ac.	No limit
Urban (Heavily Developed)	0	0	Allow infill development at up to average of surrounding residential area (Note 2)			No limit
Current Setting □	Maximum Nonresidential Intensity					
	AVERAGE NUMBER OF PEOPLE PER GROSS ACRE (NOTE 3)					
Rural Farmland / Open Space (Minimal Development)	0 (Note 4)	10-25	60-80	60-80	80-100	150
Rural / Suburban (Mostly to Partially Undeveloped)	0 (Note 4)	25-40	60-80	60-80	80-100	150
Urban (Heavily Developed)	0 (Note 4)	40-60	80-100	80-100	100-150	No limit (Note 5)
MULTIPLIERS FOR ABOVE NUMBERS (NOTE 6):						
Maximum Number of People per Single Acre	x 1.0	x 2.0	x 2.0	x 3.0	x 2.0	x 2.0
Bonus for Special Risk-Reduction Building Design	x 1.0	x 1.5	x 2.0	x 2.0	x 2.0	x 2.0
Notes:						
1) Clustering to preserve open land is encouraged in all zones.						
2) Residential infill development is appropriate only if nonresidential uses are not feasible.						
3) Certain uses should be prohibited regardless of usage intensity.						
4) Exceptions can be permitted for agricultural activities, roads, and automobile parking provided that FAA criteria are satisfied.						
5) Large stadiums and similar public assembly uses should be prohibited.						
6) Multipliers are cumulative (e.g. maximum intensity per single acre in inner safety zone is 2.0 times the average intensity for the site, but with risk-reduction building design is 2.0 x 1.5 = 3.0 times the average intensity).						
<i>Source: California Airport Land Use Planning Handbook, page 9-47, (January 2002)</i>						



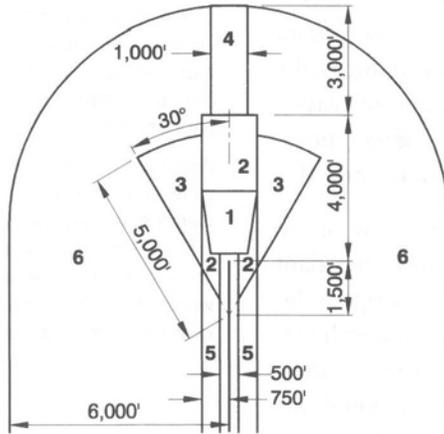
FIGURE 3-1: SAFETY COMPATIBILITY ZONE EXAMPLES FROM CALIFORNIA (GENERAL AVIATION RUNWAYS)



**Example 1:
Short General Aviation Runway**

Assumptions:

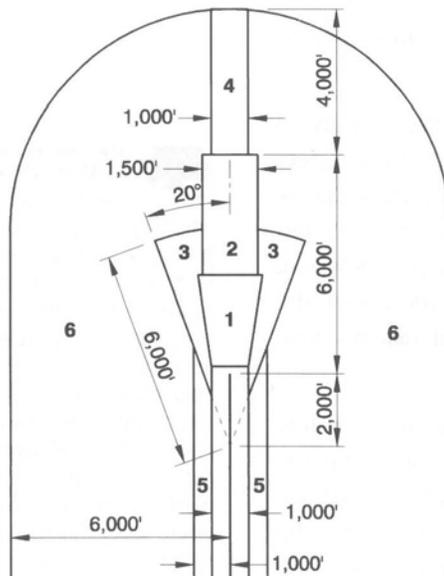
- Length less than 4,000 feet
- Approach visibility minimums \geq 1 mile or visual approach only
- Zone 1 = 250' x 450' x 1,000'



**Example 2:
Medium General Aviation Runway**

Assumptions:

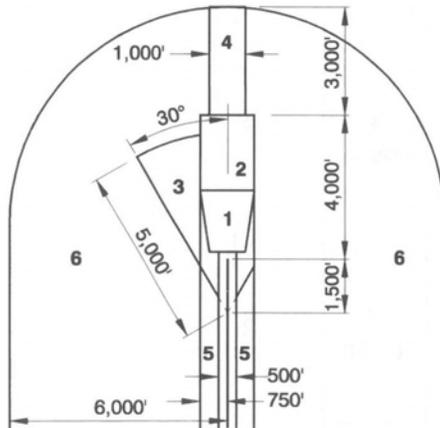
- Length 4,000 to 5,999 feet
- Approach visibility minimums \geq 3/4 mile and $<$ 1 mile
- Zone 1 = 1,000' x 1,510' x 1,700'



**Example 3:
Long General Aviation Runway**

Assumptions:

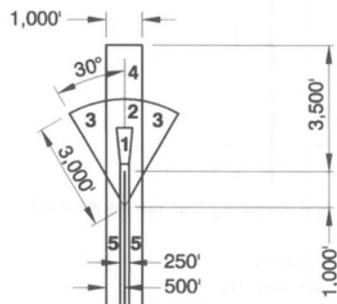
- Length 6,000 feet or more
- Approach visibility minimums $<$ 3/4 mile
- Zone 1 = 1,000' x 1,750' x 2,500'



Example 4:
**General Aviation Runway with
 Single-Sided Traffic Pattern**

Assumptions:

- No traffic pattern on right
- Length 4,000 to 5,999 feet
- Approach visibility minimums $\geq 3/4$ mile and < 1 mile
- Zone 1 = 1,000' x 1,510' x 1,700'



Example 5:
Low-Activity General Aviation Runway

Assumptions:

- Less than 2,000 takeoffs and landings per year at individual runway end.
- Length less than 4,000 feet
- Approach visibility minimums ≥ 1 mile or visual approach only
- Zone 1 = 250' x 450' x 1,000'

Legend

1. Runway Protection Zone
2. Inner Approach/Departure Zone
3. Inner Turning Zone
4. Outer Approach/Departure Zone
5. Sideline Zone
6. Traffic Pattern Zone

Notes:

- RPZ (Zone 1) size in each example is as indicated by FAA criteria for the approach type assumed. Adjustment may be necessary if the approach type differs.
- See Table 9A for factors to consider regarding other possible adjustments to these zones to reflect characteristics of a specific airport runway.
- See Tables 9B and 9C for guidance on compatibility criteria applicable with each zone.

These examples are intended to provide general guidance for establishment of airport safety compatibility zones. They do not represent California Department of Transportation standards or policy.

Source: State of California "Airport Land Use Planning Handbook," Figure 9K (January 2002)



WASHINGTON— GUIDELINES FOR DENSITY LIMITS ON USES IN AIRPORT SAFETY ZONES

Similar to California, Washington provides guidance for appropriate population densities keyed to the state’s six safety zones, and varying depending on runway length. Washington’s guidelines are shown in Table 3-3 below.

TABLE 3-3: WASHINGTON RECOMMENDATIONS FOR COMPATIBLE POPULATION DENSITY BY AIRPORT SAFETY ZONE AND RUNWAY SPECIFICATIONS

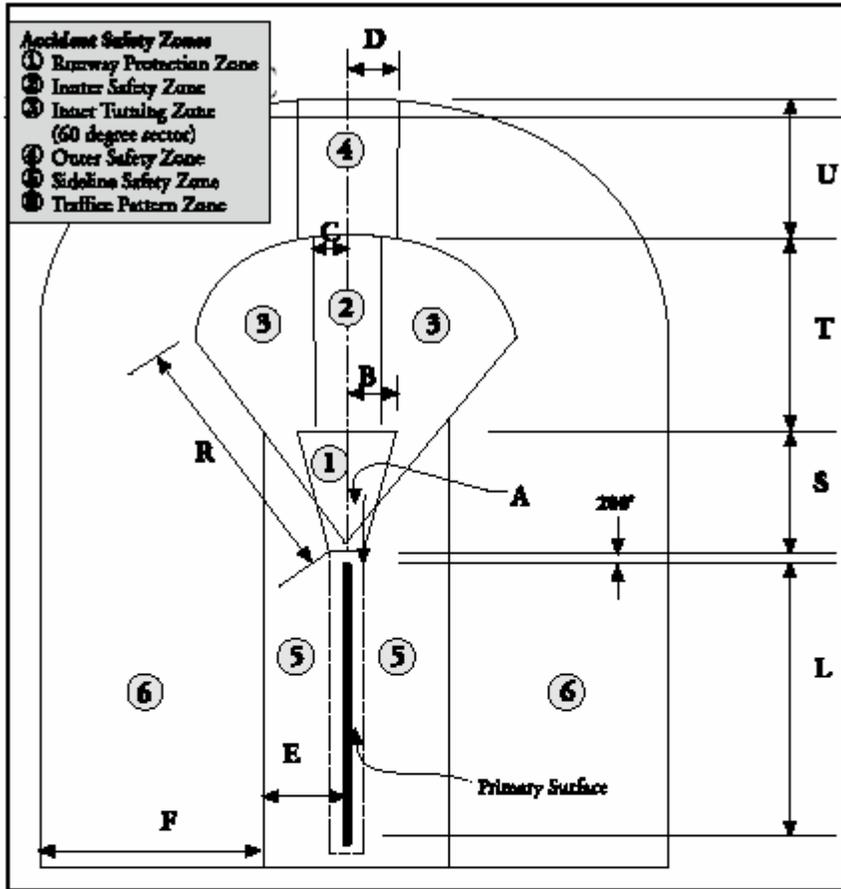
Accident Safety Zones	Population Density	Runway Specifications
ZONE 1	0-5 people/acre	
ZONE 2	0-5 people/acre	
ZONE 3	<25 people/acre	Runway <4,000 feet: Prohibit all residential land uses. Runway 4,000 – 5,999 feet: Limit residential development to 1 du/5 acres. Runway >6,000 feet: Limit residential development to 1 du/5 acres.
ZONE 4	<40 people/acre in buildings; <75 persons/acre outside building	Runway <4,000 feet: maximum 1 du/5 acre in rural or urban area. Runway 4,000 – 5,999 feet: maximum 1 du/5 acre in rural area, 1 du/2.5 acre in urban area. Runway > 6,000 feet: maximum 1 du/5 acre in rural area, 1 du/2.5 acre in urban area.
ZONE 5	0-5 people/acre	
ZONE 6	<100 people/acre in buildings; <150 persons/acre in outside buildings	Runway <4,000 feet: maximum 1 du/5 acre in rural or urban areas. Runway 4,000 – 5,999 feet: maximum 1 du/5 acre in rural area, 1 du/2.5 acre in urban area. Runway >6,000 feet: maximum 1 du/5 acre in rural area, 1 du/2.5 acre in urban area.

Source: Airports and Compatible Land Use, Volume I, Washington State Department of Transportation, Aviation Division, Appendix B page 40, (February 1999)



FIGURE 3-2: WASHINGTON STATE SAFETY ZONES

AIRCRAFT ACCIDENT SAFETY ZONE DIAGRAM



SAFETY ZONE DIMENSION (IN FEET)

Note:
 Data Source: NTSB
 accident investigations
 1984-1991. Illustration
 Source: Hodges and
 Shutt, Institute of
 Transportation Studies,
 University of California,
 Berkeley, 1993.

Dimension	Runway Length Category (L)		
	Runway less than 4,000	Runway 4,000 to 5,999	Runway 6,000 or more
A	125	250	500
B	225	505	875
C	225	500	500
D	225	500	500
E	500	1,000	1,000
F	4,000	5,000	5,000
R (60°Sector)	2,500	4,500	5,000
S	1,000	1,700	2,500
T	1,500	2,800	2,500
U	2,500	3,000	5,000

Source: Washington State
 Department of Transportation,
 Airport and Compatible Land
 Use Volume 1, February 1999.



FLORIDA— GUIDELINES FOR DENSITY LIMITS ON USES IN AIRPORT SAFETY ZONES

Florida’s airport compatible land use manual, published in 1994, provides a very detailed listing of compatible and incompatible land uses to guide local development decisions. In Table 3-3 below, only those land uses that Florida either allows or prohibits based on their density or intensity of use are included for the purposes of this manual.

TABLE 3-4: DENSITY-LIMITED LAND USES IN FLORIDA’S AIRPORT SAFETY ZONES

LAND USES AND ACTIVITIES	Overflight Zones (Note 1)		Notes
	Inner	Outer	
N = Not Permitted I = Incompatible unless mitigated by the condition noted in the last table column C = Compatible and permitted			
RESIDENTIAL DEVELOPMENT			
Single Units, Row, Semi- and Detached	N	I (Note a)	a) Density limited, 1-2 dwelling units per acre or 20% or less lot coverage for PUDs.
Duplexes	N	I (Note a)	a) Density limited, 1-2 dwelling units per acre or 20% or less lot coverage for PUDs.
Multi-Family Units	N	I (Note a)	a) Density limited, 1-2 dwelling units per acre or 20% or less lot coverage for PUDs.
Residential Hotels and Motels	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Transient Lodgings	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Mobile Home Parks and Courts	N	N	
Recreational Vehicles (RV) Parks	N	N	
Other Residential	N	N	
RELIGIOUS; CULTURAL; RECREATIONAL			
OUTDOOR ACTIVITIES			
Religious Services and Assemblies	N	I (Note c)	c) Population density limited, 40 persons per acre or less.
Entertainment Assemblies	N	I (Note c)	c) Population density limited, 40 persons per acre or less.
Sports Event Assemblies	N	I (Note c)	c) Population density limited, 40 persons per acre or less.
Sports Arenas, Court, Fields, and Tracks	N	I (Note f)	f) Spectator facilities, club houses and locker rooms not permitted.
Circuses and Carnivals	N	I (Notes b,c)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure. c) Population density limited, 40 persons per acre or less.
Amusement and Theme Parks	N	I (Notes b,c)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure. c) Population density limited, 40 persons per acre or less.
Playgrounds and Neighborhood Parks	N	I (Notes b,c)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure. c) Population density limited, 40 persons per acre or less.
Community and Regional Parks	N	I (Notes b,c)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure. c) Population density limited, 40 persons per acre or less.



TABLE 3-4: DENSITY-LIMITED LAND USES IN FLORIDA'S AIRPORT SAFETY ZONES

LAND USES AND ACTIVITIES	Overflight Zones (Note 1)		Notes
	Inner	Outer	
N = Not Permitted I = Incompatible unless mitigated by the condition noted in the last table column C = Compatible and permitted			
INDOOR ACTIVITIES			
Churches, Mosques, Synagogues, and Temples	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Theaters and Auditoriums	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Stadiums and Arenas	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Gymnasiums and Natatoriums	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
SERVICES			
Hospitals and Nursing Homes	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Other Medical Facilities	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Day Care Facilities	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Educational Facilities	N	I (Note g)	g) Low labor/manning intensity office uses only, meeting rooms, class rooms, lunch rooms, and cafeterias are not permitted.
Government Services	N	I (Note g)	g) Low labor/manning intensity office uses only, meeting rooms, class rooms, lunch rooms, and cafeterias are not permitted.
Correctional Institutions	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Cemeteries	C (Note e)	C (Note e)	e) Chapels or other occupied permanent structures are not permitted.
Professional, Financial, and Insurance	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Business and Real Estate	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Repairs and Contract Construction	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Personal and Miscellaneous	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
TRANSPORTATION; COMMUNICATION; UTILITIES			
Passenger Facilities	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Cargo-Freight Facilities	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Road, Rail, and Water Transit Ways	C (Notes e and h)	C (Note b)	e) Chapels or other occupied permanent structures are not permitted. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.



TABLE 3-4: DENSITY-LIMITED LAND USES IN FLORIDA'S AIRPORT SAFETY ZONES

LAND USES AND ACTIVITIES	Overflight Zones (Note 1)		Notes
	Inner	Outer	
N = Not Permitted I = Incompatible unless mitigated by the condition noted in the last table column C = Compatible and permitted			
Vehicle Parking	C (Notes e and h)	C (Note b)	e) Chapels or other occupied permanent structures are not permitted. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Vehicle Storage	C (Note e and h)	C (Note b)	e) Chapels or other occupied permanent structures are not permitted. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Telecommunications	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Broadcast Communications	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Electric Generating Plants	I (Note i)	C (Note h)	i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Sewer-Waste Water Treatment	I (Note i)	C (Note h)	i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Gas Utility Facilities	N	C (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Electric Utility Facilities	I (Note i)	C (Note h)	i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
RETAIL TRADE			
Building Materials and Hardware	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Automotive, Farm, and Marine Craft	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Apparel and General Merchandise	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Groceries and Food Stuff	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Eating and Drinking Establishments	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Shopping Malls and Centers	N	N	
Gasoline, Diesel, and Heating Oil	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Liquefied and Bottled Gas	N	I (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.



TABLE 3-4: DENSITY-LIMITED LAND USES IN FLORIDA'S AIRPORT SAFETY ZONES

LAND USES AND ACTIVITIES	Overflight Zones (Note 1)		Notes
	Inner	Outer	
<p>N = Not Permitted I = Incompatible unless mitigated by the condition noted in the last table column C = Compatible and permitted</p>			
WHOLESALE TRADE			
Home Furnishings and Building Materials	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Food Products and General Merchandise	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Liquefied Gasses	N	I (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Petroleum and Distillate Products	N	I (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Industrial Chemicals	N	I (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Explosive and Pyrotechnic Products	N	I (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Other Wholesale Products	N	C (Notes b,h)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure. h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
MANUFACTURING			
Food Products and Processing	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Textiles and Apparel	N	C (Note b)	b) Density limited, 1-2 occupied structures per acre; occupancy 10 or less per structure.
Lumber and Wood Products	N	C (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Paper and Allied Products	N	C (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Chemicals and Allied Products	N	I (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Petroleum Refining and Related Products	N	N	
Explosive and Pyrotechnic Products	N	N	
Rubber and Plastics Products	N	I (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.



TABLE 3-4: DENSITY-LIMITED LAND USES IN FLORIDA'S AIRPORT SAFETY ZONES

LAND USES AND ACTIVITIES	Overflight Zones (Note 1)		Notes
	Inner	Outer	
N = Not Permitted I = Incompatible unless mitigated by the condition noted in the last table column C = Compatible and permitted			
Clay and Glass Products	N	I (Note i)	i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Primary and Fabricated Metal Products	N	I (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Electronic and Optic Products	N	I (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Professional and Scientific Products	N	I (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
Other Manufacturing	N	C (Note h)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted.
RESOURCE PRODUCTION AND RECOVERY			
Livestock and Poultry Farming	N	C (Note j)	j) Low labor/manning intensity uses only, permanent above ground structures are not permitted.
Animal and Poultry Breeding	N	N	
Crop and Related Agricultural Production	N	C (Note j)	j) Low labor/manning intensity uses only, permanent above ground structures are not permitted.
RESOURCE PRODUCTION AND EXTRACTION			
Fishing and Aquaculture Activities	N	C (Note i)	i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Forestry and Timber Production	I (Notes h,j)	C (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. j) Low labor/manning intensity uses only, permanent above ground structures are not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted.
Oil and Natural Gas Wells	N	N	
Strip and Open Pit Mining	N	N	
Stone and Mineral Quarries	N	N	
Other Mining and Resource Recovery	I (Notes h,i,j)	C (Notes h,i)	h) Above ground storage of volatile, explosive, toxic, radio active or other hazardous material is not permitted. i) Open pits, excavations, ponds, dykes, levees, water courses and above ground pipes are not permitted. j) Low labor/manning intensity uses only, permanent above ground structures are not permitted.
Note 1: Florida recommends that the primary surface and the RPZ/clear zone should be designated the Inner Overflight Zone; that area beneath the approach surface extending beyond the RPZ/clear zone should be designated the Outer Overflight Zone. <i>Source: Airport Compatible Land Use Guidance for Florida Communities; Florida Department of Transportation, Appendix A (1994)</i>			



MEASURING USAGE INTENSITIES²²

Particularly for nonresidential uses, limits on population or building density are not common in most forms of land use planning and zoning. The discussion below provides helpful guidance on how usage intensity can be determined and measured.

Determining Usage Intensities for Specific Land Uses

Table 3-5 below lists average usage intensities for several types of nonresidential land uses often found or proposed in the vicinity of airports. Different methods are available by which local zoning authorities can estimate the usage intensity of other proposed uses. Each method has its advantages and disadvantages and none is clearly best in all situations. The most common methods are based on:

- Parking requirements as indicated in local parking ordinances;
- Maximum occupancy levels set in accordance with the uniform building and fire codes; and
- Surveys of similar uses.

Appendix 6 to this manual contains a brief assessment of each of these methods and examples of how usage intensities can be calculated.

TABLE 3-5: TYPICAL USAGE INTENSITIES	
Use	People Per Acre
Light-industrial uses	35-50
Two-story motel	35-50
Shopping center (single story)	75-125
Office structure (single story)	50-100
Sit-down restaurant	100
Fast food restaurant	150

Gross Versus Net Acreage

Usage intensities can be calculated in terms of the entire site or zone, regardless of streets or parcel lines (its gross acreage) or the area of a given parcel (the net acreage). Because safety area land use restrictions are applied, at least initially, at a general plan or large development level rather than with respect to small, individual parcels, **gross acreage measurements should normally be used for the purposes of safety compatibility criteria.** The California guidelines indicated in Table 3-2 above are set on the basis of gross acreage averaged over an entire compatibility zone or development site. If net is substituted, the per-acre numeric limitations should be increased (typically 15% to 20%) to account for the acreage devoted to streets, utilities, etc.



²² The following discussion of measuring usage intensities comes from the *California Airport Land Use Planning Handbook* (January 2002), pages 9-51 through 9-55, and Appendix C.



Nonresidential land use intensities (people per acre), as well as residential densities (dwelling units per acre), should both generally be calculated on the basis of gross acreage.



Except in the case of major thoroughfares running through runway protection zones and inner safety zones, the number of people in vehicles can generally be ignored in usage intensity calculations. Roads where traffic is frequently stopped in locations immediately beyond runway ends deserve attention. However, unless the road is newly planned, local zoning authorities are unlikely to have the opportunity to review these conditions.

Average Versus Peak Usage Intensities

Limitations on the numbers of people per acre sometimes are stated as a never-to-exceed maximum and sometimes as an average measured over an indicated period (typically 2, 8, or even 24 hours). A combination of the two also is possible (e.g., an average of “x” people per acre over an 8-hour period, not to exceed 2x the average at any time).

It is recommended that restrictions be stated as a never-to-exceed maximum and the level be set accordingly. This is the same approach taken by fire codes for buildings and is preferred because an averaging approach assumes that an accident will not occur when a higher-than-average number of people is present.

The nonresidential intensity guidelines for California in Table 3-2 above indicate maximums both averaged over an entire site and for any single acre. If different measures are used, the numbers may need to be adjusted accordingly.

CLUSTERING VERSUS SPREADING OF DEVELOPMENT

Rarely is the usage intensity of a development spread equally throughout the site. Buildings, for example, normally will have more occupants than the adjacent parking lots. Also, for large developments, most of the buildings and other facilities are sometimes concentrated in one portion of the site, leaving other areas as open space because of terrain, environmental, or other considerations. The latter practice is often referred to as clustering. The issues for local zoning authorities are whether to place limits on clustering or to encourage the practice in airport safety zones. Some of the airport safety tradeoffs between clustered and spread-out development are as follows.

Clustered Development

The premise behind the concept of clustering is that, in a significant percentage of off-airport mishaps, the aircraft are under some degree of control when forced to land. (The reference here to “mishaps” is intentional—if a forced landing succeeds with no serious injuries or major damage to the aircraft, it would be categorized as an incident and thus not appear in accident records.) If the area remaining undeveloped is relatively level and free of large obstacles, clustering potentially allows a greater amount of open land toward which a pilot can aim. In addition to reducing the risks for people on the ground, open land provides benefits for aircraft occupants, as addressed later in this chapter. The disadvantage of clustering is that it allows an



increased number of people to be in the potential impact area of an uncontrolled crash.

Spread-Out Development

By comparison, a uniform spreading of development may provide fewer emergency landing spots and increase the chance of someone on the ground being injured. On the plus side, a uniform distribution of development limits the maximum number of people who could possibly be in an impact area.

A compromise between these two strategies represents perhaps the optimum approach in most cases. This approach entails limiting the maximum occupancy level of a small area, but otherwise clustering development so as to provide the greatest amount of large open areas. For a small area (one acre is a good guideline), a limitation of two or three times the overall criterion is typical with the lower number applying in safety zones and parts of safety zones closest to the runway ends.



USES IN STRUCTURES VERSUS ONES NOT IN STRUCTURES

Some compatibility strategies make a distinction between the acceptable numbers of people per acre in land uses where people are outdoors versus those where the people are in a building or other enclosed area.

Outdoor Uses

One theory is that people outdoors have more of a chance to see a plane coming as well as more directions in which they can move to vacate the impact area. A greater concentration of people thus is sometimes considered acceptable for such land uses. An important exception, however, is for open stadiums and other similar uses where a large number of people are confined in a small area with limited exits. Such facilities can represent equal or higher risks than similar uses in buildings.

Uses in Buildings

Buildings provide substantial protection from the crash of a small airplane, particularly when the aircraft is still under control as it descends. If a fire subsequently ensues—historically, a relatively infrequent occurrence—it is unlikely to engulf the entire building instantly.

Taking both of these factors into account, **the suggested strategy is to set the acceptable number of people in a given area equal for uses either outdoors or in structures.** Additionally, restrictions on stadiums and other open facilities occupied by large numbers of people are appropriate.



RISK REDUCTION THROUGH BUILDING DESIGN

Although avoidance of intensive uses is always preferable, a concept that may be acceptable in some situations is risk-reduction special building design. This concept should be limited to airports which are situated in highly urbanized locations and are used predominantly by small aircraft. In these circumstances, consideration might be given to



Residential development near airports poses some of the most significant threats to human safety on many different levels. Putting larger numbers of people near airports on a day-to-day basis makes them ultimately more susceptible to aircraft accidents. Photo above shows tragic results from an aircraft that crashed into a 10-story apartment building in Tebran, Iran, on December 6, 2005.

allowing higher numbers of people (no more than 1.5 to 2.0 times the basic intensity) in buildings which incorporate special risk-reduction construction features such as:

- Concrete walls;
- Limited number and size of windows;
- Upgraded roof strength;
- No skylights;
- Enhanced fire sprinkler system;
- Single-story height; and/or
- Increased number of emergency exits.

RESIDENTIAL AREAS

Traditionally, airports have been built on the outskirts of towns and cities or in rural areas to avoid noise impacts on residential areas and to take advantage of relatively inexpensive land. Over time, however, communities grow and new houses and commercial and industrial developments creep into open space and farms that once provided a buffer around the airport. Indeed, sometimes this development is spurred by the airport itself as hotels, warehouses, and other facilities are built to service airport users. If not sited properly, this development can create threats to public safety and to airport viability.

Residential development near airports poses some of the most significant threats to human safety on many different levels. As discussed in the population density section above, the equation is quite simple—putting larger numbers of people near airports on a day-to-day basis makes them more ultimately susceptible to aircraft accidents. Moreover, residential developments can create other nuisances to aircraft operations. Distractions like street lighting at night and residential storm water detention ponds that could attract waterfowl to the area pose threats to aircraft safety. Clearly, the successful control of residential site development near airports can help alleviate these threats.

OPEN AREAS—SAFETY CONCERN FOR AIRCRAFT OCCUPANTS

Safety for people on the ground is not the only consideration in controlling development and population density around airports. The risk to airplane occupants in the event of an emergency landing is another important issue. In an emergency descent, pilots can often control the aircraft to a certain extent and will look for a farm field or other open space if they cannot reach the airport runway. Especially for small aircraft, the chances of the aircraft occupants avoiding serious or fatal injury in such situations are significantly affected by the terrain and land use features at the landing site. An open area does not have to be very large to allow a successful emergency landing in which the pilot and passengers survive the accident with limited injuries. However, in an emergency, the pilot's choices in selecting an emergency landing site are reduced as the aircraft's altitude decreases; thus, open areas should be provided in



locations where aircraft fly over not only to reduce population density, but to help save lives on the airplane itself.

Ideal emergency landing sites are ones which are long, level, and free of obstacles, much like a runway. Certainly, the closer that open land areas around airports can fit these criteria the better. For small aircraft, however, successful (meaning survivable irrespective of the damage to the aircraft) emergency landings can be accomplished in much less space. Data from the general aviation aircraft accident database indicates that the median swath length for accidents in which the aircraft was under at least some control is less than 150 feet.²³

As a general guideline, open land sites should be at least 300 feet long by 75 feet wide (about 0.5 acre or the size of a football field) to be considered useful. Such sites should be relatively level and free of objects such as structures, overhead lines, and large trees and poles that can send the plane out of control at the last moment. Parking lots, while not ideal, also can be considered as acceptable open lands in urbanized settings.²⁴

BP

Guidelines for Extent of Open Land Near Airports

Determining the desirable number of open land sites or the percentage of open land in an airport vicinity is a complex proposition. To assist in this decision, the following three observations are offered:

- Accident location patterns and related data reveal that accidents in which aircraft are under control are bunched relatively close to the runway ends—mostly within about 5,000 feet—both for arrivals and departures.
- The number of takeoff accident sites located a short distance laterally from the departure (climb-out) end of the runway may indicate that pilots have either headed for an open spot in that location or have attempted to turn around and land on the runway from the opposite direction, but not quite succeeded.
- A pilot's discretion in selecting an emergency landing site is reduced when the aircraft is at low altitude. Particularly at low altitude, the chance of a pilot seeing and successfully landing in a small open area is increased if there are more such spots from which to choose. At traffic pattern altitude (800 to 1,000 feet above the runway), a small airplane should, in the event of engine failure, normally be able to reach the runway from anywhere within the pattern. On takeoff, a small plane generally must have reached an

²³ Source: This and the following discussion of guidelines for open areas are taken from the *California Airport Land Use Planning Handbook* (2002), pp. 9-54 – 9-55.

²⁴ Although terrain is a critical factor in the survivability of emergency landings, it is not a factor over which local governments have any influence. At airports in mountainous or densely forested locations, open land useful for an emergency landing may not exist, even if no development is present. For such airports, policies to preserve open land may be pointless. The discussion here is thus directed at airports in flat or moderately hilly terrain.



altitude of at least 400 to 500 feet above the runway for a return to the runway to be possible following engine failure.

Each of these observations speaks to the need for preserving more and preferably larger open areas in locations nearest runways than in other portions of the airport vicinity. On this basis, the following guidelines are suggested.



Minnesota Safety Zone A:

Maintain all undeveloped land clear of objects in accordance with Mn/DOT standards.

Minnesota Safety Zone B:

Within Zone B to a distance of approximately 4,000 to 6,000 horizontal feet from the end of the runway, jurisdictions should seek to preserve 25% to 30% of the overall zone as usable open land. Particular emphasis should be given to preserving as much open land as possible in locations close to the extended runway centerline. Within the remainder of Safety Zone B, the goal should be to maintain approximately 15% to 20% open land within the overall zone, again with emphasis on areas along the extended runway centerline.

Minnesota Safety Zone C:

It is recognized that not every airport's traffic patterns will warrant the retention of significant open lands within Safety Zone C. However, within areas of Zone C that do fall under the standard traffic pattern, including turning zones, jurisdictions should attempt to preserve approximately 15% to 20% of the zone as open land. Elsewhere within Zone C, as warranted by proximity to the runway end and the nature of traffic patterns at the subject airport, jurisdictions might set a goal of approximately 10% usable open land or an open area approximately every 1/4 to 1/2 mile



Planes may sometimes be forced to make emergency landings on makeshift runways, such as this plane did on I-25 near Denver, Colorado.

Source: Rocky Mountain News, November 17, 2005

Open land areas need to meet minimum size criteria to be of value. Therefore, the above guidelines are only practical when applied with respect to land use patterns proposed in specific plans for development (generally 20 acres or more), not to individual smaller parcels. Both public and private lands should be counted. If the indicated amount of open land can be provided totally on public property, individual private parcels may not need to have any.

One final factor to consider is the pattern of the existing land uses in the airport vicinity. In rural, agricultural areas, requirements for preserving open land can usually be met with little restriction on the prevailing land use form. However, in urban locations, if open land is defined to mean no development of private property, the potential for an unconstitutional "takings" must be recognized.²⁵ To avoid this prospect, the property must be allowed to retain an economically viable use. In urban areas, open land is generally only a viable land use designation if the property is in public ownership or its natural environmental constraints make development

²⁵ See Chapter 5 of this manual for a more detailed discussion of the "takings" and other legal issues.



infeasible or inappropriate regardless of the airport. If no development is the desired end, the airport owner may need to acquire the property or at least the development rights.

Although open space is desirable under takeoff and landing paths from a safety perspective, it is important to consider and control the use of such open space. For example, while a farm field might seem an ideal open space use, it can act as a wildlife attractant if certain types of crops are planted, posing other safety concerns as discussed in the following section.

CONDITIONS THAT INTERFERE WITH AIRCRAFT FLIGHT AND DISTRACT PILOTS

A second major category of compatibility issues centers on structures and uses that directly interfere with and obstruct airspace or create distractions for pilots. In contrast to the population density issue which relates to the potential severity of an accident, hazards to flight can actually be the cause of an accident.

Hazards to flight fall into three basic categories:²⁶

- Obstructions to the airspace required for flight to, from, and around an airport;
- Wildlife that may affect aircraft operations, particularly the potential for bird strikes; and
- Other forms of interference with safe flight, navigation, or communication.

Structure and Building Obstructions

Limiting the heights of structures to the heights indicated by the federal Part 77 surfaces (as discussed in Chapter 2) and Minnesota airport zoning requirements provide an ample margin of safety for normal aircraft operations. The guidance provided by Part 77 is not absolute, however. Deviation from the Part 77 standards does not necessarily mean that a safety hazard exists, only that offending objects must be evaluated by the Federal Aviation Administration and that mitigation actions such as marking or lighting be taken if appropriate.

In some locations, such as adjacent to a runway, objects exceeding the Part 77 height limits may not be regarded as a hazard. On the other hand, tall objects in the approach corridors—especially along instrument approach routes—may pose risks even though they do not penetrate the defined Part 77 surfaces. Such objects also can adversely affect the minimum instrument approach altitudes allowed in accordance with the U.S. Standard for Terminal Instrument Procedures (TERPS). TERPS is particularly likely to be more restrictive than Part 77 when:



Tall objects in the approach corridors may pose risks even though they do not penetrate the defined FAR Part 77 surfaces.

²⁶ Much of this material regarding flight hazards originally appeared in the *California Airport Land Use Planning Handbook* (January 2002) Chapter 3, and the *Wisconsin Airport Land Use Guidebook* (2004) Chapter 3.



- The approach is not aligned with a runway;
- The procedure includes a circle-to-land option with low minimums;
- The missed approach segment has a low minimum altitude and requires a turning movement; and/or
- High terrain is present beneath portions of the approach procedure which lie beyond the limits of the Part 77 surfaces.

In addition to these federal regulations, Minnesota rules (Minn. R. 8800.1200) authorize the Transportation Commissioner to review proposals for tall structures to ensure no new navigational hazards are created near airports. Minnesota statutes, as reflected in the state model airport zoning ordinance, limit applicability of airport height restrictions within to a distance “not to exceed one and one half miles beyond the perimeter of the airport boundary and in that portion of an airport hazard area under the approach zone for a distance of not exceeding two miles from the airport boundary.” The operative restriction provides that “no structure or tree shall be constructed, altered, maintained, or allowed to grow in any airspace zone ... so as to project above” any of the FAR Part 77 imaginary airspace surfaces.



If a local government adopts conforming regulations and assumes authority over height restrictions in navigable airspace, the federal government—through the Federal Aviation Administration—still plays an important and valuable role in any local decisions to approve or deny tall structures that may affect airport operations or aircraft safety. First, the requirements contained in federal regulations (FAR Part 77) as well as the model airport zoning ordinance should form the basis of the local height restrictions. Second, if local jurisdictions receive an application to erect a tall structure near an airport, local decision-makers would be well-advised to ask the FAA to complete an aeronautical study of a proposed tall structure project and issue a determination of “No Hazard to Air Navigation.” The standard procedure is to submit FAA Form 7460-1 to the FAA. Local approval should be withheld until comments from both the FAA and Mn/DOT are received. The FAA will offer its opinion as to whether a proposal would be hazardous to air navigation; however, federal law specifically reserves final decision-making authority to the local level. Similarly, an FAA determination of “no hazard” does not constitute development approval that overrides local permitting authority.

Lights, Reflective Glare, Smoke, Dust, Electronic Interference, and Wildlife Attractants

In addition to structure height, there are a number of other potential conditions associated with buildings, uses, and developments that may pose significant risks to airplanes in flight. This section summarizes those items and suggests possible approaches to dealing with them.

LIGHTS

Lights that shine upward, such as those found in commercial areas or parking lots, are potentially hazardous since they can detract from



a pilot's ability to identify an airport at night. A pilot could wrongly perceive such adjacent lights as part of the airport or as runway lights. This is especially true in the case of linear lighting layouts, such as street lights in subdivisions. Bright lights can also pose a safety concern at night by causing pilots to experience a moment of night blindness as they pass from dark areas into well-lit areas and back into darkness as they approach an airport.

GLARE

Reflective surfaces can produce a blinding glare, which can distract pilots. Water surfaces, such as storm water detention ponds, and light-colored or mirrored building materials also need to be considered because they produce glare. Limiting these surfaces in adjacent areas is recommended to reduce the possibility of glare.

SMOKE OR STEAM

Smoke or steam generated by nearby power plants, industry, or agricultural (field burning) operations can create severe visual problems when a pilot is either looking for an airport or preparing to take off or land. Dust, fog, and steam, which all contribute to reduced visibility, will also limit the effectiveness of an airport. Potential land uses which may generate smoke, dust, or steam should be reviewed for potential impacts to an airport.

ELECTRONIC INTERFERENCE

Land uses that generate electronic transmissions like radar dishes should not be permitted near airports: they can interfere with aircraft instruments and radio communications. There are no Federal Aviation Administration (FAA) standards for specific electronic hazards; however, some of these hazards have been noted to include telecommunication devices and power stations. Coordination between airport owners and managers and local municipalities is essential.

WILDLIFE AND BIRD ATTRACTANTS

Water impoundments, wetlands, agricultural operations, sanitary landfills, sewage treatment plants, and certain species of flora and fauna often attract birds and wildlife. An increased number of birds and wildlife around airports amplify the possibility of collisions with aircraft. Damage to an aircraft and its occupants from a bird strike – with a gull, or goose, or birds of prey (hawks, eagles, etc.) – can be devastating. White-tail deer and even smaller mammals such as dogs, coyotes, and rabbits, also pose a risk for on-ground collisions.

The United States Department of Agriculture (USDA) provides a listing of plants that are attractive to wildlife, reproduced as Appendix 12 and therefore should be avoided on or near airports. Woody plants such as oaks, firs, pines, maples, and cedars should be avoided, as well as upland weeds and shrubs such as oats, sunflower and crabgrass. Marsh plants such as water lily, wild celery, and wild rice can create wildlife hazards, as can crops and ornamental plants such as alfalfa, corn, birch trees, and dogwoods.

Advisory Circular (AC) 150/5200-33, *Hazardous Wildlife Attractants on or Near Airports*, discusses the various incompatible land uses and



Bird collisions with airplanes are both deadly for the bird and potentially damaging to the aircraft.



bird attractants included in this list. Notable guidelines urge airport authorities to discourage the creation of pools, ponds, sewage lagoons, and fountains on or near the airport. Permanent water sources should be managed by removal, physical exclusion, or alteration of appearance. Underground facilities such as French drains or buried rock fields are examples of successful retention/detention designs, while temporary holding basins that drain within 24 hours are also an option. If drains and ditches cannot be removed, their banks should be mowed regularly to control bird nesting and perching. Reporting all bird and other wildlife strikes to the FAA is important for the study of this issue. The FAA has developed several brochures that further detail wildlife hazard management. This material can be found in Appendix 13.

LANDFILLS

FAA Order 5200.5, *Guidance Concerning Sanitary Landfills On or Near Airports*, states that sanitary landfills, because of their bird attractant qualities, are considered to be an incompatible land use if located within specified distances of an airport. FAA Order 5050.4A, *Airport Environmental Handbook*, states that it is inadvisable to locate such facilities within 5,000 feet of runways accommodating piston-type aircraft and within 10,000 feet of runways accommodating turbine (jet) powered aircraft. Minnesota has adopted these guidelines as mandated state minimums in Minnesota Rule 7035.2815.

AGRICULTURAL LAND USES

The proximity of farmland to airports can cause unwanted interactions between wildlife and aircraft, especially if the crops cultivated are highly attractive to birds or wildlife for their nutritive or nesting value. The USDA bulletin in Appendix 12, *Plants Attractive to Wildlife*, provides a list of cultivated plants that can attract wildlife much to the detriment of local airports and aircraft. Alfalfa, barley, corn, oats, rice, sorghum, wheat, vineyards, apple tress, and cherry trees are major wildlife attractants. They can create problems for departing and approaching aircraft if birds and mammals congregate to eat or nest in farm areas. Coordination between airports and surrounding local communities is important if the number of wildlife strikes caused by the close proximity of farmlands becomes an issue.

An Alternative Approach to Regulating Compatible Land Uses

OVERVIEW

This section recommends an alternative approach to regulating compatible land uses in Minnesota’s three airport safety zones that differs from the approach encapsulated in the 1990 model airport zoning ordinance. It draws on an extensive survey of laws and ordinances and airport land use manuals from other states, with updates to reflect newer land uses (e.g., wind turbines) and modern land use practice.

As used here, the term “compatible” means that the land use will not typically interfere with normal aircraft flight operations or unreasonably risk the safety of persons on the ground or in aircraft from possible accidents. The recommendations do **not** address noise compatibility, which typically involves limitations different than the use limitations at issue when safety compatibility is the focus. For example, safety concerns justify limits on uses that attract large numbers of people for long periods of time (e.g., a baseball stadium), while noise concerns justify limits on uses where the inhabitants are extra-sensitive to the disruption from airplane noise (e.g., a hospital). While overlap certainly exists between the two use groups, the safety-related use standards described in this section do not include all uses that should be limited near airports because of noise concerns.

Before presenting the details of the recommended alternative approach to regulating compatible land uses, the following Table 3-6 states the land uses and activities which Minnesota statutes and laws currently prohibit in the three airport safety zones. Regardless of the approach chosen to regulate airport vicinity land uses, the uses shown in Table 3-6 **MUST** be prohibited under Minnesota state law.

TABLE 3-6: LAND USES PROHIBITED UNDER MINNESOTA LAW (MINN. STATUTES, CHAPTER 360)	
SAFETY ZONE	PROHIBITED LAND USE OR ACTIVITY
Zone A	Uses that create or cause interference with the operations of radio or electronic facilities on the airport or with radio or electronic communications between the airport and aircraft
	Uses that make it difficult for pilots to distinguish between airport lights and other lights, results in glare in the eyes of pilots using the airport, impairs visibility in the vicinity of the airport, or otherwise endangers the landing, taking off, or maneuvering of aircraft
	Above-ground structural hazards are prohibited, including buildings, temporary structures, exposed transmission lines, and other similar above-ground structures



TABLE 3-6: LAND USES PROHIBITED UNDER MINNESOTA LAW (MINN. STATUTES, CHAPTER 360)	
SAFETY ZONE	PROHIBITED LAND USE OR ACTIVITY
	Uses that create, attract, or bring together an assembly of persons thereon.
Zone B	Uses that create or cause interference with the operations of radio or electronic facilities on the airport or with radio or electronic communications between the airport and aircraft
	Uses that make it difficult for pilots to distinguish between airport lights and other lights, results in glare in the eyes of pilots using the airport, impairs visibility in the vicinity of the airport, or otherwise endangers the landing, taking off, or maneuvering of aircraft
	Uses that create, attract, or bring together a site population that would exceed 15 times that of the site acreage
	New uses on sites less than three (3) acres in size
	Churches, hospitals, schools, theaters, stadiums, hotels and motels, trailer courts campgrounds, and other places of public or semipublic assembly.
	New uses with more than one building plot or a building plot greater than specified in Minn. R. 8800.2400, Subpart 6C.
Zone C	Uses that create or cause interference with the operations of radio or electronic facilities on the airport or with radio or electronic communications between the airport and aircraft
	Uses that make it difficult for pilots to distinguish between airport lights and other lights, results in glare in the eyes of pilots using the airport, impairs visibility in the vicinity of the airport, or otherwise endangers the landing, taking off, or maneuvering of aircraft

RECOMMENDATIONS FOR COMPATIBLE LAND USES IN AIRPORT SAFETY ZONES

Performance Standards—General Recommendations for Airport Compatible Land Uses

Virtually all of the sources researched for this section, including Minnesota’s current laws and regulations, set forth similar performance standards for uses and development in all airport safety zones. Performance standards do not prohibit or allow a specific type of use. Instead, performance standards establish limits related to the creation of adverse impacts on overhead flight or to persons or property on the ground. No use, regardless whether permitted under the applicable airport zoning regulations, can operate or perform in a way that exceeds the specified limits.

In virtually all the sources researched, the performance standards prohibit any use in the proximity of an airport that:

1. **Is tall enough to be hazardous to the navigation of aircraft**, including tall buildings, smokestacks, construction cranes, trees, and cell towers. FAA Part 77 regulations and Minnesota Rules



8800.2400 address these hazards by establishing airspace surfaces above which structures or trees must not protrude. Many airport zoning regulations reference and incorporate the state and federal height provisions.

2. **May interfere with electronic navigation aides** such as radar facilities and instrument landing systems that provide for the safe movement of aircraft. These aides may be located on-airport or off. Non-aviation electronic sources placed near electronic navigation aides may cause interference. Similarly, new structures may block the navigation aid signals. Both these types of situations must be reviewed prior to the placement of such uses and structures.
3. **May cause a visual distraction to pilots approaching the airport.** Distractions can occur from outdoor lights near an airport (e.g., high mast lighting or stadium lighting), from highly reflective exterior building materials, or from water surfaces. Smoke or steam generated by nearby businesses, industry, or field burning can also create severe visual difficulties for pilots. Activities that generate a lot of dust can cause similar problems.
4. **Has the potential to attract wildlife such as birds.** These uses include wetlands, ponds, stormwater retention facilities, and landfills, which offer excellent habitat for avian wildlife and flocks of bird. The goal is to avoid interaction between such wildlife and aircraft in flight or on the ground.

Summary Table of Compatible Land Uses by Safety Zone

IN GENERAL

In Minnesota, prior to this manual being published, the state's recommended approach to regulating compatible land uses was to specify a very short list of *prohibited* land uses (e.g., residential uses in Safety Zone A; public assembly uses in Safety Zones A and B), specify a small number of allowed compatible uses in Safety Zone A (but not for Safety Zone B), and rely heavily on general performance standards (e.g., prohibiting uses that cause glare or electronic interference) and density limits to control incompatible land uses near airports. See Table 3-6 above and Minnesota Rule 8800-2400, Subp.6 (Use Restrictions).

This section suggests an alternative to the approach described above – namely, an approach that lists more specifically which land uses are generally compatible, which are not compatible, and which may or may not be compatible in the vicinity of an airport. The vehicle chosen to achieve this is a detailed “summary use table” – typical of the summary tables of allowed uses found in most traditional zoning ordinances across the country.

In the detailed summary use table, the universe of land uses is divided into use classifications, categories, and specific use types. There are a relatively few number of broad use classifications (e.g., residential, commercial, industrial), that are further divided into a greater number of general use categories (e.g., professional offices),



and in some instances further divided into more precise use types (e.g., medical clinics).

The **advantage** of this detailed use list approach, as seen in most modern zoning ordinances, is that it can remove much of the need for interpretation of standards found in more general use listings (such as stated in Minnesota Rule 8800.2400, Subp. 6) or in a more performance-based approach. A local government may denote each listed use as compatible or incompatible, or as requiring more individualized scrutiny, within a given level of airport safety impacts. This greatly simplifies the task of local planners when they evaluate individual development proposals in the vicinity of the airport. One of the **disadvantages** of this approach is the work required to ensure consistency between the listing and interpretation of airport compatible uses in an airport zoning ordinance and a local jurisdiction's unique listing of uses for other local zoning purposes. This could be especially challenging when an airport zoning ordinance is prepared by a joint airport zoning board encompassing multiple local jurisdictions, the latter which may have varying approaches to categorizing land uses for zoning purposes.

While employing a detailed use table may be consistent with best zoning practices nationwide, a jurisdiction's choice to employ the minimum use prohibitions and allowances found in Minnesota Rule 8800.2400 and the 1990 model ordinance should not be viewed as "bad" or "wrong." To the contrary, such option is relatively simple in approach, which may be appealing for a small jurisdiction with limited staff or may offer adequate protection for a general aviation airport expecting few problems with encroaching incompatible land uses. There are also some jurisdictions that simply prefer the open-ended approach as a means to negotiate compatibility on a more case-by-case basis. On the other hand, the use restrictions in Minnesota Rule 8800.2400 (and the 1990 Ordinance) are relatively vague and unclear about the wider range of *compatible* uses (particularly nonresidential uses) that may be allowed close to an airport, which could result in development delays while an applicant seeks an interpretation, or may even result in missed economic development opportunities.

Obviously, each individual jurisdiction or joint airport zoning board must weigh the relative advantages and disadvantages of each approach to regulating land use compatibility, and determine which approach most advances local airport planning and zoning goals and which is most feasible given the existing regulatory context and available resources.

EXPLANATION OF SUMMARY USE TABLE

Table 3-7 below provides a detailed listing of potentially compatible and incompatible land uses for each Minnesota safety zone. The first part of the table summarizes performance-based limits on all uses within all safety zones, as discussed in the previous section. All specific land uses listed later in the table remain subject to the performance limits stated in the first part of the table. Thus, if a specifically allowed use fails the performance standard (e.g., causes



excessive glare), it should not be allowed, regardless in which safety zone it is located.

The table lists typical land uses and denotes whether the use is generally considered compatible in each of Minnesota’s three safety zones. If a single parcel is located in more than one safety zone, the safety zone use restrictions in the table below should apply only to the portion of the property located in that safety zone. For example, if a property under single ownership is located half in Zone A and half in Zone B, the half located in Zone A is subject to the use restrictions applicable in Zone A, and the half located in Zone B is subject to the applicable Zone B use restrictions.

A “**C**” entry in a table cell means the use is recommended as **Compatible** and permitted in that safety zone.

A “**P**” in a table cell means the use is explicitly **Prohibited** by Minnesota law (M.R.S. Chapter 360 and Minnesota Rule 8800.2400) as not compatible in that safety zone.

A “**◆**” table entry means **the use may or may not be compatible** in that zone, and will typically require additional scrutiny. A local government may find that such use is compatible based on a case-by-case review and more specific study that considers the use’s proposed location, surrounding land uses, scale, intensity/density, and operation in relation to the subject airport’s operations and long-term safety needs. Beyond what Minnesota laws require, implementing bodies are free to adjust the limitations and recommendations to suit their local situations. Accordingly, Mn/DOT suggests that each implementing body carefully review these “**◆**” uses and consider if any should be reclassified more definitively as “not compatible” or “compatible” based on local experience and factors. ***Consultation with Mn/DOT aviation planning staff prior to permitting these uses in a safety zone is strongly encouraged.*** Finally, if the implementing body decides to allow a “**◆**” use in Safety Zone B, it **MUST** carry forward the minimum use restrictions mandated by Minnesota law (Minnesota Rules, Rule 8800.2400, Subp. 6.C.) for uses allowed in Zone B: namely, a minimum lot area of three acres, a site population no greater than 15 persons per acre, and no more than one building plot of a maximum size specified in Minnesota Rule 8800.2400.

Regardless whether a use is permitted by right as compatible or is subject to additional scrutiny, there may be **Additional Regulations** that are applicable to or recommended for a specific use. A number entered with the table entry refers to one or more conditions described in the last column of Table 3-7 titled “Additional Regulations.” For example, if a table cell shows “**◆-1**” as the entry, an applicant should check the last table column under “Additional Regulations” for the condition numbered “1”. The decision-making body should approve the use only if it complies with all stated conditions in Table 3-7.



- Each implementing body should consider what the specific “additional regulations” should be. Table 3-7 provides only an indication when additional regulations may be appropriate for a particular use and what type of restriction typically is applied.
- For safety compatibility purposes, the most typical condition that an implementing body should specify is “density-limited.” The density or intensity of a use is usually limited through a cap on the number of structures allowed on a single site (e.g., 1 dwelling unit per 3 acres) or on the number of persons congregating at the use (e.g., no more than 15 persons per acre). Please note that uses allowed in Safety Zone B must comply with the minimum density/intensity standards stated in Minnesota Rule 8800.2400. See also the discussion earlier in this Chapter 3 about determining an appropriate threshold for and measuring the intensity or density of land uses.
- For a local government contemplating adoption of or updates to airport zoning regulations, the important point to take from these discussions of density/intensity is that, at this point in time, there is no “magic” number that works for every jurisdiction or every airport. Except where mandated by state law for uses in Safety Zone B, chosen density threshold should reflect thoughtful consideration of a number of local and airport variables, including but not limited to:
 - The type of airport runway and traffic;
 - Proximity of the safety zone to the runway centerline extended, and the relative risk of accidents in the safety zone;
 - Intensity of existing development in the safety zone;
 - Current local zoning use and density restrictions already in place;
 - Future runway expansion plans; and
 - Degree of development growth pressures in the safety zone.
- Other types of conditions often relate back to the performance criteria, such as approving an industrial use only if its operation are completely enclosed and will not cause smoke or glare hazardous to flight. Other conditions might restrict the specific location of a structure or activity on the development site. For example, a use might be incompatible or more hazardous if located on the extended runway centerline, but might be compatible if sited significantly far away from the centerline extended.

In all cases, all land uses proposed within a safety zone remain subject to other restrictions that prevent obstructions to airflight (i.e., height limits) and that prevent the creation of other hazards to flight (i.e., glare, smoke, dust, wildlife attractants).

TABLE 3-7: COMPATIBLE LAND USES WITHIN AIRPORT SAFETY ZONES

Use Categories and Specific Use Types	Safety Zones			Additional Regulations
	Zone A	Zone B	Zone C	
P = Prohibited by Minnesota Law C = Recommended as Permitted Compatible Use ◆ = May or May Not be Compatible – Additional Review Required – May Be Allowed with Conditions or More Specific Study – Prior Consultation with Mn/DOT Recommended				
GENERALLY PROHIBITED USES AND ACTIVITIES IN ALL SAFETY ZONES				
Uses creating large areas of standing water	P	P	◆	1. Use shall not cause smoke, ash plumes or other adverse conditions that would inhibit pilot visibility or affect the operation of aircraft.
Uses causing electrical, navigational, or radio interference between airport and aircraft	P	P	P	
Uses or structures emitting fly ash, dust, vapor, gases or other emissions	P	P	◆-1	
Uses fostering increase in bird population	P	P	◆	
Use, device, structure making it difficult to distinguish airport lights (billboards, lights, signs)	P	P	P	
Use, device, structure causing glare or impairing pilot visibility	P	P	P	
Uses or structures that promote concentrations of flammable substances or materials	P	◆	◆	
RESIDENTIAL AND ACCOMMODATION USES				
Residential Uses				
Single Family, Two-Family, Duplex Dwellings	P	◆-1	C	New residential uses are prohibited in Zone A; however, pre-existing single family residential uses may be allowed to continue, unless they are found to be a hazard so severe, either to persons on the ground or to the air traveling public, or both, that they must be prohibited under Minnesota Statutes, Section 360.066.
Multi-Family Dwellings	P	◆-1	C	
Nursing Homes and Other Group Living for the Elderly	P	P	C	



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Permanent Mobile Home Parks and Courts	P	P	C	1. The use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than one (1) building plot subject to the size limits stated in Table 3-1.
Accommodation Uses				
Hotels & motels	P	P	C	
Transient mobile home parks courts (RV Parks) or campgrounds	P	P	C	
PUBLIC, CIVIC AND INSTITUTIONAL USES				
Educational Uses				
Schools and Other Educational Services	P	P	C	
Day Care Facilities	P	P	C	
Institutional and Assembly Uses				
Correctional Institutions	P	◆-1	C	1. The use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1 consider location restrictions as well.
Government Offices	P	◆-1	C	
Hospitals	P	P	C	
Libraries	P	◆-1	C	
Religious or Cultural Assembly Uses (Outdoor or Indoor)	P	P	C	
Other Miscellaneous Public, Civic, or Institutional Uses Not Specifically Listed	P	◆-1	C	
Other Public Uses				
Cemeteries	◆-2	C	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.1. 2. Cemeteries are acceptable in Zone A with no buildings, structures, or other above-ground objects hazardous to airport operations allowed. 3. No public facilities or above-ground structures; wildlife attractants should be
Parks and Nature Exhibitions	◆-3	◆-1	C	



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				minimized. No spectator facilities allowed.
COMMERCIAL USES				
Business & Professional Offices				
Medical & Other Health Care Offices or Clinics	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
All Other Business and Professional Offices	P	◆-1	C	
Retail Sales or Services				
Shopping Malls & Centers	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
All Other Retail Sales or Service Uses, Including Repairs and Personal Services	P	◆-1	C	
Eating and/or Drinking Establishment				
Eating and drinking places	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
Amusement, Entertainment and Recreation Establishments				
Fairgrounds, Amusement Parks, Theaters, Amphitheaters, and All Other Amusement, Entertainment, and Recreation Establishments Not Specifically Listed (Indoor or Outdoor)	P	P	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1. 2. No above-ground structures; no spectator facilities; wildlife attractants should be minimized.
Golf Courses, Driving Ranges, Riding Stables & Water Recreation Establishments	◆-2	◆-1	C	
Recreational Vehicle Accommodations and Campgrounds	P	P	C	
Zoos	P	◆-1	C	



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Vehicle Sales or Service Establishment				
Vehicle Body Repair Shops, Parts and Supply Distributors; Automobile Rental/Leasing Agencies, Sales and Service	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
Vehicle Body Repair Shops, Parts and Supply Distributors; Automobile Rental/Leasing Agencies, Sales and Service	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
INDUSTRIAL, WHOLESALE TRADE AND STORAGE USES				
Manufacturing, Assembly, or Processing Uses				
Chemicals and Allied Production; Liquefied & Bottled Gas Production or Distribution; Rubber & Misc. Plastics Manufacturing; Primary Metal Industries; Fabricated Metal Production	P	◆-1,2	C-2	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1. 2. Use shall not cause smoke, ash plumes or other adverse conditions that would inhibit pilot visibility or affect the operation of aircraft.
Explosives and Pyrotechnic Production	P	◆-1,2	C-2	
General Industry – Not Otherwise Listed	P	◆-1,2	C-2	
Mail Order House	P	◆-1	C	
Mini-Storage Warehouse	P	◆-1	C	
Petroleum Refining & Related Industries (Gasoline, Diesel & Heating Oil)	P	◆-1,2	C-2	
Building and Contracting				
Building Materials And Hardware; Construction, General	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons



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Building Contractors; Building Materials Supply				per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
Manufactured/Mobile Home – Sales Only	P	◆-1	C	
Wholesale Trade				
Wholesale Trade	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
Automotive, Marine & Aircraft Accessories	P	◆-1	C	
Warehouse and Storage Services				
Warehousing And Storage Services	P	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1. 2. Subject to local community zoning ordinance.
Explosives Storage	P	◆-1	C-2	
Waste and Salvage Uses				
Hazardous Waste Facility	P	◆-1, 2	◆-2	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1. 2. Subject to additional review to determine compliance with general performance standards in Section 9.2.(f)(3) and minimum state and FAA requirements for siting of municipal waste facilities near airports.
Landfills; Solid Waste Facility	P	◆-1, 2	◆-2	
Recycling Collection Facility	P	◆-1, 2	◆-2	
Refuse Hauling Facility	P	◆-1, 2	◆-2	
Salvage or Junk Yard	P	◆-1, 2	◆-2	
TRANSPORTATION, PARKING & UTILITY USES				
Transportation Facilities (Rail Ways, Highways/Roads, Vehicle Parking)	◆-2,3	C	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
Passenger Facilities & Terminals	P	◆-1	C	



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Cargo-Freight Facilities	P	◆-1	C	2. Allowed only if no practical alternatives exist or use is directly related to airport operations. 3. Lights, guardrails, buildings, structures, above-ground transmission lines are prohibited. 4. Subject to height restrictions. 5. All utilities, power lines, and pipelines must be underground. Wind turbines are prohibited structures.
Communications Towers/ Telecommunications/ Broadcast Communications/ Antennas	◆-3	◆-1	C-4	
Energy Utilities, Transmission Lines, Wind Turbines, & Pipelines	◆-5	◆-1	C-4	
AGRICULTURAL AND RESOURCE EXTRACTION USES				
Agricultural Uses				
Agriculture, General – Annual Crops (Except Livestock)	◆-2, 3	◆-1	C	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1. 2. Wildlife attractants shall be minimized (e.g., cereal grain crops discouraged). 3. Above-ground structures prohibited including crop bales and product piles.
Agricultural Accessory Structures	P	◆-1	C	
Forestry Activities, Shooting Ranges, Game Farms & Related Services	◆-3	◆-1	C	
Fishing and Hunting Activities, Shooting Ranges, Game Farms & Related Services	C-2, 3	C-1, 2	C	
Greenhouses	P	◆-1	C	
Livestock Farms and Ranches Not Otherwise Listed	◆-2, 3	◆-1, 2	C	
Mink and Poultry Production/Breeding	◆-2, 3	◆-1, 2	C	
Resource Extraction Uses				
Mining Activities and Related Services	◆-2, 3	◆-1, 2, 3	C-2, 3	1. Use must be on a lot no less than 3 acres, the use shall result in a site population no greater than 15 persons per acre, and each site shall have no more than 1 building plot subject to the size limits stated in Table 3-1.
Oil & Natural Gas Wells; Stone & Mineral Quarries	P	◆-1, 2, 3	C-3	



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				2. Use shall not cause smoke or dust plumes or other adverse conditions that would inhibit pilot visibility or affect the operation of aircraft. Structures prohibited. 3. Activities involving creation or expansion of water impoundments shall not be created.
OTHER USES				
Water Areas	P	◆-1	C	1. Creation of wildlife attractants and hazards must be substantially mitigated if allowed.
Stormwater Detention Facilities Accessory to Another Use (Surface Only)	P	◆-1	◆-1	
Undeveloped and Vacant Land, Open Space	C	C	C	



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