

## Chapter Three: FACILITY REQUIREMENTS

The objective of this chapter is to identify, in general terms, the adequacy of the existing facilities at the Scottsdale Airport (SDL) and outline what facilities may be needed to accommodate future demands. Airport facilities include airside and landside components. Airside components include the runway system (runways and taxiways), navigational aids, lighting, and marking. Landside components include terminal facilities, aircraft parking aprons, storage and maintenance hangars, auto parking, surface road access, and support facilities. Once these facility needs are established, alternatives for providing the facilities will be evaluated in the following chapter.

This chapter examines several components of the airport and their respective capacities to determine future facility needs over the planning period. The identified deficiencies will then be examined in the alternatives evaluation.

The facility requirements were evaluated using guidance contained in Federal Aviation Administration (FAA) publications, including the following:

- Advisory Circular (AC) 150/5300-13B, *Airport Design*
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B, *Runway Length Requirements for Airport Design*
- Title 14 Code of Federal Regulations (CFR) Part 77, *Objects Affecting Navigable Airspace*
- Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*

### PLANNING HORIZONS

An updated set of aviation demand forecasts for the airport has been established; a summary of the primary forecasting elements was previously presented on Exhibit 2H. The forecasts were approved by the FAA in a letter dated August 28, 2025. These activity forecasts include annual operations, based aircraft, based aircraft fleet mix, and peak activity periods. With this information, specific components of the airfield and landside systems can be evaluated to determine their capacity to accommodate future demand.

Cost-effective, efficient, and orderly development of an airport should rely more on actual demand at an airport than on a time-based forecast figure. To develop a study that is demand-based, rather than time-based, a series of planning horizon milestones is established. The planning horizons presented in **Table 3A** are segmented as the short term (approximately years 1 through 5), the intermediate term (approximately years 6 through 10), and the long term (years 11 through 20).

**TABLE 3A: Planning Horizon Activity Levels**

Category	Activity	Base Year: 2024	Short Term (5 Years)	Intermediate Term (10 Years)	Long Term (20 Years)
Annual Operations	Air Taxi (Itinerant)	66,178	80,903	98,906	147,818
Annual Operations	General Aviation (Itinerant)	64,608	70,812	77,019	89,636
Annual Operations	Military (Itinerant)	320	365	365	365
Annual Operations	<b>Total Itinerant Operations:</b>	<b>131,106</b>	<b>152,080</b>	<b>176,290</b>	<b>237,819</b>
Annual Operations	General Aviation (Local)	35,478	39,267	43,460	53,238
Annual Operations	Military (Local)	4	2	2	2
Annual Operations	<b>Total Local Operations:</b>	<b>35,482</b>	<b>39,269</b>	<b>43,462</b>	<b>53,240</b>
Annual Operations	<b>Total Annual Operations:</b>	<b>166,588</b>	<b>191,349</b>	<b>219,752</b>	<b>291,059</b>
Based Aircraft	<b>Total Based Aircraft:</b>	<b>333</b>	<b>365</b>	<b>397</b>	<b>462</b>
Charter Enplanements	<b>Total Charter Enplanements:</b>	<b>43,765</b>	<b>92,243</b>	<b>140,072</b>	<b>236,870</b>

Table Source: Coffman Associates Analysis

Actual activity at the airport may be higher or lower than what the annualized forecast portrays. By anticipating needs according to planning horizon milestones, the resultant plan can accommodate unexpected shifts or changes in the area’s aviation demand so airport officials can respond to such unexpected changes in a timely fashion.

Utilizing milestones allows airport management the flexibility to make decisions and develop facilities according to needs generated by actual demand levels. The demand-based schedule provides flexibility in development, as development schedules can be slowed or expedited according to demand at any given time over the planning period. The resultant plan provides airport officials with a financially responsible and needs-based program.

Throughout this chapter, references to “current” mean the base year of 2024. References to “future” mean within the next five years. References to “ultimate” mean sometime in the next five to 20 years. The reason for this differentiation is that any potential projects identified for the current or future timeframe must include actual justification. Projects that may be needed beyond the five-year timeframe likely will not be justified at present but will require justification prior to implementation.

## AIRFIELD CAPACITY

An airfield’s capacity is expressed in terms of its annual service volume (ASV). ASV is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year without incurring significant delay factors. As operations near or surpass the ASV, delay factors increase exponentially. Guidance on calculating ASV is found in FAA AC 150/5060-5, *Airport Capacity and Delay*.

## FACTORS AFFECTING ANNUAL SERVICE VOLUME (ASV)

Many factors are considered in the calculation of an airport’s ASV, including airfield characteristics, meteorological conditions, aircraft mix, and demand characteristics (aircraft operations). These factors are described as follows and on **Exhibit 3A**.

## Airfield Characteristics

The layout of runway and taxiways directly affects an airfield's ASV, including the orientation of the runway and the percentage of time the runway is in use. Additional airfield characteristics include the length, width, weight-bearing capacity, and instrument approach capability of each runway at an airport, all of which determine the type(s) of aircraft that may operate on the runway, as well as if operations can occur during poor weather conditions.

### *Runway Configuration*

SDL has one runway, Runway 3-21, which is 8,249 feet long and 100 feet wide.

### *Meteorological Conditions*

Weather conditions have a significant effect on airfield capacity. Airfield capacity is usually highest in clear weather when flight visibility is best. Airfield capacity is diminished as weather conditions deteriorate and cloud ceilings and visibility are reduced. As weather conditions deteriorate, the spacing of aircraft must increase to provide allowable margins of safety. The increased distance between aircraft reduces the number of aircraft that can operate at the airport during any given period, which consequently reduces overall airfield capacity.

There are three categories of meteorological conditions, each of which is defined by the reported cloud ceiling and flight visibility. Visual flight rules (VFR) conditions exist whenever the cloud ceiling is greater than 1,000 feet above ground level and visibility is greater than three statute miles. VFR flight conditions permit pilots to approach, land, or take off by visual reference, and see and avoid other aircraft.

Instrument flight rules (IFR) conditions exist when the reported cloud ceiling is less than 1,000 feet above ground level and/or visibility is less than three statute miles. Under IFR conditions, pilots must rely on instruments for navigation and guidance to the runway. Safe separations between aircraft must be assured by following air traffic control rules and procedures. This leads to increased distances between aircraft, which diminishes airfield capacity.

Poor visibility conditions (PVC) exist when cloud ceilings are less than 500 feet above ground level or visibility is less than one mile.

SDL has an on-field automated surface observing system (ASOS). According to the last 10 years of data retrieved from the ASOS weather station, VFR conditions have been in effect 99.7 percent of the time, IFR conditions have been in effect 0.2 percent of the time, and PVC conditions have been in effect 0.1 percent of the time. **Table 3B** summarizes the annualized meteorological conditions at SDL.

**TABLE 3B: Meteorological Conditions**

Condition	Criteria: Cloud Ceiling	Criteria: Visibility	SDL ASOS: Time (minutes)	SDL ASOS: Percent	SDL ASOS: Observations	SDL ASOS: Percent
VFR	Greater than 1,000' and	Greater than 3 miles	5,204,209	99.7%	89,731	99.1%
IFR	Between 1,000' and 500' or	Between 1–3 miles	12,531	0.2%	723	0.8%
PVC	Less than 500' or	Less than 1 mile	1,200	0.1%	93	0.1%
–	–	<b>Total:</b>	<b>5,217,940</b>	<b>100%</b>	<b>90,547</b>	<b>100%</b>

Table Source: ASOS data from January 1, 2015–December 31, 2024, Station ID: 72278903192

ASOS = automated surface observing system  
 IFR = instrument flight rules  
 PVC = poor visibility conditions  
 VFR = visual flight rules

### *Instrument Approach Procedures*

The instrument approach capabilities of a runway factor into the airfield capacity determination. The lower the cloud ceiling minimums and visibility minimums are, the more capable a runway will be, thus resulting in greater airfield capacity. While the airport has instrument approach capability, the approaches are required navigation performance (RNP) approaches, which require special aircraft equipment and special pilot training and limit the airport’s capability. The visibility minimums of the RNP instrument approaches are between one and three miles.

### *Runway Use*

Runway use is normally dictated by wind conditions. The direction of takeoffs and landings is generally determined by the speed and direction of wind. It is generally safest for aircraft to depart and land into the wind to avoid a crosswind or tailwind component during these operations. In addition, due to the busy airspace in the Phoenix region, aircraft flow can be dictated by air traffic control when winds are calm. The prevailing winds favor the use of Runway 21 approximately 60 percent of the time.

### *Exit Taxiways*

Exit taxiways have a significant impact on airfield capacity because the number and locations of exits directly determine the occupancy time of an aircraft on the runway. Based on the aircraft mix using the airport, taxiways located between 2,000 and 4,000 feet from the landing threshold and separated by at least 750 feet are factored in the exit rating for the airfield. The greater the number of appropriately spaced taxiway exits, the lower the runway occupancy time for an aircraft will be, which contributes to a higher overall capacity for the airfield. Under this criterion, Runway 3 is credited with three exits and Runway 21 is credited with two. Two or more exits provide the greatest capacity relief within the capacity model.

### *Aircraft Mix*

Aircraft mix refers to the speed, size, and flight characteristics of aircraft operating at the airport. As the mix of aircraft operating at an airport increases to include larger aircraft, airfield capacity begins to diminish due to larger separation distances that must be maintained between aircraft of different speeds and sizes.



Aircraft mix for the capacity analysis is defined by the FAA in terms of four aircraft classes, only three of which are reflected in the mix at SDL. Classes A and B consist of single- and multi-engine aircraft that weigh less than 12,500 pounds. Aircraft within these classifications are primarily associated with general aviation operations, but this classification also includes some air taxi aircraft. Class C consists of aircraft that weigh over 12,500 pounds but do not exceed 300,000 pounds. Class D aircraft are those over 300,000 pounds, which do not operate at the airport and are not included in the aircraft mix calculation.

For the capacity analysis, the percentage of Class C aircraft operating at the airport impacts the ASV, as these classes include the larger and faster aircraft in the operational mix. The existing and projected operational fleet mix was previously shown in Table 2NN, which showed that more activity by larger business jets and turboprops is anticipated. By the long-term planning period, activity by aircraft that weigh more than 12,500 pounds is estimated to represent 36.4 percent of overall operations. In the capacity model, capacity begins to be constrained when operations by aircraft in Class C exceed 20 percent. **Table 3C** summarizes the aircraft operational fleet mix as classified for the capacity model.

**TABLE 3C: Aircraft Operational Fleet Mix**

Weather	Term	A and B*	C**
VFR (Visual)	Existing	69.6%	30.4%
VFR (Visual)	Short Term	68.4%	31.6%
VFR (Visual)	Intermediate Term	66.8%	33.2%
VFR (Visual)	Long Term	63.6%	36.4%
IFR (Instrument)	Existing/Future	30.0%	70.0%

Table Source: FAA AC 150/5060, Airport Capacity and Delay

\*A and B = 12,500 pounds or less (includes helicopters)

\*\*C = 12,500 to 300,000 pounds

## Demand Characteristics

Operations—not only the total number of annual operations, but also the way in which they are conducted—have an influence on airfield capacity. Peak operational periods, touch-and-go operations, and the percentage of arrivals have an impact on the number of annual operations that can be conducted at the airport.

### Peak Period Operations

For the airfield capacity analysis, average daily operations during the peak month are determined based on airport traffic control tower (ATCT) data. Typical operational activity is important in the calculation of an airport’s ASV, as peak demand levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times throughout the year. The design day of 521 operations is utilized for 2024. By 2044, the design day is estimated at 943 operations.

### Touch-and-Go Operations

A touch-and-go operation involves an aircraft making a landing and then an immediate takeoff without coming to a full stop or exiting the runway. Touch-and-go activity is counted as two operations, as both an arrival and a departure are involved. A high percentage of touch-and-go traffic normally results in

a higher operational capacity because one landing and one takeoff occur within a shorter time period than individual operations. These operations are normally associated with general aviation training operations and are included in local operations data. Touch-and-go operations at the airport have historically averaged approximately 32 percent of small general aviation operations.

### Percent Arrivals

Under most circumstances, a lower percentage of arrivals correlates to a higher capacity. Except in unique circumstances, the aircraft arrival/departure split is typically 50/50.

## ESTIMATION OF ANNUAL SERVICE VOLUME

The preceding information was used in conjunction with the airfield capacity methodology developed by the FAA to determine airfield capacity for SDL.

**Table 3D** shows the calculation of the ASV, which is C times D times H. Following this formula, the current airfield capacity is estimated at 216,800 annual operations. With the increase of operations projected over time and the increasing number of operations by larger aircraft (requiring greater separation distances on landing), the ultimate ASV is estimated at 187,200 annual operations.

**TABLE 3D: Annual Service Volume Calculation**

ASV Calculation Input	2024	Short Term	Intermediate Term	Long Term
C = Weighted hourly capacity	88	86	85	83
D = Ratio of annual demand to average daily demand during the peak month	166,588 annual operations / 521 design day operations = 320	191,349 annual operations / 620 design day operations = 309	219,752 annual operations / 712 design day operations = 309	291,059 annual operations / 943 design day operations = 309
H = Ratio of average daily demand to peak hour demand during the peak month	521 design day operations / 68 design hour operations = 7.7	620 design day operations / 85 design hour operations = 7.3	712 design day operations / 98 design hour operations = 7.3	943 design day operations / 129 design hour operations = 7.3
<b>Annual Service Volume = C x D x H</b>	<b>216,800</b>	<b>194,000</b>	<b>191,700</b>	<b>187,200</b>

Note: ASV is rounded to nearest 1,000 and C/D/H ratios have fractions.

## Delay

As the number of aircraft operations approaches the airfield's capacity, increasing amounts of delay begin to occur for arriving and departing aircraft in all-weather conditions. Arriving aircraft delays result in aircraft holding outside the airport traffic area, while departing aircraft delays result in aircraft holding at the runway end until they can safely take off.

Total annual delay at the airport is currently estimated at 1,166 hours (0.42 minutes per aircraft) (reference Figure 2.2, FAA AC 150/5060-5). If no capacity improvements are made, total annual delay can be expected to reach 39,778 hours (8.2 minutes per aircraft) by the long-term planning horizon. At times, delays five to 10 times the average could be experienced by individual aircraft.

## Conclusion

**Table 3E** provides a comparison of the ASV at the operational levels for each planning horizon. The current level of operations represents 77 percent of the ASV. In 20 years, the percentage is projected to reach 155 percent of the ASV. As shown in the table, the ASV will decline over time as a greater number of aircraft over 12,500 pounds utilize the airport. These aircraft require greater separation distances, thus reducing capacity.

**TABLE 3E: Annual Service Volume Summary**

Existing Configuration	Annual Operations (rounded)	Weighted Hourly Capacity	Annual Service Volume (rounded)	Percent of Capacity
Existing	166,600	88	216,800	77%
Short Term	191,300	86	194,000	99%
Intermediate Term	219,800	85	191,700	115%
Long Term	291,000	83	187,200	155%

*Table Source: Coffman Associates Analysis Using FAA AC 150/5060-5, Airport Capacity and Delay*

The capacity analysis shows how delays will increase exponentially as the number of operations approaches the ASV. The ASV is not an absolute maximum the runway can accommodate but represents the approximate number of operations that can occur before delay becomes significant. **Exhibit 3B** graphically shows the comparison of the ASV to projected operations.

FAA Order 5090.5, *Formulation of the NPIAS and ACIP*, indicates that improvements for airfield capacity purposes should be considered when operations reach 60 percent of the ASV and should be implemented by the time operations reach 80 percent of the ASV. The challenge at SDL is that the airfield geometry (pavement layout) already maximizes the ASV calculation with taxiway exits, parallel taxiways, and hold bays. Ultimately, the FAA Air Traffic Organization may need to be consulted to address the delay issue by implementing restrictive approach and departure procedures. Nonetheless, options to improve airfield efficiency will be evaluated as part of this study.

## AIRSIDE REQUIREMENTS

The following section examines the projected airside requirements, including runway length, runway width, pavement weight-bearing capacity, line-of-sight, and gradient. The taxiway system will be examined with respect to current and future design standards for safety, including separation and wingtip clearances.

## RUNWAY CONFIGURATION

Scottsdale Airport is a single-runway airfield with the runway oriented in a northeast/southwest manner. For the operational safety and efficiency of an airport, it is desirable for the runway to be oriented as close as possible to the direction of the prevailing winds, which reduces the impact of wind components perpendicular to the direction of travel of an aircraft that is landing or taking off.

According to FAA Order 5100.38D, *Airport Improvement Handbook*, only one runway at a NPIAS airport is eligible for ongoing maintenance and rehabilitation funding unless the FAA Airports District Office (ADO) has made a specific determination that a crosswind or secondary runway is justified. A runway that is not a primary runway, crosswind runway, or secondary runway is an *additional* runway, which is not eligible for FAA funding. **Table 3F** presents the eligibility requirements for runway types.

**TABLE 3F: Runway Eligibility**

The following runway type...	Must meet all of the following criteria...	And is...
Primary Runway	1. A single runway at an airport is eligible for development consistent with FAA design and engineering standards.	Eligible
Crosswind Runway	1. The wind coverage on the primary runway is less than 95%.	Eligible if justified
Secondary Runway	1. There is more than one runway at the airport. 2. The non-primary runway is not a crosswind runway. 3. Either of the following: a. The primary runway is operating at 60% or more of its annual capacity. b. The FAA has made a specific determination that the runway is required.	Eligible if justified
Additional Runway	1. There is more than one runway at the airport. 2. The non-primary runway is not a crosswind runway. 3. The non-primary runway is not a secondary runway.	Ineligible

Table Source: FAA Order 5100.38D, *AIP Handbook*

FAA AC 150/5300-13B, *Airport Design*, recommends a crosswind runway when the primary runway orientation provides for less than 95 percent wind coverage for specific crosswind components. The 95 percent wind coverage is computed based on wind not exceeding a 10.5-knot (12 miles per hour [mph]) component for runway design code (RDC) A-I and B-I; 13-knot (15 mph) component for RDC A-II and B-II; 16-knot (18 mph) component for RDC A-III, B-III, C-I through C-III, and D-I through D-III; and 20 knots for wider wingspans.

It is preferable to analyze weather data local to the airport being studied. The ASOS weather sensor currently located at SDL is connected to the National Oceanic and Atmospheric Administration (NOAA), so the data are available for analysis.

According to FAA guidelines, the most recent 10 years of wind data should be analyzed to determine various facility requirements, including the appropriate runway configuration. **Exhibit 3C** shows wind rose analysis of 10 years of wind data from SDL. A wind rose is a graphic tool that gives a succinct view of how wind speed and direction are historically distributed at a location. The table at the top of the wind rose indicates the percent of wind coverage for the runway at specific wind intensity.

Runway 3-21 provides 99.3 percent wind coverage at 10.5 knots and 99.7 percent wind coverage at 13 knots. Because the runway provides greater than 95 percent total wind coverage, a crosswind runway is not justified.

## DECLARED DISTANCES

Declared distances are used to define the effective runway length for landing and takeoff when a standard safety area cannot be achieved. The declared distances include the following:

- Takeoff run available (TORA): the runway length declared available and suitable for the ground run of an aircraft taking off (factors in the positioning of the departure RPZ)
- Takeoff distance available (TODA): the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA; the full length of the TODA may need to be reduced because of obstacles in the departure area
- Accelerate-stop distance available (ASDA): the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff (factors in the length of RSA/ROFA beyond the runway end)
- Landing distance available (LDA): the runway length declared available and suitable for landing an aircraft (factors in the length of RSA/ROFA beyond the runway end and the positioning of the approach RPZ)

At SDL, declared distances are currently in effect to achieve standard safety areas (described in the next section) and/or to eliminate penetrations to the departure surface. The existing declared distances are outlined in **Table 3G**.

**TABLE 3G: Current Declared Distances**

Declared Distance Parameters	Current Declared Distances: Runway 3	Current Declared Distances: Runway 21
TORA: Takeoff Run Available	8,249'	8,249'
TODA: Takeoff Distance Available	8,249'	8,249'
ASDA: Accelerate-Stop Distance Available	7,849'	8,069'
LDA: Landing Distance Available	7,110'	7,669'

*Table Source: Coffman Associates analysis of FAA AC 150/5300-13B, Airport Design*

The TORA and TODA do not involve consideration of the RSA beyond the runway ends. The ASDA and LDA must include the standard RSA beyond the ends of the runway. The standard RSA for Runway 3-21 extends 1,000 feet beyond the runway ends. The following describes how the declared distances are currently determined and applied at SDL.

### Runway 3

- Runway 3 TORA/TODA: The full pavement length is 8,249 feet.
- Runway 3 ASDA: The ASDA is measured from the pavement end of Runway 3, extending 7,849 feet to a point on the runway that is 400 feet short of the Runway 21 pavement end. The end of the Runway 3 ASDA coincides with the location of the landing threshold for Runway 21. The end of the ASDA is declared 400 feet short of the pavement end to allow for the full 1,000-foot RSA beyond the runway end.

- Runway 3 LDA: The landing threshold to Runway 3 is displaced by 739 feet. The end of the Runway 3 LDA is 400 feet short of the Runway 21 pavement end, co-located with the Runway 21 landing threshold and the end of the Runway 3 ASDA. The end of the LDA is declared 400 feet short of the pavement end to allow for the full 1,000-foot RSA beyond the runway end. The LDA is 7,110 feet in length.

## Runway 21

- Runway 21 TORA/TODA: The full pavement length is 8,249 feet.
- ASDA: The ASDA is measured from the pavement end of Runway 21, extending 8,069 feet to a point on the runway that is 180 feet short of the Runway 3 pavement end. The end of the ASDA is declared 180 feet short of the pavement end to allow for the full 1,000-foot RSA beyond the runway end.
- LDA: The landing threshold to Runway 21 is displaced by 400 feet. The end of the Runway 21 LDA is declared 180 feet short of the Runway 3 pavement end to allow for the full 1,000-foot RSA beyond the declared end of the runway. The LDA is 7,669 feet in length.

As part of this master plan, a new aerial survey of the airport has been undertaken. The data will be uploaded to the official FAA Airports Geographic Information System (AGIS) and the FAA Airport Data Information Portal (ADIP). This survey is developed following FAA protocol, and it will ultimately serve as the official survey data for the airport. It is not uncommon for the AGIS survey to improve upon past surveys of the airport and for certain elements to change, including the length of the runway. In subsequent chapters and on the airport layout plan, the new survey data will be applied to the current and future conditions of the airport. Where appropriate, adjustments to the current declared distances will be recommended.

## MODIFICATION OF STANDARDS

FAA Order 5300.1G, *Modifications to Agency Airport Design, Construction, and Equipment Standards*, establishes the process for the initiation, revision, coordination, and management of Modifications of Standards (MOS) applicable to airport design, construction, and equipment projects. An MOS is any deviation from or addition to standards that is applicable to airport design, material, and construction standards or equipment projects resulting in an acceptable level of safety, useful life, lower costs, greater efficiency, or the need to accommodate an unusual local condition on a specific project through approval on a case-by-case basis.

An MOS cannot be issued for RSA dimensions. Instead, the FAA's Regional Airports Division Manager will evaluate RSAs and issue a determination in accordance with FAA Order 5200.8, *Runway Safety Area Program*.

During the development process of the 2015 airport master plan, it was recommended that the airport and the FAA consider four MOS. Following extensive review, the following three MOS were approved by the FAA on January 3, 2019:

1. SDL-MOS1: Runway Object Free Area – Width and Length Beyond Runway
  - Establishes a ROFA that is 630 feet wide, 470 feet beyond the Runway 3 end and 500 feet beyond the Runway 21 end
2. SDL-MOS3: Runway Centerline to Parallel Taxiway Centerline
  - Establishes that the existing runway to parallel taxiway separation of 250 feet provides an acceptable level of safety
3. SDL-MOS4: Runway Centerline to Aircraft Parking
  - Establishes that aircraft parking can begin 325 feet from the runway centerline

In 2023, the FAA published Engineering Policy Memo 23-01: *Sponsor Status Updates for an Existing Approved Modification of Standards*. This policy memo replaced the requirement for sponsors to resubmit MOS forms every five years with a requirement to provide a status update utilizing the online Airport Data and Information Portal (ADIP). In April 2025, airport management submitted the MOS status update into the ADIP for the three previously approved MOS.

It should be noted that SDL-MOS4, which addressed the runway centerline to aircraft parking area standard, may no longer applicable because the design standards have changed. There is no longer a specific standard distance from the runway centerline to aircraft parking area. Instead, aircraft parking areas must be clear of all object clearing surfaces on an airport and the aircraft parking areas at SDL meet this new standard; therefore, only MOS1 and MOS3 address existing non-standard conditions. The reason for these two MOS will be discussed in this chapter and opportunities to achieve the design standard will be examined again in the alternatives chapter of this airport master plan.

## RUNWAY DESIGN STANDARDS

The FAA has established several imaginary surfaces to protect aircraft operational areas and keep them free from obstructions that could affect their safe operation. These include the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (ROFZ), and runway protection zone (RPZ).

The RSA and ROFZ areas must be owned by the airport, be maintained free of obstacles, and be readily accessible by maintenance and emergency personnel. If either of these two runway protection surfaces cannot meet the FAA standard, other options must be considered, including shortening runways. The ROFA should be under the ownership of the airport. Under certain special conditions that are approved by the FAA, some ROFA deficiencies may be permissible.

The RPZs are not required to be under airport ownership, but it is strongly recommended by the FAA. An alternative to outright ownership of the RPZs is the purchase of aviation easements (acquiring control of designated airspace within the RPZ) or having land use control measures in place (i.e., zoning) to ensure the RPZ remains free of incompatible development.

Dimensional standards for the various safety areas associated with the runways are a function of the type of critical aircraft, as well as the instrument approach visibility minimums. The FAA has approved a D-II critical aircraft in its forecast approval letter, which is dated August 28, 2025 (see **Appendix B**). Runway 3-21 should meet the design standards for RDC D-II-5000. **Table 3H** presents the runway design standards applicable to the runway. **Exhibit 3D** presents the existing RSA, ROFA, ROFZ, and RPZs, as well as the declared distances.

**TABLE 3H: Runway Design Standards**

Category	Airport Data	Runway 3 Design Standard/Actual	Runway 21 Design Standard/Actual
Runway Classification	Airport Critical Aircraft	D-II-2B	D-II-2B
Runway Classification	Runway Design Code (RDC)	D-II-5000	D-II-5000
Runway Classification	Visibility Minimums	1-mile	1-mile
Runway Design	Runway Width	100'	100'
Runway Design	Runway Shoulder Width	20' (Design Standard)/ 12' (Actual)	20' (Design Standard)/ 12' (Actual)
Runway Design	Blast Pad Length x Width (if provided)	150' x 120'	150' x 120'
Runway Protection	RSA Width	500' (Design Standard)/ 400' (Actual)*	500' (Design Standard)/ 400' (Actual)*
Runway Protection	RSA Length Beyond Departure End	1,000'	1,000'
Runway Protection	RSA Length Prior to Threshold	600'	600'
Runway Protection	ROFA Width	800' (Design Standard)/ 630' (Actual)**	800' (Design Standard)/ 630' (Actual)**
Runway Protection	ROFA Length Beyond Departure End	1,000' (Design Standard)/ 470' (Actual)**	1,000' (Design Standard)/ 500' (Actual)**
Runway Protection	ROFA Length Prior to Threshold	600'	600'
Runway Protection	ROFZ Width	400'	400'
Runway Protection	ROFZ Length Beyond End	200'	200'
Runway Protection	Approach RPZ Length	1,700'	1,700'
Runway Protection	Approach RPZ Inner Width	500'	500'
Runway Protection	Approach RPZ Outer Width	1,010'	1,010'
Runway Protection	Departure RPZ Length	1,700'	1,700'
Runway Protection	Departure RPZ Inner Width	500'	500'
Runway Protection	Departure RPZ Outer Width	1,010'	1,010'
Runway Separation	Runway Centerline to Holding Position	250' (Design Standard)/ 152' (Actual)	250' (Design Standard)/ 152' (Actual)
Runway Separation	Runway Centerline to Parallel Taxiway	300' (Design Standard)/ 250' (Actual)**	300' (Design Standard)/ 250' (Actual)**

Table Source: FAA AC 150/5300-13B, Airport Design

\*When the standard RSA width of 500 feet is not practical, an RSA width of 400 feet is permissible.

\*\*Actual dimensions are based on FAA-approved Modification of Standards.

ROFA = runway object free area

RPZ = runway protection zone

RSA = runway safety area

As documented in Chapter Two, SDL experiences more than 500 annual operations by aircraft in the D-III category; therefore, these aircraft were identified as the operational critical aircraft. The FAA approved a critical aircraft in the D-II category because, during development of the previous master plan, the FAA agreed it would be impracticable to meet all design standards associated with D-III and issued MOS in relation to those design standards.

Four primary design elements are different between D-II and D-III standards. The differing design elements are summarized in **Table 3J**.

**TABLE 3J: Design Standard Differences**

Design Element	Runway Design Standards: D-III-5000*	Runway Design Standards: D-II-5000**	Currently Available: D-II-5000
Runway-to-Taxiway Separation	400'	300'	250'***
Holding Position	266'	250'	152'
Runway Safety Area Width	500'	400'	400'
Blast Pad Length and Width	200' x 140'	150' x 120'	150' x 120'

Table Source: FAA AC 150/5300-13B, *Airport Design*

\*Operational critical aircraft

\*\*FAA-approved critical aircraft (August 28, 2025)

\*\*\*FAA Modification of Standards (approved on January 3, 2019)

### Runway Safety Area (RSA)

The RSA is defined in FAA AC 150/5300-13B, *Airport Design*, as a “surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of undershoot, overshoot, or excursion from the runway.” The RSA is centered on the runway and dimensioned in accordance with the approach speed of the critical aircraft using the runway. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of accommodating the design aircraft and fire and rescue vehicles, and free of obstacles not fixed by navigational purpose.

The traditional RSA dimensions for a D-II runway are 500 feet wide, centered on the runway, and extend 1,000 feet beyond the far end of the runway. Prior to landing, 600 feet of RSA is the standard. Behind the Runway 3 end, the standard RSA can be accommodated and there are no penetrations. Behind Runway 21, the standard RSA is penetrated by the perimeter service road, perimeter fence, East Frank Lloyd Wright Boulevard, and the Central Arizona Project Canal. **Exhibit 3E** shows details of the RSA as it extends 1,000 feet beyond the runway pavement ends.

Because the RSA is a required element for a runway, it is necessary to take mitigating steps to provide for the 1,000-foot RSA. According to FAA Order 5200.8, *Runway Safety Area Program*, the following mitigating alternatives can be considered:

1. Provide the standard traditional graded area surrounding the runway
  - At SDL, this would be impossible because of the existing penetrations to the RSA.
2. Reduce runway length where the existing runway length exceeds what is required for the existing critical aircraft
  - At SDL, more runway length is needed, not less, to accommodate the critical aircraft, which is the family of large business jets (see the *Runway Length* section).
3. A combination of runway relocation, shifting, grading, realignment, or reduction
  - Due to the constrained runway environment at SDL, this option is not feasible.

4. Implement declared distances
  - This is the option currently implemented at SDL (see the *Declared Distances* section).
5. Install an Engineered Materials Arresting System (EMAS) beyond the runway ends
  - EMAS is a crushable concrete that provides an acceptable level of RSA safety protection beyond the runway ends when in a constrained RSA environment. A standard EMAS bed requires an area of 600 feet beyond the runway end.

At SDL, declared distances are implemented to provide for the required RSA that extends 1,000-feet beyond the runway end. To do this, the end of runway is declared to be 400 feet short of the Runway 21 threshold. Pilots utilize this adjusted runway length when calculating available runway length for arrivals and departures using Runway 3. Even with the declared runway end, a corner of the RSA still crossed the perimeter service road on the northwest end.

According to FAA AC 150/5300-13B, *Airport Design*, “when an RSA width of 500 feet is not practical, an RSA width of 400 feet is permissible.” Historically, SDL has maintained a 400-foot-wide RSA. One of the reasons a 400-foot RSA is used is to mitigate the north corner RSA penetration by the perimeter service road. In 2023, the airport rerouted the perimeter service road slightly so that the 400-foot-wide RSA is completely clear.

A second reason for applying the 400-foot-wide RSA is that both parallel taxiways are 250 feet from the runway, centerline to centerline. A 500-foot-wide RSA would extend to the center of both parallel taxiways, creating a runway incursion anytime an aircraft is taxiing on one of the parallel taxiways. As a result, the permissible 400-foot-wide RSA is applied at SDL and an RSA that meets the width and length standard is provided in conjunction with declared distances.

The declared distances also affect the RSA behind the Runway 3 end. The RSA beyond the runway end for arrivals and departures on Runway 21 is declared to begin 180 feet before the Runway 3 pavement end; therefore, the RSA extends 820 feet from the pavement end. The use of declared distances provides for an RSA that fully meets the design standard for length and width.

Through the implementation of declared distances and the application of the FAA-permissible 400-foot-wide RSA, the current RSA meets design standards and should be maintained.

### **Runway Object Free Area (ROFA)**

The ROFA is “a two-dimensional ground area surrounding runways which is clear of object penetrations except for objects whose location is fixed by function (i.e., airfield lighting, signs, etc.)” The ROFA does not have to be graded and level like the RSA; instead, the primary requirement for the ROFA is that no object in the ROFA penetrates the lateral elevation of the RSA. The runway ROFA is centered on the runway and extends out in accordance with the critical aircraft design category utilizing the runway.

According to FAA AC 150/5300-13B, *Airport Design*, the principal purpose of the ROFA is to ensure:

- A development buffer in proximity to a runway; and
- Wing clearance for a runway excursion event to the outer limit of the RSA.

The standard ROFA is 800 feet wide and extends 1,000 feet beyond the runway ends and it typically ends in the same location as the RSA. **Exhibit 3F** shows the standard ROFA, which is penetrated on the north end by the perimeter service road, the perimeter fence, a blast fence, Frank Lloyd Wright Boulevard, and the Central Arizona Project Canal. On the south end, it is penetrated by the perimeter service road, the property fence, and Redfield Road. The ROFA is also penetrated on the east side by numerous hangars and buildings, including the airport traffic control tower (ATCT).

For the ROFA to be clear of object penetrations and still meet the safety intent, the length behind Runway 21 is limited to 470 feet from the pavement end. Behind the Runway 3 end, the ROFA length is limited to 30 feet due to the angle of the perimeter fence and Redfield Road.

With the existing application of declared distances, the ROFA would extend 600 feet behind the Runway 21 pavement end (the same as the RSA); however, it would still be penetrated by the perimeter service road, the perimeter fence, a blast fence, and Frank Lloyd Wright Boulevard. On the south end, the ROFA would still be penetrated by the same obstructions.

This same condition existed during the development of the previous master plan in 2015. An extensive alternatives analysis was undertaken to identify an acceptable level of safety for the ROFA. The FAA approved an MOS for the ROFA, in which the ROFA dimensions are as follows:

- 630 feet wide: 315 feet to both sides of the runway
- 470 feet beyond the Runway 3 end: behind Runway 21
- 500 feet beyond the Runway 21 end: behind Runway 3

The alternatives chapter of this master plan will reexamine opportunities to provide the standard ROFA or incrementally improve on the approved MOS dimensions for the ROFA.

### **Runway Obstacle Free Zone (ROFZ)**

The ROFZ is an imaginary surface that precludes object penetration, including taxiing and parked aircraft. The only allowance for ROFZ obstructions is for navigational aids mounted on frangible bases, which are fixed in their locations by function (such as airfield signs). The ROFZ is established to ensure the safety of aircraft operations. If the ROFZ is obstructed, the airport's approaches could be removed or its approach minimums could be increased. The base elevation of the ROFZ is the same as the highest runway elevation at that particular location.

The ROFZ is 400 feet wide, centered on the runway, and extends 200 feet beyond the physical runway ends. The presence of declared distances or displaced landing thresholds does not impact the ROFZ. The hold line markings are 152 feet from the runway centerline; therefore, any aircraft at a runway hold line are within the ROFZ because the ROFZ extends 200 feet from the runway centerline. In addition, the wing of any aircraft with a wingspan greater than 100 feet would penetrate the ROFZ while taxiing on either Taxiway A or B; however, the protected area for takeoff and landings is defined by the location of the hold lines, so holding and taxiing aircraft would not be considered incursions by the SDL ATCT.

## Runway Protection Zone (RPZ)

The RPZ is a trapezoidal area centered on the runway, typically beginning 200 feet beyond the runway end. When an RPZ begins at a location other than 200 feet beyond the end of a runway, two RPZs are required (i.e., a departure RPZ and an approach RPZ). The RPZ has been established by the FAA to provide an area that is clear of obstructions and incompatible land uses to enhance the protection of people and property on the ground.

On September 16, 2022, the FAA published AC 150/5190-4B, *Airport Land Use Compatibility Planning*. This AC represented a significant effort to address RPZ land use compatibility. Airport-compatible land uses are those that can coexist with a nearby airport without constraining the safe and efficient operations of the airport. Assuring compatible land uses within the RPZ is best achieved through one of the following methods:

1. Airport ownership of the RPZ property
2. Possessing sufficient interest in the RPZ property through easements, deed restrictions, etc.
3. Possessing sufficient land use control authority to regulate land use in the jurisdiction containing the RPZ
4. Possessing and exercising the power of eminent domain over the RPZ property
5. Possessing and exercising permitting authority over proponents of development within the RPZ

### *Expectations of Airport Sponsors*

The FAA requires all federally obligated airport sponsors to comply with FAA grant assurances. These include (but are not limited to) FAA Grant Assurance 21, *Compatible Land Use*. Sponsors should take appropriate measures to protect against, remove, or mitigate land uses that introduce incompatible development within RPZs. For projects proposed by the sponsor (such as runway extensions or new runways) that would result in moving the RPZ into an area that has incompatible land uses, the FAA expects the sponsor to have or secure sufficient control of the RPZ, ideally through fee simple ownership, including any off-airport property within the RPZ.

### *Existing Incompatible Land Uses*

The FAA expects airport sponsors to seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses. Examples may include land acquisition, land exchanges, right-of-first-refusal to purchase, agreements with property owners on land uses, easements, or other such measures. The FAA also expects sponsors to actively consider and evaluate available options any time there is an ALP update or master plan update, and to be vigilant for any other opportunities that may arise from time to time (especially opportunities to purchase land) to eliminate or minimize existing incompatibilities. The FAA expects airport sponsors to document their efforts to demonstrate that they are complying with the relevant FAA Grant Assurances.

**Table 3K** summarizes FAA expectations regarding existing incompatible land uses within an RPZ.

**TABLE 3K: Expectations of Airport Sponsors Regarding Existing Incompatible Land Uses**

Type of Land Use Control	Expectations of Airport Sponsors
The airport sponsor owns the land	Because the sponsor has total land use control, the FAA considers it a reasonable expectation that the sponsor will establish and enforce the necessary zoning controls or lease terms to enable the sponsor to address existing incompatible land uses when the opportunity arises.
The property is off-airport but the sponsor has land use authority, or the local jurisdiction and land use regulatory authority is owned by the same governing body	Because the sponsor has at least some influence over land use control, the FAA considers it a reasonable expectation that the sponsor will seek to establish the necessary zoning controls to enable the sponsor to address existing incompatible land uses when the opportunity arises.
The sponsor has no land use control (i.e., RPZ land falls in another jurisdiction)	<p>Although the sponsor has no land use control, the FAA still considers it a reasonable expectation that the sponsor will actively seek opportunities to establish the necessary zoning controls to enable the sponsor to address existing incompatible land uses when the opportunity arises.</p> <p>The FAA will consider providing financial assistance to public-sector airport sponsors for land acquisition even if the airport sponsor has no land use control, but only if the sponsor demonstrates that the airport sponsor is taking all appropriate steps available to enhance control and mitigate existing risks.</p>

*Table Source: FAA AC 150/5190-4B, Airport Land Use Compatibility Planning*

### *Proposed Incompatible Land Uses*

The FAA expects the airport sponsor to take active steps to prevent or mitigate proposed incompatible land uses; actively seek opportunities to prevent or mitigate risks associated with proposed incompatible land uses within the RPZ; and secure control of land within the RPZ if a sponsor-initiated project results in incompatible land use within the newly defined RPZ. These actions is expected of the airport sponsor, regardless of the funding source(s) involved. Sponsors should actively monitor conditions and publicly object to proposed incompatible land uses and should make it a high priority (financially or otherwise) to acquire land or otherwise establish land use controls that prevent incompatible uses. The FAA expects an airport sponsor to document its efforts so the sponsor can demonstrate that the airport is complying with its grant assurances. **Table 3L** summarizes FAA expectations regarding proposals for introducing new incompatible land uses within an RPZ.

Potential new incompatible land uses within an RPZ might be caused by one or more circumstances. Some of these circumstances may result from airport sponsor-proposed projects, including (but not limited to) one of the following:

- An airfield project (e.g., runway extension, runway shift)
- A change in the critical design aircraft that increases the RPZ dimensions
- A new or revised instrument approach procedure that increases the size of the RPZ
- A local development proposal in the RPZ (either new or reconfigured), which can include roadway construction, relocation, or improvements

**TABLE 3L: Expectations of Airport Sponsors Regarding New Incompatible Land Uses**

Type of Land Use Control	Expectations of Airport Sponsors
The airport sponsor owns the land	Because the sponsor has total land use control, the FAA expects that the sponsor will establish all necessary protections to prevent new incompatible land uses.
The property is off-airport but the sponsor has land use authority or the local jurisdiction and land use regulatory authority is owned by the same governing body	<p>The FAA expects the sponsor to take all appropriate steps available to establish and exercise zoning controls necessary to prevent any new incompatible land uses.</p> <p>The FAA recognizes that the standard of “appropriate action, to the extent reasonable” does not mean, in this case, that the sponsor can always prevail; rather, the FAA expects the sponsor to demonstrate and document a reasonable effort.</p>
The sponsor has no land use control (i.e., RPZ land falls within another jurisdiction)	Although the sponsor has no land use control, the FAA still expects the sponsor to actively pursue and consider all possible steps to secure land necessary to prevent any new incompatible land uses. The FAA recognizes that the standard of “appropriate action, to the extent reasonable” may not succeed. Even so, the FAA expects the sponsor to demonstrate and document a reasonable effort. The FAA expects the airport sponsor to adopt a strong public stance to oppose incompatible land uses and communicate the purpose of the RPZ and associated risks to the proponent, and to actively consider measures such as land acquisition, land exchanges, right-of-first-refusal to purchase, agreements with property owners regarding land uses, or other such measures.

Table Source: FAA AC 150/5190-4B, Airport Land Use Compatibility Planning

The FAA has higher expectations for the airport sponsor to mitigate potential incompatible land uses within the RPZs when the introduction of the incompatible land use is the result of an airport sponsor-initiated project (regardless of the funding source). The sponsor should submit an alternatives evaluation to the FAA unless the land use is permissible. These are the permissible land uses that require no further evaluation:

- Farming that meets airport design clearance standards in FAA AC 150/5300-13 and guidance as outlined in AC 150/5200-33
- Irrigation channels that meet the standards of AC 150/5200-33 and FAA/USDA manual, *Wildlife Hazard Management at Airports*
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator
- Underground facilities, as long as they meet other design criteria (such as RSA standards), as applicable
- Navigational aids (NAVAIDs) and aviation facilities, such as equipment for airport facilities that are considered fixed by function in regard to the RPZ
- Aboveground fuel tanks associated with backup generators for unstaffed NAVAIDs

At SDL, there are some existing incompatible land uses within the RPZs, such as public roads. The airport staff should remain engaged with city transportation planning staff and advocate for any proposed roadway alterations that would improve the land use compatibility of the RPZs. While it is not the responsibility of the airport to propose such changes, the airport should be engaged when these opportunities arise.

### **Runway/Taxiway Separation**

The design standard for the separation between runways and parallel taxiways is determined by the runway design code (RDC). The FAA-approved RDC for Runway 3-21 is D-II-5000, which has a separation standard of 300 feet from the centerline of the runway to the centerline of a parallel taxiway. Parallel Taxiways A and B are both 250 feet from the runway.

During the 2015 master plan, extensive analysis was undertaken to determine the feasibility of relocating one or both parallel taxiways to 300 feet. It was determined that such a shift would have a significant and negative impact on airport operations, as well as a significant impact on numerous hangars, buildings, and private property interests. As a result, a Modification of Standards (SDL-MOS3) was approved by the FAA on January 3, 2019.

The MOS supporting the existing runway-to-taxiway separation states the following:

*“Allowing parallel Taxiways A and B to remain in their existing locations at 250 feet from the Runway 3-21 centerline provides for an acceptable level of safety on the airfield, as the design standards for Runway Safety Area (RSA) and Runway Obstacle Free Zone (ROFZ) are met under the existing airfield configuration. Furthermore, the current locations of the parallel taxiways provide for the appropriate TOFA of 131 feet (since changed to 124 feet) and TSA of 79 feet for Airplane Design Group (ADG) II aircraft. The 250-foot runway centerline to taxiway centerline distance would provide for 171 feet of wingtip clearance of ADG II aircraft simultaneously operating on Runway 3-21 and either parallel taxiway.”*

The runway-to-taxiway separation will be reexamined in the alternatives chapter of this master plan.

### **Hold Line Separation**

The distance that aircraft hold lines should be marked on taxiways is a function of the RDC. The standard for the applicable RDC of D-II-2B is 250 feet from the runway centerline. Currently, the hold lines for Runway 3-21 are 152 feet from the runway centerline. Because the parallel taxiways are 250 feet from the runway centerline, it would be impossible to place hold lines on the centerlines of the parallel taxiways; doing so would lead to significant congestion every time an aircraft was holding because the aircraft would block the taxiway.

A Safety Risk Management Document (SRMD) was undertaken between 2010 and 2013 to address the impacts to safety if the hold position markings were relocated from the current 152 feet from the runway centerline to somewhere between 200 and 250 feet from the runway centerline. The panel included

active participation from representatives of SDL Airport Management Staff, AWP Office of Runway Safety, AWP ADO, SDL ATCT, Phoenix TRACON, AZD Safety Assurance Staff, Aircraft Owners and Pilots Association, AZD Operations Support (Procedures) Staff, Western Service Area Quality Control Group (AJV-W11), NATCA, Flight Standards, SDL FBOs, and the NBAA. Over the course of several meetings, it was concluded that a hold line change could not be introduced into the National Airspace System (NAS) with an acceptable level of risk, as defined in the FAA Safety Management System (SMS) Manual.

The SRMD states: “Based on the safety analysis conducted by the Safety Risk Management Panel (SRMP), combined with the recorded results from the Tower Simulation System (TSS), some of the air traffic control (ATC) procedures that would be required in support of the hold line relocation change cannot currently be introduced into the National Airspace System (NAS) with an acceptable level of risk, as defined in the FAA Safety Management System (SMS) manual.” The SRMD identified nine risk hazards associated with relocating hold lines. Four of the hazards were initially considered high-risk and two of the four hazards could not be sufficiently mitigated. The seven remaining risk hazards could be mitigated; therefore, the holding position markings remain at a distance of 152 feet from the runway centerline.

Operationally, the holding position markings define the runway environment for control tower personnel at SDL; therefore, if an aircraft were to fail to hold at the holding position when instructed and enter the runway environment, that action would be reported as a runway incursion. A runway incursion is defined as “any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft.” While the RSA typically defines the lateral limits of the protected area of a surface designated for the landing and takeoff, the hold position markings operationally define the lateral limits of the protected area.

The locations of the hold lines will be reexamined in the alternatives chapter.

## RUNWAY LENGTH REQUIREMENTS

Aircraft operate on a wide variety of available runway lengths. Many factors govern the suitability of runway lengths for aircraft, such as elevation, temperature, wind velocity, aircraft operating weight, wing flap settings, runway condition (wet or dry), runway gradient, vicinity airspace obstructions, and any special operating procedures. Runway 3-21 is 8,249 feet long. FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides a five-step process for determining runway length needs:

1. Identify the list of critical design airplanes or airplane group.
2. Identify the airplanes or airplane group that will require the longest runway length at maximum certificated takeoff weight (MTOW).
3. Determine which of the three methods described in the AC will be used for establishing the runway length.
4. Select the recommended runway length from the appropriate methodology.
5. Apply any necessary adjustments to the obtained runway length.

There are three methodologies for determining runway length requirements. These methodologies are based on the MTOW of the critical aircraft or the airplane group for each runway. The airplane group consists of multiple aircraft with similar design characteristics. The three weight classifications are airplanes with an MTOW of 12,500 pounds or less, those that weigh over 12,500 pounds but less than 60,000 pounds, and those that weigh 60,000 pounds or more. **Table 3M** shows these classifications and the appropriate related methodology to use in runway length determination.

**TABLE 3M: Airplane Weight Classification for Runway Length Requirements**

Airplane Weight Category (MTOW)	Design Approach	Methodology
12,500 pounds or less with approach speeds of less than 30 knots	Family grouping of small airplanes	Chapter 2: para. 203
12,500 pounds or less with approach speeds of at least 30 knots but less than 50 knots	Family grouping of small airplanes	Chapter 2: para. 204
12,500 pounds or less with approach speeds of 50 knots or more with fewer than 10 passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
12,500 pounds or less with approach speeds of 50 knots or more with 10 or more passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-1
Over 12,500 pounds but less than 60,000 pounds	Family grouping of large airplanes	Chapter 3: Figures 3-1 or 3-2 and Tables 3-1 or 3-2
60,000 pounds or more, or regional jets	Individual large airplanes	Chapter 4: <i>Airplane Performance Manuals</i>

Table Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

SDL experiences more than 500 annual operations by aircraft that weigh more than 60,000 pounds. **Table 3N** summarizes most of those aircraft and the total number of operations for 2024. The appropriate methodology for determining the optimal runway length at SDL is to reference individual aircraft planning manuals. The table also shows the recommended runway length for each of the selected aircraft. At maximum takeoff weight and on a 104-degree day, all of these aircraft would require a runway length of at least 8,350 feet.

**TABLE 3N: Operations by Aircraft Over 60,000 Pounds MTOW**

Aircraft	MTOW	2024 Operations*	Estimated Takeoff Runway Length at MTOW**
Gulfstream IV/G400	73,200	1,550	8,350'
Gulfstream V/500	91,000	1,332	9,250'
Gulfstream 600	94,600	678	8,700'
Global 5000/Express	92,500	988	8,860'
<b>Total:</b>	–	<b>4,548</b>	–

Table Sources: \*FAA, Traffic Flow Management System Counts; \*\*Flight Planning Manuals for Each Aircraft Type

MTOW = maximum takeoff weight

### Supplemental Analysis Undertaken for Typical Business Jets Operating with Local Conditions

An additional analysis was undertaken to estimate the required runway lengths for common business jets under a variety of conditions. This analysis is the output from UltraNav software, which utilizes flight planning manuals for the selected aircraft.



The required takeoff and landing lengths for maximum load and range (adjusted for temperature and elevation) for many of the turbine aircraft utilizing the airport are presented in **Table 3P** for both dry and wet pavement conditions. The takeoff distance requirements reflect maximum gross weight for the aircraft; however, the percentage of useful load has also been calculated for the existing 8,249-foot runway length. When the runway length exceeds the available runway length at the given design temperature, aircraft operators may be required to reduce payload. Runway length requirements that exceed the current length of Runway 3-21 are noted in red type.

Business jets may operate under different regulations depending on the type of flight being conducted, as noted in **Table 3P**. These regulations may impact the calculated runway available for landing. CFR Part 91k refers to operations conducted via fractional ownership, and Part 135 refers to commuter/on-demand (charter) operations. Fractional operators typically must be capable of landing within 80 percent of the landing distance available (LDA) and commuter/on-demand operators must be capable of landing within 60 percent of the LDA. Operations conducted under CFR Part 25 are general aviation operations conducted by private owners, which are unfactored.

**TABLE 3P: Runway Length Requirements for Business Jets**

Runway Parameters	Takeoff Length Required at MTOW	Percent Useful Load for Takeoff on 8,249' Runway	Landing Length Requirements: CFR Part 25 (Unfactored)	Landing Length Requirements: CFR Part 135 (60% Factored)	Landing Length Requirements: CFR Part 91k (80% Factored)
Lear 60	8,249' Dry/8,249' Wet	79.45% Dry/69.48% Wet	3,776' Dry/5,049' Wet	6,293' Dry/8,415' Wet*	4,720' Dry/6,311' Wet
Gulfstream V	9,773' Dry*/10,000' Wet*	89.27% Dry/84.23% Wet	2,880' Dry/3,312' Wet	4,800' Dry/5,520' Wet	3,600' Dry/4,140' Wet
Citation X	7,859' Dry/8,653' Wet*	83.58% Dry/78.30% Wet	3,953' Dry/5,642' Wet	6,588' Dry/9,403' Wet*	4,941' Dry/7,053' Wet
Falcon 50EX	6,783' Dry/7,174' Wet	82.34% Dry/82.34% Wet	3,019' Dry/3,472' Wet	5,032' Dry/5,787' Wet	3,774' Dry/4,340' Wet
Gulfstream IV	6,471' Dry/7,411' Wet	78.62% Dry/78.62% Wet	3,717' Dry/7,125' Wet	6,195' Dry/11,875' Wet*	4,646' Dry/8,906' Wet*
Challenger 300	8,184' Dry/8,127' Wet	100.00% Dry/100.00% Wet	2,686' Dry/5,149' Wet	4,477' Dry/8,582' Wet*	3,358' Dry/6,436' Wet
Lear 45XR	7,679' Dry/7,642' Wet	100.00% Dry/100.00% Wet	2,952' Dry/3,809' Wet	4,920' Dry/6,348' Wet	3,690' Dry/4,761' Wet
Citation (525) CJ1	10,000' Dry*/10,000' Wet*	71.74% Dry/85.15% Wet	3,031' Dry/4,096' Wet	5,052' Dry/6,827' Wet	3,789' Dry/5,120' Wet
Beechjet 400A	6,372' Dry/8,114' Wet	92.78% Dry/92.78% Wet	3,828' Dry/5,535' Wet	6,380' Dry/9,225' Wet*	4,785' Dry/6,919' Wet
Citation Bravo	6,903' Dry/6,641' Wet	100.00% Dry/100.00% Wet	3,791' Dry/5,961' Wet	6,318' Dry/9,935' Wet*	4,739' Dry/7,451' Wet
Citation 560 XLS	6,326' Dry/6,326' Wet	98.89% Dry/98.89% Wet	3,530' Dry/5,566' Wet	5,883' Dry/9,277' Wet*	4,413' Dry/6,958' Wet*
Citation Encore	5,931' Dry/6,209' Wet	100.00% Dry/100.00% Wet	3,135' Dry/4,700' Wet	5,225' Dry/7,833' Wet	3,919' Dry/5,875' Wet
Citation (525A) CJ2	5,476' Dry/5,678' Wet	97.29% Dry/97.27% Wet	3,276' Dry/4,745' Wet	5,460' Dry/7,908' Wet	4,095' Dry/5,931' Wet
Citation Sovereign	5,493' Dry/5,533' Wet	100.00% Dry/100.00% Wet	2,920' Dry/3,722' Wet	4,867' Dry/6,203' Wet	3,650' Dry/4,653' Wet
Citation CJ3	5,598' Dry/5,511' Wet	100.00% Dry/100.00% Wet	3,095' Dry/4,213' Wet	5,158' Dry/7,022' Wet	3,869' Dry/5,266' Wet
Citation I/SP	4,166' Dry/4,791' Wet	80.89% Dry/80.89% Wet	2,495' Dry/2,869' Wet	4,158' Dry/4,782' Wet	3,119' Dry/3,586' Wet

Table Source: Aircraft operating manuals from UltraNav software

**Airfield Parameters:**

- Airport Elevation: 1,510.1' MSL
- Average High Monthly Temperature: 104.1°F (July), 40°C
- Runway Gradient: 0.81% Runway 3-21 (66')

CFR = Code of Federal Regulations

MSL = mean sea level

MTOW = maximum takeoff weight

\*Figure exceeds the available runway length

CFR Part 25: standard unfactored landing lengths

CFR Part 135: 60% factored landing length as required by commuter/on-demand operators

CFR Part 91k: 80% factored as required by fractional operators

### FAA Runway Length for Jets That Weigh Less Than 60,000 Pounds

Utilizing FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, the following is the five-step process for determining the recommended runway length for aircraft with an MTOW between 12,500 pounds and 60,000 pounds.

*Step 1: Identify the critical airplane or airplane group.*

This runway length analysis assumes the critical aircraft is a large business jet that weighs less than 60,000 pounds MTOW. There are more than 500 annual operations by these types of aircraft at SDL. In this case, the appropriate runway length methodology is to examine the general runway length tables from Chapter 3 of AC 150/5325-4B for aircraft that weigh between 12,500 pounds and 60,000 pounds.

*Step 2: Identify the airplanes or airplane group that will require the longest runway length at MTOW.*

Business jets typically require the longest runway lengths; therefore, the runway length curves in Chapter 3 of AC 150/5325-4B will be examined for future conditions.

*Step 3: Determine which of the three methods described in the AC will be used to establish the runway length.*

In consideration of the growing number of business jets at SDL, it is necessary to select the specific methodology to use for the business jets. Chapter 3 of the AC groups business jets that weigh over 12,500 pounds but less than 60,000 pounds into the following two categories:

- 75 percent of the fleet
- 100 percent of the fleet

The AC states that the airplanes in the *75 percent of the fleet* category generally need 5,000 feet or less of runway at mean sea level and standard day temperature (59 degrees Fahrenheit [°F]), while those in the *100 percent of the fleet* category need more than 5,000 feet of runway under the same conditions.

The AC indicates that the airport designer must determine which category to use for runway length determination. SDL experiences significant levels of business jet activity from the full range of the business jet fleet. **Table 3Q** shows example aircraft for each runway length category. For this analysis, business jets in the 75–100 percent category will be evaluated.

**TABLE 3Q: Aircraft Categories for Runway Length Determination**

0–75 Percent of the National Fleet	MTOW	75–100 Percent of the National Fleet	MTOW
Lear 35	20,350	Lear 55	21,500
Lear 45	20,500	Lear 60	23,500
Cessna 550	14,100	Hawker 800XP	28,000
Cessna 560XL	20,000	Hawker 1000	31,000
Cessna 650 (VII)	22,000	Cessna 650 (III/IV)	22,000
IAI Westwind	23,500	Cessna 750 (X)	35,700
Beechjet 400	15,800	Challenger 604	47,600
Falcon 50	18,500	IAI Astra	23,500

Table Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

MTOW = maximum takeoff weight

Two runway length curves are presented in the AC under the 75–100 percent category:

- 60 percent useful load
- 90 percent useful load

The useful load is the difference between the maximum allowable structural weight and the operating empty weight (OEW). The useful load consists of passengers, cargo, and usable fuel. The determination of which useful load category to use will have a significant impact on the recommended runway length; however, it is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel, but pilots may choose to ferry fuel so they do not have to frequently refuel. Because of the variability in aircraft weights and haul lengths, the 60 percent useful load category is typically considered the default, unless there are specific known operations that would suggest using the 90 percent useful load category.

For SDL, there are known long-haul (cross-country) operations that would suggest applying the 90 percent useful load classification. Data acquired from GCR, Inc. documents city pairs by air taxi aircraft. An examination of the cities shows more than 800 operations between SDL and airports that are more than 1,000 miles away. This examination is of air taxi operations only and does not include private flights. Because of the frequency of long-haul flights to and from SDL, the 90 percent useful load category is the most appropriate to apply when estimating runway length requirements for business jets that weigh between 12,500 and 60,000 pounds.

*Step 4: Select the recommended runway length from the appropriate methodology.*

The next step is to examine the performance charts for the *100 percent of the fleet* classification for the 90 percent useful load category. (See **Figure 3-1.**) This chart requires the following inputs:

- Mean maximum daily temperature of the hottest month: July at 104.4°F
- The airport elevation: 1,510.1 feet above mean sea level (MSL)

By cross-referencing the temperature and elevation on the chart, the raw recommended runway length is approximately 11,000 feet.

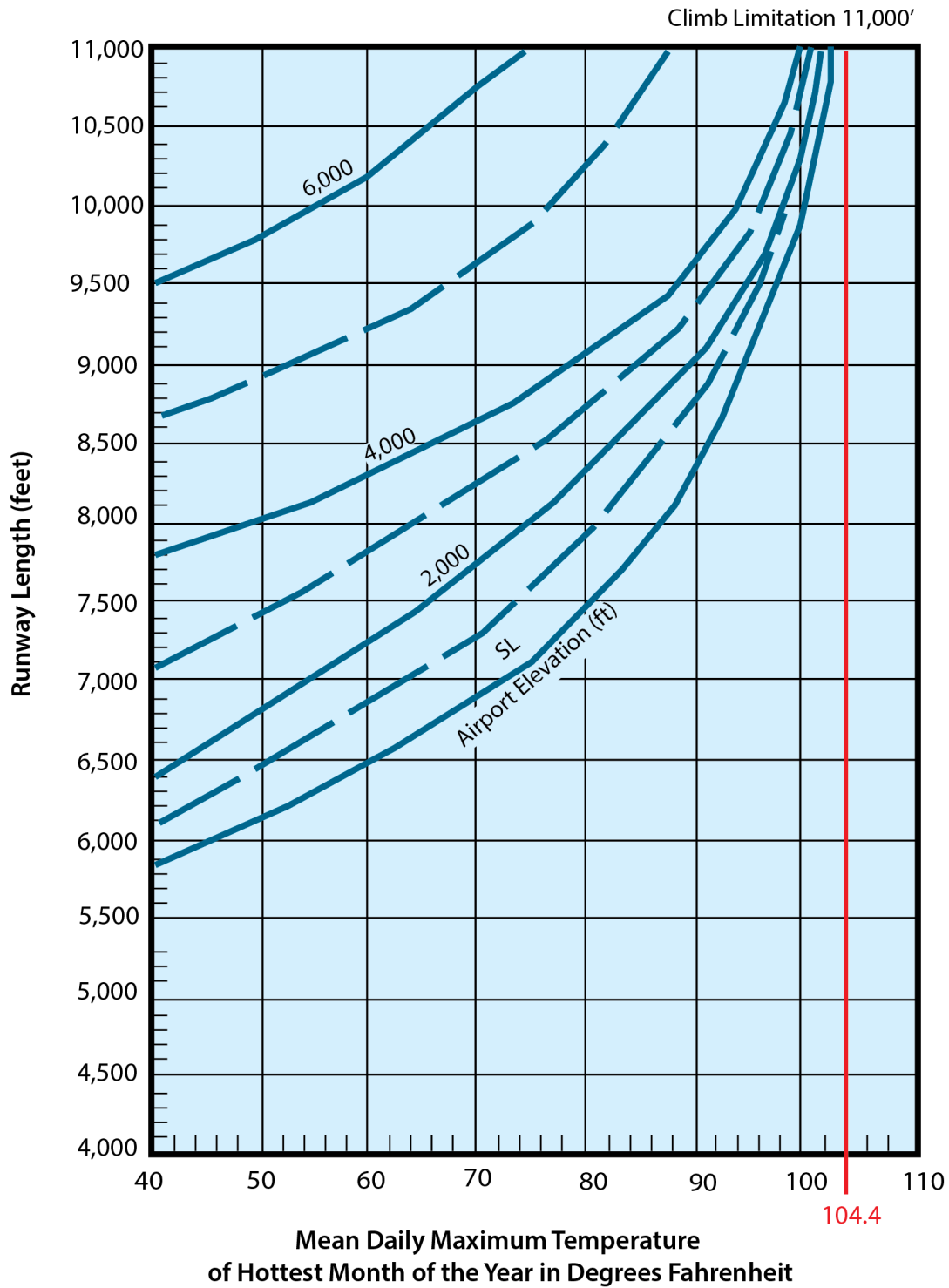
*Step 5: Apply any necessary adjustments to the obtained runway length.*

The recommended runway length determined in Step 4 is based on no wind, a dry runway surface, and zero effective runway gradient; therefore, the following criteria are applied:

- Wet runway surface
- 0.81 percent effective runway gradient (66 feet of elevation difference for Runway 3-21)

To account for a wet/contaminated surface, the runway length obtained from the load performance chart used in Step 4 is increased by 15 percent or up to 7,000 feet for the 90 percent category, whichever is less.

**100 Percent of Fleet at 90 Percent Useful Load**



Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design. Reproduced by Coffman Associates

**Figure 3-1: Raw Runway Length for Business Jets**

The runway length obtained from Step 4 is also increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. At SDL, this equates to an additional 90 feet of runway length, resulting in an adjusted runway length of 8,715 feet. **Table 3R** summarizes the data inputs and the final recommended runway lengths for SDL. To accommodate 100 percent of the fleet at 90 percent useful load, a runway length of 11,700 feet is recommended.

As shown in the table, business jets that weigh less than 60,000 pounds operating at 60 percent useful load have adequate runway length available. When the useful load is 90 percent, available runway length becomes constraining, and operators must reduce weight.

**TABLE 3R: Runway Length Requirements**

Fleet Mix Category	Raw Runway Length from FAA AC	Runway Length With Gradient Adjustment	Wet Surface Landing Length for Jets (+15%)*	Final Runway Length
75% of fleet at 60% useful load	5,211'	5,871'	5,500'	5,900'
100% of fleet at 60% useful load	6,852'	7,512'	5,500'	7,500'
75% of fleet at 90% useful load	7,902'	8,562'	7,000'	8,600'
100% of fleet at 90% useful load	11,000'	11,660'	7,000'	11,700'

Table Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

Airfield Parameters:

- Airport Elevation: 1,510.1' MSL
- Average High Monthly Temperature: 104.1°F (July), 40°C
- Runway Gradient: 0.81% Runway 3-21 (66')

\*Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet conditions

## Runway Length Summary

According to FAA 150/5325-4B, *Runway Length Requirements for Airport Design*, individual aircraft flight planning manuals should be used to determine the optimal runway length. These manuals were consulted for several of the large business jets that operate at the airport. To accommodate these aircraft, a runway length between 7,500 feet and 10,000 feet is recommended.

UltraNav software, which calculates runway length needs for certain business jets based on the flight planning manuals, was also consulted. According to UltraNav, nearly all of the selected business jets can operate unrestricted within the current runway length. Under certain conditions, some airplanes will be weight-restricted, especially on a wet/contaminated runway.

Finally, the FAA-provided runway length methodology for business jets that weigh between 12,500 pounds and 60,000 pounds was also applied. This resulted in a recommended runway length of 11,700 feet. For SDL, this recommended length would be the optimal length to plan for; however, there are known limitations to extending the runway.

For planning purposes, the airport should maintain the maximum possible runway length. If there is an opportunity to add length, those should be examined as well. As a reliever airport, SDL should be able to accommodate the full range of general aviation aircraft, including the largest business jets.

## RUNWAY WIDTH

Runway 3-21 is 100 feet wide, which is the standard for the approved critical aircraft (D-II-5000). A wider runway is only justified when there are 500 or more operations by aircraft with a MTOW of greater than 150,000 pounds is. No aircraft in the general aviation fleet greater than 150,000 pounds operate at SDL; therefore, the existing runway width should be maintained through the 20-year planning period.

## RUNWAY SHOULDERS

The runway shoulders are an area adjacent to the defined edge of the paved runway. The shoulders facilitate drainage, provide blast protection, support emergency vehicles and/or aircraft, and provide a transition between the runway pavement and the adjacent surface.

The runway at Scottsdale Airport has 10-foot-wide paved shoulders, which meets the D-II design standard. They should be maintained at this width.

## RUNWAY BLAST PADS

Blast pads are paved or prepared areas beyond the runway threshold that are intended to reduce erosion from prop wash and jet blast. Blast pads are not a required element of the runway system.

The FAA recommends blast pads under any of the following conditions:

- Runways with ADG-III as the critical aircraft
- Runways experiencing erosion of soil adjacent to the runway
- Runways with soil that is not suitable for turf establishment
- Locations experiencing wrong surface landings, to improve pilot visual cues to the runway ends

SDL has blast pads at each runway end. They are 150 feet long and 120 feet wide, which meets the D-II-5000 standard. The blast pads should be maintained through the planning period.

## RUNWAY WEIGHT-BEARING CAPACITY

An important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. The weight-bearing capacity ratings of a runway do not preclude operations by aircraft that weigh more; however, frequent activity by heavier aircraft can shorten the useful life of that pavement. The current published weight-bearing capacity for Runway 3-21 is 45,000 pounds for single-wheel (S) type landing gear (S), 75,000 pounds for dual-wheel (D) type landing gear, and 95,000 pounds for two single wheels in tandem (2S).

All federally obligated airports must remain open to the public, and it is typically up to the pilot of an aircraft to determine if a runway can support the aircraft safely. An airport sponsor cannot restrict an aircraft from using the runway simply because its weight exceeds the published weight-bearing capacity. On the other hand, the airport sponsor has an obligation to properly maintain and protect the useful life of the runway.

According to the FAA publication *Airport/Facility Directory*, “Runway strength-rating is not intended as a maximum allowable weight or as an operating limitation. Many airport pavements are capable of supporting limited operations with gross weights in excess of the published figures.” The directory goes on to say that aircraft that exceed the pavement weight-bearing capacity should contact the airport sponsor for permission to operate at the airport. This is the case at Scottsdale Airport, as the *Airport/Facility Directory* states that “Runway 3-21 is limited to 75,000 pounds (D) except with prior permission requested.” Aircraft can operate with maximum gross weights in excess of 75,000 pounds and up to 100,000 pounds at the airport under one of these conditions:

- Up to 100,000 pounds on a prior permission required (PPR) basis
- With a placard that certifies they are operating at or below a weight of 75,000 pounds

The weight-bearing capacity of a runway can change over time. Regular usage by heavier aircraft can decrease the weight-bearing capacity, while periodic runway resurfacing or reconstructing can increase the weight-bearing capacity. Given the high volume of large business jets that utilize the airport, future planning should consider providing a weight-bearing capacity of 100,000 pounds (D).

As previously noted in **Table 3N**, in 2024, SDL experienced approximately 1,700 operations by aircraft with a maximum takeoff weight of greater than 75,000 pounds. It is unknown how many of these actually operated at a weight greater than 75,000 pounds.

During the 2015 master plan process, the aviation department and FAA determined that increasing the weight-bearing capacity up to 100,000 pounds (D) may require the airport to meet D-III design standards. In the alternatives analysis, the feasibility of increasing the runway weight-bearing capacity will be re-examined.

### RUNWAY LINE-OF-SIGHT AND GRADIENT

The FAA has instituted various line-of-sight requirements to facilitate coordination among aircraft, as well as between aircraft and vehicles that are operating on active runways. This allows departing and arriving aircraft to verify the locations and actions of other aircraft and vehicles on the ground that could create conflicts.

Line-of-sight standards for an individual runway are based on the availability of a parallel taxiway. When a full-length parallel taxiway is available, thus facilitating faster runway exit times, any point five feet above the runway centerline must be mutually visible with any other point five feet above the runway centerline that is located at less than half the length of the runway. If a full-length parallel taxiway is not available, any two points five feet above the runway must be mutually visible for the whole length of the runway. Runway 3-21 meets the line-of-sight standard.

The surface gradient of a runway affects aircraft performance and pilot perception. The surface gradient is the maximum allowable slope for a runway. The maximum longitudinal grade for runways in approach categories C, D, and E, like Runway 3-21, is 1.5 percent; however, longitudinal grades that exceed 0.8 percent are not acceptable within the lesser of the following criteria:

- In the first and last quarter of the runway length
- The first and last 2,500 feet of the runway length

The runway slopes consistently from the Runway 3 end upward to the Runway 21 end with an elevation difference of 68 feet. The effective runway gradient is 0.81 percent. There is no gradient change in the first and last 2,500 feet of runway length.

Runway 3-21 meets the design standards for line-of-sight and gradient, which should both be maintained.

### TAXIWAY DESIGN STANDARDS

The design standards associated with taxiways are determined by the taxiway design group (TDG) and the airplane design group (ADG) of the critical aircraft that would potentially use that taxiway. The critical aircraft that was approved by the FAA is ADG II, but it is known that there are frequent operations by aircraft classified as ADG III; therefore, it is prudent to understand the design standards for both ADG II and ADG III because these standards determine the separation distances that protect the ground movement of aircraft. **Table 3S** presents the taxiway design standards for ADG II and ADG III.

Taxiways typically provide access to the runway via either a parallel taxiway or connecting taxiways. Taxiways usually allow for faster ground movements than taxilanes. Taxiway ground movement speeds are generally between 15 and 35 miles per hour, while taxilane movement speeds are below 15 miles per hour. Taxilanes typically extend from taxiways to hangar areas and facilitate slower movement speeds than taxiways. As result, certain separation standards are different for taxiways and taxilanes. While taxiways should be planned to meet the critical aircraft standards, taxilanes can be designed to accommodate aircraft that will use them. For example, a taxilane leading to a row of small T-hangars only needs to meet the separation requirement for small aircraft, not larger critical aircraft.

**TABLE 3S: Taxiway Design Standards**

Category	Standards Based on Wingspan/Airplane Design Group (ADG)	ADG II	ADG III
Taxiway/Taxilane Protection	Taxiway Safety Area (TSA) Width	79'	118'
Taxiway/Taxilane Protection	Taxiway Object Free Area (TOFA) Width	124'	171'
Taxiway/Taxilane Protection	Taxilane Object Free Area (TLOFA) Width	110'	158'
Taxiway/Taxilane Separation	Taxiway Centerline to Parallel Taxiway/Taxilane	101.5'	144.5'
Taxiway/Taxilane Separation	Taxiway Centerline to Fixed or Movable Object	62'	85.5'
Taxiway/Taxilane Separation	Taxilane Centerline to Parallel Taxilane	94.5'	138'
Taxiway/Taxilane Separation	Taxilane Centerline to Fixed or Movable Object	55'	79'
Wingtip Clearance	Taxiway Wingtip Clearance	22.5'	26.5'
Wingtip Clearance	Taxilane Wingtip Clearance	15.5'	20'

**TABLE 3S (continued): Taxiway Design Standards**

Category	Standards Based on Taxiway Design Group (TDG)	TDG 2B	TDG 3
Taxiway Width Standard	Taxiway Width Standard	35'	50'
Taxiway Edge Safety Margin	Taxiway Edge Safety Margin	7.5'	10'
Taxiway Shoulder Width	Taxiway Shoulder Width	15'	20'

Table Source: FAA AC 150/5300-13B, Airport Design

### Taxiway Width Standards

All taxiways and taxilanes should be constructed at the standard uniform width that applies to them. All taxiways/taxilanes that serve the critical aircraft should be at least 35 feet wide, which is the standard associated with TDG 2B. As documented in the forecast chapter, there are some operations by aircraft with wider wheelbases that fall in TDG 3, which has a 50-foot-wide taxiway standard. In 2024, there were 148 such operations at SDL, 122 of which were by the Cessna Citation Bravo.

Typically, the FAA will support maintaining the existing width of taxiways until the pavement needs to be reconstructed, even if the taxiways exceed the design standard. When the taxiways are reconstructed, they are typically designed to meet the current taxiway width standard; however, at SDL, with a high number of large business jets operating at the airport, it is recommended that all existing taxiways be maintained at their current width (between 40 and 50 feet), at a minimum, and when reconstruction is needed, additional analysis be undertaken to determine if a wider taxiway would enhance safety.

The taxiway edge safety margin (TESM) is the distance from the outermost wheels of an aircraft to the edge of the taxiway/taxilane pavement. The intersection fillets may need to be widened to prevent the rear wheels of an aircraft from rolling off the paved surface when making turns. Several of the taxiway fillets at SDL have already been widened for this purpose, including Taxiways A1, B1, A3, B3, A5, A7, B7, A10, B10, A13, B13, A15, A16, and B16. The recommended development concept of this master plan will include any necessary modifications to taxiways to accommodate the TESM.

Taxiway shoulders are intended to prevent erosion or jet and prop wash from creating foreign object debris (FOD), which can damage aircraft. At a minimum, stabilized taxiway shoulders are recommended. For airports with critical aircraft of ADG III and larger, paved taxiway shoulders are recommended. The taxiway shoulders at SDL are paved, which should be maintained.

### **Taxiway/Taxilane Protection Surfaces**

Taxiways and taxilanes have protective object-clearing surfaces. The taxiway safety area (TSA) has the same function as the RSA in that it is a surface level protective area. The taxiway/taxilane object free areas (TOFA/TLOFA) serve the same function as the ROFA, which is that of wingtip clearance. The TOFA is the most restrictive of the taxiway protective surfaces, the dimensions of which are a function of the applicable ADG.

All taxiways are surrounded by an object free area (TOFA). The TOFA and all object clearing surfaces are intended to be free of object penetration, except by required navigational aids, such as taxiway edge lighting, that are mounted on frangible bases. The TOFA is centered on the taxiway, the width of which is a function of the ADG of the airport critical aircraft. The FAA-approved critical aircraft is D-II; therefore, ADG II standards apply. The ADG II TOFA is 124 feet. This standard applies to any taxiway that could support ADG II aircraft, which includes all the taxiways at SDL.

As previously noted, SDL experiences frequent operations by ADG III aircraft; therefore, consideration will be given to the adequacy of all TOFA/TLOFAs. In some cases, it may be desirable to apply the ADG III TOFA/TLOFA standards to ensure proper separation of aircraft taxiing and parking, as well as distance to other fixed or movable objects. This analysis, which will be undertaken in the alternatives chapter, will be particularly important in locations with parallel taxiways/taxilanes to ensure proper wingtip clearance.

A taxilane also has an object free area (TLOFA), which is centered on the taxiway. The ADG II TLOFA is 110 feet wide. This standard applies to all on-airport taxilanes that are not designated with a letter A or B, including the apron edge taxilane between Taxiways A3 and A7 and the taxilane between Taxiways A15 and A16. The taxilanes that extend between Taxiways A7 and A8 and between Taxiways A9 and A15 are designed to ADG I standards, which include a TLOFA width of 79 feet, as centered on the taxilane.

## Taxiway Separation to Parallel Taxiways/Taxilanes

FAA AC 150/5300-13B, *Airport Design*, provides guidance on the taxiway-to-parallel taxiway/taxilane separation standards. For ADG II, the separation standard from a taxiway to a parallel taxiway/taxilane is 101.5 feet, centerline to centerline. For ADG III, the separation standard is 144.5 feet, centerline to centerline.

There are three locations on the airfield with parallel taxiways/taxilanes:

- Taxiway A between Taxiway A3 and A7; 105 feet to the parallel taxiway/taxilane
- Taxiway A between Taxiway A9 and A16; 105 feet to the parallel taxiway/taxilane
- Taxiway B between Taxiway B9 and B10; 125 feet to the parallel taxiway/taxilane

Each of these parallel taxiway/taxilane locations currently meets the ADG II separation standard of 101.5 feet; however, the airport gets frequent activity by aircraft with ADG III wingspans. To fully protect these aircraft, the parallel taxiway/taxilane centerline should be 144.5 feet apart in each location. The standard wingtip clearance between ADG II aircraft is 22.5 feet and the standard wingtip clearance between ADG III aircraft is 26.5 feet. The combination of the wingspan (79 feet) plus the wingtip clearance (22.5 feet) equals the separation standard of 101.5 feet. For ADG III, the wingspan (118 feet) plus the wingtip clearance (26.5 feet) equals 144.5 feet, which is the separation standard.

If two ADG II (largest wingspan of 79 feet) aircraft pass each other on the parallel taxiway/taxilanes associated with Taxiway A, there would be 26 feet of wingtip clearance. This is calculated as the existing separation of 105 feet minus the wingspan (79 feet), which equals 26 feet. On Taxiway B, there would be 46 feet of wingtip clearance. This is calculated as the existing separation of 125 feet minus the wingspan (79 feet), which equals 46 feet. Both meet (and exceed) the 22.5-foot standard for wingtip clearance.

If two ADG III (largest wingspan of 118 feet) aircraft pass each other on the parallel taxiway/taxilanes associated with Taxiway A, there would be negative 13 (-13) feet of wingtip clearance. On Taxiway B there would be seven (7) feet of wingtip clearance. Obviously, neither of these meet the 26.5-foot standard for wingtip clearance.

Appendix J of FAA AC 150/5300-13B, *Airport Design*, provides a methodology by which taxiway/taxilane object free areas can be modified based on the wingspans of specific aircraft. Because SDL currently limits operations to aircraft with MTOWs below 100,000 pounds, and all of those aircraft have wingspans less than 100-feet, the acceptable modified separation distance between parallel taxiways and taxiway/taxilanes can be calculated. Assuming two aircraft with 100-foot wingspans, the minimum separation distance between the centerlines would be 126.5 feet. This is calculated as the wingspan (100 feet) plus the wingtip buffer for ADG III (26.5 feet).

In the alternatives chapter, various options to address the issue of parallel taxiway/taxilane separation will be examined.

## AIRCRAFT PARKING AREAS (FIXED OR MOVABLE OBJECTS)

According to FAA AC 150/5300-13B, *Airport Design*, aircraft parking areas are to be clear of object clearing surfaces, which are the ROFA, TOFA, TLOFA, OFZ, navigational aid critical areas, and approach/departure surfaces. Currently, all parking areas are clear of all object clearing surfaces. **Exhibit 3G** identifies the aircraft parking areas, where they can begin in relation to the runway, and what the controlling object clearing surface is for each.

- From the south end of the west side terminal apron to Taxiway A3, aircraft parking can begin at the outer edge of the ROFA, which is 315 feet from the runway centerline. The ROFA distance from the runway centerline is a function of the FAA-approved Modification of Standards that was approved on January 3, 2019.
- From Taxiway A3 to Taxiway A7, the controlling object clearing surface is the apron edge taxilane object free area (TLOFA). The TLOFA is 55 feet to either side, which is based on ADG II.
- From Taxiway A7 to A8, the controlling object clearing surface is the TLOFA edge. This section of the TLOFA is designed to ADG I standards; therefore, the west edge of the TLOFA is 39.5 feet from the taxilane centerline.
- From Taxiway A8 to A9, the controlling object clearing surface is the ROFA, which is 315 feet from the runway centerline. The ROFA distance from the runway centerline is a function of the FAA-approved Modification of Standards that was approved on January 3, 2019.
- From Taxiway A9 to A15, the controlling object clearing surface is the west edge of the TLOFA. This portion of the taxilane is designed to ADG I standards, which mandate 39.5 feet to either side of the taxilane centerline.
- From Taxiway A15 to A16, the controlling object clearing surface is the west edge of the TLOFA. This portion of the taxilane is designed to ADG II standards, which mandate 55 feet to either side of the taxilane centerline.
- For the length of the east side of the runway, aircraft parking areas can begin 315 feet from the runway centerline, which is the outer edge of the ROFA. The ROFA distance from the runway centerline is a function of the FAA-approved Modification of Standards that was approved on January 3, 2019.

## Taxiway Design Considerations

FAA AC 150/5300-13B, *Airport Design*, provides guidance on taxiway design with a goal of enhancing safety by providing a taxiway geometry that reduces the potential for runway incursions. As previously noted, a runway incursion is defined as “any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft.”

The following is a list of the taxiway design guidelines and the basic rationale behind each recommendation.

1. *Taxi Method*: Taxiways are designed for cockpit-over-centerline taxiing with pavement that is sufficiently wide to allow a certain amount of wander. On turns, enough pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, upgrading existing intersections should be undertaken to eliminate judgmental oversteering, which is when a pilot must intentionally steer the cockpit outside the marked centerline to ensure the aircraft remains on the taxiway pavement.
2. *Steering Angle*: Taxiways should be designed so the nose gear steering angle is no more than 50 degrees, which is the generally accepted value to prevent excessive tire scrubbing.
3. *Three-Node Concept*: To maintain pilot situational awareness, a taxiway intersection should provide a pilot with a maximum of three choices of travel direction. Ideally, these are right- and left-angle turns and a continuation straight ahead.
4. *Intersection Angles*: Turns should be designed to be 90 degrees wherever possible. For acute-angle intersections, standard angles of 30, 45, 60, 120, 135, and 150 degrees are preferred.
5. *Runway Incursions*: Taxiways should be designed to reduce the probability of runway incursions.
  - *Increase Pilot Situational Awareness*: A pilot who knows where they are on the airport is less likely to improperly enter a runway. Complexity leads to confusion; taxiway systems should be kept simple using the three-nodes concept.
  - *Avoid Wide Expanses of Pavement*: Wide pavements require placement of signs far from a pilot's eye. This is especially critical at runway entrance points. Where a wide expanse of pavement is necessary, direct access to a runway should be avoided.
  - *Limit Runway Crossings*: The taxiway layout can reduce the opportunity for human error. The benefits are twofold: through a simple reduction in the number of occurrences and a reduction in air traffic controller workload.
  - *Avoid High-Energy Intersections*: These are intersections in the middle thirds of runways. By limiting runway crossings to the first and last thirds of a runway, the portion of the runway where a pilot can least easily maneuver to avoid a collision is kept clear.
  - *Increase Visibility*: Right-angle intersections between taxiways and runways provide the best visibility. Acute-angle runway exits provide for greater efficiency in runway usage but should not be used as runway entrances or crossing points. A right-angle turn at the end of a parallel taxiway is a clear indicator to a pilot approaching a runway.
  - *Avoid Dual-Purpose Pavements*: Runways used as taxiways and taxiways used as runways can lead to confusion. A runway should always be clearly identified as a runway, and only a runway.
  - *Indirect Access*: Taxiways should not be designed to lead directly from an apron to a runway. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway.

- *Hot Spots*: Confusing intersections near runways are more likely to contribute to runway incursions. These intersections must be redesigned when the associated runway is subject to reconstruction or rehabilitation. Other hot spots should be corrected as soon as practicable.
6. *Runway/Taxiway Intersections*:
- *Right Angle*: Right-angle intersections are the standard for all runway/taxiway intersections, except where there is a need for a high-speed exit. Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide optimal orientation of the runway holding position signs so the signs are visible to pilots.
  - *Acute Angle*: Acute angles should not be larger than 45 degrees from the runway centerline. A 30-degree taxiway layout should be reserved for high-speed exits. The use of multiple intersecting taxiways with acute angles creates pilot confusion and improper positioning of taxiway signage.
  - *Large Expanses of Pavement*: Taxiways must never coincide with the intersection of two runways. Taxiway configurations with multiple taxiway and runway intersections in a single area create large expanses of pavement, making it difficult to provide proper signage, marking, and lighting.
7. *Taxiway/Runway/Apron Incursion Prevention*: Apron locations that allow direct access to a runway should be avoided. Pilot situational awareness should be increased by designing taxiways in a manner that forces pilots to consciously make turns. Taxiways that originate from aprons and form straight lines across runways at mid-span should be avoided.
- *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided. Such large expanses of pavement may cause pilot confusion and make lighting and marking more difficult.
  - *Direct Access from Apron to Runway*: Taxiway connectors that cross over a parallel taxiway and directly onto a runway should be avoided. A staggered taxiway layout that forces pilots to make a conscious decision to turn should be considered.
  - *Apron to Parallel Taxiway End*: Direct connection from an apron to a parallel taxiway at the end of a runway should be avoided.

### **Taxiway Design Considerations at SDL**

The following taxiway geometry issues will be addressed in the alternatives analysis and are depicted on **Exhibit 3H**:

- Taxiways A3, A4, A5, A6, and A7 allow direct access from an apron area to the runway.
- Taxiways A7/B7 and A10/B10 allow runway crossings in the high-energy portion (middle third) of the runway.
- Taxiways A2, A4, A6, A9, A11, A12, B5, B6, B11, and B12 are angled taxiways.

None of these taxiway considerations for SDL are non-standard but they do not follow the current design recommendations. For example, the FAA has prioritized removing direct-access configurations, where feasible. Angled taxiways have been less of a priority and, in some cases, are justified by capacity needs at an airport. Even runway crossings may be needed if there is no appropriate alternative that does not diminish ground movement efficiency.

The alternatives chapter will examine possible taxiway geometry changes that would improve pilot situational awareness and reduce potential pilot confusion. Any changes will consider the practicality of each alternative in terms of cost and benefit.

## HOLD APRONS

Hold aprons are an important feature at busy airports like SDL. Pilots can pull off the main taxiways onto a hold apron to perform final pre-flight checks and engine run-ups. These activities can take several minutes, so other aircraft that are ready for takeoff are able to proceed to the runway threshold for departure without delay.

Hold aprons are designed to allow other aircraft to bypass aircraft using the hold apron. Specifically, the location on a hold apron where aircraft park should be outside the TOFA for the taxiway. Because it is recommended that Taxiways A and B protect for the 171-foot-wide ADG III TOFA, the closest wing of a holding aircraft should be at least 85.5 feet from the taxiway centerline.

The hold aprons at the north and south ends of Taxiways A and B have a depth of 120 feet, which provides 34.5 feet of wingtip clearance to the TOFA; therefore, aircraft with wingspans of less than 69 feet will not penetrate the taxiway TOFA while using the hold bay.

Beyond the north end of Taxiway A is a hold bay complex that includes five channelized positions. A hold bay of this design is recommended, as it presents a uniform and predictable use of the space and provides the appropriate separation between wingtips.

## NAVIGATIONAL AND APPROACH AIDS

Navigational aids are devices that provide pilots with guidance and position information when utilizing the runway system. Electronic and visual guidance to arriving aircraft enhances the safety and capacity of the airfield. Such facilities are vital to the success of the airport and provide additional safety for passengers using the air transportation system. While instrument approach aids are especially helpful during poor weather, they are often used by pilots conducting flight training and operating larger aircraft when visibility is good. SDL has the following navigational and approach aids.

### Instrument Approach Aids

Instrument approaches are categorized as either precision or non-precision. Precision instrument approach aids provide an exact course alignment and vertical descent path for an aircraft on final approach to a runway, while non-precision instrument approach aids provide only course alignment information. In the past, most existing precision instrument approaches in the United States have been the instrument landing system (ILS); however, with advances in global positioning system (GPS) technology, GPS is now used to provide both vertical and lateral navigation for pilots.

At Scottsdale Airport, there are six published instrument approaches (reference Exhibit 1L), all of which provide visibility minimums greater than or equal to one mile. Three are RNP approaches, which are available for specific aircraft with specific specialized equipment and performance monitoring. Use of RNP approaches requires specialized pilot training and a requirement to perform a missed approach if lateral or vertical navigation limits are exceeded, even if visibility is sufficient for a landing. As such, these instrument approach procedures are rarely used.

The other three instrument approaches are circling in nature; pilots cannot navigate directly to a runway end for landing. Instead, they navigate to the airport traffic pattern and then circle to land, assuming visibility minimums are met.

Busy reliever airports with high volumes of business jet activity, such as SDL, should be equipped with the most sophisticated instrument approach capability available. This may include ILS and/or GPS approaches with visibility minimums not lower than ½ mile.

To date, neither type of approach has been implemented for two primary reasons:

1. The airspace in and around SDL is complex; activity related to Phoenix Deer Valley Airport (DVT) and Phoenix Sky Harbor International Airport (PHX) impacts activity at SDL.
2. Visual conditions apply nearly all the time, making the need for lower visibility minimums less important.

Nevertheless, nearly all pilots of business jets would utilize an instrument approach procedure (either ILS or GPS) regardless of the visibility conditions. While it is obvious to recommend better instrument approach capability for SDL, it will require extensive coordination with all airports and air traffic organizations responsible for the Phoenix region and may require consultation with national airspace experts within the FAA and other organizations, including the military.

Because the dimensions of certain airfield design standards, including the sizes of the RPZs, are a function of the instrument approach visibility minimums, the existing instrumentation is planned to be maintained. No new instrument approaches with visibility minimums below one mile will be recommended because below one mile is the threshold for various design standard changes.

### **Visual Approach Aids**

To provide pilots with visual guidance information during landings, electronic visual approach aids are commonly provided at airports. Both landing thresholds are outfitted with two-box precision approach path indicator (PAPI-2) systems. The PAPIs are set to provide a 4.0-degree glidepath for obstacle clearance, which is higher than the standard 3.0-degree glide path. It is recommended that a four-box PAPI system ultimately be implemented on the runway; the PAPI-4s would better serve business jets that regularly use the airport because they are more visible for these faster approaching aircraft.

REILs are flashing strobe lights located at the outside edge of the landing threshold. REILs provide pilots with a quick indication of the location of the threshold. REILs are typically provided for lighted runways that serve business jet operations. REILs are currently available for approaches to both ends of the runway. The REILs should be maintained through the planning period.

Some airports are equipped with visual approach lighting systems (ALS). An ILS and any instrument approach with ½-mile visibility minimums are required to have an ALS, which are installed at airports with more frequent lower visibility conditions. SDL does not require an ALS and one is not planned because visibility minimums are not planned to be below one mile.

### **AIRFIELD LIGHTING, MARKING, AND SIGNAGE SYSTEMS**

Airfield lighting, marking, and signage provide information to pilots to assist in ground movements, as well as in locating the airport at night.

The airport has a rotating beacon that projects a green light on one side and a white light on the other. Pilots can see the rotating beacon at night from a distance of up to 20 miles. The existing beacon is located on top of the airport operations center building on the west side of the airfield. This location is accessible and should be maintained.

The runway has white medium intensity runway edge lighting (MIRL). The last 2,000 feet of each end of the runway have amber lighting to indicate to pilots that the runway end is approaching. The taxiways (A, B, and all connectors) have blue medium intensity taxiway lighting (MITL). Both of these edge lighting systems are appropriate and should be maintained.

Runway markings are designed according to the type of straight-in instrument approaches available to each runway end. The runway has non-precision markings which include the threshold bar, threshold markings, runway designation, runway centerline, edge markings, and aiming point markings. Because both landing thresholds are displaced, there are additional markings leading to the threshold, which include lead-in arrows and four arrowheads at the landing threshold. These markings are appropriate for SDL and should be maintained.

The airfield is outfitted with a runway/taxiway signage system. The signage system includes runway and taxiway designations, hold positions, routing/directional signs, runway end and exit signs, and runway distance remaining signs. These systems should be maintained.

The taxiways and taxilanes have yellow centerline markings. The taxiways also have yellow edge markings. The parallel taxilanes have yellow edge markings on the east side of each centerline. The connecting taxiways leading to the runway are all enhanced centerline markings that add dashed yellow lines to both sides of the centerline leading to the hold bars. This is a feature typically reserved for commercial service airports; however, many reliever general aviation airports have installed them as a safety enhancement feature.

When the control tower is closed, pilots can use the common traffic advisory frequency (CTAF) (119.9 megahertz [MHz]) to activate the PAPIs, REILs, and MIRL. These systems will remain on for 15 minutes.

The existing lighting and marking systems are appropriate and should be maintained.

## WEATHER AND COMMUNICATION AIDS

The airport has two windsocks. The primary windsock is lighted and located within the segmented circle, 85.5 feet from the Taxiway B centerline, which places it outside the existing ADG II TOFA and also outside an ADG III TOFA. The secondary windsock is located on the west side near Gate 5 and the Kilo GA hangars. Both windsocks should be maintained. The airport should consider another secondary windsock, to be located near the south end of the airport, as wind conditions can be different at different locations on the airfield.

The segmented circle provides traffic pattern information to pilots in the air. Most general aviation airports and airports with control towers that are not open 24 hours a day should have visible segmented circles. The segmented circle should be maintained.

The remote communication outlet is an unmanned remote aviation radio transceiver that is used to extend the communication range of air traffic control facilities. This communications equipment should be maintained.

The automated surface observation system (ASOS) is located at the south end of the airfield is located. The ASOS automatically records in-situ weather information and broadcasts it via the automated terminal information service (ATIS) to pilots via frequency 118.6 MHz. The ASOS collects temperature, dew point, wind speed, altimeter setting, visibility, sky condition, and precipitation. Typically, it is desirable to have the ASOS more centrally located; however, it cannot penetrate any of the object clearing surfaces. At SDL, there is not a viable location that is more centrally located, so the ASOS should be maintained in its current location.

## AIRPORT TRAFFIC CONTROL TOWER

The 90-foot-tall FAA airport traffic control tower (ATCT) was constructed in 1989. The tower is open from 6:00 a.m. to 9:00 p.m. seven days a week. Tower personnel control the Class D airspace around SDL. The mid-field location of the tower is ideal and it provides clear visibility to all movement surfaces (i.e., the runway and parallel taxiways).

The ATCT is 36 years old and predates the *Americans with Disabilities Act of 1990*. The FAA may want to consider beginning planning for a replacement control tower in the near term, as it can take four to eight years to get a replacement tower constructed. The airport's responsibility is to provide adequate land area for the tower in a location that is acceptable. Presumably, the current site would be acceptable.

## AIRSIDE SUMMARY

This airside facility requirements section covered the runway and taxiway systems, navigational aids, and lighting, marking, and signage. **Exhibit 3J** summarizes each of these airfield elements and indicates what should be done in the future.

## **LANDSIDE REQUIREMENTS**

Landside facilities provide the essential interface between the airside facilities and ground access to and from the airport. The capacities of existing facilities have been examined against the projected requirements to gauge anticipated timing of needs. Included in the following analysis are aircraft hangars and storage, aircraft parking apron, general aviation terminal services, automobile parking, and support elements, such as fuel storage, perimeter fencing, and a potential replacement control tower.

### **AIRCRAFT STORAGE REQUIREMENTS**

The demand for aircraft hangars typically depends on local climate, security, and owner preferences. The trend in general aviation aircraft, whether single- or multi-engine aircraft, is toward more sophisticated (and, consequently, more expensive) aircraft; therefore, many aircraft owners prefer enclosed hangar space to outside tiedowns.

The demand for aircraft storage hangars is dependent on the number and type of aircraft expected to be based at the airport in the future. For planning purposes, it is necessary to estimate hangar requirements based on forecasted operational activity; however, hangar development should be based on actual demand trends and financial investment conditions.

While the majority of aircraft owners prefer enclosed aircraft storage, a number of aircraft owners will still use outdoor tiedown spaces due to lack of hangar availability, hangar rental rates, and/or operational needs; therefore, enclosed hangar facilities do not need to be planned for each based aircraft.

Currently, there is approximately 500,000 square feet (sf) of hangar space on airport property. There are also 140 parcels in the airpark that have taxiway access. Through the long-term planning period, the forecast indicates the addition of up to 129 more based aircraft. The mix of based aircraft is anticipated to continue to include a higher percentage of larger business jets. For planning purposes, future hangar space needs are a function of providing 2,500 sf for smaller aircraft and 3,000 sf for larger aircraft.

It is estimated that an additional 394,000 sf of hangar space will be needed over the next 20 years. This hangar space may be accommodated on airport property and within the airpark.

### **Redevelopment Opportunities**

Scottsdale Airport is a mature facility and is fully developed with hangars. As a result, it may be more cost-effective to replace older structures with new and modern facilities. The landside alternatives (to be presented in the next chapter) will consider redevelopment of some hangars if doing so provides for the most efficient development plan.

### **AIRCRAFT PARKING APRON REQUIREMENTS**

Aircraft parking aprons should provide for the locally based aircraft that are not stored in hangars, transient aircraft, and apron areas used for maintenance functions, such as temporary ramp space when moving aircraft around. The aprons at SDL are multi-use, meaning local and itinerant aircraft will both

use the aprons—typically at the direction of the fixed base operator (FBO) line services—to maximize apron utilization. As documented in Chapter One, the main terminal apron encompasses approximately 131,000 square yards (sy). The northern portion of the terminal apron includes 24 tiedown positions for smaller aircraft. There are 22 additional tiedown positions north of the terminal area, adjacent to Taxiway A. The other apron areas are under private leaseholds, including the NetJets apron (20,000 sy), the Signature West apron (14,000 sy), and the Signature Main apron (24,000 sy). The total apron area is approximately 189,000 sy.

**Table 3T** presents the forecasted apron area needs based on standard industry models. The model is a function of busy day itinerant operations and the percentage of those aircraft that may be parked on an apron at one time. The result of the model shows there is a current need for 210,600 sy of aircraft parking apron; therefore, there is a current need for 21,600 sy of new aircraft parking apron. Over the next 20 years, approximately 67,000 sy of aircraft parking apron would be needed. In the alternatives chapter, opportunities to add additional aircraft parking apron will be examined.

**TABLE 3T: Aircraft Parking Apron**

Factor	Current Need	Short Term	Intermediate Term	Long Term
Busy Day Operations	531	567	586	623
Percentage of Itinerant Operations	79%	79%	80%	82%
Busy Day Itinerant Operations	418	451	470	509
Multiplier (% on ground at once)	35%	35%	35%	35%
Total Itinerant Aircraft Positions	146	158	165	178
Piston Aircraft Positions	29	32	33	36
Turbine Aircraft Positions	117	126	132	143
<b>Total Itinerant Apron Area:</b>	<b>210,600 sy</b>	<b>227,100 sy</b>	<b>236,900 sy</b>	<b>256,600 sy</b>

sy = square yards

Note: 800 sy per small plane; 1,600 sy per large plane

### AAM/UAM/EVTOL FACILITIES

Advanced air mobility (AAM), urban air mobility (UAM), and electric vertical takeoff and landing (eVTOL) vehicles are terms describing the emergence of a highly anticipated aviation market. This market will use highly automated to fully automated aircraft that will operate and transport passengers and cargo at low altitudes within urban and suburban areas. Within the next two years, several new aircraft are expected to be certified by the FAA for commercial use. These smaller aircraft offer passenger seating for up to six people and are typically battery-powered, have vertical takeoff capability, and fly like fixed-wing aircraft once airborne.

While nearly 100 companies are attempting to enter this emerging market, those closest to commercial viability are looking to establish commuter service in more densely populated markets. The business model is to ferry passengers between destinations, like Uber.

The FAA is currently in the process of developing infrastructure standards for airports to support AAM/UAM activity. In April 2023, the FAA published *Concept of Operations v.2.0 for Urban Air Mobility*. This document, which is a working analysis of the emergence of AAM/UAM, will continue to be updated and includes information about the likely infrastructure needs, including vertiports and vertistops.

As this segment of transportation begins, operators are likely to use existing helicopter infrastructure. In March 2022, the FAA issued draft interim guidance via Engineering Brief 105, *Vertiport Design*, for the design and operation of facilities to support AAM/UAM activity. This Engineering Brief will be utilized to guide subsequent planning in this master plan for facilities to support AAM/UAM at SDL.

### DRONES/UNMANNED AIRCRAFT SYSTEMS (UAS)

The proliferation of interest in and the use of UAS, or drones, has led to significant policy and regulatory adaptations to integrate these platforms into the airport environment. Operating UAS from airport property is complex. As of this writing (August 2025), the FAA continues to research best practices for UAS integration and has issued numerous publications to inform airport sponsors of various safety considerations.

The FAA organizes small UAS operators into three categories:

1. **Government, Public Safety, and Law Enforcement:** Government functions for authorized public aircraft operations often occur with a certificate of authorization (COA).
2. **Certificated Remote Pilots (Business, Commercial, Non-Profits):** Most of these operations must comply with Part 107 rules, while operations for package delivery are regulated by Part 135 and operations for dispensing of chemicals or agricultural products are regulated by Part 137.
3. **Recreational/Model Aircraft or for Higher Education:** Operations strictly for enjoyment, fun, or education and research are permissible under U.S. Code (USC) 44809; however, recreational UAS operations are considered a non-aeronautical activity for purposes of airport access under the *Airport Improvement Program Grant Assurances*.

Additionally, airspace access should not be construed as access to the airport. Physical access to the airport is an approval granted by the airport sponsor and governing authority. As the owner/operator of the airport property, airport sponsors have the authority to approve or disapprove a UAS operation requesting access to operate at an airport.

An airport has discretion to permit drone/UAS activity on the airport. Operators may be outside entities or the airport itself (e.g., fence inspections). Typically, dedicated facilities are not required for drone operations; however, there could be a need in the future. Specific drone/UAS facilities are not planned to be incorporated into this master plan, but the airport sponsor should monitor any inquiries and follow the FAA-published best practices to ensure safety.

### ELECTRIC CHARGING STATIONS

There is a growing demand for charging stations to support electric vehicles (EV) and aircraft and airports should consider these needs. There are three levels of EV charging:

- **Level 1:** a 120-volt outlet that takes days to fully charge; these have the least impact on existing electrical systems and are best for longer-term parking.

- **Level 2:** a 220-volt outlet that fully charges a vehicle within eight hours; these are the most common chargers in use today.
- **Level 3:** direct-current fast chargers that can fully charge an EV in about 30 minutes; these chargers have a significant impact on existing electrical sources. Good airport locations for these charging stations may be cell phone lots, taxi and rideshare lots, and short-term parking. The installation cost is higher than other charging station types, so airports must weigh the cost-benefit.

Additional study beyond this master plan should be undertaken to determine if the installation of any or all of the charging capability is beneficial. The potential impact on the electrical grid and the potential need to increase capacity at the airport should also be considered. Providing EV charging stations is one step airports can take when embracing sustainability initiatives.

Aircraft that operate on batteries alone are beginning to be utilized. Initially, the AAM/UAM market will have the need for recharging capability; ultimately, general aviation and commercial aircraft will have the need, as well. There are many unknowns when planning for aircraft charging. Planning for this capability will require an understanding of the charging equipment, the location of the charging equipment, and the size of aircraft to be charged. For a general aviation airport, an ideal location would be in proximity to a terminal building or FBO so pilots and passengers have a place to rest comfortably. There could be a need for expanded aircraft apron space near charging stations.

### GENERAL AVIATION TERMINAL BUILDING SERVICES

General aviation (GA) terminal buildings generally provide several functions, such as flight planning, a pilots' lounge, airport management offices, and general circulation space. Many airports will also have leasable space in the terminal building for features such as a restaurant or concessions area, FBO line services, and other amenities. It is also common for FBOs to provide many of these services, which is the case at SDL.

The Business Aviation Center at SDL provides some of these functions; however, each FBO has dedicated space for pilots and passengers, including lounge areas, shower facilities, flight planning facilities, and line services.

The methodology used in estimating general aviation terminal facility needs is based on the number of airport users expected to utilize these facilities during the design hour. General aviation space requirements are based on providing 120 sf per design hour itinerant passenger. Design hour itinerant passengers are determined by multiplying design hour itinerant operations by the estimated number of passengers on the aircraft.

By the long-term planning period, approximately 21,505 sf of space should be available for terminal services. Today, the combination of the GA terminal building and FBO-provided terminal services is estimated at 17,000 sf. The calculations described above show the combination of the existing terminal building and the space provided by the FBOs is adequate through the long-term planning period. The existing terminal building is in the ideal location, central to the runway system and fronted by a large transient apron. Because the terminal building also serves as the first introduction travelers may have to the region, it should be maintained and remodeled as necessary to reflect the values of the community.

## AUTOMOBILE PARKING

Airport planners should be cognizant of the need for vehicle parking space at general aviation airports. At the same time, parking needs are generally determined by hangar owners' needs. Those operating businesses may have a need for more parking, while private hangars may not have a need for any dedicated parking as their users park in their hangars when utilizing their aircraft. For this reason, it is inherently challenging to estimate future hangar needs.

Parking needs can be divided between transient airport users and locally based users. Transient users include visitors and those employed at the airport, while locally based users primarily include those attending to their based aircraft. Ideally, both user types would have access to dedicated vehicle parking outside the fence; however, at general aviation airports, it is common for locally based aircraft owners to park in their hangars. Rather than attempt to determine a specific number of vehicle positions needed in the future, developers should include vehicle parking in their development plans, where necessary.

The managers of each FBO were interviewed early in the master planning process. Each indicated that customer vehicle parking was a significant issue. This problem is particularly acute for Atlantic Aviation because its facilities are used in support of the JSX scheduled charter flights.

The airport has considered the idea of constructing a parking structure in proximity to the Aviation Business Center. This concept will be examined in the alternatives chapter along with other opportunities to increase vehicle parking at the airport.

## SUPPORT FACILITIES

Various facilities that do not logically fall within the airside or landside classification are examined in this support facilities section. These support facilities relate to the overall operations of the airport.

## FUEL STORAGE

Fuel sales are primarily managed by the fuel providers on the airport, which own and operate their own fuel storage and delivery vehicles; therefore, it is a business decision if additional fuel storage capacity is needed. Among the FBOs, the existing total fuel capacity is:

- Jet A fuel: 135,000 gallons of static storage and 79,000 gallons of fuel truck storage
- AvGas fuel: 55,000 gallons of static storage and 5,000 gallons of fuel truck storage

In addition, there are currently 27 fuel farm facility permits for self-fueling of personal aircraft. Nearly all of these are off airport property in the airpark. Each permit may cover more than one aircraft owner.

## Sustainable and Alternative Fuels

In recent years, there has been significant movement in the development of alternative and sustainable aviation fuels (SAFs). SAF is developed from a more sustainable source than traditional fossil fuels and has the effect of reducing emissions when compared to fossil fuels. In fact, each of the FBOs at SDL

offers SAF through the Book & Claim process, which is essentially the ability to buy SAF credits at SDL without physically taking on the fuel. Alternative aviation fuels include unleaded AvGas, batteries, and hydrogen power. Generally, these aviation fuel options will require dedicated storage capacity and delivery vehicles; therefore, additional space may need to be reserved to support the installation of infrastructure to support alternative and sustainable fuel options at the airport.

## PERIMETER FENCING

At general aviation airports, full perimeter fencing is not required like it is at commercial service airports. Perimeter fencing serves multiple purposes, including basic airfield security and wildlife deterrence. As development occurs around general aviation airports, the need for full perimeter fencing becomes more necessary, especially for airports in developed environments, like SDL.

Perimeter fencing is used at airports primarily to secure the aircraft operational area. The physical barrier of perimeter fencing provides the following functions:

- Gives notice of the legal boundary of the outermost limits of a facility or security-sensitive area
- Assists in controlling and screening authorized entries into a secured area by deterring entry elsewhere along the boundary
- Supports surveillance, detection, assessment, and other security functions by providing a zone for installing intrusion-detection equipment and closed-circuit television (CCTV)
- Deters casual intruders from penetrating a secure area by presenting a barrier that requires an overt action to enter
- Demonstrates the intent of an intruder by their overt action of gaining entry
- Causes a delay in gaining access to a facility, thereby increasing the possibility of detection
- Creates a psychological deterrent
- Optimizes the use of security personnel while enhancing the capabilities for detection and apprehension of unauthorized individuals
- Demonstrates a corporate concern for facilities
- Limits inadvertent access to the aircraft operations area by wildlife

Scottsdale Airport's air operations areas are completely enclosed with six-foot-tall chain-link fence topped by three-strand barbed wire, eight-foot-tall chain-link fence, or other walls that are eight feet tall. Several access-controlled and manual gates associated with the fencing lead to different areas on the airfield.

In addition, there are six controlled-access gates leading to and from private entities located within designated areas associated with the Scottsdale Airpark. Certain parcels on the east side of the airfield are also located within the Scottsdale Airpark but are granted direct access to the airfield without having

to enter through a controlled-access gate. These direct-access properties are required to maintain a security plan that demonstrates the ability to meet the functions listed above in order to enhance safety and security at Scottsdale Airport.

The airport should continuously monitor the condition of the perimeter barriers and fencing. Any deterioration or damage should be repaired or replaced as soon as possible.

### **AIRPORT ACCESS**

Primary access to the airport is E Butherus Drive, which extends from the intersection with N Scottsdale Road. E Butherus Drive is a four-lane divided boulevard-type road that terminates at N Airport Drive immediately across from the Aviation Business Center. Airport Drive provides access to most on-airport facilities on the west side of the airfield. Various surface roads within the Scottsdale Airpark provide access to other aviation facilities on both sides of the airport.

Interior to the airport is a perimeter service road that is for the exclusive use of authorized airport staff. This interior road is not available to the public to move from one side of the airport to the other.

### **AIRPORT MAINTENANCE FACILITIES**

In 2017, the airport constructed a new 10,000-sf Airport Operations Center. This two-story facility has eight vehicle bays and operations offices. All airport maintenance equipment is housed in this facility. This facility is in excellent condition and should be maintained through the planning period.

### **WASH RACKS**

There is one aircraft wash rack on the airport. The public wash rack is on the north end of the airfield adjacent to the Kilo connected box hangars. This facility is adequate and should be maintained through the planning period.

### **AIRCRAFT RESCUE AND FIREFIGHTING FACILITIES (ARFF)**

Airports that are certificated under Title 14 CFR Part 139 with a commercial operating certificate, are required to meet certain on-site firefighting capabilities. SDL is not a certified commercial service airport; therefore, it is not required to have on-site ARFF capability. The City of Scottsdale owns and maintains an ARFF-certified fire station at the airport to provide an additional level of safety for airport users. The station house has two ARFF crash trucks, is staffed 24 hours a day, and responds to both on-airport and off-airport emergencies.

The availability of ARFF services is a benefit to airport users; many charter and fractional aircraft operators will only use airports with ARFF capability. Several of these charter and fractional operators have invested significantly into facilities at SDL because of the availability of ARFF services. The airport and the City of Scottsdale should maintain ARFF services at the airport.

## LANDSIDE SUMMARY

This section has documented the potential needs of the airport for landside facilities. The most prominent landside facility for general aviation airports is the aircraft storage hangars. Aircraft hangars range in size from small single-unit hangars to large corporate or FBO hangars. SDL currently provides a variety of hangar types. The on-airport hangar development areas are currently fully built out; therefore, the airport may want to identify older hangars that have reverted or are about to revert to airport ownership for potential redevelopment.

The airport is forecasted to need approximately 394,000 sf of new aircraft storage space within the next 20 years. This can be accommodated both on the airport (through redevelopment) or in the Scottsdale Airpark.

The airport has a high need for additional aircraft parking apron. Industry models resulted in an immediate need for an additional 21,600 sy of apron and a total long-term need of 67,600 sy. The airport and tenants will likely have to find a balance between offering hangar space and apron space. For example, it could be beneficial to remove an old hangar and replace it with apron space rather than a replacement hangar.

The terminal facilities at SDL are adequate. The airport provides the Aviation Business Center, which also contains event space and a popular restaurant. The FBOs provide traditional general services like line services, lounges, and pilot facilities. Each FBO facility is constructed to a high standard and represents the Scottsdale community well. If additional terminal space is needed, the FBOs will make that decision and investment.

**Exhibit 3K** summarizes the landside facility needs for the 20-year forecast period. In the next chapter of this master plan, various development alternatives and hangar layout concepts will be presented. The alternatives will include accommodations for the identified needs.

## SUMMARY

This chapter outlines airside and landside facility requirements for SDL for a 20-year planning period.

At its current length of 8,249 feet, Runway 3-21 meets the needs of most current airport users. The airport supports a wide range of aircraft types and sizes, including the largest business jets in the general aviation fleet. This capability is important, as SDL is a reliever airport. Analysis in this chapter showed that some operators would benefit from a longer runway; however, SDL is likely constrained from adding runway length.

The ROFA dimensions and the runway-to-taxiway separation standard have been modified based on an FAA approved Modification of Standards. During the master planning process is the appropriate time to revisit any MOS. The alternatives chapter will revisit the MOS in place at the airport.

On the landside, it is anticipated that the airport (including the Scottsdale Airpark) could need approximately 394,000 square feet of new aircraft hangar space. The airport is also in need of additional aircraft parking apron space. Opportunities to meet these needs will be examined in the alternatives chapter.

The following chapter will consider various airside and landside layouts to address forecasted growth at Scottsdale Airport.

### AIRFIELD LAYOUT

Runway Configuration



Runway Use



Number of Exits



### WEATHER CONDITIONS

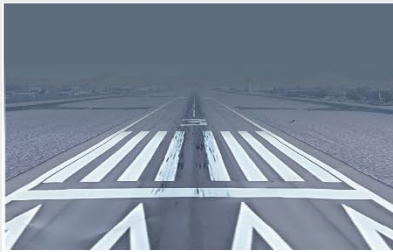
VMC (VFR)

Visual Meteorological Conditions



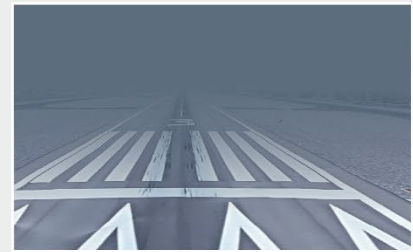
IMC (IFR)

Instrument Meteorological Conditions



PVC

Poor Visibility Conditions



### AIRCRAFT MIX

Category A & B Aircraft  
(0-12,500 lbs)



Category C Aircraft  
(12,500-300,000 lbs)



Category D Aircraft  
(>300,000 lbs)



### OPERATIONS

Arrivals



Departures

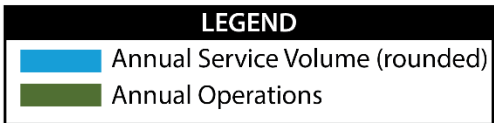
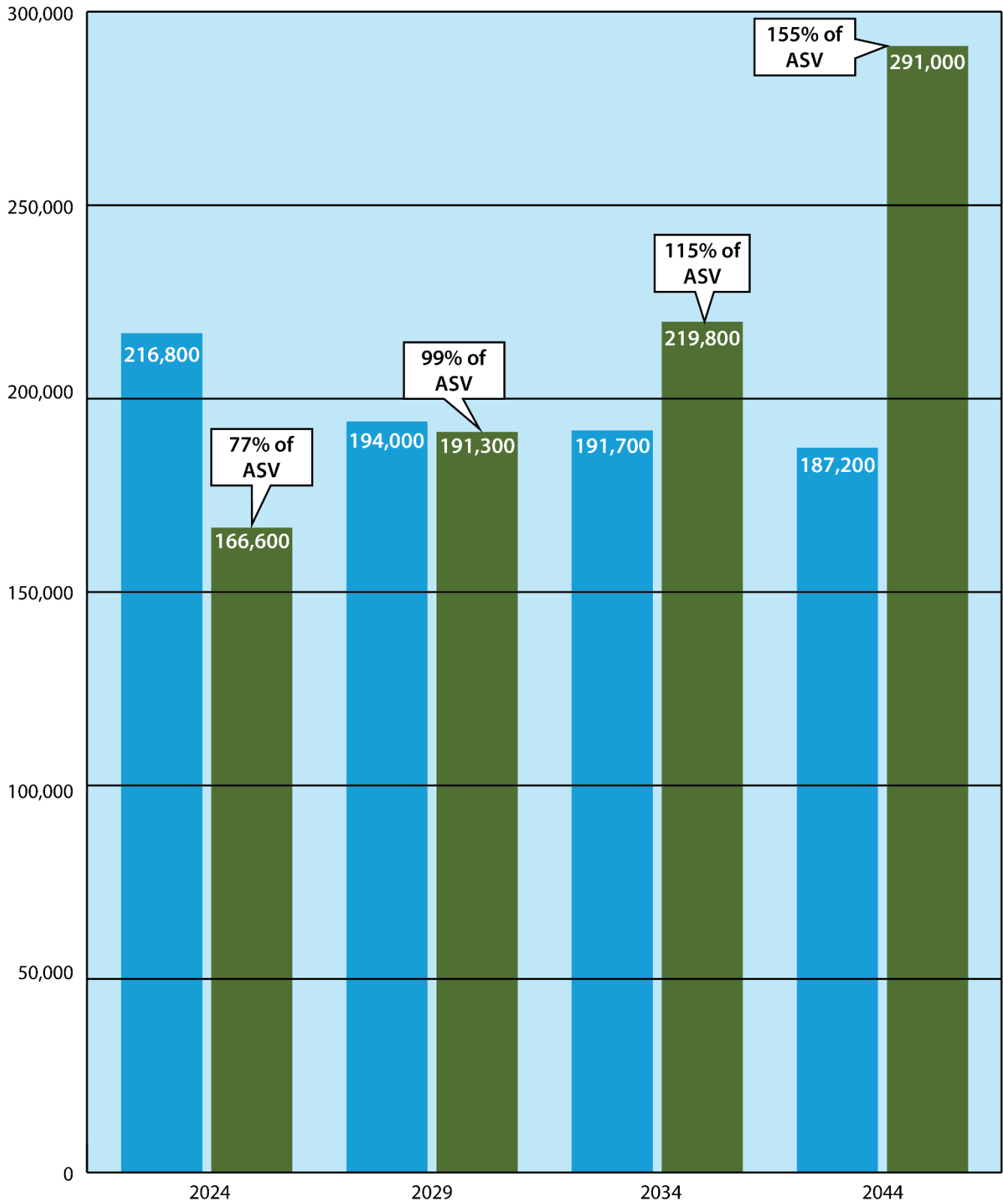


Touch-and-Go Operations

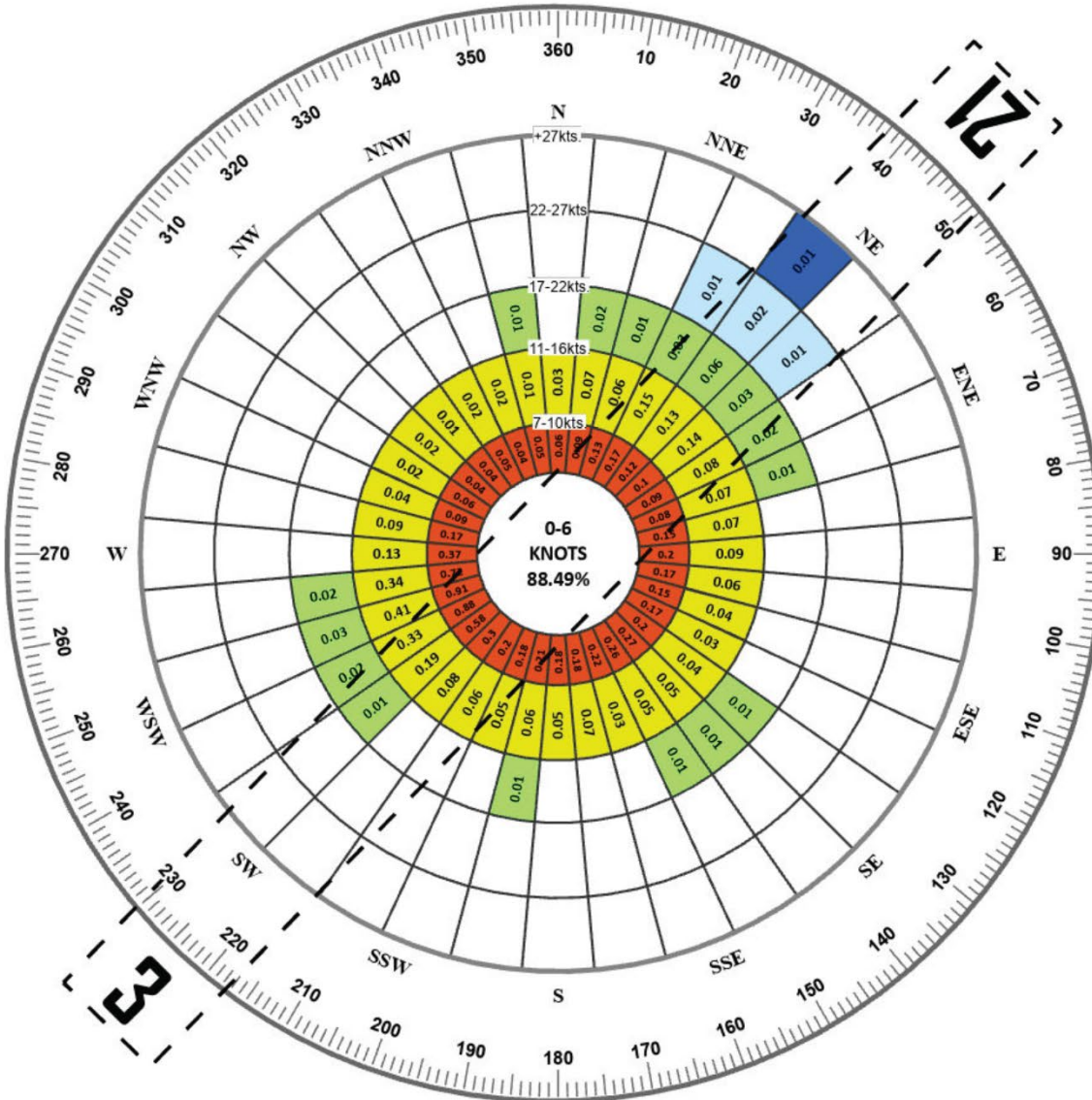


Total Annual Operations





ALL WEATHER WIND COVERAGE				
Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 3-21	99.27%	99.69%	99.93%	99.98%

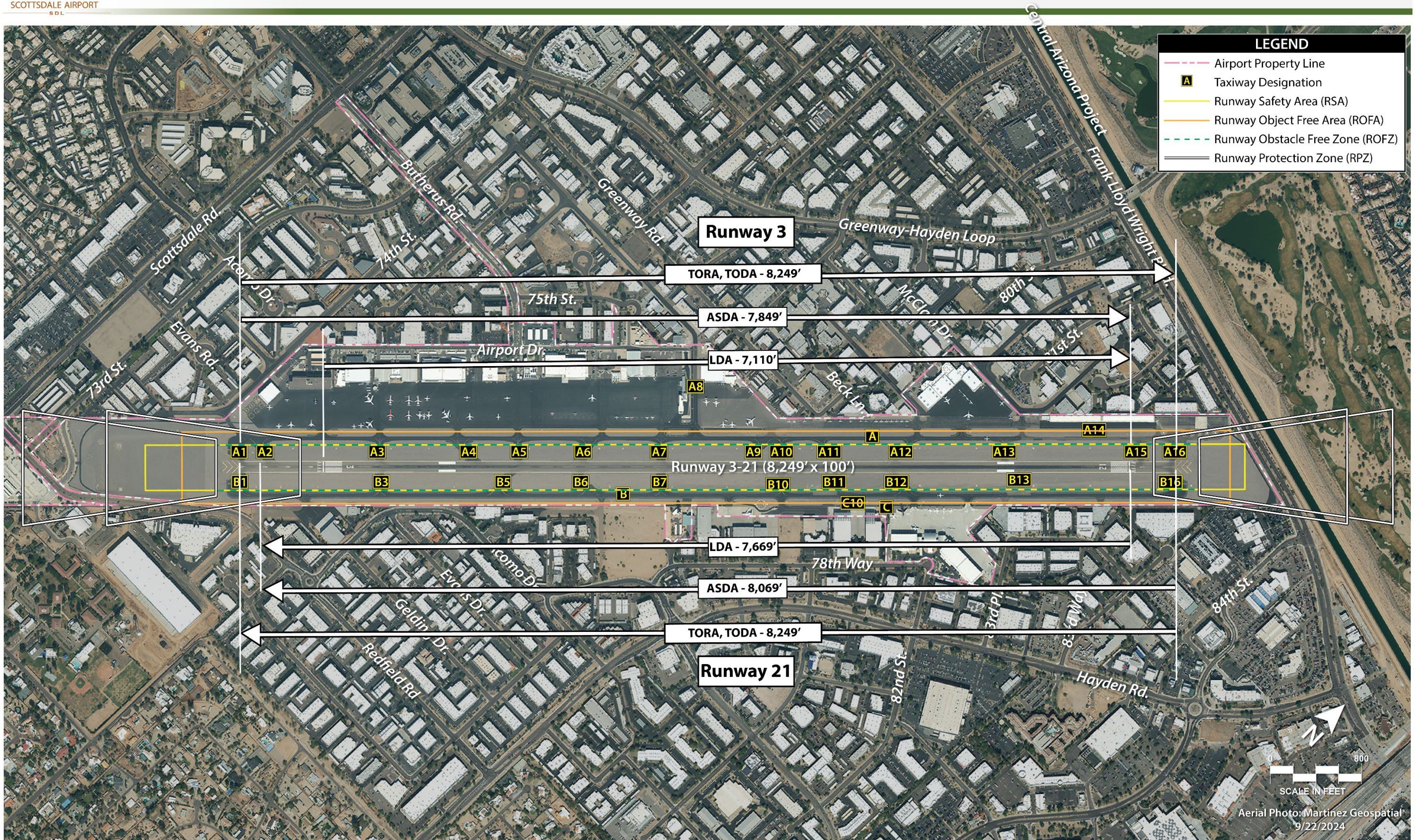


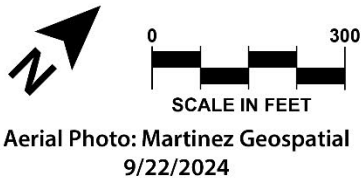
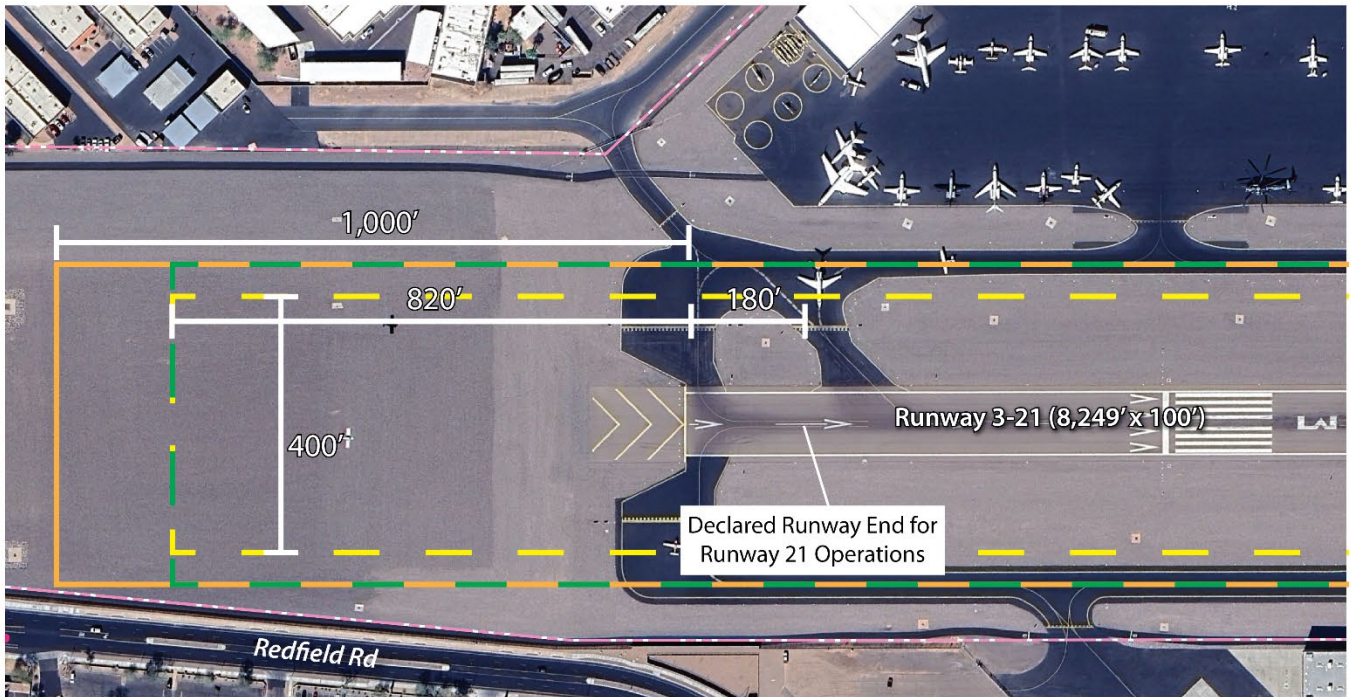
Wind Speed Percentages

- 7 - 10 kts.
- 11 - 16 kts.
- 17 - 22 kts.
- 23 - 27 kts.
- + 27 kts.

SOURCE:  
NOAA National Climatic Center  
Asheville, North Carolina  
Scottsdale Airport  
Scottsdale, Arizona, USA

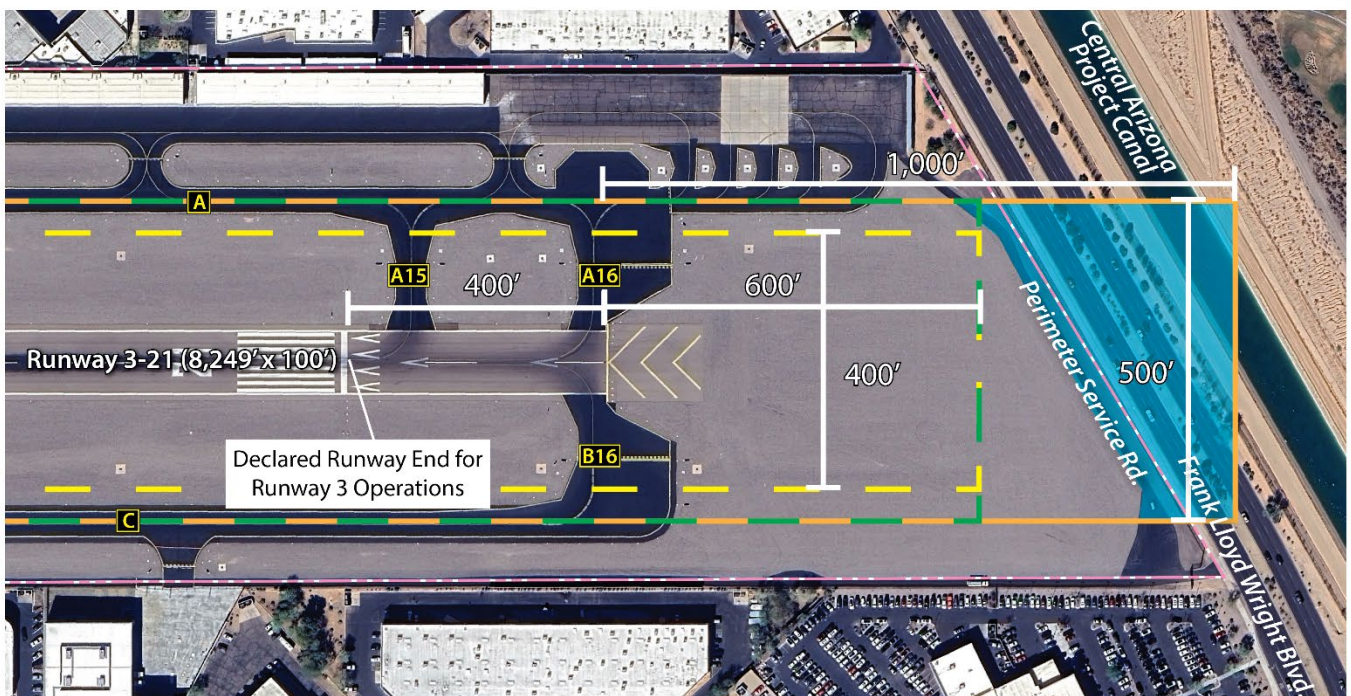
OBSERVATIONS:  
81,099 All Weather Observations  
Jan. 1, 2016 - Dec. 31 2025

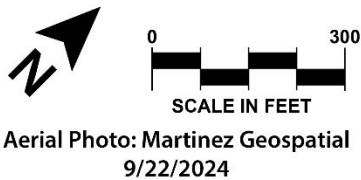
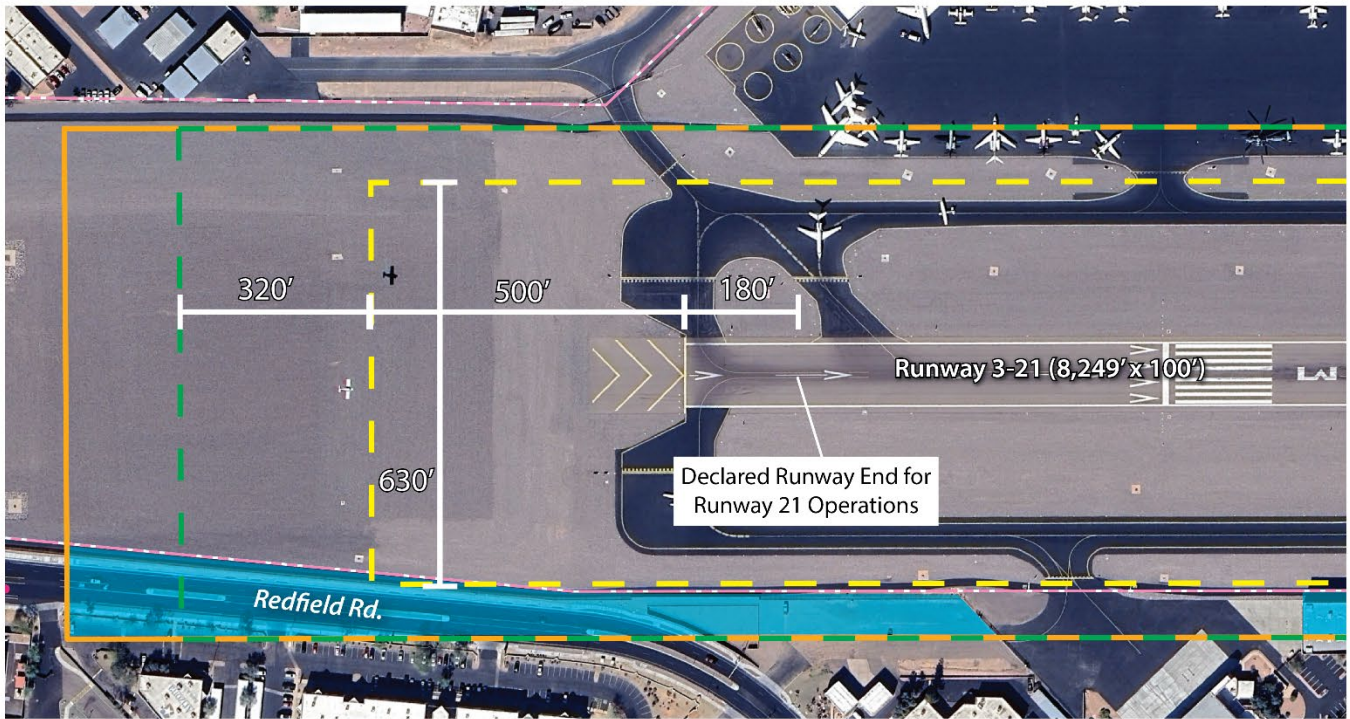




**KEY**  
**RSA - Runway Safety Area**

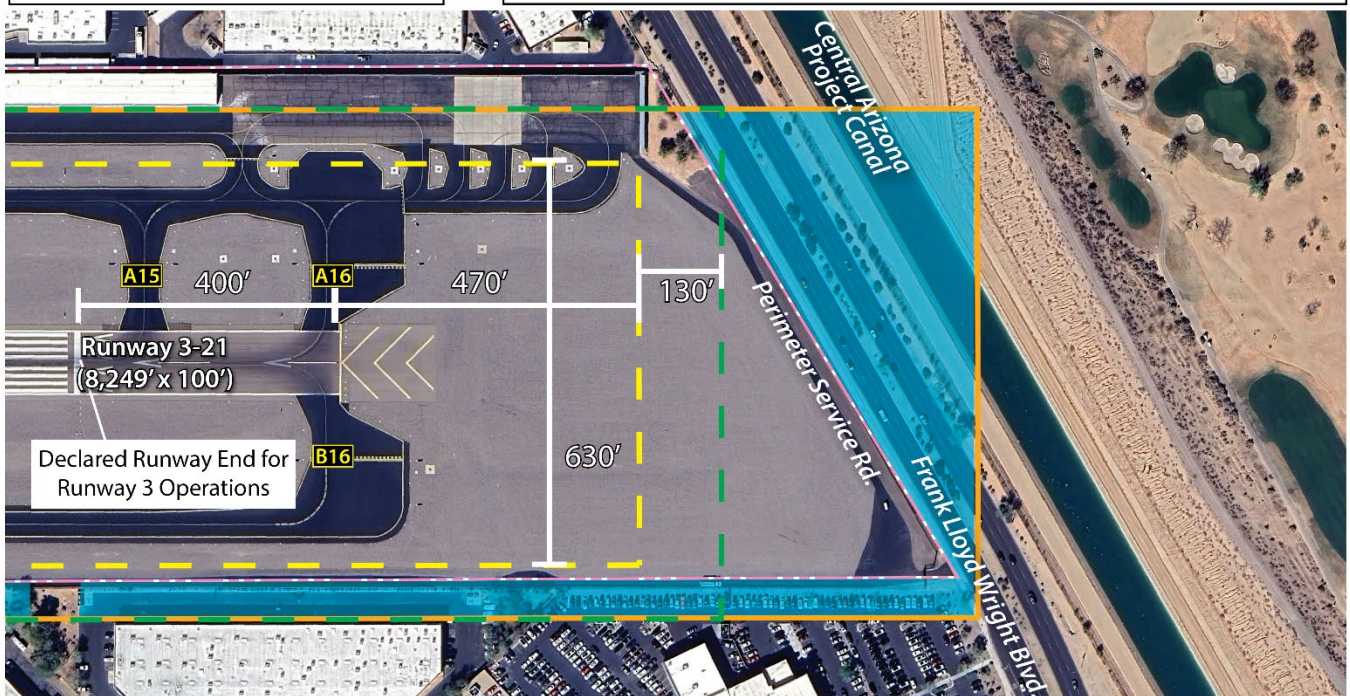
LEGEND	
	Airport Property Line
	Taxiway Designation
	Current 400' -Wide RSA with Declared Distances
	RSA Based on Runway Pavement End
	RSA Based on Declared Distances
	RSA Penetrations Without Declared Distances and MOS

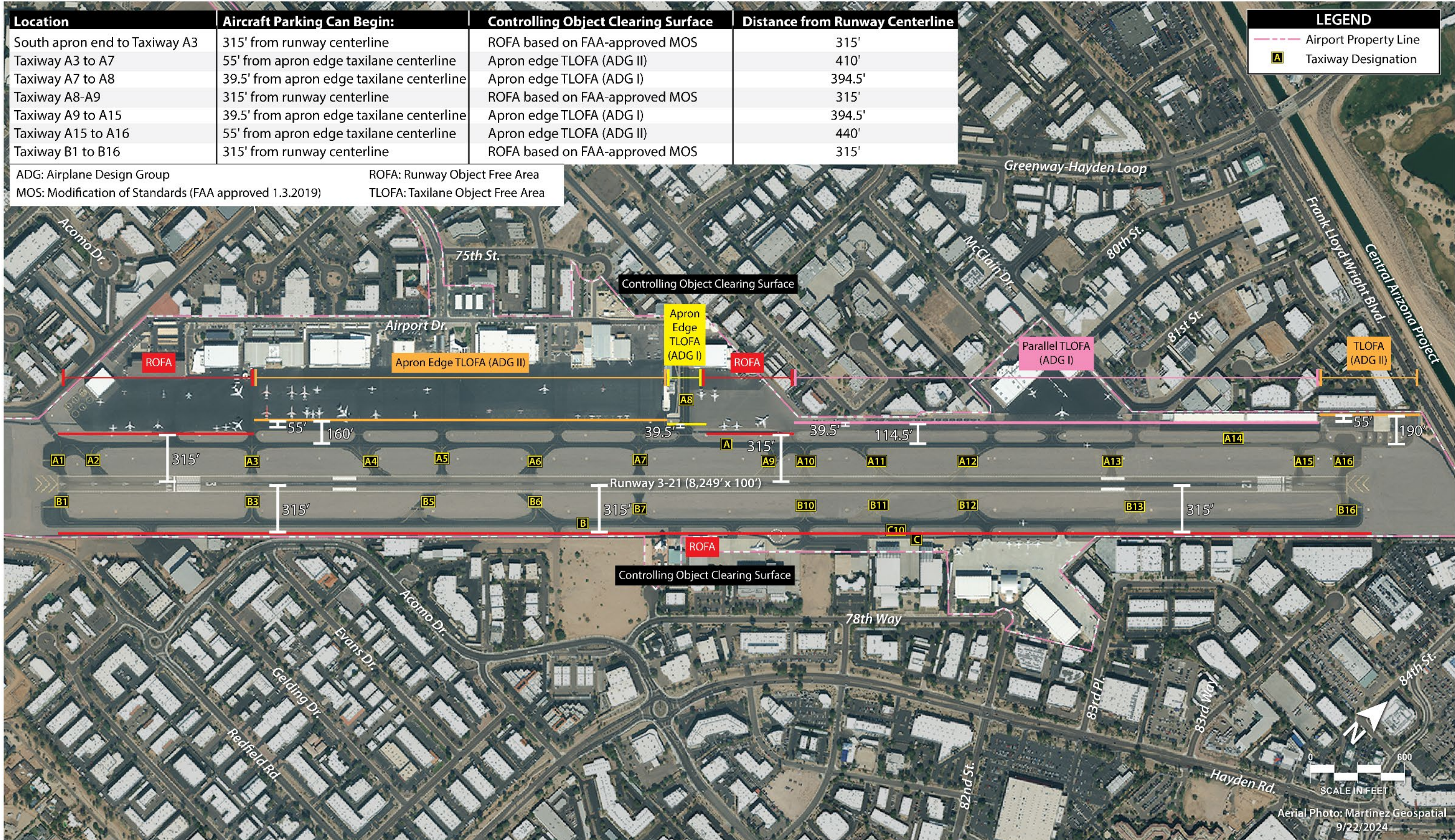








LEGEND	
	Airport Property Line
	Taxiway Designation
	Current ROFA - FAA-Approved Modification of Standards
	ROFA Based on Runway Pavement Ends
	ROFA Based on Declared Distances
	ROFA Penetrations Without Declared Distances and MOS

KEY	
<b>ROFA - Runway Object Free Area</b>	







		EXISTING	FUTURE
<b>AIRPORT DATA</b>			
	Critical Aircraft	D-II-2B	Maintain
	Runway Design Code	D-II-5000	Maintain
	Visibility Minimums	1-mile	Maintain
<b>RUNWAY 3-21</b>			
	Length x Width	8,249' x 100'	Maintain
	Pavement Weight-Bearing Capacity	45,000 lbs. (S) / 75,000 lbs. (D)	Consider increase
	Shoulders	10'	Maintain
	Declared Distances	Yes	Review declared distances to maximize length
	Hold Lines	152' from runway centerline	Evaluate hold line separation
	RSA	400' feet wide/1,000' beyond ends	Maintain
	ROFA	630' wide/470' behind Rwy 21/500' behind Rwy 3	Maintain MOS
	OFZ	400' wide/200' beyond ends/meets standard	Maintain
	RPZ	Some incompatible land uses	Remove incompatible land uses if feasible
<b>TAXIWAYS/APRONS</b>			
	Width	40'-50'	Maintain existing width
	Taxiway Geometry	High-energy crossings, direct access, angled taxiways	Evaluate each taxiway and plan to reconstruct to current recommendations, including fillet design
	Runway/Taxiway Separation	250'	Maintain MOS
	Holding Aprons	Four hold aprons	Maintain
	Aircraft Parking Areas	Terminal, NetJet, Signature East + West	Maximize aircraft parking apron
	Taxilanes	Parallel taxilanes/apron edge taxilanes	Evaluate separation distance
<b>NAVIGATION AND APPROACH AIDS</b>			
	Control Tower	ATCT constructed in 1989	FAA to consider replacement
	Weather Equipment	ASOS	Maintain
	Windsocks	Two (one lighted)	Add wind cone to south end of airfield
	Visual Approach Aids	PAPI-2L REILs	Upgrade to PAPI-4L Maintain
	Instrument Approach Procedures	Circling and RNP	Consider SRMP for straight-in GPS approach
<b>LIGHTING, MARKING, AND SIGNAGE</b>			
	Universal Beacon	Rotating beacon	Maintain
	Runway Edge Lighting	MIRL	Maintain
	Taxiway Edge Lighting	MITL	Maintain
	Runway Markings	Non-precision markings	Maintain
	Hold Bar Location	152' from runway centerline	Maintain
	Signage	Lighted airfield signs	Maintain
	Distance Remaining Signs	Distance remaining signs	Maintain

<b>KEY</b>	<b>ASOS</b> - Automated Surface Observation System	<b>MIRL</b> - Medium Intensity Runway Lighting	<b>MOS</b> - FAA-Approved Modification of Standards
	<b>ATCT</b> - Airport Traffic Control Tower	<b>MITL</b> - Medium Intensity Taxiway Lighting	<b>S</b> - Single Wheel Landing Strut
	<b>ATIS</b> - Automated Terminal Information System	<b>PAPI</b> - Precision Approach Path Indicator	<b>SRMP</b> - Safety Risk Management Panel
	<b>D</b> - Dual Wheel Landing Strut	<b>REIL</b> - Runway End Identification Lighting	<b>OFZ</b> - Runway Obstacle Free Zone
	<b>GPS</b> - Global Positioning System	<b>RDC</b> - Runway Design Code	<b>RPZ</b> - Runway Protection Zone

	CURRENTLY AVAILABLE	20-YEAR PROJECTED NEED	DIFFERENCE
Aircraft Hangar Needs	Approx. 500,000 sf	Approx. 894,000 sf.	394,000 sf.
Aircraft Parking Apron Needs	189,000 sy.	256,600 sy.	67,600 sy.
Terminal Service Needs	17,000 sf.	21,500 sf.	4,500 sf.
Public Auto Parking	More needed currently	Consider parking structure/construct parking with each new hangar	
<b>Fuel Storage Capacity</b>			
Jet A	178,000 gallons	Based on FBO needs	
AvGas 100LL	58,100 gallons		
Perimeter Fencing	Chain-link fencing with barbed wire, various walls	Maintain full perimeter fencing and walls	
Maintenance Facilities	Airport Operations Center	Maintain	
Wash Racks	One public	Maintain	
ARFF Facility	On-airport	Maintain	

