Chapter 3
Facility Requirements

Proper airport planning requires the translation of forecasted aviation demand into the specific types and quantities of facilities that can adequately serve the identified demand. This chapter analyzes the existing capacities of facilities at Kerrville-Kerr County Airport (ERV). The existing capacities are then compared to the forecasted activity levels prepared in Chapter Two to determine the adequacy of the existing facilities and identify whether deficiencies currently exist or may be expected to materialize in the future. This chapter presents the following elements:

- Planning horizon activity levels
- Airfield capacity
- Airport physical planning criteria
- Airside and landside facility requirements

This exercise is intended to identify the adequacy of existing airport facilities, outline what new facilities may be needed, and determine when new facilities may be needed to accommodate forecasted demand. After establishing these facility requirements, alternatives for providing these facilities will be evaluated in the next chapter to determine the most practical, cost-effective, and efficient means for implementation.

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

- FAA Advisory Circular (AC) 150/5300-13B, *Airport Design*, Change 1
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B, *Runway Length Requirements for Airport Design*
- Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*
- FAA Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems* (*NPIAS) and the Airports Capital Improvement Plan (ACIP)*

DEMAND-BASED PLANNING HORIZONS

An updated set of aviation demand forecasts for ERV was established and detailed in Chapter Two. These activity forecasts include annual aircraft operations, based aircraft, aircraft fleet mix, and peaking characteristics. With this information, specific components of the airfield and landside system can be evaluated to determine their capacity to accommodate future demand.

Cost-effective, efficient, and orderly development of an airport should be based more on actual demand at an airport than on a time-based forecast figure. To develop a master plan that is demand-based, rather than time-based, a series of planning horizon milestones has been established that takes into consideration the reasonable range of aviation demand projections. The planning horizons are the short term (years 1-5), the intermediate term (years 6-10), and the long term (years 11-20).

It is important to consider that the actual activity at the airport may be higher or lower than what the annualized forecast portrays. By planning according to activity milestones, the resultant plan can accommodate unexpected shifts or changes in the area's aviation demand by allowing airport management the flexibility to make decisions and develop facilities based on need generated by actual demand levels, rather than dates in time. 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. **Table 3A** presents the short-, intermediate-, and long-term planning horizon milestones for each aircraft activity level forecasted in Chapter Two.

TABLE 3A | Aviation Demand Planning Horizons

	Base Year (2024)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
BASED AIRCRAFT				
Single-Engine	59	65	72	93
Multi-Engine	2	2	2	1
Turboprop	4	5	6	9
Jet	18	22	25	31
Helicopter	5	6	7	9
Other	0	0	1	2
Total Based Aircraft:	**88**	**100**	**113**	**145**
ANNUAL OPERATIONS				
Itinerant				
Air Carrier	0	0	0	0
Air Taxi	1,164	1,300	1,600	2,400
General Aviation	33,314	38,800	43,700	54,200
Military	62	46	46	46
Total Itinerant	**34,540**	**40,146**	**45,346**	**56,646**
Local				
General Aviation	10,334	11,900	13,300	16,400
Military	0	0	0	0
Total Local	**10,334**	**11,900**	**13,300**	**16,400**
Total Annual Operations:	**44,874**	**52,046**	**58,646**	**73,046**

Source: Coffman Associates analysis

AIRFIELD CAPACITY

An airport's airfield capacity is expressed as annual service volume (ASV), which is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year without incurring significant delay factors. As aircraft operations near or surpass the ASV, delay factors exponentially increase. The airport's ASV was examined utilizing FAA AC 150/5060-5, *Airport Capacity and Delay*.

FACTORS AFFECTING ANNUAL SERVICE VOLUME

This analysis accounts for specific factors regarding the airfield in order to calculate the airport's ASV. These various factors are depicted on **Exhibit 3A**. This section describes the input factors as they relate to ERV, including airfield layout, weather conditions, aircraft mix, and operations.

Runway Configuration | The existing airfield configuration consists of a dual-runway system with full-length parallel taxiways supporting both runways. Primary Runway 12-30 is 6,004 feet long and 100 feet wide; crosswind Runway 3-21 is 3,597 feet long and 58 feet wide.

Runway Use | Runway use in capacity conditions is controlled by wind and/or airspace conditions. For ERV, the direction of takeoffs and landings is typically determined by the speed and direction of the wind, or as directed by the airport traffic controller. It is generally safest for aircraft to take off and land into the wind, avoiding a crosswind (wind blowing perpendicular to the travel of the aircraft) or tailwind components during these operations. Runway utilization data have been determined by analyzing 12 months of automatic dependent surveillance-broadcast (ADS-B) data collected by Virtower. A runway utilization summary is provided in **Table 3B**.

TABLE 3B | Operations by Runway

Runway	Takeoff	Landing	T&G	Total Operations	%
Runway 12	11,901	11,372	7,280	30,553	68.1%
Runway 30	3,656	3,835	2,350	9,841	21.9%
Runway 21	1,460	1,034	372	2,866	6.4%
Runway 3	776	506	332	1,614	3.6%
T&G = touch-and-go					

Source: Virtower data, 12 months ending July 2024

Exit Taxiways | Exit taxiways have a significant impact on airfield capacity because the number and location(s) of exits directly determine the occupancy time of an aircraft on the runway. The airfield capacity analysis gives credit to taxiway exits located within the prescribed range from a runway's threshold. This range is based on the mix index of the aircraft that use the runways. Based on mix, only exit taxiways between 2,000 feet and 4,000 feet from the landing threshold count in the exit rating at ERV. The exits must be at least 750 feet apart to count as separate exit taxiways. Utilizing these criteria, Runway 12 is credited with one exit taxiway and Runway 30 is credited with zero exit taxiways. Runway 3 is credited with one exit and Runway 21 is credited with two exits.

AIRFIELD LAYOUT

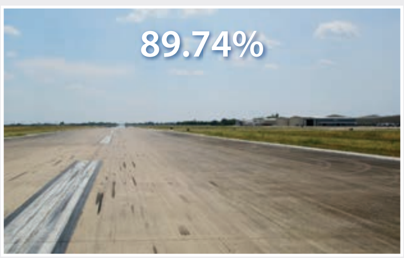
Runway Configuration

Runway Use

Number of Exits

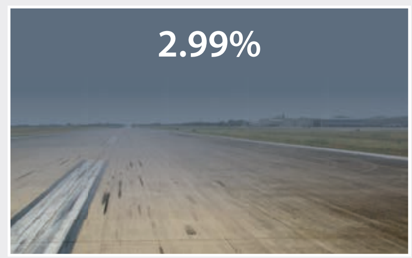
WEATHER CONDITIONS

VMC (VFR)
Visual Meteorological Conditions



IMC (IFR)
Instrument Meteorological Conditions

PVC
Poor Visibility Conditions



AIRCRAFT MIX

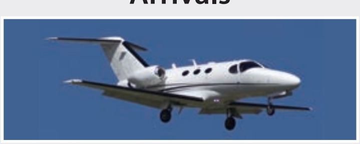
Category A & B Aircraft

Category C Aircraft

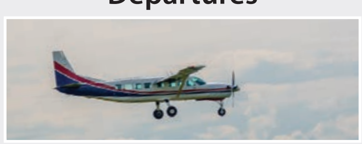
Category D Aircraft

OPERATIONS

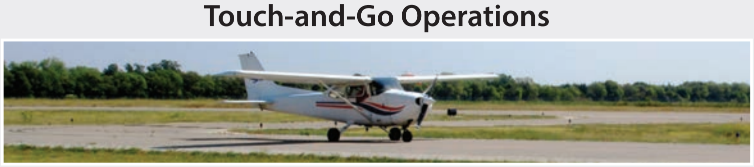
Arrivals



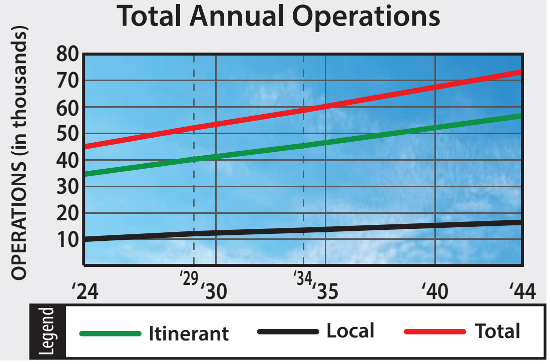
Departures



Touch-and-Go Operations



Total Annual Operations



Weather Conditions | Weather conditions can have a significant impact on airfield capacity. Airport 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 and air traffic vectoring. The increased distance between aircraft reduces the number of aircraft that can operate at the airport during any given period, thus reducing overall airfield capacity.

According to local meteorological data, the airport operates under visual meteorological conditions (VMC) approximately 89.74 percent of the time. VMC exist whenever the cloud ceiling is greater than 1,000 feet above ground level (AGL) and visibility is greater than three statute miles. Instrument meteorological conditions (IMC) are defined when cloud ceilings are between 500 and 1,000 feet AGL or visibility is between one and three miles. Poor visibility conditions (PVC) apply for cloud ceilings below 500 feet and visibility minimums below one mile. **Table 3C** summarizes the weather conditions experienced at the airport over a 10-year period.

TABLE 3C | Weather Conditions

Condition	Cloud Ceiling	Visibility	% of Total
VMC	≥ 1,000' AGL	≥ 3 statute miles	89.74%
IMC	≥ 500' AGL to < 1,000' AGL	≥ 1 to < 3 statute miles	7.27%
PVC	< 500' AGL	< 1 statute mile	2.99%

AGL = above ground level
IMC = instrument meteorological conditions
PVC = poor visibility conditions
VMC = visual meteorological conditions

Source: Kerrville-Kerr County Airport, TX Station ID 72253712961, observations from January 1, 2014, through December 31, 2023

Aircraft Mix | The aircraft mix for the capacity analysis is defined in terms of four aircraft classifications. Classes A and B consist of small- and medium-sized propeller and some jet aircraft, all of which weigh 12,500 pounds or less. These aircraft are primarily associated with general aviation activity but include some air taxi, air cargo, and commuter aircraft. Class C consists of aircraft that weigh between 12,500 pounds and 300,000 pounds. These aircraft include most business jets and some turboprop aircraft that utilize the airport on a regular basis. Class D consists of aircraft that weigh more than 300,000 pounds.

Most operations at ERV are conducted by aircraft in Classes A and B. According to the FAA's Traffic Flow Management System Counts (TFMSC) data for the 12-month period ending July 2024, there were approximately 2,500 total operations by Class C aircraft at ERV, which represents six percent of all operations. Class D aircraft did not conduct any operations during that period. The remaining operations were conducted by aircraft within Classes A and B, which represent 94 percent of total operations at ERV. It is anticipated that operations by Class C aircraft will represent approximately eight percent of total operations by 2044.

Percent Arrivals | The percentage of arrivals as they relate to total operations of the airport is important in determining airfield capacity. Under most circumstances, the lower the percentage of arrivals, the higher the hourly capacity will be. The aircraft arrival/departure percentage split is typically 50/50, which is the case at ERV.

Touch-and-Go Activity | 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. As previously discussed in Chapter Two, these operations are normally associated with general aviation training activity and are classified as local operations. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and takeoff occurs within a shorter time than an individual operation. Touch-and-go operations at ERV accounted for 23 percent of total annual operations in the 12-month period ending July 2024. This percentage is anticipated to remain fairly constant throughout the planning horizon.

Peak Period Operations | Average daily operations and average peak hour operations during the peak month are utilized for the airfield capacity analysis. Operations 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.

CAPACITY ANALYSIS CONCLUSION

Given the factors outlined above, the airfield's ASV will range between 225,000 and 270,000 annual operations. The ASV does not indicate a point of absolute gridlock for the airfield; however, it represents the point at which operational delay for each aircraft operation will exponentially increase.

ERV experienced 44,874 operations over the 12-month period ending July 2024. This operational level for the airport represents approximately 20 percent of the airfield's ASV if the ASV is considered at the low end of the typical range of 225,000 annual operations. By the end of the long-term planning period, total annual operations are expected to represent 32 percent of the airfield's ASV.

FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems*, indicates that improvements for airfield capacity purposes should be considered when operations reach 60 to 75 percent of the ASV. This is an approximate level to begin the detailed planning of capacity improvements. When 80 percent of the ASV is reached, capacity improvement projects should become higher priority capital improvements. According to this analysis, existing and forecasted operations levels at ERV do not warrant significant capacity improvements; however, options to improve airfield efficiency (such as additional exit taxiways) will still be considered as part of this master plan.

AIRSIDE FACILITY REQUIREMENTS

Airside facilities are related to the arrival, departure, and ground movement of aircraft. Airside facility requirements are primarily based on the runway design code (RDC) for each runway. Analysis in Chapter Two identified the existing and ultimate RDC for Runway 12-30 as C-II-5000 and the existing and ultimate RDC for Runway 3-21 as A/B-I-5000.

RUNWAYS

Runway conditions (such as orientation, length, width, and pavement strength) were analyzed at ERV. From this information, requirements for runway improvements were determined for the airport.

Runway Orientation

The orientation for wind coverage and the operational capacity of the runway system are important considerations in the runway configuration of an airport. FAA AC 150/5300-13B, *Airport Design*, Change 1, recommends that a crosswind runway be made available when the primary runway orientation provides less than 95 percent crosswind component coverage for an airplane design group.

The all-weather wind rose for the airport was detailed in Chapter One (Exhibit 1D) and shows the orientation of Runway 12-30 provides 96.74 percent coverage for the 10.5-knot component and greater than 98 percent coverage for 13-, 16-, and 20-knot components in all weather conditions. In instrument flight rule (IFR) conditions, Runway 12-30 provides greater than 98 percent coverage for each crosswind component. Together, Runway 12-30 and Runway 3-21 provide over 99 percent coverage in all crosswind components (in both all-weather and IFR conditions). Because Runway 12-30 (the primary runway at ERV) provides greater than 95 percent crosswind coverage in all-weather and IFR conditions, a crosswind runway is not needed to meet FAA recommendations for crosswind coverage; however, the *FAA Reauthorization Act of 2024* allows for the reconstruction or rehabilitation of an existing crosswind runway, regardless of the wind coverage of the primary runway, if the crosswind runway has previously been depicted on an approved airport layout plan (ALP). Runway 3-21 is shown on the ERV ALP set that was last approved by the Texas Department of Transportation (TxDOT) in November 2012; therefore, **Runway 3-21 is eligible to be maintained to A/B-I-5000 design standards.**

Runway Designations

A runway's designation is based on its magnetic headings, which are determined by the magnetic declination for the area. Runway 12-30 has a true heading of 131°/311°. Adjusting for the magnetic declination, the current magnetic heading of Runway 12-30 is 127°/307°, resulting in an ideal runway designation of 13-31. **The plan will reflect an ultimate designation change from 12-30 to 13-31 for the primary runway at ERV.**

The true heading of Runway 3-21 is 033°/213° and its magnetic heading is 029°/209°. The existing runway designation meets the ideal designation now and for the next 10+ year period; therefore, no runway designation change is required for the crosswind runway.

Runway Length

The determination of runway length requirements for the airport is based on five primary factors:

- Mean maximum temperature of the hottest month
- Airport elevation
- Runway gradient
- Critical aircraft type expected to use the runway
- Stage length of the longest nonstop destination (specific to larger aircraft)

The mean maximum daily temperature of the hottest month for ERV is 92.8 degrees Fahrenheit (°F), which occurs in August. The airport elevation is 1,616.8 feet mean sea level (MSL). Runway 12-30 has a longitudinal gradient of 0.26 percent, while Runway 3-21 has a gradient of 1.20 percent. Both runways conform to FAA runway longitudinal gradient design standards, which specify maximum longitudinal grades of ±1.50 percent on runways serving aircraft approach category (AAC) C and D aircraft (Runway 12-30) and ±2.00 percent on runways serving AAC A and B aircraft (Runway 3-21).

There are three methodologies for determining runway length requirements, which are based on the maximum certificated takeoff weight (MTOW) of the critical aircraft or the airplane group for each runway; the airplane group includes multiple aircraft with similar design characteristics. The three weight classifications are airplanes with a MTOW of 12,500 pounds or less, airplanes that weigh over 12,500 pounds but less than 60,000 pounds, and airplanes that weigh 60,000 pounds or more. **Table 3D** shows these classifications and the appropriate methodology to use in runway length determination.

TABLE 3D | Airplane Weight Classification for Runway Length Requirements

Airplane Weight Category (MTOW)		Design Approach	Methodology
12,500 pounds or less	Approach speeds of less than 30 knots	Family grouping of small airplanes	Chapter 2: para. 203
	Approach speeds of at least 30 knots but less than 50 knots	Family grouping of small airplanes	Chapter 2: para. 204
	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
	Approach speeds of 50 knots or more with 10 or more passenger seats	Family grouping of small airplanes	Chapter 2: para. 205, Figure 2-2
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: *Airplane Performance Manuals*

MTOW = maximum takeoff weight

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

Small General Aviation Aircraft (≤12,500 pounds)

Most operations at ERV are conducted using smaller general aviation (GA) aircraft that weigh less than 12,500 pounds. Following guidance from AC 150/5325-4B, to accommodate 95 percent of these small aircraft with less than 10 passenger seats, a 3,700-foot runway length is recommended. For 100 percent of these small aircraft, a 4,300-foot runway length is recommended. For small aircraft with 10 or more passenger seats, a 4,500-foot runway length is recommended.

Small and Mid-Size Turbine Aircraft (12,500–60,000 pounds)

Turbine operations account for a smaller percentage of ERV operations, but this category of activity is projected to experience strong growth over the planning period. Runway length requirements for this classification of aircraft also utilize charts from AC 150/5325-4B and take into consideration the runway gradient and landing length requirements for contaminated (wet) runways. Business jets tend to need greater runway length when landing on wet surfaces because of their increased approach speeds.

AC 150/5325-4B stipulates that runway length determination for business jets must consider a grouping of airplanes with similar operating characteristics. The AC provides two separate family groupings of airplanes, each of which is based on its representative percentage of aircraft in the national fleet. The first grouping is those business jets that comprise 75 percent of the national fleet, and the second group is those that comprise 100 percent of the national fleet. **Table 3E** shows example aircraft for both groups.

TABLE 3E | Aircraft Categories for Runway Length Determination

0-75 Percent of the National Fleet	MTOW (pounds)	75-100 Percent of the National Fleet	MTOW (pounds)
Challenger 300	38,850	Lear 55	21,500
Lear 40/45	20,500	Lear 60	23,500
Cessna 550 Citation II	14,100	Hawker 800XP	28,000
Cessna 560XL Excel	20,000	Hawker 1000	31,000
Cessna 650 VII	22,000	Cessna 650 III/IV	22,000
Cessna 680 Sovereign	30,775	Cessna 750 X	35,700
Beechjet 400	15,800	Challenger 604	47,600
Falcon 50	18,500	Falcon 2000	42,800
MTOW = maximum takeoff weight			

Source: 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 a 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 mid-size business jet that weighs less than 60,000 pounds MTOW. There are more than 500 annual operations by these types of aircraft at ERV, including by the critical aircraft, the Falcon 900. 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 methods described in the AC will be used to establish the runway length.

In consideration of the growing number of business jets, 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 of runway (or less) at MSL and standard day temperature (59°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. ERV experiences significant levels of business jet activity from the full range of the business jet fleet.

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, useful load is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel; however, pilots may choose to ferry fuel so they do not have to refuel frequently.

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 support using the 90 percent useful load category. For ERV, there are known long-haul operations that would support applying the 90 percent useful load classification. TFMSC data documents city pairs by departing aircraft. An examination of the destinations shows there were 260 departures from ERV in the 12-month period ending July 2024 to destination airports that are 1,000 miles or more away from ERV. Because of the frequency of long-haul flights to and from ERV, both the 60 and 90 percent useful load categories are included when calculating 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 (see **Figures 3A**, **3B**, **3C**, and **3D**). These charts require the following inputs:

- Mean maximum daily temperature of the hottest month: August at 92.8°F
- Airport elevation: 1,616.8 feet above MSL

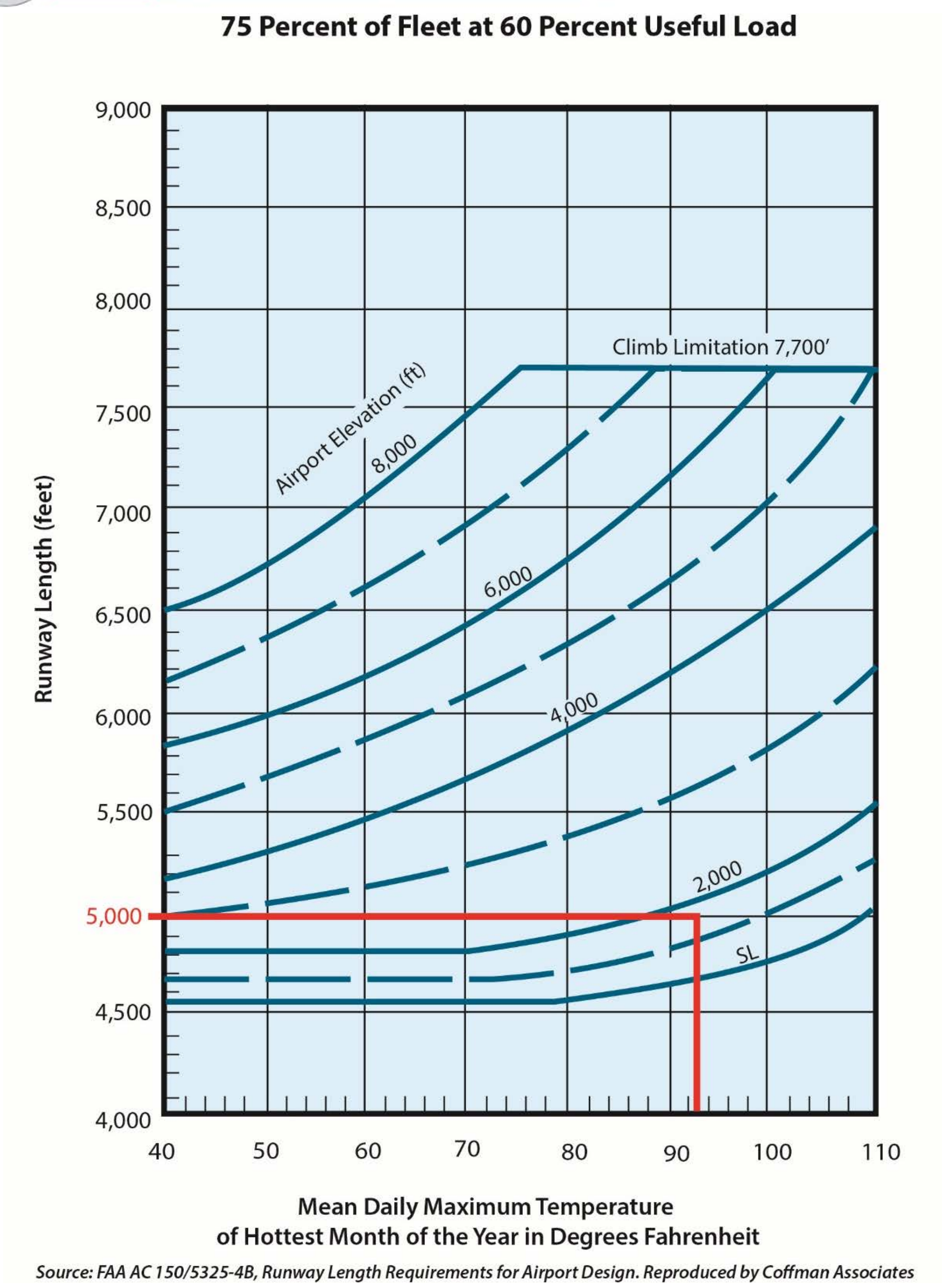


Figure 3A – Business Jet Runway Length Charts: 75% of the Fleet at 60% Useful Load

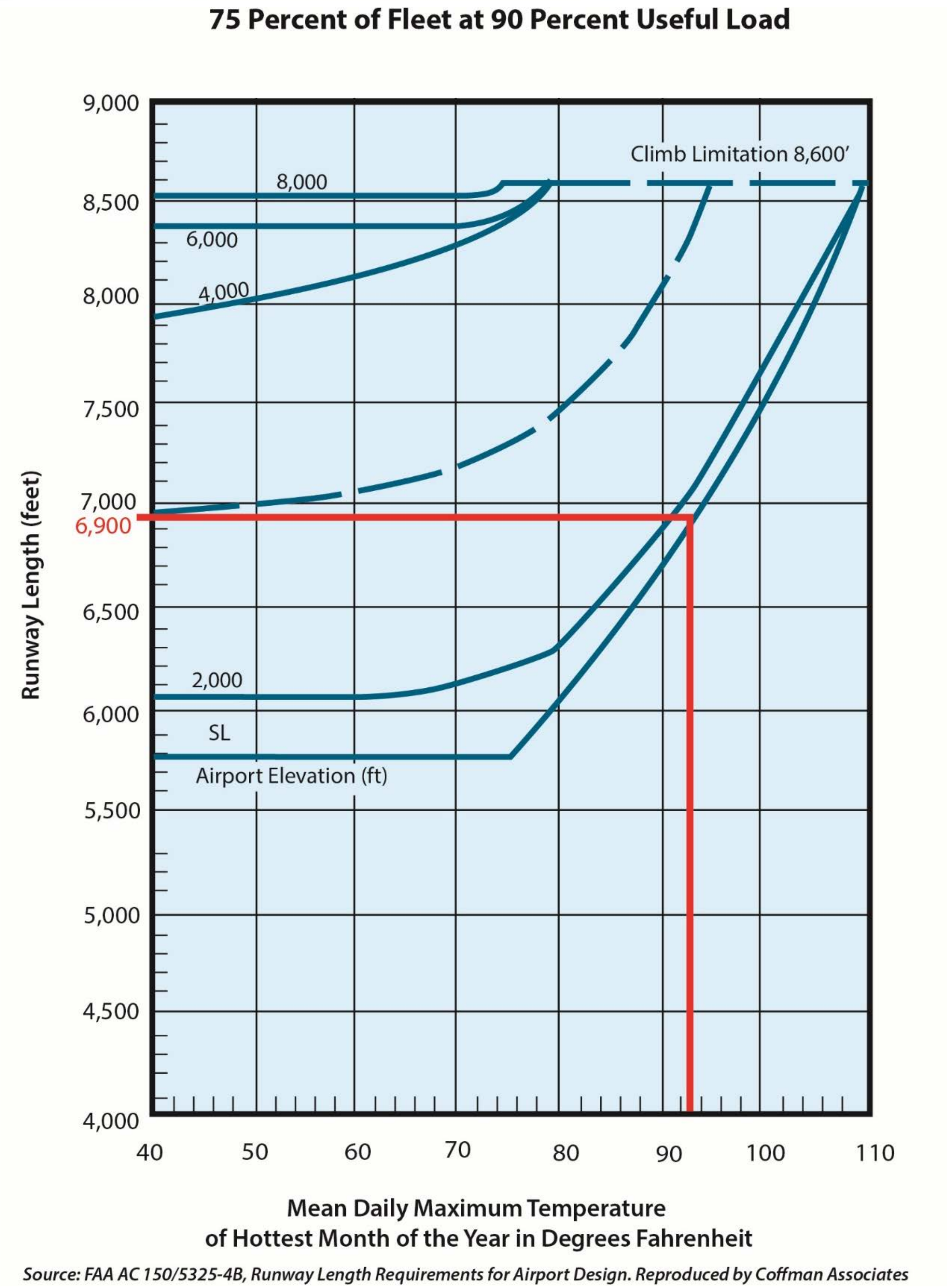
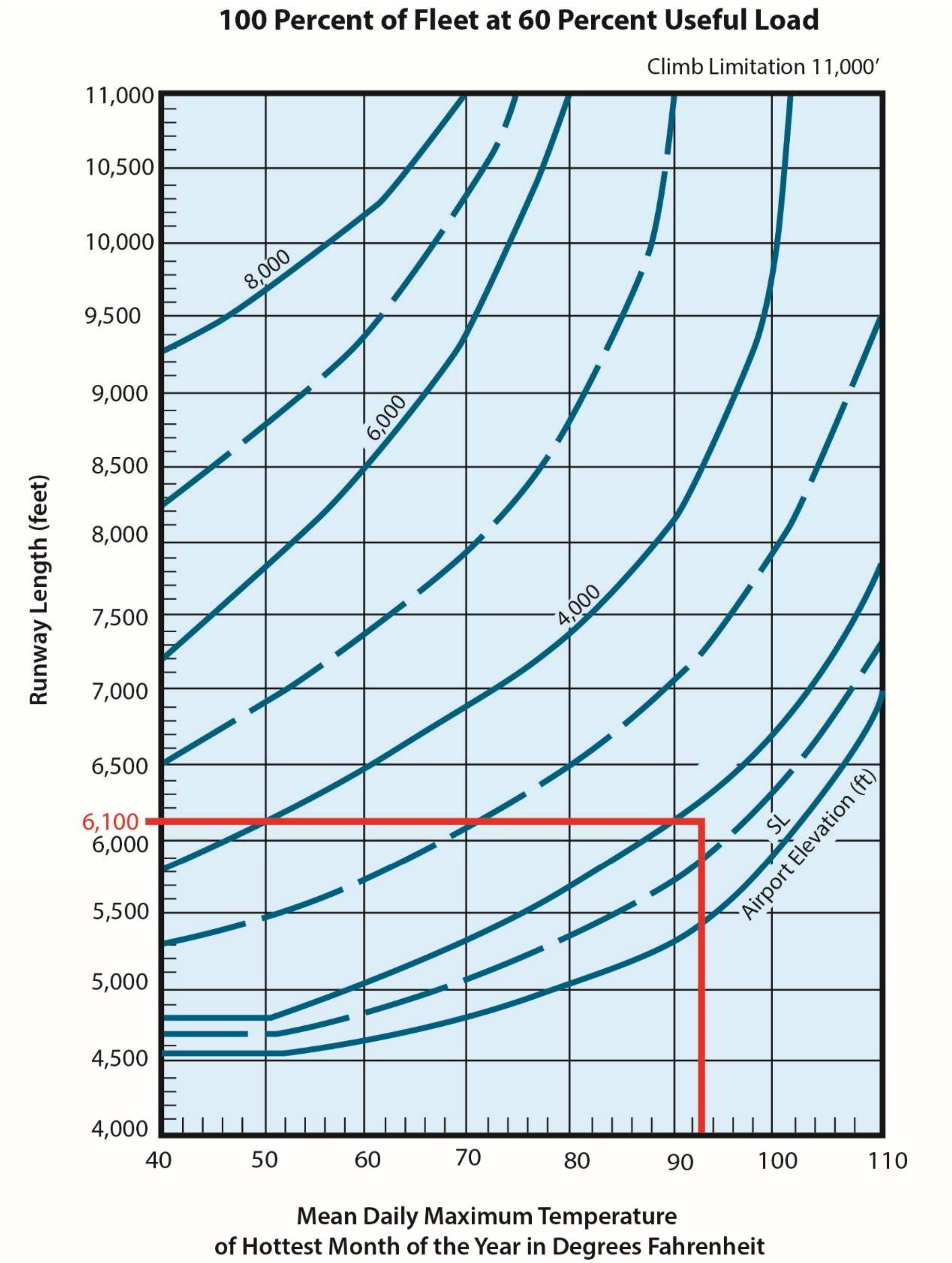


Figure 3B – Business Jet Runway Length Charts: 75% of the Fleet at 90% Useful Load



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

Figure 3C – Business Jet Runway Length Charts: 100% of the Fleet at 60% Useful Load

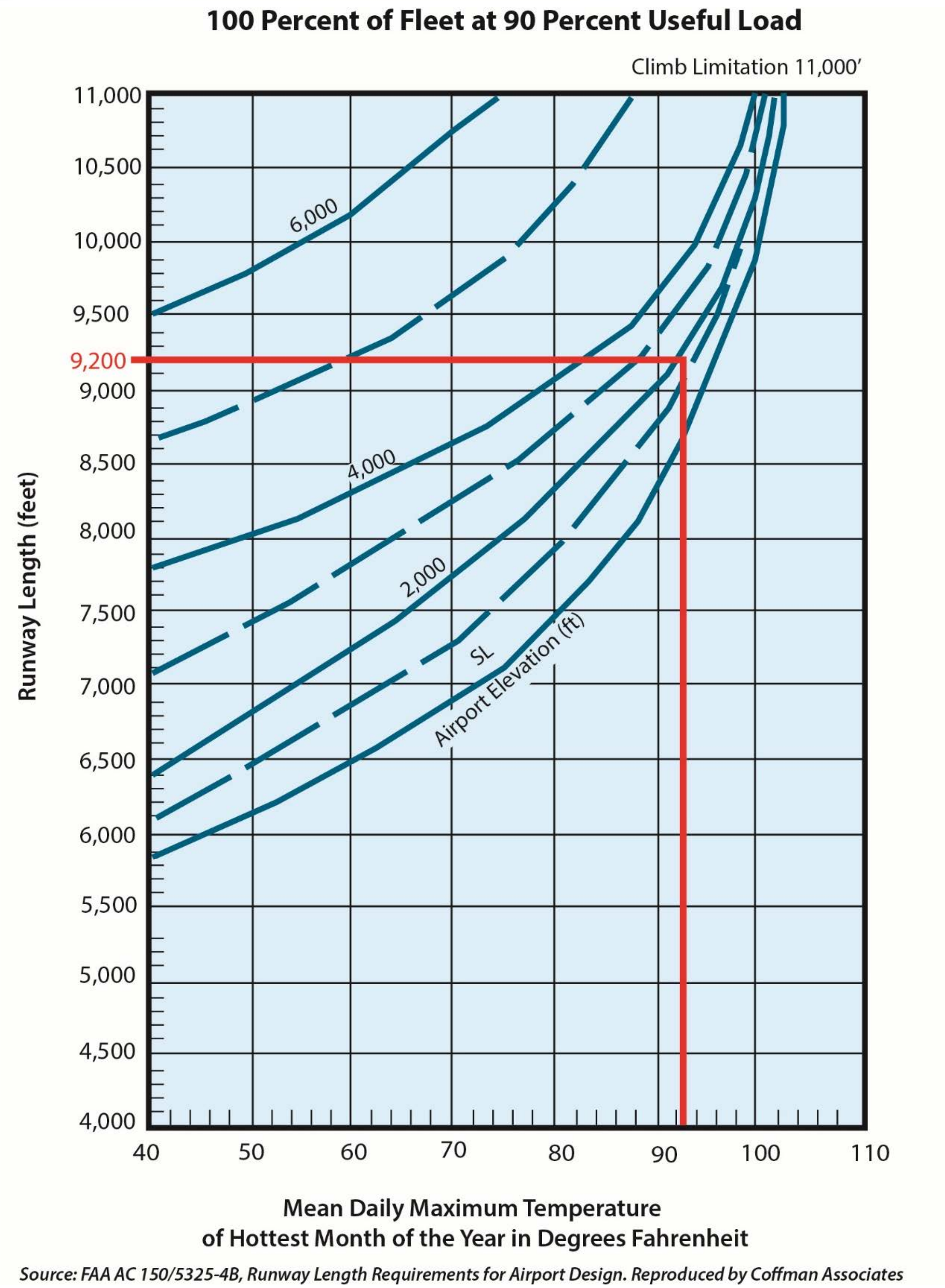


Figure 3D – Business Jet Runway Length Charts: 100% of the Fleet at 90% Useful Load

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

The raw runway lengths calculated in Step #4 are based on no wind, a dry runway surface, and zero effective runway gradient; therefore, the following criteria are applied:

- Wet runway surface (applies to landing operations only)
- 0.26 percent effective runway gradient, 15.9 feet of elevation difference for Runway 12-30 (applies to takeoff operations only)

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 5,000 feet, for the 60 percent category and 7,000 feet for the 90 percent category (whichever is less).

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 ERV, this equates to an additional 159 feet of runway length.

Table 3F presents the results of the runway length analysis for business jets that weigh between 12,500 and 60,000 pounds; the analysis was developed following the guidance provided in AC 150/5325-4B. To accommodate 75 percent of the business jet fleet at 60 percent useful load, a runway length of 6,000 feet is recommended. This length is derived from a raw length of 5,500 feet, which is adjusted for runway gradient and consideration of landing length needs on a contaminated (wet and slippery) runway. To accommodate 100 percent of the business jet fleet at 60 percent useful load, a runway length of 7,800 feet is recommended, and to accommodate 75 percent of the fleet at 90 percent useful load, a runway length of 8,700 feet is recommended.

TABLE 3F | Runway Length Requirements – Aircraft Between 12,500 and 60,000 Pounds

Airport Elevation	1,616.8' feet above mean sea level			
Average High Monthly Temp.	92.8°F (August)			
Runway Gradient	0.26% Runway 12-30 (15.9')			
Fleet Mix Category	**Raw Runway Length from FAA AC**	**Runway Length with Gradient Adjustment**	**Wet Surface Landing Length for Jets (+15%)[1]**	**Final Runway Length[2]**
75% of fleet at 60% useful load	5,000'	5,159'	5,500'	5,500'
100% of fleet at 60% useful load	6,100'	6,259'	5,500'	6,300'
75% of fleet at 90% useful load	6,900'	7,059'	7,000'	7,100'
100% of the fleet at 90% useful load	9,200'	9,359'	7,000'	9,400'

[1]Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet conditions
[2]Longest runway need rounded up to nearest hundred
Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Supplemental Analysis Undertaken for Typical Business Jets Operating Under Local Conditions

Another method to determine runway length requirements for aircraft at ERV is to examine aircraft flight planning manuals under conditions specific to the airport. **Table 3G** provides a detailed runway length analysis for several of the most common turbine aircraft in the national fleet. These data were obtained from UltraNav software, which computes operational parameters for specific aircraft based on flight manual data. The analysis includes the MTOW allowable and the percent useful load from 60 percent to 100 percent.

The analysis shows that each business jet evaluated can operate at ERV at 60 percent useful load during the hottest days of the summer, and all but the Lear 60 and Challenger 601 can operate at 70 percent useful load. The existing/ultimate critical aircraft, the Falcon 900, can operate at up to 80 percent useful load but requires additional length for 90 percent or higher useful loads.

TABLE 3G | Supplemental Business Aircraft Takeoff Length Requirements

		TAKEOFF LENGTH REQUIREMENTS (FEET)				
		Useful Load				
Aircraft	MTOW	100%	90%	80%	70%	60%
Pilatus PC-12	9,921	3,052	2,836	2,629	2,432	2,244
King Air C90GTi	10,100	3,621	3,402	3,183	2,964	2,763
King Air C90B	10,100	3,849	3,594	3,354	3,131	2,915
King Air 200 GT	12,500	4,170	4,049	3,909	3,765	3,630
Citation CJ3	13,870	4,301	3,963	3,680	3,418	3,168
Citation Sovereign	30,300	4,527	4,213	3,918	3,678	3,528
Citation (525A) CJ2	12,375	4,711	4,372	4,089	3,786	3,496
King Air 350	15,000	4,775	4,421	4,123	3,954	3,784
Citation 560XLS	20,200	5,006	4,664	4,336	4,017	3,727
Challenger 300	38,850	6,837	6,302	5,796	5,313	4,850
Gulfstream G280	39,600	6,972	6,276	5,670	5,111	4,611
Gulfstream G450	74,600	7,084	6,469	5,882	5,347	4,842
Falcon 900EX	49,200	7,210	6,600	5,910	5,230	4,630
Citation X	35,700	C/L	6,694	6,069	5,527	5,062
Challenger 604/605	48,200	7,965	7,276	6,595	5,956	5,394
Gulfstream G550	91,000	8,234	7,301	6,476	5,702	5,012
Lear 60	23,500	8,300	7,447	6,773	6,251	5,621
Canadair Challenger 601	45,100	8,680	7,750	6,920	6,190	5,550

Red figures are greater than 6,004 feet (length of the primary runway at ERV).
Runway length calculation assumptions: 1,616.8' MSL field elevation; 92.8°F ambient temperature; 0.26% runway grade
C/L = climb limited: aircraft cannot maintain required climb gradient at this useful load
MTOW = maximum takeoff weight
Source: UltraNav software

Table 3H presents the runway length required for landing under three operational categories: Title 14 Code of Federal Regulations (CFR) Part 91, CFR Part 135, and CFR Part 91k. CFR Part 91 operations are those conducted by individuals or companies that own their aircraft. CFR Part 135 applies to all for-hire charter operations, including most fractional ownership operations. CFR Part 91k includes operations in fractional ownership that utilize their own aircraft under the direction of pilots specifically assigned to said aircraft. Part 91k and Part 135 rules regarding landing operations require operators to land at a destination airport within 60 percent of the effective runway length. An additional rule allows operators to land within 80 percent of the effective runway length if the operator has an approved destination airport analysis in the aircraft's program operating manual. The landing length analysis conducted accounts for both scenarios.

The landing length analysis shows that all business jets and turboprops evaluated are capable of landing at ERV (on the published landing distance available for Runway 12, which is 5,313 feet) during dry runway conditions under the 80 percent rule, and all but eight jets (including the Falcon 900) can land under the 60 percent rule. Wet runway conditions present additional restrictions for several jets when operating under Part 91K or 135 rules; however, all but the Gulfstream G450, Citation 560 XLS, and Citation X are capable of landing under Part 91 rules.

TABLE 3H | Supplemental Business Aircraft Landing Length Requirements

		LANDING LENGTH REQUIREMENTS (FEET)					
		Dry Runway Condition			Wet Runway Condition		
Aircraft Name	MLW	Part 91	80% Rule	60% Rule	Part 91	80% Rule	60% Rule
King Air 200	12,500	1,263	1,579	2,105	No Data	No Data	No Data
King Air C90B	9,600	1,417	1,771	2,362	No Data	No Data	No Data
King Air C90GTi	9,600	1,452	1,815	2,420	No Data	No Data	No Data
Pilatus PC-12	9,921	2,406	3,008	4,010	No Data	No Data	No Data
Challenger 300	33,750	2,693	3,366	4,488	5,161	6,451	8,602
Gulfstream G550	75,300	2,865	3,581	4,775	5,298	6,623	8,830
Challenger 604/605	38,000	2,900	3,625	4,833	4,532	5,665	7,553
King Air 350	15,000	2,947	3,684	4,912	3,389	4,236	5,648
Citation Sovereign	27,100	3,043	3,804	5,072	3,916	4,895	6,527
Gulfstream G280	32,700	3,129	3,911	5,215	3,599	4,499	5,998
Citation CJ3	12,750	3,216	4,020	5,360	4,372	5,465	7,287
Gulfstream G450	66,000	3,369	4,211	5,615	5,936	7,420	9,893
Citation (525A) CJ2	11,500	3,381	4,226	5,635	4,876	6,095	8,127
Canadair Challenger 601	36,000	3,463	4,329	5,772	4,155	5,194	6,925
Citation 560 XLS	18,700	3,624	4,530	6,040	5,752	7,190	9,587
Lear 60	19,500	3,758	4,698	6,263	5,081	6,351	8,468
Falcon 900EX	44,500	3,793	4,741	6,322	4,362	5,453	7,270
Citation X	31,800	4,112	5,140	6,853	5,857	7,321	9,762

Red figures are greater than 5,313 feet (published landing distance available for Runway 12 at ERV).
Runway length calculation assumptions: 1,616.8' MSL field elevation; 92.8°F ambient temperature; 0.26% runway grade
MLW = maximum landing weight
No Data = turboprop aircraft landing lengths are not adjusted for wet runway conditions

Source: UltraNav software

Runway Length Summary

Many factors were considered when determining appropriate runway length for safe and efficient operations of aircraft at ERV. The airport should strive to accommodate business jets and turboprop aircraft to the greatest extent possible, as demand dictates. Primary Runway 12-30 is currently 6,004 feet long. It should be noted that the airport's published declared distances reduce the available runway in certain takeoff and landing situations. (Declared distances are discussed in more detail in the Safety Area Design Standards section of this chapter.) For example, the published landing distance available (LDA) on Runway 12 is 5,313 feet and the LDA on Runway 30 is 5,300 feet, so the full 6,004-foot length of runway pavement is not usable in all operational situations.

The available Runway 12-30 length sufficiently meets the needs of all small aircraft and 75 percent of the business jet fleet operating at 60 percent useful loads. The Falcon 900 (critical aircraft) can operate at up to 80 percent useful load during takeoff but is restricted when landing at MLW while operating under Part 91k or Part 135, particularly during wet runway conditions.

The analysis shows additional length is needed to accommodate some of the larger and heavier business jets. Aside from the Citation Sovereign, no jet evaluated with a MTOW over 30,000 pounds can operate at 100 percent useful load. This classification of aircraft is projected for significant operational growth at ERV, as well as across the country. Furthermore, the published declared distances limit the utility of the runway pavement. The 687 feet of pavement prior to the Runway 12 displaced threshold can only be used for takeoff operations. For these reasons, the alternatives analysis will consider runway improvements, including shifting/extending the runway, so it can better meet the needs of jet aircraft and mitigate the need for declared distances.

Justification for any runway extension to meet the needs of turbine aircraft would require regular use (500 annual itinerant operations) by a representative aircraft or family of aircraft, which is the minimum threshold required to obtain FAA grant funding assistance. Alternatives (to be discussed in the next chapter) will analyze multiple options for a future potential runway extension.

As a crosswind runway designed to RDC A/B-I-5000 standards, Runway 3-21 should be planned to accommodate small aircraft. At 3,597 feet long, Runway 3-21 is 103 feet short of the FAA-recommended 3,700 feet to satisfy 95 percent of small aircraft with fewer than 10 passenger seats. This is a marginal deficiency and the supplemental runway length analysis shows the existing runway length can accommodate most Beechcraft King Air variants at up to 90 percent useful loads. The crosswind runway can also accommodate smaller business jets at 60 percent useful load. The existing length is sufficient to meet the needs of smaller aircraft that are more susceptible to crosswind conditions. As a result, an extension to Runway 3-21 will not be evaluated in the alternatives analysis.

Runway Width

Runways that meet RDC C-II-5000 standards should be 100 feet wide. Runway 12-30 meets this standard; therefore, no change to runway width is planned for the primary runway at ERV.

Runways that meet RDC A/B-I-5000 standards should be 60 feet wide. Runway 3-21 is 58 feet wide and falls short of this design standard. Historical information suggests the runway previously met the 60-foot width requirement but its width has since been reduced to 58 feet. A project to increase the width of the crosswind runway to 60 feet should be considered.

Pavement Strength

An important feature of airfield pavement is its ability to withstand repeated use by aircraft of varying weights. Runway 12-30 is currently rated at 22,400 pounds for single wheel aircraft (SWL) and 73,700 pounds for dual wheel aircraft (DWL). Runway 3-21 is rated at 15,000 pounds SWL and does not have a rating for DWL. The strength rating of a runway does not preclude aircraft that weigh more than the published strength rating from using the runway. 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 safely support the aircraft. An airport sponsor cannot restrict an aircraft from using the runway simply because its weight exceeds the published strength rating; however, the airport sponsor has an obligation to properly maintain and protect the useful life of the runway (typically for 20 years).

The strength rating of a runway can change over time. Regular usage by heavier aircraft can decrease the strength rating, while periodic runway resurfacing can increase the strength rating. The current runway strength rating for primary Runway 12-30 is adequate to accommodate most aircraft, including the critical aircraft, as the Falcon 900 has a MTOW of 49,200 pounds on dual wheel main landing gear;

however, as operations by larger/heavier aircraft increase over time, it may become beneficial to increase the pavement strength to a rating of 100,000 pounds DWL, which would accommodate some of the largest business jets in the national fleet, including the Gulfstream G650, which has a MTOW of 99,600 pounds.

The current strength rating of Runway 3-21 is adequate for small aircraft and should be maintained.

Blast Pads

Runway blast pads provide resistance to jet blast erosion beyond runway ends. Under existing C-II design standards, blast pads are not a design requirement; however, the construction of blast pads could be considered if the airport experiences significant erosion of soil adjacent to the runway ends due to increased jet traffic. The recommended blast pad dimensions are 150 feet long and 120 feet wide to meet C-II standards.

Runway 3-21 is not planned to accommodate regular jet operations; therefore, Runway 3-21 does not need blast pads.

SAFETY AREA DESIGN STANDARDS

The FAA has established several imaginary surfaces to protect aircraft operational areas and keep them free from obstructions, including the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (ROFZ), and runway protection zone (RPZ).

The entire RSA, ROFA, and ROFZ must be under the direct ownership of the airport sponsor to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel. RPZs should also be under airport ownership. Alternatives to outright ownership of the RPZ include purchasing aviation easements (acquiring control of designated airspace within the RPZ) or having sufficient land use control measures in place that ensure the RPZ remains free of incompatible development. The various airport safety areas and their dimensions (as sourced from FAA AC 150/5300-13B, *Airport Design*, Change 1) are presented graphically on **Exhibit 3B**.

Runway Safety Area

The RSA is defined in FAA AC 150/5300-13B, *Airport Design*, Change 1, as a "defined area surrounding the runway consisting of a prepared surface 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 critical aircraft and fire and rescue vehicles, and free of obstacles that are not fixed by navigational purpose (such as runway edge lights or approach lights).

The FAA places high significance on maintaining adequate RSAs at all airports. The FAA established the Runway Safety Area Program under Order 5200.8 (effective October 1, 1999). The Order states: "The objective of the Runway Safety Area Program is that all RSAs at federally obligated airports…shall conform to the standards contained in AC 150/5300-13B, Change 1, *Airport Design*, to the extent practicable." Each Regional Airports Division of the FAA is obligated to collect and maintain data on the RSAs for all runways and perform airport inspections.

For RDC C-II-5000 design standards on Runway 12-30, the FAA calls for the RSA to be 500 feet wide, extend 1,000 feet beyond the runway ends, and start 600 feet prior to the landing threshold. At these dimensions, the RSA extends beyond airport property north of the Runway 12 threshold and includes the localizer antenna, Al Mooney Road, and various terrain and vegetation obstructions; however, ERV has published declared distances for Runway 12-30, which are used to define the effective runway length for landing and takeoff when a standard RSA or ROFA cannot be achieved or when an RPZ needs to be relocated.

The four 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 the 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 the RSA/ROFA beyond the runway end and the positioning of the approach RPZ)

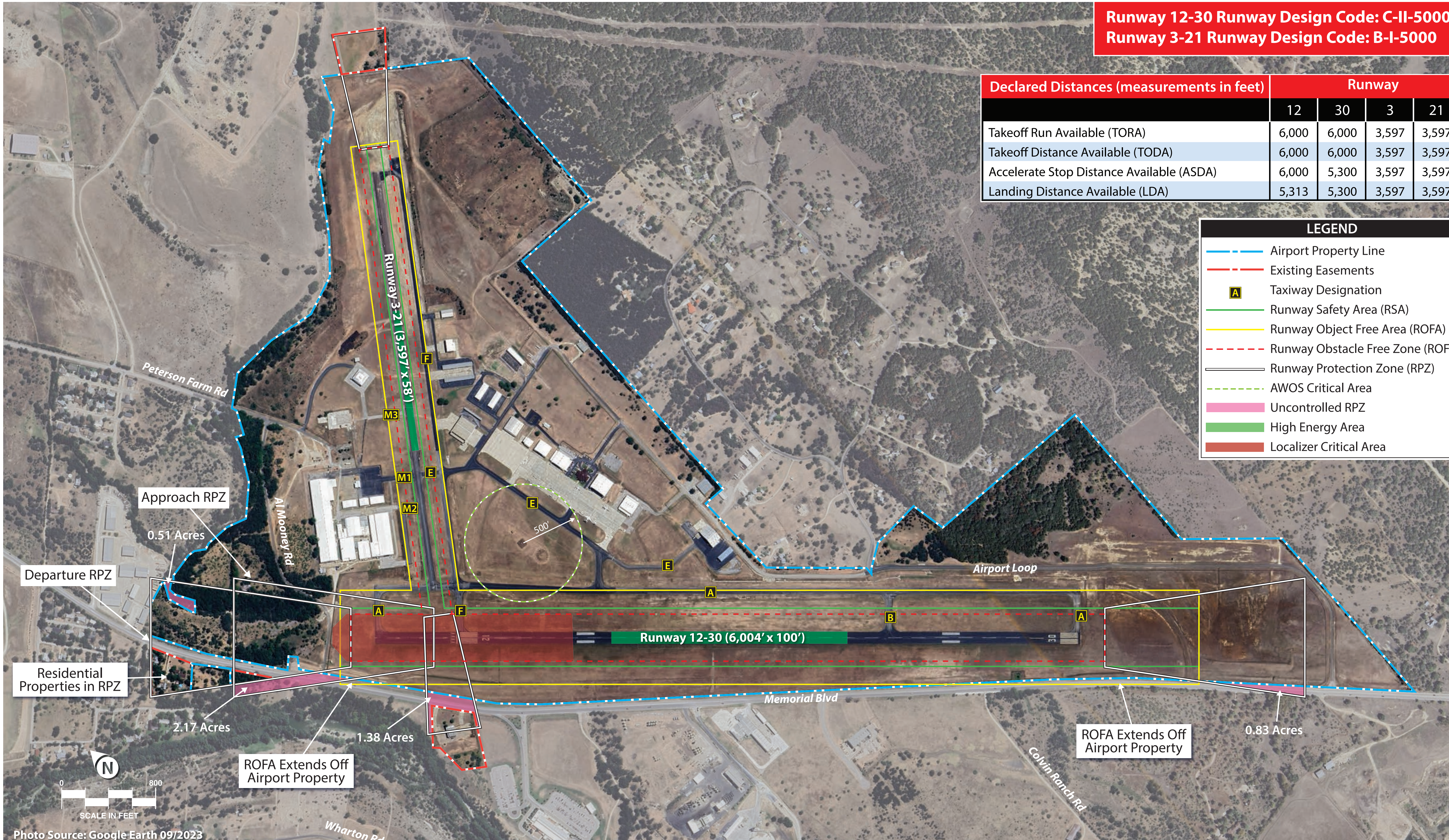
Because the RSA extends beyond airport property to the north of the Runway 12 threshold, ERV has applied an ASDA and LDA of 5,300 feet to Runway 30, which results in the RSA extending only 296 feet beyond the north end of the runway. To achieve the required 600-foot RSA prior to the landing threshold and ensure proper clearance of aircraft on approach over Al Mooney Road, as well as other potential obstructions, the Runway 12 threshold is displaced by 687 feet. As a result, the LDA for Runway 12 is reduced to 5,313 feet.

The Runway Length section concluded that additional runway length would benefit the airport and alternatives should be considered for mitigating the need to reduce runway utility through the published declared distances. As such, the runway alternatives in the next chapter will explore how Runway 12-30 can be improved to meet full RSA design standards without the need for declared distances.

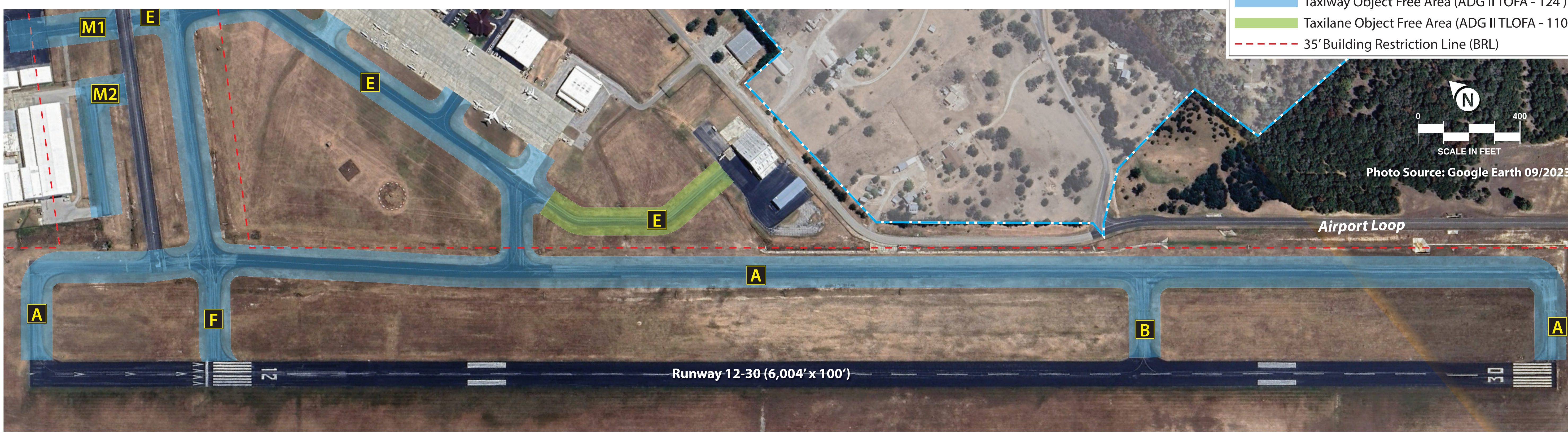
RDC A/B-I-5000 standards apply for the Runway 3-21 RSA, which call for the RSA to be 120 feet wide and extend 240 feet prior to and beyond the ends of each runway. There are no known obstructions or incompatibilities within the Runway 3-21 RSA.

Runway 12-30 Runway Design Code: C-II-5000
Runway 3-21 Runway Design Code: B-I-5000

Declared Distances (measurements in feet)	Runway 12	Runway 30	Runway 3	Runway 21
Takeoff Run Available (TORA)	6,000	6,000	3,597	3,597
Takeoff Distance Available (TODA)	6,000	6,000	3,597	3,597
Accelerate Stop Distance Available (ASDA)	6,000	5,300	3,597	3,597
Landing Distance Available (LDA)	5,313	5,300	3,597	3,597




N
0
400
SCALE IN FEET
Photo Source: Google Earth 09/2023
A
M2
M1
M3
Runway 3-21 (3,597' x 58')
E
F
F
12
LEGEND
Airport Property Line
Taxiway Designation
Taxiway Object Free Area (ADG II TOFA - 124')
Taxilane Object Free Area (ADG II TLOFA - 110')
35' Building Restriction Line (BRL)


M1
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SCALE IN FEET
Photo Source: Google Earth 09/2023
Airport Loop
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Runway 12-30 (6,004' x 100')
12
30

Runway Object Free Area

The ROFA is "a clear area limited to equipment necessary for air and ground navigation and provides wingtip protection in the event of an aircraft excursion from the runway." The ROFA is a two-dimensional ground area surrounding a runway, taxiways, and taxilanes that is clear of objects, except objects with locations that are fixed by function (e.g., airfield lighting). 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 ROFA is centered on the runway and extends out in accordance with the critical aircraft utilizing the runway.

The RDC C-II-5000 design standards associated with the Runway 12-30 ROFA call for the ROFA to be 500 feet wide and extend 1,000 feet beyond the runway ends. Like the RSA, the ROFA on the north end of the runway has been reduced through the publishing of declared distances to extend 296 feet beyond the end of the runway, which mitigates the localizer antenna, perimeter fencing, and Al Mooney Road from obstructing the ROFA. Additional incompatibilities include portions of the ROFA that extend beyond airport property along the west boundary with Texas Highway 27 (Memorial Boulevard). The ground profile slopes down from the runway to the highway, particularly on the south end of the runway; however, the ROFA should be under the control of the airport sponsor, when possible, and vehicles traveling on the road likely penetrate the ROFA surface on the northern portion.

The previous master plan identified the same ROFA incompatibility and noted that the FAA and TxDOT are aware of the non-standard condition. Due to the high cost of relocating either Runway 12-30 or Highway 27, the FAA/TxDOT accepted the deficiency as a minor modification to standard, allowing the condition to remain.

For Runway 3-21, FAA standards call for the ROFA to be 250 feet wide and extend 240 feet prior to and beyond the ends of the runway. There are no known obstructions or incompatibilities within the Runway 3-21 ROFA.

Runway Obstacle Free Zone

The ROFZ is an imaginary surface that precludes object penetrations, including taxiing and parked aircraft. The only allowance for ROFZ obstructions is navigational aids mounted on frangible bases that 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 the approach minimums could be increased.

For all runways serving aircraft over 12,500 pounds, the ROFZ is 400 feet wide, centered on the runway, and extends 200 feet beyond the runway ends. This standard applies to Runway 12-30 at ERV. There are no known obstructions or incompatibilities within the Runway 12-30 ROFZ.

Runway 3-21 is designed to accommodate small aircraft under 12,500 pounds but with approach speeds greater than or equal to 50 knots. The Runway 3-21 ROFZ measures 250 feet wide and extends 200 feet beyond the runway ends. There are no known obstructions or incompatibilities within the Runway 3-21 ROFZ.

Runway Protection Zone

An RPZ is a trapezoidal area centered on the extended runway centerline beginning 200 feet from the end of the runway. This safety area is established to protect the end of the runway from airspace penetrations and incompatible land uses. The RPZ dimensions are based on the established RDC and the approach visibility minimums serving the runway. While the RPZ is intended to be clear of incompatible objects or land uses, some land uses are permitted with conditions and other land uses are prohibited. According to AC 150/5300-13B, Change 1, the following land uses are permissible within the RPZ:

- Farming that meets the minimum buffer requirements
- Irrigation channels, as long as they do not attract birds
- 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 requirements, as applicable
- Unstaffed navigational aids (NAVAIDs) and facilities, such as those required for airport facilities that are fixed by function regarding the RPZ
- Aboveground fuel tanks associated with backup generators for unstaffed NAVAIDS

In September 2022, the FAA published AC 150/5190-4B, *Airport Land Use Compatibility Planning*, which states that airport owner control over RPZs is preferred. Airport owner control over RPZs may be achieved through the following methods:

- Ownership of the RPZ property in fee simple
- Possessing sufficient interest in the RPZ property through easements, deed restrictions, etc.
- Possessing sufficient land use control authority to regulate land use in the jurisdiction that contains the RPZ
- Possessing and exercising the power of eminent domain over the property
- Possessing and exercising permitting authority over proponents of development within the RPZ (e.g., where the sponsor is a state)

AC 150/5190-4B further states that "control is preferably exercised through acquisition of sufficient property interest and includes clearing RPZ areas (and keeping them clear) of objects and activities that would impact the safety of people and property on the ground." The FAA recognizes that land ownership, environmental, geographical, and other considerations can complicate land use compatibility within RPZs; regardless, airport sponsors must comply with FAA grant assurances, including (but not limited to) Grant Assurance 21, *Compatible Land Use*. Sponsors are expected to take appropriate measures to "protect against, remove, or mitigate land uses that introduce incompatible development within RPZs."

For a proposed project that would shift an RPZ into an area with existing incompatible land uses, such as a runway extension or the construction of a new runway, the sponsor is expected to have or secure sufficient control of the RPZ, ideally through fee simple ownership. Where existing incompatible land uses are present, the FAA expects sponsors to "seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses" through acquisition, land exchanges, right-of-first refusal to purchase, agreement with property owners on land uses, easements, or other such measures. These efforts should be revisited during master plan or ALP updates, and periodically thereafter, and should be documented to demonstrate compliance with FAA grant assurances. If a new or proposed incompatible land use impacts an RPZ, the FAA expects the airport to take the above actions to control the property within the RPZ and adopt a strong public stance opposing the incompatible land use.

For a new incompatible land use that results from a sponsor-proposed action (e.g., an airfield project like a runway extension, a change in the critical aircraft that increases the RPZ dimension, or lower minimums that increase the RPZ dimension), the airport sponsor is expected to conduct an alternatives evaluation. The intent of the alternatives evaluation is to "proactively identify a full range of alternatives and prepare a sufficient evaluation to be able to draw a conclusion about what is 'appropriate and reasonable'." For incompatible development off-airport, the sponsor should coordinate with the FAA Airports District Office (ADO) as soon as the sponsor learns of the development, and the alternatives evaluation should be conducted within 30 days of the sponsor's first awareness of the development within the RPZ. The following items are typically necessary in an alternatives evaluation:

- Sponsor's statement of the purpose and need of the proposed action (airport project, land use change, or development)
- Identification of any other interested parties and proponents
- Identification of any federal, state, and/or local transportation agencies involved
- Analysis of sponsor control of the land within the RPZ
- Summary of all alternatives considered, including the following:
    - Alternatives that preclude introducing the incompatible land use within the RPZ (e.g., zoning action, purchase, and design alternatives, such as implementation of declared distances or displaced thresholds, runway shift or shortening, raising minimums, etc.)
    - Alternatives that minimize the impact of the land use in the RPZ (e.g., rerouting a new roadway through less of the RPZ, etc.)
    - Alternatives that mitigate risk to people and property on the ground (e.g., tunnelling, depressing, and/or protecting a roadway through the RPZ, implementing operational measures to mitigate any risks, etc.)
- Narrative discussion and exhibits or figures depicting the alternative
- Rough order of magnitude cost estimates associated with each alternative, regardless of potential funding sources
- Practicability assessment based on the feasibility of the alternative in terms of constructability, cost, operational impacts, and other factors

Once the alternatives evaluation has been submitted to the ADO, the FAA will determine whether the sponsor has made an adequate effort to pursue and consider appropriate and reasonable alternatives.

The FAA will not approve or disapprove the airport sponsor's preferred alternative; rather, the FAA will evaluate whether an acceptable level of alternatives analysis has been completed before the sponsor makes the decision to allow or disallow the proposed land use within the RPZ.

In summary, the RPZ guidance published in September 2022 shifts the responsibility of protecting the RPZ to the airport sponsor. The airport sponsor is expected to take action to control the RPZ or demonstrate that appropriate actions have been taken. The decision to permit or disallow existing or new incompatible land uses within an RPZ is ultimately up to the airport sponsor, with the understanding that the sponsor still has grant assurance obligations, and the FAA retains the authority to review and approve or disapprove portions of the ALP that would adversely impact the safety of people and property within the RPZ.

RPZs have been further designated as approach and departure RPZs. The approach RPZ is a function of the AAC and approach visibility minimums associated with the approach runway end. The departure RPZ is a function of the AAC and departure procedures associated with the runway. For a particular runway end, the more stringent RPZ requirements (usually associated with the approach RPZ) will govern the property interests and clearing requirements the airport sponsor should pursue.

The approach and departure RPZs associated with the ends of Runway 12-30 are 500 feet wide at the inner portion, 1,010 feet wide at the outer portion, and 1,700 feet long. The approach and departure RPZs for Runway 30 coincide but are separate for Runway 12 because it has a 687-foot displaced threshold. The location of each RPZ is depicted on **Exhibit 3B**. The airport has undertaken projects to acquire properties and avigation easements to protect the Runway 12 RPZs, including acquisition of land on the northwest side of Memorial Boulevard; some of this land contains residential properties, which are considered an incompatible land use within the RPZ. Approximately 3.51 acres of the Runway 12 and 30 approach and departure RPZs are not owned by the airport or are uncontrolled by avigation easements.

Because Runway 3-21 is planned to accommodate small aircraft, its RPZs have an inner width of 250 feet, an outer width of 450 feet, and a length of 1,000 feet. The Runway 3 RPZ is protected by a combination of airport-owned property and avigation easements. The Runway 21 RPZ extends over Memorial Boulevard and a small building west of the road. Most of this area is protected by an avigation easement; however, approximately 1.38 acres of the Runway 21 RPZ are uncontrolled, most of which are part of the Memorial Boulevard right-of-way. While public roads are considered incompatible with RPZs, they can be grandfathered if no other changes (e.g., extensions, improved instrument approach capabilities, etc.) are made to the runway.

The alternatives analysis will consider options to mitigate RPZ incompatibilities and allow the airport to establish full control over the RPZs.

SEPARATION STANDARDS

Several other standards are related to separation distances from runways and taxiways. Each is designed to enhance the safety of the airfield.

Runway/Taxiway Separation

The C-II design standard is 300 feet for the separation between a runway with not lower than ¾-mile visibility minimums and parallel taxiways. The existing separation between Runway 12-30 and Taxiway A is 400 feet at its nearest point. This distance meets the separation standard for C-II runways with instrument approach visibility minimums below ¾-mile and should be maintained.

The A/B-I (small aircraft) runway/taxiway separation standard is 150 feet. Parallel Taxiway F is separated from the Runway 3-21 centerline by 200 feet, which exceeds the design standard. The existing runway/taxiway separation for Runway 3-21 should be maintained.

Hold Line Position Separation

Hold line position markings are placed on taxiways leading to runways. Pilots are instructed to stop short of the holding position marking line to visually confirm that the runway environment is clear of traffic. The existing and ultimate design standards for Runway 12-30 call for holding positions to be separated from the runway centerline by 250 feet. The existing hold lines associated with Runway 12-30 are situated at the standard 250-foot separation distance and should be maintained.

The existing and ultimate design standards for Runway 3-21 call for holding positions to be separated from the runway centerline by 125 feet. The existing hold lines associated with Runway 3-21 are situated at the standard 125-foot separation distance and should be maintained.

Aircraft Parking Area Separation

According to FAA AC 150/5300-13B, Change 1, aircraft parking positions should be located to ensure aircraft components (wings, tail, and fuselage) do not:

1. Conflict with the object free area for the adjacent runway or taxiways:

    a. Runway object free area (ROFA)
    b. Taxiway object free area (TOFA)
    c. Taxilane object free area (TLOFA)

Or

2. Violate any of the following aeronautical surfaces and areas:

    a. Runway approach or departure surface
    b. Runway visibility zone (RVZ)
    c. Runway obstacle free zone (ROFZ)
    d. Navigational aid equipment critical areas

As shown on **Exhibit 3B**, there are no existing conflicts between the aircraft parking areas at ERV and the safety areas or aeronautical surfaces listed above.

TAXIWAYS

The design standards associated with taxiways are determined by the taxiway design group (TDG) or airplane design group (ADG) of the airport's critical aircraft. As previously determined, ADG II standards apply to primary Runway 12-30 and ADG I standards apply to Runway 3-21. **Table 3J** presents the various taxiway design standards related to both ADG I and II. The table also shows the taxiway design standards related to TDG. The TDG standards are based on the main gear width (MGW) and cockpit to main gear (CMG) distance of the critical aircraft expected to use those taxiways. Different taxiway and taxilane pavements can and should be planned to the most appropriate TDG design standards, based on usage.

TABLE 3J | Taxiway Dimensions and Standards

STANDARDS BASED ON WINGSPAN	ADG I	ADG II
Taxiway and Taxilane Protection		
Taxiway Safety Area Width (TSA)	49'	79'
Taxiway Object Free Area Width (TOFA)	89'	124'
Taxilane Object Free Area Width (TLOFA)	79'	110'
Taxiway and Taxilane Separation		
Taxiway Centerline to Parallel Taxiway Centerline	70'	101.5'
Taxiway Centerline to Fixed or Moveable Object	44.5'	62'
Taxilane Centerline to Parallel Taxilane Centerline	64'	94.5'
Taxilane Centerline to Fixed or Moveable Object	39.5'	55'
Wingtip Clearance		
Taxiway Wingtip Clearance	20'	22.5'
Taxilane Wingtip Clearance	15'	15.5'
STANDARDS BASED ON TDG	**TDG 1A/B**	**TDG 2A/B**
Taxiway Width Standard	25'	35'
Taxiway Edge Safety Margin	5'	7.5'
Taxiway Shoulder Width	10'	15'

All dimensions are in feet.
ADG = airplane design group
TDG = taxiway design group

Source: FAA AC 150/5300-13B, Airport Design, Change 1

The current design standard for all taxiways at ERV is TDG 2A, which dictates a width of 35 feet. Taxiways A and B are currently 50 feet wide and Taxiways E and F are 40 feet wide. Taxiway M1 is 40 feet wide, Taxiway M2 is 75 feet wide, and Taxiway M3 is 25 feet wide. For taxiways that exceed the current design standard, TxDOT and/or the FAA may elect not to fund regular pavement maintenance for the portions of taxiway pavement that exceed the standard. If the airport chooses to maintain the taxiways at their current widths, the costs may need to come from a local funding source, rather than federal or state grant monies. Certain portions of the landside area that are utilized exclusively by small aircraft should adhere to TDG 1A/1B standards.

Taxiway and Taxilane Design Considerations

FAA AC 150/5300-13B, *Airport Design*, Change 1, provides guidance on recommended taxiway and taxilane layouts to enhance safety by avoiding runway incursions. 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 FAA's taxiway design guidelines and the basic rationale behind each recommendation included in the current AC, as well as previous FAA safety and design recommendations.

1. *Taxiing Method*: Taxiways are designed for cockpit-over-centerline taxiing with pavement that is wide enough to allow a certain amount of wander. On turns, sufficient pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, existing intersections should be upgraded 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. *Curve Design*: 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-Path Concept*: To maintain pilot situational awareness, taxiway intersections should provide a pilot with a maximum of three choices of travel. Ideally, these are right, left, and a continuation straight ahead.

4. *Channelized Taxiing*: To support visibility of airfield signage, taxiway intersections should be designed to meet standard taxiway width and fillet geometry.

5. *Designated Hot Spots and Runway Incursion Mitigation (RIM) Locations*: A hot spot is a location on the airfield with elevated risk of collisions or runway incursions. Mitigation measures should be prioritized for areas the FAA designates as hot spots or RIM locations. **ERV does not have any FAA-designated taxiway hot spots or RIM locations.**

6. *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.

7. *Runway Incursions*: Taxiways should be designed to reduce the probability of runway incursions.

    - *Increase Pilot Situational Awareness*: Pilots who know where they are on the airport are less likely to enter a runway improperly. Complexity leads to confusion. Taxiway systems should be kept simple by using the three-path 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 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 greater efficiency in runway usage but should not be used as runway entrance or crossing points. A right-angle turn at the end of a parallel taxiway is a clear indication of 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.

- *Avoid Direct 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.

- *Mitigate 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.

8. *Runway/Taxiway Intersections*:

    - *Right Angle*: Right-angle intersections are the standard for all runway/taxiway intersections, except where there is a need for an acute-angled 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 signage is 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. The construction of high-speed exits is typically only justified for runways that experience regular use by jet aircraft in approach categories C and above.

    - *Large Expanses of Pavement*: A taxiway 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, which make it difficult to provide proper signage, marking, and lighting.

9. *Taxiway/Runway/Apron Incursion Prevention*: Apron locations that allow direct access to a runway should be avoided. Taxiways should be designed in a manner that increases pilot situational awareness by forcing 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 because such large expanses of pavement may cause pilot confusion and can 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 or a no-taxi island 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.

The taxiway system at ERV generally provides for the efficient movement of aircraft, and there are no FAA-designated hot spots or RIM locations. There are no direct-access points, areas of wide and expansive pavement, or acute-angled connecting taxiways to the runways. Any new taxiways should continue to meet FAA standards for taxiway design to minimize runway incursion potential and improve efficiency.

Taxilane Design Considerations

Taxilanes are distinguished from taxiways in that they do not provide direct access to or from the runway system. Taxilanes typically provide access to hangar areas and can be planned to varying design standards, depending on the type(s) of aircraft that utilize the taxilane, as previously described.

NAVIGATIONAL AND APPROACH AIDS

Navigational aids are devices that provide pilots with guidance and position information when utilizing the runway system. Systems that provide electronic and visual guidance to arriving aircraft enhance the safety and capacity of the airfield. Such facilities are vital to the success of an airport and provide additional safety to pilots and 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.

Instrument Approach Aids

ERV has four published instrument approaches, including two area navigation (RNAV) global positioning system (GPS) instrument approaches to Runways 12 and 30, a localizer (LOC) non-precision approach to Runway 30, and a very high frequency omni-directional range (VOR)-based approach that provides circling-only approaches to any runway end at ERV. Each approach procedure provides for as low as one-mile visibility minimums.

Runway 3-21 does not have published straight-in instrument procedures and is planned to remain a visual or circling-only runway through the planning period. Implementation of straight-in procedures to either runway end is limited by rising terrain to the northeast and southwest of the runway.

Visual Approach Aids

In most instances, the landing phase of any flight must be conducted in visual conditions. Electronic visual approach aids are commonly used at airports to provide pilots with visual guidance information during landings on runways. Both ends of Runway 12-30 are currently equipped with four-box precision approach path indicator (PAPI-4) systems, which should be maintained through the planning period.

Runway end identifier lights (REIL) are flashing lights located at a runway threshold end that facilitate rapid identification of the runway end at night and during poor visibility conditions. REILs provide pilots with the ability to identify the runway thresholds and distinguish the runway end lighting from the other lighting on the airport and in the approach areas. The FAA indicates that REILs should be considered for all lighted runway ends not planned for more sophisticated approach lighting systems (ALS). Both ends of primary Runway 12-30 are equipped with REILs, which should be maintained through the planning period.

Both ends of Runway 3-21 are equipped with two-box precision approach path indicator (PAPI-2) systems, which are adequate for small aircraft. Runway 3-21 is not currently equipped with REILs. As noted above, the FAA recommends REILs be installed on all lighted runway ends not planned for a more sophisticated ALS; therefore, it is recommended that REILs be installed on both ends of Runway 3-21.

Weather Reporting Aids

ERV has a lighted wind cone and segmented circle, which are centrally located between the two runways. These aids provide information to pilots regarding wind speed and direction and should be maintained through the planning period. A segmented circle is often co-located with an airport's primary wind cone and is a system of visual indicators designed to provide traffic pattern information to pilots.

The airport is also equipped with an automated weather observation station (AWOS), which provides weather observations 24 hours per day. The system updates weather observations every minute, continuously reporting significant weather changes as they occur in real time. This information is transmitted via a designated radio frequency at regular intervals.

FAA siting criteria indicate that the AWOS should be located between 1,000 and 3,000 feet from the runway threshold and between 500 and 1,000 feet perpendicular to the runway centerline. The AWOS has a 500-foot radius critical area that must be kept free of obstructions that could interfere with its sensors.

The locations of the segmented circle, lighted wind cone, and AWOS equipment limit potential development in the core terminal/apron area. Consideration in the alternatives chapter will be given to relocating these facilities to allow for new landside developments.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

Several lighting and pavement marking aids serve pilots using the airport. These aids assist pilots in locating the airport and runway at night or in poor visibility conditions. They also serve aircraft navigating the airport environment on the ground when transitioning to/from aircraft parking areas to the runway.

Airport Identification Lighting | ERV's rotating beacon is located adjacent to the terminal building. The beacon should be maintained through the planning period.

Runway and Taxiway Lighting | Both runways are equipped with medium intensity runway lighting (MIRL) systems, which are adequate and should be maintained. The taxiway system is equipped with medium intensity taxiway edge lighting (MITL), which should also be maintained.

Airfield Signs | Airfield identification signs assist pilots in identifying their locations on the airfield and directing them to their desired locations. Lighted signs are installed on the runway and taxiway systems on the airfield. The signage system includes lighted runway and taxiway designations, as well as directional and mandatory instruction signage. All signs should be maintained through the planning period.

It should be noted that many airports are transitioning to light-emitting diode (LED) systems. LEDs have many advantages, including lower energy consumption, longer lifespan, increased durability, reduced size, greater reliability, and faster switching. While a larger initial investment is required up front, the energy savings and reduced maintenance costs outweigh any additional costs over time. When signage systems at ERV are upgraded or replaced, LED systems should be considered.

Pavement Markings | Runway markings are typically designed to the type(s) of instrument approach(es) available on a runway. FAA AC 150/5340-1K, *Standards for Airport Markings*, provides the guidance necessary to design airport markings. Runway 12-30 is equipped with non-precision markings and Runway 3-21 is equipped with basic markings. These markings are adequate for the available instrument approach capabilities and should be maintained.

A summary of the airside facilities at ERV is presented on **Exhibit 3C**.

LANDSIDE FACILITY REQUIREMENTS

Landside facilities are necessary for the handling of aircraft and passengers while on the ground. These facilities provide the essential interface between the air and ground transportation modes. The capacity of the various components of each element was examined in relation to projected demand to identify future landside facility needs. For ERV, this includes the following components for general aviation needs:

- General aviation terminal facilities and auto parking
- Aircraft storage hangars
- Aircraft parking aprons
- Airport support facilities

Projections made for aircraft storage hangars, aircraft parking aprons, and marked parking positions are based on the number of aircraft currently based and forecasted to base on the airport property through the 20-year planning horizon. Terminal facilities, auto parking, and other airport support facilities are based on the annual number of operations projected to occur over the planning period.

A summary of the overall general aviation landside facilities is presented on **Exhibit 3D**.

GENERAL AVIATION TERMINAL SERVICES

The general aviation terminal facilities at an airport often provide corporate officials and visitors with their first impressions of the community. General aviation terminal facilities at an airport can provide space for passenger waiting, a pilots' lounge, flight planning, concessions, management, storage, and many other needs. This space is not necessarily limited to a single, separate terminal building and can include space offered by fixed base operators (FBO) and other specialty operators for these functions and services. At ERV, general aviation terminal services are provided in the 5,000-square-foot (sf) general aviation terminal building. This facility was constructed in 2007, accommodates typical general aviation terminal services, and serves as a focal point for itinerant traffic at the airport.

The methodology used to estimate general aviation terminal facility needs was based on the number of airport users expected to utilize general aviation facilities during the design hour. This methodology is a general airport planning practice and is not considered exacting, as each airport terminal serves unique functions. The space requirements for terminal building facilities were based on providing 125 sf per design hour itinerant passenger. A multiplier of 2.5 in the short term, increasing to 3.0 in the long term, was also applied to terminal facility needs to better determine the number of passengers associated with each itinerant aircraft operation. This increasing multiplier indicates an expected increase in operations by larger aircraft through the planning period.

Table 3K outlines the space requirements for general aviation terminal services at ERV through the long-term planning period. The 5,000-sf general aviation terminal building is adequately sized for current operations levels; however, additional terminal space may become necessary as the levels of operations grow beyond the intermediate-term period. The alternatives in the next chapter will consider options for expansion of general aviation terminal services at ERV.

TABLE 3K | General Aviation Terminal Area Facilities

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need
Input Data				
General Aviation Itinerant Design Hour Operations	–	10	12	15
Passenger Multiplier	–	2.5	2.7	3.0
Design Hour Passengers	–	25	32	45
Terminal Service Space Requirements				
Space per Design Hour Passenger (sf)	–	125	125	125
Terminal Building Need (sf)	**5,000**	**3,125**	**4,000**	**5,625**
Terminal Vehicle Parking Requirements				
Terminal Visitor Vehicle Space Need	–	25	32	45
Based Aircraft Space Need	–	25	28	36
Total Terminal Visitor/Tenant Vehicle Parking	**81**	**50**	**60**	**81**
Red indicates a projected need that exceeds current capacity.				

Source: Coffman Associates analysis

General aviation vehicle parking demands have also been determined for ERV. Space determinations for passengers were based on an evaluation of existing airport use, as well as standards set forth to help calculate projected terminal facility needs. Currently, 35 marked individual vehicle spaces are provided at the general aviation terminal and an additional 46 spaces are available on an adjacent overflow lot, for a total of 81 supporting terminal services. Vehicle parking lot needs at the terminal building were determined based on a combination of the calculated design hour passengers and an estimated need to accommodate 25 percent of based aircraft owners/operators for each planning period. This analysis shows that the existing capacity adequately meets the long-term projected need. Proposed hangar layouts in the next chapter will include new dedicated vehicle parking to accommodate airport tenants and users throughout the landside areas.

	EXISTING	ULTIMATE
RUNWAY 12-30		
Runway Design Code (RDC)	C-II-5000	C-II-5000
Dimensions	6,004' x 100'	Consider Extension Alternatives
Pavement Strength	22,400 SWL; 73,700 DWL	Increase DWL Rating to 100,000 Pounds
Blast Pads	None	Add Blast Pads (120' x 150')
RSA	RSA with Declared Distances	Consider RSA Improvements with Runway Extension
ROFA	ROFA with Declared Distances and Modification to Standard	Maintain Modification to Standard; Improve with Runway Extension
ROFZ	Standard ROFZ	Maintain
RPZ	Residential Properties in RPZ and 3.51 Acres Uncontrolled	Consider Options to Remove Incompatibilities and Acquire Uncontrolled Properties
RUNWAY 3-21		
Runway Design Code (RDC)	A/B-I-5000	A/B-I-5000
Dimensions	3,597' x 58'	Increase Width to 60'
Pavement Strength	15,000 SWL	Maintain
Blast Pads	None	None
RSA	Standard RSA	Maintain
ROFA	Standard ROFA	Maintain
ROFZ	Standard ROFZ	Maintain
RPZ	Public Roadway in Runway 21 RPZ	Maintain (Roadway to be "Grandfathered")
TAXIWAYS		
Design Group	2A	Maintain
Parallel Taxiway	Taxiway A (12-30); Taxiway F (3-21)	Maintain
Parallel Taxiway Separation from Runway	400' (A); 200' (F)	Maintain
Widths	50' (A); 40' (F)	FAA/TXDOT Support up to 35'
Holding Position Separation	250' (A); 125' (F)	Maintain
Notable Conditions	No Non-Standard Airfield Geometry	Maintain
NAVIGATIONAL AND WEATHER AIDS		
Instrument Approaches	LPV GPS (12, 30); LOC (30); Visual/Circling Only (3-21)	Maintain
Weather Aids	AWOS, Wind Cone, Rotating Beacon, Segmented Circle	Relocate AWOS, Segmented Circle, Wind Cone
Approach Aids	PAPI-4 & REILs (12, 30); PAPI-2 (3, 21)	Add REILs to Runways 3, 21
LIGHTING AND MARKING		
Runway Lighting	MIRL (Both Runways)	Maintain
Runway Marking	Non-Precision (12-30); Basic (3-21)	Maintain
Taxiway Lighting	MITL	Maintain

KEY:

- **AWOS** - Automated Weather Observation Station
- **DWL** - Dual Wheel Loading
- **GPS** - Global Positioning System
- **LOC** - Localizer
- **LPV** - Localizer Performance with Vertical Guidance
- **MIRL** - Medium Intensity Runway Lighting
- **PAPI** - Precision Approach Path Indicator
- **RSA** - Runway Safety Area
- **REIL** - Runway End Identification Lights
- **ROFA** - Runway Object Free Area
- **ROFZ** - Runway Obstacle Free Zone
- **RPZ** - Runway Protection Zone
- **SWL** - Single Wheel Loading

Exhibit 3C
AIRSIDE FACILITY REQUIREMENTS

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	Available	Short Term	Intermediate Term	Long Term
Aircraft Storage Hangar Requirements				
Total Based Aircraft	88	100	113	145
Aircraft to be Hangared	88	100	113	145
T-Hangar Area (sf)	34,320	41,500	51,100	76,000
Box/Conventional Hangar Space (sf)	152,350	176,900	196,400	238,400
Manufacturing Hangars (sf)	248,500	248,500	248,500	248,500
Total Hangar Storage Area (sf)	435,170	466,900	496,000	562,900

	Available	Short Term	Intermediate Term	Long Term
Aircraft Parking Apron				
Transient GA Apron (sy)		41,500	46,800	58,900
Transient Jet Apron (sy)		2,200	4,300	5,400
Local Based Apron (sy)		5,300	5,800	8,500
Total Public Apron Area (sy)	32,200	49,000	56,900	72,800

	Available	Short Term	Intermediate Term	Long Term
General Aviation Terminal Facilities and Parking				
Building Space (sf)	5,000	3,125	4,000	5,625
Total Terminal Parking Spaces	81	50	60	81

	Available	Short Term	Intermediate Term	Long Term
Fuel Storage				
Jet A 14-Day Supply (gal.)	24,000	22,112	25,430	34,275
100LL 14-Day Supply (gal.)	15,000	2,785	3,130	3,874

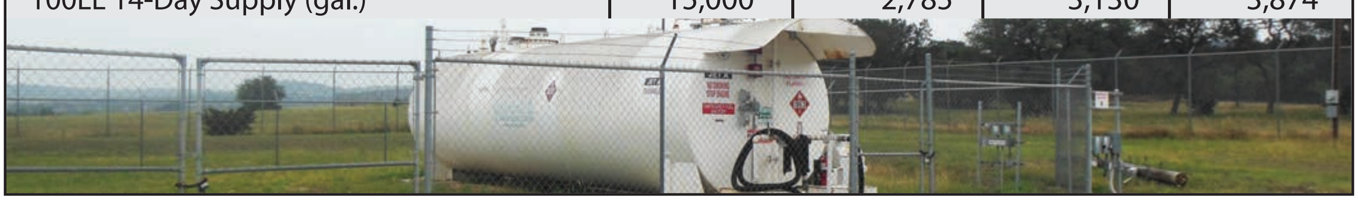

Exhibit 3D
LANDSIDE FACILITY REQUIREMENTS

AIRCRAFT HANGARS

Utilization of hangar space varies as a function of local climate, security, and owner preference. The trend in general aviation aircraft is toward more sophisticated (and, consequently, more expensive) aircraft; therefore, many aircraft owners prefer enclosed hangar space over outside tiedowns.

The demand for aircraft storage hangars is dependent on the number and type(s) 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 most aircraft owners prefer enclosed aircraft storage, some will still use outdoor tiedown spaces, usually due to lack of available hangar space, high hangar rental rates, or operational needs; therefore, enclosed hangar facilities do not necessarily need to be planned for each based aircraft.

Hangar types vary greatly in size and function. T-hangars are popular with aircraft owners who need to store individual private aircraft. These hangars typically provide individual spaces within a larger structure or in portable standalone buildings. There is approximately 34,320 sf of total T-hangar storage space, including 34 individual T-hangar storage units, at ERV. For determining future aircraft storage needs, it is assumed that owners of new single-engine, multi-engine, and other aircraft (ultralights, gliders, etc.) will prefer T-hangar storage space. Planning standards of 1,200 sf per single-engine piston and other aircraft and 1,500 sf per multi-engine piston aircraft are utilized for this hangar type.

Box and conventional hangars are open-space facilities with no interior supporting structures. Box hangars can vary in size from 1,500 and 2,500 sf to nearly 10,000 sf. They are typically able to house single-engine, multi-engine, turboprop, and jet aircraft, as well as helicopters. Conventional hangars provide for bulk aircraft storage and are often utilized by airport businesses, such as FBOs or aircraft maintenance operators. Conventional hangars are generally larger than executive box hangars and can range in size from 10,000 sf to more than 20,000 sf. There is approximately 120,025 sf of space for box and conventional hangars at ERV. The airport also has 248,500 sf of manufacturing hangar capacity (consisting of the Mooney hangar complex), which has been excluded from the total hangar capacity because it is not used for the storage of based aircraft. For future planning, standards of 3,000 sf per turboprop, 5,000 sf per jet, and 1,500 sf per helicopter are utilized for box and conventional hangars.

Future hangar requirements for the airport are summarized in **Table 3L**.

TABLE 3L | Aircraft Hangar Requirements

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need	Difference
Total Based Aircraft	**88**	**100**	**113**	**145**	**+57**
Hangar Area Requirements					
T-Hangar Area (sf)	34,320	41,500	51,100	76,000	+41,680
Box/Conventional Hangar Area (sf)	152,350	176,900	196,400	238,400	+86,050
Manufacturing Hangar Area (sf)	248,500	248,500	248,500	248,500	–
Total Hangar Area (sf)	**435,170**	**466,900**	**496,000**	**562,900**	**+127,730**

Red indicates a projected need that exceeds current capacity.

Source: Coffman Associates analysis

Because most based aircraft owners prefer enclosed hangar space, it is assumed that all based aircraft will occupy hangar spaces, as opposed to tying down on the apron. The analysis shows that future hangar requirements indicate a potential need for over 127,700 sf of new hangar storage capacity through the long-term planning period. This includes a mixture of hangar types; the largest need is projected in the box/conventional hangar category. Due to the projected increase in based aircraft, the existing demand for hangar space, annual general aviation operations, and hangar storage needs, facility planning will consider additional hangars at the airport. It is expected that the aircraft storage hangar requirements will continue to be met through a combination of hangar types.

It should be noted that hangar requirements are general in nature and are based on aviation demand forecasts. The actual need for hangar space will further depend on the usage within the hangars. For example, some hangars may be utilized entirely for non-aircraft storage, such as maintenance, but they have an aircraft storage capacity from a planning standpoint; therefore, the needs of an individual user may differ from the calculated space necessary.

AIRCRAFT PARKING APRONS

The aircraft parking apron is an expanse of paved area intended for aircraft parking and circulation. Typically, a main apron is centrally located near the airside entry point, such as the terminal building or FBO facility. Ideally, the main apron is large enough to accommodate transient airport users, as well as a portion of locally based aircraft. Smaller aprons are often available adjacent to specialty aviation service operator (SASO) hangars and at other locations around the airport. The apron layout at ERV generally follows this pattern: the main apron is adjacent to the terminal and the FBO facilities (Kerrville Aviation).

To determine future apron needs, the FAA-recommended planning criterion[1] of 755 square yards (sy) was used for ADG I aircraft (single-engine and multi-engine piston aircraft), while a planning criterion of 1,075 sy was used for larger ADG II aircraft (turboprops and jets). A parking apron should also provide space for locally based aircraft that require temporary tiedown storage. Locally based tiedowns are typically utilized by smaller single-engine aircraft; thus, a planning standard of 755 sy per position was utilized in the analysis.

The total apron parking requirements are presented in **Table 3M**. The existing apron pavement area at ERV encompasses approximately 32,200 sy. Using the planning standards described above and factoring in assumptions regarding operational and based aircraft growth, an additional 40,600 sy of aircraft parking apron pavement is estimated to be needed over the next 20 years.

[1] Per the FAA Apron Size Calculation Tool.

TABLE 3M | Aircraft Parking Apron Requirements

	Currently Available	Short-Term Need	Intermediate-Term Need	Long-Term Need	Difference
Aircraft Parking Positions					
Based/Local GA Aircraft	–	5	6	7	–
Transient GA Aircraft	–	55	62	78	–
Corporate Jet Aircraft	–	2	4	5	–
Helicopter	–	2	2	4	–
Total Parking Positions	**–**	**64**	**74**	**94**	**–**
Total Apron Area (square yards)	**32,200**	**49,000**	**56,900**	**72,800**	**+40,600**

Red indicates a projected need that exceeds current capacity.

Source: Coffman Associates analysis

SUPPORT FACILITIES

Various other landside facilities that support overall airport operations have also been identified. These support facilities include the following:

- Aviation fuel storage
- Perimeter fencing and gates

Aviation Fuel Storage

The airport's fuel storage capacity consists of two 12,000-gallon Jet A aboveground fuel storage tanks, one 10,000-gallon 100LL fuel storage tank, and one 5,000-gallon self-service 100LL fuel storage tank. Each storage tank is owned by the airport and leased to fuel service providers at the airport.

Fuel flowage from the FBO averaged approximately 497,218 gallons of Jet A fuel over a three-year period from 2021 to 2023. Over the same period, 100LL fuel flowage averaged approximately 62,571 gallons. Current usage data represent the full 2023 calendar year, during which fuel flowage was above average (510,201 gallons of Jet A fuel and 70,411 gallons of 100LL fuel). Utilizing the FAA's TFMSC data, turbine operations for 2024 totaled 3,450 at ERV. Of the 44,874 total base year operations for this master plan, 41,424 were conducted by piston-powered aircraft. As such, it is estimated that 144 gallons of Jet A fuel were pumped per turbine operation, while approximately 1.51 gallons of 100LL fuel were pumped per piston operation.

Maintaining a 14-day fuel supply would allow the airport to limit the impact of a disruption of fuel delivery. The airport currently has enough static fuel storage to meet the 14-day supply criteria for 100LL fuel through the long-term horizon. The forecasted fuel storage requirements summarized in **Table 3N** show a need for additional Jet A fuel storage capacity by the intermediate-term horizon.

Fuel storage requirements are typically based on keeping a two-week supply of fuel during an average month; however, more frequent deliveries can reduce the fuel storage capacity requirements. If demand warrants, the airport could begin ordering fuel on a weekly basis to meet demand until additional storage capacity can be added. Generally, a fuel tank should be of adequate capacity to accept a full refueling tanker (approximately 8,000 gallons) while maintaining a reasonable level of fuel in the storage tank.

TABLE 3N | Fuel Storage Requirements

	Capacity	2023 Flowage Summary	PLANNING HORIZON		
			Short Term	Intermediate Term	Long Term
AvGas (100LL)					
Daily Usage (gal.)	15,000	193	199	224	277
14-Day Supply (gal.)		2,708	2,785	3,130	3,874
Annual Usage (gal.)		70,411	72,600	81,600	101,000
Jet A					
Daily Usage (gal.)	24,000	1,398	1,579	1,816	2,448
14-Day Supply (gal.)		19,623	22,112	25,430	34,275
Annual Usage (gal.)		510,201	576,500	663,000	893,600
Red indicates a projected need that exceeds current capacity.					

Sources: Historical fuel flowage data provided by airport administration; fuel supply projections prepared by Coffman Associates

Future aircraft demand experienced by the FBO will determine the need for additional fuel storage capacity. It is important that airport personnel work with the FBO to plan for adequate levels of fuel storage capacity through the long-term planning period of this study.

Planning should consider an additional tank to store unleaded aviation fuel (100UL). The FAA has recently approved the use of 100UL fuel in piston-powered aircraft, although unknowns regarding production, infrastructure, and distribution remain; nevertheless, the alternatives will include placeholders for these facilities.

Perimeter Fencing and Gates

Perimeter fencing is used at airports primarily to secure the aircraft operations area. The physical barrier of perimeter fencing:

- Gives notice of the legal boundary of the outermost limits of the facility or security-sensitive areas;
- 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 the aircraft operations area on the airport;
- Creates a psychological deterrent;
- Demonstrates a corporate concern for facilities; and
- Limits inadvertent access to the aircraft operations area by wildlife.

ERV is equipped with 10-foot wildlife fencing that includes three-strand barbed wire on top. Secured access gates are equipped with electronic gate codes. All fencing and coded gates should be maintained through the planning period and should be regularly inspected to ensure they are functioning properly and are undamaged. As new facilities are developed on the airport, it may be necessary to modify or expand the perimeter fencing.

SUMMARY

This chapter outlines the safety design standards and facilities required to meet the potential aviation demand projected at ERV for the next 20 years. To provide a more flexible master plan, the yearly forecasts from Chapter Two have been converted to planning horizon levels. The short term roughly corresponds to a five-year period, the intermediate term is approximately 10 years, and the long term is 20 years. By utilizing planning horizons, airport management can focus on demand indicators for initiating projects and grant requests, rather than on specific dates in the future.

In Chapter Four, potential improvements to the airside and landside systems will be examined through a series of airport development alternatives. Most of the alternatives discussion will focus on capital improvements that would be eligible for federal and state grant funds. Ultimately, an overall airport development plan that presents a vision beyond the 20-year scope of this master plan will be developed.