Missoula MONTANA AIRPORT

CHAPTER THREE:

FACILITY REQUIREMENTS

3.1 Introduction

The previous chapter forecasted the levels of aviation demand that could reasonably be expected to occur at Missoula Montana Airport (MSO) through the planning period (2042). This chapter will assess whether the existing facilities are adequate to meet that demand. This chapter will also identify what types and quantities of new facilities may be required as well as establish a time frame for when these facilities may be needed to accommodate the future demand. Further, an extensive analysis will be conducted to ensure that all airside facilities meet current FAA design standards and, if necessary, a list of all deviations from the current standards will be provided.

The FAA outlines the essential facilities into the following categories:

- Runways
- Taxiways
- Navigational Aids
- Aprons
- Terminal Building and Associated Facilities
- Airport Access and Automobile Parking
- Airport Support Facilities

This chapter will provide a complete assessment of these facilities at MSO.

In this chapter, requirements for new facilities will be expressed in Planning Horizon Activity Levels rather than in years. This is because the need to develop facilities is determined by demand, rather than a point in time. Activity levels for short, intermediate and long-term planning horizons roughly correlate to five-year, ten-year, and twenty-year time frames in the forecasts. Future facility needs will be tied to these activity levels rather than a specific year in order to retain flexibility in the plan. **Table 3-1** summarizes the activity levels that define the planning horizons used in the remainder of this master plan.

Table 3-1: Planning Horizon Activity Levels

	Short Term Planning Horizon (2027)	Intermediate Term Planning Horizon (2032)	Long Term Planning Horizon (2042)
Enplanements	532,559	629,540	762,774
Based Aircraft	184	199	230
Annual Operations	48,863	52,121	59,231

3.2 Demand / Capacity Analysis

Based on the forecasts from Chapter 2, it is expected that within 20 years, the airport is likely to provide service for over 59,000 operations per year. Future development at the airport within this time frame will be necessary to accommodate this future demand. The next step in the Demand / Capacity Analysis is to determine the current capacity of the airfield.

The principal guidance for the analysis of airfield capacity is FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*. There are two key measurements of airfield capacity that assist planners in evaluating the adequacy of airfield facilities – hourly capacity and Annual Service Volume (ASV).

Hourly capacity considers the throughput during a typical busy hour. Factors such as percentage of arrivals, runway crossings, and taxiway exit locations are considered to arrive at an hourly number of aircraft that can use the airfield without undue delays.

Annual Service Volume (ASV) is an estimate of the number of aircraft operations that can be accommodated in one year. This measure is used to program additional runways, and/or modified taxiway exits. Airfield capacity improvements are typically programmed when actual annual operations reach 60 percent of ASV and constructed when operations reach 80 percent of ASV.

This approach utilizes the projections of annual operations by the specified fleet mix as projected in the Aviation Activity Forecasts. It considers a variety of factors including airfield layout, meteorological conditions, runway conditions, runway use, aircraft mix, percent arrivals, percent touch-and-go's, and exit taxiway locations.

Weather also plays a key role in determining hourly capacity. When weather conditions are such that there are low clouds and/or reduced visibility, arriving and departing aircraft operate under different flight rules. The conditions for each set of rules are listed below:

Visual Flight Rules (VFR)
Conditions necessary to operate under VFR are a cloud ceiling that is equal to or greater than 1,000 feet above the ground level (AGL) and the visibility is equal to or greater than 3 statute miles. This does not cover every situation, but these are the most common criteria used at most commercial service airports with instrument approaches.

Instrument Flight Rules (IFR)
Conditions requiring operation under IFR are complicated, but in general are conditions that do not qualify as VFR. Weather that is worse than the minimum requirements for instrument approach procedures at an airport will preclude any operation at the airport and can cause cancellations or diversions to other airports. These conditions vary by operation type, type of aircraft, and aircraft equipment.

When operating in VFR conditions, pilots are responsible for the separation of their aircraft from other aircraft and obstacles. However, when IFR operations are required, Air Traffic Control is responsible for the separation of aircraft and obstacle clearance. This is done through the use of RADAR, where available, and through the use of Standard Instrument Procedures. Large margins are built into the system, which is what limits the capacity in the airspace surrounding the airport, as well as the hourly capacity of the airfield.

3.2.1 Airfield Capacity

The airport's ASV and hourly capacity are calculated using the methodology documented in FAA AC 150/5060-5 *Airport Capacity and Delay*. Calculation in this method requires the mix index and runway use configuration. The mix index is an equation (C+3D) that determines the percentage of aircraft operations that have a Maximum Takeoff Weight (MTOW) over 12,500 pounds. C represents the percent of aircraft over 12,500 but under 300,000 pounds. D represents the percent of aircraft over 300,000 pounds.

MSO currently does not have regular operations by aircraft with a certified takeoff weight over 300,000 pounds and these aircraft are not expected to regularly utilize the airport over the planning period. The mix index is, then, the percentage of Class C aircraft that use the airport. Typically, a higher mix index results in a greater separation between aircraft, therefore lessening the overall airfield capacity. **Table 3-2** shows the VFR mix index for MSO based on tower operations counts and TFMSC data for 2022. Based on the forecast fleet mix, MSO's fleet mix index of 45 is calculated as follows:

Table 3-2: VFR Mix Index

2022 Operations (>12,500 lbs)*	20,064
Total MSO Operations 2022**	44,899
C	45%
D	0%
Mix index (C+3D)	45%

* TFMSC Counts
** Tower Counts

In IFR conditions, the mix index is assumed to be 100% C aircraft with no aircraft weighing less than 12,500 pounds operating in IFR conditions.

Runway Configuration

MSO has a two runway system. Runway 12-30 serves as the primary runway, principally because of its orientation with respect to the prevailing winds, length, strength, and navigational aids. Runway 8-26 serves as a crosswind runway for small "utility" aircraft weighing less than 12,500 pounds. Crosswind Runway 8-26 was not included in capacity calculations given its short length and the understanding that any traffic utilizing the crosswind runway would delay traffic on the main runway, thereby reducing the capacity of Runway 12-30.

The runway use configuration for MSO is number 1 from Chapter 3 of AC 150/5060-5 shown in Figure 3-2 of the advisory circular and **Figure 3-1** below.

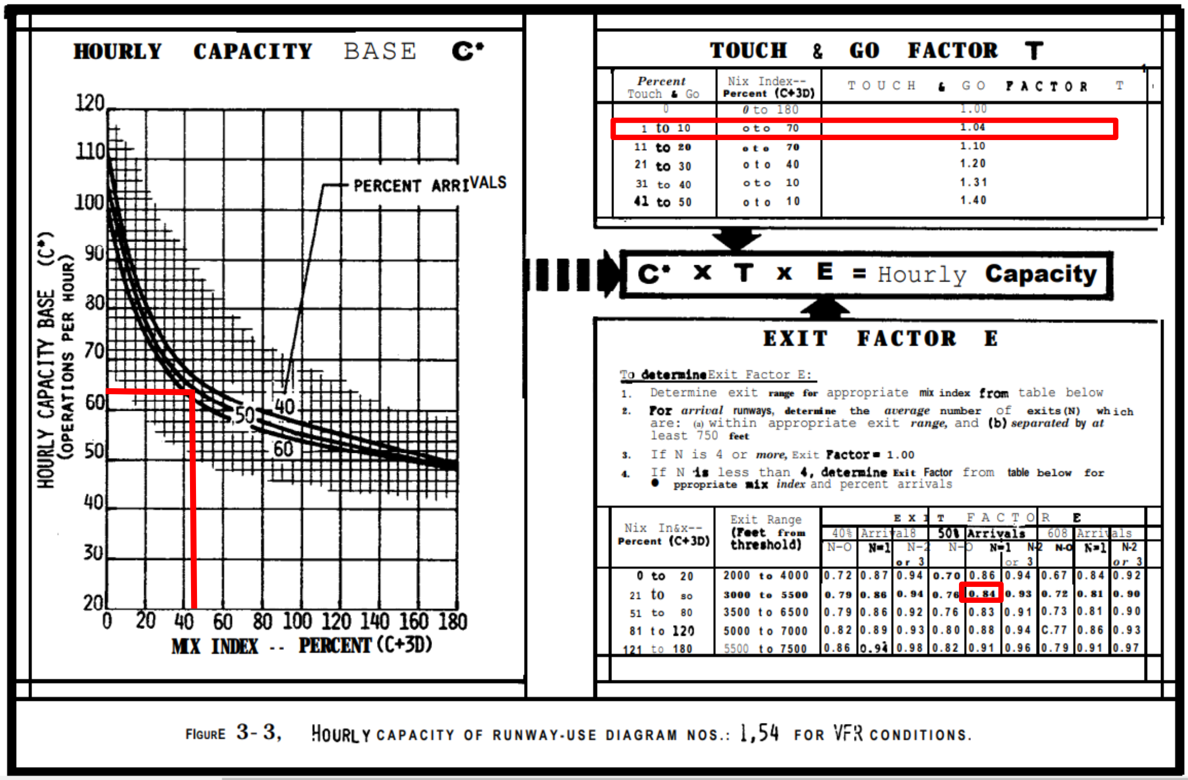
Figure 3-1: Runway Configuration – Capacity and Delay AC 150/5060-5

Runway-Use Diagram	Diag. No.	Runway Spacing in Feet	Figure No.			
			For Capacity		For Delay	
			VFR	IFR	VFR	IFR
	1	NA	3-3	3-43	3-71	3-90

Source: Figure 3-2 AC 150/5060-5

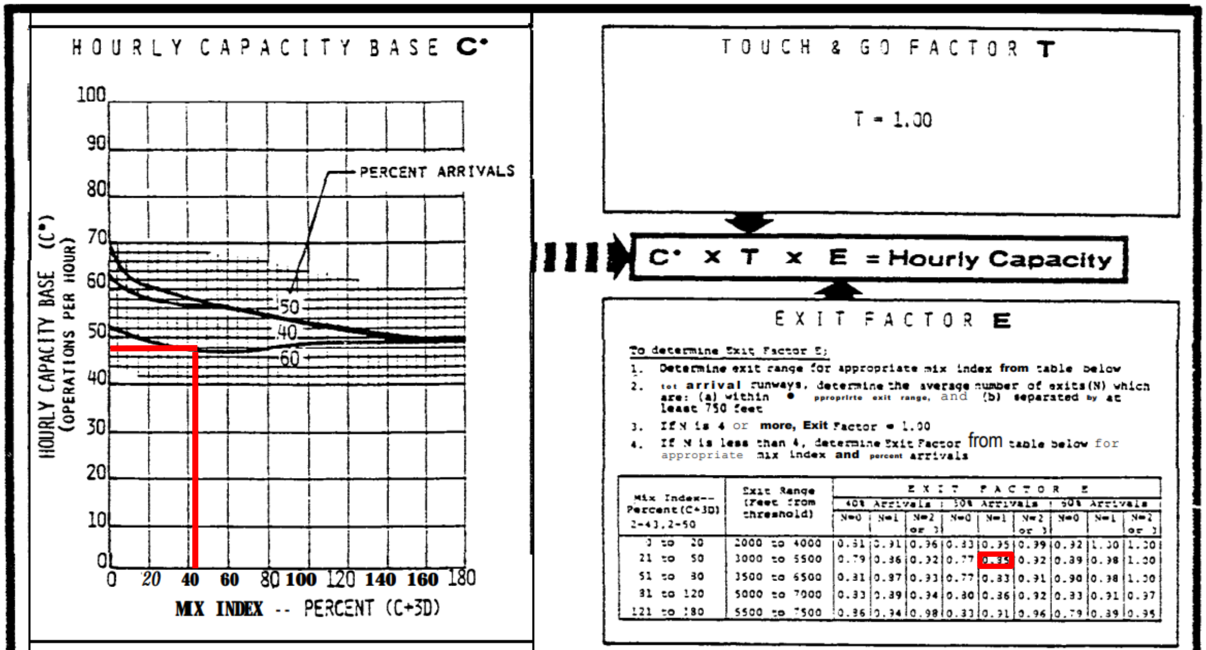
Hourly Capacity

VFR hourly capacity was calculated using Figure 3-3 from the AC and IFR hourly capacity was calculated using Figure 3-43 as indicated in the runway configuration chart. The output was 135 operations per hour (OPH) for VFR conditions and 44 OPH for IFR conditions as depicted in **Figure 3-2** and **Figure 3-3**.



C X T X E = Hourly Capacity
44 X 1.04 X 0.84 = 56

Figure 3-2: Hourly Capacity of Runway Use – VFR Conditions



Mix Index--Percent (C+3D) 2-43, 2-50	Exit Range (Feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.81	0.91	0.96	0.83	0.95	0.99	0.92	1.00	1.00
21 to 50	3000 to 5500	0.79	0.86	0.92	0.77	0.85	0.92	0.89	0.98	1.00
51 to 80	3500 to 6500	0.81	0.87	0.93	0.77	0.83	0.91	0.90	0.98	1.00
81 to 120	5000 to 7000	0.83	0.89	0.94	0.80	0.86	0.92	0.83	0.91	0.97
121 to 180	5500 to 7500	0.86	0.94	0.98	0.83	0.91	0.96	0.79	0.89	0.95

FIGURE 3-43. HOURLY CAPACITY OF RUNWAY-USE DIAGRAM **NOS.** 1, **54** FOR IFR CONDITIONS.

C X T X E = Hourly Capacity
46 X 1.00 X 0.85 = 39

Figure 3-3: Hourly Capacity of Runway Use – IFR Conditions

The weighted hourly service volume (Cw) models hourly capacity taking into account the percent of time each meteorological condition occurs and is modeled by the equation:

$$Cw = \frac{(P1 * C1 * W1) + (P2 * C2 * W2)}{(P1 * W1) + (P2 * W2)}$$

Where:

P1 = the percent of time the airport is under VFR conditions
C1 = hourly capacity under VFR conditions
W1= weighting factor for VFR conditions
P2 = the percent of time the airport is under IFR conditions
C2= hourly capacity under IFR conditions
W2= weighting factor for IFR conditions

VFR conditions exist 85% (P1) of the time according to NOAA data, with 56 operations per hour (C1). IFR conditions exist 15% of the time (P2) with 44 operations per hour (C2). According to Table 3-1 of the advisory circular, weighting factors are 5 for VFR and 16 for IFR.

The hourly combined capacity is calculated as:

$$Cw = \frac{(0.85 * 56 * 5) + (0.15 * 44 * 16)}{(0.85 * 5) + (0.15 * 16)} = 52 \text{ OPH}$$

Annual Service Volume
Annual Service Volume (ASV) is calculated as:

ASV=Cw X D X H

Where:
D = the ratio of annual demand to the average daily demand in the peak month
H = the ratio of the average daily demand in the peak month to the average peak hour in the peak month.

The current and future ASV for MSO was determined to be approximately 87,000 operations. With operations in 2022 at 44,899, the airport is currently at 52% of its annual service volume. **Table 3-3** summarizes the airport's the airport's ASV over the long range planning horizon under the current runway configuration.

Table 3-3: Annual Service Volume – Current Runway Configuration

		Forecasts			
	2022	2027	2032	2037	2042
Total Annual Operations	44,899	48,863	52,121	55,677	59,231
Peak Month	5,543	6,027	6,427	6,867	7,307
Average Day	179	194	207	222	236
Peak Hour	27	29	31	33	35
D = Total Annual Ops / Average Day	251	251	251	251	251
H= Average Day / Peak Hour	6.7	6.7	6.7	6.7	6.7
ASV	86,501	86,577	86,603	86,579	86,559
Ops % ASV	52%	56%	60%	64%	68%
Hourly Capacity	52	52	52	52	52
Ops % Hourly Capacity	52%	56%	60%	64%	68%

Airfield Capacity Conclusions and Recommendations
FAA Order 5090.5, *Formulation of the NPIAS and ACIP*, identifies the 60% to capacity level as the point that planning for additional runways or changes in runway configurations to improve capacity should begin with development to occur at 80%. According to ASV analysis, the airport should begin planning for capacity improvements in the intermediate-term horizon.

MSO has historically reserved space for a parallel runway to the south of Runway 12-30 on its Airport Layout Plan (ALP) and in previous planning documents. It is recommended that planning for a parallel runway be preserved in planning documents to maintain airspace and land use protections for when the runway becomes needed. Chapter 4 *Alternatives* will evaluate the advantages and disadvantages of alternative locations and sizing of a parallel runway.

3.3 Airfield Requirements

3.3.1 Design Standards Concepts and Terminology

The planning and design of airfield facilities is based primarily on the types of aircraft using the airport. The FAA has established the **Airport Reference Code (ARC)** for planning and design purposes that signifies the airport's highest **Runway Design Code (RDC)** minus the third (visibility) component of the RDC. The RDC is a code based on planned development and signifies the design standards to which the runway is to be built.

The Runway Design Code has three components. The first component, depicted by a letter, is the **Aircraft Approach Category (AAC)** and relates to aircraft approach speed. The second component, depicted by a Roman numeral, is the **Airplane Design Group (ADG)**. ADG is a function of the design aircraft's wingspan and tail height. The third component of the RDC is the Visibility Minimums and is used to establish runway to taxiway separation distances. The FAA has also introduced the Runway Reference Code (RRC) which is comprised of the same three components as the RDC, however, describes the current operation capabilities of a runway where no special operating procedures are necessary. For layout of airport facilities, the design aircraft is the most demanding aircraft or group of aircraft having, or forecast to have, more than 500 annual operations at the airport.

AAC is a grouping of aircraft based on 1.3 times their stall speed in their landing configuration at their maximum certificated landing weight. FAA design standards recognize the following Aircraft Approach Categories:

Table 3-4: Aircraft Approach Categories

Aircraft Approach Category (AAC)	
AAC	**Approach Speed (1.3 X Stall Speed)**
A	Less than 91 knots.
B	91 knots or more but less than 121 knots.
C	121 knots or more but less than 141 knots.
D	141 knots or more but less than 166 knots.
E	166 knots or more.

The ADG is a grouping of aircraft based on wingspan and tail height. FAA design standards recognize the following ADGs:

Table 3-5: Airplane Design Groups

Airplane Design Group (ADG)		
ADG	**Tail Height (ft.)**	**Wingspan (ft.)**
I	<20'	< 49'
II	20' - < 30'	49' - < 79'
III	30' - < 45'	79' - < 118'
IV	45' - < 60'	118' - < 171'
V	60' - < 66'	171' - < 214'
VI	66' - < 80'	214' - < 262'

It is important to note that it is not necessary to design all of the airfield system to the standards of the most demanding aircraft using the airfield. **Figure 3-4** provides a visual representation of various aircraft and their associated ARC's.

Figure 3-4 Airport Reference Codes

Visibility Minimums are expressed as **Runway Visual Range (RVR)** values in feet corresponding to the following Flight Visibility categories:

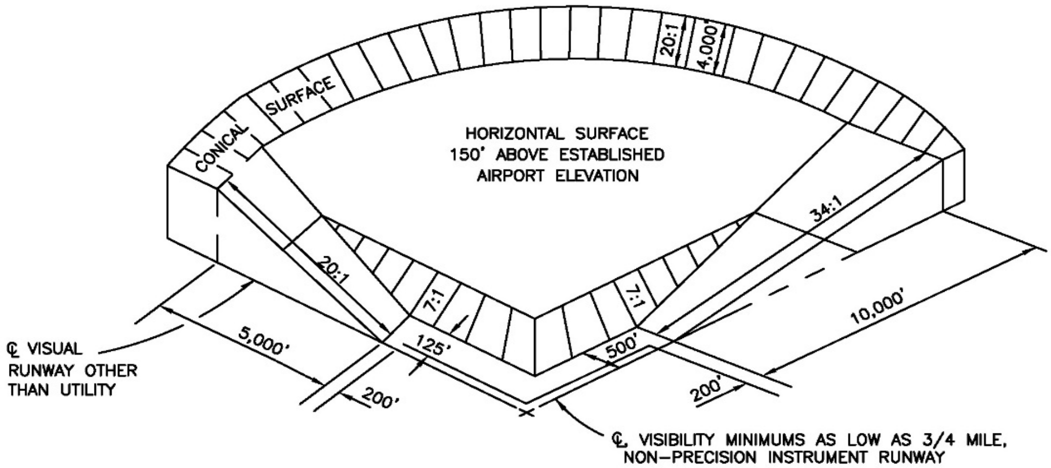
Table 3-6: Runway Visual Range

Runway Visual Range (RVR)	
4000 ft:	Lower than 1 mile but not lower than ¾ mile
2400 ft:	Lower than ¾ mile but not lower than ½ mile
1600 ft:	Lower than ½ mile but not lower than ¼ mile
1200 ft:	Lower than ¼ mile

Therefore, for example, RDC B-I/2400 is an aircraft meeting the requirements for Aircraft Approach Category B (91 knots or more but less than 121 knots) and Airplane Design Group I (wingspan up to but not including 49 feet, tail height less than 20 feet) with visibilities lower ¾ mile. Typically, increasing the Aircraft Approach Category or Airplane Design Group, and providing for lower approach visibility minimums will increase required airport geometric design standards.

Additional design criteria are determined based on aircraft weight and type of approach. A small aircraft is defined in Advisory Circular 150/5300-13B, Airport Design, as an airplane of 12,500 pounds or less maximum certificated takeoff weight. An aircraft weighing more than 12,500 pounds is considered a large aircraft.

Aircraft weight affects the required Part 77 surfaces, runway length requirements and pavement design strength. Part 77 of the Federal Aviation Regulations defines "Objects Affecting Navigable Airspace" and establishes imaginary surfaces around airfields and approach/departure slopes to and from runways. **Figure 3-5** illustrates the Part 77 airspace surface structure for different runway categories.



TYPICAL CIVIL AIRPORT
IMAGINARY SURFACES DETAIL

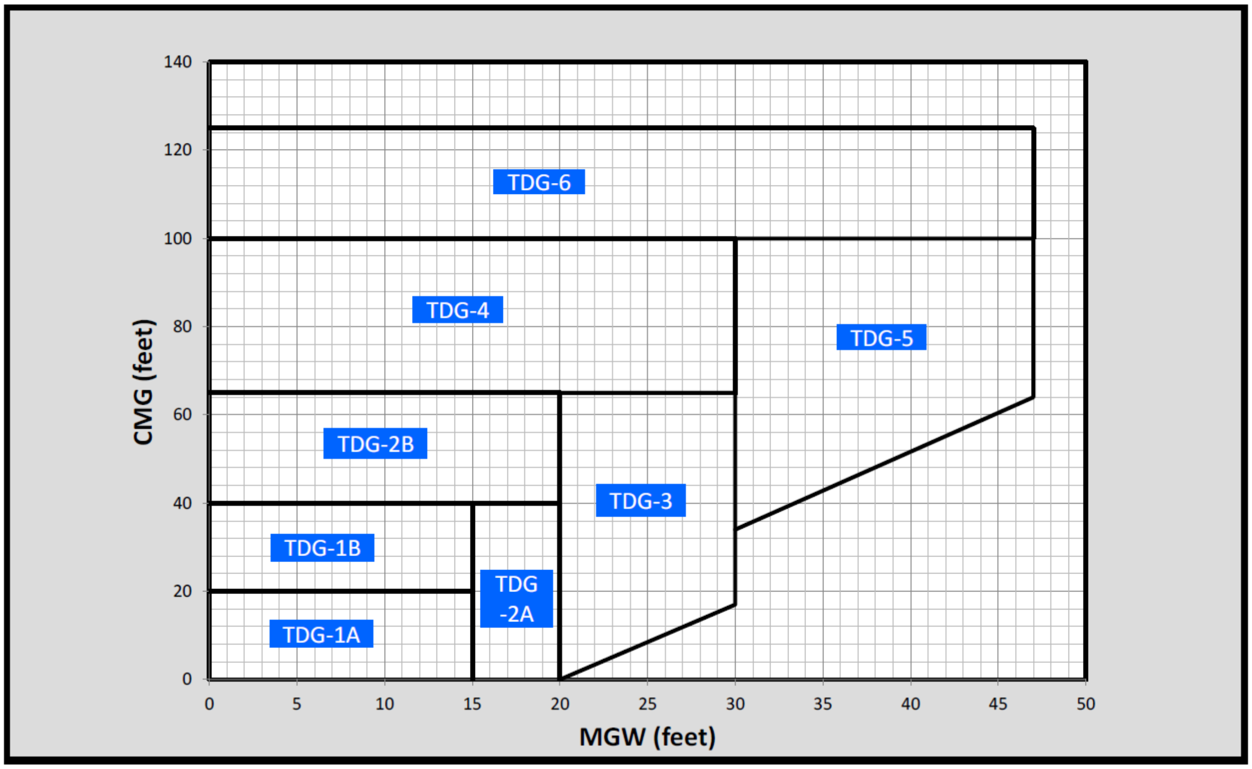
AIRPORT SURFACE DATA

ITEM	DIMENSIONAL STANDARDS (FEET)					
	VISUAL RUNWAY		NON-PRECISION INSTUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
				B		
	A	B	A	C	D	
WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
	VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
				B		
	A	B	A	C	D	
APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	a
APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	a

A - UTILITY RUNWAYS
B - RUNWAYS LARGER THAN UTILITY (EXISTING VISUAL)
C - VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D - VISIBILITY MINIMUMS AS LOW AS 3/4 MILE (ULTIMATE)
a - PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET

Figure 3-5 Typical Civil Aircraft Imaginary Surfaces Detail

Under former guidance, taxiway design was based on ADG. In the updated Advisory Circular AC 150/5300-13B, taxiway design is based on **Taxiway Design Groups (TDG)**, which are based on the overall Main Gear Width (MGW) and the Cockpit to Main Gear (CMG) distance. TDG classifications are presented in **Figure 3-6**.



Source: Figure 1-1 from AC 5300-13B

Figure 3-6: Taxiway Design Groups

Critical Aircraft

Federal Aviation Administration (FAA) Advisory Circular AC150-5325-4B, *Runway Length Requirements for Airport Design*, indicates that critical aircraft, upon which runway design is based, are required for federally funded projects to "have at least 500 or more annual itinerant operations at the airport (landings and takeoffs are considered as separate operations) for an individual airplane or a family grouping of airplanes." The AC also states that adjustments may be made to the 500 total annual itinerant operations threshold after considering the circumstances of a particular airport.

Based on the analysis in Chapter 2 - *Forecasts of Aviation Demand*, the current critical aircraft at the MSO is a family of airplanes with AAC – D and ADG – III, weighing more than 12,500 pounds. In the future, D-III aircraft are projected to be the most demanding type of aircraft with more than 500 operations at the MSO.

It is important to note that it is not necessary to design the entire airfield system to the standards of the most demanding aircraft using the airfield. For airports with two or more runways it is most practical to design some components for a less demanding RDC. For example, at MSO, Runway 12-30 has a more demanding AAC and ADG than Runway 8-26.

Crosswind Runway 8-26 currently meets the dimensional standards of a B-I runway for small aircraft exclusively (under 12,500 pounds gross weight). As a crosswind runway, requirements for Runway 8-26 are based on wind analysis. Analysis of crosswind components at MSO, provided later in this chapter, determined that crosswind Runway 8-26 is not necessary to achieve the desired 95 percent wind coverage required for general aviation A-I and B-I aircraft that regularly use the airport.

As previously noted in the capacity analysis of this chapter, planning for a new parallel runway is justified within the planning period. Dimensional standards for a new parallel runway will depend on the runway's functional role, which will be determined in Chapter 4 *Alternatives*.

In terms of taxiway design, as noted in Chapter 2, *Forecasts*, the most demanding aircraft regularly operating at MSO is the Bombardier Dash 8 Q-400, which is in TDG 5. Taxiways serving portions of the airfield meant to accommodate the most demanding critical aircraft should be designed to TDG 5 standards. Other taxiways should be designed according to the associated runway and landside facilities served.

In summary, the Runway Reference Code and Taxiway Design Groups of the associated airside facilities are shown in **Table 3-7.**

Table 3-7 Facility Classifications

	Existing Classification	Ultimate Classification
Runway 12-30	D-III	D-III
Runway 8-26	B-I (Small)	B-II (Small)
Taxiways*	TDG 5	TDG 5

* Taxiways designed according to applicable runway and landside facility

Runway Length

Adequate planning for runway configuration requirements is very important as runway projects can affect the community beyond the property line. Runway projects are large in magnitude and can require many resources and long lead times for planning, environmental review and funding allocation.

The design approach identified in *FAA AC 150/5325-4B, "Runway Length Requirements for Airport Design"* was used to determine runway length calculations for the MSO.

Aircraft Less than 60,000 Pounds

Chapter 2 of *FAA AC 150/5325-4B "Runway Length Requirements for Airport Design"* provides the guidance to determine recommended runway lengths for aircraft of 12,500 pounds or less, while Chapter 3 provides the guidance to determine recommended runway lengths for aircraft weighing more than 12,500 pounds and less than 60,000 pounds (large aircraft). These recommendations are based on the assumption of no obstructions, zero wind, dry runway surfaces, and zero effective gradient.

Utilizing this information results in the recommended runway lengths summarized in **Table 3-8**. The runway lengths for large aircraft should be increased from the values shown at a rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline.

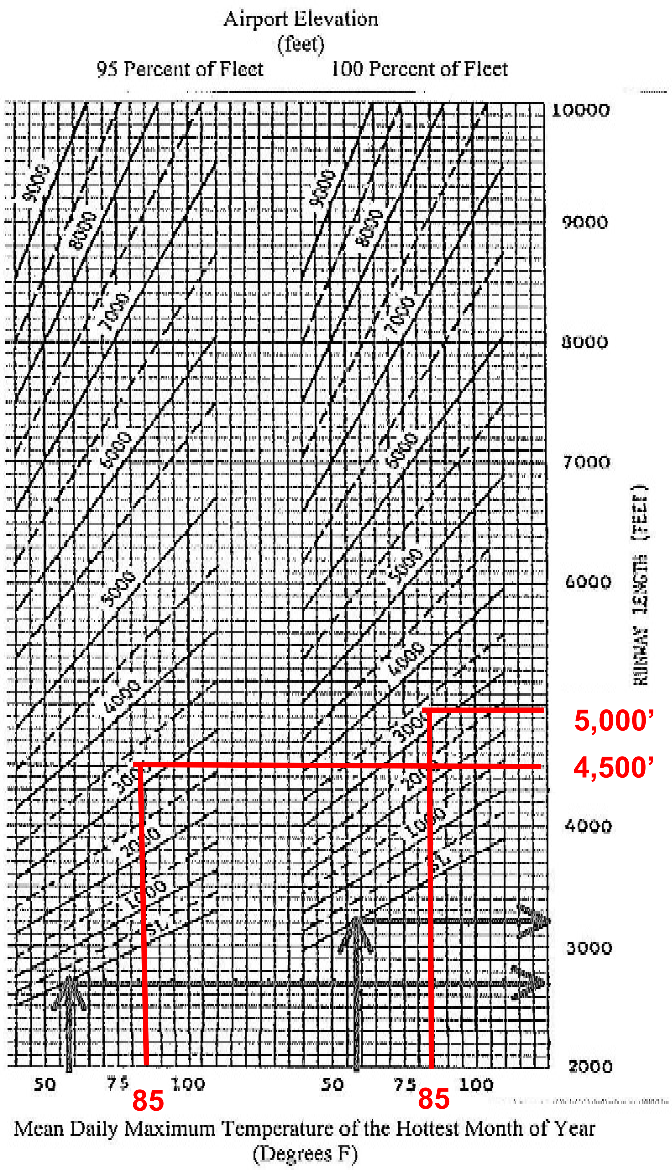
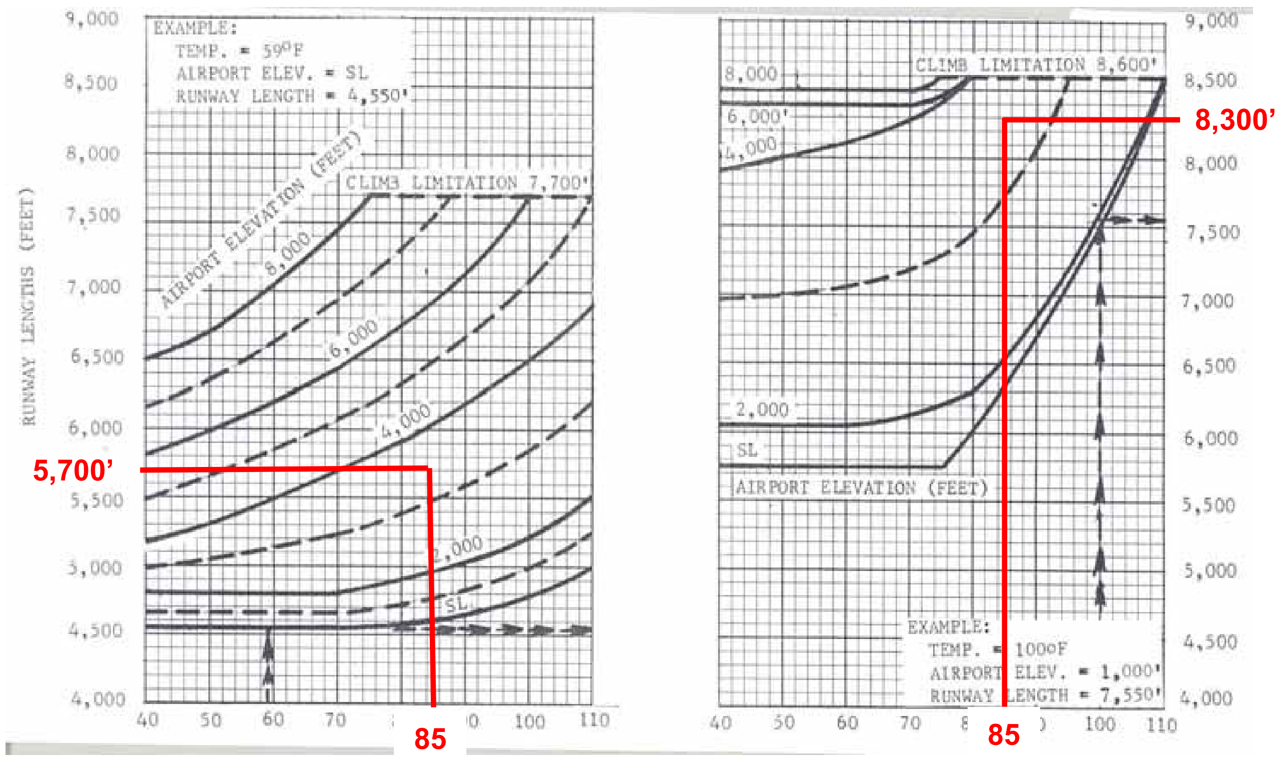


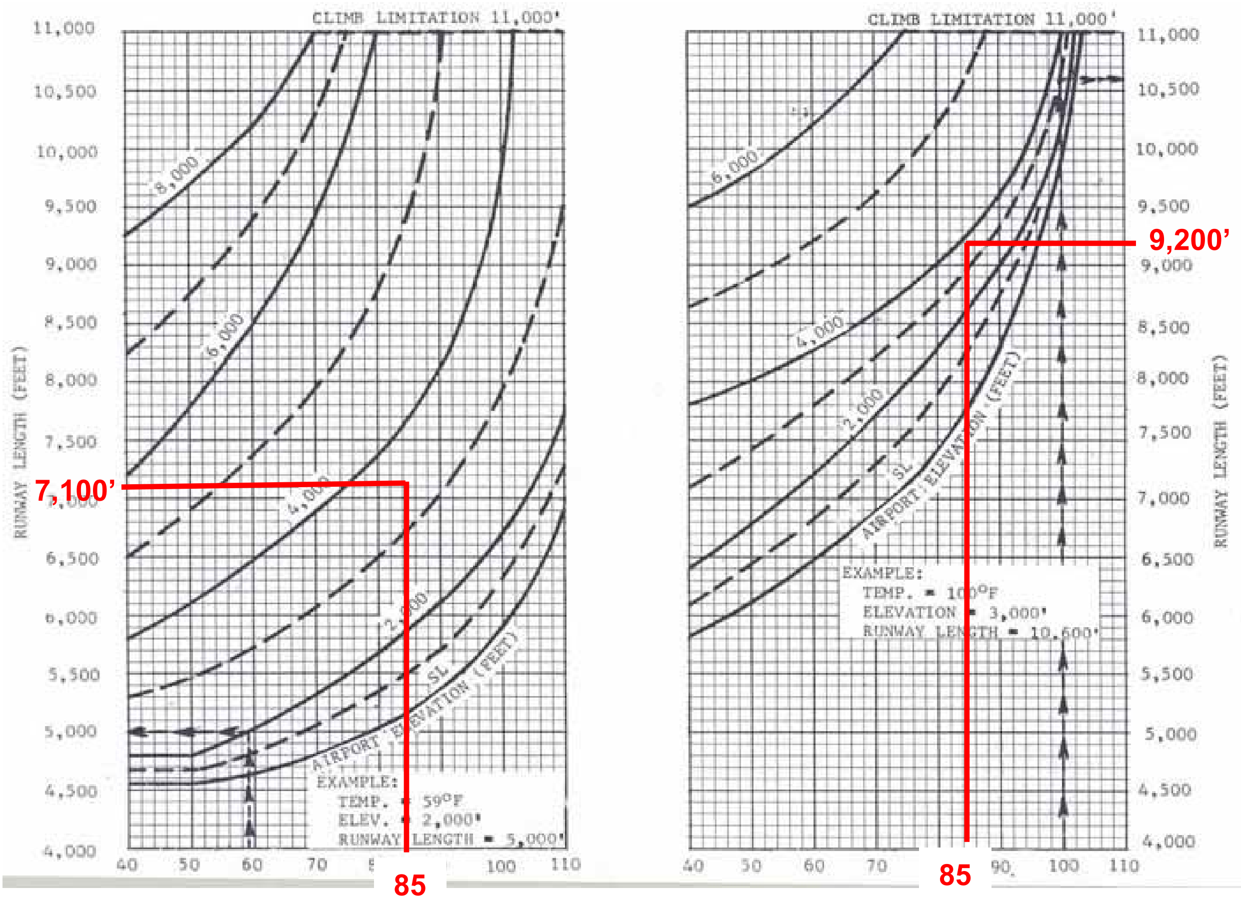
Figure 3-7: AC 150/5325-4B: Small Airplanes with Fewer than 10 Passenger Seats 95 or 100 percent Useful Load



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

75 percent of feet at 60 percent useful load **75 percent of feet at 90 percent useful load**

Figure 3-8: AC 150/5325-4B: Large Airplanes Over 12,500 Pounds 75 Percent of Fleet at 60 or 90 percent Useful Load



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

100 percent of feet at 60 percent useful load **100 percent of feet at 90 percent useful load**

Figure 3-9: AC 150/5325-4B: Large Airplanes Over 12,500 Pounds
100 Percent of Fleet at 60 or 90 percent Useful Load

Table 3-8 FAA Runway Lengths

AIRPORT AND RUNWAY DATA	
Airport elevation.	3205.2 feet
Mean daily maximum temperature of the hottest month	85.2 F
RUNWAY LENGTHS RECOMMENDED FOR AIRPORT DESIGN	
Small airplanes with approach speeds of less than 30 knots	396 feet
Small airplanes with approach speeds of less than 50 knots	1,056 feet
Small airplanes with less than 10 passenger seats	
95 percent of these small airplanes	4,500 feet
100 percent of these small airplanes	5,000 feet
Small airplanes with 10 or more passenger seats	5,000 feet
Large airplanes of 60,000 pounds or less	
75 percent of these large airplanes at 60 percent useful load	5,700 feet
75 percent of these large airplanes at 90 percent useful load	8,300 feet
100 percent of these large airplanes at 60 percent useful load	7,100 feet
100 percent of these large airplanes at 90 percent useful load	9,200 feet

Note: For large airplanes, the runway lengths should be increased from the values shown at a rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline.

REFERENCE:
Chapter 2 of *AC 150/5325-4B, "Runway Length Requirements for Airport Design",* no Changes included.

At 9,501 feet in length, and with 13.2 feet of difference between the high and low points of the runway centerline (increasing lengths shown by 132 feet), Runway 12-30 can accommodate 100 percent of large aircraft under 60,000 pounds at 90 percent useful load.

Aircraft More than 60,000 Pounds

Runway Length calculations for regional jets and aircraft over 60,000 pounds are based on the requirements of the most demanding aircraft that regularly uses the runway. Chapter 3 of Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5325-4B "Runway Length Requirements for Airport Design" sets forth the procedure used to determine recommended runway lengths for runways serving regional jets and aircraft over 60,000 pounds. Runway 12-30 is the designated runway for use by regional jets aircraft over 60,000 pounds at MSO, therefore, length analysis for Runway 12-30 follows this procedure.

The steps outlined in the advisory circular are as follows:

- **Step 1:** Identify the list of critical airplanes.
- **Step 2:** Identify the aircraft that require the longest length at Maximum Takeoff Weight (MTOW).
- **Step 3:** Determine the method to be used in determining runway length.
- **Step 4:** Select the runway length requirement for the critical aircraft.
- **Step 5:** Make adjustments to the length calculations.

The key factors influencing runway length calculation and specific data used for MSO include:

- Airport Elevation: 3,205.5 feet
- Mean Maximum Temperature: 85.2 degrees F
- Runway Gradient: 0.05%
- Airplane Operating Weights: Due to the airport elevation of 3,205.5 MSL and the maximum mean temp of the hottest month of 85.2º F, most of the airplanes maximum takeoff weight (MTOW) is restricted. Operating weights are evaluated relative to fuel load requirements for anticipated stage lengths.

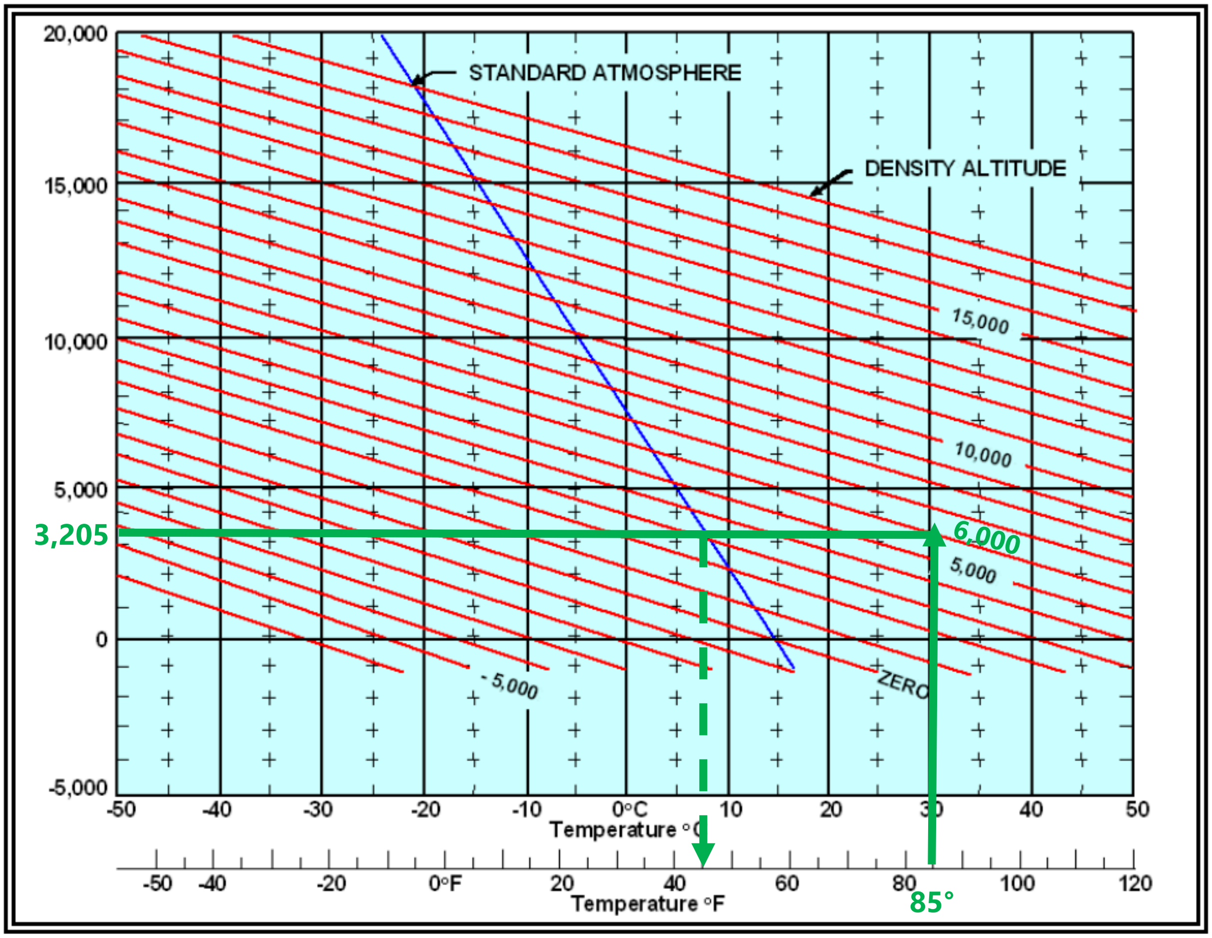
International Standard Atmosphere (ISA) is a mathematical model that describes how the earth's atmosphere, or air pressure and density, change depending on altitude. The atmosphere is less dense at higher elevations. ISA is frequently used in aircraft performance calculations because deviation from ISA will change how an aircraft performs. ISA at sea level occurs when the temperature is 59°F. ISA at MSO's 3,205 feet AMSL occurs when the temperature is 45°F.

Density Altitude (DA) is a measurement comparing air density at a point in time and specific location to ISA is a critical component of aircraft performance calculations. DA is used to understand how aircraft performance differs than the performance that would be expected under ISA. DA is primarily influenced by elevation and air temperature. To examine the effect of changes to either variable, this calculation holds the other variable constant.

- When elevation is constant: When air temperature increases, DA increases. When air temperature decreases, DA decreases. This comparison is often used when analyzing aircraft performance at an airport during different times of the day and different days of the year.
- When temperature is constant: When elevation increases, DA increases. When elevation decreases, DA decreases. This comparison, which is not often used, can be employed to compare aircraft performance at different airports under identical climate conditions.

Figure 3-10 illustrates how DA is impacted when factoring in the average maximum temperature (85.2°F) for MSO. The result is a density altitude increased to approximately 6,000 feet MSL.

Figure 3-10 Density Altitude for MSO Average Maximum Temperature



The overall goal of AC 150/5325-4B is to assure that sufficient runway length is available to serve the needs of the aircraft and users of the airport. The process used for MSO is as follows:

Step 1: Identify the list of critical design aircraft: The projected aircraft fleet for MSO has been presented in the forecast of aviation demand. The most critical aircraft were identified as the commercial aircraft used by the Part 121 carriers. These aircraft are shown in **Table 3-9** together with the haul lengths of the destinations they currently serve.

Table 3-9: Aircraft By Destination Served and Haul Length

Current Destinations	Haul Length (NM)	*2022 Departures	Aircraft
Seattle, WA	389	1,118	Q400, ERJ 175
Salt Lake City, UT	436	1,146	A220, A319, A320, CRJ 700, ERJ 175
Denver, CO	679	883	A319, A320
Las Vegas, NV	750	110	A320
San Francisco, CA	769	113	CRJ 200, ERJ 175
Los Angeles, CA	923	149	A320, CRJ 700, ERJ 175
Phoenix, AZ	948	108	A319, A320
Minneapolis, MN	1,013	442	A319, A320, A321, 737-800, 737-900, ERJ 175
Dallas/Fort Worth, TX	1,320	434	A319, A321, 737-800, ERJ 175
Chicago, IL	1,332	100	ERJ 175

Source: BTS T-100 Domestic Segment Data

Note: Scheduled Passenger Service Carriers, Departures Performed

Step 2: Identify the aircraft that require the longest runway lengths. The runway length requirements at MSO are driven by the commercial carriers as listed in the previous exhibit.

Step 3: Determine the method to be used in defining runway length: The AC directs that for commercial aircraft runway length requirements should be determined using the airplane manufacturers Airport Planning Manuals (APMs).

Step 4: Select the recommended runway length for the critical aircraft: In calculating runway length, APM data was used to determine takeoff and landing length requirements. These are presented in **Table 3–10** which shows the maximum landing and takeoff weights and the runway length requirements at stage lengths of 1500 Nautical Miles (NM).

Table 3-10: Recommended Runway Lengths

	Airbus A 319	Airbus A 320	Airbus A 321	Boeing 737-800	Boeing 737-900
Maximum Landing Design Weight (MLW)	134,482	142,198	164,244	146,300	146,300
Landing Length					
- Wet Conditions	5,980	6,440	7,245	7,600	7,700
- Dry conditions	5,200	5,600	6,300	6,500	6,700
Maximum Takeoff Design Weight (MTOW)	166,000	170,000	196,000	174,200	174,200
Takeoff Weight for length of haul @ 1500 NM	141,000	153,000	165,000	147,000	150,000
Takeoff Length for length of haul @ 1500 NM	6,000	6,400	6,700	8,000	9,300
* Adjusted Takeoff Length for length of haul @ 1500 NM	6,132	6,532	6,832	8,132	9,432

Notes:
Assumes maximum passengers & baggage @200 lb. ea.
Assumes temperature of 85° F.
A319, A320, A321 Wet Conditions calculated by adding 15% to dry conditions.
Manufacturers' data is for planning purposes and recommends consultation with local commercial air carriers to determine actual aircraft operating weights and conditions prior to construction of a runway extension.
* 10 feet added for each foot of difference between Runway high and low points = 132 feet

Step 5: Make adjustments to the length calculations: An adjustment to the calculated runway length table is made to account for variations in the runway gradient. In this case, a distance of 10 feet of runway length for every foot of difference between the runway high and low points needs to be added. With a high point of 3205.2 feet and a low point of 3192.0 feet, this equals an additional 132 feet of length for takeoffs. The calculations are reflected in **Table 3–10**.

Required Runway Length
Results of the runway length analysis show that 9,500 feet of runway is acceptable for the aircraft currently operating at MSO with the maximum number of passengers on board.

Runway 8-26 is designed to serve small aircraft under 12,500 lbs exclusively. As indicated in **Table 3-8**, a length of 4,500 feet serves 95% of small aircraft and a length of 5,000 feet would serve 100% of small aircraft.

Chapter 4 *Alternatives* will examine the optimal length for a new parallel runway given functional role considerations and geographical constraints.

Runway Orientation
FAA design standards recommend additional runway orientations when the primary runway orientation provides less than 95 percent wind coverage.

Crosswind limitations are a function of an aircraft's stall speed, pilot proficiency and other factors. For general planning purposes, the FAA has established crosswind limits of 10.5 knots for general aviation A-I and B-I aircraft, 13 knots for A-II and B-II general aviation aircraft and 16 knots for transport aircraft A-III, B-III and C-I through D-III. Aircraft in design group IV have a crosswind limit of 20 knots.

Prevailing winds are generally the primary factor in determining runway orientation. The most desirable orientation based on wind is one which has the largest wind coverage and minimum crosswind components.

Wind data was obtained from the National Climatic Data Center (NCDC) utilizing the Wind Rose File Generator and Wind Analysis Tool on the FAA Airports GIS Program website. The data is from the ASOS (KMSO) at MSO, for years 2011 through 2020. Three separate sets of data were analyzed, All Weather wind data, IFR wind data, and VFR wind data. The All Weather set includes all wind observations in the data set, the IFR Wind Data includes only observations when instrument flight rules apply, and the VFR Wind Data Set incudes observation under visual flight rules. The three sets of wind data were analyzed for each runway and both runways combined. For each runway an allowable crosswind component is used depending on the runway design group. The allowable crosswind components are shown below and the results of the analysis are shown in **Table 3-11**.

Runway	Runway Design Group	Allowable Crosswind Component
RW 12-30	D-III	16 knots
RW 8-26	B-I	10.5 knots

Table 3-11 Wind Coverage Summary

Runway Combination	True Bearing (deg. From true north)	Crosswind Component (Knots)	All Weather	IFR	VFR
Runway 12-30	130/310	10.5	97.46%	98.41%	97.27%
Runway 12-30	130/310	13	98.81%	99.12%	98.74%
Runway 12-30	130/310	16	99.67%	99.64%	99.66%
Runway 12-30	130/310	20	99.94%	99.91%	99.94%
Runway 8-26	89/269	10.5	96.53%	97.85%	96.26%
Runway 8-26	89/269	13	98.32%	98.89%	98.20%
Runway 12-30 & Runway 8-26	130 / 89	16 / 10.5	99.83%	99.77%	99.83%

Source of Data: Station 727730 at MSO, for years 2011, 2012, 2013, 2015, 2016, 2017, 2018, 2019, 2020 – 122,221 observations

The analysis based on runway design group shows the wind coverage for the three sets of weather data for each runway individually as well as the existing combined runway configuration.

As shown in **Table 3-11**, the wind coverage for Runway 12-30 alone is greater than 95 percent under all weather, IFR and VFR conditions for the 10.5 knot crosswind component. This indicates that crosswind Runway 8-26 is not necessary to achieve the desired 95 percent wind coverage required for general aviation A-1 and B-I aircraft that regularly use the airport. With the current configuration of Runway 12-30 and Runway 8-26, 99.83 percent wind coverage is provided in all weather conditions, 99.77 percent in IFR conditions and 99.83 percent in VFR conditions.

Runway Width

The width of the existing runway was also examined to determine if it meets the needs for aircraft that currently, and are forecasted to, use the airfield. Currently, Runway 12-30 is 150 feet wide. For D-III aircraft with a maximum certificated takeoff weight over 150,000 pounds (such as the A319, A320 and B737), FAA design standards call for a minimum runway width of 150 feet. Therefore, the 150 foot runway width should be sufficient for the planning period.

Runway 8-26 is currently 75 feet wide. This width meets FAA standards and is sufficient for the current RDC of B-II small for the runway.

Runway Pavement Strength

The FAA Airport Master Record 5010 form indicates Runway 12-30 has a pavement strength rating of 145,000 pounds single wheel loading, 170,000 pounds dual wheel loading and 255,000 dual wheel tandem loading. This strength rating is sufficient to serve the aircraft currently operating and expected to operate on the runway in the future.

Runway 8-26 has a documented pavement strength rating of 30,000 pounds single wheel loading and 50,000 pounds dual wheel loading. This strength rating is sufficient to serve the small aircraft currently operating on the runway.

The FAA began using the standardized International Civil Aviation Organization (ICAO) method, to report airport runway strength in 2014. The standardized method is used to determine a Pavement Classification Number (PCN) which represents the load carrying capacity of a pavement for unrestricted operations. The PCN is a five-part code, describing the piece of pavement. The first part is the PCN numerical value which indicates the load-carrying capacity of the pavement in thousands of pounds. The second part calls out whether the pavement is rigid or flexible. The third part is a code that indicates the strength of the subgrade. The fourth part calls out the maximum tire pressure the pavement can support. The fifth part describes how the first part, the load-carrying capacity, was determined, either technical evaluation or a physical test.

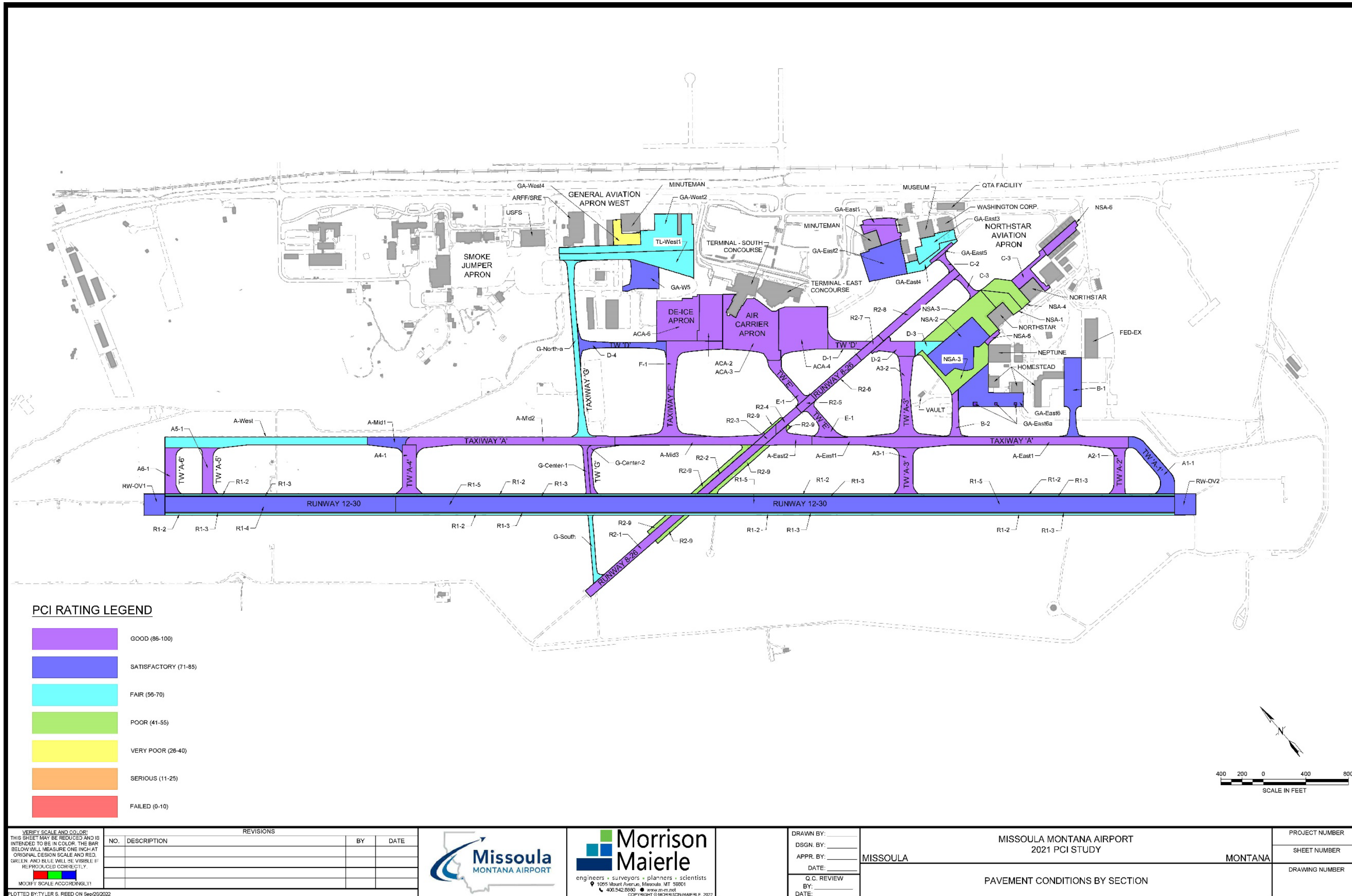
The PCN for Runway 12-30 is 83/F/D/W/T, and for Runway 8-26 is 40/F/ D/W/T.

Airfield Pavement Maintenance

Runway 12-30 was rehabilitated in 2007 during which approximately two and a half to three inches of Porous Friction Course (PFC) was milled and replaced with a two-and-a-half-inch asphalt overlay. Runway 8-26 was rehabilitated in 2011-2012 with a mill/overlay and crack repair and a full-depth reconstruction of certain sections. A pavement maintenance project was completed in 2018 on both runways and on all connector taxiways from the runway, back to each runway hold bar which included crack seal, seal coat and re-painting. A pavement maintenance project is currently underway (2023) which will include crack sealing, seal coat, and remarking for all asphalt taxiways, taxilanes and aprons.

In 2021, an inspection of all airport pavements was completed. Generalized results of the PCI inspection are shown in **Figure 3-11**.

A regular series of pavement maintenance is recommended for all airfield pavements. Based on the current condition of existing pavements, a general schedule for major and preventative maintenance items is presented in **Table 3-12**. Actual project timing will depend on the availability of funding and actual wear on pavement. The primary elements are listed, followed by their typical useful life.



Note: PCI Ratings shown are prior to 2023 pavement maintenance on all taxiways, taxilanes and asphalt aprons.

Figure 3-11 Pavement Condition Index Map

Table 3-12 Airfield Pavement Maintenance

Recommended Maintenance Program	Approximate Life Expectancy
Asphalt Pavement Mill & Overlay	15 to 20 years
Concrete Reconstruction	40 years
Sealcoat	4 years
Crack Sealing	4 years

Pavement	Last Major Maintenance/ Construction	Asphalt Mill & Overlay / * Concrete Reconstruction	Sealcoat / Spall Repair	Crack Sealing / Joint Repair*
Runway 12-30	2007	2025	2029	4 year cycle
Runway 8-26	2012	2032	2027	4 year cycle
Parallel Taxiway A	2010	2030	2023	4 year cycle
Taxiway B-1	2016	2036	2023	4 year cycle
Taxiway B-2	2014	2034	2023	4 year cycle
Taxiway C-2	2014	2034	2023	4 year cycle
Taxiway C-3	2013	2033	2023	4 year cycle
Taxiway D	2011/ 2013 / 2015	2031	2023	4 year cycle
Taxiway E	2009	2029	2023	4 year cycle
Taxiway F	2010	2030	2023	4 year cycle
Taxiway G	2004 / 2011	2031	2023	4 year cycle
Commercial Apron – (Concrete)	2015	*TBD	2030	4 year cycle
De-Ice Apron (Concrete)	2008	*TBD	2030	4 year cycle
General Aviation Apron – West	2004	2028	2023	4 year cycle
Northstar Apron	2000 / 2008 / 2012 / 2013	2028	2023	4 year cycle
General Aviation Apron – East	2006 / 2012 / 2014	2028	2023	4 year cycle
Taxilane West	1989	2028	2023	4 year cycle

*Concrete pavements to be reconstructed as needed per PCI observations
Note: Maintenance on exit and connecting taxiways and taxilanes should be done as part of related runway, parallel taxiway, or apron projects.

Taxiway Requirements

Taxiways are constructed primarily to facilitate aircraft movement to and from the runway system. Some taxiways are necessary simply to provide access between aprons and runways, while other taxiways become necessary as activity increases and safer and more efficient use of the airfield is needed.

Under former guidance, taxiway design was based on Airplane Design Groups (ADG). In the updated Advisory Circular AC 150/5300-13A, taxiway design is also based on newly established Taxiway Design Groups (TDG), which are based on the overall Main Gear Width (MGW) and the Cockpit to Main Gear (CMG) distance.

Runway 12-30 is served by one parallel taxiway located northeast of the runway. Taxiway A is located 600 feet from the runway centerline and is 75 feet wide. Connecting taxiways are 101 to 130 feet wide.

The existing 75 foot taxiway width of Parallel Taxiway A is adequate for the existing and planned future Taxiway Design Group 5.

Acute angled high-speed taxiway exits reduce time on the runway by landing aircraft, improving the operational efficiency of the airfield. Acute angled high-speed taxiway exits do not exist on today's airfield but should be considered to serve the runway system within the planning period.

Runway 8-26 is not served by a parallel taxiway. Connecting taxiways for Runway 8-26 range from 40 to 50 feet wide. These meet the FAA standard with of 35 feet for taxiways serving small aircraft up to TDG 2B.

Future taxiways should be developed to the standards of the critical aircraft of the runway they are designed to serve.

Airport Design AC 150/5300-13A states that taxiway connectors that cross over a parallel taxiway from an apron and directly onto a runway are not recommended. To prevent runway incursion and promote good situational awareness by pilots, a staggered layout when taxiing from an apron onto a parallel taxiway and then onto a stub-taxiway or taxiway connector to a runway is recommended. No current taxiway connectors at MSO directly connect an apron with a runway. Design of future aprons and taxiways should be designed consistent with this standard.

Holding aprons and bypass taxiways can improve the efficiency of the taxiway system. Holding aprons allow aircraft to prepare for departure in an area off the taxiway. Bypass taxiways allow traffic ready for departure to bypass aircraft preparing for departure. Taxiway A2 and Taxiway A5 serve as bypass taxiways for Runway 12 and 30. Consideration should be given to constructing bypass taxiways and holding aprons for any future planned runways. According to Order 5090.5, Formulation of the NPIAS and ACIP, Table 4-4, planning and development of holding aprons and bypass taxiways should begin at 75,000 total operations, 20,000 itinerant operations, or 30 peak hour operations per runway. MSO currently has over 20,000 annual itinerant operations.

As facilities are built to accommodate growing demand in the terminal area and general aviation areas, taxiways and taxilanes will need to be extended to provide access from those areas to the airfield.

FAA Design Standards

One of the key considerations of any airport planning effort is to evaluate the dimensional standards for the airfield layout, established by the FAA. **Table 3-13** presents a summary of significant FAA design standards that need to be compared with existing conditions to evaluate whether MSO meets criteria for the aircraft currently being served. The application of these design standards establishes airport geometry. The airport operates as a D-III facility. Runway 12-30 is planned to accommodate the most demanding aircraft while Runways 8-26 provides an operational alternative for less demanding aircraft types.

Table 3-13 FAA Design Standards

	RW 12-30		RW 8-26	
	Existing	Required	Existing	Required
ARC	D-III	D-III	B-II (Small)	B-II (Small)
Approach Visibility Minimum	<1/2 mile	<1/2 mile	Visual	Visual
Runway Object Free Area				
Width	800′	800′	500′	500′
Length Beyond Runway End	1000′	1000′	300′	300′
Runway Safety Area				
Width	500′	500′	150′	150′
Length Beyond Runway End	1,000	1,000	300	300
Runway Obstacle Free Zone				
Width	400′	400′	250′	250′
Length Beyond Runway End	200′	200′	200′	200′
Taxiway Object Free Area				
Width	171′	171′	124′	124′
Taxiway Safety Area				
Width	118′	118′	79′	79′
Design Criteria				
Runway Width	150′	150′	75′	75′
Taxiway Width	75′(TDG 5)	75′(TDG 5)	35′ (TDG 2B)	35′(TDG 2B)
Runway Centerline to Parallel T/W Centerline	600′	400′	NA	240′
Runway Centerline to Holdline	280′	280′	125′	125′
Runway Centerline to Edge of Aircraft Parking	>815′	815′	>335′	335′
Taxiway centerline to Fixed or Movable Object	>85.5′	85.5′	62′	>62′

Runway Object Free Area (OFA): The Runway Object Free Area is a two dimensional ground area surrounding the runway. The runway OFA clearing standard precludes parked airplanes and objects except those whose location is fixed by function such as a navigational aid. As shown in **Table 3-13,** the OFA for Runway 12-30 is 800 feet wide and 1,000 feet beyond the runway end (D-III facility). The OFA for Runway 8-26 is 500 feet wide and 300 feet beyond the runway end (B-II small facility).

Runway Safety Area (RSA): The Runway Safety Area is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway. The RSA should be cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations. As shown in **Table 3-15**, the RSA for Runway 12-30 is and will remain 500 feet wide and 1,000 feet beyond the runway end (D-III facility). The OFA for Runway 8-26 is 150 feet wide and 300 feet beyond the runway end (B-II small facility).

Runway Obstacle Free Zone (OFZ): The runway OFZ is a defined volume of airspace centered above the runway centerline. It is the airspace above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline. For runways serving small aircraft under 12,500 pounds (Runway 8-26), the OFZ is 250 feet wide and 200 feet beyond the runway end. For runways serving aircraft over 12,500 pounds (Runway 12-30),the OFZ is 400 feet wide and 200 feet beyond the runway end.

Taxiway Object Free Area (TOFA): The TOFA is a two dimensional ground area adjacent to taxiways. The taxiway OFA clearing standard precludes vehicle service roads, parked airplanes, and objects except those whose location is fixed by function such as a navigational aid. The FAA standard TOFA for Group III aircraft (for taxiways serving Runway 12-30) is 171 feet wide, and for Group II aircraft (for taxiways serving Runway 8-26) is 124 feet centered on the taxiway centerline.

Taxiway Safety Area (TSA): The TSA is a defined surface alongside the taxiway prepared or suitable for reducing risk of damage to an airplane unintentionally departing the taxiway. The FAA standard TOFA for Taxiways serving Group III aircraft is 118 feet, for Group II aircraft 79 feet centered on the taxiway centerline.

<u>Design Criteria</u>

Line of Sight: FAA line of sight standards require that two points five feet above the centerline of a runway, without a parallel taxiway, be mutually visible for the entire runway. For runways with a full parallel taxiway, the standard requires that two points, five feet above the centerline, be mutually visible for one half of the runway length. Further, there is a requirement that for intersecting runways, points five feet above the centerline must be mutually visible within the Runway Visibility Zone (RVZ).

Based on the contour data developed as part of the 2006 Runway 12-30 pavement overlay, it was found that the centerline profile for Runway 12-30 five-foot line of sight is violated by approximately 0.78 feet. The violation will be remedied at the time of a future project, such as full-depth reconstruction of Runway 12-30. In addition, care must be taken not to create a line of sight problem in the course of future development.

Runway Centerline to Parallel Taxiway Centerline: This design criterion establishes the minimum separation between the centerline of the runway and the centerline of the parallel taxiway. The existing parallel Taxiway A for Runway 12-30 is separated from the runway centerline by 600 feet. This exceeds the separation standards for D-III of 400′ as shown in **Table 3-13.** Runway 8-26 does not have an existing parallel taxiway. A runway centerline to taxiway centerline separation of at least 240 feet would be required to meet the standard for a B-II small runway.

Runway Centerline to Holdline: This standard provides for marking on pavement and placing signs at locations on taxiways where aircraft hold prior to entering the runway. These locations are chosen to ensure that aircraft are clear of the RSA and OFZ during operations by other aircraft on the runway. Hold positions for Runways 12-30 and 8-26 are separated from their runway centerlines by 280 feet and 125 feet respectively. These separations meet the separation standards for the existing design categories for the runways shown in **Table 3-13**.

Runway Centerline to Edge of Parking Area: This standard is designed to allow additional clearance between aircraft parking areas and aircraft operations on the runway, while protecting space between these areas for a parallel taxiway and accommodate FAR Part 77 surfaces. For Runway 12-30, 815 feet will accommodate a tail height of 45 feet and a 1,000 foot precision instrument primary surface. For Runway 8-26, 335 feet will accommodate a tail height of 30 feet and a primary surface of 250 feet. The airport's aircraft parking separation currently exceed the minimum required distances for the ultimate runway design groups. No construction of aircraft parking aprons should be permitted within the designated area in the future.

3.3.2 Airfield Marking, Lighting and Signage

Pavement markings, lighting and signage facilitate the safe movement of aircraft about the airfield by directing pilots to their destinations. Runway markings are designed according to the type of instrument approach available on the runway. FAA Advisory Circular (AC) 150/5340-1L, Standards for Airport Markings, provides the guidance necessary to design an airport's markings.

Runway 12-30 has Precision Instrument markings on the Runway 12 end and Non-precision markings on the Runway 30 end. In the event Runway 30 is upgraded to a precision approach, precision markings will be required.

Runway 8-26 has basic markings. Besides routine maintenance of the runway markings, these markings should suffice for the planning period.

Taxiway and apron areas also require marking. Yellow centerline stripes are currently painted on all taxiway and taxilane surfaces at the airport to provide guidance to pilots. Runway, taxiway and taxilane markings should be maintained in conjunction with the routine maintenance of the pavement surface.

Airport lighting systems provide critical guidance to pilots during nighttime and low visibility operations. Runway 12-30 is equipped with high intensity runway edge lighting (HIRL) and Runway 8-26 is equipped with medium intensity runway edge lighting (MIRL). The existing runway lighting systems on Runway 12-30 and Runway 8-26, while adequate in intensity, will need routine maintenance during the planning period.

Effective ground movement at night is enhanced by the availability of taxiway lighting. The taxiway system is currently served by medium intensity taxiway lighting (MITL). Taxiway lights have been upgraded to LED. The existing taxiway lighting systems, while adequate in intensity, will need routine maintenance during the planning period.

Airfield signage provides another means of notifying pilots as to their location on the airport. A system of signs placed at several airfield intersections on the airport is the best method available to provide this guidance. Signs located at intersections of runways and taxiways provide crucial information to avoid conflicts between moving aircraft. Directional signage instructs pilots as to the location of taxiways and terminal aprons.

Signage for the MSO includes hold position signs, and directional signs. Airfield signs are internally lighted and reflect current FAA standards. Airfield signage should be reviewed and replaced as needed within applicable projects at the airport.

3.3.3 Navigational and Approach Aids

Electronic and visual approach aids provide guidance to arriving aircraft and enhance the safety and capacity of the airfield. Such facilities are vital to the success of the airport and provide additional safety to passengers using the air transportation system. While instrument approach aids are especially helpful during poor weather, they are often used by commercial pilots when visibility is good.

Instrument Approach Procedures

While instrument approach aids are especially helpful during poor weather, they are often used by commercial pilots when visibility is good. Instrument approaches are categorized as either precision or non-precision. Precision instrument approach aids provide an exact alignment and decent path for an aircraft on final approach to a runway while non-precision instrument approach aids provide only runway alignment information. Most existing instrument approaches in the United States are global positioning systems (GPS) or instrument landing systems (ILS).

With the advent of GPS, stand-alone instrument assisted approaches will eventually be established that provide vertical guidance down to visibility minimums currently associated with precision runways. As a result, airport design standards that formerly were associated with a type of instrument procedure (precision/non-precision) are now revised to relate instead to the designated or planned approach visibility minimums.

An ILS instrument approach is available to Runway 12. This Category I approach to Runway 12 consists of a glide-slope, localizer and a Medium-Intensity Approach Lighting System with Runway alignment indicator (MALSR). The approach may be flown with cloud ceilings as low as 211 feet and visibility reduced to one-half mile.

Runway 12 also has two RNAV approaches. An RNAV GPS approach to Runway 12 has been established, which may be flown with visibility reduced to 1/2 mile and cloud ceilings as low as 200 feet. In addition, an RNAV RNP approach to Runway 12 may be flown with visibility reduced to 3/4 mile and cloud ceilings as low as 318 feet.

Runway 30 has an RNAV RNP approach which may be flown with visibility reduced to 1 mile and cloud ceilings as low as 318 feet. In addition, an RNAV GPS circling approach is available may be flown with visibility reduced to between 1 ¼ and 3 statute miles depending on aircraft speed. A new approach procedure for Runway 30 has been initiated by FAA tower personnel and is in development.

Two published VOR approaches make use of the VHF Omnidirectional Range (VOR) which is located approximately 1,500 feet southwest of the Runway 30 threshold. A VOR approach does not align the aircraft with the runway, so it is a “circling” approach. This means that after the aircraft makes visual contact with the runway, a circling maneuver is required to line up with the runway and execute the landing. This approach allows the aircraft to descend to approximately 2000 feet above the threshold. Visibility minimums are between 1¼ and 3 statute miles.

Straight-in instrument approaches are not available to Runway 8-26.

With the ILS on Runway 12 and the RNAV/RNP approach to Runway 30, the precision capability of MSO is adequate. Incremental improvements to approach procedures to further reduce visibility minimums on Runway 30 would be beneficial and are recommended. Ultimately, protection for precision equivalent approach minimums below ¾ mile should be protected for Runway 30. . The smaller demand for Runway 8-26 suggests that another instrument approach to this runway would not be a significant benefit. Planning for a new parallel runway should assume accommodation of clearances for GPS approaches to both runway ends.

Visual Approach Aids

In most instances, the landing phase of any flight must be conducted in visual conditions. To provide pilots with visual guidance information during landings to the runway electronic visual approach aids are commonly provided at airports. The existing visual approach aids consist of four box precision approach path indicators (PAPI-4) on Runway 12-30.

Existing PAPIs require routine maintenance and should be replaced at the end of their useful life. (FAA considers the minimum useful life for airfield lighting and signage to be ten years for grant eligibility under the Airport Improvement Program per Table 308 of FAA Order 5100.38D).

Runway end identifier lights (REILs) provide rapid and positive identification of the approach end of the runway. Runway 30 at MSO is equipped with REILs. Like other airfield equipment, REILs require routine maintenance and should be replaced at the end of their useful life.

Approach lighting systems provide the basic means to transition from instrument flight to visual flight for landing. The existing MALSR system on the Runway 12 approach is adequate for future instrument approaches to Runway 12.

Weather Observation & Wind Indicators

Weather information is provided to pilots through an Automated Surface Observing System (ASOS) on site. This system is functioning well and is adequate to meet the airport's needs with routine maintenance and ultimate replacement at the end of its useful life.

Wind indicating devices provide pilots with information as to ground level wind conditions while segmented circles indicate airport traffic patterns.

MSO has a lighted wind cone with segmented circle at midfield. A supplemental wind cone is provided near the 1000 foot mark from the threshold of Runway 12. This arrangement should be sufficient for the planning period.

Air Traffic Control

The FAA air traffic control tower (ATCT) serving the airport is located at the center of the airfield and south side of Runway 12-30. The facility is centrally located with good visibility to movement areas. The tower was constructed in 2013 and is currently in good condition.

Currently, the MSO ATCT tower operates between 6am-10pm. Between 10pm and 6am, approach and departure control transfers to the Spokane ATCT. It is recommended that the MSO ATCT upgrade to a 24/7 operation in the planning period.

A summary of Airside Facilty Requirements is provided in **Figure 3-12**.

RUNWAYS AND TAXIWAYS		
EXISTING	**SHORT TERM (2027)**	**ULTIMATE (2042)**
Runway 12-30 150' X 9,501' 145,000 lbs SWL 170,000 lbs DWL 255,000 lbs DTL Full Length Parallel TW A – 75'W Runway 8-26 75' X 4612' 30,000 SWL 50,000 lbs DWL	Runway 12-30 150' X 9,501' 145,000 lbs SWL 170,000 lbs DWL 255,000 lbs DTL Full Length Parallel TW A – 75'W Runway 8-26 75' X 4612' 30,000 SWL 50,000 lbs DWL	Runway 12L-30R 150' X 9,501' 145,000 lbs SWL 170,000 lbs DWL 255,000 lbs DTL Full Length Parallel TW A – 75'W Runway 8-26 (TBD) 75' X 4612' 30,000 SWL 50,000 lbs DWL New Parallel Runway - 12R-30L Size and Strength TBD Full Length Parallel TW
NAVIGATIONAL AIDS		
Runway 12-30 ILS (12) VOR/DME RNAV GPS Runway 8-26 Visual	Runway 12-30 ILS (12) VOR/DME RNAV GPS Runway 8-26 Visual	Runway 12L-30R ILS (12) VOR/DME RNAV GPS Runway 8-26 (TBD) Visual New Parallel Runway - 12R-30L GPS
LIGHTING AND MARKING		
Runway 12-30 Precision Markings (12) Nonprecision Instrument Markings (30) HIRL, MITL MALSR (12) REIL (30) 4- Box PAPI Runway 8-26 Basic Markings	Runway 12-30 Precision Markings (12) Nonprecision Instrument Markings (30) HIRL, MITL MALSR (12) REIL (30) 4- Box PAPI Runway 8-26 Basic Markings	Runway 12L-30R Precision Markings (12) Precision Instrument Markings (30) HIRL, MITL MALSR (12) REIL (30) 4- Box PAPI Runway 8-26 (TBD) Basic Markings New Parallel Runway - 12R-30L Nonprecision Instrument Markings MIRL, MITL 4- Box PAPI REIL

Figure 3-12 Airfield Facility Requirements

3.4 Terminal Area Requirements

Components of the terminal area complex include the terminal apron, airline gate positions, and the various functional elements within the terminal building. In addition, the terminal area is served by various access, auto parking, and rental car facilities. This section identifies the terminal area facilities required to meet the airport's needs through the planning period.

The existing terminal facility was newly constructed in 2022 with Phase 2 of construction ongoing during the development of this Master Plan. For the purposes of this Master Plan, the terminal was considered a complete facility assuming completion of both Phase 1 and Phase 2 as existing facilities.

The requirements for various terminal complex functional areas were determined with the guidance of Federal Aviation Administration AC 150/5360-13A, *Airport Terminal Planning*. This advisory circular combined and superseded two previous FAA ACs on this topic: AC 150-5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*, and AC 150/5360-9, *Planning and Design Guidelines for Airport Terminal Facilities at Non-hub Locations*. In addition, ACRP Report 25, *Airport Passenger Terminal Planning and Design*, and Transportation Security Administration's (TSA) *Recommended Security Guidelines for Airport Planning, Design and Construction* were consulted. These documents, along with updated forecasts, were used to prepare estimates of various terminal complex requirements.

Facility requirements were developed for the forecast years of 2027, 2032, 2037 and 2042. It should be noted that actual need for construction of facilities will be based upon enplanement levels and airline service characteristics, rather than a forecast year.

Based upon the enplanements forecasted in Chapter 2 the MSO is projected to serve nearly 763,000 enplaned passengers annually within the 20-year planning horizon.

3.4.1 Aircraft Parking

The principal factors of parking air carrier aircraft at the terminal relate to the number of positions, and the apron layout.

Number of Aircraft Parking Positions

There are a total of nine marked positions on the terminal ramp. Seven marked positions correspond with six terminal boarding gates (one gate serves two positions). In addition, there are two ground loading positions. New marked aircraft parking positions will need to be added to correspond with future gate additions and to accommodate aircraft that are scheduled to remain overnight (RON).

Apron Design

The terminal apron parking positions are designed for ADG II and ADG III aircraft. The projected commercial mix indicates future operations by ADG II and ADG III aircraft. The terminal apron has been designed and constructed to meet the weight and dimensional standards of these aircraft and should meet commercial aircraft parking requirements for the planning horizon. Future expansion of the terminal apron should continue to accommodate the dimensions and weights of these aircraft types.

Infrastructure & Lighting

Apron design must consider the utilities and infrastructure needed for servicing aircraft parked at the terminal. Examples include fueling, grounding systems, power, conditioned air, storm water, deicing, and fire deluge systems and apron lighting. AC 150/5360-13A provides the following guidance on terminal apron lighting:

> Most outdoor areas associated with the terminal apron require some degree of illumination during nighttime and low-visibility conditions. Lighting levels in the vicinity of aircraft parking areas and the terminal apron should be of sufficient intensity to provide a safe, secure, and efficient operating environment for airport operations during nighttime conditions and inclement weather (e.g. to permit deicing at the gate).

The commercial apron is equipped with mounted floodlights, which are the preferred method of lighting the apron area.

3.4.2 Terminal Auto Parking

AC 150/5360-13A, Airport Terminal Planning indicates that terminal parking facilities are commonly planned to accommodate volume on an average day of a peak month. For planning purposes, the number of effective parking spaces assumes only 95 percent of the actual supply of spaces is available at any given time due to maintenance, snow removal or circulating parkers. In 2022, there were 49,425 enplanements in the peak month of August, averaging 1,594 passengers per day. Assuming 0.85 parking spaces per passenger (accounting for a level of ride sharing), and an average length of space occupancy of 1.3 days, results in a current demand for 1,850 parking spaces. The current number of public parking spaces in the main terminal parking lot is 1,338 (152 short term + 1,186 long term = 1,338 total spaces), indicating a current shortage of approximately 512 parking spaces. This is consistent with airport staff observation that the public lot is frequently at capacity and overflowing on a daily basis during peak periods. Assuming increased demand over the planning period proportional to forecast enplanements results in a future demand for 3,320 parking spaces by the end of the planning horizon (2042).

Employee spaces serve airport staff and tenants including the airline(s), rental car agencies, TSA, and the restaurant. Currently there are 150 employee spaces provided plus and an additional 50 spaces for overnight flight crews. The current need for employee parking is estimated at 200 spaces and is expected to grow proportionally with enplanements.

There are currently 314 spaces for ready, return and storage of rental cars at the airport. The estimated current demand for is estimated at 400 spaces, based on current overflowing conditions. Overall parking requirements for rental cars are anticipated to grow in proportion with enplanements.

Table 3-14 presents public, rental and employee parking requirements through the planning period as determined through the noted assumptions.

Table 3-14 Public Parking Requirements MSO

	Existing Spaces	Current Demand	2027	2032	2037	2042
Enplanements	424,945	424,945	532,559	629,540	710,396	762,774
Public Parking	1,338	1,850	2,318	2,740	3,092	3,320
Employee Parking	200	200	251	296	334	359
Rental Car Ready/Return	314	400	501	593	669	718
Total Existing Parking	**1,852**	**1,852**	**1,852**	**1,852**	**1,852**	**1,852**
Total Parking Demand		**2,450**	**3,070**	**3,629**	**4,096**	**4,397**
Total Capacity / (Deficiency)		**(598)**	**(1,218)**	**(1,777)**	**(2,244)**	**(2,545)**

*Red Text = Deficiency

3.4.3 Terminal Curbside

The terminal curb serves as the interface between the terminal building and the ground transportation system.

Some of the key points to be considered on the design and operation of curb fronts are the following:

- Lighting
- Speed tables/humps at pedestrian crossings
- Adequate transition areas
- Sidewalk/curb width – at least 12 feet; 15 to 20 feet is desirable
- Signage – large type, lighted
- Pavement marking – reflective, raised (where possible), rumble strips

The sidewalk adjoining the curb is wide enough to allow for the swinging open of a car door plus circulation. The terminal curb is lit to provide a safe and secure environment for passengers and airport operations at night and during inclement weather.

Two curbside areas adjacent to the arrival and departure areas serve MSO's terminal building. In addition, two lanes across from the arrivals curb have dedicated curb frontage for buses, taxis, and rideshare shuttles. The arrivals curb has 213 feet linear feet of available vehicular curbside length, the departures curb has 386 linear feet for a total of 599 feet. In addition, the buses/taxi/shuttle lane has 471 feet. Combined, total curbside is 1,070 linear feet (599 passenger + 471 commercial).

Terminal curbside needs are evaluated using industry planning criteria to determine linear frontage for the curb to meet Level of Service (LOS) standards. Curbside linear frontage estimates are modeled based on the methodology described in ACRP Report 25, Airport Passenger Terminal Planning and Design.

The analysis used the following assumptions to reach the curbside projections shown in **Table 3-15**:

- Peak hour traffic growth will follow design hour passenger growth.
- 30 percent of peak hour demand occurs during a 15-minute peak period.

Percent of Vehicle Type and vehicle length

- 85 percent – Private auto, 22 feet
- 8 percent – Hotel shuttles, 50 feet
- 5 percent – Taxis, 22 feet
- 1 percent –Buses (charter and public), 50 feet
- 1 percent – Other, 30 feet
- Multiple Stop Factor of 1.0 (for all vehicle types)

Vehicle Dwell Time

- Private auto, 5.0 minutes
- Hotel shuttles, 3.0 minutes
- Taxis and TNC, 1.5 minutes
- Buses (charter and public), 5.0 minutes
- Other, 1.5 minutes

Table 3-15 Curbside Requirements

	Current Need	2027	2032	2037	2042
Annual Enplaned Passengers	424,945	532,559	629,540	710,396	762,774
Total Design Hour Vehicles	300	376	444	502	538
Peak 15 Minute Demand (Linear Feet)	573	717	848	957	1,028
Required LOS Curbside Range (Linear Feet)	440	552	652	736	791
	520	652	771	870	934
Existing Curbfront (Linear Feet)	**1,070**	**1,070**	**1,070**	**1,070**	**1,070**
Total Capacity / (Deficiency) in Linear Feet	**550**	**418**	**299**	**200**	**136**

*Red Text = Deficiency

Based on the existing 599 linear feet of available curbside, with additional 471 linear feet of dedicated commercial vehicle frontage (for a total of 1,070 linear feet) of vehicle frontage, MSO should not require additional curbside frontage within the planning period. Should future demand require, additional curbside can be gained by relocating designated curbside vehicle modes, and also with the addition of traffic lanes to allow for double parking.

3.4.4 Gate Capacity Requirements

The airport terminal currently has the equivalent of eight gates, six terminal gates board with jet bridges and one terminal door, which functions as two gates, serving two ground-loading positions. Future gate requirements have been determined through formulas for growth based on historical measures of annual passenger enplanements and annual departures per gate. This approach is based on methodology described in ACRP Report 25, *Airport Passenger Terminal Planning and Design*

The enplanement per gate approach uses the current ratio of annual passengers per gate, adjusted for forecast changes in fleet mix and annual load factors. This methodology assumes that the pattern of gate utilization will remain relatively stable over the forecast period. The changes in passengers per gate would be due to changes in enplanements per departure (due to fleet seating capacity and/or passenger load factors), as opposed to increasing (or decreasing) numbers of departures per gate.

Table 3-16 shows a requirement of gates based on a measure of enplanements per gate. Using forecasts for the four planning horizons within the period, eight gates to represent current airline schedule activity, and enplanements per gate yields a total requirement of ten gates.

Table 3-16 Airline Gate Demand Forecast – Enplanements per Gate

Enplaned Passengers per Gate Approach					
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2020	208,473	4,321	3	69,500	48
2021	385,818	5,977	3	128,600	65
2022	424,945	4,716	8	53,100	90
2027	532,559	4,971	8	63,100	107
2032	629,540	5,240	9	70,800	120
2037	710,396	5,659	10	74,000	126
2042	762,774	6,076	10	74,300	126

The departure operations per gate approach yields a total number of gates based on a higher efficiency in gate use. **Table 3-17** shows a requirement of gates based on a measure of departures per gate. Using forecasts for the four planning horizons within the period, seven gates to represent current airline schedule activity, and departures per gate yields a total requirement of nine gates.

Table 3-17 Airline Gate Demand Forecast – Departures per Gate

Departures per Gate Approach					
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2020	208,473	4,321	3	1,440	4
2021	385,818	5,977	3	1,990	6
2022	424,945	4,716	8	590	2
2027	532,559	4,971	7	700	2
2032	629,540	5,240	7	700	2
2037	710,396	5,659	8	700	2
2042	762,774	6,076	9	700	2

The average of both methods yields a long-term demand for 9 gates at MSO with a need for an additional gate in the ten-year time horizon as shown in **Table 3-18**.

Table 3-18 Airline Gate Demand Forecast – Average of Enplanements per Gate and Departures per Gate Approaches

Average of Both Methods			
Year	Passengers per Gate	Departures per Gate	GATES
2027	8	7	8
2032	9	7	8
2037	10	8	9
2042	10	9	9

Effective space planning requires a consistent definition of "gate." By using the forecasted fleet mix and the Equivalent Aircraft (EQA) Index, a technique which estimates the number of gates needed based on aircraft seating capacity, the equivalent number of gates are calculated based on the ADG served. The EQA index for ADG III Narrowbody Aircraft is 1. Assuming all gates are designed to accommodate narrowbody aircraft at MSO results in an EQA equal to the unweighted forecast gate total. **Table 3-19** lists the recommended EQA by ADG for the planning period.

Table 3-19: Equivalent Aircraft (EQA) Index

	Existing	2027	2032	2037	2042
Annual Enplaned Passengers	**424,945**	**532,559**	**629,540**	**710,396**	**762,774**
ADG III Gates	8	8	8	9	9
Total Gates	**8**	**8**	**8**	**9**	**9**
ADG III EQA (EQA Index 1)	8	8	8	9	9
Total EQA	**8**	**8**	**8**	**9**	**9**

3.4.5 Ticketing /Check-in Area

The Ticketing and Check-in Lobby includes ticket queuing area, cross circulation, entrance vestibules and general circulation at the main entrance to the building. AC 150-5360-13A notes that since 2001, technology and evolved security requirements have significantly changed the way passengers and airlines use the check-in lobby. Computers and personal electronic devices allow passengers to check-in off-airport, interacting with airline personnel only to drop off bags or to resolve problems. While check in lobbies of the past were traditionally grand public spaces, increasing trends toward remote self check-in has resulted in a significant change in passenger and airline approaches to the check-in process and the potential for reduced space requirements in the lobby.

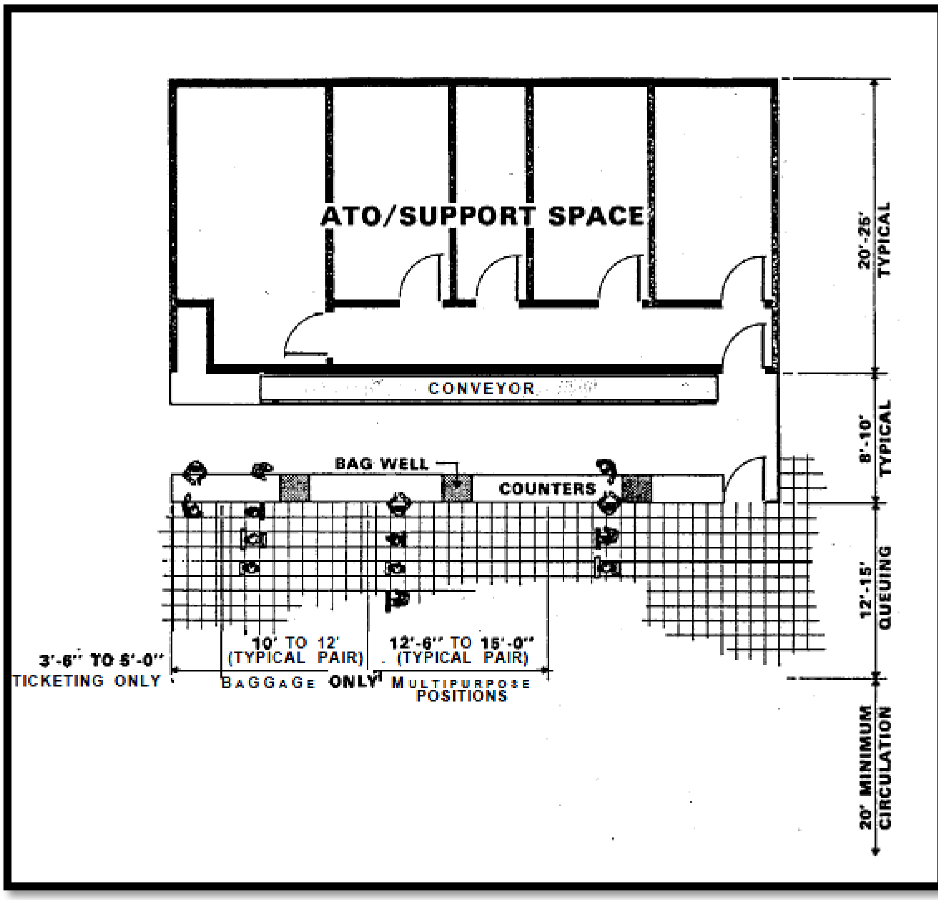
Space requirements for the ticketing / check-in lobby is typically a function of the counter width, combined with cueing and circulation area.

A total of six airlines currently provide service at MSO. It was assumed that an additional major airline, requiring four counters, and an additional secondary airline, requiring two counters, would enter the market in the planning period. A total of six additional counters were assumed over the long-term timeframe. Requirements will vary, depending upon the number of airlines serving MSO in the future, as well as individual airline needs. In addition, some consolidation of existing counter space may occur as the self check-in process reduces airline ticket counter requirements in the future.

The ticketing lobby at MSO currently consists of approximately 14,500 square feet for ticket counters, active check-in, queuing, and circulation. This space is linear with 58 feet of unobstructed depth available from the wall to the front of the counter, for circulation, queuing, and active check-in. At the time of this report, MSO provides a total of 26 check-in positions across approximately 110 linear feet of counter space. The staff occupies a width of 10 feet from the back wall to the front of the counter, with ticket counters about 3 feet deep.

Former guidance in AC 150-5360-13 provided the illustration, shown in **Figure 3-13**, of a typical linear counter layout for ticketing agent area and ATO area. This arrangement is typical and still appropriate for a facility like the MSO. As shown, the minimum distance from the face of the ticket counter to any obstruction should be 32 to 35 feet. This includes queuing depth of 12 to 15 feet and the remainder in cross circulation.

At MSO, the unobstructed depth of the ticketing lobby is approximately 58 feet. **Table 3-20** summarizes airline ticketing area requirements based on these assumptions.



Source: AC 150/5360-13 Figure 5-6

Figure 3-13: Linear Counter

Table 3-20: Check in / Ticketing Lobby Requirements

	Current Need	2027	2032	2037	2042
Counter positions	26	26	30	32	32
Counter (LF)	110	110	127	135	135
Counter Area (SF)	1,100	1,100	1,269	1,354	1,354
Queuing Area (SF)	1,650	1,650	1,904	2,031	2,031
Circulation (SF)	4,730	4,730	5,458	5,822	5,822
Total Required (SF)	**7,480**	**7,480**	**8,631**	**9,206**	**9,206**
Existing Ticket Lobby Area (SF)	**14,500**	**14,501**	**14,502**	**14,503**	**14,504**
Total Capacity / (Deficiency) (SF)	**7,020**	**7,021**	**5,871**	**5,297**	**5,298**

*Red Text = Deficiency

Projected growth in ticket counter needs can be accommodated within the existing 14,500 square foot ticket lobby space. As noted, the need to add additional ticket counters will depend on factors including the number of airlines serving MSO in the future, individual airline needs and changes in check-in procedures over time.

3.4.6 Airline Offices and Operational Spaces

At most medium and small airport terminal buildings, airline office space is provided behind the ticket counters. Airline ticketing offices (ATOs) are typically located here and are often used by staff to handle related administrative and operational duties while monitoring the ticket counter for passengers. It is also common for airline storage and break rooms to be included in the ATOs. This office area should have access to the ticket counter and baggage makeup area. It is used primarily by the agents as a workspace, and space is frequently needed for a lounge and training purposes. Sometimes a multipurpose room is used for all these functions. The airline manager's office may also be in this location.

The amount of airline leased space behind the counter is largely dependent on the length of the ticket counter with a typical overall depth of 25-30'. The area leased by airlines will largely be impacted by the number of air carriers.

Currently, the five air carriers serving MSO are accommodated in four shared ATO offices behind the ticket counter. Three additional ATO offices are available for new airline entries or growth of existing airline needs. Calculations for additional space required are based on the current proportion of utilized counter positions to utilized ATO office space.

Airline office space requirements are shown in **Table 3-21.**

Table 3-21: Airline Ticketing Office

	Current Need	2027	2032	2037	2042
Airline Office Requirement (SF)	**5,912**	**5,912**	**9,760**	**11,684**	**11,684**
Existing Airline Office Space (SF)	**11,974**	**11,974**	**11,974**	**11,974**	**11,974**
Total Capacity / (Deficiency) (SF)	**6,062**	**6,062**	**2,214**	**290**	**290**

*Red Text = Deficiency

MSO has 11,974 square feet of existing airline office space, with 6,062 square feet currently unused. This surplus space is anticipated to be sufficient to accommodate future needs for the planning period.

3.4.7 Outbound Baggage Screening

TSA requires that all baggage be screened before it is brought into the baggage make-up area and loaded onto an aircraft.

Outbound baggage processing includes the area and equipment required to accommodate, sort, security screen, and process checked baggage from the check-in lobby to the aircraft. At MSO, the baggage screening facilities are directly behind the ticketing counters and between the airline offices.

Preliminary estimates are modeled based on the methodology described in ACRP Report 25, Airport Passenger Terminal Planning and Design.

The assumptions used to model the bag screening requirement shown in **Table 3-22** are:

- Percent of passengers checking bags: 80 percent
- Average bags/passenger: 1.2
- EDS screening process rate: 550 bags/hour

Table 3-22 Outbound Bag Screening

	Current Need	2027	2032	2037	2042
Design Hour Passengers Departing	375	470	556	627	673
Total bags to process in peak hour	360	451	534	602	646
Total bags through Level 1 EDS screening (includes 1.12 surge factor)	408	500	582	650	694
Number of Level 1 EDS units	2	2	2	2	2
Baggage Screening Requirements (Bags / Hour)	**408**	**500**	**582**	**650**	**694**
Current Screening Capacity (Bags / Hour)	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**
Total Capacity / (Deficiency) (Bags / Hour)	**692**	**600**	**518**	**450**	**406**

*Red Text = Deficiency

Preliminary estimates modeled based on the methodology described in ACRP Report 25, Airport Passenger Terminal Planning and Design indicate that the throughput of the TSA baggage screening equipment should be sufficient for the planning period.

3.4.8 Baggage Make-up

After baggage is tagged at the ticket counter, it is conveyed to a baggage make-up area that is used for the sorting and loading of checked baggage onto carts. Once the carts are loaded, they are brought to the enplaning aircraft. Baggage make-up includes manual or automated make-up units, the cart/container staging areas, and baggage tug/cart, or baggage train, maneuvering lanes. The type of system selected for a terminal depends on several factors including the number of airlines, the terminal configuration, operating policies (common use, exclusive use), and size of the terminal complex. In the past, baggage was manually carried or mechanically conveyed from the ticketing counter directly to the baggage make-up area. Currently, TSA requires all baggage to be screened by the TSA prior to being brought into the baggage make-up area and loaded onto an aircraft. In order to improve efficiency, the TSA is encouraging the use of a centralized bag screening area at almost all airports. This practice results in a single outbound baggage room shared by all airlines, instead of individual baggage make-up areas in the ATOs.

The area recommendations provided here are based on the size and maneuverability of baggage tugs, as well as the sizes of baggage conveyance equipment and staging areas.

Table 3-23 shows the space requirements projected for the baggage make-up area based on methodology described in ACRP Report 25, *Airport Passenger Terminal Planning and Design*.

Table 3-23: Baggage Makeup

	Current Need	2027	2032	2037	2042
Gates	8	8	8	9	9
EQA	8	8	8	9	9
Expected Dep. Per gate (in 2 hr staging period)	1.09	1.14	1.20	1.16	1.24
Staging Period Departures	8.7	9.1	9.6	10.4	11.2
Baggage Makeup Area	13,000	13,300	14,800	15,300	17,600
15% Baggage Train Circulation Allowance (sf)	2,000	2,000	2,200	2,300	2,600
Total Required (sf)	**15,000**	**15,300**	**17,000**	**17,600**	**20,200**
Existing Makeup Area (sf)	**16,195**	**16,195**	**16,195**	**16,195**	**16,195**
Total Capacity / (Deficiency) (SF)	**1,195**	**895**	**(805)**	**(1,405)**	**(4,005)**

*Red Text = Deficiency

The approximately 16,195 square feet baggage make-up space currently provided is anticipated to be adequate until the intermediate planning horizon, with a shortfall of 4,005 square feet by the end of the planning period.

3.4.9 Passenger Security Screening

The security screening checkpoint (SSCP) area is used by TSA to screen commercial airline passengers and carry-on baggage to ensure that prohibited or harmful items are not carried onto aircraft.

AC 150-5360-13A identifies the primary components of security screening checkpoints in passenger terminals as follows:

- Queuing area – area reserved for passengers waiting to enter the screening area.
- Document check – location where TSA employees examine a passenger's bonafides (boarding pass and government issued identification) to confirm authenticity and allow them to proceed to screening.
- Divestiture area – zone where passengers must divest items such as metal objects, electronic devices, coats, belts, shoes, and baggage onto a conveyor belt for screening. This is also the area where passengers queue for screening.
- Screening area – location where passengers pass through screening equipment (advanced imaging technology or magnetometers). Baggage is screened through advanced technology machines. Secondary baggage screening is located adjacent to the primary screening. Private, manual passenger screening is provided remotely.

- Recomposure area – seating area or vacant space at the end of the screening checkpoint for passengers to gather and re-pack divested items.
- Administrative space –areas within or adjacent to the security screening checkpoints where security operates and monitor the security screening equipment. Space for detention rooms, training rooms, break rooms, and other administrative functions can be located remotely from the screening checkpoint.

The future layout of the SSCP will need to be closely coordinated with the TSA. Space requirements for a SSCP are developed according to metrics from ACRP's terminal planning guidebook and are shown in **Table 3-24** below.

Table 3-24: Security Screening Checkpoint

	Current Need	2027	2032	2037	2042
Annual Enplaned Passengers	424,945	532,559	629,540	710,396	762,774
Peak 30 min Originating PAX	150	188	222	251	269
Checkpoint Lanes Required	2	3	3	3	4
Total Checkpoint Required Area	2,250	3,375	3,375	3,375	4,500
Checkpoint Queue Area (SF)	360	540	540	540	720
Total Required SSCP Area (SF)	**2,610**	**3,915**	**3,915**	**3,915**	**5,220**
Existing SSCP Area	**6,200**	**6,200**	**6,200**	**6,200**	**6,200**
Total Capacity / (Deficiency) (SF)	**3,590**	**2,285**	**2,285**	**2,285**	**980**

*Red Text = Deficiency

With a capacity of 980 square feet by the end of the planning period, the existing SCCP space is anticipated to be sufficient to accommodate future needs for the planning period.

3.4.10 Passenger Holdrooms

Since 2001, increased security requirements have resulted in passengers checking in earlier and spending more time in the secure side holdroom prior to boarding aircraft. For this reason, amenities for passenger comfort have become increasingly important for secure side holdrooms. The design of the secure holdroom should include considerations for passenger comfort such as:

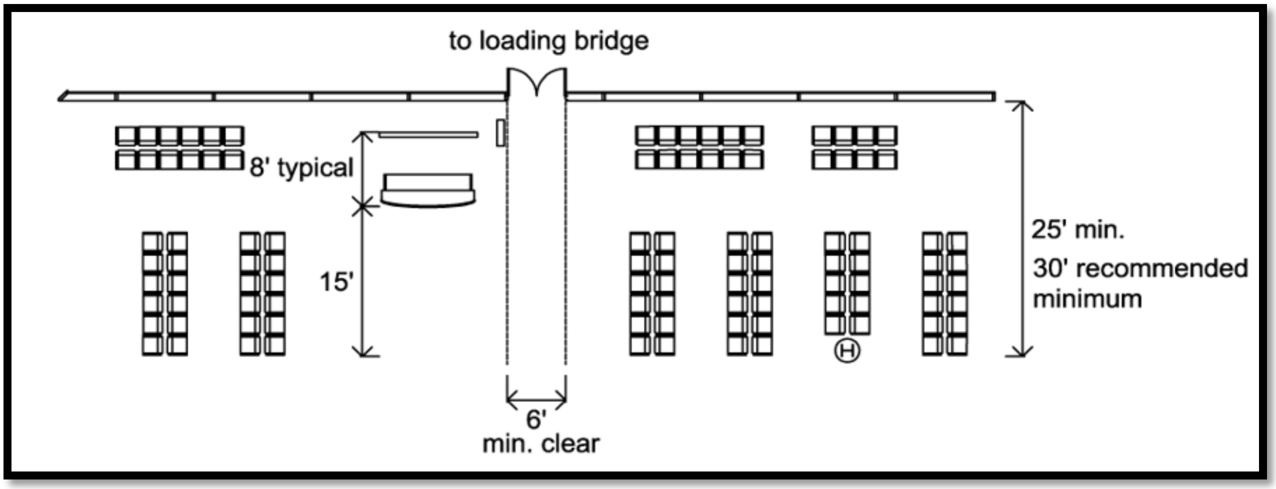
- Restroom facilities (Separate mens / womens, or family, all ADA accessible)
- Service Animal facilities
- Lactation rooms (private, ADA accessible)
- Concessions (Staffed retail or vending)
- Wi-Fi connectivity
- Televisions
- Easily accessible power connections
- Attractive viewing of the airfield (panoramic windows)

Holdrooms or departure lounges are where passengers wait to board aircraft after they have been processed through security. These are the principal areas of the "secure" or "sterile" side of the terminal and must be designed to maintain security through monitored or controlled entrances and exits.

As noted in AC 150/5360-13A, the primary components of a departure area holdroom include:

- Waiting area – designated airline-specific space where passengers wait to board a flight. The area includes seating for passengers.
- Airline gate podium and queuing – area where passengers queue and ultimately communicate with airline representatives.
- Boarding and egress corridor – designated area near the gate used for queuing passengers to board the aircraft, and for passenger egress from the aircraft when it arrives at the gate. Individual airlines have differing boarding and egress procedures.

ACRP Report 25, *Airport Passenger Terminal Planning and Design* provides recommendations for holdroom facilities. **Figure 3-14** shows typical minimum design paramaters for a single gate holdroom from the ACRP Report.



Source: ACRP Report 25, Airport Passenger Terminal Planning and Design

Figure 3-14: Typical Single Gate Holdroom Parameters

Holdroom space requirements based on ACRP Report 25 are shown in **Table 3-25.** These numbers include holdroom floor area and gate podium area, but not public circulation.

The sizing of each holdroom assumes 80 percent of the total number of passengers are seated and the remaining 20 percent are standing. The required additional space for the gate podium and podium queue are also considered.

The following assumptions were applied for planning purposes, as shown in **Table 3-25**:

- Design aircraft: Boeing 737-800, with 175 seats
- Seated/standing passenger mix: 80/20 (LOS B)
- Seated passenger space requirement: 15 square feet/passenger
- Standing passenger space requirement: 10 square feet/passenger
- Podiums per gate: 1, with 120 square feet of podium and queueing area
- Boarding/egress corridor area: 180 square feet of area/gate

Table 3-25: Passenger Holdrooms

	Current Need	2027	2032	2037	2042
Number of Seats on Design Aircraft	175	175	175	175	175
Load Factor	0.85	0.85	0.85	0.85	0.85
Number of Design Passengers	149	149	149	149	149
Seated and Standing Area (SF)	2,083	2,083	2,083	2,083	2,083
Allowance For Amenities (increase)	10%	10%	10%	10%	10%
Holdroom Sharing Factor (decrease)	10%	10%	10%	10%	10%
Adjusted Seated and Standing Area (SF.)	2,060	2,060	2,060	2,060	2,060
Podium and Queue Area	120	120	120	120	120
Boarding Area Corridor (SF)	180	180	180	180	180
Total Holdroom Area for One Gate (SF)	2,400	2,400	2,400	2,400	2,400
Equivalent Gate	8.0	8.0	8.0	9.0	9.0
Total Required Holdroom Area (SF)	**19,200**	**19,200**	**19,200**	**21,600**	**21,600**
Existing Holdroom Area (SF)	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**
Total Capacity / (Deficiency) (SF)	**800**	**800**	**800**	**(1,600)**	**(1,600)**

*Red Text = Deficiency

With the completion of phase 2 of the passenger terminal, MSO will have 20,000 square feet in passenger holdroom space. Using the above noted assumptions, this meets the current need, but is deficient by 1,600 square feet by 2037.

3.4.11 Baggage Claim

Baggage claim length requirements can vary from location to location and are influenced by the types of passengers who use the facility, and by changes in airline policy relating to baggage fees. The claiming facility should be situated convenient *to* the deplaning passenger flow patterns and in proximity to the terminal curb. Car rental counter space should be provided adjacent to the claim area. In addition, the length of belt should accommodate TSA and airline operational requirements that all baggage must be in the non-sterile area prior to turning the claim device off.

The recommendations for baggage claim device lengths in this report are based on guidance from ACRP Report 25, *Airport Passenger Terminal Planning and Design*. The recommended overall length of claim device public frontage at the airport is determined by estimating the number of peak hour terminating passengers with bags, and then applying a multiplier to account for the sizes of bags and numbers of passengers having more than one bag.

ACRP Report 25 recommends a space around the claim device that is approximately 15 feet wide to allow sufficient space for passengers to unload bags from the baggage claim device. The baggage claim public area provides space to accommodate a variety of ancillary and shared uses. For example, this portion of the building can provide space for information kiosks, hotel boards and other related conveniences for passengers. Design of the baggage area should also accommodate meeters and greeters, who will often meet passengers in the baggage claim area. Passengers and meeters and greeters should have access to seating (including minor business center improvements - 110V charging and bar top type infrastructure) and restrooms since they generally arrive in the bag claim area before their baggage is off-loaded from the aircraft. Further, the baggage claim area should be designed to be expandable to accommodate increasing demand over time.

The amount of baggage claim area needed to meet terminal requirements over the planning horizon are shown in **Table 3-26**.

The assumptions used to model the bag claim requirements are:

- Percent of passengers checking bags: 80 percent
- Average traveling party size: 1.8
- Percent additional passengers at claim: 30 percent
- Claim frontage per person: 1.5 linear feet
- Slope plate claim device + circulation area: 30 square feet/linear foot of required frontage
- Meeting and greeter lobby: 15 percent of baggage claim area required

Table 3-26: Baggage Claim Demand Requirements

	Current Need	2027	2032	2037	2042
Peak Hour Deplaning Passengers	375	470	556	627	673
Percent Deplaning in Peak 20 Min	50%	50%	50%	50%	50%
Percent Terminating Passengers	100%	100%	100%	100%	100%
Percent Passengers Checking Bags	80%	80%	80%	80%	80%
Average Traveling Party Size	1.8	1.8	1.8	1.8	1.8
Total Claim Frontage Required (LF)	**155**	**194**	**230**	**259**	**278**
Existing Claim Frontage (LF)	**232**	**232**	**232**	**232**	**232**
Total Capacity (Deficiency) (LF)	**77**	**38**	**2**	**(27)**	**(46)**
Baggage Claim Area Required (SF)	4,650	5,820	6,900	7,770	8,340
Meeter/Greeter Lobby (SF) (15%)	698	873	1,035	1,166	1,251
Total Baggage Claim Lobby Required (SF)	**5,348**	**6,693**	**7,935**	**8,936**	**9,591**
Existing Baggage Claim Lobby Area (SF)	**13,447**	**13,447**	**13,447**	**13,447**	**13,447**
Total Capacity (Deficiency) (SF)	**8,100**	**6,754**	**5,512**	**4,512**	**3,856**

*Red Text = Deficiency

With the completion of phase 2 of the terminal, MSO's baggage claim will consist of 13,447 square feet. This includes the area used for the two baggage claim devices, circulation areas and the meeter / greeter lobby. The bag claim devices have presentation length of 116 linear feet each for a total of 232 linear feet. As shown in **Table 3-26**, a total of 278 linear feet of claim frontage is recommended by 2042 to meet demand. Assuming common use, the existing 216 linear feet of frontage has the capacity to handle peak hour passengers until approximately 2037. Additional linear footage can be accommodated in the existing space by expanding claim devices into the meeter/greeter lobby area.

In addition to the public baggage claim space, passenger service counters and storage for late or unclaimed bags is part of the baggage service operation. Full baggage offices are typically required only by airlines with sufficient activity to warrant staffing. Other airlines often will request baggage lock-up areas to store late or unclaimed baggage and will handle passenger claims at their ATO counters.

3.4.12 Restrooms

ACRP Report 130, *Terminal Restroom Planning* provides recommendations for programming restroom space.

Typical restroom components include:

- Entry area
- Sink area
- Baby diaper changing area
- Toilet stall
- Wheelchair-accessible stall
- Urinal area
- Family room
- Plumbing chase
- Janitor’s closet/storage
- Service animal restroom

Currently, the first level non-secure side of the terminal provides two modules of restrooms serving departing and arriving passengers and their guests: one located adjacent to the ticketing lobby and one near baggage claim. The second level non-secure lobby also has one module of restrooms. The upper level secure concourse has two modules of restrooms; one on the east concourse and one on the south concourse. A summary of existing bathroom fixtures is shown in **Table 3-27.**

Table 3-27: Current Terminal and Concourse Fixtures

	Male	Female	Family	Total
Non-Secure Side Restrooms				
Ticketing	8	10	3	21
Baggage Claim	7	3	0	10
Second Floor Lobby	2	3	1	6
Total Non Secure Side	**17**	**16**	**4**	**37**
Secure Side Restrooms				
East Concourse	8	8	1	17
South Concourse	8	8	1	17
Total Secure Side	**16**	**16**	**2**	**34**

Note: non-public fixtures not counted.

The number of suggested restroom fixtures is based on the peak hour passengers in the public, non-secure area, and on the number of EQA within the secure area, as shown in **Table 3-28**.

Table 3-28: Terminal and Concourse Fixture Requirements

	Current Need	2027	2032	2037	2042
Non-Secure Side Restrooms					
Peak Hour Enplaning & Deplaning Passengers	375	470	556	627	673
Percent Additional Passengers (WW & MG)	30%	30%	30%	30%	30%
Total Peak Hour Passengers	487	611	722	815	875
Men's Fixtures	6	7	8	8	8
Women's Fixtures	9	9	10	11	11
Total Non-Secure Side Fixtures Required	**15**	**16**	**18**	**19**	**19**
Existing Secure Side Fixtures	**37**	**37**	**37**	**37**	**37**
Surplus / (Defecit)	**22**	**21**	**19**	**18**	**18**
Secure Side Restrooms					
EQA	8	8	8	9	9
Total Restroom Modules (1 per 8 EQA)	1	1	1	2	2
Design Passengers	1,260	1,260	1,260	1,418	1,418
Peak 20 minute Demand	630	630	630	709	709
Design Factor	378	378	378	425	425
Men's Fixtures	15	15	15	16	16
Women's Fixtures	18	18	18	20	20
Total Secure Side Fixtures Required	**33**	**33**	**33**	**37**	**37**
Existing Secure Side Fixtures	**34**	**34**	**34**	**34**	**34**
Surplus / (Defecit)	**1**	**1**	**1**	**(3)**	**(3)**

*Red Text = Deficiency

Table 3-28 shows the potential need for an additional three fixtures required by the end of the planning period.

3.5 Concessions

Terminal concessionaire services provide food, beverage and retail options to travelers on both sides of the security checkpoint. Concession services on the secure side of the checkpoint contribute to passenger convenience since passengers are often unable to leave the secure portion of the area once they have passed through the security checkpoint. In addition, airlines have reduced inflight meal services. It is therefore important for future airport terminal design to allow passengers to have food and beverage options available on both sides of the security checkpoint. Vending areas can replace or supplement staffed facilities, especially when flight times do not coincide with the operating hours of the concessions.

Concession areas should be strategically located in both the sterile and nonsterile portions of the terminal. The size of the concession area(s) varies from airport to airport, depending on individual concessionaire needs.

The following concession area functions were considered in determining the concessions space requirements are shown in **Table 3-29**.

Table 3-29: Concessions

	Existing	2027	2032	2037	2042
Annual Enplaned Passengers	424,945	532,559	629,540	710,396	762,774
Total Square Feet of Concession Space (per 1,000 enplaned passengers)	24.7	15	15	15	15
Total Recommended Concessions (SF)	**10,500**	**7,988**	**9,443**	**10,656**	**11,442**
Food / Gifts Secure (85%)	8,200	6,790	8,027	9,058	9,725
Food / Gifts Non-Secure (15%)	2,300	1,198	1,416	1,598	1,716
Existing Concessions Area (SF)	**10,500**	**10,500**	**10,500**	**10,500**	**10,500**
Total Capacity / (Deficit) (SF)	**0**	**2,512**	**1,057**	**(156)**	**(942)**

*Red Text = Deficiency

Concession space allocation varies widely from airport to airport, but ACRP Report 54, *Resource Manual for Airport In-Terminal Concessions*, suggests that a range of 10 to 20 square feet per 1,000 enplaned passengers is typical. **Table 3-29** shows recommended concessions space based on a planning standard of 15 square feet per 1,000 passengers. The table indicates sufficient space for concessions until 2037 when additional space will be required. Concessions spaces should be designed cooperatively with concessionaires to meet the size and space needs of the industry.

3.6 Rental Car Counters

Car rental facilities at terminals generally include an office area with a front counter and queuing space in front of counters. Counters for car rental transactions are typically located in or near the baggage claim area and located to provide easy access to the car rental parking area. Approximately one hundred linear feet of counter space currently serves the four rental car companies operating at the airport. Provision of space for an additional rental car agency is assumed within the planning horizon. Counter and space provisions for rental car agencies in the terminal are shown in **Table 3-30**.

Table 3-30: Rental Car Space

	Current Need	2027	2032	2037	2042
Agencies	4	4	4	5	5
Counter Frontage (LF)	100	100	100	125	125
Counter Area (SF) - (area behind ticket counter)	650	650	650	813	813
Queuing Area (SF)	1,000	1,000	1,000	1,250	1,250
Office/Storage (SF)	2,400	2,400	2,400	3,000	3,000
Circulation (SF)	3,000	3,000	3,000	3,750	3,750
Total Required Rental Car Area	**7,050**	**7,050**	**7,050**	**8,813**	**8,813**
Existing Rental Car Area	**7,050**	**7,050**	**7,050**	**7,050**	**7,050**
Total Capacity / (Defecit) (SF)	**0**	**0**	**0**	**(1,763)**	**(1,763)**

*Red Text = Deficiency

With the completion of phase 2 of the terminal, the existing counter space queuing area and office space will serve the four rental car agencies currently operating at MSO. Additional counters and office space would be required with the addition of an additional rental car agency.

3.7 Airport Administration

At the completion of phase 2 of the terminal construction, the Airport Administration terminal areas will include 14,700 square feet office and conference room space. This space is currently adequate and is expected to accommodate administrative office needs for the planning period.

Table 3-31: Airport Administration

	Existing	2027	2032	2037	2042
Annual Enplaned Passengers	424,945	532,559	629,540	710,396	762,774
Peak Hour Enplanements	375	470	556	627	673
Admin. Office/Conference (SF)	14,700	14,700	14,700	14,700	14,700

3.8 Terminal Requirements Summary

Table 3-32 on the following page summarizes the key functional area requirements for of the MSO passenger terminal through the twenty-year planning horizon.

Table 3-32 Terminal Requirements by Functional Area

	Existing	2027	2032	2037	2042
Annual Enplanements	424,945	532,559	629,540	710,396	762,774
Peak Hour Enplanements	375	470	556	627	673
Curbside					
Curbside Frontage (Linear Feet)	1,070	652	771	870	934
Ticketing					
Counter positions	26	26	30	32	32
Counter (LF)	110	110	127	135	135
Counter Area (SF)	1,100	1,100	1,269	1,354	1,354
Queuing Area (SF)	1,650	1,650	1,904	2,031	2,031
Airline Office (SF)	11,974	7,480	8,631	9,206	9,206
Baggage Make up (SF)	16,195	15,300	17,000	17,600	20,200
Hold Room					
# of Gates	8	8	8	9	9
Hold Room Waiting (SF)	20,000	19,200	19,200	21,600	21,600
Baggage Claim					
Baggage Claim Frontage (LF)	232	194	230	259	278
Claim Lobby Area (SF)	13,447	6,693	7,935	8,936	9,591
Rental Cars					
Counter Frontage (LF)	100	100	100	125	125
Counter Area (SF) - (behind counter)	650	650	650	813	813
Queuing Area (SF)	1,000	1,000	1,000	1,250	1,250
Office/Storage (SF)	2,400	2,400	2,400	3,000	3,000
Concessions					
Food/Gifts secure (SF)	8,200	6,790	8,027	9,058	9,725
Food/Gifts Non-secure (SF)	2,300	1,198	1,416	1,598	1,716
Total Concessions	10,500	7,988	9,443	10,656	11,442
Public Restrooms					
Public Restroom Fixtures - non-secure	37	16	18	19	19
Public Restroom Fixtures - secure	34	33	33	37	37
Security					
Passenger Screening (SF)	6,200	3,375	3,375	3,375	4,500
Security Queuing (SF)	840	540	540	540	720
Administration					
Office/Conference (SF)	14,700	14,700	14,700	14,700	14,700

*Red Text = Deficiency

3.9 General Aviation Facilities

The purpose of this section is to determine the space requirements for general aviation (GA) facilities including, FBO, hangar and apron parking facilities, during the planning period.

3.9.1 General Aviation Pilot Lounge

A general aviation pilot lounge can serve several functions including providing space for passenger waiting, pilot's lounge, flight planning, concessions, line service, and airport management offices.

These functions, aside from airport management offices, are currently served by the FBOs and private operators located on the airport. This arrangement is working well and is presumed to continue through the planning period.

3.9.2 Hangars

The demand for hangar facilities typically depends on the number and type of aircraft expected to be based at the airport. For planning purposes, it is necessary to estimate hangar and apron facilities based on peak design periods. However, hangar and apron development should be based on actual demand trends and financial investment conditions.

Typical utilization of hangar space varies across the country as a function of local climate conditions, airport security and owner preferences. Nationwide trends for general aviation aircraft, whether single or multi-engine, are toward larger, more sophisticated and expensive aircraft. Owners of these types of aircraft normally desire hangar space to protect their investment. Due to climatic and security issues, it is believed that the vast majority of based aircraft owners at the MSO will desire enclosed hangar storage facilities.

Demand forecasts prepared in Chapter 2 of this study concluded that 61 new based aircraft would locate at the MSO during the planning period. Areas for the development of new hangars will be identified and long range development concepts for these hangars will be options developed the in *Chapter 4 Alternatives*.

3.9.3 Aircraft Parking Apron

Aircraft parking should be provided for locally-based aircraft which are not stored in hangars and transient aircraft visiting the airport. Nationwide trends for general aviation aircraft, whether single or multi-engine, are toward larger, more sophisticated and expensive aircraft. Owners of these types of aircraft normally desire hangar space to protect their investment.

At MSO, the number of itinerant spaces was estimated to be approximately 50 percent of busy day itinerant operations. Additionally, total space requirements also assume 10 percent of the based aircraft are located on the apron for transient purposes.

Aviation forecasts were applied to project future fleet mix. Aircraft types were then split by Airplane Design Group (ADG) classification to determine the necessary parking area with required FAA setbacks. Size requirements were planned for each aircraft type as follows:

Single/Multi-Engine Piston (ADG-I) – 800 square yards per aircraft
Turboprop / Business Jet (ADG-II) – 1,700 square yards per aircraft
Business Jet (ADG-III) – 3,400 square yards per aircraft
Rotorcraft – 1,000 square yards per aircraft

The results of this analysis are presented in **Table 3-33.** There is currently approximately 133,000 square yards of parking apron in the general aviation area, which includes the general aviation ramp, the general aviation tie down area and the east ramp. The results shown in the table indicate that additional apron space and parking positions are needed immediately and through the planning period.

Table 3-33: Aircraft Parking Apron Requirements

	Currently Available	Current Need	Short Term	Intermediate Term	Long Term
Based Aircraft		169	184	199	230
10% Utilizing Apron Space *		19	20	22	25
Tie-down Area (s.y.)		22,350	24,153	25,955	29,560
Transient Aircraft					
Busy Day Itinerant Operations		94	104	111	124
Transient Parking Positions		48	52	56	63
Transient GA Apron Area		111,402	120,685	129,969	146,215
Total Parking Apron					
Positions	44	67	72	78	88
GA Apron Area (s.y.)**	132,850	133,752	144,838	155,924	175,775

* Includes added contingency of 2 aircraft
**Includes Minuteman West, Minuteman East and Northstar Aprons

3.10 Support Requirements and Facilities

Various facilities that do not logically fall within classifications of airfield, terminal building or general aviation areas have also been identified. These other areas provide certain functions related to the overall operation of the airport and include: aircraft rescue and firefighting, fuel storage, snow removal equipment and airport maintenance facilities.

3.10.1 Aircraft Rescue and Firefighting

Requirements for aircraft rescue and firefighting (ARFF) services at an airport are established under Federal Aviation Regulations (FAR) Part 139. FAR Part 139 applies to the certification and operation of land airports served by any scheduled or unscheduled passenger operation of an air carrier using aircraft with more than 30 seats. Paragraph 139.315 establishes ARFF index ratings based on the length of the largest aircraft with an average of five or more daily departures. MSO currently operates as an Index "B" facility, which includes aircraft at least 90 feet but less than 126 feet in length.

Index C includes aircraft at least 126 feet but less than 159 feet in length. The Boeing 737-800, an Index C aircraft, currently operates at MSO, but with fewer than five daily departures. It is anticipated that operations by B737-800 aircraft will increase to five or more daily departures in the near-term planning period, placing MSO into Index C.

Index C requires either two vehicles, or three vehicles. For the two-vehicle option, one vehicle must carry at least at least 500 pounds of sodium-based dry chemical, halon 1211, or clean agent and 1,500 gallons of water and the commensurate quantity of Aqueous Film Forming Foam (AFFF) for foam production. The other vehicle must carry water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by both vehicles is at least 3,000 gallons. For the three-vehicle option, one vehicle carrying the extinguishing agents required by Index A is required. In addition, two vehicles are required which carry an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 3,000 gallons.

As noted in Chapter 1, the airport has two ARFF engines, the newest of which was purchased in 2022 and the oldest purchased in 2007. Both engines provide 1,500 gallons of water and 200 gallons of AFFF to meet fire-fighting capabilities for Index "C". ARFF vehicles are considered to have a fifteen-year life, which would require replacement of the Airport's ARFF vehicles during the planning period.

The current ARFF storage facility was built in 1987 and is co-located with airfield maintenance and snow removal facilities and personnel. In 2013, the joint use facility was expanded by approximately 15,000 square feet to its current footprint of 40,000 square feet. While the joint facility currently provides sufficient warm storage for the existing equipment, it is at full capacity. In order to add additional ARFF equipment required to meet Index C requirements expansion and/or relocation of the Airport's ARFF Building will be required.

Originally, ARFF and snow removal and maintenance functions were performed as a combined operation with overlapping staff. These functions have now grown to the point that they are now performed as independent operations, each with dedicated staff. A new ARFF facility, separate from maintenance and snow removal functions, would allow for greater operational efficiency for dedicated ARFF staff and provide capacity for additional equipment and future growth.

3.10.2 Airport Maintenance and Snow Removal Facilities

Airfield Maintenance/Snow Removal Equipment (SRE) facilities provide a sheltered environment for repair and storage of airport service vehicles and equipment. These facilities protect valuable airport property from moisture, debris, and other environmental contaminants. The airfield maintenance/SRE facility is co-located with the ARFF facilities at the north end of Taxiway G.

The current maintenance equipment is listed in Table 1-7 in *Chapter 1 Inventory*. Some of the equipment is getting older and should be considered for replacement in the planning period.

The FAR Part 139 specifies the adequate snow removal equipment needs that airports provide. For a commercial service airport, the airport must have enough equipment to remove one inch per hour from the primary runway, primary taxiway, and the commercial service apron.

Co-located with ARFF storage, the maintenance and snow removal storage building is currently at full capacity for equipment storage and personnel workspace. As airport surfaces are expanded and existing equipment ages, new purchases will be required. While the existing maintenance and SRE building is meeting current needs, there is no room to keep up with future growth in equipment and personnel needs.

With the addition of new maintenance and snow removal equipment, expansion to the snow removal and equipment storage building and / or separation of ARFF functions from the facility will be required. As noted previously, snow removal / maintenance and ARFF now operate as separate functions with separate staffing and responsibilities. Separating ARFF from maintenance and snow removal functions, through the construction of a new facility would allow for greater operational efficiency for dedicated snow removal and maintenance staff and provide capacity for additional equipment and future growth.

3.10.3 Fuel Storage

Minuteman and Northstar/Neptune both operate a fuel farm at MSO, supplying fuel to air carrier, commuter, USFS contractors, and GA aircraft. The fuel farm is located in the northeast corner of the airport, near the Northstar/Neptune development area. The fuel storage and dispensing system includes a total of 56,055 gallons of 100LL storage and 107,000 of jet fuel storage. A 24-hour credit card payment system is available for self-fueling. **Table 3-34** shows the existing capacity of fuel storage facilities in the fuel farm.

Table 3-34: Current Fuel Storage Capacity (Gallons)

	JetA	100LL
Northstar	59,995	32,055
Minuteman	48,000	24,000
Total	**107,995**	**56,055**

To estimate future fuel storage requirements, it is assumed that existing tanks are currently adequately sized to serve existing operations. Storage requirements were presumed to grow proportionally with annual fuel flowage as estimated in the forecast as shown in **Table 3-35**.

Table 3-35: Fuel Storage Requirements (Gallons)

Year	Jet A	100LL
2022 (Existing Storage)	107,995	56,055
2027	148,451	56,055
2032	156,542	56,055
2037	164,633	56,055
2042	172,725	56,055
Planning Period Total Deficiency	**(64,730)**	**0**

As shown, a deficiency of approximately 65,000 gallons of fuel storage capacity is projected over the planning period, equating to three additional 20,000 – 25,000 gallon tanks. There is adequate space within the existing fuel farm area to accommodate growth of this scale.

3.10.4 Security

MSO has a TSA approved Airport Security Plan (ASP) which governs all aspects of airport security. Security requirements pursuant to the ASP, are accommodated in the terminal area with access control on all doors, and appropriate protection of the SIDA, sterile and public spaces according to the ASP.

A seven-foot chain link security fence with an additional foot of three-strand barbed wire encloses the airport operating area and serves as an animal control / security fence. Access to the airfield is through controlled access gates, which are monitored and controlled with a looped fiber optic infrastructure.

The security systems at MSO are functioning satisfactorily and, with routine maintenance and updating are expected to continue to function through the planning period. Security fencing and access control infrastructure should be extended as needed to encompass any expansion to the air operations area (AOA) including any land the airport acquires in the future.